

# 2009

Ministry of Agriculture and Lands

Animal Health Branch – Fish Health



## SUPPLEMENTAL APPENDICES TO THE ANNUAL REPORT FISH HEALTH PROGRAM

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## **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.

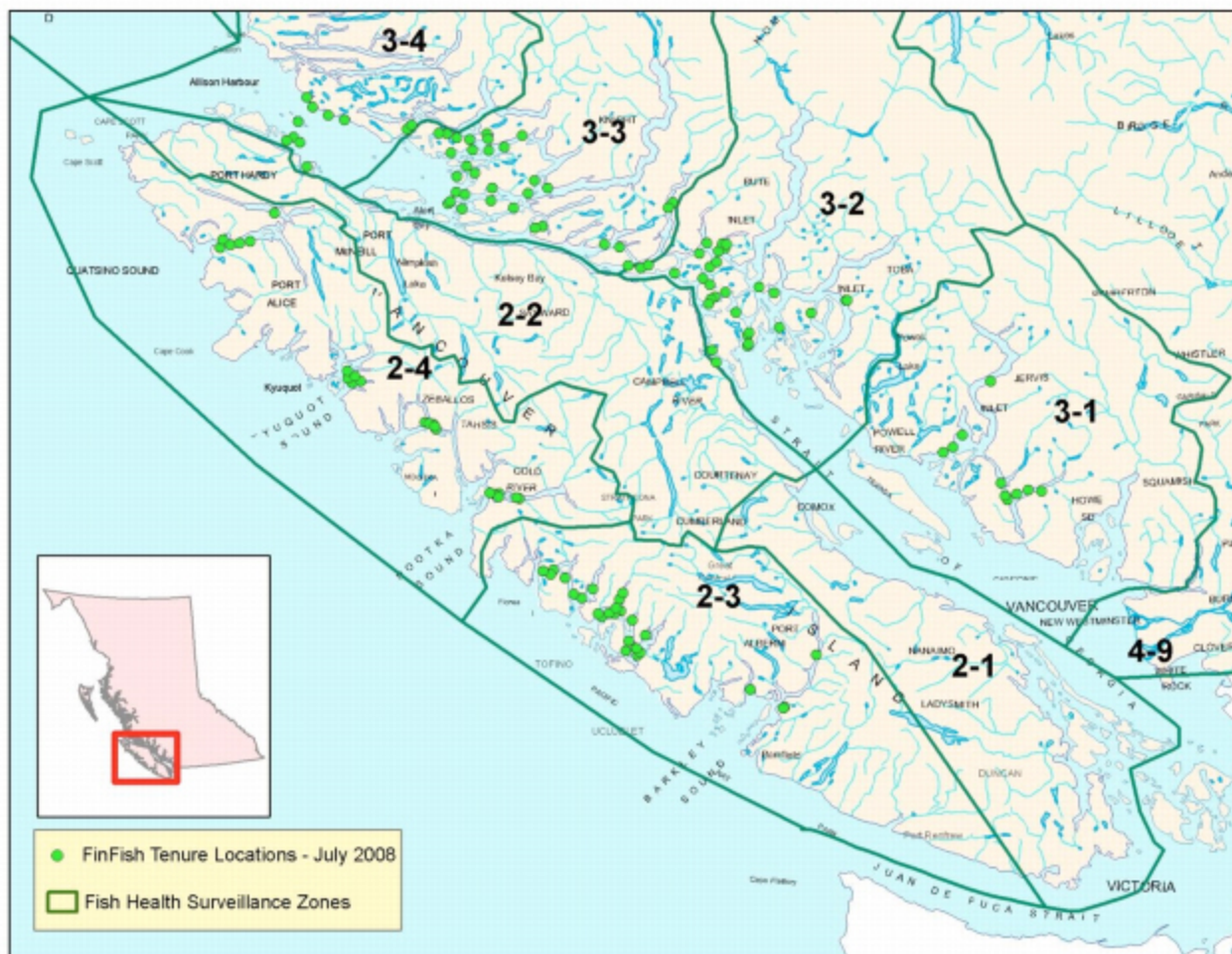
### **Mortality Causes – Salt water:**

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 Sub-zones in British Columbia



Not appearing on this map is the central coast **sub-zone 3.5** that spans the mainland coast from Deas Channel northward to Douglas Channel. In 2009, sub-zone 3.5 had three to five active fish farms operating at any given time 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 2009 (by calendar quarter)**

<b>Atlantic Salmon</b>	<b>Quarter 1</b>	<b>Quarter 2</b>	<b>Quarter 3</b>	<b>Quarter 4</b>	<b>Average</b>
Sub-zone 2.3 SW Vanc. Island	11	11	10	13	11
Sub-zone 2.4 NW Vanc. Island	6	10	10	11	9
Sub-zone 3.1 Sunshine Coast	2	2	2	1	2
Sub-zone 3.2 Campbell River	15	14	11	11	13
Sub-zone 3.3 Broughton	14	13	13	16	14
Sub-zone 3.4 Port Hardy	4	6	6	7	6
Sub-zone 3.5 Central Coast	5	4	3	4	4
<b>Pacific Salmon</b>					
Zone 2 Vancouver Island	3	4	3	4	3
Zone 3 East of Vanc. Island	5	6	5	3	5
<b>Totals</b>	<b>65</b>	<b>70</b>	<b>63</b>	<b>70</b>	<b>67</b>

## APPENDIX 7.4 Bacteriology Findings

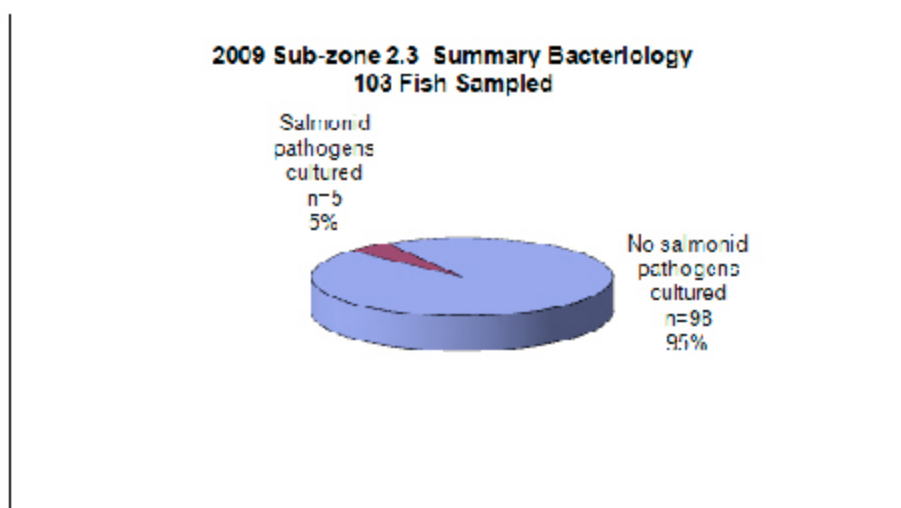
**Table 7.4.1: Bacterial Findings for Sub-zone 2.3 (SW Vancouver Island)  
Atlantic Salmon Farm Audits 2009**

Quarter	# farms sampled*	# fish sampled	# of farms with bacteria cultured	Number of positive fish (per bacteria type) ^	Bacterial species cultured
Q1 Jan - Mar	5(4)	27	1	1	<i>Aliivibrio wodanis</i>
Q2 Apr - Jun	4	14	1	5	<i>Aeromonas salmonicida</i>
Q3 July - Sept	5	30	1	1	<i>Vibrio splendidus</i>
Q4 Oct - Dec	6	32	0	0	No bacteria cultured
<b>Totals</b>	<b>20(19)</b>	<b>103</b>	<b>3</b>	<b>7</b>	

\* 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.

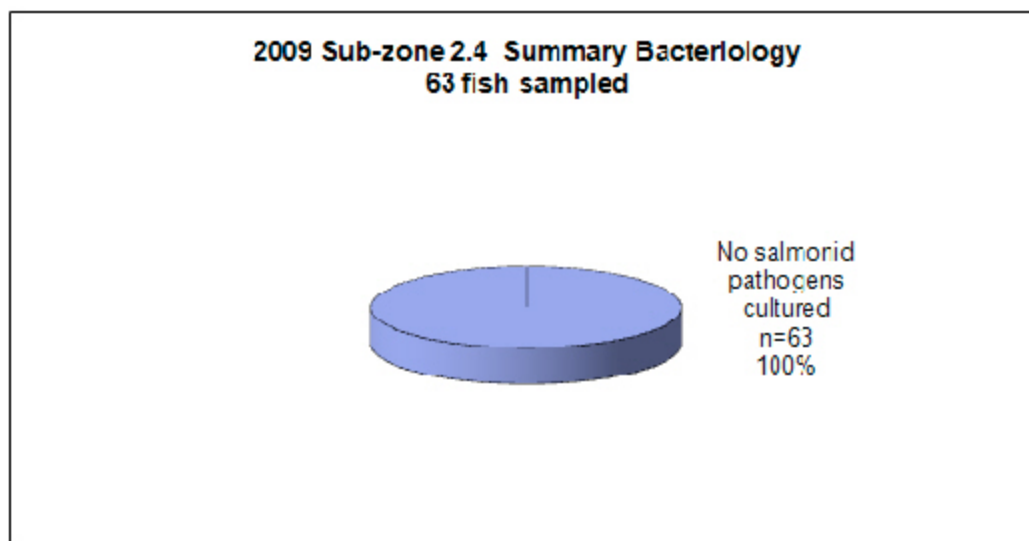
**Figure 7.4.1: Summary of Bacterial Findings from Sub-zone 2.3  
Atlantic Salmon Farm Audits 2009**



**Table 7.4.2 : Bacterial Findings for Sub-zone 2.4 (NW Vancouver Island)  
Atlantic Salmon Farm Audits 2009**

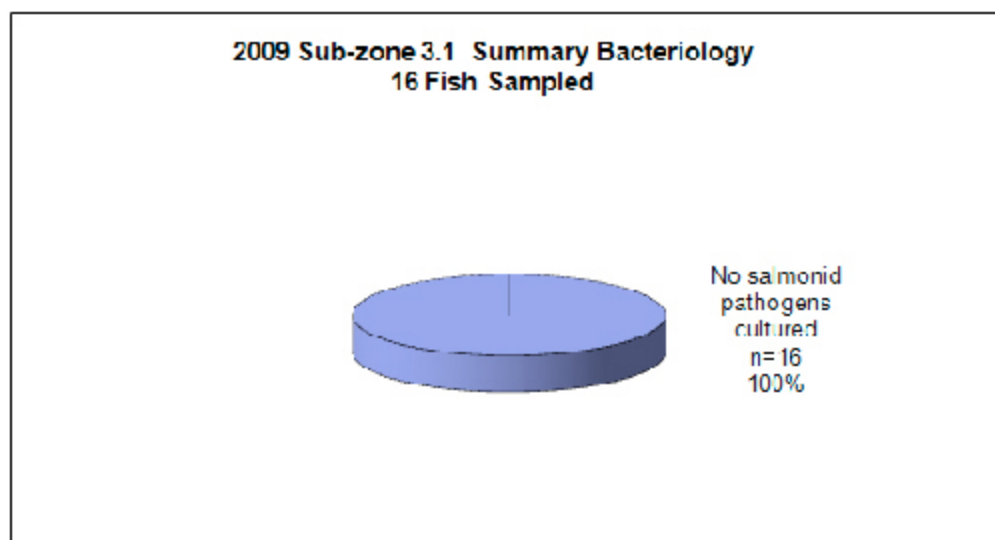
Quarter	# farms sampled	# fish sampled	# of farms with bacteria cultured	Number of positive fish (per bacteria type)	Bacterial species cultured
Q1 Jan - Mar	2(1)	9	0	0	No bacteria cultured
Q2 Apr - Jun	4(3)	17	0	0	No bacteria cultured
Q3 July - Sept	4	18	1	1	<i>Vibrio ichthoenteri</i>
Q4 Oct - Dec	5	19	1	1	<i>Obesumbacterium</i> sp
<b>Totals</b>	<b>15(13)</b>	<b>63</b>	<b>2</b>	<b>2</b>	

**Figure 7.4.2: Summary of Bacterial Findings from Sub-zone 2.4  
Atlantic Salmon Farm Audits 2009**



<b>Table 7.4.3: Bacterial Findings for Sub-zone 3.1 (Sunshine Coast) Atlantic Salmon Farm Audits 2009</b>					
<b>Quarter</b>	<b># farms sampled</b>	<b># fish sampled</b>	<b># of farms with bacteria cultured</b>	<b>Number of positive fish (per bacteria type)</b>	<b>Bacterial species cultured</b>
<b>Q1 Jan – Mar</b>	1	8	0	0	No bacteria cultured
<b>Q2 Apr – Jun</b>	1	3	0	0	No bacteria cultured
<b>Q3 July – Sept</b>	1(0)	0	0	0	No bacteria cultured
<b>Q4 Oct – Dec</b>	1	5	0	0	No bacteria cultured
<b>Totals</b>	4(3)	16	0	0	

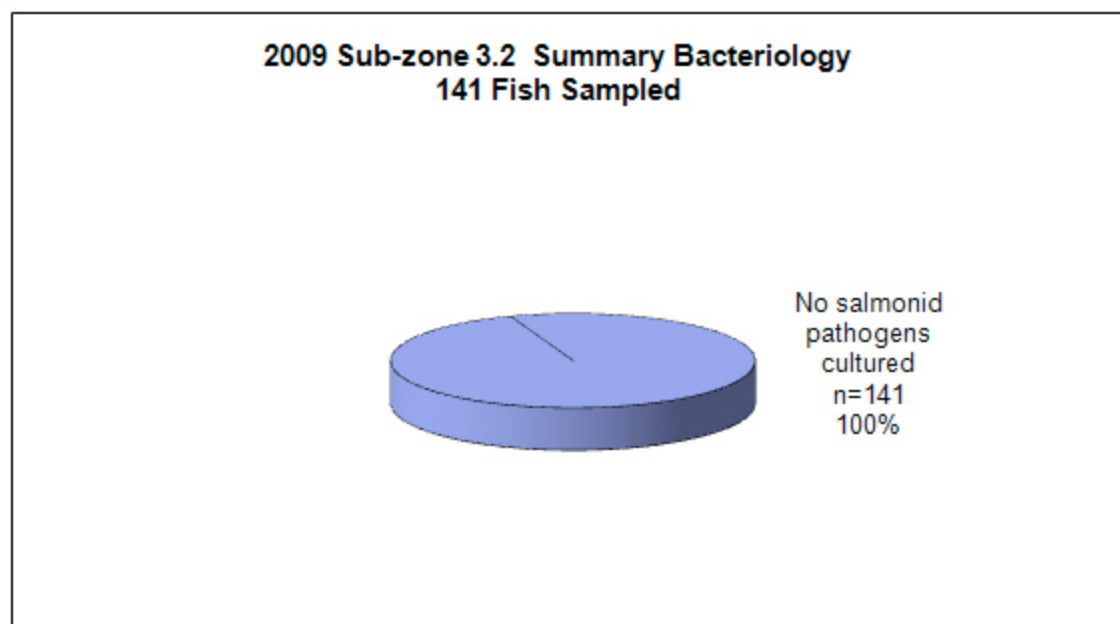
**Figure 7.4.3: Summary of Bacterial Findings from Sub-zone 3.1  
Atlantic Salmon Farm Audits 2009**





