Fish Health Program | 2006

BRITISH COLUMBIA
The Best Place on Earth

Ministry of Agriculture and Lands

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Section 1 Overview

1.1 Executive Summary

The Province of British Columbia has a comprehensive health management program for salmon aquaculture. The program includes a requirement for on-farm health management plans, mandatory monitoring and reporting of disease events and a British Columbia Ministry of Agriculture and Lands (BCMAL) audit of industry reported information.

In 2006 the BC Ministry of Agriculture and Lands (BCMAL) completed 108 salmon farm audits and collected diagnostic samples for disease analysis from 644 fish. Expected background mortality reported from BC salmon farms ranges from 2 to 6%. All farms categorize these mortalities by cause, giving reasons for the losses. A small portion of the routine fish death has no obvious cause of mortality (i.e. "fresh silvers / silvers"). This group of carcasses generally represents less than 1% of the total dead. It is this group of dead fish which is sampled and tested by BCMAL specifically for infectious disease.

The audit of aquaculture sites has identified only diseases that have already been reported in wild, hatchery-reared, or research salmonids of British Columbia. With regard to Atlantic salmon farms, 78% of the silver carcasses sampled from audited farms were free from infectious disease; of the remaining dead fish examined, the main disease diagnoses were: myxobacteriosis (9%) and bacterial kidney disease (9%). From Pacific salmon farms, 57% of the dead fish examined were free from infectious disease, and the main disease diagnoses were: bacterial kidney disease (18%) and Rickettsiosis (14%).

Audits of sea lice abundance were also conducted at Atlantic farm sites. In 2006, BCMAL conducted lice counts at 47 farms and assessed 2,764 live fish. Lice density triggers, for monitoring and managing sea lice, were introduced and implemented in 2004 after examining the data available in the published literature and from government sources in other jurisdictions. Although BC's Atlantic salmon have shown no outward signs of disease or ill health from sea lice, trigger levels were viewed as rational and precautionary based on the existing science at that time. The aquaculture industry continues to comply with the requirements of this management strategy.

The Ministry's Fish Health Program provides regulators with a comprehensive understanding of the health status of fish stocks on salmon farms. The program supports the monitoring, reporting and regulation of fish disease, and it addresses any health concerns that may arise in farmed fish of British Columbia. The annual report is just that, a reflection of 2006 information. It is not intended to be a year-to-year comparative exercise.

The reference document forming the base and background of this 2006 report is the 2003-2005 Fish Health Report released by BCMAL in December 2006. It can be viewed at http://www.al.gov.bc.ca/ahc/fish_health/FISH_HEALTH_03-05.pdf

1.2 Mandate

In response to the 1997 Environmental Assessment Review of Aquaculture, the government of British Columbia developed a comprehensive policy designed to improve monitoring and regulation of fish disease in the aquaculture industry. The intent of the fish health program is to ensure a standardized approach to the management of disease of fish cultured at private and public facilities in British Columbia.

In 1999, BCMAL accepted the recommendations, developed a new Salmon Aquaculture Policy and committed to addressing concerns through the staged implementation of a new regulatory and management framework with the major objective to improve fish health. Implementation of the program began in 2001 and for the last six years it has served to better regulate the finfish aquaculture sector.

1.3 Objectives

Ensuring a comprehensive approach to aquaculture health management is a key objective of the Provincial Fish Health Program. The cornerstone of the Provincial Fish Health program is the Fish Health Management Plan (FHMP). These plans encompass all aspects of farming that can affect the health of the animals being farmed. Since 2003, all private companies and public fish culture facilities are required to develop and maintain a current FHMP specific to their rearing unit. For private companies and the provincially licensed public facilities, the FHMP is enforceable as a Term & Condition of an aquaculture licence.

Another objective of the Fish Health Program is to ensure access to accurate and verifiable data on the disease status of cultured fish stocks. For salmon aquaculture, all facilities in freshwater and saltwater are required to report site-specific information to an industry database monthly; companies must report all mortality, causes of mortality and fish health / disease events (FHE's)[1]. In addition, quarterly reports of the health status are submitted to government and posted for public viewing on the Animal Health Centre – Fish Health website. Health monitoring and reporting of disease status is a requirement under the FHMP and compliance monitoring is built-in to the system.

This 2006 report provides a detailed synopsis of the annual findings from the Fish Health Audit and Surveillance Program in addition to the 2006 data submitted to government by industry. The annual report is just that, a reflection of 2006 information. It is not intended to be a year-to-year comparative exercise.

[1] Fish Health Event (FHE) is defined as a disease occurrence on a farm which requires veterinary intervention.

2 Section 2 Fish Health Management Plans

2.1 Fish Health Management Plans

The objective of a Fish Health Management Plan (FHMP) is to outline the best possible health conditions for cultured fish in British Columbia. All operators of fish culture facilities must develop and maintain a current FHMP specific to their rearing unit. The plans are written at the company level and the practices are applied at the site or fish group level. The FHMP is enforced as a condition of an aquaculture license.

2.1.1 Review and Approval of FHMP

Three documents comprise a FHMP: The *Required Elements* document provides the guiding principles for the FHMP process; the *Template for Writing a Facility Specific Fish Health Management Plan*, details what is required of operators and lists required Standard Operating Procedures (SOPs) for management of farm activities affecting fish health; and the *Manual of Fish Health Practices* is used by government regulators as a standards document against which the industry SOPs are assessed.

2.1.2 Monitoring and Compliance of FHMP

Fish Health Management Plans continue to be a condition of license. By the end of 2004, all major private facilities excluding three small producers were in compliance with approved FHMPs. At that time, that represented 99% of the fish biomass produced and 82 % compliance with the FHMP requirement. In 2005, all but two facilities had approved FHMPs (88% compliance rate) and in 2006, all salmonid producers with fish on private marine sites conduct activities based on approved FHMPs (100% compliance).

With respect to provincial ‘public’ enhancement facilities, in 2004 all public facilities (Freshwater Fisheries Society of BC) had initiated operational FHMPs. In 2006, 15 key federal enhancement facilities (Fisheries and Oceans Canada; DFO) report their Fish Health Events to the BC Salmon Farmers’ database, and 4 of those 15 fish-rearing units have operational FHMPs that continue to undergo revision and review.

Private aquaculture FHMPs are reviewed annually by the Animal Health Branch of BCMAL. Letters are sent to all FHMP holders requesting that they submit all revisions, if any, made to their FHMP within the previous year. BCMAL also conducts an annual review of the Template and Manual each January. Changes to the Template are posted to the website for industry to follow. Changes to the Manual are posted on the website and reflect any changes to the fish health standards set by government against which industry practices are compared. In addition, annual renewal of aquaculture licenses, amendments or issuance of a new license triggers a review of the FHMP by a government Fish Health Veterinarian. If, at the time of the review changes are required, a letter of notification is sent to the company indicating these changes.

2.2 Industry Monitoring and Reporting

The Fish Health Management Plan dictates that all salmon farming companies operating in British Columbia must monitor their fish and report to the industry database monthly the status of fish health at their farms. These monitoring results are aggregated within fish health zones and reported to BCMAL on a quarterly basis. The reports are standardized and include: total mortality and infectious and non-infectious causes of that mortality for all farms. The list of various causes of mortality are included in Appendix 7.1. In addition, private sector veterinarians report Fish Health Events (FHE) when their intervention is required. FHEs account for the diseases that occur on farms on a quarterly basis. To enhance public confidence and to validate industry information, BCMAL audits the farm sites sampling specifically for endemic diseases.

2.2.1 Verification and Compliance of Industry Database Reports

There are two types of reports provided to BCMAL from the British Columbia salmon farmers' database ("industry database"); quarterly Fish Health reports, and monthly Sea Lice reports.

All reporting is a condition of license under the Fish Health Management Plan. Monitoring compliance of the companies reporting to the database is built into the reporting process. The industry database is operated by a third party professional computer company and verified by an independent contract veterinarian. All industry fish health reports to the industry database are due on the 10th of the month following each calendar quarter (Example: Quarter 1 January to March is due April 10). All sea lice data are required on the 10th day of the month following the sampling (Example: January data is due February 10th). If a company does not comply with the reporting requirements, they are granted 10 days to communicate. If by the 20th of the month a company is not compliant the industry database manager will provide details of the non-compliance in a report to the Ministry and mitigative actions can be taken. Depending on the nature and reason for non-compliance, actions will vary from a letter reminding companies of the legal obligations, outlining specific actions to be taken such as addition of equipment and staff to enforcement action if required.

Further verification of the industry-reported information is completed by Ministry staff through on-farm site audit and records review. During these site visits samples of fish are collected and tested for specified diseases or monitored for sea lice abundance. This provides an opportunity for the Ministry to ensure that farm staff are collecting and compiling the information and classifying mortalities and causes of mortality as per the established protocols. On site reports can be generated by companies to verify that the site has entered the required data for that quarter.

3 Section 3 Fish Health Auditing and Surveillance

3.1 Fish Health Auditing and Surveillance Program

The Fish Health Auditing and Surveillance component of the Fish Health Program is comprised of: 1) fish health bio-technicians monitor activities and review health related records at marine salmon net pens as outlined in Fish Health Management Plans; 2) fish health bio-technicians collect samples from farmed fish for active surveillance for bacteria, viruses and parasites and determination of farm-level disease events; and 3) audit results are compared to reports generated through the BC Salmon Farmers Database. The fish health auditing and surveillance program audits industry activities and monitors for endemic and emerging pathogens of concern.

3.2 Methodology

3.2.1 Zonation

British Columbia coastal waters have been divided into fish health zones and sub-zones based on Fisheries and Oceans watersheds for salmonid transfers. Zone 2 represents Vancouver Island. Zone 3 is the inside passage from the Fraser River North to the North Coast. These two major zones are broken down into sub-zones.

Atlantic salmon farm reports are summarized by zone and sub zone; Pacific salmon farms are reported by zone only because of the small number of Pacific salmon farms. Table 1 summarizes the fish health zones and a map of the fish zones may be found in Appendix 7.2.

Table 1: Fish Health Zones and Sub-zones in British Columbia

Zone	Sub-zone	Geographical Description
Atlantic Salmon Reporting Sub-zones		
2	2.3	West Coast of Vancouver Island, Southern Area
2	2.4	West Coast of Vancouver Island, Northern Area
3	3.1	South East Coast Vancouver Island + Sunshine Coast
3	3.2	Inside Passage - Campbell River
3	3.3	Broughton Area
3	3.4	Port Hardy
3	3.5	Central Coast
Pacific Salmon Reporting Zones		
2		Vancouver Island
3		East of Vancouver Island

3.2.2 Sampling Methodology

BCMAL applies a multistage sampling system within designated fish health zones. All farms within a zone are assigned a random number (primary unit) and the computer selection of the farms within a zone for sampling is weighted based on the species and the number of farms in that zone as a percentage of the total number of farms in the province. In other words, if an area has 30% of the farms then 30% of the farms selected for audit would be randomly chosen from that area. This ensures equal probability of each farm being selected for sampling. The farms are widely dispersed in remote areas of the coastline so for reasons of practicality and resource allocation the maximum sample size is 30 farms per quarter. The aim is to achieve 120 site audits each year which ensures at least all sites have equal opportunity to be sampled within a year.

There are approximately 135 tenures and between 60 and 80 operating sites annually; however, for audit the purposes, the total number of "active farms"[2] varies. In 2006, the number of active sites available for audit each quarter ranged from 52 to 60 (mean = 57) (See Table 2 for summary and Appendix 7.3 for detailed active site results). Thus the audit of 30 farms each quarter means that between 50 to 58% of the farms were audited quarterly for fish health alone.

Site selection for sea lice audit is conducted separately and an additional 25% to 50% of active Atlantic salmon sites are audited each quarter (See Section 4.0).

3.2.3 Site Selection

At the beginning of each calendar quarter a list of all licensed sites is reviewed by the fish health bio-technicians in discussion with industry to determine which sites during that quarter are "active". From the list of active sites a computer generated random selection of sites is chosen for audit. Site audits are conducted in conjunction with the weekly dive schedule to allow for access to the fish carcasses; this approach of "targeted disease sampling" increases the likelihood of finding disease, if present. The total number of sites chosen for audit is 30 out of a total of approximately 60 to 80 operating sites each quarter (see Table 3 and Figure 1).

Occasionally, site audits are cancelled due to weather conditions, over-riding health issues such as plankton blooms or other unforeseen events. Whenever possible these site audits are rescheduled, however, there are times when it is not possible to complete all 30 site audits during a calendar quarter.

3.2.4 Sampling and Sample Selection

Fish sampling for audit purposes occurs during routine carcass collection dives conducted by industry. Carcasses are categorised in accordance with industry health experts (see Appendix 7.1 for definitions). A selection of the "fresh or fresh silver" carcasses[3] are sampled for routine

[2] Active farms are those farms which are determined to have a minimum of 3 pens of fish on site during the quarter which sampling is to occur. This does not include broodstock.
[3] Fresh or fresh silver means that the sample has bright red or pink gills and/or no visual signs of tissue autolysis.

histopathology, bacteriology, and virology. As the intent of the program is to establish the occurrence of endemic disease on farms and use the information to compare to the industry reported health information, carcass sampling enhances the likelihood of detecting disease.

The sample population is the diagnostically valuable "fresh silver" carcasses. These fish represent the population that is "dead from unknown cause". This inherent bias increases the likelihood of detection of emerging disease should it occur. On average 7 to 10 fish per farm are collected to a maximum of 30 (secondary unit). Sampling is aimed at achieving a 95% confidence of detection of 2% disease prevalence. As sampling is limited by the availability of fresh fish, the total number of carcasses sampled varies at each site visit. The number of fish sampled in 2006 was 644. For the quarterly breakdown of samples see Table 4.

3.2.5 Diagnostic Testing

Samples are sent to the BCMAL Animal Health Centre (AHC) in Abbotsford for evaluation. The Animal Health Centre is an AAVLD (American Association of Veterinary Laboratory Diagnosticians) accredited diagnostic laboratory; the use of an accredited laboratory provides confidence in the diagnostic results due to high standards of quality assurance and quality control.

Samples are collected for bacteriology, virology, molecular diagnostics, and histopathology. For bacteriology, kidney tissue from each individual fish examined is streaked onto Trypticase Soya Agar and Blood agar plates. Biochemical analyses and/ or gene sequencing are used to identify bacterial agents.

