

2008

Ministry of Agriculture and Lands

Animal Health Branch – Fish Health



FISH HEALTH PROGRAM SUPPLEMENTAL APPENDICES TO THE ANNUAL REPORT

<i>APPENDIX 7.1 List of Mortality Classifications.....</i>	<i>3</i>
<i>APPENDIX 7.2 Map of Fish Health Zones in British Columbia</i>	<i>5</i>
<i>APPENDIX 7.3 Active Marine Salmon Farms.....</i>	<i>6</i>
<i>APPENDIX 7.4 Bacteriology Findings.....</i>	<i>7</i>
<i>APPENDIX 7.5 Molecular Diagnostics (PCR) Findings.....</i>	<i>17</i>
<i>APPENDIX 7.6 Audit Case Definitions</i>	<i>26</i>
<i>APPENDIX 7.7 BCSFA Mortality Reports</i>	<i>29</i>
<i>BCSFA Mortality Reports: Quarter 1 (Jan - Mar)</i>	<i>29</i>
<i>BCSFA Mortality Reports: Quarter 2 (Apr – Jun).....</i>	<i>31</i>
<i>BCSFA Mortality Reports: Quarter 3 (Jul – Sep).....</i>	<i>33</i>
<i>BCSFA Mortality Reports: Quarter 4 (Oct – Dec)</i>	<i>35</i>
<i>APPENDIX 7.8 BCSFA Fish Health Events</i>	<i>37</i>
<i>APPENDIX 7.9 Sea Lice Life Stages Defined.....</i>	<i>39</i>
<i>APPENDIX 7.10 Sea Lice BCMAL Audit Tables.....</i>	<i>40</i>
<i>APPENDIX 7.11 Sea Lice BCSFA Reports (Tables and Graphs).....</i>	<i>47</i>

APPENDIX 7.1 List of Mortality Classifications

Mortality Rate and Mortality Categories Recorded and Reported by BC Salmon Farmers Association Fish Health Database

Average Mortality Rate

The average mortality rate is calculated as the total number of carcasses out of the total number of fish cultured in that zone or sub-zone. This is reported for each species in the zone or sub-zone for each category of water type on a quarterly basis. For example, “all zones Pacific freshwater” data indicate the average mortality rate for all Pacific salmon of all zones cultured in fresh water.

Mortality Rate by Cause (previously: Proportional Mortality by Cause)

The mortality rate by cause is intended to provide a detailed breakdown of the average mortality rate. This breakdown indicates what proportion of the average mortality is attributed to each of the causes below. Since the reasons for death vary in fresh and saltwater rearing environment and by species, the reports provided to BCMAL reflect these different causes.

Mortality Causes – Fresh water:

Data entry starts at the EYED EGG stage and is reported in monthly intervals to the BCSFA Industry Database.

- Culls/quality control: includes all culls for inventory management (e.g., precocious males and non-smolts.)
- Systems related: rolled up category that includes all losses due to acute incidents, including:
 - systems/physical plant problems (e.g. power outage);
 - transport incidents, accidents;
 - any acute disruption of “life support” for the fish; and,
 - vandalism and acute human induced toxicological events.
- Background mortality: rolled up category that includes all causes that are not culls, systems-related or fresh carcasses, including:
 - Poor performers (smalls, deformities, non-smolts (died, not culled), pin heads etc.);
 - Water chemistry problems;
 - Eye pick;
 - Jumpers;
 - Feed/ feeding problems;
 - Handling;
 - Old (not of histological (diagnostic) quality);
 - Fungus;
 - Parasites;
 - Bacterial Gill Disease (BGD); and,
 - Predators.
- Fisheries and Oceans Canada (DFO) divides the background mortality category into:

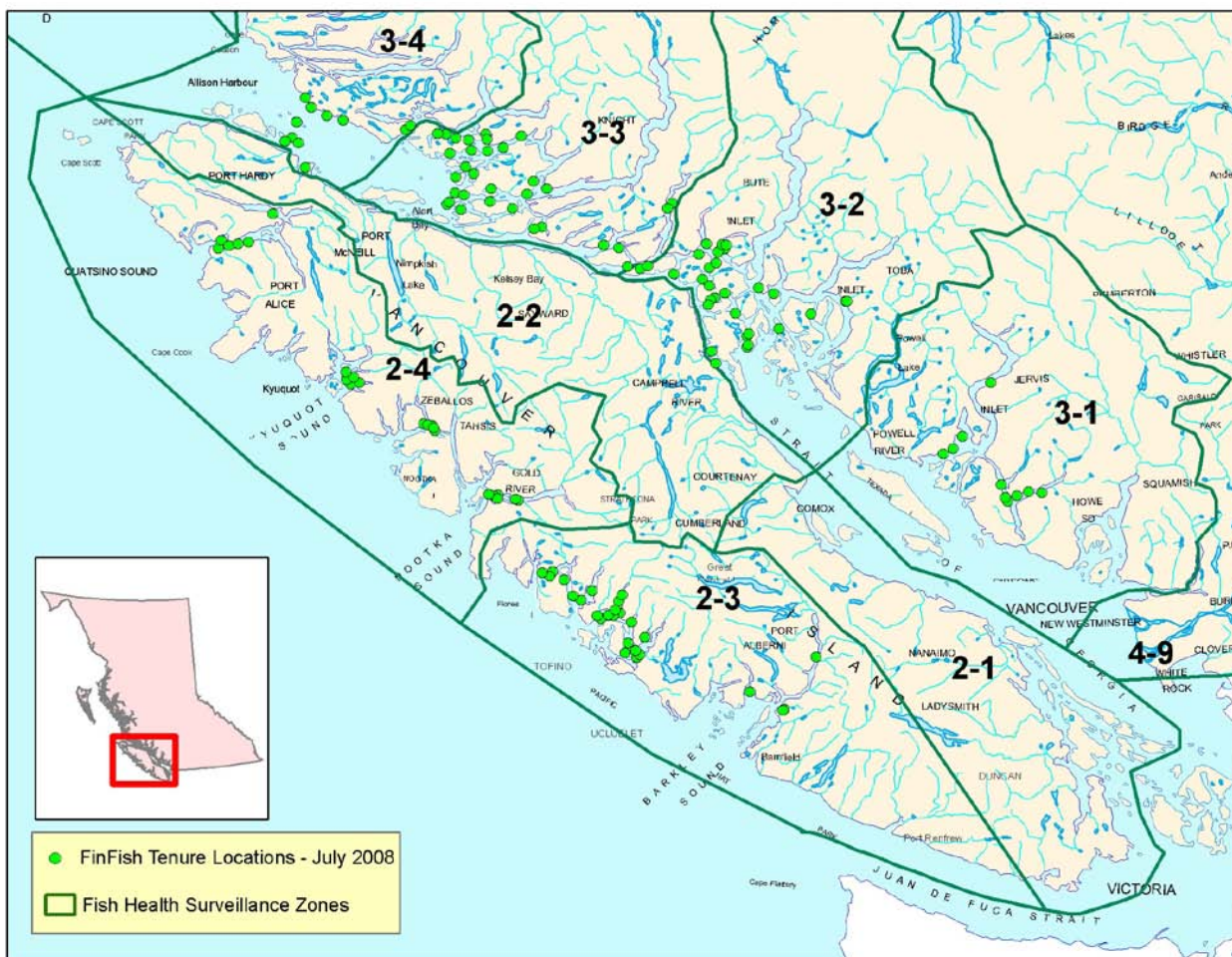
- Husbandry-related including feed/feeding problems, handling, treatment errors; and,
 - Routine / daily: mortalities—fungus, predators etc.
- Fresh: rolled up category that includes total number of “fresh” carcasses
 - Mortalities due to suspected disease;
 - Unexplained mortality; and,
 - Mortalities “of concern”.
- DFO puts all fresh carcasses, resulting from unexpectedly high mortality rates, and all suspect mortalities (including BGD, parasites, and other disease) into the ‘fresh’ category.

Mortality Causes – Salt water:

This applies to all sea water fish farms, acclimation pens, captive brood stock (DFO) and preliminary rearing of select stocks prior to saltwater release (by DFO). These categories are intended for smolt and post-smolt life stages, including “smolt”, “immature/grow-out/harvest” and “brood stock”.

- Predators: total number of carcasses due to predators
- Environmental: total number of carcasses due to environment (e.g. algae, low D.O)
- Poor Performers: total number of carcasses due to poor performers (includes precocious and maturing males and poor performers)
- Handling/Transport: total number of carcasses due to handling, transport or mechanical damage
- “Old”: total number of carcasses not of diagnostic quality (no reliable histological diagnosis)
- “Silvers”: total number of fresh carcasses that still have silver skin/scales and have died most recently, due to: no apparent reason, or they may show signs of disease. These carcasses are likely most reflective of the robust living ‘production population’ and they generally represent less than 1% of the dead group.
- Matures: jacks – Pacific salmon species only

APPENDIX 7.2 Map of Fish Health Zones in British Columbia



Not appearing on this map is **sub-zone 3.5** (central coast) that spans the mainland coast from Deas Channel northward to Douglas Channel. In 2008, sub-zone 3.5 had four to five active fish farms in the Klemtu/Bella Bella region (see Table 7.3.1).

APPENDIX 7.3 Active Marine Salmon Farms**Table 7.3.1 Active Marine Salmon Farms 2008 (by calendar quarter)**

Atlantic Salmon	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Average
Sub-zone 2.3 SW Vanc. Island	8	8	12	10	10
Sub-zone 2.4 NW Vanc. Island	6	10	9	3	7
Sub-zone 3.1 Sunshine Coast	2	2	2	1	2
Sub-zone 3.2 Campbell River	14	13	13	13	13
Sub-zone 3.3 Broughton	16	12	14	14	14
Sub-zone 3.4 Port Hardy	5	5	5	5	5
Sub-zone 3.5 Central Coast	4	5	4	4	4
Pacific Salmon					
Zone 2 Vancouver Island	3	4	3	4	3
Zone 3 East of Vanc. Island	6	6	7	3	6
Totals	64	65	69	57	64

APPENDIX 7.4 Bacteriology Findings

Table 7.4.1: Bacterial Findings for Sub-zone 2.3 (SW Vancouver Island) Atlantic Salmon Farm Audits 2008					
Quarter	# farms sampled*	# fish sampled	# of farms with bacteria cultured	Number of positive fish per bacteria ^	Bacterial species cultured
Q1 Jan - Mar	4	27	1	6	<i>Yersinia ruckeri</i>
Q2 Apr – Jun	3	23	0	0	No bacteria cultured
Q3 Jul – Sep	3	17	0	0	No bacteria cultured
Q4 Oct – Dec	5	33	1	3	<i>Vibrio splendidus</i>
Totals	15	100	2	9	

* Occasionally there are no fish available or suitable for sampling on a farm. When a site audit is conducted but no samples are taken, the number of farms where samples were collected is indicated in brackets (e.g. 5(4) indicates that 5 farms were visited but fish samples were only available from 4 of those 5 farms).

^ Not all bacteria cultured are the cause of disease (i.e. pathogenic); many are opportunists. For a complete list of the bacteria cultured and their classification as either pathogen or opportunist, see Table 7.4.10 at the end of this appendix. In addition, a single carcass may be culture-positive for more than one type of bacteria.

**Figure 7.4.1: Summary of Bacterial Findings from Sub-zone 2.3
Atlantic Salmon Farm Audits 2008**

**2008 Sub-zone 2.3 Summary Bacteriology Culture
100 Fish Sampled**

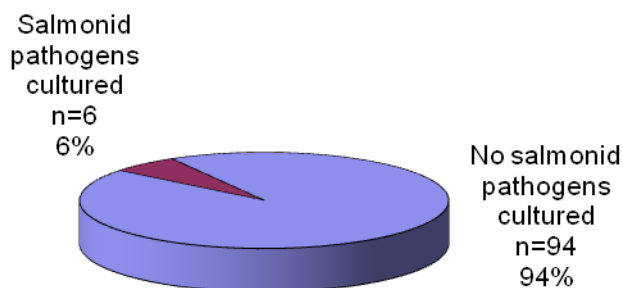


Table 7.4.2 : Bacterial Findings for Sub-zone 2.4 (NW Vancouver Island) Atlantic Salmon Farm Audits 2008					
Quarter	# farms sampled	# fish sampled	# of farms with bacteria cultured	Number of positive fish per bacteria	Bacterial species cultured
Q1 Jan - Mar	3	16	1	1	<i>Photobacterium damsela</i>
Q2 Apr - Jun	4	26	2	1	<i>Photobacterium phosphoreum</i>
				1	<i>Photobacterium sp.</i>
Q3 Jul - Sep	4	15	0	0	<i>No bacteria cultured</i>
Q4 Oct - Dec	1	8	1	1	<i>Alivibrio wodanis</i>
				1	<i>Flavobacterium aquidurense</i>
Totals	12	65	4	5	

**Figure 7.4.2: Summary of Bacterial Findings from Sub-zone 2.4
Atlantic Salmon Farm Audits 2008**

**2008 Sub-zone 2.4 Summary Bacteriology Culture
65 fish sampled**

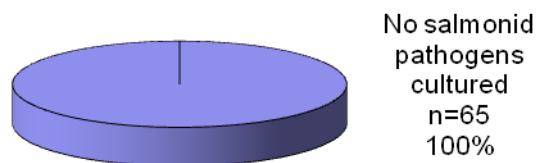
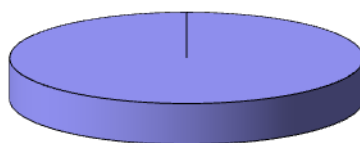


Table 7.4.3: Bacterial Findings for Sub-zone 3.1 (Sunshine Coast) Atlantic Salmon Farm Audits 2008					
Quarter	# farms sampled	# fish sampled	# of farms with bacteria cultured	Number of positive fish per bacteria	Bacterial species cultured
Q1 Jan – Mar	1	2	0	0	No bacteria cultured
Q2 Apr – Jun	1	7	0	0	No bacteria cultured
Q3 Jul – Sep	0	0	0	0	No bacteria cultured
Q4 Oct – Dec	1	2	0	0	No bacteria cultured
Totals	3	11	0	0	