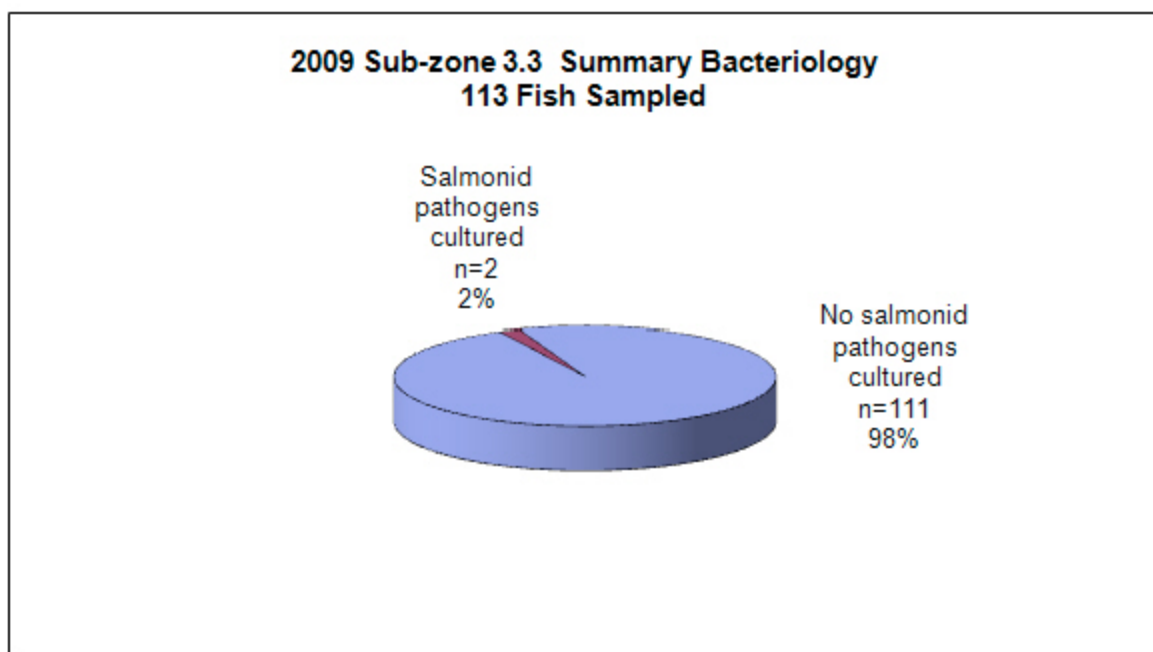
<b>Table 7.4.4: Bacterial Findings for Sub-zone 3.2 (Campbell River) Atlantic Salmon Farm Audits 2009</b>					
<b>Quarter</b>	<b># farms sampled</b>	<b># fish sampled</b>	<b># of farms with bacteria cultured</b>	<b>Number of positive fish (per bacteria type)</b>	<b>Bacterial species cultured</b>
<b>Q1 Jan – Mar</b>	6	32	2	2	<i>Pseudoalteromonas</i> sp.
			1	1	<i>Vibrio wodanis</i>
				1	<i>Photobacterium phosphorum</i>
<b>Q2 Apr – Jun</b>	6	42	1	1	<i>Lactococcus lactis</i>
			2	2	<i>Aliivibrio wodanis</i>
			1	1	<i>Photobacterium phosphorum</i>
<b>Q3 July – Sept</b>	5	40	1	1	<i>Pseudomonas</i> sp.
<b>Q4 Oct – Dec</b>	4	27	0	0	No bacteria cultured
<b>Totals</b>	21	141	8	9	

**Figure 7.4.4: Summary of Bacterial Findings from Sub-zone 3.2  
Atlantic Salmon Farm Audits 2009**



<b>Table 7.4.5: Bacterial Findings for Sub-zone 3.3 (Broughton) Atlantic Salmon Farm Audits 2009</b>					
Quarter	# farms sampled	# fish sampled	# of farms with bacteria cultured	Number of positive fish (per bacteria type)	Bacterial species cultured
<b>Q1</b> Jan – Mar	6	45	4	2	<i>Aliivibrio wodanis</i>
				1	<i>Pseudoalteromonas</i> sp.
				1	<i>Janthinobacterium livdum</i>
				2	<i>Photobacterium damsela</i>
<b>Q2</b> Apr – Jun	5	25	1	2	<i>Phosphobacterium ilopiscarium</i>
<b>Q3</b> July – Sept	6(5)	13	1	2	<i>Proteus vulgaris</i>
<b>Q4</b> Oct – Dec	5	30	4	2	<i>Aeromonas salmonicida</i>
				1	<i>Aliivibrio</i> sp.
				1	<i>Aliivibrio wodanis</i>
				1	<i>Pseudomonas</i> sp.
				1	<i>Carnobacterium</i> sp.
				1	<i>Psychrobacter</i> sp.
<b>Totals</b>	<b>22(21)</b>	<b>113</b>	<b>10</b>	<b>17</b>	

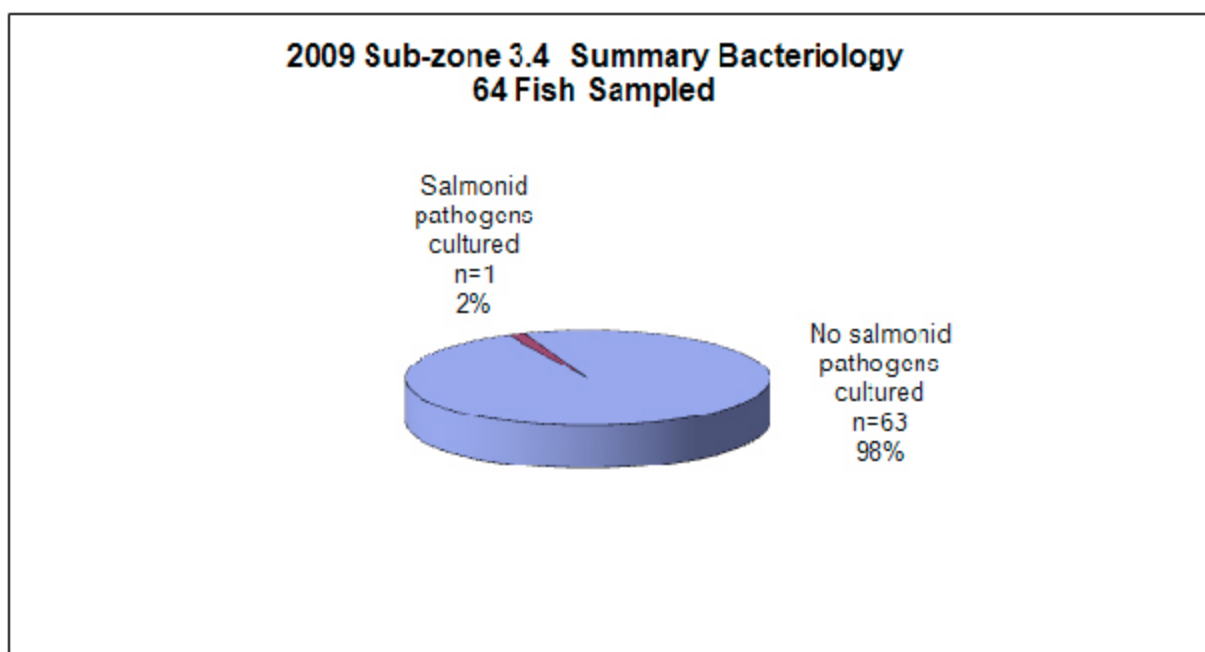
**Figure 7.4.5: Summary of Bacterial Findings from Sub-zone 3.3  
Atlantic Salmon Farm Audits 2009**



**Table 7.4.6: Bacterial Findings for Sub-zone 3.4 (Port Hardy)  
Atlantic Salmon Farm Audits 2009**

Quarter	# farms sampled	# fish sampled	# of farms with bacteria cultured	Number of positive fish (per bacteria type)	Bacterial species cultured
Q1 Jan – Mar	3(2)	8	0	0	No bacteria cultured
Q2 Apr – Jun	3	15	1	1	<i>Photobacterium</i> sp.
Q3 July – Sept	3	17	0	0	No bacteria cultured
Q4 Oct – Dec	4	24	2	1	<i>Aliivibrio wodanis</i>
				1	<i>Moritella viscosa</i>
Totals	13(12)	64	3	3	

**Figure 7.4.6: Summary of Bacterial Findings from Sub-zone 3.4  
Atlantic Salmon Farm Audits 2009**



<b>Table 7.4.7: Bacterial Findings for Sub-zone 3.5 (Central Coast) Atlantic Salmon Farm Audits 2009</b>					
<b>Quarter</b>	<b># farms sampled</b>	<b># fish sampled</b>	<b># of farms with bacteria cultured</b>	<b>Number of positive fish (per bacteria type)</b>	<b>Bacterial species cultured</b>
<b>Q1 Jan – Mar</b>	2(1)	5	0	0	No bacteria cultured
<b>Q2 Apr – Jun</b>	2	6	0	0	No bacteria cultured
<b>Q3 July – Sept</b>	1	2	0	0	No bacteria cultured
<b>Q4 Oct – Dec</b>	0	0	0	0	No bacteria cultured
<b>Totals</b>	5(4)	13	0	0	

**Figure 7.4.7: Summary of Bacterial Findings from Sub-zone 3.5  
Atlantic Salmon Farm Audits 2009**

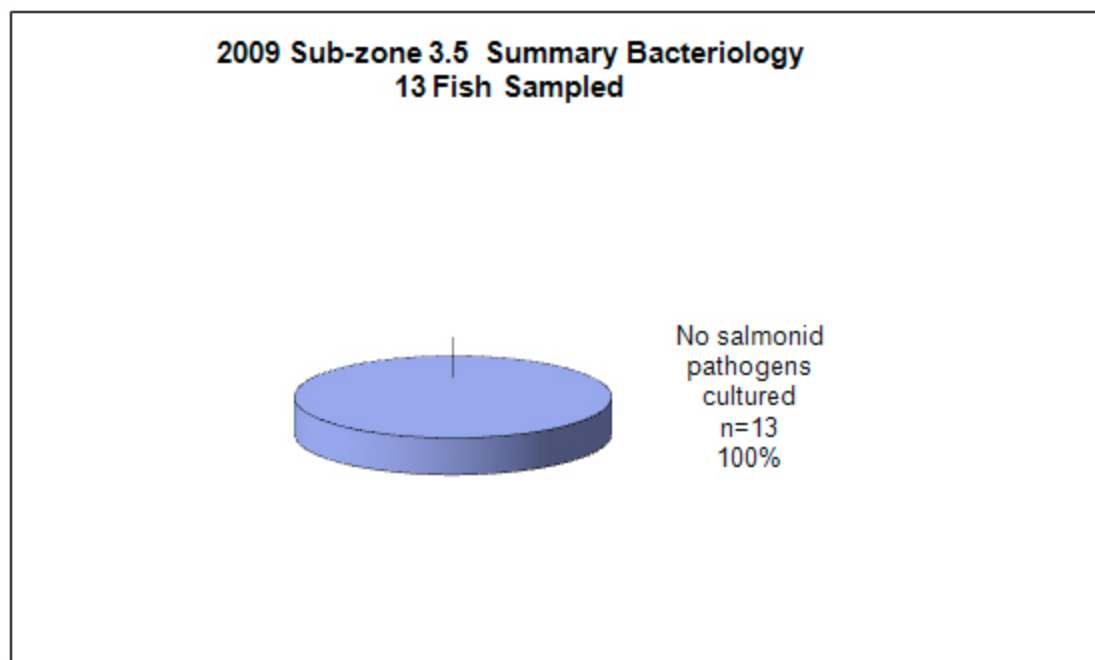


Table 7.4.8: Bacterial Findings for Zone 2 (Vancouver Island) Pacific Salmon Farm Audits 2009					
Quarter	# farms sampled	# fish sampled	# of farms with bacteria cultured	Number of positive fish (per bacteria type)	Bacterial species cultured
Q1 Jan – Mar	1	6	0	0	No bacteria cultured
Q2 Apr – Jun	2	11	0	0	No bacteria cultured
Q3 July – Sept	1	3	0	0	No bacteria cultured
Q4 Oct – Dec	1	1	0	0	No bacteria cultured
Totals	5	21	0	0	

Figure 7.4.8: Summary of Bacterial Findings from Zone 2  
Pacific Salmon Farm Audits 2009

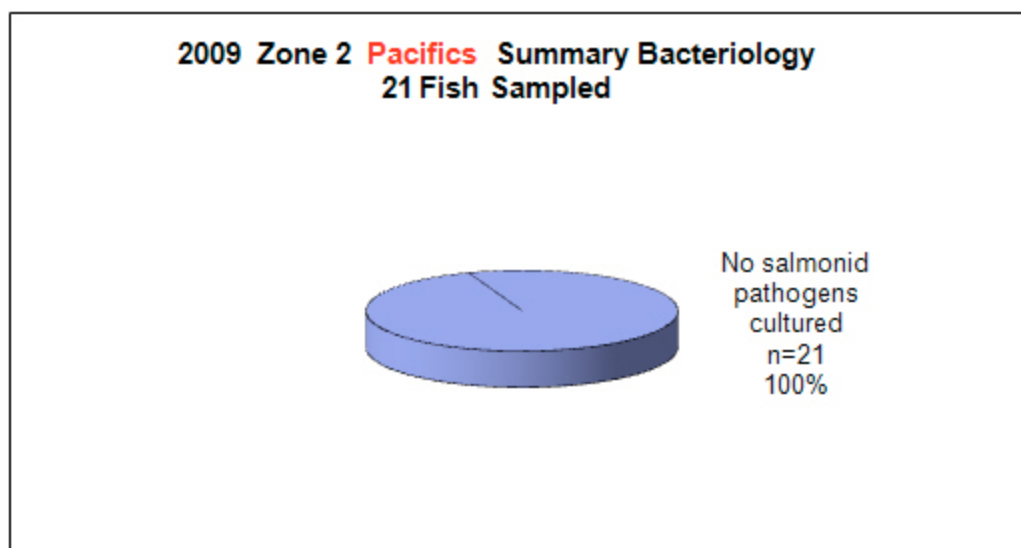
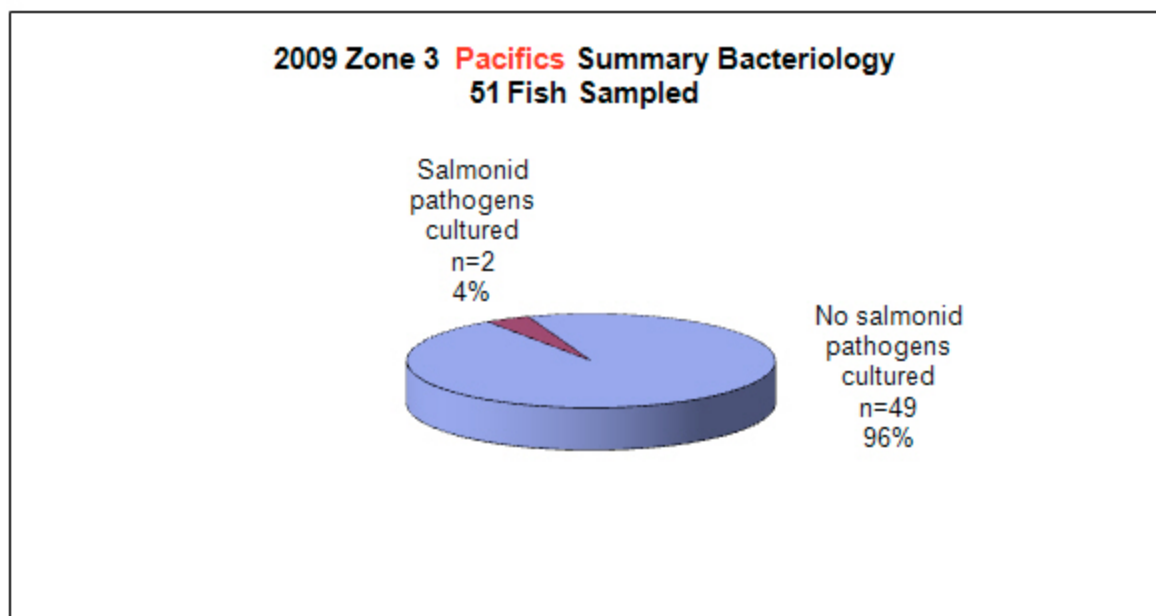