Tissues for virology from each individual carcass include anterior kidney, posterior kidney, liver, spleen, gill and pyloric cecae. Additional samples of tissues with lesions or otherwise required to aid in diagnosis are selected as required. Samples are pooled to a maximum of five fish per sample and screened using conventional Polymerase Chain Reaction (PCR) technique for the following pathogens of concern:

- Infectious Hematopoietic Necrosis Virus (IHNv)
- Infectious Pancreatic Necrosis Virus (IPNv)
- Infectious Salmon Anaemia (ISAv)
- Viral Hemorrhagic Septicaemia (VHSv North American strain)
- *Piscirickettsia salmonis*

If PCR findings are positive or a viral septicaemia is suspected, the samples are cultured on appropriate cell lines or other diagnostic gold standard test method for confirmation. Standard cell lines include CHSE 214, EPC, RTG, and FHM.

All tissues samples for microscopic evaluation are examined for lesions and, if possible, to determine the cause of the mortality. The Fish Pathologist is an ACVP (American College of Veterinary Pathologists) board-certified veterinary pathologist. Histopathology allows for detailed review of the cause of mortality on an individual fish basis.

3.2.6 Other Components of Audits

3.2.6.1 Record Assessment

During site audits ministry fish health personnel assess farm records for mortality and categories, records of treatments (if any) and reasons for treatment.

3.2.6.2 Audit of Fish Health Related Activities

The site visits also allow assessment of the frequency of the mortality collections, and biosecurity protocols during mortality handling. In 2007, the fish health program is enhanced to include a checklist to better evaluate the on-site activities and compliance with government's evaluation of the Fish Health Management Plan.

3.3 Results

3.3.1 Number of Active Farms

A summary of the number of active farms during each year is provided in Table 2 (detailed summary by calendar quarter in Appendix 7.3). The definition of an active site used in the auditing program varies for a fish health audit versus a sea lice audit. For fish health sampling, a site is considered "active" if stock is present greater than 30 days post-entry of the first pen on site. If a site contains harvest sized fish, fish must be present on site before the last month of the quarter for the site to be considered active. For sea lice evaluation, sampling is conducted if the fish have been stocked at the site for greater than 120 days post-entry of the first fish pen. For harvest fish there must be a minimum of 3 full net pens on site to allow for statistically significant sample. The calculation of an average often results in a non-integer so the calculated numbers have been rounded up or down accordingly.

Table 2. Average Number of Active Salmon Farm Sites 2006

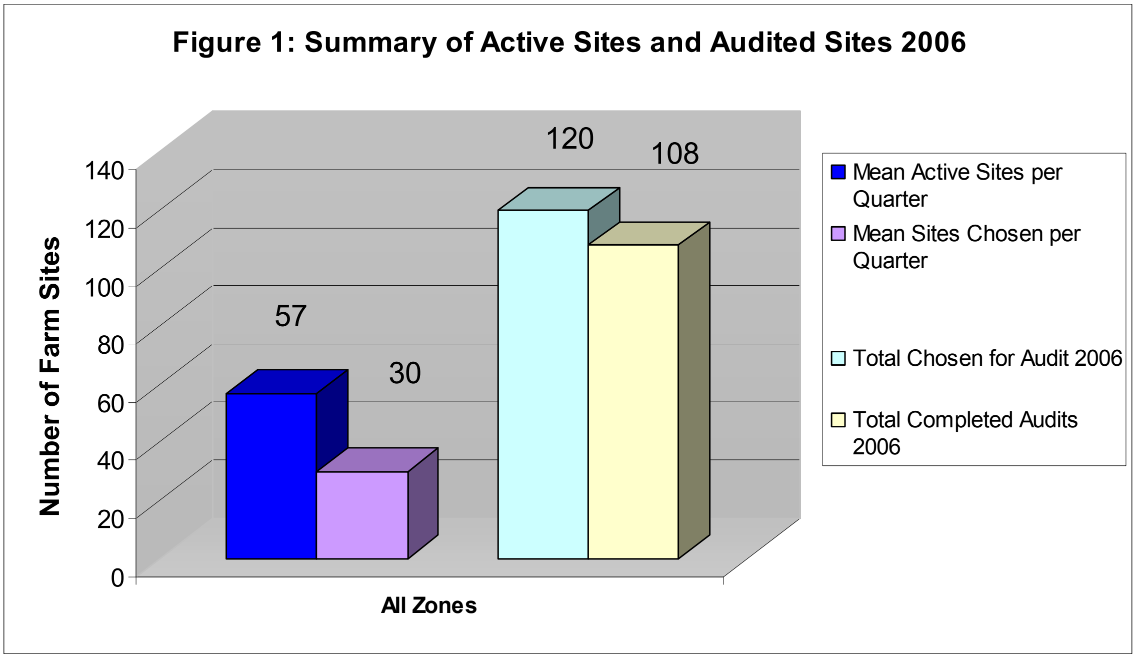
Atlantic Salmon	**2006**
Zone 2.3 SW Vancouver Island	7.5 = 8
Zone 2.4 NW Vancouver Island	6.25 = 6
Zone 3.1 Sunshine Coast	2.5 = 3
Zone 3.2 Campbell River	8.5 = 9
Zone 3.3 Broughton	11
Zone 3.4 Port Hardy	6.5 = 7
Zone 3.5 Central Coast	3.5 = 4
Pacific Salmon	
Zone 2 Vancouver Island	3.5 = 4
Zone 3 East of Vancouver Island	7.75 = 8

NB: BCSFA considers farms with any fish inventory to be a production unit so BCSFA's list of farm sites will almost always show higher numbers of sites than BCMAL's lis of 'active for audit' farms. Broodstock populations are not assessed by BCMAL.

Table 3: Number of Salmon Farms Chosen for Audit (and Site Visit Completed) During Each Quarter of 2006

Location	Jan – March	April - June	July - Sept	Oct - Dec	2006 Totals
Sub-zone 2.3 SW Vancouver Island	5	5	2	4	16
Sub-zone 2.4 NW Vancouver Island	3	3	4	3	13
Sub-zone 3.1 Sunshine Coast	2	1	1 (0)	1	5 (4)
Sub-zone 3.2 Campbell River	4	4	5	5	18
Sub-zone 3.3 Broughton	7	6	5 (3)	6	24 (22)
Sub-zone 3.4 Port Hardy	2 (1)	3	5 (4)	3 (0)	13 (8)
Sub-zone 3.5 Central Coast	2	2	2	2 (0)	8 (6)
Atlantic Sub Total	**25 (24)**	**24**	**24 (20)**	**24 (19)**	**97 (87)**
Zone 2 Vancouver Island	2 (1)	1	2	2	7 (6)
Zone 3 East of Vancouver Island	4 (3)	5	4 (3)	4	17 (15)
Pacific Sub Total	**6 (4)**	**6**	**6 (5)**	**6**	**24 (21)**
Grand Total	**31 (28)**	**30**	**30 (25)**	**30 (25)**	**121 (108)**

NB: When only one number is present in the square, the number of sites chosen for audit and number of sites actually visited are equal. Where a lower number is shown in brackets it reflects the actual number of sites visited (i.e. due to adverse weather or the site had been harvested, etc.). The Grand Total of 31 sites (instead of 30) selected in Q1 is explained by the fact that one farm was selected twice by the computer to audit both the Atlantic salmon and the Pacific salmon raised on that farm, so this one site represents two separate audits.



3.3.2 Number of Fish Sampled

Dozens of fish may be examined during a site audit but only those that are suitably "fresh" are chosen for further diagnostic evaluation. A maximum of thirty fish are selected across all pens for diagnostic tissue collection. The number actually sampled will depend on the mortality rate at the site which in turn depends on the size and age of fish, time of year and if there had been a recent health event.

In some instances (5.6% of site visits) there are no fish available or suitable for sampling; when this occurs all other aspects of the audit are conducted including assessment of mortality records and dive procedures. In 2006, 108 site audits were conducted and fish samples were collected on 102 of those site audits. The detailed breakdown of samples collected by zone, sub-zone and quarter is provided in Table 4.

Table 4 : Number of Fish Sampled During Each Quarter of 2006

Location	Jan - March	April - June	July - Sept	Oct - Dec	2006 Totals
Sub-zone 2.3 SW Vancouver Island	24	23	10	27	84
Sub-zone 2.4 NW Vancouver Island	18	15	28	22	83
Sub-zone 3.1 Sunshine Coast	1	4	0	0	5
Sub-zone 3.2 Campbell River	23	27	36	58	144
Sub-zone 3.3 Broughton	38	25	11	47	121
Sub-zone 3.4 Port Hardy	6	11	30	0	47
Sub-zone 3.5 Central Coast	5	11	10	0	26
Atlantic Sub Total	**115**	**116**	**125**	**154**	**510**
Zone 2 Vancouver Island	4	3	7	29	43
Zone 3 East of Vancouver Island	16	26	9	40	91
Pacific Sub Total	**20**	**29**	**16**	**69**	**134**
Grand Total	**135**	**145**	**141**	**223**	**644**

3.3.3 Bacteriology

Table 5 contains information on all bacteriology findings from the BCMAL audit program in 2006. The data represents the findings from the fish examined on audited farms within each coastal zone and sub-zone. The data reflects only those organisms that can readily cause disease in fish (pathogens).

In the majority of fish carcasses sampled (97.7%) no bacterial pathogens (disease-causing organisms) were isolated and cultured. In 2006, a total of 644 fish were sampled for the presence of bacterial agents yet only 2.3% (15 fish) revealed a salmonid pathogen. Bacteria were also isolated and cultured from twenty two (22) additional carcasses however these bacteria are considered opportunistic environmental bacteria and inconsequential to fish production or fish health events.

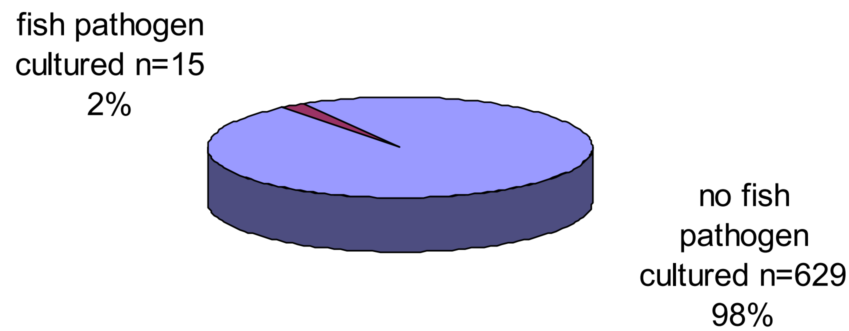
Bacteria samples are cultured on two types of agar and all colonies are identified by either standard biochemical techniques or by gene sequencing. The detailed summary of bacteriology results by zone, sub-zone, quarter and annual summary are provided in Appendix 7.4; this includes the names of the pathogenic and non-pathogenic agents that have been cultured.

Table 5: 2006 Total farms and numbers of fish carcasses sampled, and number of fish with positive cultures (by quarter)

	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Annual
# farms sampled *	27	28	23	24	**102**
# fish sampled	135	145	141	223	**644**
# fish with a pathogen cultured	5	1	1	8	**15**

* During some farm audit visits there are no fish carcasses available or suitable for diagnostic sampling; in 2006, although 108 site audits were conducted, fish samples were collected from only 102 of those site audits.

Figure 2: 2006 Summary Bacteriology Culture Results
644 Fish Sampled



3.3.4 Virology / Molecular Diagnostics

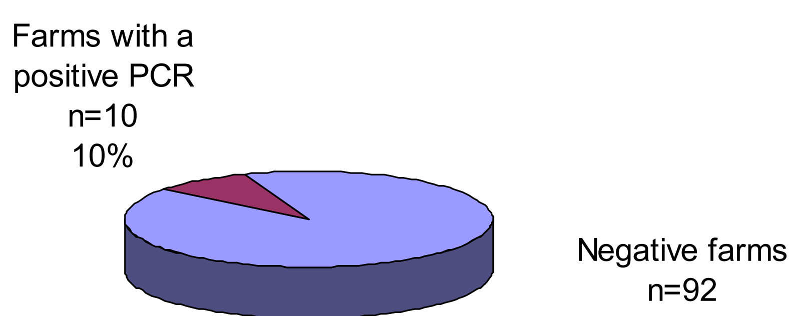
Molecular diagnostics analysis (the analysis of samples for the genetic material of known micro-organisms) is completed on all tissue samples collected for a specific list of known fish pathogens that are endemic (naturally occurring) or exotic to British Columbia. This includes Infectious Hematopoietic Necrosis virus (IHNv), Infectious Pancreatic Necrosis virus (IPNv), Viral Hemorrhagic Septicaemia virus (VHSv, North American Strain genotype IVa), Infectious Salmon Anaemia virus (ISAv) and *Piscirickettsia salmonis*.

In 2006, a total of 644 carcasses provided tissue samples for examination using molecular diagnostic techniques (polymerase chain reaction, PCR). The majority of fish showed no signs of disease and were unaffected by any fish pathogen. Samples were collected from individual fish but sub-samples of each group were pooled for testing. Any molecular "test positive" results in further evaluation by tissue culture to determine if viable virus is present. As fish samples are pooled, results are summarized at the farm level rather than individual fish level. A summary of the annual findings of molecular diagnostics is provided in Table 6 and Figure 3. Complete results of all testing completed in each zone/sub-zone, by quarter and annually are provided in Appendix 7.5. Of the total 102 sites sampled* in 2006, 10 farms had a positive PCR test result from pooled groups of fish carcasses; hence 90% of sites sampled showed neither detectable viral agents nor *Piscirickettsia*.

Table 6: 2006 Total farms and numbers of fish carcasses sampled, and number of farms with a positive PCR result (per quarter).

	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Annual
# farms sampled *	27	28	23	24	**102**
# fish sampled	135	145	141	223	**644**
# farms with a positive PCR	3	0	2	5	**10**

Figure 3: 2006 Summary of Molecular Diagnostics Findings
102 Farms Sampled



* During some farm audit visits there are no fish carcasses available or suitable for diagnostic sampling; in 2006, although 108 site audits were conducted, fish samples were collected from only 102 of those site audits.

3.3.5 Histopathology

Tissue samples (anterior and posterior kidney, liver, spleen and heart and occasionally gill) are collected for microscopic examination by an ACVP board-certified veterinary pathologist. Additional tissues samples may also be taken if there are any lesions or suspect disease causing agents present. Histopathology results are used in combination with all other information collected to make a farm-level diagnosis.