**Figure 7.4.3: Summary of Bacterial Findings from Sub-zone 3.1
Atlantic Salmon Farm Audits 2008**

**2008 Sub-zone 3.1 Summary Bacteriology Culture
11 Fish Sampled**

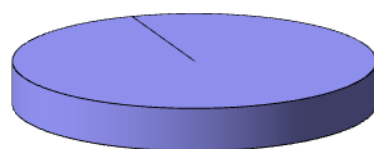


No salmonid
pathogens
cultured
n=11
100%

Table 7.4.4: Bacterial Findings for Sub-zone 3.2 (Campbell River) Atlantic Salmon Farm Audits 2008					
Quarter	# farms sampled	# fish sampled	# of farms with bacteria cultured	Number of positive fish per bacteria	Bacterial species cultured
Q1 Jan – Mar	6	26	1	2	<i>Photobacterium</i> sp.
			1	1	<i>Alivibrio logei</i>
Q2 Apr – Jun	8	24	1	1	<i>Photobacterium</i> sp.
Q3 Jul – Sep	7	33	1	2	<i>Alivibrio wodanis</i>
				1	<i>Vibrio</i> sp.
			1	1	<i>Photobacterium iliopiscarium</i>
Q4 Oct – Dec	8	40	1	1	<i>Vibrio splendidus</i>
Totals	29	123	6	9	

**Figure 7.4.4: Summary of Bacterial Findings from Sub-zone 3.2
Atlantic Salmon Farm Audits 2008**

**2008 Sub-zone 3.2 Summary Bacteriology Culture
123 Fish Sampled**



No salmonid
pathogens
cultured
n=123
100%

Table 7.4.5: Bacterial Findings for Sub-zone 3.3 (Broughton) Atlantic Salmon Farm Audits 2008					
Quarter	# farms sampled	# fish sampled	# of farms with bacteria cultured	Number of positive fish per bacteria	Bacterial species cultured
Q1 Jan – Mar	7 (6)	30	1	1	<i>Yersinia ruckeri</i>
				2	<i>Alivibrio logei</i>
Q2 Apr – Jun	5	28	1	2	<i>Alivibrio wodanis</i>
				1	<i>Alivibrio logei</i>
Q3 Jul – Sep	6	20	0	0	No bacteria cultured
Q4 Oct – Dec	6 (5)	27	1	1	<i>Photobacterium iliopiscarium</i>
Totals	22	105	3	7	

Figure 7.4.5: Summary of Bacterial Findings from Sub-zone 3.3
Atlantic Salmon Farm Audits 2008

2008 Sub-zone 3.3 Summary Bacteriology Culture
105 Fish Sampled

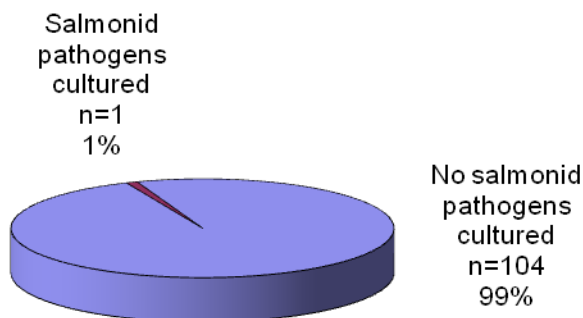


Table 7.4.6: Bacterial Findings for Sub-zone 3.4 (Port Hardy) Atlantic Salmon Farm Audits 2008					
Quarter	# farms sampled	# fish sampled	# of farms with bacteria cultured	Number of positive fish per bacteria	Bacterial species cultured
Q1 Jan – Mar	2	4	0	0	No bacteria cultured
Q2 Apr – Jun	2	11	1	1	<i>Alivibrio logei</i>
Q3 Jul – Sep	2	16	0	0	No bacteria cultured
Q4 Oct – Dec	2	12	1	2	<i>Alivibrio wodanis</i>
				1	<i>Photobacterium iliopiscarium</i>
Totals	8	43	2	4	

**Figure 7.4.6: Summary of Bacterial Findings from Sub-zone 3.4
Atlantic Salmon Farm Audits 2008**

**2008 Sub-zone 3.4 Summary Bacteriology Culture
43 Fish Sampled**

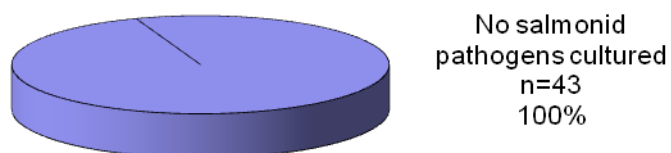


Table 7.4.7: Bacterial Findings for Sub-zone 3.5 (Central Coast) Atlantic Salmon Farm Audits 2008					
Quarter	# farms sampled	# fish sampled	# of farms with bacteria cultured	Number of positive fish per bacteria	Bacterial species cultured
Q1 Jan – Mar	2 (1)	2	0	0	No bacteria cultured
Q2 Apr – Jun	2	3	1	1	<i>Photobacterium</i> sp
Q3 Jul – Sep	2	12	0	0	No bacteria cultured
Q4 Oct – Dec	2	6	0	0	No bacteria cultured
Totals	7	23	1	1	

**Figure 7.4.7: Summary of Bacterial Findings from Sub-zone 3.5
Atlantic Salmon Farm Audits 2008**

**2008 Sub-zone 3.5 Summary Bacteriology Culture
23 Fish Sampled**

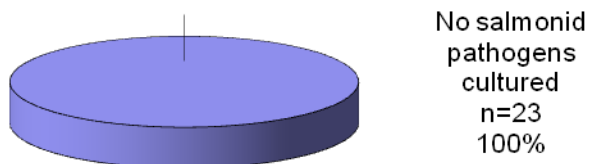
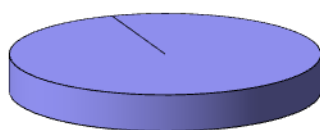


Table 7.4.8: Bacterial Findings for Zone 2 (Vancouver Island) Pacific Salmon Farm Audits 2008					
Quarter	# farms sampled	# fish sampled	# of farms with bacteria cultured	Number of positive fish per bacteria	Bacterial species cultured
Q1 Jan – Mar	1	10	0	0	No bacteria cultured
Q2 Apr – Jun	3	14	1	1	<i>Alivibrio wodanis</i>
Q3 Jul – Sep	2 (1)	7	0	0	No bacteria cultured
Q4 Oct – Dec	3	17	1	1	<i>Vibrio tubashii</i>
Totals	8	48	2	2	

**Figure 7.4.8: Summary of Bacterial Findings from Zone 2
Pacific Salmon Farm Audits 2008**

2008 Zone 2 **Pacifics** Summary Bacteriology Culture
48 Fish Sampled



No salmonid
pathogens
cultured
n=48
100%

Table 7.4.9: Bacterial Findings for Zone 3 (East of Vancouver Island) Pacific Salmon Farm Audits 2008					
Quarter	# farms sampled	# fish sampled	# of farms with bacteria cultured	Number of positive fish per bacteria	Bacterial species cultured
Q1 Jan – Mar	3	15	1	1	<i>Alivibrio wodanis</i>
				1	<i>Vibrio tasmaniensis</i>
Q2 Apr - Jun	3	19	1	1	<i>Photobacterium</i> sp.
Q3 Jul – Sep	4	23	1	1	<i>Vibrio ordalii</i>
Q4 Oct – Dec	2	13	2	1	<i>Alivibrio wodanis</i>
				3	<i>Listonella anguillarum</i>
Totals	12	70	5	8	

**Figure 7.4.9: Summary of Bacterial Findings from Zone 3
Pacific Salmon Farm Audits 2008**

**2008 Zone 3 Pacifics Summary Bacteriology Culture
70 Fish Sampled**

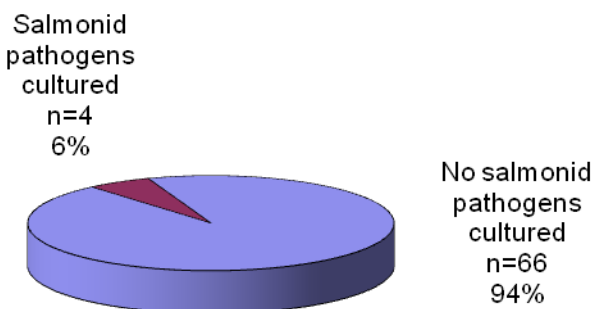


Table 7.4.10: Summary of Bacterial Organisms Cultured 2008

Salmon Pathogens	Opportunists / Environmental
	<i>Flavobacterium aquidurens</i>
<i>Listonella anguillarum</i> <i>Vibrio ordalii</i>	<i>Alivibrio logei</i> <i>Alivibrio wodanis</i> <i>Vibrio splendidus</i> <i>Vibrio tubiashii</i> <i>Vibrio tasmaniensis</i> <i>Vibrio splendidus</i> <i>Vibrio</i> sp. <i>Photobacterium damsela</i> <i>Photobacterium phosphoreum</i> <i>Photobacterium iliopiscarium</i> <i>Photobacterium</i> sp.
<i>Yersinia ruckeri</i> (Type 1)	

APPENDIX 7.5 Molecular Diagnostics (PCR) Findings

Table 7.5.1: Molecular Testing Results for Sub-zone 2.3 (SW Vancouver Island) Atlantic Salmon Farm Audits 2008									
Quarter	# farms sampled	# fish sampled	Number of Molecular Tests					Positive Sites	Organism Identified
			IHN	IPNV	ISA	<i>Piscirickettsia</i>	VHSV-NAS		
Q1 Jan-Mar	4	27	7	7	7	7	7	0	None
Q2 Apr-Jun	3	23	6	6	6	6	6	0	None
Q3 Jul-Sep	3	17	5	5	5	5	5	0	None
Q4 Oct-Dec	5	33	8	8	8	8	8	1	<i>Piscirickettsia salmonis</i>
Totals	15	100	26	26	26	26	26	1	

**Figure 7.5.1: Summary of Molecular Diagnostics Findings from Sub-zone 2.3
Atlantic Salmon Farm Audits 2008**

2008 Sub-zone 2.3 Summary of Molecular Diagnostics 15 Farms Sampled

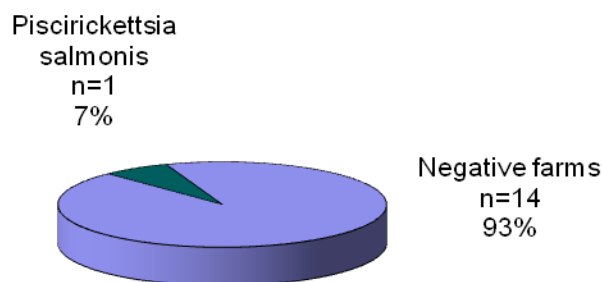


Table 7.5.2: Molecular Testing Results for Sub-zone 2.4 (NW Vancouver Island) Atlantic Salmon Farm Audits 2008									
Quarter	# farms sampled	# fish sampled	Number of Molecular Tests					Positive Sites	Organism Identified
			IHN	IPNV	ISAV	<i>Piscirickettsia</i>	VHSV-NAS		
Q1 Jan-Mar	3	16	5	5	5	5	5	1	VHSV NAS
Q2 Apr-Jun	4	26	6	6	6	6	6	0	None
Q3 Jul-Sep	4	15	5	5	5	5	5	0	None
Q4 Oct-Dec	1	8	2	2	2	2	2	0	None
Totals	12	65	18	18	18	18	18	1	

**Figure 7.5.2: Summary of Molecular Diagnostics Findings from Sub-zone 2.4
Atlantic Salmon Farm Audits 2008**

**2008 Sub-zone 2.4 Summary of Molecular Diagnostics
12 Farms Sampled**

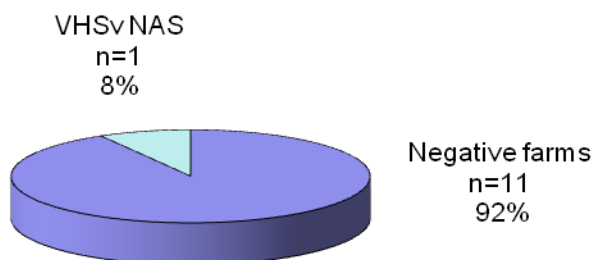


Table 7.5.3: Molecular Testing Results for Sub-zone 3.1 (Sunshine Coast) Atlantic Salmon Farm Audits 2008									
Quarter	# farms sampled	# fish sampled	Number of Molecular Tests					Positive Sites	Organism Identified
			IHN	IPNV	ISAV	<i>Piscirickettsia</i>	VHSV-NAS		
Q1 Jan-Mar	1	2	1	1	1	1	1	0	None
Q2 Apr-Jun	1	7	2	2	2	2	2	0	None
Q3 Jul-Sep	0	0	0	0	0	0	0	0	None
Q4 Oct-Dec	1	2	1	1	1	1	1	0	None
Totals	3	11	4	4	4	4	4	0	

Figure 7.5.3:

Summary of Molecular Diagnostics

Findings from Sub-zone 3.1
Atlantic Salmon Farm Audits 2008

2008 Sub-zone 3.1 Summary of Molecular Diagnostics 3 Farms Sampled

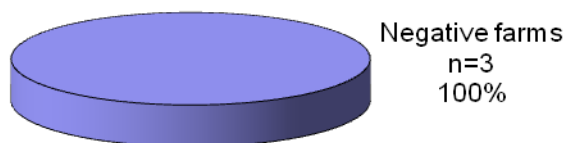


Table 7.5.4: Molecular Testing Results for Sub-zone 3.2 (Campbell River) Atlantic Salmon Farm Audits 2008									
Quarter	# farms sampled	# fish sampled	Number of Molecular Tests					Positive Sites	Organism Identified
			IHNv	IPNV	ISAV	<i>Piscirickettsia</i>	VHSv-NAS		
Q1 Jan-Mar	6	26	7	7	7	7	7	1	VHSv NAS
Q2 Apr-Jun	7	24	8	8	8	8	8	0	None
Q3 Jul-Sep	7	33	10	10	10	10	10	0	None
Q4 Oct-Dec	8	40	12	12	12	12	12	0	None
Totals	28	123	37	37	37	37	37	1	

**Figure 7.5.4: Summary of Molecular Diagnostics Findings from Sub-zone 3.2
Atlantic Salmon Farm Audits 2008**

**2008 Sub-zone 3.2 Summary of Molecular Diagnostics
28 Farms Sampled**

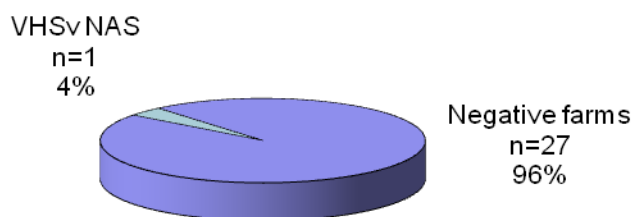


Table 7.5.5: Molecular Testing Results for Sub-zone 3.3 (Broughton) Atlantic Salmon Farm Audits 2008									
Quarter	# farms sampled	# fish sampled	Number of Molecular Tests					Positive Sites	Organism Identified
			IHNv	IPNV	ISAV	<i>Piscirickettsia</i>	VHSv-NAS		
Q1 Jan-Mar	6	30	9	9	9	9	9	3	VHSv NAS
Q2 Apr-Jun	5	28	8	8	8	8	8	0	None
Q3 Jul-Sep	6	20	7	7	7	7	7	0	None
Q4 Oct-Dec	5	27	7	7	7	7	7	0	None
Totals	22	105	31	31	31	31	31	3	