Table 7.4.9: Bacterial Findings for Zone 3 (East of Vancouver Island) Pacific Salmon Farm Audits 2009					
Quarter	# farms sampled	# fish sampled	# of farms with bacteria cultured	Number of positive fish (per bacteria type)	Bacterial species cultured
Q1 Jan – Mar	4	15	1	1	<i>Vibrio</i> sp.
Q2 Apr – Jun	3	13	1	1	<i>Listonella anguillarum</i>
Q3 July – Sept	3	18	2	1	<i>Vibrio splendidus</i>
				1	<i>Vibrio tapetis</i>
				1	<i>Aliivibrio</i> sp.
				1	<i>Vibrio ordalli</i>
					<i>Psychrobacter</i> sp.
Q4 Oct – Dec	1	5	0	0	<i>Aerococcus viridans</i>
Totals	11	51	4	6	No bacteria cultured

Figure 7.4.9: Summary of Bacterial Findings from Zone 3  
Pacific Salmon Farm Audits 2009



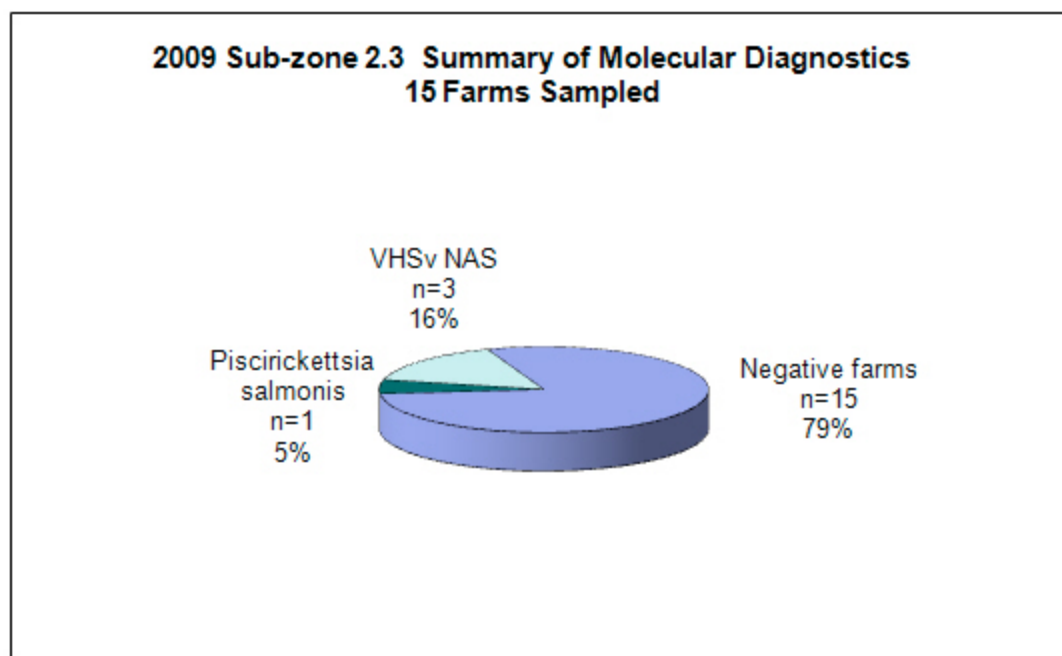
**Table 7.4.10: Summary of Bacterial Organisms Cultured 2009**

<b>Salmon Pathogens</b>	<b>Opportunists / Environmental</b>
<i>Aeromonas salmonicida</i> <i>Listonella anguillarum</i> <i>Moritella viscosa</i> <i>Vibrio ordalii</i>	<i>Aerococcus viridans</i> <i>Aliivibrio</i> sp. <i>Aliivibrio wodanis</i> <i>Carnobacterium</i> sp. <i>Janthinobacterium lividum</i> <i>Lactococcus lactis</i> <i>Obesumbacterium</i> sp. <i>Photobacterium damsela</i> <i>Photobacterium ilopiscarium</i> <i>Photobacterium phosphoreum</i> <i>Photobacterium</i> sp. <i>Proteus vulgaris</i> <i>Pseudoalteromonas</i> sp. <i>Pseudomonas</i> sp. <i>Psychrobacter</i> sp. <i>Vibrio ichthyenteri</i> <i>Vibrio</i> sp. <i>Vibrio splendidus</i> <i>Vibrio tapetis</i> <i>Vibrio wodanis</i>

### 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 2009									
Quarter	# farms sampled	# fish sampled	Number of Molecular Tests					Positive Sites	Organism Identified
			IHNV	IPNV	ISAV	Piscirickettsia	VHSV-NAS		
Q1 Jan-Mar	4	27	7	7	7	7	7	3	VHSV NAS
Q2 Apr-Jun	4	14	4	4	4	4	4	0	None
Q3 Jul-Sep	5	30	9	9	9	9	9	0	None
Q4 Oct-Dec	6	32	9	9	9	9	9	1	<i>Piscirickettsia salmonis</i>
Totals	19	103	29	29	29	29	29	4	

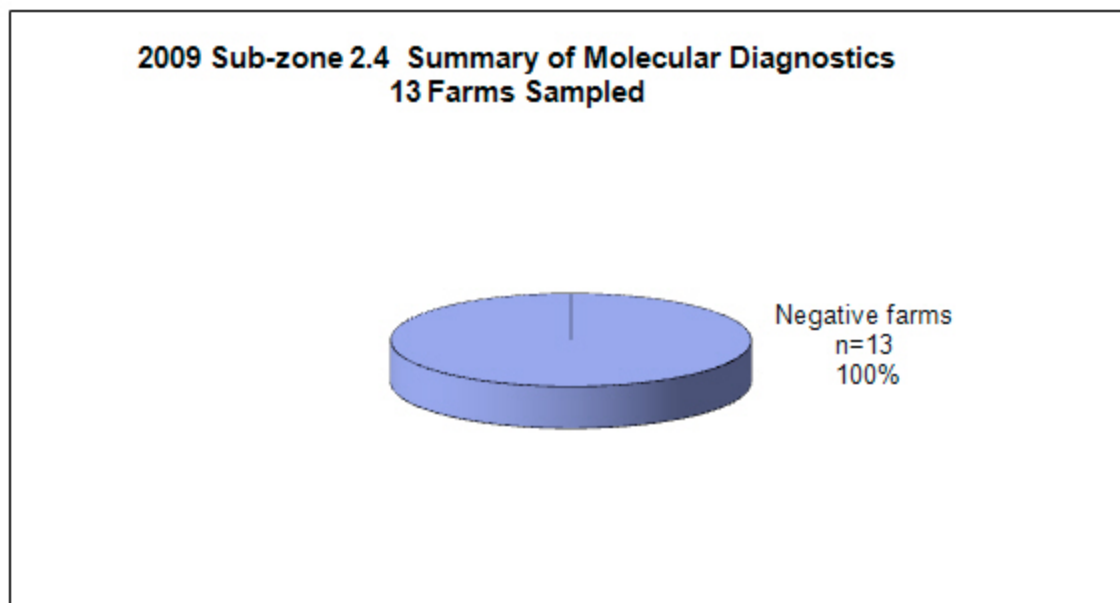
Figure 7.5.1: Summary of Molecular Diagnostics Findings from Sub-zone 2.3  
Atlantic Salmon Farm Audits 2009



**Table 7.5.2: Molecular Testing Results for Sub-zone 2.4 (NW Vancouver Island)  
Atlantic Salmon Farm Audits 2009**

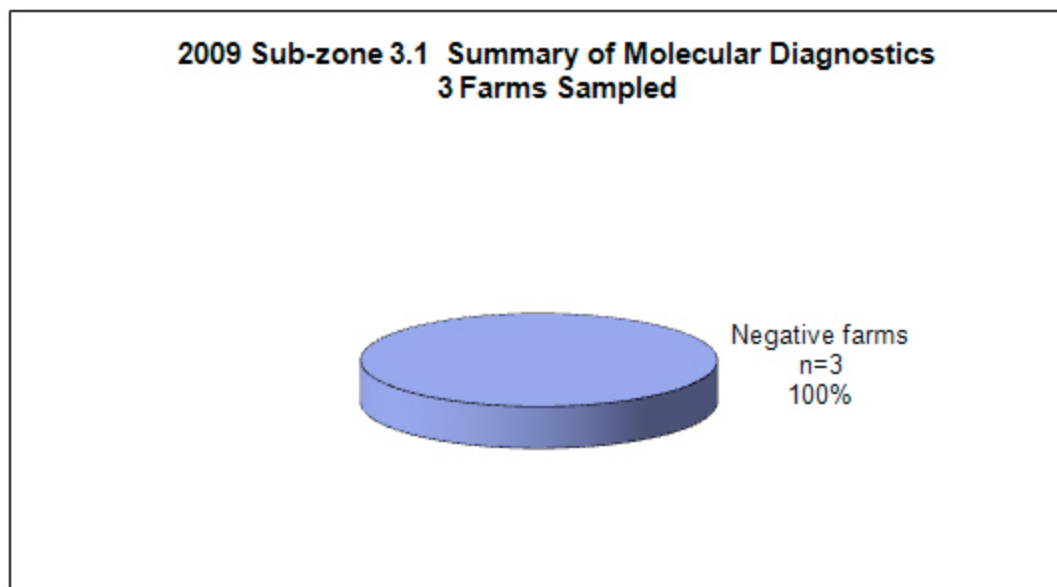
Quarter	# farms sampled	# fish sampled	Number of Molecular Tests					Positive Sites	Organism Identified
			IHN	IPNV	ISAV	Piscirickettsia	VHSV-NAS		
Q1 Jan-Mar	1	9	2	2	2	2	2	0	None
Q2 Apr-Jun	3	17	4	4	4	4	4	0	None
Q3 Jul-Sep	4	18	5	5	5	5	5	0	None
Q4 Oct-Dec	5	19	5	5	5	5	5	0	None
Totals	13	63	16	16	16	16	16	0	

**Figure 7.5.2: Summary of Molecular Diagnostics Findings from Sub-zone 2.4  
Atlantic Salmon Farm Audits 2009**



<b>Table 7.5.3: Molecular Testing Results for Sub-zone 3.1 (Sunshine Coast) Atlantic Salmon Farm Audits 2009</b>									
Quarter	# farms sampled	# fish sampled	Number of Molecular Tests					Positive Sites	Organism Identified
			IHN	IPNV	ISAV	Piscirickettsia	VHSV-NAS		
Q1 Jan-Mar	1	8	2	2	2	2	2	0	None
Q2 Apr-Jun	1	3	1	1	1	1	1	0	None
Q3 Jul-Sep	0	0	0	0	0	0	0	0	None
Q4 Oct-Dec	1	5	1	1	1	1	1	0	None
Totals	3	16	4	4	4	4	4	0	

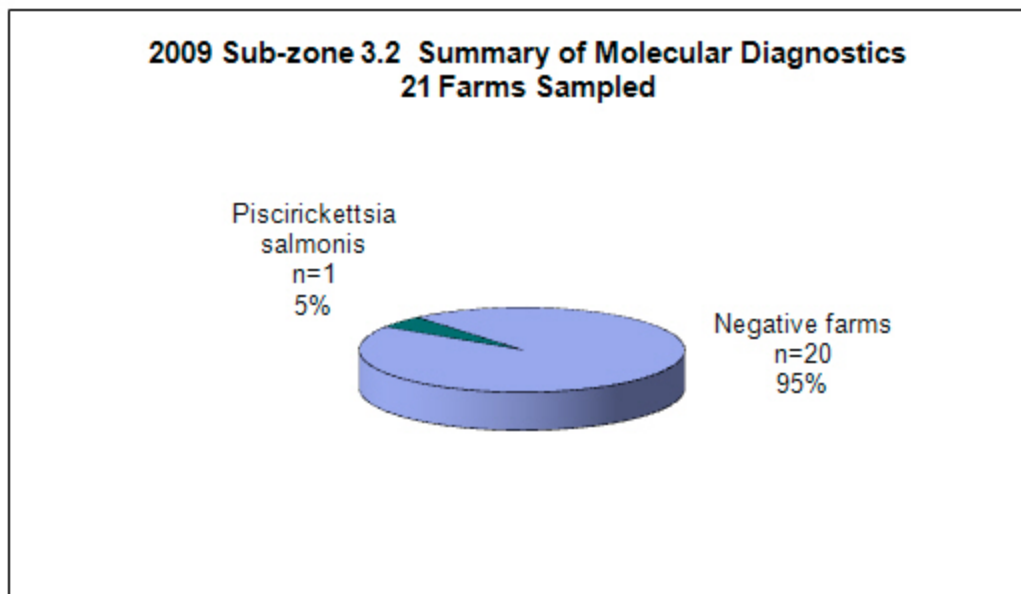
**Figure 7.5.3: Summary of Molecular Diagnostics Findings from Sub-zone 3.1  
Atlantic Salmon Farm Audits 2009**





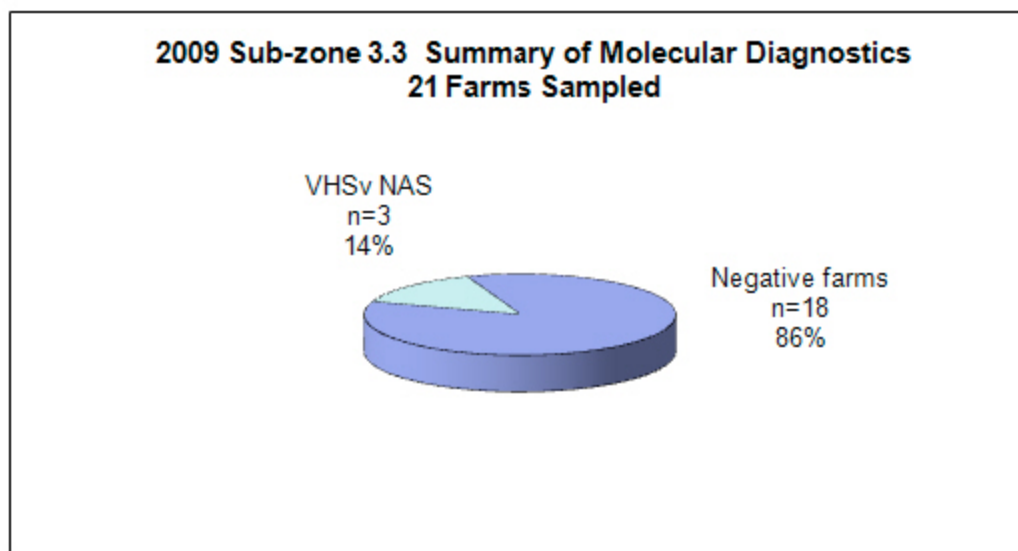
<b>Table 7.5.4: Molecular Testing Results for Sub-zone 3.2 (Campbell River) Atlantic Salmon Farm Audits 2009</b>									
Quarter	# farms sampled	# fish sampled	Number of Molecular Tests					Positive Sites	Organism Identified
			IHN	IPNV	ISAV	Piscirickettsia	VHSV-NAS		
Q1 Jan-Mar	6	32	9	9	9	9	9	0	None
Q2 Apr-Jun	6	42	10	10	10	10	10	0	None
Q3 Jul-Sep	5	40	9	9	9	9	9	0	None
Q4 Oct-Dec	4	27	7	7	7	7	7	1	<i>Piscirickettsia salmonis</i>
<b>Totals</b>	<b>21</b>	<b>141</b>	<b>35</b>	<b>35</b>	<b>35</b>	<b>35</b>	<b>35</b>	<b>1</b>	