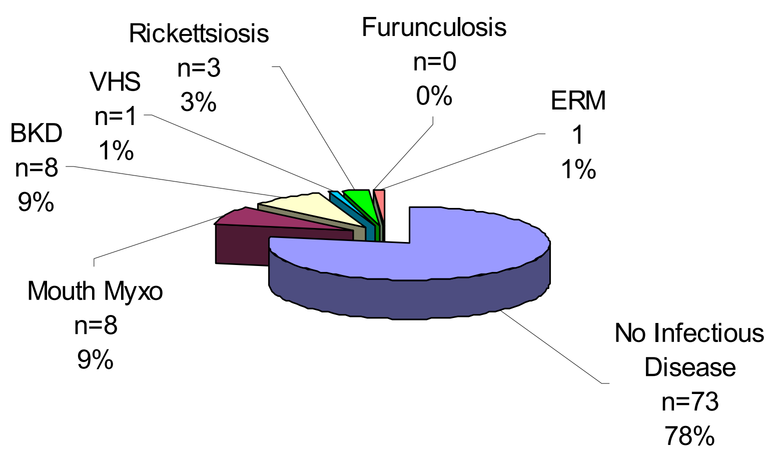
3.3.6 Disease Diagnosis through Audits

Farm-level diagnosis of disease is made on the basis of a review by fish health veterinarians of all the information collected and recorded during the individual audit. This information includes the mortality levels on the farm on the day of the audit, treatments that have occurred and results of audit diagnostic testing. It is important to understand that the presence of a pathogen in an individual fish does not directly translate as a clinical disease event in a population. To ensure accurate interpretation of the information gathered, diagnoses must be made by veterinarians experienced in the management of fish health and disease. Thus the results reported below represent the final audit diagnosis of disease at the farm-level which is based on the information collected and results of testing from an audit. There may be cases where micro-organisms have been isolated or identified in the laboratory, however this does not necessarily correspond to a farm-level diagnosis of disease attributable to that particular microscopic agent. As well, there can be more than one diagnosis per farm audit so the number of disease cases is not necessarily equivalent to the number of audits.

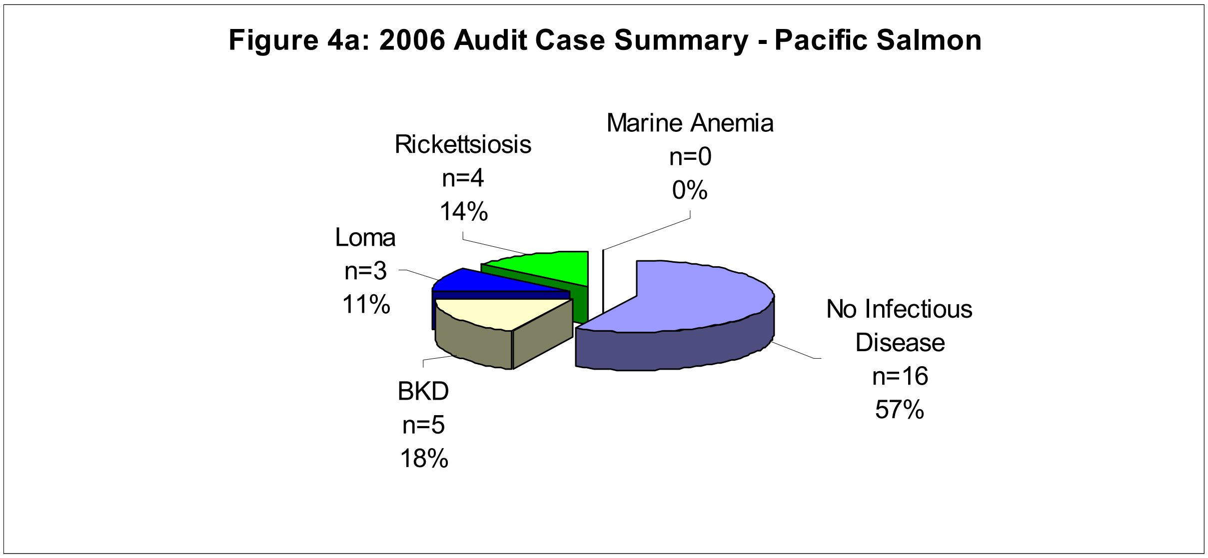
Table 7 and Figures 4 and 4a summarize the farm-level diagnoses of disease based on all audits reported here annually. Disease Case definitions are provided in Appendix 7.6.

Table 7: 2006 Summary of 122 Diagnoses from 102 Audit Samples	
Atlantic Salmon	**Number of Diagnostic Cases = 94**
No Infectious Disease (NID) *	73
Mouth Myxobacteriosis	8
Bacterial Kidney Disease	8
VHS (NAS)	1
Rickettsiosis	3
Furunculosis	0
Enteric Red Mouth	1
Net Pen Liver Disease (NID)	(2)
Peritonitis (NID)	(2)
Environmental (NID)	(2)
Pacific Salmon	**Number of Diagnostic Cases = 28**
No Infectious Disease (NID)	16
Bacterial Kidney Disease	5
Loma	3
Rickettsiosis	4
Marine Anaemia	0
Enteritis (NID)	(3)
Environmental (NID)	(2)

Figure 4: 2006 Audit Case Summary - Atlantic Salmon

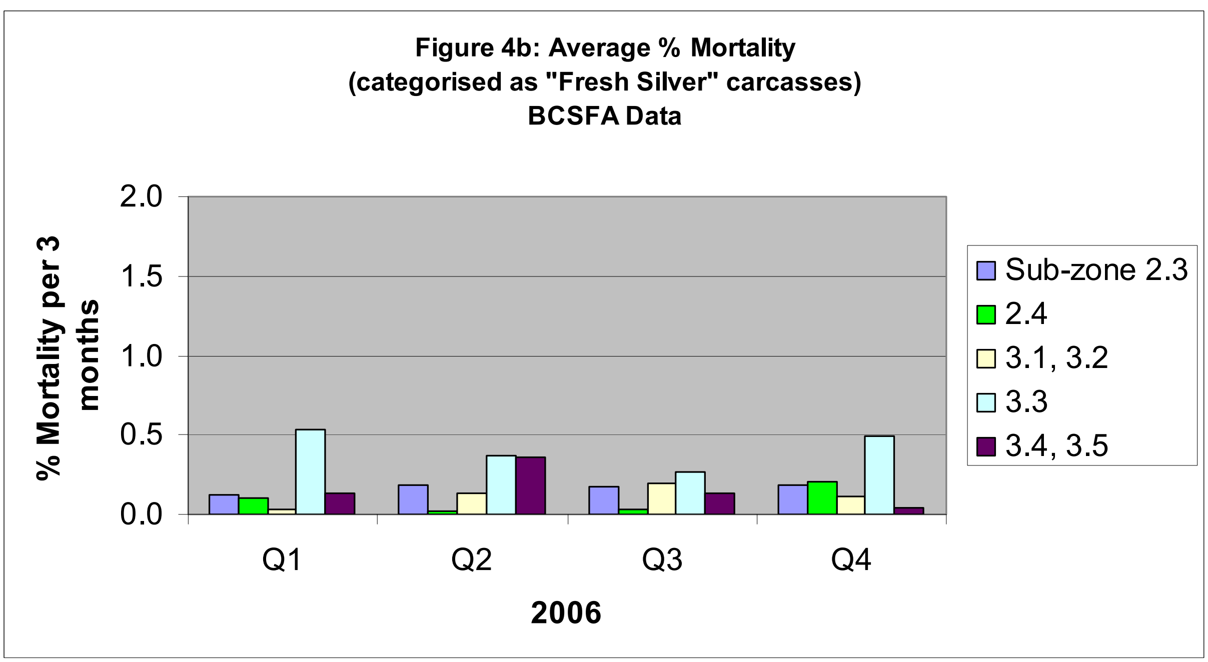


* No Infectious Disease (NID) includes the laboratory cases where no identifiable cause for mortality was diagnosed from the carcasses collected. It also includes the diseases caused by: environment, Net Pen Liver Disease, enteritis and post-vaccination peritonitis (numbers appear in brackets in Table 7); each of the latter diseases exhibit gross or microscopic lesions but the cause of death is not considered infectious.



3.3.7 Annual Summary of Diagnosis of Disease by Species and Sub-zone

The majority of farm sites have a very low level of naturally occurring diseases all of which have been previously identified from wild salmonids in coastal waters of British Columbia. These naturally occurring disease agents are easily controlled through husbandry or farm management techniques, treatment with therapeutants approved for fish, or in some instances are self- limiting events. Proper health management of stocks allows farms to maintain the low occurrence of disease yet, when disease does occur, it can be controlled quickly. The overall mortality in the aquaculture sector is very low; on average less than 1% of quarterly mortality (categorized as "fresh silvers"; those which we use for assessment) can be attributed to infectious disease agents (see Figure 4b; BCSFA data, Atlantic salmon). The same can be said for Pacific salmon fresh silvers, with the exception of a 1.4% loss overall in quarter three.



The following pages reflect the 'snapshot of the diseases' found on farms sampled for audit in 2006. When examining the data, bear in mind that the audit information does not represent the total number of cases of disease amongst industry sites, rather the proportion of the audit cases where disease was found. Hence:

$$\text{Proportion of Audit Diagnosis} = \frac{\text{Nos. of Cases of Diseases Diagnosed on Audit}}{\text{Total Number of Audits Conducted}}$$

Information on the total proportion of disease reported from industry sites is calculated from the BCSFA database and reported on a quarterly basis as Fish Health Events (FHE) documents on the MAL website. A comparison of the findings between the audit and industry FHE reports is provided in Section 3.4.

Occasionally the number of cases of disease can be greater than the number of farm audits; this indicates that farm visits identified multiple diagnoses from a single audit. For example, both VHSv and Mouth Myxobacteriosis may be diagnosed from one Atlantic salmon farm as a result of one site audit. A breakdown of diagnoses by year and zone / sub-zone is provided in Tables 8 - 16 and corresponding Figures 5 - 13 of sections 3.3.7.1 and 3.3.7.2 below. The detailed summary of this information broken down by calendar quarter is provided in Appendix 7.7.

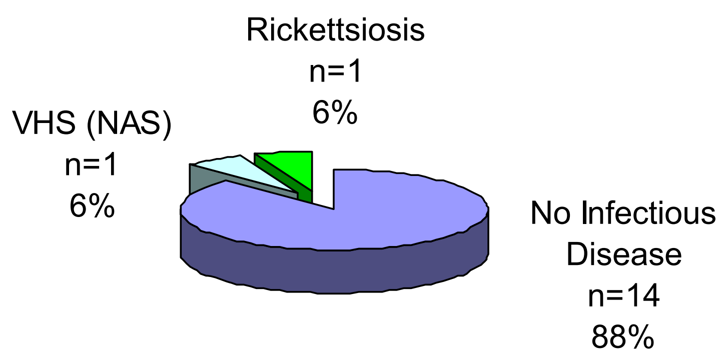
3.3.7.1 Atlantic Salmon

3.3.7.1.1 Sub-zone 2.3 South West Vancouver Island

Table 8. 2006 Diagnoses for sub-zone 2.3 (South West Vancouver Island) Atlantic Salmon Farms

Number of Farm Audits	Number of Cases[4]	Farm Level Diagnoses
16	14	No Infectious Disease
	1	VHS (North American strain genotype IVa)
	1	Rickettsiosis

Figure 5: South West Vancouver Island (Zone 2.3) 2006 Case Summary - Atlantic Salmon

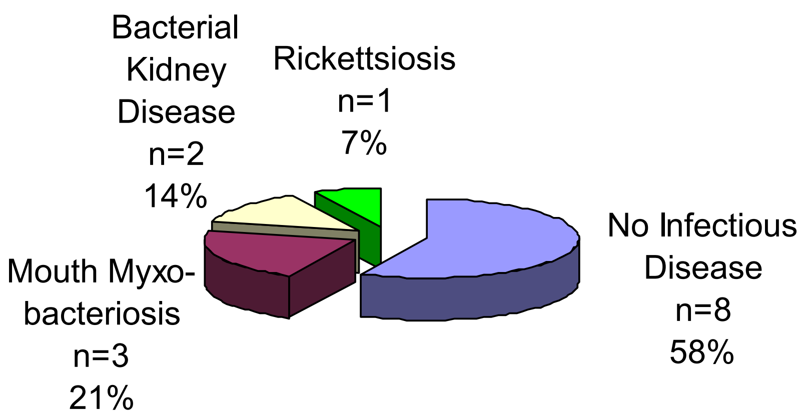


[4] Number of cases does not equal number of farm audits except when the diagnosis is 'No Infectious Disease'. More than one farm-level diagnosis can be made per site, thus the number of cases can exceed the number of farm sites audited.