**Figure 7.5.5: Summary of Molecular Diagnostics Findings from Sub-zone 3.3
Atlantic Salmon Farm Audits 2008**

**2008 Sub-zone 3.3 Summary of Molecular Diagnostics
22 Farms Sampled**

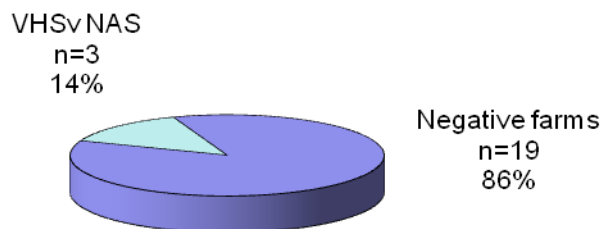


Table 7.5.6: Molecular Testing Results for Sub-zone 3.4 (Port Hardy) Atlantic Salmon Farm Audits 2008									
Quarter	# farms sampled	# fish sampled	Number of Molecular Tests					Positive Sites	Organism Identified
			IHNv	IPNV	ISAV	<i>Piscirickettsia</i>	VHSv NAS		
Q1 Jan-Mar	2	4	2	2	2	2	2	0	None
Q2 Apr-Jun	2	11	3	3	3	3	3	0	None
Q3 Jul-Sep	2	16	4	4	4	4	4	0	None
Q4 Oct-Dec	2	12	3	3	3	3	3	1	VHSv NAS
Totals	8	43	12	12	12	12	12	1	

**Figure 7.5.6: Summary of Molecular Diagnostics Findings from Sub-zone 3.4
Atlantic Salmon Farm Audits 2008**

**2008 Sub-zone 3.4 Summary of Molecular Diagnostics
8 Farms Sampled**

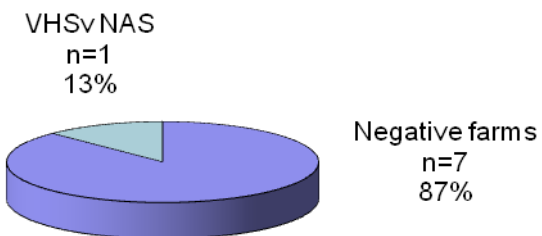


Table 7.5.7: Molecular Testing Results for Sub-zone 3.5 (Central Coast) Atlantic Salmon Farm Audits 2008									
Quarter	# farms sampled	# fish sampled	Number of Molecular Tests					Positive Sites	Organism Identified
			IHNv	IPNV	ISAV	<i>Piscirickettsia</i>	VHSV NAS		
Q1 Jan-Mar	1	2	1	1	1	1	1	0	None
Q2 Apr-Jun	2	3	2	2	2	2	2	0	None
Q3 Jul-Sep	2	12	3	3	3	3	3	0	None
Q4 Oct-Dec	2	6	2	2	2	2	2	0	None
Totals	7	23	8	8	8	8	8	0	

**Figure 7.5.7: Summary of Molecular Diagnostics Findings from Sub-zone 3.5
Atlantic Salmon Farm Audits 2008**

**2008 Sub-zone 3.5 Summary of Molecular Diagnostics
7 Farms Sampled**

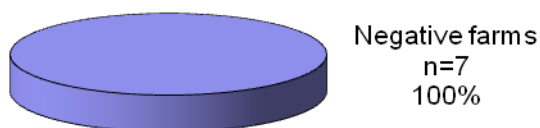


Table 7.5.8: Molecular Testing Results for Zone 2 (Vancouver Island) Pacific Salmon Farm Audits 2008									
Quarter	# farms sampled	# fish sampled	Number of Molecular Tests					Positive Sites	Organism Identified
			IHNv	IPNV	ISAV	<i>Piscirickettsia</i>	VHSV-NAS		
Q1 Jan-Mar	1	10	2	2	2	2	2	0	None
Q2 Apr-Jun	3	14	4	4	4	4	4	1	VHSV NAS
Q3 Jul-Sep	1	7	2	2	2	2	2	1	<i>Piscirickettsia salmonis</i>
Q4 Oct-Dec	3	17	5	5	5	5	5	0	None
Totals	8	48	13	13	13	13	13	2	

Figure 7.5.8: Summary of Molecular Diagnostics Findings from Zone 2
Pacific Salmon Farm Audits 2008

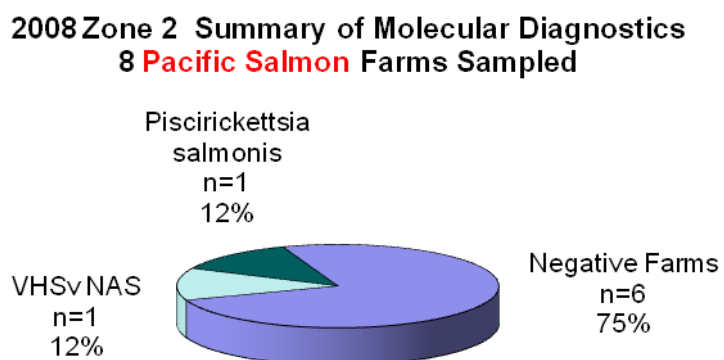
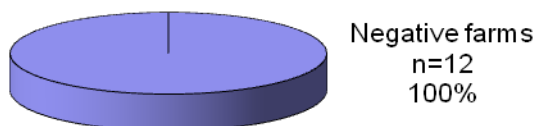


Table 7.5.9: Molecular Testing Results for Zone 3 (East of Vancouver Island) Pacific Salmon Farm Audits 2008									
Quarter	# farms sampled	# fish sampled	Number of Molecular Tests					Positive Sites	Organism Identified
			IHNv	IPNV	ISAV	<i>Piscirickettsia</i>	VHSV-NAS		
Q1 Jan-Mar	3	15	4	4	4	4	4	0	None
Q2 Apr-Jun	3	19	5	5	5	5	5	0	None
Q3 Jul-Sep	4	23	6	6	6	6	6	0	None
Q4 Oct-Dec	2	13	3	3	3	3	3	0	None
Totals	12	70	18	18	18	18	18	0	

Figure 7.5.9: Summary of Molecular Diagnostics Findings from Zone 3 **Pacific Salmon Farm Audits 2008**

**2008 Zone 3 Summary of Molecular Diagnostics
12 **Pacific Salmon** Farms Sampled**



APPENDIX 7.6 Audit Case Definitions

Bacterial Kidney Disease (BKD): A chronic granulomatous disease; the causative agent is *Renibacterium salmoninarum*. BKD is diagnosed in an Atlantic salmon population when the population is undergoing treatment for the disease, or if the fish sampled show gross clinical signs of the disease as well as population-level mortality.

BKD is often found in Pacific salmon populations to some degree. A Pacific salmon farm is diagnosed as positive for BKD if the farm is under treatment for the disease or if the fish sampled have gross clinical signs of BKD, histopathological lesions of BKD and the farm is experiencing population-level losses to the disease.

Furunculosis: A septicaemic disease caused by Gram negative *Aeromonas salmonicida*. Furunculosis is diagnosed in an Atlantic salmon population when the farm is undergoing treatment for the disease or when sampled carcasses exhibit septicaemia and population-level mortality.

Furunculosis disease rarely occurs in farmed Pacific salmon populations however the definition matches that of Atlantic salmon with the disease.

Infectious Haematopoietic Necrosis (IHNV): A viral 'septicaemia' caused by a marine rhabdovirus. Atlantic salmon appear to have little or no natural immunity to IHNV. The disease is diagnosed on a farm by means of a positive Polymerase Chain Reaction (PCR) test for the virus and confirmation by cell culture. High morbidity and mortality rates are often evident within 7 to 10 days of the initial infection. Farmed Chinook and Coho salmon are refractory to disease.

Loma salmonae: An endemic disease of Pacific salmon characterized by the presence of xenomas in the gill, pseudobranch and some internal organs. Loma is a microsporidian parasite found in fresh and saltwater populations of wild fish and in marine farmed Chinook salmon. Farmed Chinook may exhibit substantial weekly mortality rates over several months due to this parasite, particularly when water temperatures are between 12°C to 17°C.

Marine Anaemia (MA): An endemic disease of farmed Pacific salmon characterized by marked gill pallor, enlarged kidneys and spleens, ascites and exophthalmia. The cause of this disease may include a retroviral infection and/or an intranuclear microsporidian, *Nucleospora salmonis*. Marked haemoblast proliferation in specific organs is the histopathological hallmark of the disease. Grossly MA can appear similar and concurrent to BKD. A diagnosis of MA is considered in Pacific salmon populations if: the fish sampled have gross clinical signs of MA; histopathological lesions of MA; the farm is experiencing population-level losses, and severe BKD is not largely evident. Atlantic salmon do not appear to be afflicted by this form of marine anaemia.

Mouth Myxobacteriosis: A production disease of Atlantic salmon smolts during initial months of entry to sea water; the disease tends to be problematic in spring-entered smolts more so than in fall-entered smolts. The bacterium *Tenacibaculum maritimum* is consistently associated with the mouth lesions and is generally accepted as the etiologic agent. This diagnosis is assigned to an Atlantic smolt population when the group is being medicated for the disease, or if the fish sampled show gross clinical signs and histological evidence of the disease as well as population-level mortality (see VHS NAS for more information).

Net Pen Liver Disease (NPLD): Some farmed Atlantic smolts experience a debilitating liver condition thought to be associated with the natural algal toxin microcystin LR. The disease is environmental, not infectious, and is diagnosed as NPLD in Atlantic smolt populations when characterized by hepatic necrosis, hepatocellular megalocytosis and elevated mortality rates.

No Significant Findings / No Infectious Disease: Occasionally audits are scheduled that result in: a lack of fresh silver carcasses available for collection; or an interruption of travel or assessment due to weather; dive problems; or active natural harmful algae blooms. On these occasions insufficient data is available to assign a diagnosis of the fish, nor is evidence of infection apparent.

Open diagnosis: The information collected and observations made during an audit are often inconsistent with the results of laboratory tests, or the test results of the samples submitted reflect a mixed etiology, or 'no pathogen observed'. Often insufficient evidence exists to suggest population involvement of a specific disease (i.e. there is a low mortality rate and few silvers are available). In these cases, one must conclude that either the cause of death remains unknown or the mortality observed is incidental and not sufficient to assign a farm-wide disease diagnosis.

Parasitic Meningitis and/or Encephalitis: Microsporidian and Myxosporean parasites are indigenous to waters of BC and their appearance in the brains of some Atlantic salmon carcasses suggests this form of brain inflammation could be an incidental emerging disease, at least in selected groups of Atlantic salmon. The natural hosts of the parasites and the routes of transmission are unknown for those parasites found sporadically in brains of Atlantic salmon. To date, the population-level mortality rate is low and the condition is deemed a laboratory finding, not an infectious disease or production disease of salmon.

Post-vaccination Peritonitis (PVP): The presence of adhesions and peritonitis is observed grossly and histologically in farmed Atlantic and Pacific salmon that have received intra-peritoneal oil based vaccines. Severe PVP can decrease fish productivity and perhaps contribute to low-level mortality and downgrades at harvest due to adhesions and flesh melanisation.

Rickettsiosis: A chronic granulomatous and systemic disease caused by the intracellular pathogen *Piscirickettsia salmonis*. Rickettsiosis is diagnosed on an audit if the farm has: silvers with gross clinical signs of septicemic disease, a positive PCR test for the pathogen, histopathological lesions by *Piscirickettsia* and population-level losses, or if an oral medication is underway to control the disease mortality.

Viral Haemorrhagic Septicaemia, North American Strain, genotype IVa (VHS NAS): A viral 'septicaemia' caused by a rhabdovirus. VHS (NAS) is endemic in the Pacific herring populations and its presence in BC farms coincides with the herring migration. VHS is diagnosed on an audit if there is a positive PCR for VHS virus and/or positive culture on appropriate cell line, population-level losses (that may reach 2% per month) or histopathological lesions consistent with VHS viral infection. In recent years, VHS virus has been implicated as a confounding factor and/or an influence to mortality in other 'secondary infections' like mouth myxobacteriosis.

APPENDIX 7.7 BCSFA Mortality Reports

BCSFA Mortality Reports: Quarter 1 (Jan - Mar)

Average Mortality Rate (2008 Quarter 1)					
Fish Health SubZone	Species	Life stages	# Fish Group	# Site	Rate
All Zones	Atlantic salmon	"Early"	5	5	6.57%
2-3	Atlantic salmon	"Later"	29	14	0.31%
2-4	Atlantic salmon	"Later"	24	13	1.25%
3-1 + 3-2	Atlantic salmon	"Later"	25	18	1.67%
3-3	Atlantic salmon	"Later"	42	20	0.76%
3-4 + 3-5	Atlantic salmon	"Later"	18	12	0.30%
All Zones ⁴	Atlantic salmon	"Later"	154	71	1.29%
All Zones	Pacific salmon	"Early"	23	8	0.73%
All Zones	Pacific salmon	"Later"	28	17	1.50%

Notes

1 Rate figures are aggregate weighted averages (agreed to with BCMAL April 25, 2003)

2 Definitions for lifestages:

"Early"	Eyed Egg -->	Alevin / Larvae / Fry -->	Pre-smolt (= parr)
"Later"	Smolt -->	Grow-out / Harvest (= immature adult)	Broodstock --> Spent/Post-Spawn (public facilities)

3	The following participants' data are in the system for this quarter	Companies/ participants not yet on the system	Data in the system for this quarter but may be incomplete
	Creative Salmon	AgriMarine Industries	Fisheries and Oceans Canada
	Grieg Seafoods	Omega Pacific	
	Heritage Salmon	Saltstream Engineering	
	Marine Harvest Canada/ Stolt Seafoods	Totem Oysters	
	Mainstream (Pacific National Aquaculture)	Yellow Island Aquaculture	
	Panfish Canada (Omega Salmon Group)		
	Target Marine Products	Freshwater Fisheries Society of BC	
	West Coast Fish Culture	(some data in the system)	

4 This field has been added to encompass a small number of later lifestage Atlantic salmon (e.g., broodstock) raised in areas other than the subzones shown above.