**Figure 7.5.4: Summary of Molecular Diagnostics Findings from Sub-zone 3.2  
Atlantic Salmon Farm Audits 2009**



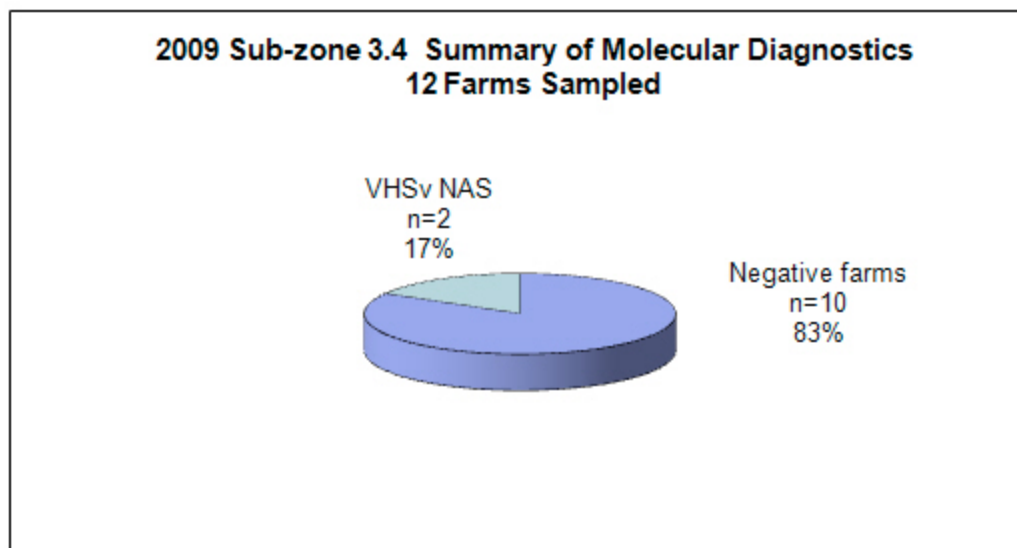
<b>Table 7.5.5: Molecular Testing Results for Sub-zone 3.3 (Broughton)</b> <b>Atlantic Salmon Farm Audits 2009</b>									
Quarter	# farms sampled	# fish sampled	Number of Molecular Tests					Positive Sites	Organism Identified
			IHNv	IPNV	ISAV	Piscirickettsia	VHSv-NAS		
Q1 Jan-Mar	6	45	11	11	11	11	11	1	VHSv NAS
Q2 Apr-Jun	5	25	7	7	7	7	7	2	VHSv NAS
Q3 Jul-Sep	5	13	5	5	5	5	5	0	None
Q4 Oct-Dec	5	30	8	8	8	8	8	0	None
Totals	21	113	31	31	31	31	31	3	

**Figure 7.5.5: Summary of Molecular Diagnostics Findings from Sub-zone 3.3**  
**Atlantic Salmon Farm Audits 2009**



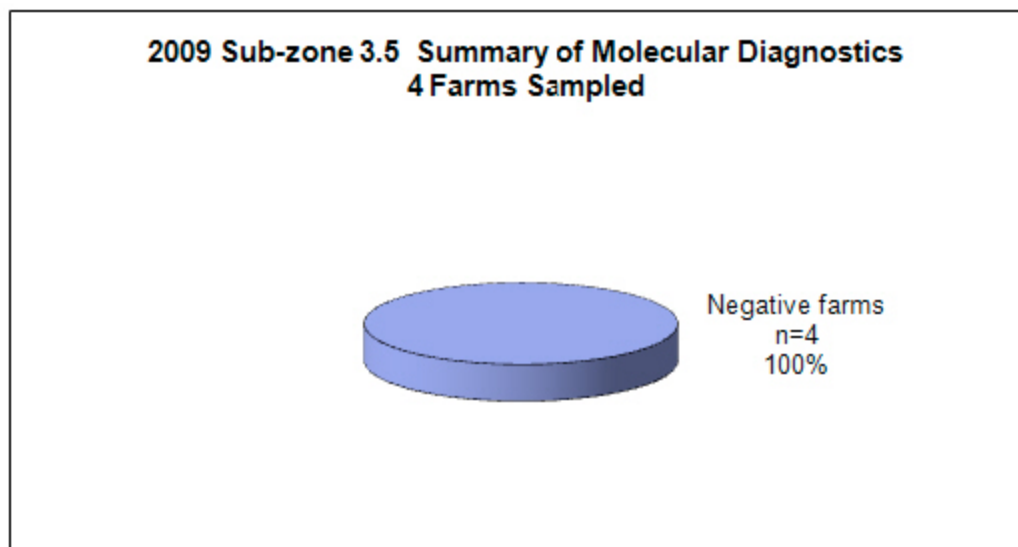
<b>Table 7.5.6: Molecular Testing Results for Sub-zone 3.4 (Port Hardy) Atlantic Salmon Farm Audits 2009</b>									
Quarter	# farms sampled	# fish sampled	Number of Molecular Tests					Positive Sites	Organism Identified
			IHN	IPNV	ISAV	Piscirickettsia	VHSV NAS		
Q1 Jan-Mar	2	8	2	2	2	2	2	0	None
Q2 Apr-Jun	3	15	4	4	4	4	4	0	None
Q3 Jul-Sep	3	17	5	5	5	5	5	0	None
Q4 Oct-Dec	4	24	6	6	6	6	6	2	VHSV NAS
Totals	12	64	17	17	17	17	17	2	

**Figure 7.5.6: Summary of Molecular Diagnostics Findings from Sub-zone 3.4  
Atlantic Salmon Farm Audits 2009**



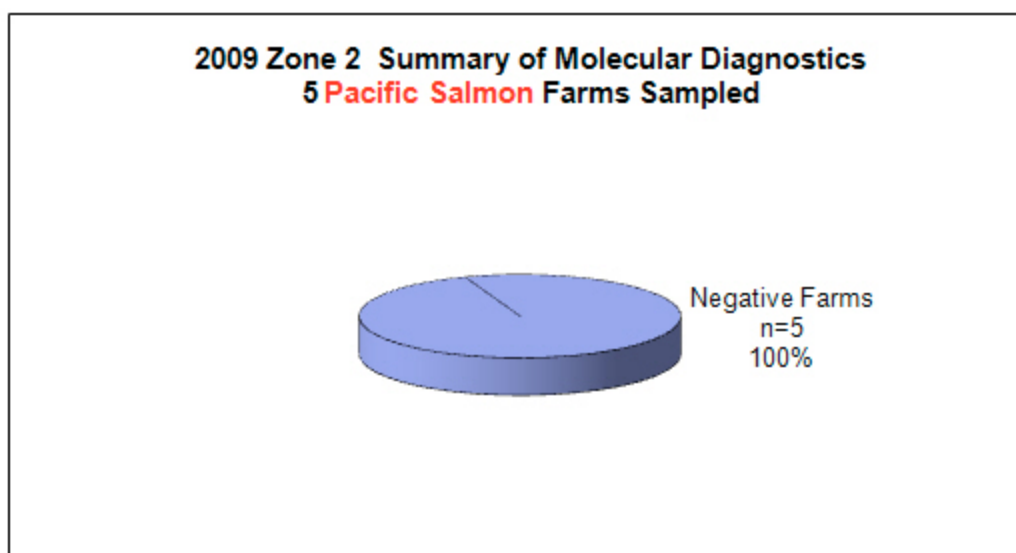
<b>Table 7.5.7: Molecular Testing Results for Sub-zone 3.5 (Central Coast) Atlantic Salmon Farm Audits 2009</b>									
Quarter	# farms sampled	# fish sampled	Number of Molecular Tests					Positive Sites	Organism Identified
			IHNv	IPNV	ISAV	Piscirickettsia	VHSV NAS		
Q1 Jan-Mar	1	5	1	1	1	1	1	0	None
Q2 Apr-Jun	2	6	2	2	2	2	2	0	None
Q3 Jul-Sep	1	2	1	1	1	1	1	0	None
Q4 Oct-Dec	0	0	0	0	0	0	0	0	None
Totals	4	13	4	4	4	4	4	0	

**Figure 7.5.7: Summary of Molecular Diagnostics Findings from Sub-zone 3.5  
Atlantic Salmon Farm Audits 2009**



<b>Table 7.5.8: Molecular Testing Results for Zone 2 (Vancouver Island)</b> <b>Pacific Salmon Farm Audits 2009</b>									
Quarter	# farms sampled	# fish sampled	Number of Molecular Tests					Positive Sites	Organism Identified
			IHN	IPNV	ISAV	Piscirickettsia	VHSV-NAS		
Q1 Jan-Mar	1	6	2	2	2	2	2	0	None
Q2 Apr-Jun	2	11	3	3	3	3	3	0	None
Q3 Jul-Sep	1	3	1	1	1	1	1	0	None
Q4 Oct-Dec	1	1	1	1	1	1	1	0	None
Totals	5	21	7	7	7	7	7	0	

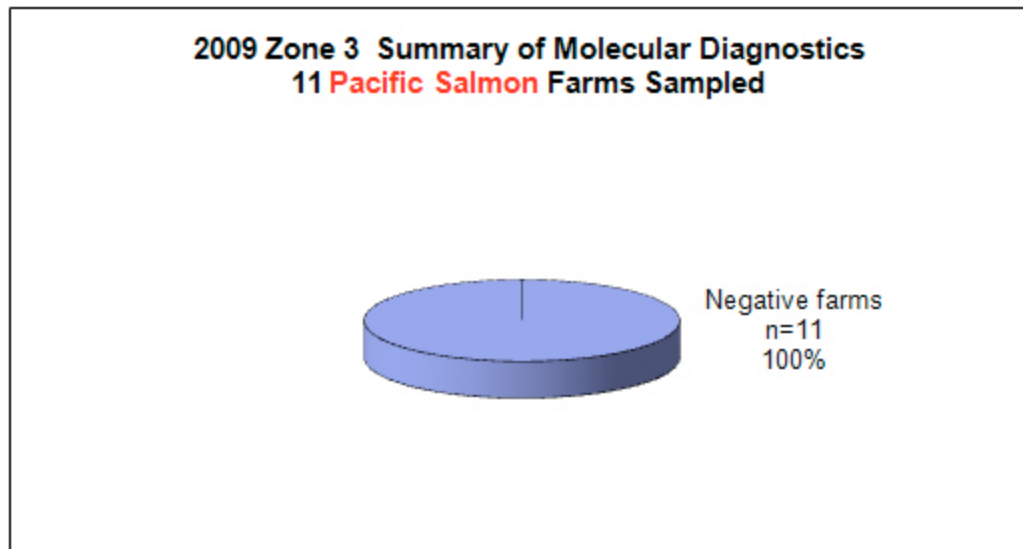
**Figure 7.5.8: Summary of Molecular Diagnostics Findings from Zone 2**  
**Pacific Salmon Farm Audits 2009**





<b>Table 7.5.9: Molecular Testing Results for Zone 3 (East of Vancouver Island)</b> <b>Pacific Salmon Farm Audits 2009</b>									
Quarter	# farms sampled	# fish sampled	Number of Molecular Tests					Positive Sites	Organism Identified
			IHN	IPNV	ISAV	Piscirickettsia	VHSV-NAS		
Q1 Jan-Mar	4	15	4	4	4	4	4	0	None
Q2 Apr-Jun	3	13	5	5	5	5	5	0	None
Q3 Jul-Sep	3	18	5	5	5	5	5	0	None
Q4 Oct-Dec	1	5	1	1	1	1	1	0	None
Totals	11	51	15	15	15	15	15	0	

**Figure 7.5.9: Summary of Molecular Diagnostics Findings from Zone 3**  
**Pacific Salmon Farm Audits 2009**



## 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 infection and disease on a farm is diagnosed 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 10 days of the initial infection. Farmed Chinook and Coho salmon are refractory to disease, but not the infection.

**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 (mouth rot):** A production disease of Atlantic salmon smolts during initial months of entry to sea water when the smolts are small; 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 to the fish, nor is evidence of infection in numerous fish 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 remain 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 (NID) or a production disease of salmon. There is no evidence that these parasites are moving beyond the brain vault of their Atlantic salmon host.

**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 septicaemic 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.

**Skin ulcers:** A production disease of salmon typically during initial months of entry to sea water but it can also arise in larger or adult fish following physical handling or trauma, such as transport, grading, strong currents (abrasions from netting). The open skin lesions tend to develop during the cool-water winter months, sometimes called 'winter sores'. The primary cause of the lesion is questionable but opportunistic and invasive bacteria of various types are always associated with the ulcers. This diagnosis is assigned to a fish population when the group is being medicated as a result of skin ulcers, or if the fish sampled show gross clinical signs and histological evidence of the disease as well as related population-level mortality at that farm (VHS NAS may again have an association with these ulcers).

**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 ( Quarter 1 2009 )					
Fish Health SubZone	Species	Life stages	# Fish Group	# Site	Rate
All Zones	Atlantic salmon	"Early"	17	11	5.11%
2-3	Atlantic salmon	"Later"	13	13	0.61%
2-4	Atlantic salmon	"Later"	11	11	0.36%
3-1 + 3-2	Atlantic salmon	"Later"	18	18	0.73%
3-3	Atlantic salmon	"Later"	24	19	1.19%
3-4 + 3-5	Atlantic salmon	"Later"	12	11	0.50%
All Zones <sup>4</sup>	Atlantic salmon	"Later"	78	72	0.76%
All Zones	Pacific salmon	"Early"	96	15	1.49%
All Zones	Pacific salmon	"Later"	28	10	1.35%

## Notes

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

2 Definitions for life stages:

"Early"	Eyed Egg -->	Alvin / Larvae / Fry -->	Pro-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
	<ul style="list-style-type: none"> <li>Creative Salmon</li> <li>Greg Seafoods</li> <li>Heritage Salmon</li> <li>Marine Harvest Canada/ Stolt Seafoods</li> <li>Mainstream (Pacific National Aquaculture)</li> <li>Panfish Canada (Omega Salmon Group)</li> <li>Target Marine Products</li> <li>West Coast Fish Culture</li> </ul>	<ul style="list-style-type: none"> <li>AcuMarine Industries</li> <li>Omega Pacific</li> <li>Saltstream Engineering</li> <li>Totem Oysters</li> <li>Yellow Island Aquaculture</li> <li>Freshwater Fisheries Society of BC (some data in the system)</li> </ul>	<ul style="list-style-type: none"> <li>Fisheries and Oceans Canada</li> </ul>

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

Mortality Rates by Cause (Quarter 1 2009)						
Early Life stages						
Fish Health SubZone	Species	# Fish Groups	Background Mortality	Systems Related	Fresh	Culls / Quality Control
All Zones	Atlantic salmon	17	0.16%	1.21%	0.71%	0.03%
All Zones	Pacific salmon	96	0.56%	0.92%	0.00%	0.01%

Mortality Rates by Cause ( Quarter 1 2009 )									
Later Life stages									
Fish Health SubZone	Species	# Fish Groups	Environmental	Fresh "Silvers"	Handling / Transport	Matures	Old	Poor Performers	Predators
All Zones	Atlantic salmon	78	0.05%	0.12%	0.12%	0.16%	0.14%	0.09%	0.07%
2-3	Atlantic salmon	13	0.00%	0.07%	0.03%	0.00%	0.06%	0.19%	0.26%
2-4	Atlantic salmon	11	0.00%	0.05%	0.14%	0.00%	0.06%	0.04%	0.04%
3-1 + 3-2	Atlantic salmon	18	0.19%	0.12%	0.02%	0.04%	0.16%	0.04%	0.05%
3-3	Atlantic salmon	24	0.00%	0.20%	0.13%	0.43%	0.25%	0.13%	0.02%
3-4 + 3-5	Atlantic salmon	12	0.01%	0.05%	0.35%	0.01%	0.07%	0.03%	0.01%
All Zones	Pacific salmon	28	0.01%	0.38%	0.03%	0.33%	0.30%	0.06%	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 2 (Apr – Jun)

Average Mortality Rate ( Quarter 2 2009 )					
Fish Health SubZone	Species	Life stages	# Fish Group	# Site	Rate
All Zones	Atlantic salmon	"Early"	21	12	3.96%
2-3	Atlantic salmon	"Later"	13	13	1.49%
2-4	Atlantic salmon	"Later"	12	12	0.46%
3-1 + 3-2	Atlantic salmon	"Later"	19	18	0.85%
3-3	Atlantic salmon	"Later"	24	20	0.56%
3-4 + 3-5	Atlantic salmon	"Later"	11	11	0.28%
All Zones <sup>4</sup>	Atlantic salmon	"Later"	80	74	0.73%
All Zones	Pacific salmon	"Early"	143	24	0.99%
All Zones	Pacific salmon	"Later"	35	15	1.49%