3.3.7.1.2 Sub-zone 2.4 North West Vancouver Island

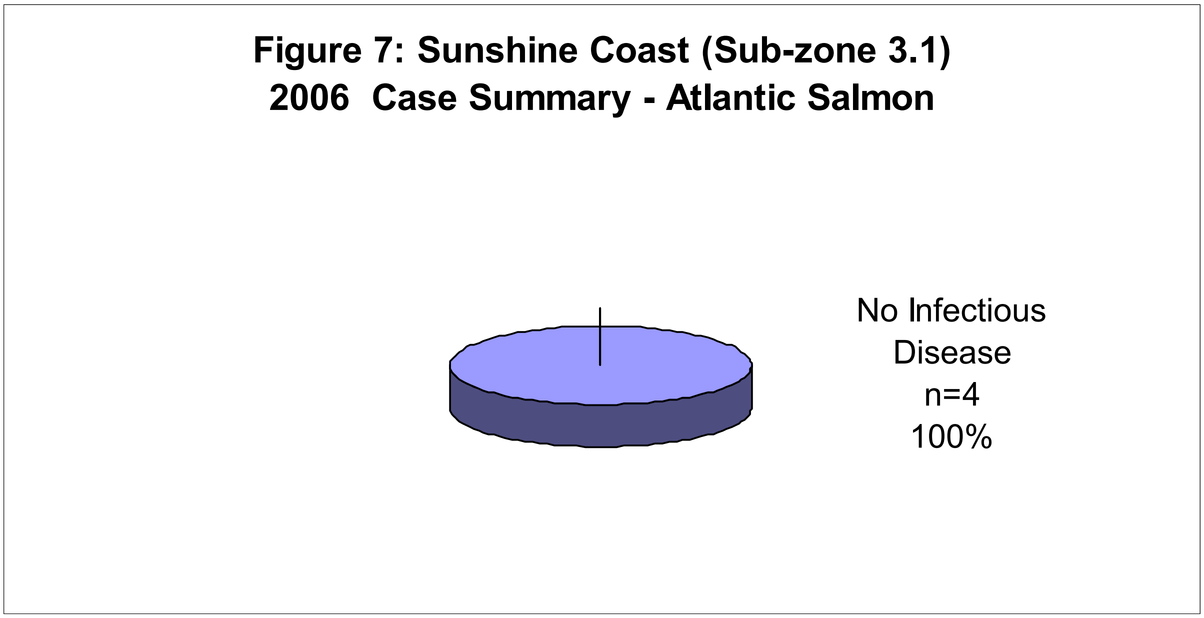
Table 9. 2006 Diagnoses for sub-zone 2.4 (North West Vancouver Island) Atlantic Salmon Farms		
Number of Farm Audits	**Number of Cases**	**Farm Level Diagnoses**
13	8	No Infectious Disease
	3	Mouth Myxobacteriosis
	2	Bacterial Kidney Disease
	1	Rickettsiosis

Figure 6: South West Vancouver Island (Sub-zone 2.4)
2006 Case Summary - Atlantic Salmon



3.3.7.1.3 Sub-zone 3.1 Sunshine Coast

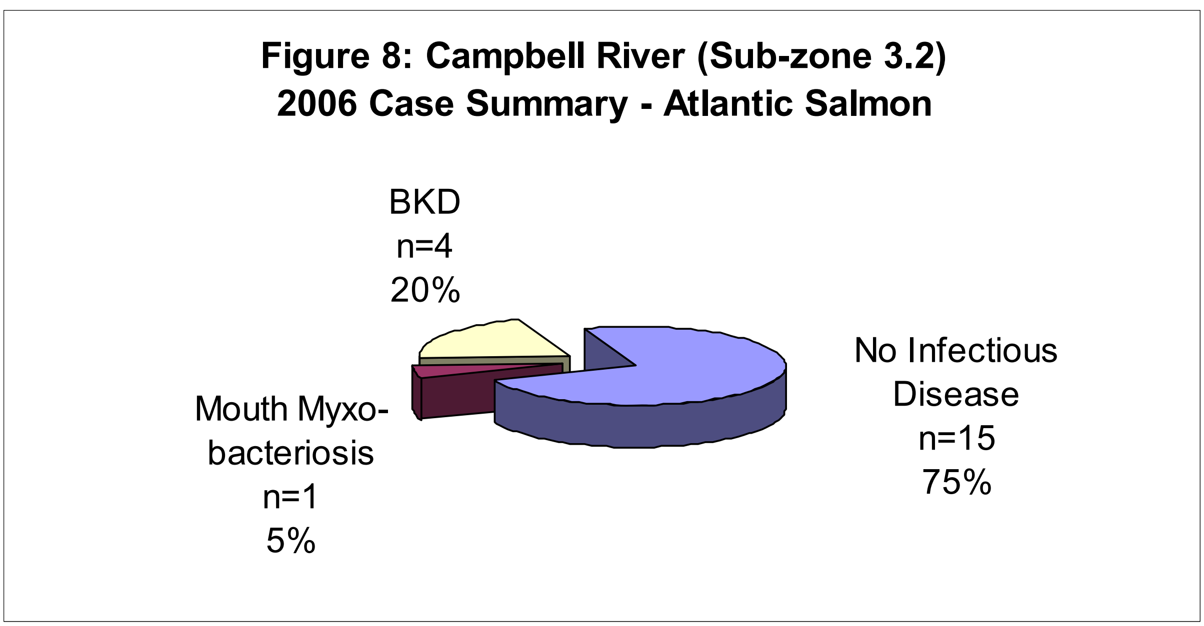
Table 10. 2006 Diagnoses for sub-zone 3.1 (Sunshine Coast) Atlantic Salmon Farms		
Number of Farm Audits	**Number of Cases**	**Farm Level Diagnoses**
4	4	No Infectious Disease



3.3.7.1.4 Sub-zone 3.2 Campbell River

Table 11. 2006 Diagnoses for sub-zone 3.2 (Campbell River) Atlantic Salmon Farms

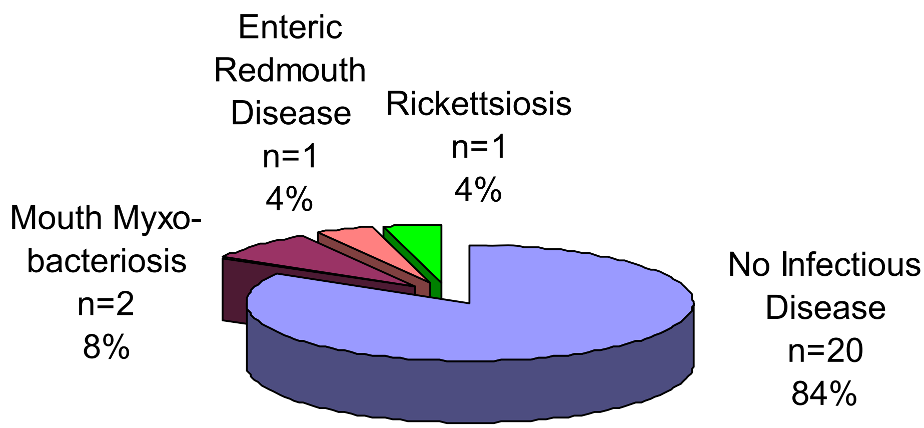
Number of Farm Audits	Number of Cases	Farm Level Diagnoses
18	15	No Infectious Disease
	1	Mouth Myxobacteriosis
	4	Bacterial Kidney Disease



3.3.7.1.5 Sub-zone 3.3 Broughton Area

Table 12. 2006 Diagnoses for sub-zone 3.3 (Broughton) Atlantic Salmon Farms		
Number of Farm Audits	**Number of Cases**	**Farm Level Diagnoses**
22	20	No Infectious Disease
	2	Bacterial Kidney Disease
	1	Rickettsiosis
	1	Enteric Red Mouth

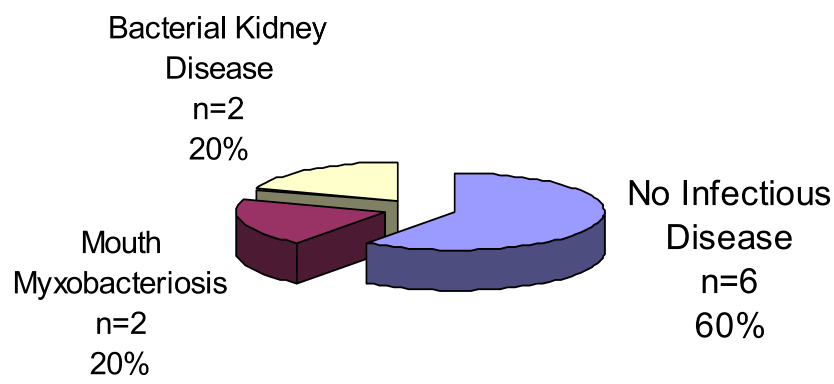
Figure 9: Broughton (Sub-zone 3.3)
2006 Case Summary - Atlantic Salmon



3.3.7.1.6 Sub-zone 3.4 Port Hardy

Table 13. 2006 Diagnoses for sub-zone 3.4 (Pt Hardy) Atlantic Salmon Farms		
Number of Farm Audits	**Number of Cases**	**Farm Level Diagnoses**
8	6	No Infectious Disease
	2	Mouth Myxobacteriosis
	2	Bacterial Kidney Disease

Figure 10: Pt Hardy (Sub-zone 3.4)
2006 Case Summary - Atlantic Salmon

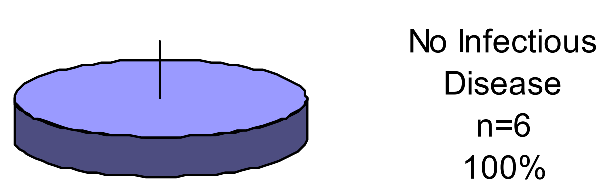


3.3.7.1.7 Sub-zone 3.5 Central Coast

Table 14. 2006 Diagnoses for sub-zone 3.5 (Central Coast) Atlantic Salmon Farms

Number of Farm Audits	Number of Cases	Farm Level Diagnoses
6	6	No Infectious Diseases

Figure 11: Central Coast (Sub-zone 3.5)
2006 Case Summary - Atlantic Salmon



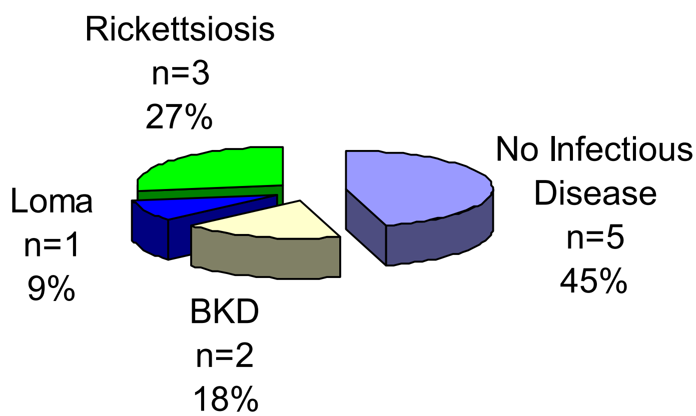
3.3.7.2 Pacific Salmon

3.3.7.2.1 Zone 2 Vancouver Island

Table 15. 2006 Diagnoses for Zone 2 (Vancouver Island) Pacific Salmon Farms

Number of Farm Audits	Number of Cases	Farm Level Diagnoses
6	5	No Infectious Disease
	2	BKD
	1	Loma
	3	Rickettsiosis

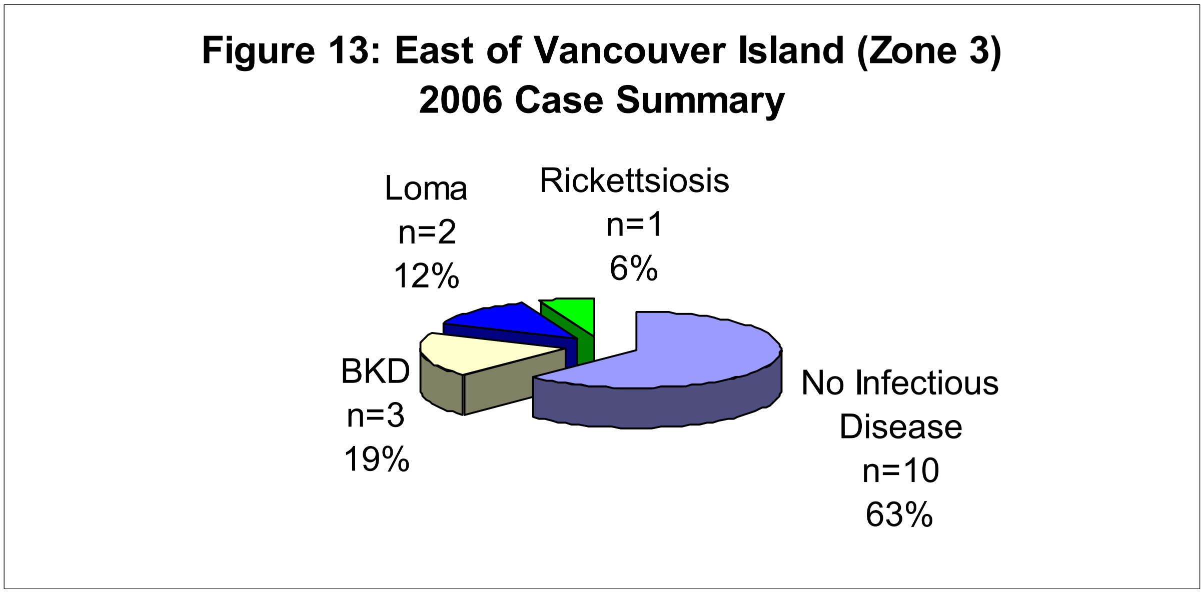
Figure 12: Vancouver Island (Zone 2)
2006 Case Summary



3.3.7.2.2 Zone 3 East of Vancouver Island

Table 16 2006 Diagnoses for Zone 3 (East of Vancouver Island) Pacific Salmon Farms

Number of Farm Audits	Number of Cases	Farm Level Diagnoses
15	10	No Infectious Disease
	3	BKD
	2	Loma
	1	Rickettsiosis



3.4 Comparison to Industry

One of the main objectives of the Fish Health Program is to verify the accuracy of the industry reporting on the disease status of farm sites. This presents some challenges for two reasons: first, the audit provides a "snapshot" to which the more complete picture of industry's reports can be compared; and second, the subset of freshest silver carcasses collected at the audit may not always reflect the Fish Health Events reported by industry. The presence of BCMAL fish health technicians on sites, reviewing records and testing for disease in parallel with industry fish health staff provides valuable information on how things are recorded and reported.

As previously discussed, the audit information does not represent the total proportion of disease diagnosed amongst industry sites. To do so would require government to have staff present at all sites, at all times. This information is captured in the required industry reports as part of their Fish Health Management Plans and it is presented publicly on the website of BCMAL (http://www.al.gov.bc.ca/ahc/fish_health/index.htm). The audit enables a randomized validation of the reported information with targeted disease testing. The industry reports encompass all sites and therefore provide a more complete picture of the health status of farmed salmon.

Three reports are provided to government by the industry on a quarterly basis:

1. Average mortality (by species) and by fish health zone for both fresh and salt water sites (see Figure 14)
2. Mortality Rates by Infectious and Non-infectious Cause
3. Fish Health Events (FHEs; see Figures 15a and 15b)

The first two reports reflect the overall losses and common causes of death at both private and public fish culture facilities. There are many reasons why fish may succumb within a culture system, however relatively few deaths are due to infectious disease. Each site must examine and categorize their fish carcasses. Amongst the categories is a group called “fresh silver”; these represent carcasses that have most recently died for either no apparent reason, or that may show signs of disease. These are the carcasses sampled by the BCMAL fish health staff during routine audit.