Mortality Rates by Cause (2008 Quarter 1) ^{1,2}						
Early Life stages						
Fish Health SubZone	Species	# Fish Groups	Background Mortality	Systems Related	Fresh	Culls / Quality Control
All Zones	Atlantic salmon	10	1.02%	0.01%	0.07%	5.47%
All Zones	Pacific salmon	23	0.64%	0.03%	0.00%	0.06%

Mortality Rates by Cause (2008 Quarter 1)									
Later Life stages									
Fish Health SubZone	Species	# Fish Groups	Environmental	Fresh "Silvers"	Handling / Transport	Matures	Old	Poor Performers	Predators
All Zones	Atlantic salmon	154	0.10%	0.40%	0.08%	0.34%	0.22%	0.51%	0.03%
2-3	Atlantic salmon	29	0.00%	0.08%	0.00%	0.03%	0.11%	0.05%	0.04%
2-4	Atlantic salmon	24	0.74%	0.04%	0.05%	0.00%	0.32%	0.02%	0.08%
3-1 + 3-2	Atlantic salmon	25	0.01%	0.31%	0.10%	1.16%	0.09%	0.04%	0.05%
3-3	Atlantic salmon	42	0.01%	0.04%	0.15%	0.13%	0.35%	0.06%	0.01%
3-4 + 3-5	Atlantic salmon	18	0.03%	0.04%	0.01%	0.01%	0.16%	0.04%	0.02%
All Zones	Pacific salmon	28	0.00%	0.35%	0.14%	0.59%	0.21%	0.02%	0.23%

Notes

1 See notes for Average Mortality Rate report

2 Sum of individual Proportional Mortality Rates reconciles to Average Mortality Rate to 0.005% (rounding errors)

BCSFA Mortality Reports: Quarter 2 (Apr – Jun)

Average Mortality Rate (Quarter 2 2008)					
Fish Health SubZone	Species	Life stages	# Fish Group	# Site	Rate
All Zones	Atlantic salmon	"Early"	9	5	7.22%
2-3	Atlantic salmon	"Later"	12	6	3.32%
2-4	Atlantic salmon	"Later"	25	11	0.57%
3-1 + 3-2	Atlantic salmon	"Later"	50	35	1.32%
3-3	Atlantic salmon	"Later"	42	19	1.47%
3-4 + 3-5	Atlantic salmon	"Later"	20	12	0.70%
All Zones ⁴	Atlantic salmon	"Later"	160	90	1.53%
All Zones	Pacific salmon	"Early"	21	7	0.69%
All Zones	Pacific salmon	"Later"	25	15	1.22%

Notes

1 Rate figures are aggregate weighted averages (agreed to with BCMAL April 25, 2003)

2 Definitions for lifestages:

"Early"	Eyed Egg -->	Alevin / Larvae / Fry -->	Pre-smolt (= parr)
"Later"	Smolt -->	Grow-out / Harvest (= immature adult) -->	Broodstock --> Spent/Post-Spawn (public facilities)

3	The following participants' data are in the system for this quarter	Companies/ participants not yet on the system	Data in the system for this quarter but may be incomplete
	Creative Salmon Grieg Seafoods Heritage Salmon Marine Harvest Canada/ Stolt Seafarms Mainstream (Pacific National Aquaculture) Panfish Canada (Omega Salmon Group) Target Marine Products West Coast Fish Culture	AgriMarine Industries Omega Pacific Saltstream Engineering Totem Oysters Yellow Island Aquaculture Freshwater Fisheries Society of BC (some data in the system)	Fisheries and Oceans Canada

4 This field has been added to encompass a small number of "later lifestage" Atlantic salmon (e.g., broodstock) raised in areas other than the sub-zones shown above.

Mortality Rates by Cause (Quarter 2 2008) ^{1,2}							
Early Life stages							
Fish Health SubZone	Species	# Fish Groups	Background Mortality	Systems Related	Fresh	Culls / Quality Control	
All Zones	Atlantic salmon	9	3.34%	0.02%	0.47%	3.19%	
All Zones	Pacific salmon	21	0.45%	0.15%	0.00%	0.09%	

Mortality Rates by Cause (Quarter 2 2008)									
Later Life stages									
Fish Health SubZone	Species	# Fish Groups	Environmental	Fresh "Silvers"	Handling / Transport	Matures	Old	Poor Performers	Predators
All Zones	Atlantic salmon	160	0.22%	0.37%	0.2856	0.01%	0.36%	0.24%	0.05%
2-3	Atlantic salmon	12	0.03%	0.95%	1.17%	0.04%	0.39%	0.59%	0.16%
2-4	Atlantic salmon	25	0.12%	0.06%	0.00%	0.00%	0.28%	0.05%	0.06%
3-1 + 3-2	Atlantic salmon	50	0.76%	0.05%	0.03%	0.00%	0.19%	0.25%	0.04%
3-3	Atlantic salmon	42	0.01%	0.62%	0.27%	0.00%	0.29%	0.27%	0.01%
3-4 + 3-5	Atlantic salmon	20	0.07%	0.10%	0.17%	0.01%	0.22%	0.09%	0.00%
All Zones	Pacific salmon	25	0.00%	0.53%	0.09%	0.02%	0.29%	0.05%	0.28%

Notes

- 1 See notes for Average Mortality Rate report
- 2 Sum of individual Proportional Mortality Rates reconciles to Average Mortality Rate to 0.005% (rounding errors)

BCSFA Mortality Reports: Quarter 3 (Jul – Sep)

Average Mortality Rate (Quarter 3 2008)					
Fish Health SubZone	Species	Life stages	# Fish Group	# Site	Rate
All Zones	Atlantic salmon	"Early"	10	5	4.87%
2-3	Atlantic salmon	"Later"	26	14	4.40%
2-4	Atlantic salmon	"Later"	23	12	5.02%
3-1 + 3-2	Atlantic salmon	"Later"	24	20	1.02%
3-3	Atlantic salmon	"Later"	41	20	1.02%
3-4 + 3-5	Atlantic salmon	"Later"	22	9	1.30%
All Zones ⁴	Atlantic salmon	"Later"	156	87	2.52%
All Zones	Pacific salmon	"Early"	28	6	2.26%
All Zones	Pacific salmon	"Later"	33	16	2.99%

Notes

1 Rate figures are aggregate weighted averages (agreed to with BCMAL April 25, 2003)

2 Definitions for lifestages:

"Early"	Eyed Egg -->	Alevin / Larvae / Fry -->	Pre-smolt (= parr)
"Later"	Smolt -->	Grow-out / Harvest (= immature adult) Broodstock -->	Spent/Post-Spawn (public facilities)

3	The following participants' data are in the system for this quarter	Companies/ participants not yet on the system	Data in the system for this quarter but may be incomplete
	Creative Salmon	AgriMarine Industries	Fisheries and Oceans Canada
	Grieg Seafoods	Omega Pacific	
	Heritage Salmon	Saltstream Engineering	
	Marine Harvest Canada/ Stolt Seafoods	Totem Oysters	
	Mainstream (Pacific National Aquaculture)	Yellow Island Aquaculture	
	Panfish Canada (Omega Salmon Group)		
	Target Marine Products	Freshwater Fisheries Society of BC	
	West Coast Fish Culture	(some data in the system)	

4 This field has been added to encompass a small number of later lifestage Atlantic salmon (e.g., broodstock) raised in areas other than the subzones shown above.

Mortality Rates by Cause (Quarter 3 2008) ^{1,2}						
Early Life stages						
Fish Health SubZone	Species	# Fish Groups	Background Mortality	Systems Related	Fresh	Culls / Quality Control
All Zones	Atlantic salmon	10	1.80%	0.03%	0.30%	2.73%
All Zones	Pacific salmon	28	1.12%	0.00%	0.00%	1.13%

Mortality Rates by Cause (Quarter 3 2008)									
Later Life stages									
Fish Health SubZone	Species	# Fish Groups	Environmental	Fresh "Silvers"	Handling / Transport	Matures	Old	Poor Performers	Predators
All Zones	Atlantic salmon		0.73%	0.34%	0.03%	0.05%	0.53%	0.82%	0.02%
2-3	Atlantic salmon	26	0.00%	1.31%	0.03%	0.00%	0.97%	2.01%	0.08%
2-4	Atlantic salmon	23	4.39%	0.04%	0.10%	0.19%	0.25%	0.05%	0.00%
3-1 + 3-2	Atlantic salmon	24	0.08%	0.11%	0.02%	0.00%	0.68%	0.10%	0.02%
3-3	Atlantic salmon	41	0.00%	0.15%	0.01%	0.06%	0.27%	0.52%	0.00%
3-4 + 3-5	Atlantic salmon	22	0.01%	0.21%	0.00%	0.00%	0.23%	0.84%	0.00%
All Zones	Pacific salmon	33	0.01%	1.08%	1.08%	0.43%	0.68%	0.24%	0.08%

Notes

- 1 See notes for Average Mortality Rate report
- 2 Sum of individual Proportional Mortality Rates reconciles to Average Mortality Rate to 0.005% (rounding errors)

BCSFA Mortality Reports: Quarter 4 (Oct – Dec)

Average Mortality Rate (Quarter 4 2008)					
Fish Health SubZone	Species	Life stages	# Fish Group	# Site	Rate
All Zones	Atlantic salmon	"Early"	8	5	7.68%
2-3	Atlantic salmon	"Later"	10	12	1.52%
2-4	Atlantic salmon	"Later"	10	12	1.65%
3-1 + 3-2	Atlantic salmon	"Later"	19	18	0.24%
3-3	Atlantic salmon	"Later"	20	19	0.78%
3-4 + 3-5	Atlantic salmon	"Later"	13	13	0.35%
All Zones ⁴	Atlantic salmon	"Later"	92	85	0.85%
All Zones	Pacific salmon	"Early"	17	8	0.63%
All Zones	Pacific salmon	"Later"	24	17	5.03%

Notes

1 Rate figures are aggregate weighted averages (agreed to with BCMAL April 25, 2003)

2 Definitions for lifestages:

"Early"	Eyed Egg -->	Alevin / Larvae / Fry -->	Pre-smolt (= parr)
"Later"	Smolt -->	Grow-out / Harvest (= immature adult) Broodstock -->	Spent/Post-Spawn (public facilities)

3	The following participants' data are in the system for this quarter	Companies/ participants not yet on the system	Data in the system for this quarter but may be incomplete
	Creative Salmon Grieg Seafoods Heritage Salmon Marine Harvest Canada/ Stolt Seafoods Mainstream (Pacific National Aquaculture) Panfish Canada (Omega Salmon Group) Target Marine Products West Coast Fish Culture	AgriMarine Industries Omega Pacific Saltstream Engineering Totem Oysters Yellow Island Aquaculture Freshwater Fisheries Society of BC (some data in the system)	Fisheries and Oceans Canada

4 This field has been added to encompass a small number of later lifestage Atlantic salmon (e.g., broodstock) raised in areas other than the subzones shown above.

Mortality Rates by Cause (Quarter 4 2008) ^{1,2}						
Early Life stages						
Fish Health SubZone	Species	# Fish Groups	Background Mortality	Systems Related	Fresh	Culls / Quality Control
All Zones	Atlantic salmon	8	1.66%	0.62%	0.19%	5.22%
All Zones	Pacific salmon	17	0.53%	0.07%	0.00%	0.03%

Mortality Rates by Cause (Quarter 4 2008)									
Later Life stages									
Fish Health SubZone	Species	# Fish Groups	Environmental	Fresh "Silvers"	Handling / Transport	Matures	Old	Poor Performers	Predators
All Zones	Atlantic salmon	92	0.00%	0.16%	0.24%	0.09%	0.23%	0.09%	0.03%
2-3	Atlantic salmon	10	0.00%	0.58%	0.07%	0.01%	0.57%	0.21%	0.08%
2-4	Atlantic salmon	10	0.00%	0.05%	1.10%	0.00%	0.43%	0.03%	0.03%
3-1 + 3-2	Atlantic salmon	19	0.00%	0.04%	0.35%	0.01%	0.08%	0.04%	0.03%
3-3	Atlantic salmon	20	0.00%	0.12%	0.17%	0.28%	0.13%	0.07%	0.01%
3-4 + 3-5	Atlantic salmon	13	0.00%	0.04%	0.15%	0.00%	0.06%	0.05%	0.05%
All Zones	Pacific salmon	24	0.00%	0.49%	0.89%	2.19%	0.86%	0.05%	0.57%

Notes

- 1 See notes for Average Mortality Rate report
- 2 Sum of Individual Proportional Mortality Rates reconciles to Average Mortality Rate to 0.005% (rounding errors)

APPENDIX 7.8 BCSFA Fish Health Events

Fish Health Events (2008 Quarter 1)						
Fish Health SubZone	Species	Life Stage	Veterinary Diagnosis	Count of Fish Health Events ^{1,2,3}		
				New	Ongoing/Recurring	Relapsing
All	Atlantic Salmon	"Early"		0	0	0
All zones ⁵	Atlantic Salmon	"Later"	Renibacterium salmoninarum Infection	0	1	0
2-3	Atlantic Salmon	"Later"	Lepeophtheirus Infection	2	1	0
			Piscirickettsia salmonis Infection	1	2	0
2-4	Atlantic Salmon	"Later"	Lepeophtheirus Infection	4	0	0
			Myxobacterial Infection	1	0	0
3-1 + 3-2	Atlantic Salmon	"Later"	Lepeophtheirus Infection	4	0	0
			Myxobacterial Infection	4	1	0
3-3	Atlantic Salmon	"Later"	Lepeophtheirus Infection	2	0	0
			Viral Haemorrhagic Septicemia Virus Infection	0	1	0
3-4 + 3-5	Atlantic Salmon	"Later"	Lepeophtheirus Infection	3	0	0
All zones	Pacific Salmonids	"Early"		0	0	0
All zones	Pacific Salmonids	"Later"	Renibacterium salmoninarum Infection	1	6	0

Notes

- 1 Reporting reflects life stage rather than water type. See notes 1 - 2 of Average Mortality Rate report.
- 2 Counts of veterinary diagnosis are based on FISH GROUP (not site); more than one fish group may exist at a site
- 3 Fish Health Events reflect the following categories:

New	First time occurrence; new event
Ongoing/recurring	Repeat or ongoing occurrence from previous calendar quarter
Relapsing	Repeat occurrence from calendar quarter at least two quarters preceding the current one
- 4 "Case worked up but no diagnosis" category requires workup and management steps taken, e.g., further investigation, husbandry change etc.
- 5 This field has been added to encompass a small number of later lifestage Atlantic salmon (e.g., broodstock) raised in areas other than the subzones shown above.