## Notes

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

2 Definitions for life stages:

"Early"	Eyed Egg →	Alevin / 1 larvae / Fry →	Pre-smolt (= post)
"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
	<ul style="list-style-type: none"> <li>Creative Salmon</li> <li>Criq Seafoods</li> <li>Hentage Salmon</li> <li>Marine Harvest Canada/ Stolt Seafoods</li> <li>Mainstream (Pacific National Aquaculture)</li> <li>Panfish Canada (Omega Salmon Group)</li> <li>Target Marine Products</li> <li>West Coast Fish Culture</li> </ul>	<ul style="list-style-type: none"> <li>AgriMarine Industries</li> <li>Omco Pacific</li> <li>Salitream Engineering</li> <li>Totem Oysters</li> <li>Yellow Island Aquaculture</li> <li>Freshwater Fisheries Society of BC (some data in the system)</li> </ul>	<ul style="list-style-type: none"> <li>Fisheries and Oceans Canada</li> </ul>

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



Mortality Rates by Cause (Quarter 2 2009)						
Early Life stages						
Fish Health SubZone	Species	# Fish Groups	Background Mortality	Systems Related	Fresh	Culls / Quality Control
All Zones	Atlantic salmon	21	3.63%	0.00%	0.16%	0.26%
All Zones	Pacific salmon	143	0.44%	0.33%	0.00%	0.22%

Mortality Rates by Cause ( Quarter 2 2009 )									
Later Life stages									
Fish Health SubZone	Species	# Fish Groups	Environmental	Fresh "Silvers"	Handling / Transport	Matures	Old Performers	Poor Performers	Predators
All Zones	Atlantic salmon	80	0.03%	0.27%	0.11%	0.02%	0.14%	0.10%	0.01%
2-3	Atlantic salmon	13	0.02%	0.74%	0.26%	0.01%	0.07%	0.18%	0.21%
2-4	Atlantic salmon	12	0.00%	0.07%	0.07%	0.00%	0.16%	0.15%	0.02%
3-1 + 3-2	Atlantic salmon	19	0.10%	0.23%	0.15%	0.01%	0.24%	0.07%	0.04%
3-3	Atlantic salmon	24	0.00%	0.26%	0.04%	0.05%	0.13%	0.06%	0.01%
3-4 + 3-5	Atlantic salmon	11	0.03%	0.04%	0.03%	0.01%	0.07%	0.09%	0.01%
All Zones	Pacific salmon	35	0.00%	0.60%	0.03%	0.01%	0.58%	0.10%	0.17%

## 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 2009 )					
Fish Health SubZone	Species	Life stages	# Fish Group	# Site	Rate
All Zones	Atlantic salmon	"Early"	14	11	3.55%
2-3	Atlantic salmon	"Later"	12	13	1.83%
2-4	Atlantic salmon	"Later"	11	11	1.85%
3-1 + 3-2	Atlantic salmon	"Later"	17	17	0.83%
3-3	Atlantic salmon	"Later"	21	17	0.83%
3-4 + 3-5	Atlantic salmon	"Later"	11	11	1.55%
All Zones <sup>4</sup>	Atlantic salmon	"Later"	75	70	1.67%
All Zones	Pacific salmon	"Early"	50	22	3.80%
All Zones	Pacific salmon	"Later"	24	11	5.99%

## Notes

1 Rate figures are aggregate weighted averages (agreed to with BC MAL 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-Spent (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 Greg Seatoode Heritage Salmon Marine Harvest Canada/ Stolt Seafoods Mainstream (Pacific National Aquaculture) Parrfish Canada (Omega Salmon Group) Target Marine Products West Coast Fish Culture	AgriMarine Industries Omega Foods Saltstream Engineering Toten 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 3 2009) <sup>1,2</sup>					
Early Life stages					
Fish Health SubZone	Species	# Fish Groups	Background Mortality	Systems Related	Fresh Culls / Quality Control
All Zones	Atlantic salmon	14	1.36%	0.28%	0.44%
All Zones	Pacific salmon	50	3.64%	0.16%	0.00%

Mortality Rates by Cause (Quarter 3 2009)									
Later Life stages									
Fish Health SubZone	Species	# Fish Groups	Environmental	Fresh "Silvers"	Handling / Transport	Matures	Old	Poor Performers	Predators
All Zones	Atlantic salmon	75	0.36%	0.31%	0.47%	0.00%	0.21%	0.22%	0.02%
2-3	Atlantic salmon	12	0.21%	0.60%	0.36%	0.01%	0.12%	0.46%	0.05%
2-4	Atlantic salmon	11	1.22%	0.25%	0.00%	0.00%	0.29%	0.08%	0.00%
3-1 + 3-2	Atlantic salmon	17	0.00%	0.17%	0.02%	0.02%	0.27%	0.30%	0.04%
3-3	Atlantic salmon	21	0.01%	0.13%	0.14%	0.23%	0.18%	0.09%	0.00%
3-4 + 3-5	Atlantic salmon	11	1.00%	0.07%	0.03%	0.02%	0.21%	0.22%	0.01%
All Zones	Pacific salmon	24	0.04%	0.14%	0.15%	0.20%	0.55%	0.38%	0.07%

## Notes

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

## BCSFA Mortality Reports: Quarter 4 (Oct – Dec)

Average Mortality Rate ( Quarter 4 2009 )					
Fish Health SubZone	Species	Life stages	# Fish Group	# Site	Rate
All Zones	Atlantic salmon	"Early"	18	18	4.21%
2-3	Atlantic salmon	"Later"	14	14	2.32%
2-4	Atlantic salmon	"Later"	13	12	0.57%
3-1 + 3-2	Atlantic salmon	"Later"	20	19	5.04%
3-3	Atlantic salmon	"Later"	23	19	1.02%
3-4 + 3-6	Atlantic salmon	"Later"	13	12	0.27%
All Zones <sup>4</sup>	Atlantic salmon	"Later"	85	77	3.14%
All Zones	Pacific salmon	"Early"	31	10	0.94%
All Zones	Pacific salmon	"Later"	22	9	13.10%

## Notes

1 Rate figures are aggregate weighted averages (agreed to with BC MAL 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 in the system	Data in the system for this quarter but may be incomplete
<ul style="list-style-type: none"> <li>Creative Salmon</li> <li>Grieg Seafoods</li> <li>Marine Harvest Canada</li> <li>Mainstream Canada</li> </ul>	<ul style="list-style-type: none"> <li>Midco Bay</li> <li>Omega Pacific</li> <li>Saltstream Engineering</li> <li>Totem Oysters</li> <li>Yellow Island Aquaculture</li> <li>Freshwater Fisheries Society of BC (some data in the system)</li> </ul>	<ul style="list-style-type: none"> <li>Fisheries and Oceans Canada</li> </ul>

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

Mortality Rates by Cause (Quarter 4, 2009) <sup>1,2</sup>					
Early Life stages					
Fish Health SubZone	Species	# Fish Groups	Background Mortality	Systems Related	Fresh Quality Control
All Zones	Atlantic salmon	18	2.05%	0.07%	0.97%
All Zones	Pacific salmon	31	0.91%	0.00%	0.00%

Mortality Rates by Cause ( Quarter 4, 2009 )									
Later Life stages									
Fish Health SubZone	Species	# Fish Groups	Environmental	Fresh "Silvers"	Handling / Transport	Matures	Old Performers	Poor Performers	Predators
All Zones	Atlantic salmon	65	0.46%	1.72%	0.10%	0.39%	0.31%	0.07%	0.05%
2-3	Atlantic salmon	14	0.01%	1.22%	0.08%	0.02%	0.84%	0.12%	0.04%
2-4	Atlantic salmon	13	0.00%	0.69%	0.03%	0.05%	0.32%	0.05%	0.04%
3-1 + 3-2	Atlantic salmon	20	1.90%	1.50%	0.16%	1.19%	0.05%	0.07%	0.10%
3-3	Atlantic salmon	23	0.02%	0.10%	0.24%	0.37%	0.21%	0.03%	0.03%
3-4 + 3-5	Atlantic salmon	13	0.00%	0.03%	0.04%	0.08%	0.09%	0.03%	0.00%
All Zones	Pacific salmon	22	0.19%	0.43%	0.40%	11.78%	0.35%	0.09%	0.04%

## Notes

1 See notes for Average Mortality Rate report.

2 Sum of individual Mortality Rates by Cause, rounded to Average Mortality Rate to 11 (11.5%, rounding error).

## APPENDIX 7.8 BCSFA Fish Health Events

Fish Health Events ( Quarter 1 2009 )						
Fish Health SubZone	Species	Life Stage	Veterinary Diagnosis	Count of Fish Health Events <sup>1,2,3</sup>		
				New	Ongoing/Recurring	Relapsing
All	Atlantic Salmon	Early		0	0	0
All zones <sup>4</sup>	Atlantic Salmon	Later		0	0	0
2-3	Atlantic Salmon	Later	Lepeophtheirus Infection Myxobacterial Infection Viral Haemorrhagic Septicemia Virus Infection Piscirickettsia salmonis Infection	4 0 3 0	2 1 0 2	0 0 0 0
2-4	Atlantic Salmon	Later	Lepeophtheirus Infection Myxobacterial Infection	4 3	1 0	0 0
3-1 + 3-2	Atlantic Salmon	Later	Lepeophtheirus Infection Myxobacterial Infection	4 3	1 0	0 0
3-3	Atlantic Salmon	Later	Aeromonas salmonicida (Atypical) Infection Lepeophtheirus Infection Viral Haemorrhagic Septicemia Virus Infection Myxobacterial Infection	0 2 0 1	0 1 1 0	0 0 0 0
3-4 + 3-5	Atlantic Salmon	Later	Lepeophtheirus Infection	0	2	0
All zones	Pacific Salmonids	Early	Aeromonas salmonicida Infection Case worked up but no diagnosis	1 0	0 1	0 0
All zones	Pacific Salmonids	Later	Renibacterium salmoninarum Infection Vibrio (Listonella) Infection	1 0	4 0	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 further investigation and management steps taken, e.g., further investigations, husbandry change etc.
- This field has been added to encompass a small number of later life stage Atlantic salmon (e.g., broodstock) raised in areas other than the volumes shown above.

Fish Health Events ( Quarter 2 2009 )						
Fish Health SubZone	Species	Life Stage	Veterinary Diagnosis	Count of Fish Health Events <sup>1,2,3</sup>		
				New	Ongoing/Recurring	Relapsing
All	Atlantic Salmon	Early		0	0	0
All zones <sup>4</sup>	Atlantic Salmon	Later		0	0	0
2-3	Atlantic Salmon	Later	Lepeophtheirus Infection Myxobacterial Infection Viral Haemorrhagic Septicemia Virus Infection Aeromonas salmonicida Infection Piscirickettsia salmonis Infection	4 2 0 3 0	4 0 3 0 2	0 0 0 0 0
2-4	Atlantic Salmon	Later	Lepeophtheirus Infection Myxobacterial Infection	2 2	1 0	0 0
3-1 + 3-2	Atlantic Salmon	Later	Lepeophtheirus Infection Renibacterium salmoninarum Infection Myxobacterial Infection	0 1 6	2 0 2	0 0 0
3-3	Atlantic Salmon	Later	Lepeophtheirus Infection Viral Haemorrhagic Septicemia Virus Infection Myxobacterial Infection	0 0 1	1 1 0	0 0 0
3-4 + 3-5	Atlantic Salmon	Later	Lepeophtheirus Infection	0	1	0
All zones	Pacific Salmonids	Early	Renibacterium salmoninarum Infection Myxobacterial Infection Case worked up but no diagnosis	3 1 2	0 1 0	0 0 0
All zones	Pacific Salmonids	Later	Renibacterium salmoninarum Infection Vibrio (Listonella) Infection	1 0	4 0	0 0

- 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 further investigation and management steps taken, e.g., further investigations, husbandry change etc.
- This field has been added to encompass a small number of later life stage Atlantic salmon (e.g., broodstock) raised in areas other than the volumes shown above.



Fish Health Events ( Quarter 3 2009 )						
Fish Health SubZone	Species	Life Stage	Veterinary Diagnosis	Count of Fish Health Events <sup>1,2,3</sup>		
				New	Ongoing/Recurring	Relapsing
All	Atlantic Salmon	"Early"	Renibacterium salmoninarum Infection	1	0	0
All zones <sup>2</sup>	Atlantic Salmon	"Later"				
2-3	Atlantic Salmon	"Later"	Lepeophtheirus Infection	0	2	0
			Myxobacterial Infection	2	0	0
			Viral Haemorrhagic Septicemia Virus Infection	0	3	0
			Aeromonas salmonicida Infection	1	0	0
			Piscirickettsia salmonis Infection	0	2	0
2-4	Atlantic Salmon	"Later"	Lepeophtheirus Infection	0	0	0
			Myxobacterial Infection	0	2	0
3-1 + 3-2	Atlantic Salmon	"Later"	Lepeophtheirus Infection	1	1	0
			Renibacterium salmoninarum Infection	0	0	0
			Myxobacterial Infection	2	2	0
3-3	Atlantic Salmon	"Later"	Lepeophtheirus Infection	0	1	0
			Viral Haemorrhagic Septicemia Virus Infection	0	1	0
			Myxobacterial Infection	0	1	0
3-4 + 3-5	Atlantic Salmon	"Later"	Myxobacterial Infection	1	0	0
			Lepeophtheirus Infection	2	0	0
All zones	Pacific Salmonids	"Early"	Renibacterium salmoninarum Infection	1	1	0
			Myxobacterial Infection	4	0	0
			Case worked up but no diagnosis	1	0	0
All zones	Pacific Salmonids	"Later"	Renibacterium salmoninarum Infection	2	4	0
			Myxobacterial Infection	1	0	0

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 late life stage Atlantic salmon (e.g., broodstock) raised in areas other than the subzones shown above.

Fish Health Events ( Quarter 4 2009 )						
Fish Health SubZone	Species	Life Stage	Veterinary Diagnosis	Count of Fish Health Events <sup>1,2,3</sup>		
				New	Ongoing/Recurring	Relapsing
All	Atlantic Salmon	"Early"	Renibacterium salmoninarum Infection	0	1	0
All zones <sup>2</sup>	Atlantic Salmon	"Later"				
2-3	Atlantic Salmon	"Later"	Lepeophtheirus Infection	1	2	0
			Myxobacterial Infection	1	2	0
			Viral Haemorrhagic Septicemia Virus Infection	0	3	0
			Aeromonas salmonicida Infection	2	1	0
			Piscirickettsia salmonis Infection	0	2	0
2-4	Atlantic Salmon	"Later"	Lepeophtheirus Infection	0	2	0
			Myxobacterial Infection	1	0	0
3-1 + 3-2	Atlantic Salmon	"Later"	Lepeophtheirus Infection	3	1	0
			Renibacterium salmoninarum Infection	0	1	0
			Myxobacterial Infection	1	2	0
3-3	Atlantic Salmon	"Later"	Lepeophtheirus Infection	1	1	0
			Viral Haemorrhagic Septicemia Virus Infection	0	1	0
3-4 + 3-5	Atlantic Salmon	"Later"	Lepeophtheirus Infection	4	0	0
			Renibacterium salmoninarum Infection	1	1	0
All zones	Pacific Salmonids	"Early"	Aeromonas salmonicida	1	0	0
			Case worked up but no diagnosis	1	0	0
			Renibacterium salmoninarum Infection	2	4	0
All zones	Pacific Salmonids	"Later"	Vibrio (Listonella) Infection	0	1	0

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 late life stage 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** or **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 1<sup>st</sup> 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 Statistics****Table 7.10.1 Sub-zone 2.3** (BCMAL Audits 2009) Quarterly Mean and Median Abundance of Motile and Female *Lepeophtheirus salmonis*, Chalimus (*L. salmonis* & *Caligus clemensi*) and Motile *C. clemensi* on Atlantic Salmon (including tote counts).