Fish Health Events (FHE) are those occurrences of farm management or disease management where intervention by a fish health veterinarian is required. In other words, the FHEs arise when there has been a significant effect on the health of the animals, or a disease event has occurred that requires treatment or a change in farming husbandry. Routine sea lice management strategy and activities also fall within the definition of FHE. Comparison of the disease diagnoses reported by farms to those diagnosed during audit allows for independent assessment of what diseases are affecting fish health and being reported by industry.

The following is a synopsis of the data described above. Complete details of the BCSFA data reports are found on the BCMAL website in a pdf format. An annual summary of all the FHE diagnoses and the audit diagnoses indicates that the same diseases reported on salmon farms were also diagnosed through the government audit process. The number of farms where no infectious disease was found ranged from 57% to 95 % through audit and industry reporting. In addition, the common Fish Health Events such as: Bacterial Kidney Disease (*Renibacterium*), Rickettsiosis (*Piscirickettsia*) and Mouth myxobacteriosis reported as requiring intervention amongst farms, were verified through the audit process.

The BC Salmon Farmers’ database is a more complete dataset than that represented here. It contains information from all individual farms. In addition, each individual farm site maintains its own records of the mortality and disease diagnoses to fulfil the record-keeping component of their Fish Health Management Plan. The audit data is a much smaller dataset and the information is useful for verification of the reported findings from the BC salmon farmers. The audit values in Figures 4, 4a (page 17) and Figures 5 through 13 are understandably less representative of the regular disease occurrences at the salmon farms as compared to the BCSFA data reflecting mortality rates and FHE values shown in Figure 4b (page 18) and Figures14, 15a and 15b below. However the audit data has greater specificity (lower probability of false negatives) than does the industry data.

We see strong agreement between audit results and BCSFA’s Fish Health Event reports in 2006. Some endemic pathogens are occasionally found during the audit process yet the infections do not necessarily trigger veterinary intervention or management changes on the farms because either the potential disease can be self-limiting or there is no known treatment. Examples of these endemic diseases are: Viral Hemorrhagic Septicaemia (VHS, North American Strain – genotype IVa), Loma branchitis and Marine anaemia. Enteric red mouth and rickettsiosis are, on occasion, detected by audit yet not specifically ‘treated’ at the farm-level since these infections can be managed in a concurrent fashion with an FHE already assigned to address Bacterial Kidney Disease or Mouth Myxobacteriosis in the same group of fish.

Figure 14. BCSFA data: The average mortality rate of Atlantic salmon (from smolt to brood) as reported by the BC Salmon Farmers Association quarterly in 2006. Data from some sub-zones is combined for reporting to avoid isolating the death rates at individual farms or companies (i.e. only one aquaculture producer resides in sub-zone 3.1). The elevated mortality reported in sub-zone 3.3 quarter 1 reflects a loss of salmon due to grilse death (early maturation in sea water); these fish may have died naturally or may have been culled after spawning by the producer(s).

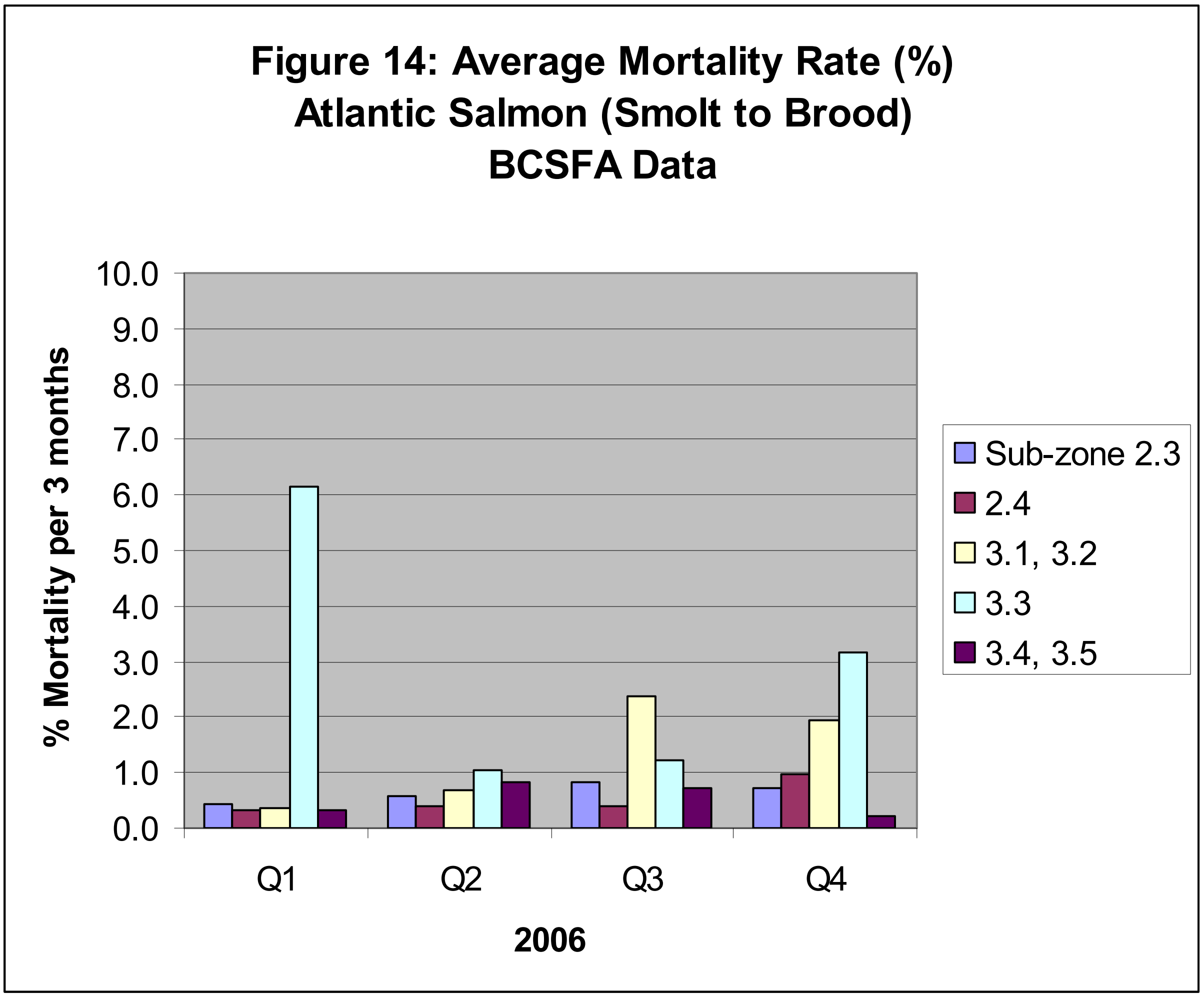


Figure 15a. BCSFA data: Annual Fish Health Events (FHEs) of groups of Atlantic salmon within farm sites that do experience an FHE; reported quarterly by the BC Salmon Farmers Association in 2006 for all zones.

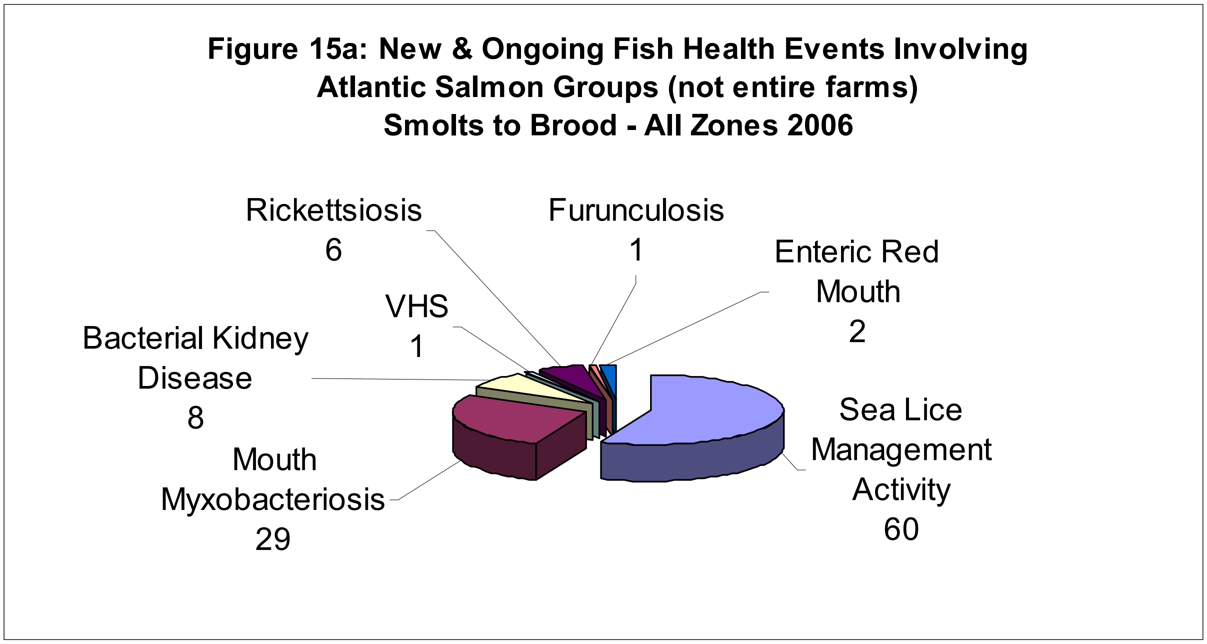
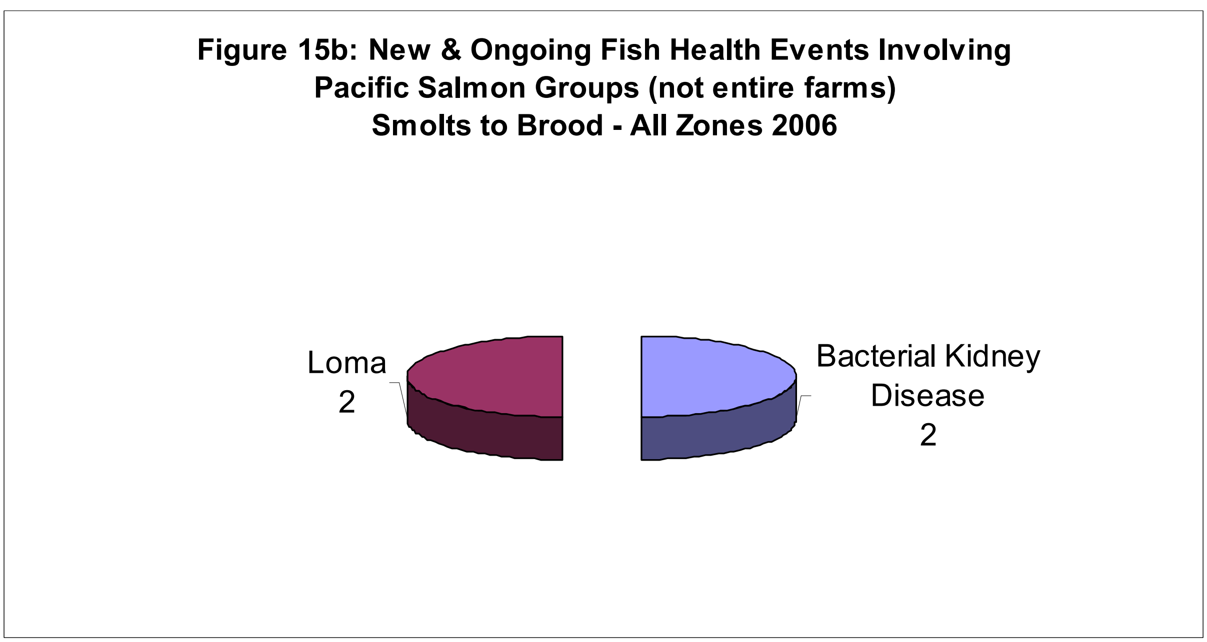


Figure 15b. BCSFA data: Annual Fish Health Events (FHE) of groups of Pacific salmon within farm sites reported by the BC Salmon Farmers Association each quarter in 2006 for all zones.



4 Section 4: Sea Lice Management Program

4.1 Mandate

Sea lice are common parasitic copepods that have the potential to affect both farmed and wild fish stocks. Sea lice monitoring conducted on Atlantic salmon farms provides information for effective management and treatment decisions at the farm level. The program generates information from the monitoring of lice found on farmed fish at Atlantic salmon farms to determine: trends in lice concentrations; the management of sea lice on farmed salmon; and to integrate with data on wild stock migration, when possible.

4.2 Overview

The Ministry of Agriculture and Lands has been actively monitoring the status of sea lice infections on BC salmon farms since 2003. By 2004 the sea lice management strategy was integrated into the provincial Fish Health Management Plans (FHMPs) and the associated sea lice auditing aspect was extended to include the entire British Columbia aquaculture industry. As part of the reporting requirements of the FHMPs, industry information is provided to government monthly and posted to the BCMAL Fish Health website. In addition, the Ministry audits industry lice counts to verify the accuracy of the reporting. In 2006, 47 farm sites were audited for sea lice and 2,764 live production fish were evaluated for lice infestations. The objective of the FHMPs and the audit program is to provide validated information on the status of sea lice infestations within BC's Atlantic salmon farms.

4.3 Provincial Sea Lice Monitoring

There are two components to the provincial sea lice monitoring initiative:

1. Industry's on-farm monitoring and reporting, and
2. BCMAL's audit of these procedures.

As part of the Fish Health Management Plans, BCMAL requires monthly sea lice sampling and reporting of aggregate, monthly data by fish health zone. In 2004, 'trigger levels' were set and actions required to control sea lice were established by BCMAL. This became a condition of license through the FHMP. In 2004, sea lice trigger levels were initially set at 3 motile lice from March 1 to July 1 and 6 for the remainder of the year. In 2005, those numbers were reduced to 3 motile lice year round. Actions that were required were species-specific and outlined below. The industry on-farm sampling program is based on internationally accepted standards for sea lice monitoring.

4.4 Industry Monitoring and Sampling Protocols

A working group of fish health experts and veterinarians responsible for management of the aquaculture stocks assist with integration of the information collected and evaluation of the effectiveness of the program. This is a key component of the program as these health professionals are responsible for the management and treatment of farmed fish stock under their care.

The monitoring program has been divided into categories according to the species of sea lice found on farms and differences in susceptibility to lice amongst farmed fish species. For details on the categories and definitions of lice see Appendix 7.10

4.4.1 Atlantic Salmon Farms

Industry sampling is conducted once a month for sites within each BCMAL sub-zone (unless an acceptable reason for not sampling was provided[5]).