Fish Health Events (Quarter 2 2008)						
Fish Health SubZone	Species	Life Stage	Veterinary Diagnosis	Count of Fish Health Events ^{1,2,3}		
				New	Ongoing/Recurring	Relapsing
All	Atlantic Salmon	"Early"		0	0	0
All zones ⁵	Atlantic Salmon	"Later"	Lepeophtheirus Infection	0	1	0
2-3	Atlantic Salmon	"Later"	Aeromonas salmonicida Infection	0	1	1
			Lepeophtheirus Infection	0	1	0
			Piscirickettsia salmonis Infection	0	2	1
2-4	Atlantic Salmon	"Later"	Myxobacterial Infection	3	1	0
3-1 + 3-2	Atlantic Salmon	"Later"	Lepeophtheirus Infection	4	0	0
			Myxobacterial Infection	0	1	0
			Renibacterium salmoninarum Infection	1	0	0
3-3	Atlantic Salmon	"Later"	Lepeophtheirus Infection	1	0	0
			Renibacterium salmoninarum Infection	1	1	0
			Viral Haemorrhagic Septicemia Virus Infection	0	1	0
3-4 + 3-5	Atlantic Salmon	"Later"	Myxobacterial Infection	2	0	0
All zones	Pacific Salmonids	"Early"	Case worked up but no diagnosis	1	0	0
			Myxobacterial Infection	3	0	0
All zones	Pacific Salmonids	"Later"	Renibacterium salmoninarum Infection	4	4	0

Notes

- 1 Reporting reflects life stage rather than water type. See notes 1 - 2 of Average Mortality Rate report.
- 2 Counts of veterinary diagnosis are based on FISH GROUP (not site); more than one fish group may exist at a site
- 3 Fish Health Events reflect the following categories:

New	First time occurrence; new event
Ongoing/recurring	Repeat or ongoing occurrence from previous calendar quarter
Relapsing	Repeat occurrence from calendar quarter at least two quarters preceding the current one
- 4 "Case worked up but no diagnosis" category requires workup and management steps taken, e.g., further investigation, husbandry change etc.
- 5 This field has been added to encompass a small number of later lifestage Atlantic salmon (e.g., broodstock) raised in areas other than the subzones shown above.

Fish Health Events (Quarter 3 2008)						
Fish Health SubZone	Species	Life Stage	Veterinary Diagnosis	Count of Fish Health Events ^{1,2,3}		
				New	Ongoing/Recurring	Relapsing
All	Atlantic Salmon	"Early"		0	0	0
All zones ⁵	Atlantic Salmon	"Later"		0	0	0
2-3	Atlantic Salmon	"Later"	Aeromonas salmonicida Infection	1	2	0
			Lepeophtheirus Infection	2	0	0
			Myxobacterial Infection	3	1	0
			Piscirickettsia salmonis Infection	0	3	0
2-4	Atlantic Salmon	"Later"	Myxobacterial Infection	0	2	0
3-1 + 3-2	Atlantic Salmon	"Later"	Lepeophtheirus Infection	2	1	0
			Myxobacterial Infection	2	1	0
			Piscirickettsia salmonis Infection	1	0	0
3-3	Atlantic Salmon	"Later"	Lepeophtheirus Infection	0	1	10
			Viral Haemorrhagic Septicemia Virus Infection	0	1	0
3-4 + 3-5	Atlantic Salmon	"Later"		0	0	0
All zones	Pacific Salmonids	"Early"	Myxobacterial Infection	0	1	0
All zones	Pacific Salmonids	"Later"	Renibacterium salmoninarum Infection	0	6	0
			Vibrio (Listonella) Infection	1	0	0

Notes

- Reporting reflects life stage rather than water type. See notes 1 - 2 of Average Mortality Rate report.
- Counts of veterinary diagnosis are based on FISH GROUP (not site); more than one fish group may exist at a site
- Fish Health Events reflect the following categories:

New	First time occurrence; new event
Ongoing/recurring	Repeat or ongoing occurrence from previous calendar quarter
Relapsing	Repeat occurrence from calendar quarter at least two quarters preceding the current one
- "Case worked up but no diagnosis" category requires workup and management steps taken, e.g., further investigation, husbandry change etc.
- This field has been added to encompass a small number of later lifestage Atlantic salmon (e.g., broodstock) raised in areas other than the subzones shown above.

Fish Health Events (Quarter 4 2008)						
Fish Health SubZone	Species	Life Stage	Veterinary Diagnosis	Count of Fish Health Events ^{1,2,3}		
				New	Ongoing/Recurring	Relapsing
All	Atlantic Salmon	"Early"		0	0	0
All zones ⁵	Atlantic Salmon	"Later"		0	0	0
2-3	Atlantic Salmon	"Later"	Lepeophtheirus Infection	0	2	0
			Myxobacterial Infection	5	1	0
			Piscirickettsia salmonis Infection	2	2	0
2-4	Atlantic Salmon	"Later"	Lepeophtheirus Infection	2	0	0
			Myxobacterial Infection	1	0	0
3-1 + 3-2	Atlantic Salmon	"Later"	Lepeophtheirus Infection	3	0	0
			Myxobacterial Infection	2	1	0
3-3	Atlantic Salmon	"Later"	Aeromonas salmonicida (Atypical) Infection	1	0	0
			Lepeophtheirus Infection	9	0	0
			Viral Haemorrhagic Septicemia Virus Infection	1	0	0
			Myxobacterial Infection	0	1	0
3-4 + 3-5	Atlantic Salmon	"Later"	Lepeophtheirus Infection	0	2	0
All zones	Pacific Salmonids	"Early"	Aeromonas salmonicida Infection	1	0	0
			Case worked up but no diagnosis	0	1	0
All zones	Pacific Salmonids	"Later"	Renibacterium salmoninarum Infection	2	4	0
			Vibrio (Listonella) Infection	1	1	0

Notes

- Reporting reflects life stage rather than water type. See notes 1 - 2 of Average Mortality Rate report.
- Counts of veterinary diagnosis are based on FISH GROUP (not site); more than one fish group may exist at a site
- Fish Health Events reflect the following categories:

New	First time occurrence; new event
Ongoing/recurring	Repeat or ongoing occurrence from previous calendar quarter
Relapsing	Repeat occurrence from calendar quarter at least two quarters preceding the current one
- "Case worked up but no diagnosis" category requires workup and management steps taken, e.g., further investigation, husbandry change etc.
- This field has been added to encompass a small number of later lifestage Atlantic salmon (e.g., broodstock) raised in areas other than the subzones shown above.

APPENDIX 7.9 Sea Lice Life Stages Defined for Industry Monitoring and BCMAL Audits

***Lepeophtheirus salmonis*:**

Adult female – includes all adult female lice, with egg strings (i.e. gravid female) or without egg strings.

Motile Lice / Mobile Lice – includes all ‘not permanently attached’ free-moving life stages: adult females (as above) plus adult male and pre-adult male/female lice.

Caligus – total numbers of motile *Caligus clemensi*, or other species if detectable grossly.

Chalimus - attached immature stages of both *Caligus* and *Lepeophtheirus*. Both types are categorised as chalimus since louse identification at those very early stages is not practical when cage-side.

Year class – age of fish in saltwater.

- “Year class 1” represents fish groups that share a similar date of salt water entry with the first fish on farm (i.e. within 6 months), plus the subsequent 12 months.
- “Year class 2” is defined as the remaining time in saltwater after that initial 12 months.
- Broodstock held in saltwater would be included in the Year class 2 group, up to March 1st of the year in which eggs will be collected. For broodstock relocated to freshwater facilities, information on health will be included in the freshwater section of the BCSFA industry database reports.

APPENDIX 7.10 Sea Lice BCMAL Audit Tables**Table 7.10.1 Sub-zone 2.3** (BCMAL Audits 2008) Quarterly Mean and Median Abundance of Motile and Female *Lepeophtheirus salmonis*, Chalimus (*L. salmonis* & *Caligus clemensi*) and Motile *C. clemensi* on Atlantic Salmon (not including tote counts).

Year Class 1 - 2008	Q1		Q2		Q3		Q4	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Number of Farms Audited (n)	1		2		0		2	
Motile	0.1000	0	0.2667	0	ø	ø	0.5083	0
Standard Deviation (SD)	0.3542		0.6044				0.8599	
Female	0	0	0.0417	0	ø	ø	0.2167	0
SD			0.2007				0.5052	
Chalimus	0.3667	0	0.2917	0	ø	ø	0.3000	0
SD	0.6097		0.6786				0.7288	
Caligus Motile	0.0167	0	0.0583	0	ø	ø	0.2167	0
SD	0.1291		0.3253				0.5052	

Year Class 2 - 2008	Q1		Q2		Q3		Q4	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Number of Farms Audited (n)	0		2		2		1	
Motile	ø	ø	0.6917	0	0.1667	0	0.2167	0
SD			1.2421		0.5076		0.5237	
Female	ø	ø	0.3083	0	0.1000	0	0.1500	0
SD			0.7970		0.3757		0.4444	
Chalimus	ø	ø	0.100	0	0	0	0.3833	0
SD			0.3280				1.0100	
Caligus Motile	ø	ø	0.2583	0	0.0083	0	0.0833	0
SD			0.5423		0.0913		0.2787	

Table 7.10.2 Sub-zone 2.4 (BCMAL Audits 2008) Quarterly Mean and Median Abundance of Motile and Female *Lepeophtheirus salmonis*, Chalimus (*L. salmonis* & *Caligus clemensi*) and Motile *C. clemensi* on Atlantic Salmon (not including tote counts).

Year Class 1 - 2008	Q1		Q2		Q3		Q4	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Number of Farms Audited (n)	0		2		1		1	
Motile	ø	ø	0.0750	0	0.6000	0	1.2500	1
Standard Deviation (SD)			0.2645		1.1078		1.3976	
Female	ø	ø	0.0083	0	0.2500	0	0.3833	0
SD			0.0913		0.5084		0.6911	
Chalimus	ø	ø	0.1000	0	0	0	0	0
SD			0.3527					
Caligus Motile	ø	ø	0.0083	0	0	0	0.0167	0
SD			0.0913				0.1291	

Year Class 2 - 2008	Q1		Q2		Q3		Q4	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Number of Farms Audited (n)	1		3		2		0	
Motile	0.3833	0	0.8611	0	0.7167	0	ø	ø
SD	1.6477		1.7264		1.1241			
Female	0.1500	0	0.3389	0	0.4500	0	ø	ø
SD	0.5771		0.7779		0.7543			
Chalimus	0	0	0.1667	0	0	0	ø	ø
SD			0.6298					
Caligus Motile	0	0	0.0167	0	0	0	ø	ø
SD			0.1663					

Table 7.10.3 Sub-zone 3.1 (BCMAL Audits 2008) Quarterly Mean and Median Abundance of Motile and Female *Lepeophtheirus salmonis*, Chalimus (*L. salmonis* & *Caligus clemensi*) and Motile *C. clemensi* on Atlantic Salmon (not including tote counts).

Year Class 1 - 2008	Q1		Q2		Q3		Q4	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Number of Farms Audited (n)	0		1		1		0	
Motile	ø	ø	0	0	0.0667	0	ø	ø
Standard Deviation (SD)					0.2515			
Female	ø	ø	0	0	0.0667	0	ø	ø
SD					0.2515			
Chalimus	ø	ø	0	0	0	0	ø	ø
SD								
Caligus Motile	ø	ø	0	0	0	0	ø	ø
SD								

Year Class 2 - 2008	Q1		Q2		Q3		Q4	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Number of Farms Audited (n)	1		1		0		1	
Motile	0.2167	0	0.1000	0	ø	ø	0.1667	0
SD	0.4903		0.3025				0.3237	
Female	0.1333	0	0.0500	0	ø	ø	0.0167	0
SD	0.3891		0.2198				0.1291	
Chalimus	0.3833	0	0.5000	0	ø	ø	0.0167	0
SD	0.6662		1.0000				0.1291	
Caligus Motile	0.0500	0	0.2167	0	ø	ø	0	0
SD	0.2198		0.6662					

Table 7.10.4 Sub-zone 3.2 (BCMAL Audits 2008) Quarterly Mean and Median Abundance of Motile and Female *Lepeophtheirus salmonis*, Chalimus (*L. salmonis* & *Caligus clemensi*) and Motile *C. clemensi* on Atlantic Salmon (not including tote counts).

Year Class 1 - 2008	Q1		Q2		Q3		Q4	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Number of Farms Audited (n)	2		3		3		1	
Motile	0.0900	0	0.5444	0	1.1167	0	0.5667	0
Standard Deviation (SD)	0.2876		0.8003		1.9783		1.0312	
Female	0	0	0.0667	0	0.2389	0	0.0333	0
SD			0.2914		0.7119		.1810	
Chalimus	0.4800	0	0.8722	0	2.7444	1	5.3000	4.5
SD	0.9043		1.2904		4.4835		4.1550	
Caligus Motile	0.0500	0	0.0167	0	1.4778	0	0.3000	0
SD	0.3295		0.1284		2.6266		0.8088	

Year Class 2 - 2008	Q1		Q2		Q3		Q4	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Number of Farms Audited (n)	1		6		1		3	
Motile	4.0333	3	1.5889	0	0.2333	0	1.1222	1
SD	3.0641		3.9598		0.5635		1.7293	
Female	2.05	2	0.4583	0	0.1333	0	0.3500	0
SD	1.7985		1.4590		0.4305		0.6641	
Chalimus	1.8167	1	0.7278	0	0.2667	0	0.7667	0
SD	1.8910		2.2412		0.4825		1.1438	
Caligus Motile	0.0833	0	0.0500	0	0	0	0.0444	0
SD	0.3340		0.2747				0.2956	

Table 7.10.5 Sub-zone 3.3 (BCMAL Audits 2008) Quarterly Mean and Median Abundance of Motile and Female *Lepeophtheirus salmonis*, Chalimus (*L. salmonis* & *Caligus clemensi*) and Motile *C. clemensi* on Atlantic Salmon (not including tote counts).