Year Class 1 - 2009	Q1		Q2		Q3		Q4	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Number of Farms Audited (n)	1		3		2		1	
Motile	0.2667	0	0.0833	0	0.5000	0	0.3000	0
Standard Deviation (SD)	0.5164		0.3486		0.7118		0.5264	
Female	0.0667	0	0.0444	0	0.1000	0	0.1000	0
SD	0.3117		0.2956		0.2906		0.2807	
Chalimus	2.7500	2	0.9389	0	0.6600	0	0.3670	0
SD	2.5805		3.0657		1.5211		0.8455	
Caligus Motile	3.8500	4	0.0111	0	1.3250	1	0.5833	0.5
SD	1.1604		0.1051		1.5956		0.7253	

Year Class 2 - 2009	Q1		Q2		Q3		Q4	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Number of Farms Audited (n)	2		3		1		2	
Motile	1.0333	0.5	0.4167	0	0.1333	0	0.3917	0
SD	1.6006		0.8059		0.3237		0.7824	
Female	0.3333	0	0.1500	0	0.1000	0	0.2167	0
SD	0.7582		0.4884		0.2807		0.4520	
Chalimus	1.5500	1	0.3056	0	0.0830	0	0.0500	0
SD	2.0227		0.9281		0.2725		0.2484	
Caligus Motile	2.1500	2	0.2944	0	0.0500	0	0.2833	0
SD	2.0715		0.6115		0.1334		0.9706	



**Table 7.10.2 Sub-zone 2.4** (BCMAL Audits 2009) Quarterly Mean and Median Abundance of Motile and Female *Lepeophtheirus salmonis*, Chalimus (*L. salmonis* & *Caligus clemensi*) and Motile *C. clemensi* on Atlantic Salmon (including tote counts).

Year Class 1 - 2009	Q1		Q2		Q3		Q4	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Number of Farms Audited (n)	0		1		2		3	
Motile	na*	na	0.1000	0	1.3167	1	2.9056	2.5
Standard Deviation (SD)			0.2504		1.2486		2.0633	
Female	na	na	0.0167	0	0.1750	0	1.0222	1
SD			0.1291		0.3658		1.2949	
Chalimus	na	na	0.6833	0	1.8300	1	0.4700	0
SD			1.0495		1.6730		1.0983	
Caligus Motile	na	na	0.1000	0	1.4083	2	0.3556	0
SD			0.1334		1.1789		0.6362	

Year Class 2 - 2009	Q1		Q2		Q3		Q4	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Number of Farms Audited (n)	1		4		0		0	
Motile	2.0500	2	1.0917	0	na	na	na	na
SD	1.3830		1.6629					
Female	0.4333	0	0.4875	0	na	na	na	na
SD	0.6275		1.0171					
Chalimus	0.3670	0	0.0208	0	na	na	na	na
SD	0.8455		0.1699					
Caligus Motile	0.0667	0	0.0042	0	na	na	na	na
SD	0.0951		0.0645					

\* na means no lice data was generated because no random audit was selected or performed, or no lice were present.

**Table 7.10.3 Sub-zone 3.1** (BCMAL Audits 2009) Quarterly Mean and Median Abundance of Motile and Female *Lepeophtheirus salmonis*, Chalimus (*L. salmonis* & *Caligus clemensi*) and Motile *C. clemensi* on Atlantic Salmon (including tote counts).

Year Class 1 - 2009	Q1		Q2		Q3		Q4	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Number of Farms Audited (n)	1		0		1		0	
Motile	0.0167	0	na	na	1.4167	1	na	na
Standard Deviation (SD)	0.1291				1.4740			
Female	0	0	na	na	0.5600	0	na	na
SD	0				0.7951			
Chalimus	0.5300	0	na	na	0.0500	0	na	na
SD	0.9817				0.2799			
Caligus Motile	0.0500	0	na	na	0.1500	0	na	na
SD	0.1841				0.2099			

Year Class 2 - 2009	Q1		Q2		Q3		Q4	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Number of Farms Audited (n)	0		1		0		1	
Motile	na	na	0.6667	0	na	na	6.9500	6.5
SD			0.9028				3.3678	
Female	na	na	0.1833	0	na	na	3.2833	3
SD			0.4315				2.0439	
Chalimus	na	na	0	0	na	na	3.4700	3
SD			0				2.8547	
Caligus Motile	na	na	0	0	na	na	1.5333	1.5
SD			0				0.6013	

**Table 7.10.4 Sub-zone 3.2 (BCMAL Audits 2009) Quarterly Mean and Median Abundance of Motile and Female *Lepeophtheirus salmonis*, Chalimus (*L. salmonis* & *Caligus clemensi*) and Motile *C. clemensi* on Atlantic Salmon (including tote counts).**

Year Class 1 - 2009	Q1		Q2		Q3		Q4	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Number of Farms Audited (n)	1		2		0		1	
Motile	0.4667	0	0.2800	0	na	na	0.0500	0
Standard Deviation (SD)	0.7667		0.5519				0.2198	
Female	0.0833	0	0.0200	0	na	na	0.0167	0
SD	0.2787		0.1407				0.1291	
Chalimus	1.000	0	0.5200	0	na	na	0.0670	0
SD	1.6697		0.9479				0.2458	
Caligus Motile	1.4167	0.5	0.3200	0	na	na	0.0167	0
SD	1.4797		0.4181				0.1291	

Year Class 2 - 2009	Q1		Q2		Q3		Q4	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Number of Farms Audited (n)	3		5		3		1	
Motile	4.2889	3	0.4500	0	0.6000	0	1.4833	1.5
SD	3.5860		1.3368		0.9281		1.4165	
Female	1.7833	1.5	0.1867	0	0.3333	0	0.1833	0
SD	2.0913		0.5230		0.6712		0.3902	
Chalimus	3.3250	0	0.3887	0	1.0200	0	5.1700	4
SD	5.4339		1.5400		1.4692		4.2476	
Caligus Motile	3.9278	0	0.0700	0	0.3778	0	2.7167	2.5
SD	6.0807		0.2272		0.5249		0.6954	

**Table 7.10.5 Sub-zone 3.3** (BCMAL Audits 2009) Quarterly Mean and Median Abundance of Motile and Female *Lepeophtheirus salmonis*, Chalimus (*L. salmonis* & *Caligus clemensi*) and Motile *C. clemensi* on Atlantic Salmon (including tote counts).

Year Class 1 - 2009	Q1		Q2		Q3		Q4	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Number of Farms Audited (n)	1		4		1		1	
Motile	0.3000	0	0.1042	0	0.3000	0	2.7500	2.5
Standard Deviation (SD)	0.4308		0.3088		0.6113		1.7039	
Female	0.0333	0	0.0083	0	0.0500	0	1.1000	1
SD	0.1810		0.0911		0.2198		1.1335	
Chalimus	0.3500	0	0.1500	0	0.7670	0	3.75	2
SD	0.6476		0.4780		1.0193		3.6487	
Caligus Motile	1.1500	1	0.2792	0	0	0	0.4667	0.5
SD	0.4318		0.6280		0		0.2787	

Year Class 2 - 2009	Q1		Q2		Q3		Q4	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Number of Farms Audited (n)	2		2		2		3	
Motile	0.6417	0.5	0.0917	0	0.0417	0	3.1111	2.5
SD	0.6436		0.3011		0.1797		2.7267	
Female	0.2917	0	0.0083	0	0.0250	0	1.4222	1
SD	0.4583		0.0913		0.1288		1.6692	
Chalimus	0.0500	0	0.8000	0	0.0500	0	3.9200	2
SD	0.4536		1.3067		0.2484		6.3912	
Caligus Motile	0.0333	0	0.3000	0.5	0	0	1.2333	1
SD	0.1349		0.4463		0		1.4608	

**Table 7.10.6 Sub-zone 3.4** (BCMAL Audits 2009) Quarterly Mean and Median Abundance of Motile and Female *Lepeophtheirus salmonis*, Chalimus (*L. salmonis* & *Caligus clemensi*) and Motile *C. clemensi* on Atlantic Salmon (including tote counts).

Year Class 1 - 2009	Q1		Q2		Q3		Q4	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Number of Farms Audited (n)	0		1		2		0	
Motile	na	na	0.1000	0	1.7167	1	na	na
Standard Deviation (SD)			0.2807		2.6598			
Female	na	na	0	0	0.2667	0	na	na
SD			0		1.0186			
Chalimus	na	na	6.1333	5	0.5420	0	na	na
SD			3.8022		0.8554			
Caligus Motile	na	na	1.3667	1	0.7083	0.5	na	na
SD			0.6020		0.5329			

Year Class 2 - 2009	Q1		Q2		Q3		Q4	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Number of Farms Audited (n)	1		2		0		2	
Motile	3.9500	4	2.2083	2	na	na	7.2250	7
SD	1.7691		1.7911				3.9840	
Female	2.1833	2	0.8417	0.5	na	na	4.3083	4
SD	1.3872		1.0148				2.7197	
Chalimus	0.3830	0	1.6000	1	na	na	0.3600	0
SD	0.8093		1.7412				0.7501	
Caligus Motile	0.9333	0	0.2250	0	na	na	0.1583	0
SD	1.3884		0.2837				0.2591	

**Table 7.10.7 Sub-zone 3.5** (BCMAL Audits 2009) Quarterly Mean and Median Abundance of Motile and Female *Lepeophtheirus salmonis*, *Chalimus* (*L. salmonis* & *Caligus clemensi*) and Motile *C. clemensi* on Atlantic Salmon (including tote counts).

Year Class 1 - 2009	Q1		Q2		Q3		Q4	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Number of Farms Audited (n)	0		1		0		0	
Motile	na	na	1.6667	1	na	na	na	na
Standard Deviation (SD)			1.6750					
Female	na	na	0.6333	0	na	na	na	na
SD			1.0246					
Chalimus	na	na	0.1167	0	na	na	na	na
SD			0.3724					
Caligus Motile	na	na	0.6667	0.5	na	na	na	na
SD			0.1856					

Year Class 2 - 2009	Q1		Q2		Q3		Q4	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Number of Farms Audited (n)	1		1		1		0	
Motile	0.4667	0	1.7383	1	3.1000	2.5	na	na
SD	0.6214		1.3305		2.5226			
Female	0.0833	0	0.4000	0	1.2167	1	na	na
SD	0.2787		0.5764		1.2718			
Chalimus	1.4200	1	0.1167	0	0.1670	0	na	na
SD	1.3459		0.3724		0.4098			
Caligus Motile	0.2667	0	0	0	0	0	na	na
SD	0.6856		0		0			

## 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

### Atlantic Salmon Sea Lice Abundances

Yearclass 1				
ZONE/SUBZONE 2.3	Mobile	Female	Caligus	n
Jan-09	0.80	0.33	0.46	7(9)
std error	0.39	0.19	0.18	
Feb-09	0.62	0.21	0.15	3(6)
std error	0.39	0.15	0.03	
Mar-09	1.03	0.24	0.34	4(6)
std error	0.28	0.09	0.16	
Apr-09	0.43	0.15	0.21	5(6)
std error	0.20	0.07	0.15	
May-09	0.49	0.21	0.16	5(6)
std error	0.33	0.15	0.09	
Jun-09	0.33	0.06	0.34	6(8)
std error	0.10	0.02	0.26	
Jul-09	0.27	0.12	0.26	7(10)
std error	0.09	0.05	0.17	
Aug-09	0.53	0.19	0.14	7(13)
std error	0.22	0.09	0.07	
Sep-09	0.38	0.15	0.05	5(12)
std error	0.20	0.09	0.03	
Oct-09	0.05	0.29	0.08	7(14)
std error	0.27	0.19	0.03	
Nov-09	0.40	0.16	0.07	6(10)
std error	0.17	0.08	0.03	
Dec-09	0.83	0.28	0.28	5(8)
std error	0.29	0.11	0.15	

Yearclass 2				
ZONE/SUBZONE 2.3	Mobile	Female	Caligus	n
Jan-09	0.28	0.13	0.22	1
std error				
Feb-09	0.65	0.21	1.67	4
std error	0.45	0.14	0.89	
Mar-09	0.58	0.24	0.17	3(6)
std error	0.09	0.06	0.11	
Apr-09	0.69	0.24	0.27	3(5)
std error	0.22	0.10	0.18	
May-09	0.60	0.20	0.06	4(6)
std error	0.21	0.06	0.05	
Jun-09	0.84	0.46	0.03	2(3)
std error	0.68	0.42	0.02	
Jul-09	0.38	0.21	0.18	4(7)
std error	0.32	0.17	0.01	
Aug-09	0.02	0.02	0.02	2(4)
std error	0.02	0.02	0.02	
Sep-09	0.14	0.05	0.04	3(7)
std error	0.08	0.02	0.02	
Oct-09	0.23	0.15	0.07	3(4)
std error				
Nov-09	0.27	0.15	0.02	3
std error	0.15	0.09	0.02	
Dec-09	0.21	0.12	0.06	4(5)
std error	0.12	0.05	0.04	

Yearclass 1				
ZONE/SUBZONE 2.4	Mobile	Female	Caligus	n
<b>Jan-09</b>	1.47	0.63	0.18	3
std error	0.39	0.31	0.12	
<b>Feb-09</b>	0.81	0.40	0.00	3
std error	0.59	0.31	0.00	
<b>Mar-09</b>	1.11	0.40	0.02	3
std error	0.94	0.36	0.01	
<b>Apr-09</b>	0.96	0.37	0.00	3
std error	0.87	0.37	0.00	
<b>May-09</b>	0.34	0.05	0.00	4
std error	0.28	0.05	0.00	
<b>Jun-09</b>	0.18	0.02	0.02	5
std error	0.10	0.01	0.01	
<b>Jul-09</b>	0.50	0.03	0.00	5
std error	0.17	0.01	0.00	
<b>Aug-09</b>	3.33	1.14	0.00	3
std error	2.76	1.02	0.00	
<b>Sep-09</b>	4.65	2.11	0.04	6
std error	3.27	1.62	0.03	
<b>Oct-09</b>	7.16	3.00	0.04	6
std error	5.28	2.19	0.03	
<b>Nov-09</b>	2.96	1.19	0.09	5
std error	0.48	0.27	0.07	
<b>Dec-09</b>	2.77	0.94	0.09	6
std error	0.50	0.33	0.07	

Yearclass 2				
ZONE/SUBZONE 2.4	Mobile	Female	Caligus	n
<b>Jan-09</b>	3.10	1.18	0.13	2
std error	1.82	0.90	0.13	
<b>Feb-09</b>	4.71	1.42	0.00	2(3)
std error	2.59	0.60	0.00	
<b>Mar-09</b>	1.30	0.35	0.00	3
std error	0.64	0.22	0.00	
<b>Apr-09</b>	0.55	0.21	0.18	5(6)
std error	0.23	0.08	0.18	
<b>May-09</b>	0.95	0.20	0.00	2
std error	0.85	0.13	0.00	
<b>Jun-09</b>	0.61	0.32	0.02	4(6)
std error	0.18	0.08	0.02	
<b>Jul-09</b>	0.65	0.46	0.90	4
std error	0.47	0.18	0.37	
<b>Aug-09</b>	3.64	1.44	0.00	2
std error	3.12	1.22	0.00	
<b>Sep-09</b>	11.70	6.70	0.28	4(6)
std error	6.56	3.92	0.14	
<b>Oct-09</b>	5.81	2.25	0.14	3
std error	4.19	1.51	0.14	
<b>Nov-09</b>	11.52	5.26	0.00	3
std error	6.06	2.80	0.00	
<b>Dec-09</b>	6.21	2.71	0.07	5(6)
std error	2.02	0.89	0.05	



Yearclass 1				
ZONE/SUBZONE	Mobile	Female	Caligus	n
3.1				
Jan-09				
	std error			
Feb-09				
	std error			
Mar-09				
	std error			
Apr-09				
	std error			
May-09				
	std error			
Jun-09				
	std error			
Jul-09				
	std error			
Aug-09				
	std error			
Sep-09				
	std error			
Oct-09				
	std error			
Nov-09				
	std error			
Dec-09				
	std error			

Yearclass 2				
ZONE/SUBZONE	Mobile	Female	Caligus	n
3.1				
Jan-09				
	std error			
Feb-09				
	std error			
Mar-09				
	std error			
Apr-09				
	std error			
May-09				
	std error			
Jun-09				
	std error			
Jul-09				
	std error			
Aug-09				
	std error			
Sep-09				
	std error			
Oct-09				
	std error			
Nov-09				
	std error			
Dec-09				
	std error			

<sup>NB.</sup> 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).