Monthly sampling intensity is increased to twice monthly when the trigger level of 3 motile lice per fish is reached anytime throughout the year. During juvenile wild salmon out migration times (April to July), and if the farm reaches the trigger of 3 motile lice per fish, regulations require that action such as treatment or harvest must be taken to reduce the lice concentration. Continuous review of the sea lice data from wild and farmed fish stocks may lead to refinement of the lice control strategies in various farming sub-zones.

4.4.2 Sampling Regimen

At each farm site, monthly sampling is conducted using three pens; 20 live fish per pen are sampled (site total = 60 fish). Pens chosen for sampling include one "standard" or "index pen" (i.e. first pen entered in the system and/or the pen with the highest probability of having lice based on site historical information) plus two other randomly selected pens.

Fish are captured using a seine or other method that ensures representative sampling of the population. Twenty fish are placed in an anaesthetic bath. Occasionally farms choose to humanely euthanize the fish before examination. Handling of the live fish is minimised to avoid dislodging the lice and the method of handling is recorded. The fish are examined for the presence of lice regardless of the health status of the fish. Fish may be culled or otherwise removed from the population, if appropriate, once lice counts have been recorded.

[5] Reasons for not reporting include:

1. Site is harvesting and < 3 pens left on site
2. Smolt entry and < 3 pens on site, or <1 month since third smolt pen entered
3. Fish being treated for sea lice
4. Fish being treated/ managed for other fish health problem
5. Fish could not be handled due to environmental problem, e.g. low DO
6. Monitoring in sub-zone 3.1 (Sechelt) will be required only if there is a visible increase in lice levels on the farms detected through routine health monitoring programs.

levels on the farms were detected through routine health monitoring programs.

4.4.3 Reporting

All farms report monthly to the BCSFA Database which in turn provides aggregate monthly reports to BCMAL by specific fish health sub-zones. In 2006, the trigger level for the management and control of sea lice remained set at 3 motile lice. From end-March to July this meant that once the trigger level was reached, immediate action was undertaken (either harvest or treatment) to reduce lice concentrations per fish. During the remainder of the year, action includes increased monitoring and sampling in addition to other management efforts.

4.5 Provincial Government Audit of Industry

The sea lice audit program is designed to verify the industry reported results and provide government with knowledge of sea lice levels on BC salmon farms. The audit program follows the model for the Fish Health Audit Program with a subset of active farms sampled on a quarterly basis.

4.5.1 Zonation

Fish health zones as described in section 3.2.1 are also used for the sea lice audit program. A Map of the zones is provided in 7.2.

4.5.2 Site selection for audit

BCMAL uses the same multi-stage sampling system for sea lice audit as is used with the fish health audit program. The unit of concern is the fish health sub-zone. All sites within a sub-zone are assigned a random number (Primary unit). Selection of the farms within a zone for sampling is weighted based on the number of farms in that zone as a percentage of the total number of farms in the province – that is, if an area has 30% of the farms then only 30% of the farms in the area would be randomly selected. This ensures equal probability of each farm being selected for sampling.

Twenty five (25) percent of the active[6] Atlantic salmon farm sites are selected for sea lice audit quarterly; during the second quarter (April – June) 50% of the active sites are selected for audit. The second quarter is selected for increased audit to correspond with the time of the wild smolt out-migration.

4.5.3 Records evaluation

The fish health technicians evaluate records related to sea lice while conducting the audit visit. The date of the most recent sea lice count is recorded as well as any treatment that may have been conducted during that quarter. Fish Health technicians also record the farm environmental parameters for the day; water temperature and salinity are recorded at 0, 1, 5 and 10 meters depth.

[6] Active farms are those farms which have been stocked for 120 days and have a minimum of 3 pens of fish on site during the quarter which sampling is to occur. Broodstock are not sampled for sea lice.

4.5.4 Fish collection and sampling procedures

Fish collection and sampling procedures are evaluated during the site visit. Fish health technicians are experienced in fish handling and follow standard operating procedures for fish handling, anaesthesia and lice counts.

Twenty (20) fish from each of three (3) net pens are sampled, as is required for a standard industry sea lice count. Ten (10) of the fish from each pen are evaluated by the BCMAL bio-technician and 10 by an industry staff member. The fish are systematically examined by the fish health technician and lice numbers enumerated and classified accordingly. On occasion, BCMAL staff may also collect lice samples from anaesthetized or euthanized fish for specific evaluation and confirmation of lice species and life-stage. All lice that become dislodged in the anaesthetic bath are included in the summation for the site count.

4.5.5 Analysis of Sea Lice Audit Data: Atlantic Salmon Farms

Active sites satisfying the criteria for sea lice audit were identified and were randomly selected for audit. Table 17 summarizes the audit activity of 2006. Weather was the cause of cancellations of audits during the first and fourth quarters of the year, and environment (low dissolved oxygen or plankton bloom) was the cause of cancellations during the third quarter.

Table 17: 2006 Total farms selected, total farms audited and numbers of live fish assessed (per quarter).

	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Annual
# farms selected *	10	25	11	8	**54**
# farms visited	9	25	7	6	**47**
# fish counted	540	1,444	420	360	**2,764**

Analysis of the 47 lice-counting comparisons made in 2006 found no significant difference between counts performed by BCMAL personnel and designated farm staff at the farm-level for the *Lepeophtheirus* motile or female stages, or the *Caligus* motiles ($p>0.05$). This agreement between paired count results (of the mean abundance of lice counted, on different fish, from the same pen) provides confidence in the technical proficiency of the farm personnel generating the count data reported by the farms.

This on-farm, split-sample, lice-counting procedure and the examination of records represents a compliance audit. The results of the pooled counts, also submitted for the monthly reporting by the farm, are recorded as the audit "snapshot" of the farm. These pooled counts are also added to the audit data for the sub-zone that quarter and are used for 'within sub-zone' analysis and the Sub-sample Validation test (see below). Table 18 and Figure 16 below show the aggregated results of the BCMAL average abundance of sea lice on Atlantic salmon farms for all zones in 2006. For a more detailed breakdown of mean sea lice abundance on audited farms in each sub-zone, please refer to Appendix 7.11. All statistical analyses were completed using Microsoft Statistix 8.

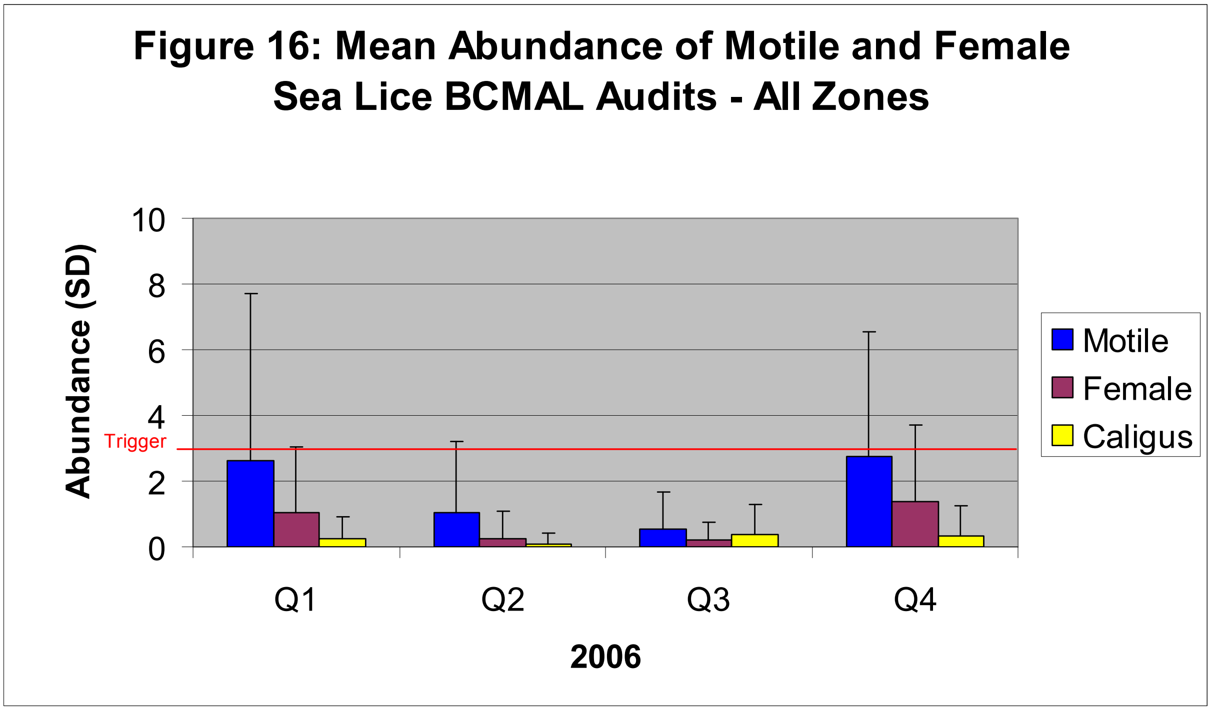
To further increase the confidence in the data reported by industry, data from all the audited farms within each sub-zone were examined for 'within farm' (farm-level) and 'within sub-zone' variation together. This is an important test for the auditing function because it best models the industry situation; in other words, data collection from different farms, with different personnel, occurring on different days, with different ages of fish exposed to lice, etc. The analyses found no significant difference between counts performed by government personnel and farm personnel at the sub-zone level, for all but a few cases. BCMAL made slightly higher counts ($p = 0.04$) for one case of female *Lepeophtheirus salmonis* and four cases of *Caligus*. The *Caligus* motile stages tend to detach from fish during handling procedures, more so than *Lepeophtheirus*. In each case where BCMAL counts were higher, the "missing lice" were recovered and counted from the anaesthesic totes (and added to the farm total), suggesting that a sampling bias is associated with time between anaesthesia and counting.

In conclusion, lice detection and identification by industry in 2006 was found to tolerate statistical scrutiny, both at the farm- and the sub-zone levels, which gives us confidence in the industry-reported lice abundance.

Table 18. Mean abundance of motile, female *L. salmonis* and chalimus sea lice and motile *Caligus clemensi* during Atlantic salmon farm audits in 2006 (per quarter) – 1st & 2nd year classes combined*.

2006 Mean abundance	Q1	Q2	Q3	Q4
Number of Farms Audited (n)	9	25	7	6
Motile	2.61	1.05	0.56	2.75
Standard Deviation (SD)	5.09	2.17	1.10	3.81
Female	1.05	0.27	1.93	1.39
SD	1.99	0.79	0.54	2.32
Chalimus	0.78	0.59	1.70	3.17
SD	1.86	1.49	2.55	6.11
Caligus Motile	0.23	0.08	0.36	0.34
SD	0.69	0.36	0.93	0.905

* Tables of comparable audit data reflecting separate year classes of Atlantic salmon can be found in Appendix 7.11.



With regard to Pacific salmon, initial sampling of farmed Pacific salmon in 2004 supported information from scientific studies in that farmed Pacific salmon harbour lice to a minimal degree (see Fish Health Report 2003-2005). As a result, BCMAL no longer requires Pacific salmon farmers to report. However, those producers continue to visually monitor the salmon for sea lice during routine carcass assessments, weight sampling events or at times when lice have historically been documented (i.e. at harvest or during brood sorts in the autumn). This information must be available for audit review to BCMAL fish health staff upon request.

4.5.6 Evaluation and Audit Comparison to Industry Lice Reports

The BCSFA average abundance of sea lice on Atlantic salmon farms for all zones in 2006 by year class is shown below in Figures 17a and 17b. The BCSFA monthly sea lice tables and bar charts submitted to BCMAL for each sub-zone can be found in Appendix 7.12.

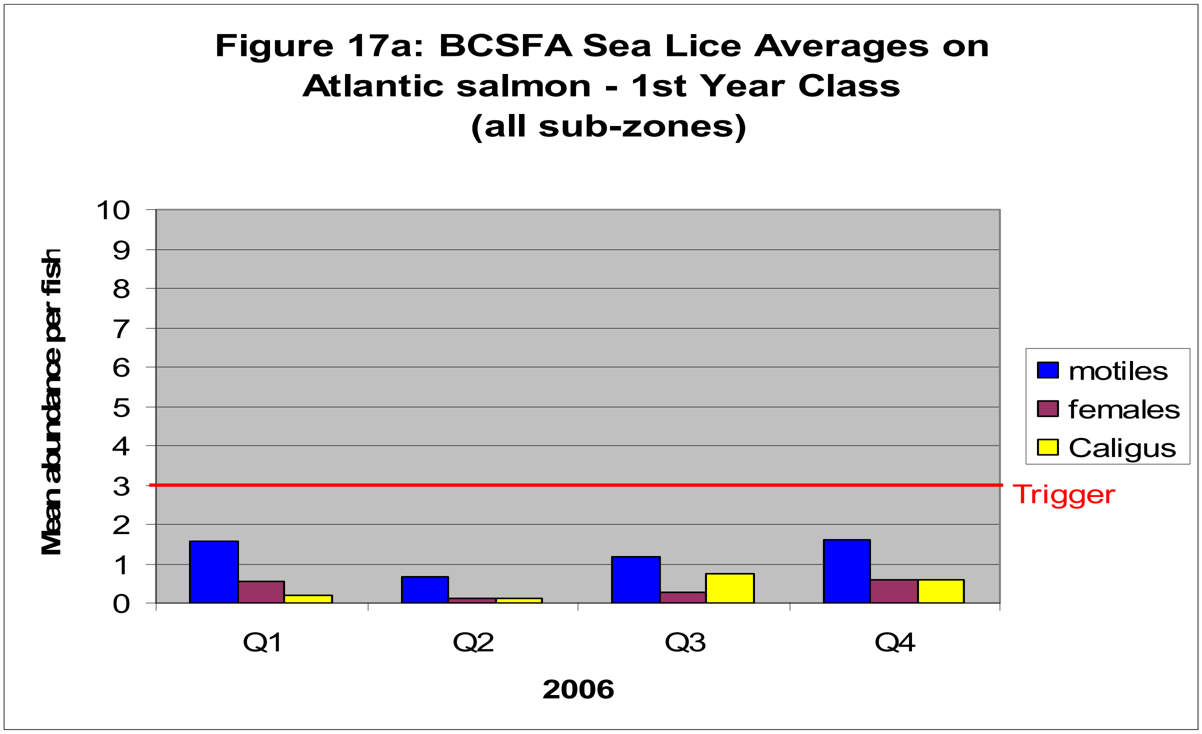


Figure 17a: BCSFA Sea Lice Averages on Atlantic salmon - 1st Year Class (all sub-zones)
Mean abundance per fish
10
9
8
7
6
5
4
3
2
1
0
Q1
Q2
Q3
Q4
2006
motiles
females
Caligus
Trigger