Year Class 1 - 2008	Q1		Q2		Q3		Q4	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Number of Farms Audited (n)	1		2		1		0	
Motile	0.1000	0	0.0917	0	0.6500	0	ø	ø
Standard Deviation (SD)	0.3025		0.3174		0.9885			
Female	0	0	0	0	0.0833	0	ø	ø
SD					0.3340			
Chalimus	0.2167	0	0.1250	0	2.6000	2.5	ø	ø
SD	0.4155		0.3321		2.5258			
Caligus Motile	0.0500	0	0.0917	0	0.0333	0	ø	ø
SD	0.2198		0.3174		0.1810			

Year Class 2 - 2008	Q1		Q2		Q3		Q4	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Number of Farms Audited (n)	3		3		3		2	
Motile	0.5667	0	0.0444	0	0.2889	0	2.1667	2
SD	0.9578		0.2321		0.6472		2.2279	
Female	0.2000	0	0	0	0.0778	0	0.5000	0
SD	0.4409				0.2686		0.7886	
Chalimus	0.7222	0	0.0500	0	0.4722	0	6.1667	4
SD	1.0834		0.2428		1.2072		6.4721	
Caligus Motile	0.0611	0	0.0222	0	0.0167	0	0.0833	0
SD	0.2829		0.1478		0.1284		0.2775	

Table 7.10.6 Sub-zone 3.4 (BCMAL Audits 2008) Quarterly Mean and Median Abundance of Motile and Female *Lepeophtheirus salmonis*, Chalimus (*L. salmonis* & *Caligus clemensi*) and Motile *C. clemensi* on Atlantic Salmon (not including tote counts).

Year Class 1 - 2008	Q1		Q2		Q3		Q4	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Number of Farms Audited (n)	0		2		1		1	
Motile	ø	ø	0.1000	0	0.3333	0	2.1667	2
Standard Deviation (SD)			0.3280		0.5724		2.3947	
Female	ø	ø	0	0	0.1000	0	0.4667	0
SD					0.3025		0.6501	
Chalimus	ø	ø	0.0917	0	0.2833	0	1.8000	1.5
SD			0.2898		0.5552		2.1297	
Caligus Motile	ø	ø	0.0083	0	0.0500	0	0.2333	0
SD			0.0913		0.2198		0.5326	

Year Class 2 - 2008	Q1		Q2		Q3		Q4	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Number of Farms Audited (n)	1		1		0		0	
Motile	4.0333	3	0.5167	0	ø	ø	ø	ø
SD	3.2624		0.7477					
Female	2.1167	2	0.3500	0	ø	ø	ø	ø
SD	2.0176		0.6058					
Chalimus	0.0500	0	0	0	ø	ø	ø	ø
SD	0.2867							
Caligus Motile	0.1000	0	0	0	ø	ø	ø	ø
SD	0.3025							

Table 7.10.7 Sub-zone 3.5 (BCMAL Audits 2008) Quarterly Mean and Median Abundance of Motile and Female *Lepeophtheirus salmonis*, Chalimus (*L. salmonis* & *Caligus clemensi*) and Motile *C. clemensi* on Atlantic Salmon (not including tote counts).

Year Class 1 - 2008	Q1		Q2		Q3		Q4	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Number of Farms Audited (n)	0		0		1		0	
Motile	ø	ø	ø	ø	0.2833	0	ø	ø
Standard Deviation (SD)					0.4903			
Female	ø	ø	ø	ø	0.0333	0	ø	ø
SD					0.1810			
Chalimus	ø	ø	ø	ø	0.0500	0	ø	ø
SD					0.2198			
Caligus Motile	ø	ø	ø	ø	0	0	ø	ø
SD								

Year Class 2 - 2008	Q1		Q2		Q3		Q4	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Number of Farms Audited (n)	1		2		0		1	
Motile	0.6000	0	0.0917	0	ø	ø	0.0500	0
SD	0.8868		0.3174				0.2198	
Female	0.2333	0	0.0250	0	ø	ø	0.0167	0
SD	0.5326		0.1568				0.1291	
Chalimus	0.0333	0	0.6083	0	ø	ø	0	0
SD	0.2582		1.5355					
Caligus Motile	0	0	0.0250	0	ø	ø	0	0
SD			0.2034					

APPENDIX 7.11 Sea Lice BCSFA Reports (Tables and Graphs)

KEY:

Motile ~ *Lepeophtheirus* sp. (pre-adult and adult stages)

Female ~ Adult female *Lepeophtheirus* sp. (adult female)

Caligus ~ sp. (pre adult and adult)

Yearclass 1 ~ For salmon 1 year or less in seawater

Yearclass 2 ~ For salmon 2 years or more in seawater

Notes:

() ~ total number of farms counts for months where two counts have been requested.

* Reasons for missing farm lice counts

- ~Site is fallow
- ~Site is harvesting and < 3 pens left on site
- ~Smolt entry and < 3 pens on site, or <1 month since third smolt pen entered
- ~Fish being treated for sea lice
- ~Fish being treated / managed for other fish health concerns
- ~Fish could not be handled due to environmental concerns, e.g. low DO

Atlantic Salmon Sea Lice Abundance

Yearclass 1						Yearclass 2					
ZONE/SUBZONE 2.3		Motile	Female	Caligus	n	ZONE/SUBZONE 2.3		Motile	Female	Caligus	n
Jan-08		4.53	2.21	0.15	3(5)	Jan-08		2.32	1.08	0.00	3
	std error	3.87	1.92	0.02			std error	2.14	0.99	0.00	
Feb-08		1.18	0.57	0.00	2(3)	Feb-08		0.68	0.27	0.02	3(6)
	std error	1.10	0.57	0.00			std error	0.279	0.10	0.02	
Mar-08		0.41	0.22	0.03	2(3)	Mar-08		0.85	0.27	0.07	2(4)
	std error	0.23	0.19	0.03			std error	0.64	0.23	0.07	
Apr-08		0.43	0.09	0.03	3	Apr-08		1.49	0.58	0.25	2(3)
	std error	0.16	0.02	0.01			std error	1.39	0.57	0.25	
May-08		0.28	0.02	0	1	May-08		1.27	0.60	0.15	4(7)
	std error						std error	0.72	0.41	0.06	
Jun-08		0.64	0.10	0.00	2	Jun-08		2.42	0.72	0.24	3
	std error	0.64	0.10	0.00			std error	1.88	0.62	0.13	
Jul-08		0.31	0.06	0.03	2(3)	Jul-08		0.19	0.07	0.00	3(4)
	std error	0.31	0.06	0.03			std error	0.12	0.04	0.00	
Aug-08		0.35	0.11	0.03	3(4)	Aug-08		0.28	0.20	0.03	1
	std error	0.15	0.04	0.03			std error				
Sep-08		0.64	0.22	3.96	5(7)	Sep-08		*	*	*	
	std error	0.24	0.08	3.86			std error				
Oct-08		0.88	0.19	0.17	4	Oct-08		0.02	0.00	0.00	1
	std error	0.22	0.05	0.09			std error				
Nov-08		0.97	0.35	1.66	5(6)	Nov-08		1.47	0.90	0.17	1
	std error	0.33	0.14	1.33			std error				
Dec-08		0.90	0.48	1.07	5(6)	Dec-08		0.25	0.17	0.00	1
	std error	0.50	0.30	0.92			std error				

Yearclass 1					
ZONE/SUBZONE 2.4		Motile	Female	Caligus	n
Jan-08		3.05	0.83	0.00	2(3)
	std error	0.83	0.64	0.00	
Feb-08		1.96	1.05	0.00	2
	std error	1.31	1.02	0.00	
Mar-08		0.83	0.46	0.00	2
	std error	0.83	0.46	0.00	
Apr-08		0.30	0.18	0.00	2
	std error	0.30	0.18	0.00	
May-08		0.28	0.14	0.00	2
	std error	0.11	0.12	0.00	
Jun-08		0.07	0.02	0.00	3
	std error	0.05	0.01	0.00	
Jul-08		0.03	0.00	0.00	1
	std error				
Aug-08		0.20	0.08	0.00	2
	std error	0.13	0.06	0.00	
Sep-08		0.40	0.20	0.00	1
	std error				
Oct-08		4.84	1.16	0.19	3
	std error	3.44	0.57	0.19	
Nov-08		2.97	1.33	0.12	2
	std error	2.15	0.90	0.12	
Dec-08		3.17	1.39	0.99	2
	std error	2.65	1.17	0.99	
ZONE/SUBZONE 3.1		Motile	Female	Caligus	n
Jan-08					
	std error				
Feb-08					
	std error				
Mar-08					
	std error				
Apr-08					
	std error				
May-08					
	std error				
Jun-08					
	std error				
Jul-08					
	std error				
Aug-08					
	std error				
Sep-08					
	std error				
Oct-08					
	std error				
Nov-08					
	std error				
Dec-08					
	std error				

Yearclass 2					
ZONE/SUBZONE 2.4		Motile	Female	Caligus	n
Jan-08		0.94	0.41	0.00	7(8)
	std error	0.25	0.06	0.00	
Feb-08		1.34	0.53	0.18	6
	std error	0.78	0.25	0.17	
Mar-08		0.47	0.23	0.00	7
	std error	0.12	0.07	0.00	
Apr-08		0.47	0.13	0.01	6
	std error	0.23	0.06	0.01	
May-08		0.48	0.22	0.00	6
	std error	0.24	0.11	0.00	
Jun-08		0.77	0.33	0.01	5
	std error	0.49	0.21	0.01	
Jul-08		1.06	0.36	0.01	7
	std error	0.53	0.24	0.01	
Aug-08		2.02	0.80	0.08	6(7)
	std error	1.15	0.37	0.08	
Sep-08		4.27	1.23	0.00	3
	std error	3.27	0.59	0.00	
Oct-08		0.86	0.66	0.04	2
	std error	0.27	0.21	0.02	
Nov-08		1.67	0.78	0.00	3
	std error	0.53	0.56	0.00	
Dec-08		2.72	1.60	0.08	4
	std error	1.64	1.01	0.08	
ZONE/SUBZONE 3.1		Motile	Female	Caligus	n
Jan-08					
	std error				
Feb-08					
	std error				
Mar-08					
	std error				
Apr-08					
	std error				
May-08					
	std error				
Jun-08					
	std error				
Jul-08					
	std error				
Aug-08					
	std error				
Sep-08					
	std error				
Oct-08					
	std error				
Nov-08					
	std error				
Dec-08					
	std error				

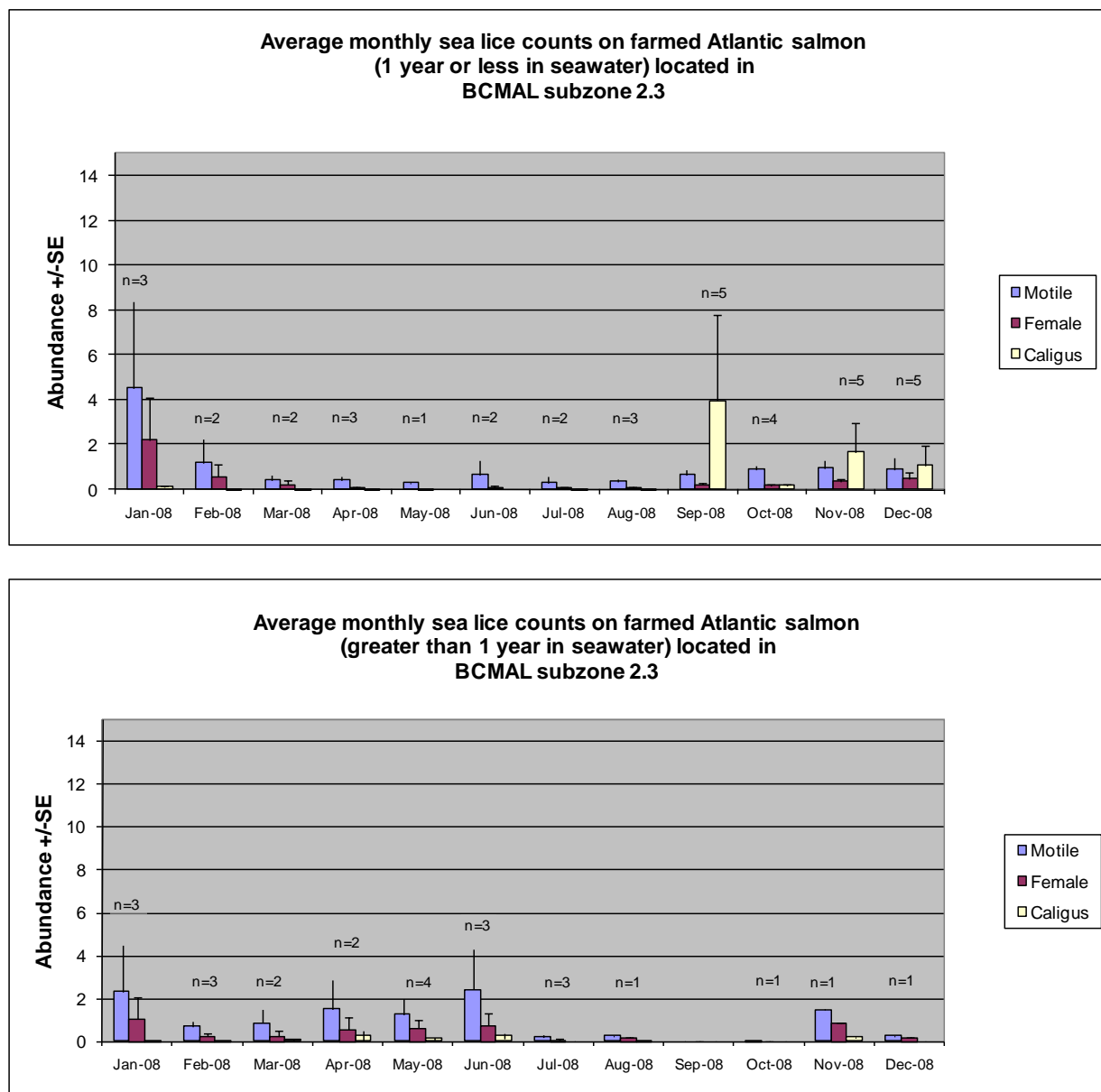
Yearclass 1					
ZONE/SUBZONE 3.2		Motile	Female	Caligus	n
Jan-08		1.61	0.77	0.15	6
	std error	0.70	0.48	0.02	
Feb-08		1.17	0.55	0.34	5
	std error	0.41	0.23	0.09	
Mar-08		1.37	0.42	0.19	8
	std error	0.63	0.25	0.09	
Apr-08		0.94	0.12	0.15	5
	std error	0.40	0.06	0.05	
May-08		0.79	0.17	0.18	4(6)
	std error	0.24	0.07	0.09	
Jun-08		1.31	0.39	0.04	4
	std error	0.76	0.28	0.02	
Jul-08		0.45	0.05	0.30	2
	std error	0.27	0.02	0.28	
Aug-08		1.30	0.23	2.03	4
	std error	0.60	0.13	1.82	
Sep-08		0.68	0.20	0.00	5
	std error	0.31	0.13	0.15	
Oct-08		0.32	0.08	0.20	3
	std error	0.15	0.00	0.13	
Nov-08		0.37	0.12	0.02	1
	std error				
Dec-08		0.59	0.19	0.83	2
	std error	0.06	0.14	0.55	
ZONE/SUBZONE 3.3		Motile	Female	Caligus	n
Jan-08		0.34	0.12	0.23	5
	std error	0.15	0.07	0.09	
Feb-08		0.52	0.23	0.28	3
	std error	0.27	0.13	0.19	
Mar-08		0.33	0.09	0.23	4
	std error	0.19	0.07	0.18	
Apr-08		0.18	0.14	0.27	2
	std error	0.16	0.14	0.17	
May-08		0.28	0.03	0.03	1
	std error				
Jun-08		0.21	0.02	0.16	3(4)
	std error	0.08	0.07	0.05	
Jul-08		0.11	0.05	0.02	2
	std error	0.04	0.02	0.02	
Aug-08		0.53	0.14	0.12	2
	std error	0.40	0.14	0.09	
Sep-08		0.74	0.18	0.08	5
	std error	0.37	0.13	0.08	
Oct-08		1.09	0.33	0.21	6(7)
	std error	0.40	0.16	0.12	
Nov-08		1.10	0.40	0.34	7(8)
	std error	0.40	0.22	0.16	
Dec-08		0.31	0.05	0.28	3
	std error	0.13	0.04	0.28	