Yearclass 1				
ZONE/SUBZONE 3.2	Mobile	Female	Caligus	n
Jan-09	0.60	0.21	4.41	2
std error	0.13	0.14	1.66	
Feb-09	1.47	0.18	1.91	2
std error	0.93	0.18	0.18	
Mar-09	0.68	0.13	2.45	2
std error	0.22	0.05	1.07	
Apr-09	0.55	0.21	0.19	2
std error	0.38	0.13	0.07	
May-09	0.52	0.07	1.77	2
std error	0.30	0.05	1.60	
Jun-09	0.62	0.09	0.57	4
std error	0.37	0.06	0.44	
Jul-09	1.07	0.17	3.48	5(6)
std error	0.32	0.11	2.74	
Aug-09	1.27	0.23	1.82	5
std error	0.40	0.05	0.93	
Sep-09	1.13	0.51	0.46	6(7)
std error	0.46	0.27	0.31	
Oct-09	1.17	0.39	0.22	5
std error	0.48	0.21	0.13	
Nov-09	1.43	0.47	0.06	5
std error	0.62	0.18	0.04	
Dec-09	1.38	0.56	0.53	7(9)
std error	0.61	0.24	0.31	

Yearclass 2				
ZONE/SUBZONE 3.2	Mobile	Female	Caligus	n
Jan-09	3.29	1.48	1.90	11
std error	0.45	0.24	1.06	
Feb-09	2.28	0.99	1.16	11
std error	0.60	0.29	0.59	
Mar-09	1.36	0.61	0.44	9
std error	0.77	0.33	0.31	
Apr-09	0.37	0.12	0.33	9(11)
std error	0.19	0.07	0.26	
May-09	0.45	0.19	0.26	8
std error	0.22	0.11	0.19	
Jun-09	0.57	0.30	0.23	6
std error	0.15	0.09	0.20	
Jul-09	0.99	0.46	0.90	4
std error	0.47	0.18	0.37	
Aug-09	0.82	0.45	0.22	4
std error	0.29	0.11	0.10	
Sep-09	2.64	1.06	0.52	2
std error	0.14	0.46	0.07	
Oct-09	*	*	*	
std error				
Nov-09	1.12	0.28	1.18	1
std error				
Dec-09	1.98	0.95	0.50	1
std error				

Yearclass 1				
ZONE/SUBZONE	Mobile	Female	Caligus	n
3.3				
Jan-09	0.32	0.03	0.26	3
std error	0.10	0.01	0.26	
Feb-09	0.22	0.02	0.51	3
std error	0.08	0.01	0.34	
Mar-09	0.16	0.03	0.35	4
std error	0.06	0.02	0.21	
Apr-09	0.16	0.07	0.11	3
std error	0.07	0.01	0.07	
May-09	0.12	0.02	0.24	4(5)
std error	0.06	0.02	0.22	
Jun-09	0.09	0.03	0.19	6
std error	0.04	0.02	0.18	
Jul-09	0.09	0.01	0.02	7
std error	0.06	0.00	0.01	
Aug-09	0.10	0.03	0.10	7
std error	0.04	0.01	0.06	
Sep-09	0.54	0.09	0.25	7(8)
std error	0.20	0.03	0.24	
Oct-09	1.47	0.52	0.57	5(6)
std error	0.60	0.17	0.38	
Nov-09	0.13	0.03	0.06	3(4)
std error	0.10	0.02	0.04	
Dec-09	0.26	0.02	0.03	4(5)
std error	0.16	0.01	0.02	

Yearclass 2				
ZONE/SUBZONE	Mobile	Female	Caligus	n
3.3				
Jan-09	0.98	0.56	0.29	13(14)
std error	0.26	0.17	0.11	
Feb-09	0.99	0.48	0.14	12(14)
std error	0.32	0.19	0.07	
Mar-09	1.12	0.59	0.01	11(12)
std error	0.68	0.40	0.00	
Apr-09	0.09	0.03	0.02	11
std error	0.03	0.01	0.01	
May-09	0.16	0.08	0.05	9(10)
std error	0.09	0.06	0.03	
Jun-09	0.07	0.02	0.09	8
std error	0.03	0.01	0.05	
Jul-09	0.14	0.06	0.29	8
std error	0.07	0.03	0.21	
Aug-09	0.25	0.09	0.09	8
std error	0.08	0.03	0.04	
Sep-09	0.73	0.64	0.13	5
std error	0.51	0.30	0.11	
Oct-09	2.50	1.32	0.06	8
std error	0.93	0.52	0.05	
Nov-09	3.12	1.73	0.76	11(12)
std error	0.85	0.58	0.33	
Dec-09	3.83	1.58	0.65	9(10)
std error	2.14	0.75	0.42	

Yearclass 1				
ZONE/SUBZONE	Mobile	Female	Caligus	n
3.4				
Jan-09	1.32	0.32	0.41	2
std error	0.56	0.14	0.13	
Feb-09	0.67	0.17	0.18	3
std error	0.26	0.10	0.09	
Mar-09	0.27	0.12	0.25	2
std error	0.07	0.05	0.08	
Apr-09	*	*	*	
std error				
May-09	0.21	0.04	0.13	2
std error	0.11	0.02	0.12	
Jun-09	0.11	0.00	0.52	3
std error	0.01	0.00	0.34	
Jul-09	0.16	0.01	1.00	3
std error	0.05	0.01	0.08	
Aug-09	0.52	0.12	0.75	3
std error	0.17	0.07	0.39	
Sep-09	0.98	0.43	0.70	3
std error	0.62	0.31	0.43	
Oct-09	3.59	1.29	0.52	3(4)
std error	2.24	0.82	0.24	
Nov-09	1.88	0.77	0.43	3
std error	0.91	0.29	0.35	
Dec-09	0.30	0.18	0.85	2
std error	0.10	0.13	0.85	

Yearclass 2				
ZONE/SUBZONE	Mobile	Female	Caligus	n
3.4				
Jan-09	1.08	0.56	0.54	2
std error	0.14	0.08	0.54	
Feb-09	1.97	0.95	0.88	2
std error	1.17	0.40	0.02	
Mar-09	2.49	1.28	0.59	2
std error	1.72	1.07	0.19	
Apr-09	1.15	0.51	0.10	4(5)
std error	0.54	0.26	0.04	
May-09	0.92	0.34	0.04	3(4)
std error	0.33	0.16	0.04	
Jun-09	0.81	0.33	0.26	3
std error	0.38	0.18	0.20	
Jul-09	0.59	0.25	0.05	3
std error	0.30	0.13	0.05	
Aug-09	0.40	0.21	0.48	3
std error	0.16	0.11	0.25	
Sep-09	0.34	0.11	0.14	2
std error	0.32	0.11	0.14	
Oct-09	4.54	3.09	0.13	3
std error	0.98	0.95	0.04	
Nov-09	5.69	3.70	0.13	3(4)
std error	1.51	0.91	0.05	
Dec-09	4.29	2.69	0.15	3(5)
std error	1.21	0.91	0.01	

Yearclass 1				
ZONE/SUBZONE 3.5	Mobile	Female	Caligus	n
Jan-09	0.64	0.25	0.03	2
std error	0.04	0.03	0.03	
Feb-09	0.67	0.22	0.26	1
std error				
Mar-09	0.22	0.07	0.83	1
std error				
Apr-09	0.44	0.08	1.04	2
std error				
May-09	0.03	0.00	0.00	1
std error				
Jun-09	0.02	0.00	0.00	1
std error				
Jul-09	0.05	0.02	0.00	1
std error				
Aug-09	0.45	0.10	0.08	1
std error				
Sep-09	0.23	0.37	0.07	1
std error				
Oct-09	2.27	0.42	0.03	1
std error				
Nov-09	3.68	1.04	0.96	2
std error	1.58	0.54	0.49	
Dec-09	6.97	2.98	0.22	1
std error				

Yearclass 2				
ZONE/SUBZONE 3.5	Mobile	Female	Caligus	n
Jan-09	0.24	0.06	0.11	2
std error	0.19	0.06	0.11	
Feb-09	0.22	0.00	0.00	2
std error	0.18	0.00	0.00	
Mar-09	0.24	0.03	0.18	2
std error	0.09	0.01	0.18	
Apr-09	0.34	0.12	1.70	2
std error	0.26	0.10	0.90	
May-09	0.95	0.46	0.11	3
std error	0.42	0.23	0.08	
Jun-09	0.91	0.53	0.09	3
std error	0.40	0.28	0.07	
Jul-09	2.26	1.17	0.01	2(3)
std error	0.42	0.15	0.00	
Aug-09	3.00	1.90	0.00	1
std error				
Sep-09	3.50	2.34	0.00	2
std error	3.43	2.31	0.00	
Oct-09	*	*	*	
std error				
Nov-09	0.55	0.22	0.13	1
std error				
Dec-09	1.93	0.40	0.16	3
std error	1.64	0.26	0.10	

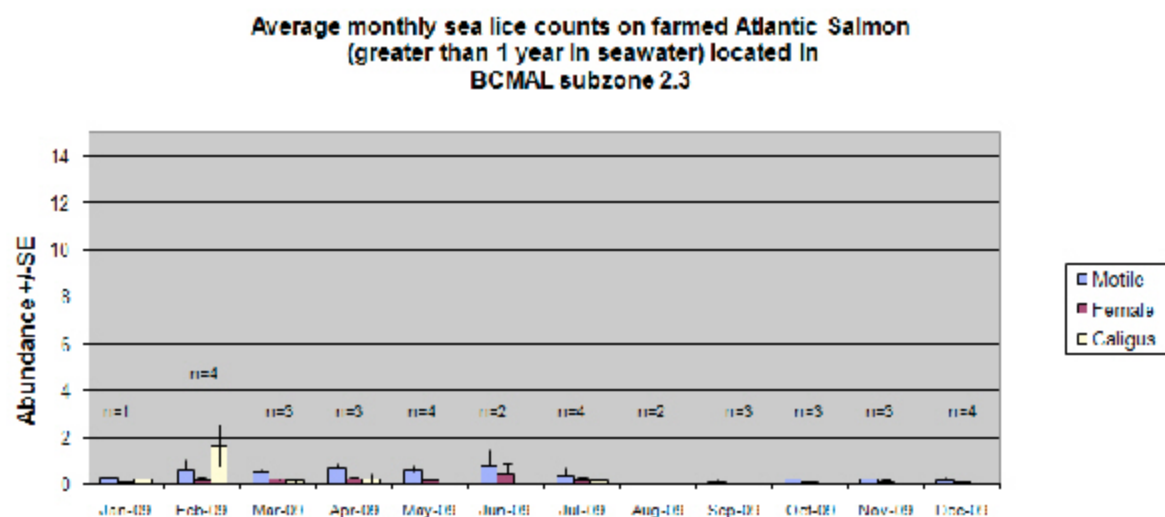
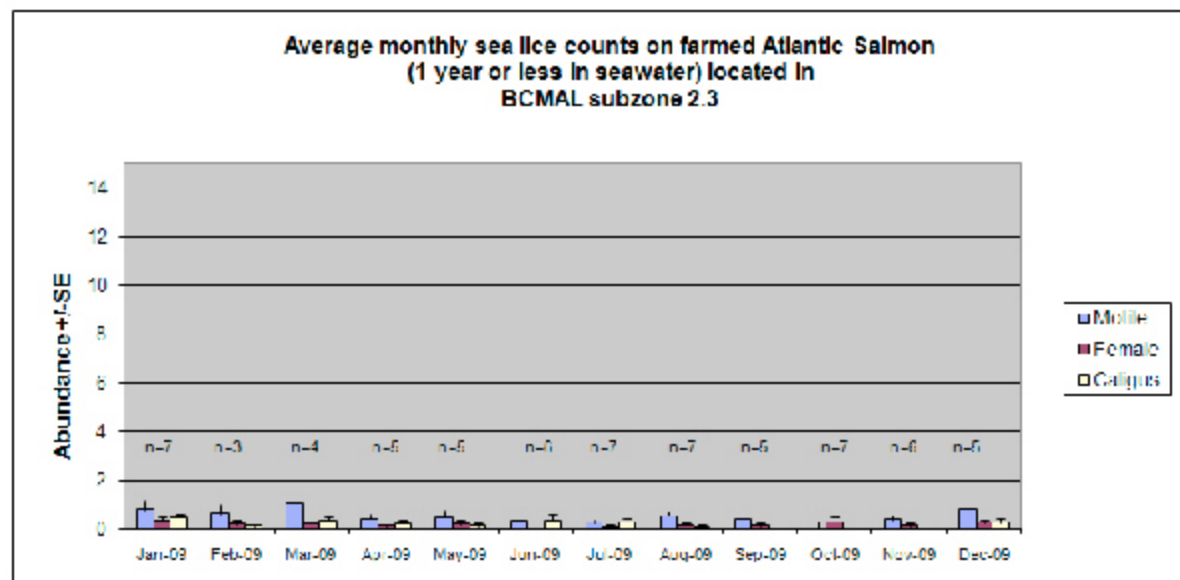
**Notes:**

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

**\* Reasons for missing farm lice counts**

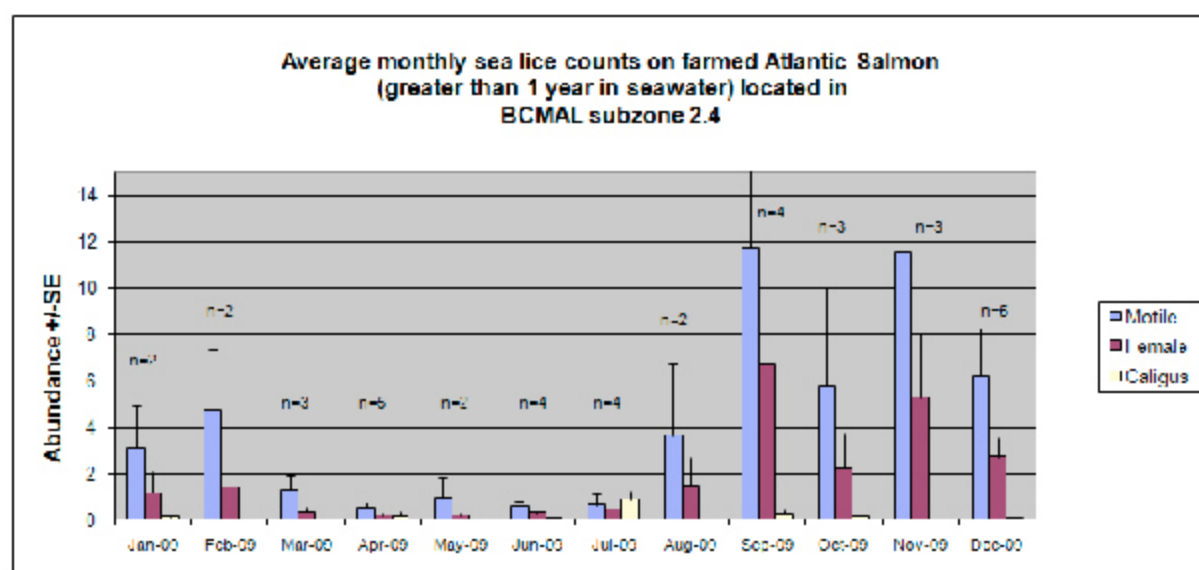
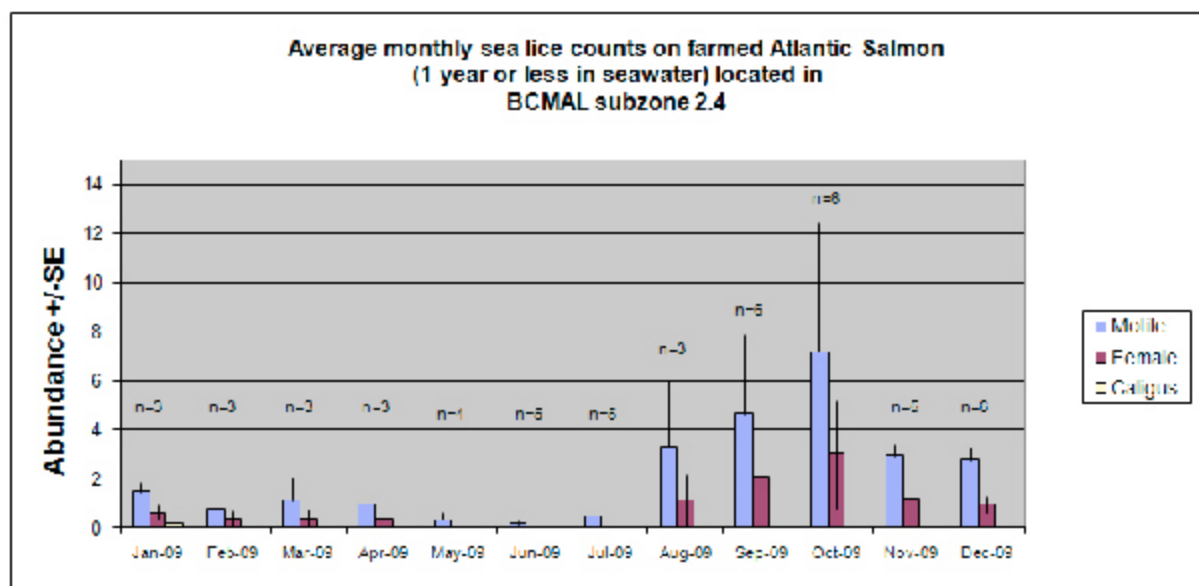
- ~Site is fallow
- ~Site is harvesting and < 3 pens left on site
- ~Smolt entry and < 3 pens on site, or <1 month since third smolt pen entered
- ~Fish being treated for sea lice
- ~Fish being treated / managed for other fish health concerns
- ~Fish could not be handled due to environmental concerns,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

**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 2009.



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 2009 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 2009.