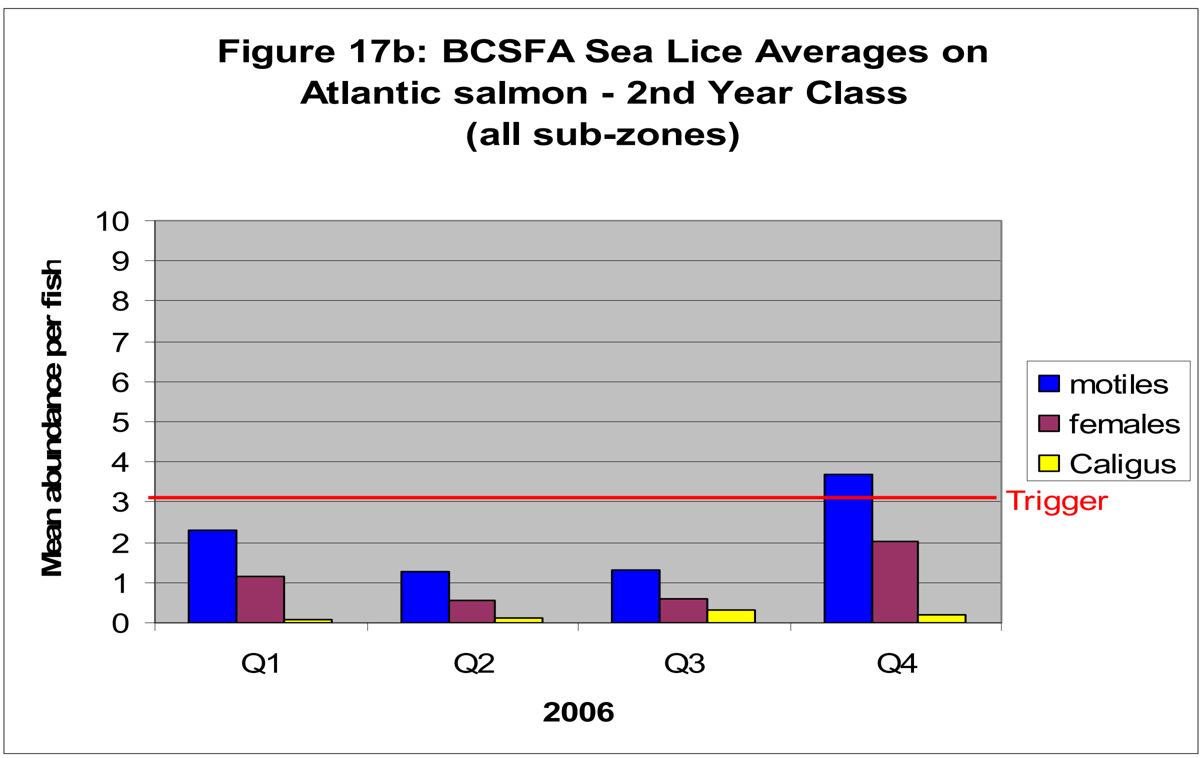
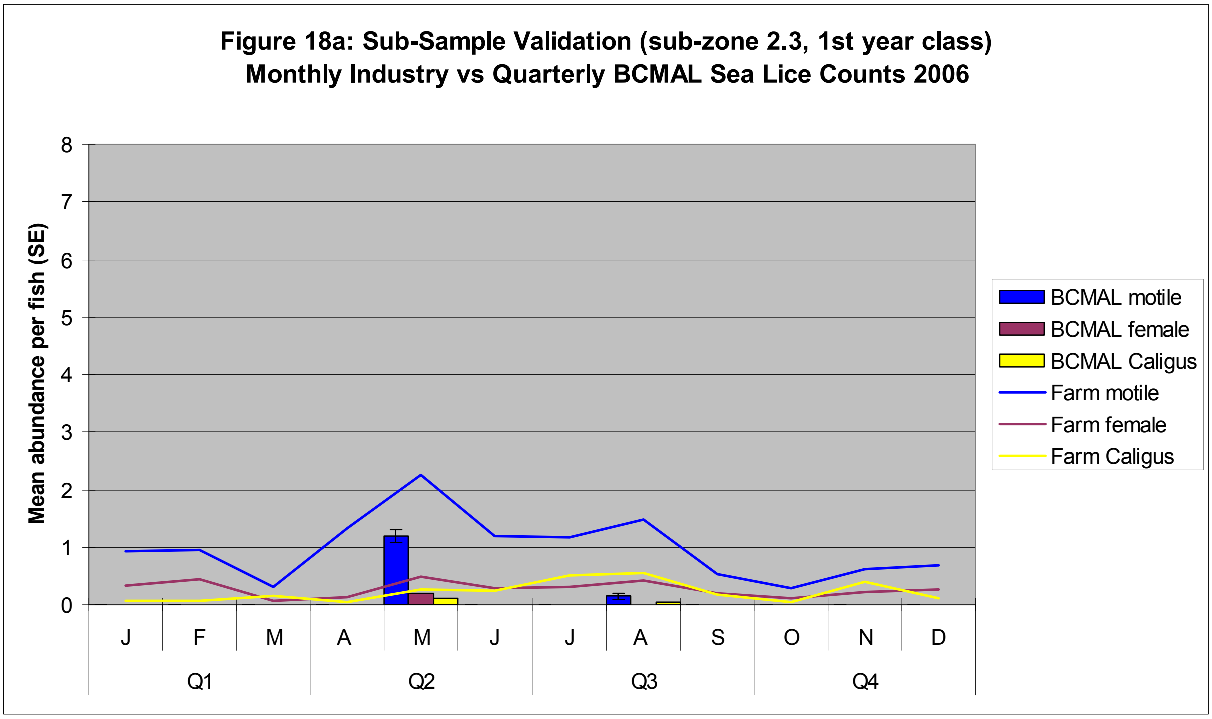
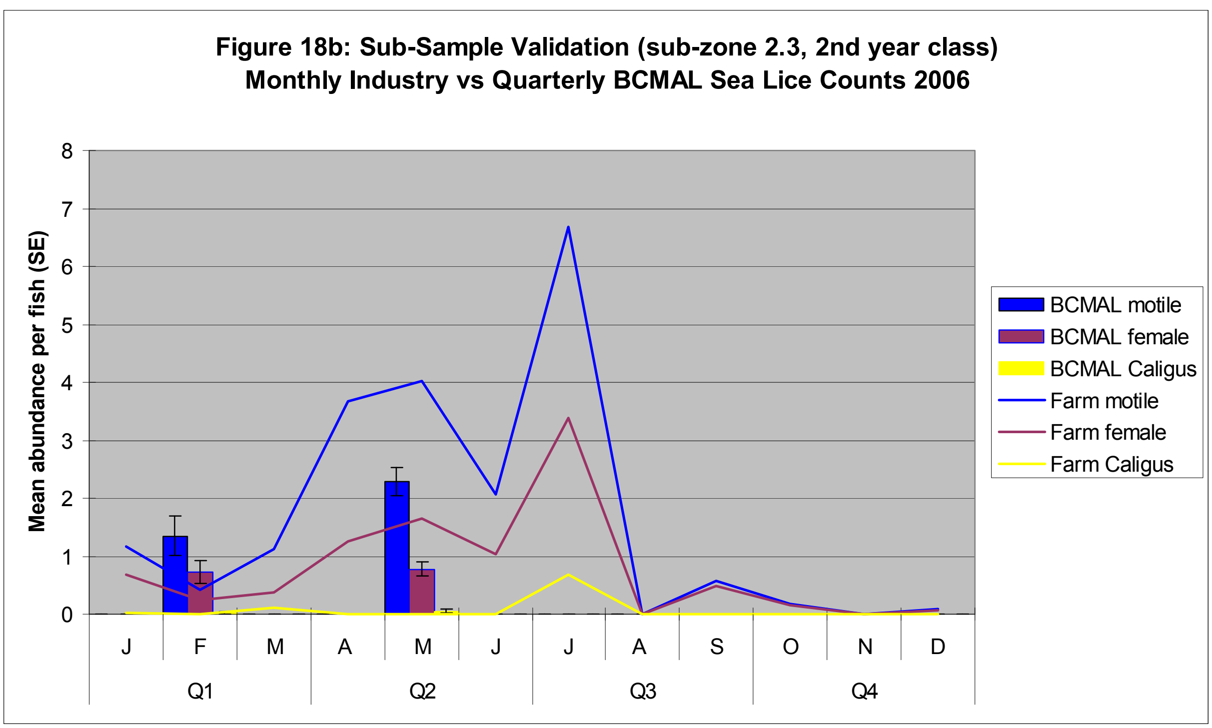


Figure 17b: BCSFA Sea Lice Averages on Atlantic salmon - 2nd Year Class (all sub-zones)
Mean abundance per fish
10
9
8
7
6
5
4
3
2
1
0
Q1
Q2
Q3
Q4
2006
motiles
females
Caligus
Trigger

BCMAL sea lice audit data is generated on discrete days each quarter and contributes to the monthly and semi-monthly data collected by industry. As such, the BCMAL data is a sub-set of the farm-reported data and therefore is not an independent estimate of sea lice abundance. By using these "snapshots" of farm and sub-zone data to check the validity of the data reported by industry, we refer to this as "sub-sample validation". This is a useful tool to evaluate confidence in the data collected from 624 routine assessments by farm personnel in 2006.

Figures 18a to 24b present BCMAL discrete quarterly estimates (bars) overlying monthly average lice abundance (line graph) submitted by industry. Although 'within pen', 'between pen', and 'between farms within a sub-zone' variance all contribute to the difficulty in generating a good estimate of average lice abundance for a sub-zone, the BCMAL sub-sampling validation results show general agreement with the abundance reported by industry.





NB. Lice abundance in sub-zone 2.3 exceeded the trigger level of three (3) motile lice per fish in quarter 2 (Apr-May) due to various factors: a) in Q1 there was no foreseeable need to medicate fish (1 motile per fish), b) the unexpected rise in Q2 initiated both management controls: medication of some fish and harvest of other groups; and c) in Q2 and Q3 environmental events such as seasonally low dissolved oxygen and harmful algae blooms resulted in limited opportunities to apply lice medication.

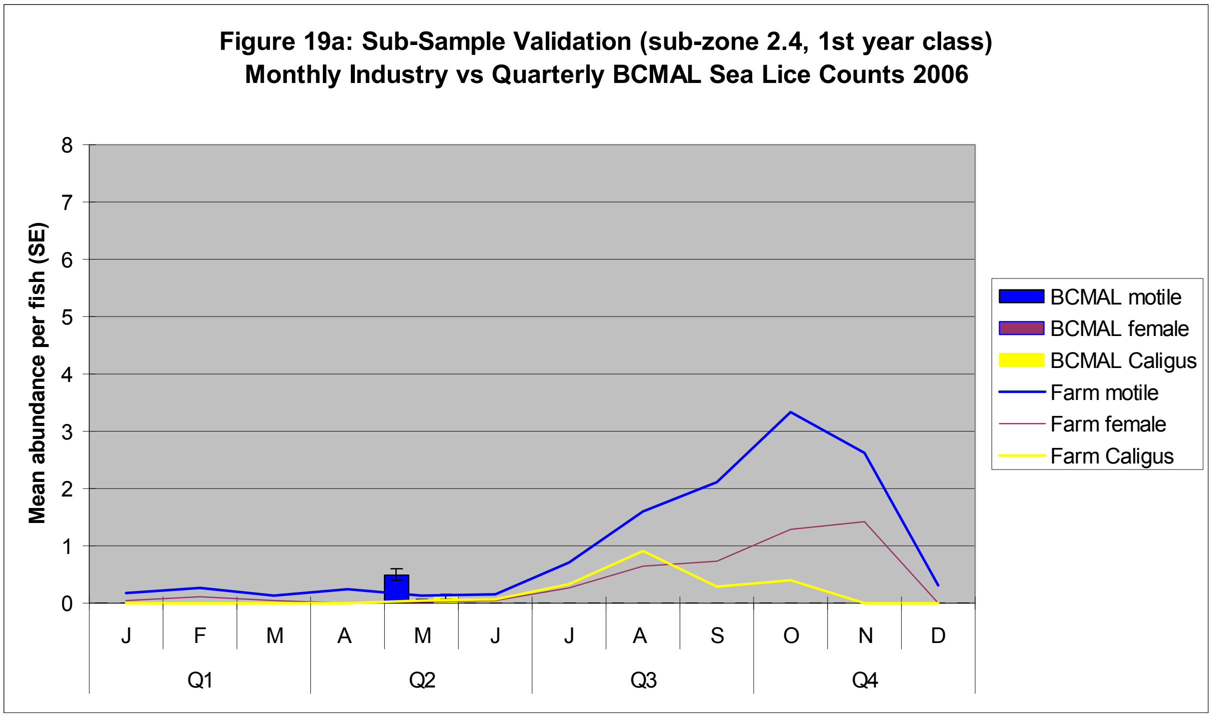


Figure 19a: Sub-Sample Validation (sub-zone 2.4, 1st year class)
Monthly Industry vs Quarterly BCMAL Sea Lice Counts 2006
Mean abundance per fish (SE)
0
1
2
3
4
5
6
7
8
J
F
M
A
M
J
J
A
S
O
N
D
Q1
Q2
Q3
Q4
BCMAL motile
BCMAL female
BCMAL Caligus
Farm motile
Farm female
Farm Caligus