Yearclass 2					
ZONE/SUBZONE 3.2		Motile	Female	Caligus	n
Jan-08		2.35	1.30	0.14	7(8)
	std error	0.64	0.40	0.06	
Feb-08		0.81	0.38	0.00	5
	std error	0.62	0.30	0.00	
Mar-08		2.17	1.03	0.14	6
	std error	0.82	0.39	0.11	
Apr-08		3.29	0.93	0.24	9(14)
	std error	1.44	0.45	0.12	
May-08		1.72	0.79	0.12	10(11)
	std error	0.68	0.33	0.08	
Jun-08		0.35	0.15	0.11	8
	std error	0.10	0.04	0.11	
Jul-08		0.37	0.19	0.12	8
	std error	0.13	0.09	0.05	
Aug-08		0.39	0.17	0.08	7
	std error	0.14	0.06	0.01	
Sep-08		0.86	0.33	0.10	7
	std error	0.23	0.12	0.03	
Oct-08		0.72	0.32	0.18	8
	std error	0.15	0.10	0.07	
Nov-08		1.27	0.56	0.28	11
	std error	0.28	0.17	0.12	
Dec-08		2.87	1.33	0.80	11
	std error	0.51	0.31	0.37	
ZONE/SUBZONE 3.3		Motile	Female	Caligus	n
Jan-08		2.00	0.86	0.34	11(13)
	std error	0.81	0.32	0.14	
Feb-08		1.48	0.57	0.11	9(10)
	std error	0.86	0.35	0.05	
Mar-08		1.05	0.54	0.13	10(11)
	std error	0.49	0.31	0.08	
Apr-08		0.49	0.16	0.15	12
	std error	0.21	0.07	0.09	
May-08		0.65	0.30	0.23	12
	std error	0.33	0.18	0.09	
Jun-08		0.43	0.17	0.23	11(12)
	std error	0.33	0.15	0.14	
Jul-08		0.37	0.13	0.08	11(12)
	std error	0.18	0.08	0.05	
Aug-08		0.29	0.12	0.26	9
	std error	0.13	0.07	0.26	
Sep-08		0.34	0.18	0.18	10
	std error	0.16	0.10	0.15	
Oct-08		0.58	0.21	0.07	9
	std error	0.19	0.07	0.04	
Nov-08		1.60	0.64	0.21	8(9)
	std error	0.59	0.25	0.12	
Dec-08		1.79	0.76	0.30	9(10)
	std error	0.69	0.32	0.15	

Yearclass 1					
ZONE/SUBZONE		Motile	Female	Caligus	n
3.4					
Jan-08		*	*	*	
	std error				
Feb-08		*	*	*	
	std error				
Mar-08		*	*	*	
	std error				
Apr-08		*	*	*	
	std error				
May-08		0.43	0.12	0.02	3
	std error	0.29	0.07	0.02	
Jun-08		0.21	0.11	0.08	3
	std error	0.08	0.07	0.05	
Jul-08		0.22	0.08	0.18	3
	std error	0.10	0.08	0.13	
Aug-08		0.55	0.14	0.39	3
	std error	0.11	0.08	0.25	
Sep-08		1.03	0.30	1.13	3
	std error	0.22	0.06	1.03	
Oct-08		0.86	0.44	0.68	3
	std error	0.04	0.09	0.37	
Nov-08		1.05	0.38	0.32	4
	std error	0.23	0.10	0.17	
Dec-08		1.35	0.45	1.40	3
	std error	0.51	0.14	0.58	
ZONE/SUBZONE		Motile	Female	Caligus	n
3.5					
Jan-08		0.65	0.09	0.01	2(3)
	std error	0.33	0.04	0.01	
Feb-08		0.15	0.05	0.00	1
	std error				
Mar-08		0.18	0.08	0.04	2
	std error	0.10	0.05	0.01	
Apr-08		0.08	0.00	0.25	1
	std error				
May-08		0.07	0.00	0.02	1
	std error				
Jun-08		0.03	0.00	0.02	1
	std error				
Jul-08		0.03	0.01	0.00	1(2)
	std error				
Aug-08		0.01	0.00	0.00	1
	std error				
Sep-08		0.20	0.00	0.00	1(2)
	std error				
Oct-08		0.27	0.14	0.08	1
	std error				
Nov-08		*	*	*	
	std error				
Dec-08		*	*	*	
	std error				

Yearclass 2					
ZONE/SUBZONE		Motile	Female	Caligus	n
3.4					
Jan-08		3.80	2.47	0.16	4(5)
	std error	1.20	0.66	0.05	
Feb-08		3.41	1.83	0.21	3(4)
	std error	0.84	0.38	0.06	
Mar-08		2.72	1.81	0.14	4(5)
	std error	1.05	0.79	0.09	
Apr-08		1.86	1.14	0.04	4(6)
	std error	0.90	0.68	0.02	
May-08		1.29	0.97	0.06	3(4)
	std error	0.87	0.71	0.02	
Jun-08		0.82	0.32	0.22	2
	std error	0.52	0.32	0.14	
Jul-08		0.35	0.10	0.23	1
	std error				
Aug-08		0.33	0.12	0.77	1
	std error				
Sep-08		0.80	0.20	0.20	1
	std error				
Oct-08		0.88	0.27	0.55	1
	std error				
Nov-08		0.65	0.33	0.00	1
	std error				
Dec-08		0.27	0.05	0.00	1
	std error				
ZONE/SUBZONE		Motile	Female	Caligus	n
3.5					
Jan-08		1.62	1.01	0.00	2
	std error	0.10	0.11	0.00	
Feb-08		0.73	0.41	0.00	2(3)
	std error	0.63	0.40	0.00	
Mar-08		0.82	0.50	0.10	1
	std error				
Apr-08		0.91	0.50	0.02	3
	std error	0.59	0.38	0.00	
May-08		0.05	0.02	0.00	2
	std error				
Jun-08		0.03	0.00	0.00	2
	std error				
Jul-08		0.10	0.02	0.00	1
	std error				
Aug-08		0.18	0.04	0.00	2
	std error	0.05	0.01	0.00	
Sep-08		0.25	0.10	0.00	2
	std error	0.05	0.00	0.00	
Oct-08		0.26	0.15	0.01	2(4)
	std error	0.17	0.11	0.01	
Nov-08		0.04	0.02	0.00	2
	std error	0.02	0.02	0.00	
Dec-08		0.00	0.00	0.00	1
	std error				

Figure 7.11.1 Monthly mean abundance of motile and female *Lepeophtheirus salmonis*, and motile *C. clemensi* on farmed Atlantic Salmon in sub-zone 2.3 as submitted to BCMAL by the BC Salmon Farmers Association (BCSFA) in 2008.



NB. Farm monitoring and audit procedures continue to identify a transient presence of *Caligus* lice species in a number of sub-zones. *Caligus* species are common on non-salmonid fishes; their presence on salmon in 2008 is attributable to wild herring and pilchard populations near salmon farms. *Caligus* lice are ubiquitous in the Pacific Ocean and recording their abundance on farmed fish can enable trend assessments over time.

Figure 7.11.2 Monthly mean abundance of motile and female *Lepeophtheirus salmonis*, and motile *C. clemensi* on farmed Atlantic Salmon in sub-zone 2.4 as submitted to BCMAL by the BC Salmon Farmers Association (BCSFA) in 2008.

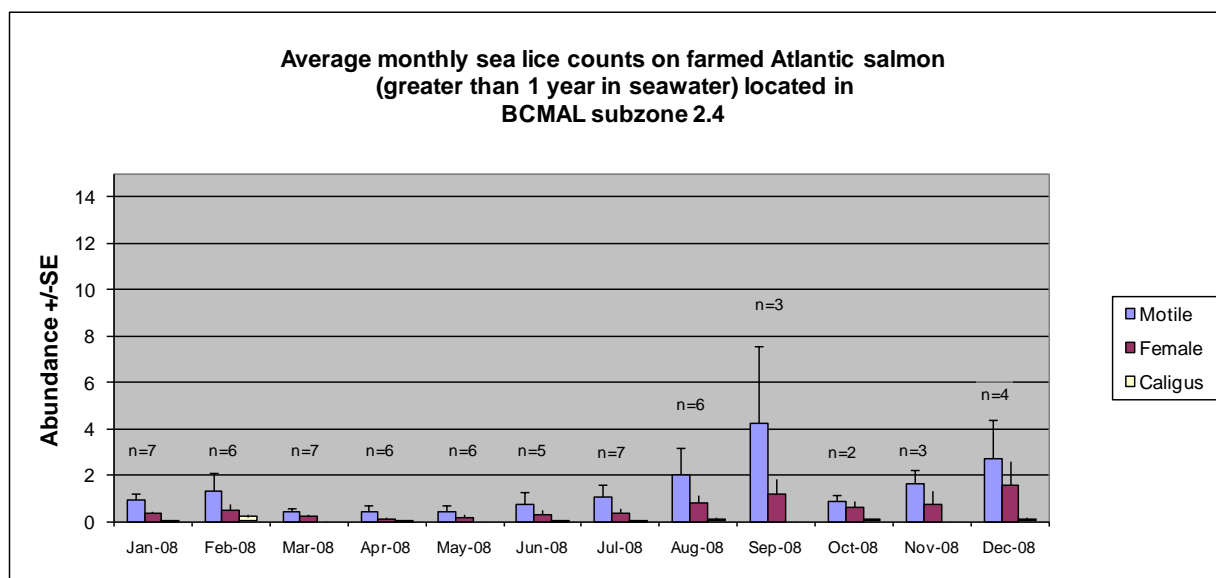
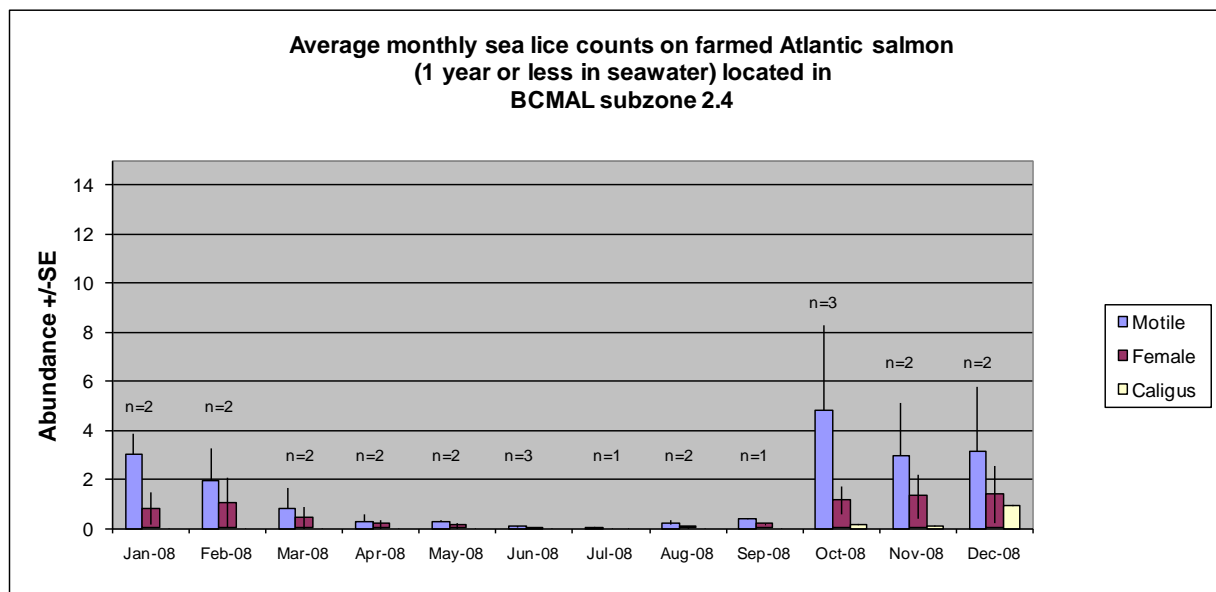



Figure 7.11.3 Monthly mean abundance of motile and female *Lepeophtheirus salmonis*, and motile *C. clemensi* on Farmed Atlantic Salmon in sub-zone 3.1 ¹ as submitted to BCMAL by the BC Salmon Farmers Association (BCSFA) in 2008.



*This page is
intentionally blank*

¹ Sea lice abundance on salmon raised within sub-zone 3.1 has been so low since monitoring began (2003) that the handling of these fish was deemed more harmful than useful. Consequently, this area was granted an exemption from routine sea lice counts until further notice, yet opportune counts are conducted by farm staff whenever possible. Audit counts by BCMAL continue (see Report Fig. 20a, 20b, and Table 7.10.3).

Figure 7.11.4 Monthly mean abundance of motile and female *Lepeophtheirus salmonis*, and motile *C. clemensi* on Farmed Atlantic Salmon in sub-zone 3.2 as submitted to BCMAL by the BC Salmon Farmers Association (BCSFA) in 2008.