**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<sup>1</sup> as submitted to BCMAL by the BC Salmon Farmers Association (BCSFA) in 2009.

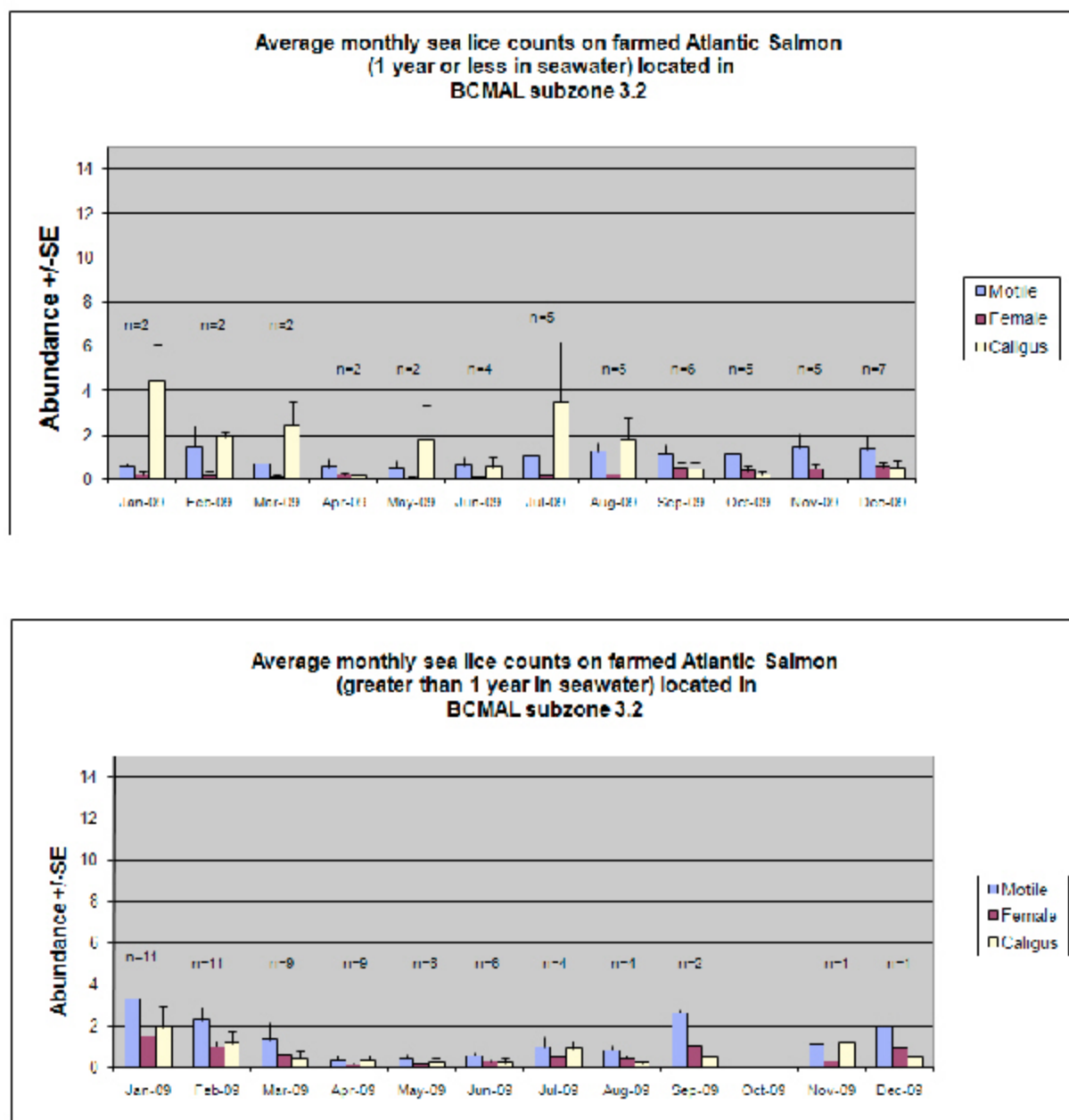
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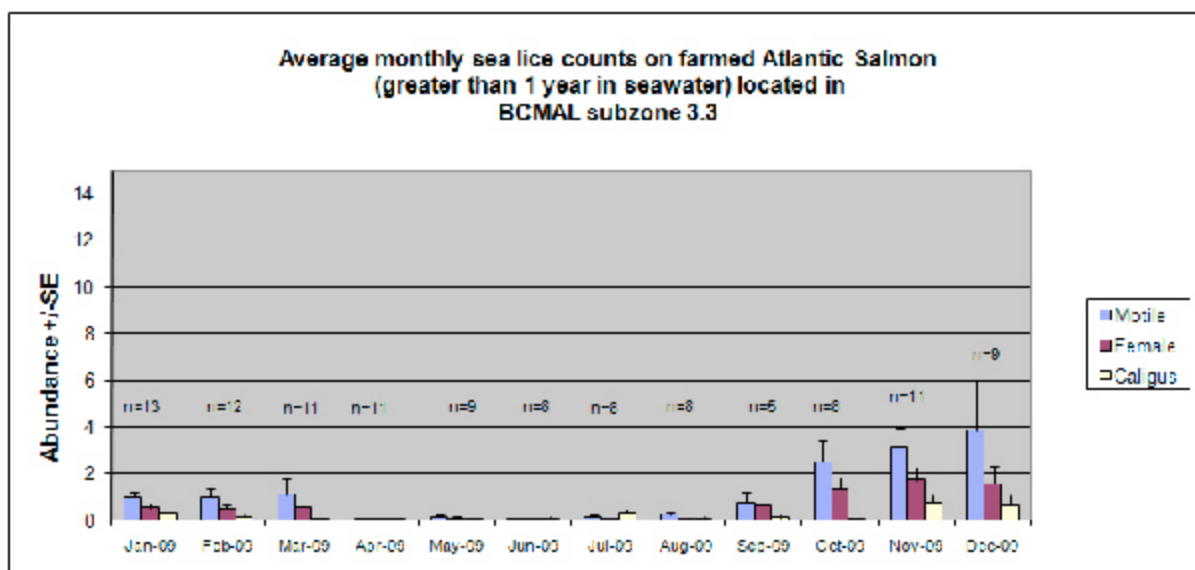
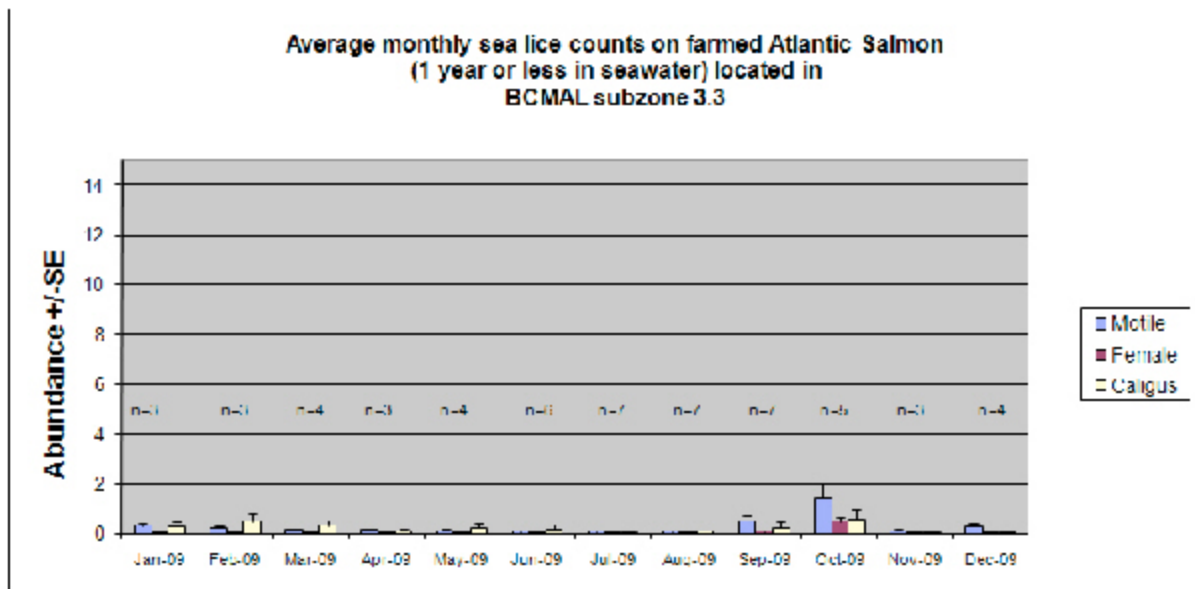
<sup>1</sup> Sea lice abundance on salmon raised within sub-zone 3.1 has been so low since monitoring began (2003) that the handling of these fish was deemed more harmful than useful. Consequently, this area was granted an exemption from routine sea lice counts until further notice, yet opportune counts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



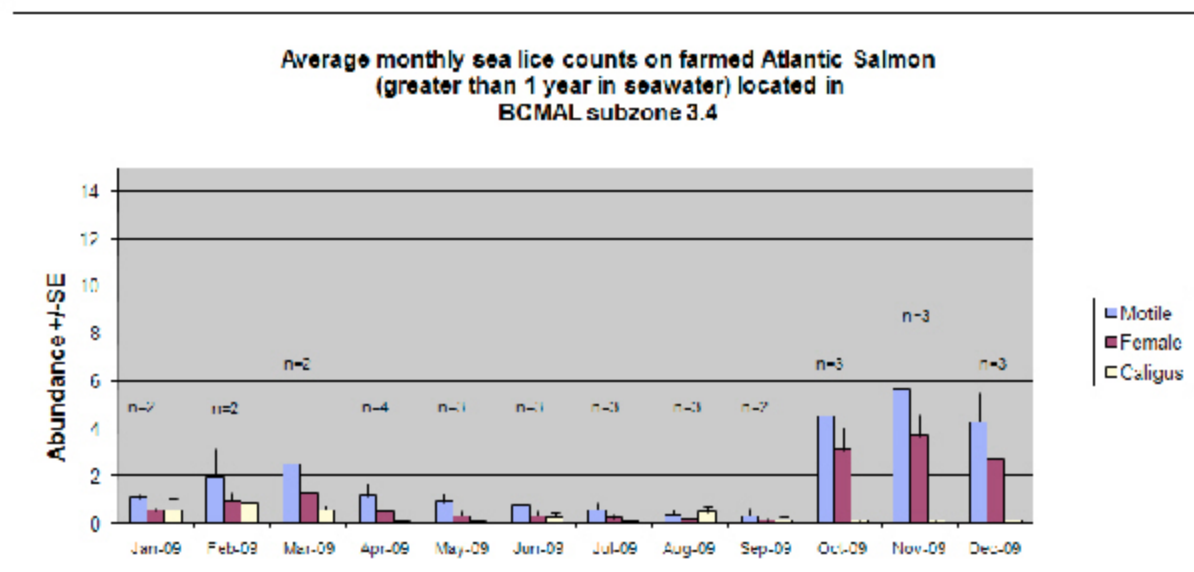
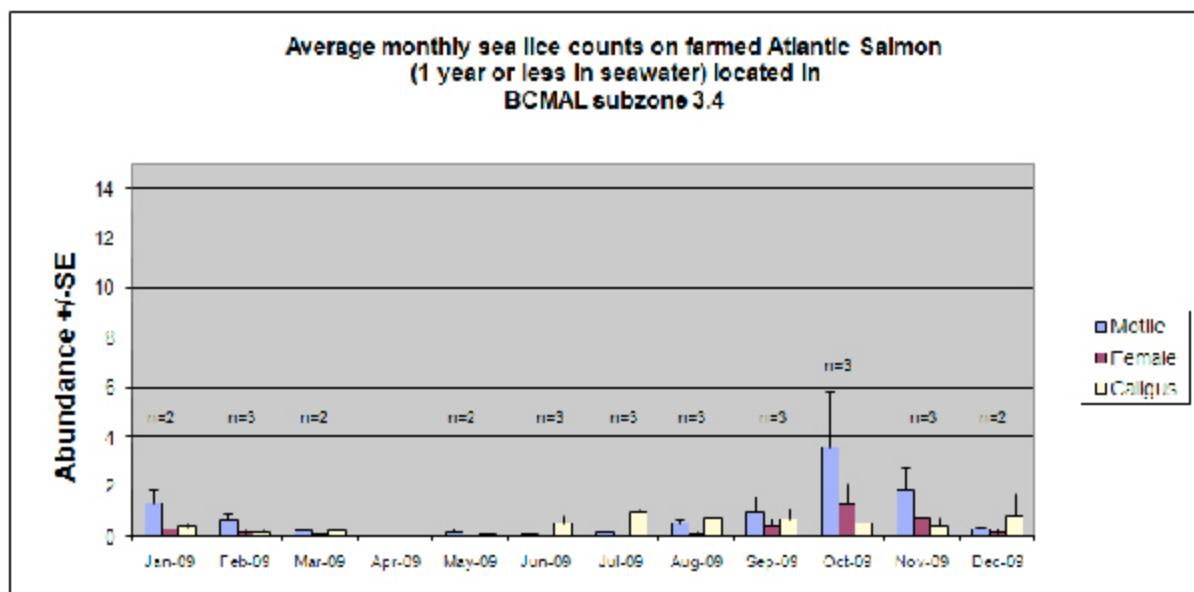
**Figure 7.11.4** Monthly mean abundance of motile and female *Lepeophtheirus salmonis*, and motile *C. clemensi* on Farmed Atlantic Salmon in sub-zone 3.2 as submitted to BCMAL by the BC Salmon Farmers Association (BCSFA) in 2009.



**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 2009.



**Figure 7.11.6** Monthly mean abundance of motile and female *Lepeophtheirus salmonis*, and motile *C. clemensi* on Farmed Atlantic Salmon in sub-zone 3.4<sup>2</sup> as submitted to BCMAL by the BC Salmon Farmers Association (BCSFA) in 2009.



**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 2009.