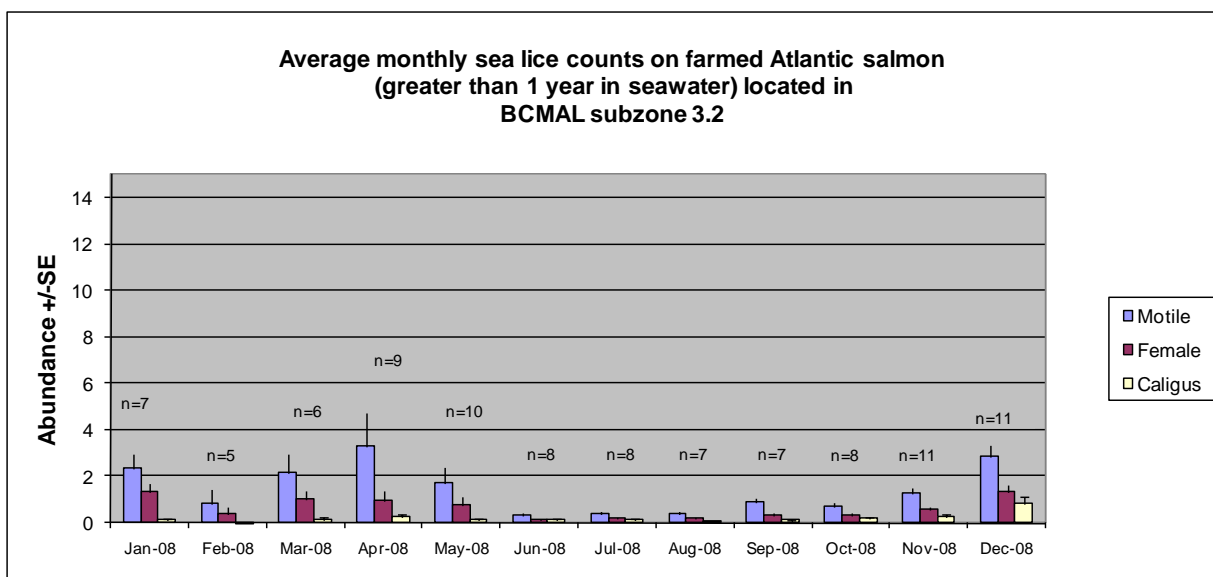
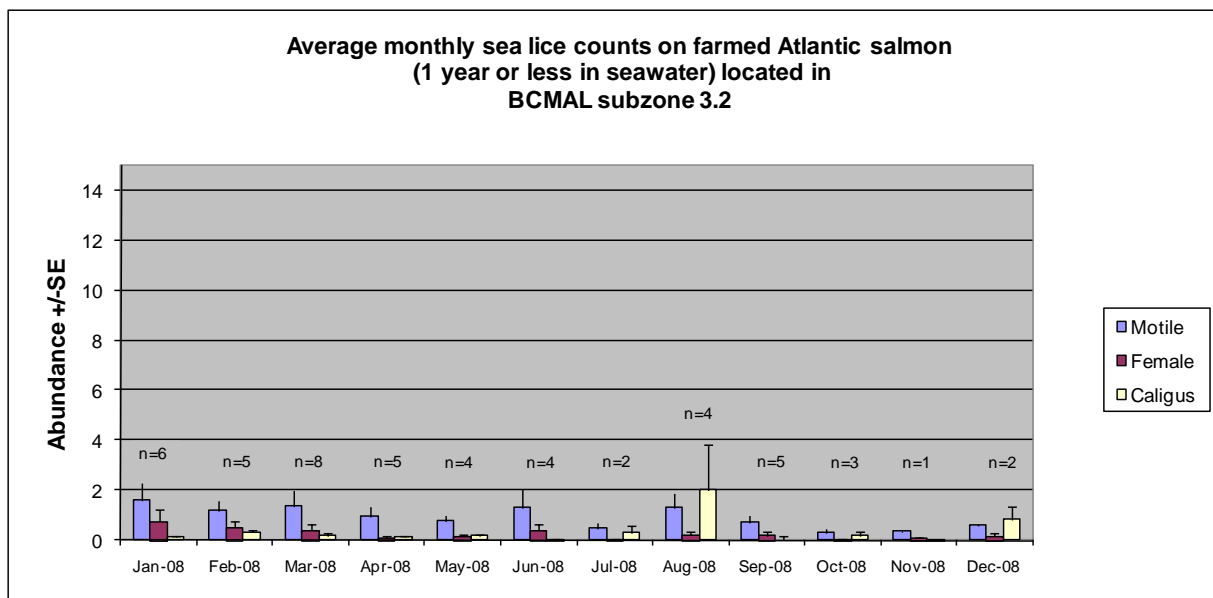


Figure 7.11.5 Monthly mean abundance of motile and female *Lepeophtheirus salmonis*, and motile *C. clemensi* on Farmed Atlantic Salmon in sub-zone 3.3 as submitted to BCMAL by the BC Salmon Farmers Association (BCSFA) in 2008.

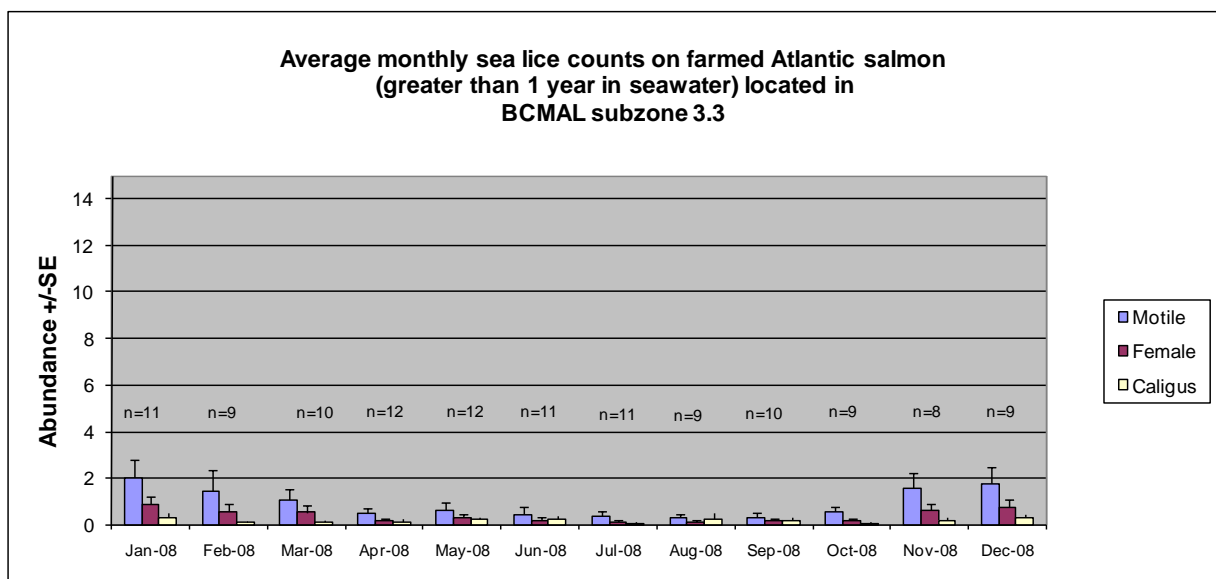
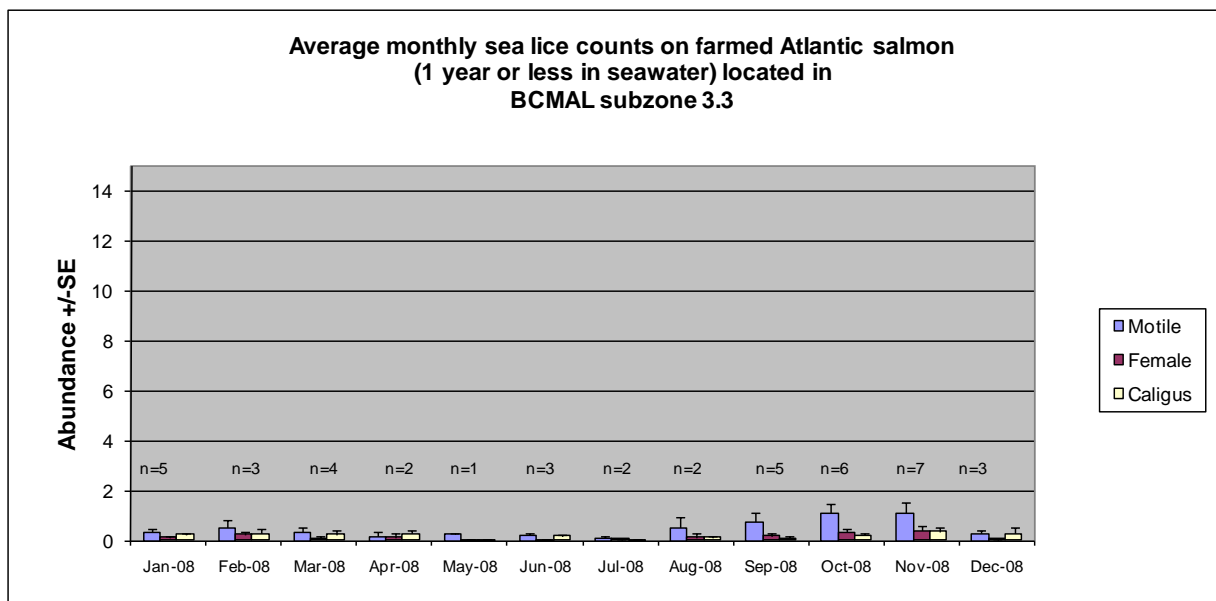
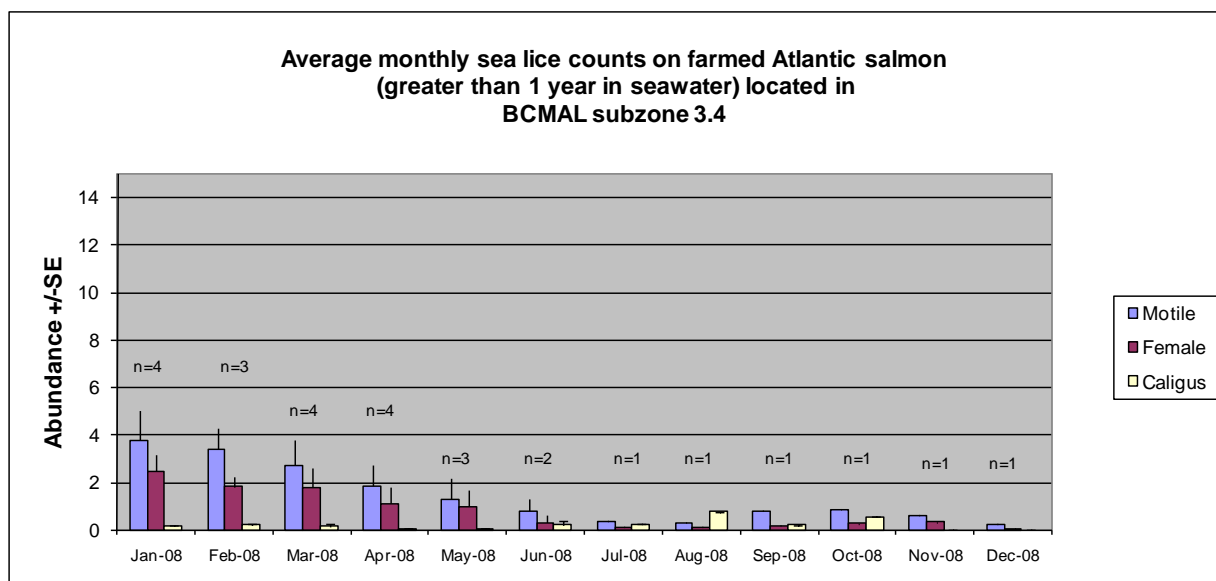
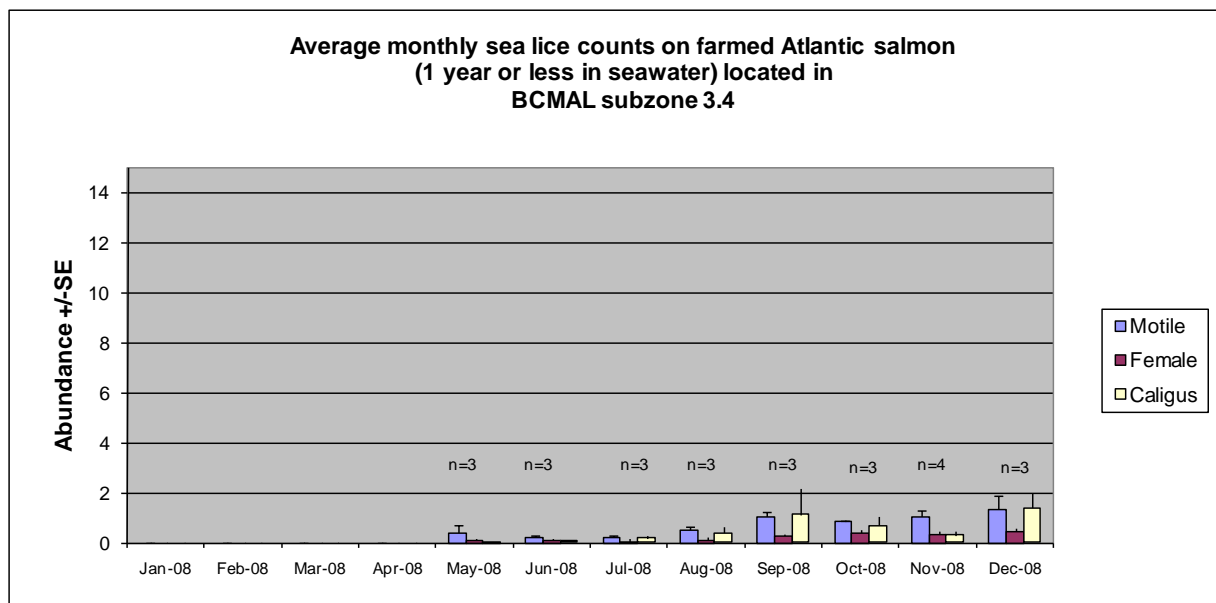


Figure 7.11.6 Monthly mean abundance of motile and female *Lepeophtheirus salmonis*, and motile *C. clemensi* on Farmed Atlantic Salmon in sub-zone 3.4² as submitted to BCMAL by the BC Salmon Farmers Association (BCSFA) in 2008.



² The populations of 1st year class fish in sub-zone 3.4 entered cages in April/May. In 2nd year class fish the abundance of lice in March continued to decline as harvest activity continued throughout the spring.

Figure 7.11.7 Monthly mean abundance of motile and female *Lepeophtheirus salmonis*, and motile *C. clemensi* on Farmed Atlantic Salmon in sub-zone 3.5 as submitted to BCMAL by the BC Salmon Farmers Association (BCSFA) in 2008.