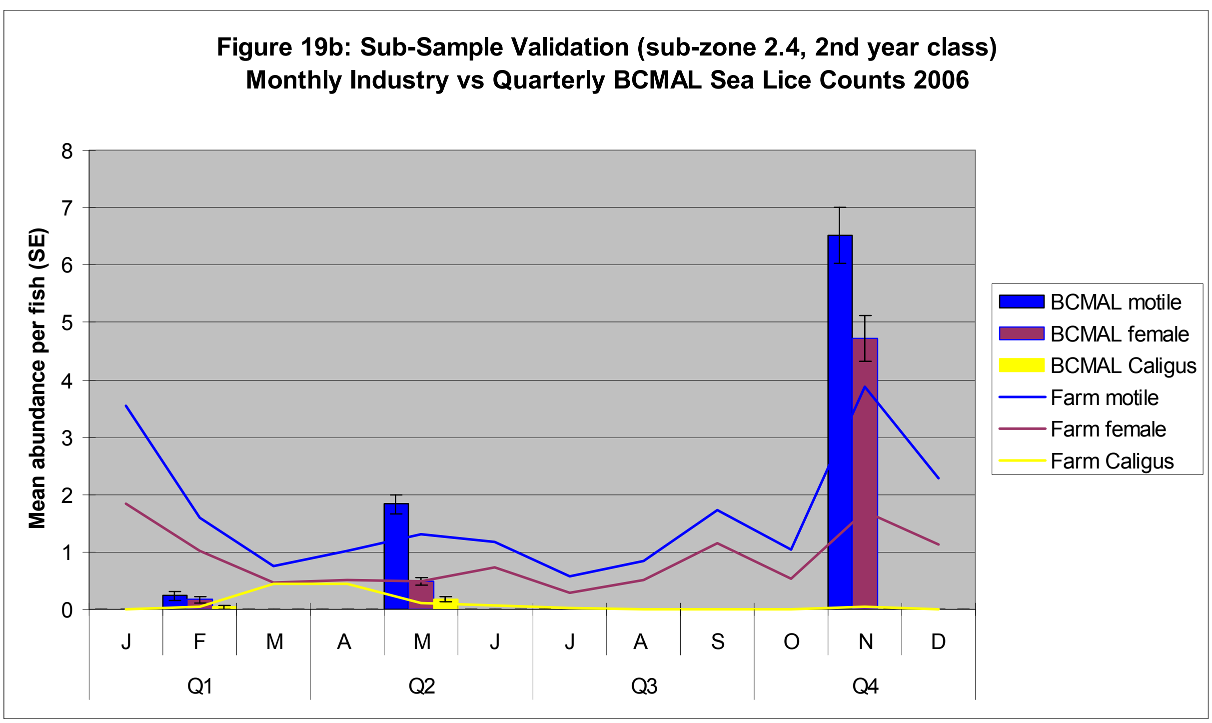


Figure 19b: Sub-Sample Validation (sub-zone 2.4, 2nd year class)
Monthly Industry vs Quarterly BCMAL Sea Lice Counts 2006
Mean abundance per fish (SE)
0
1
2
3
4
5
6
7
8
J
F
M
A
M
J
J
A
S
O
N
D
Q1
Q2
Q3
Q4
BCMAL motile
BCMAL female
BCMAL Caligus
Farm motile
Farm female
Farm Caligus

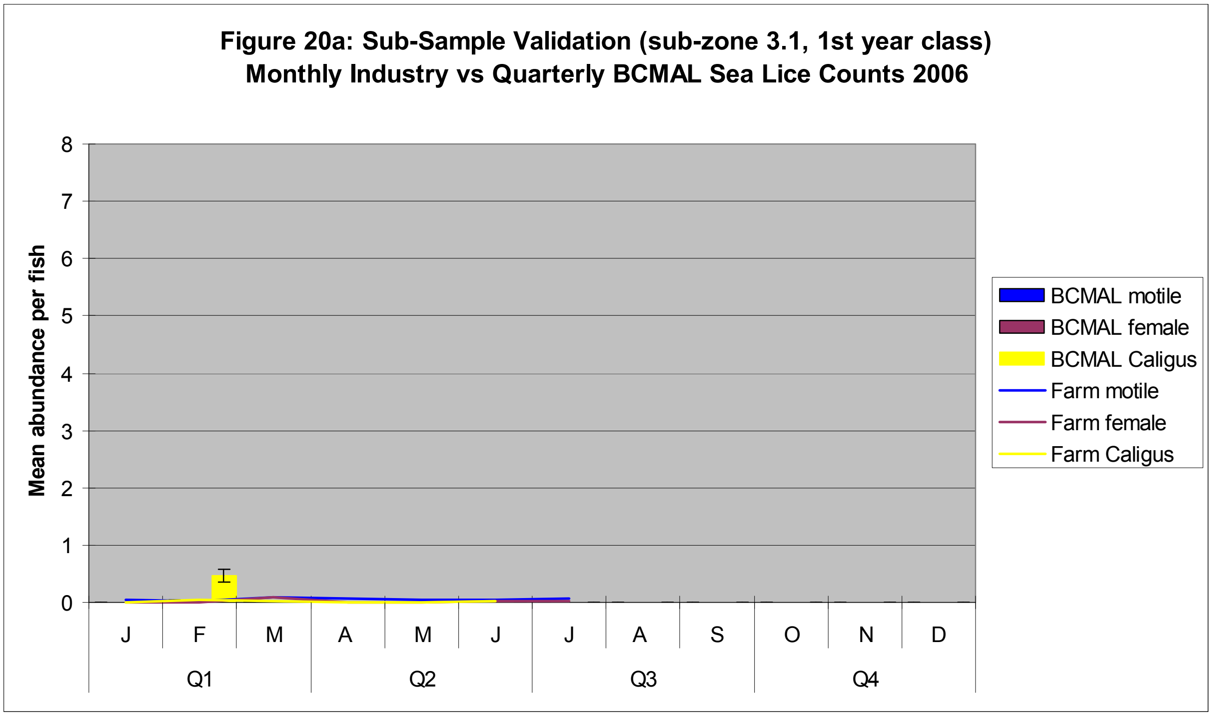


Figure 20a: Sub-Sample Validation (sub-zone 3.1, 1st year class)
Monthly Industry vs Quarterly BCMAL Sea Lice Counts 2006
Mean abundance per fish
0
1
2
3
4
5
6
7
8
J
F
M
A
M
J
J
A
S
O
N
D
Q1
Q2
Q3
Q4
BCMAL motile
BCMAL female
BCMAL Caligus
Farm motile
Farm female
Farm Caligus

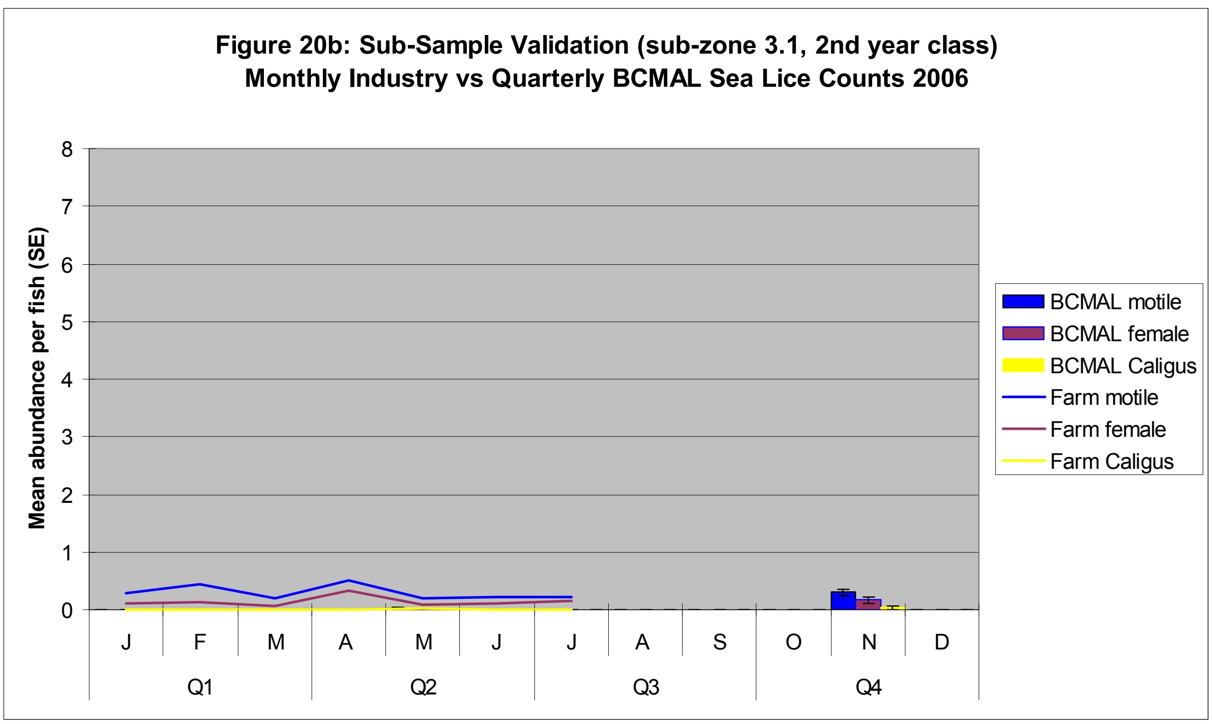
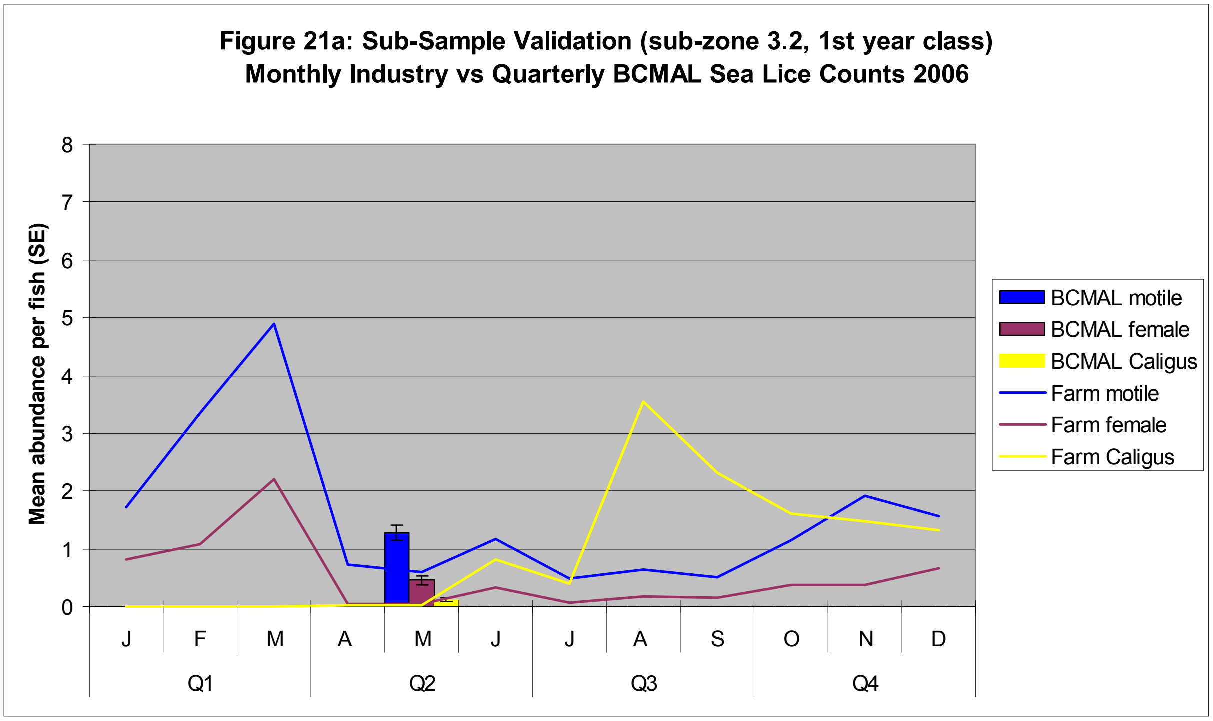
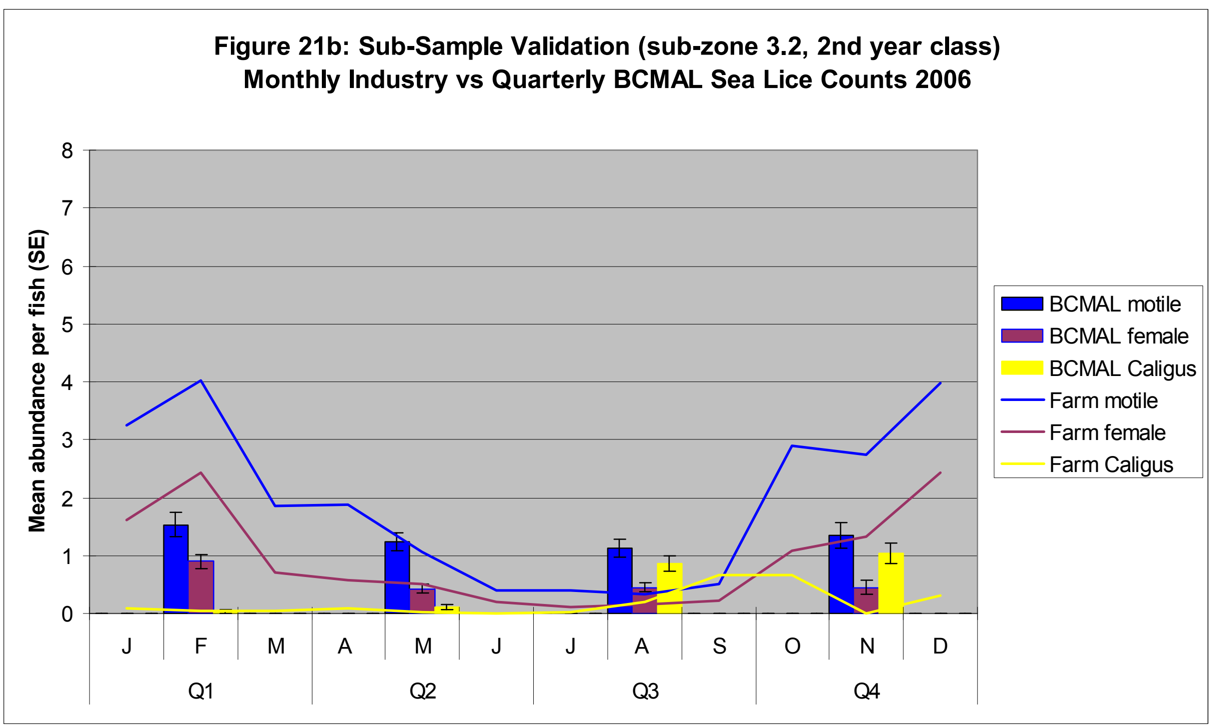
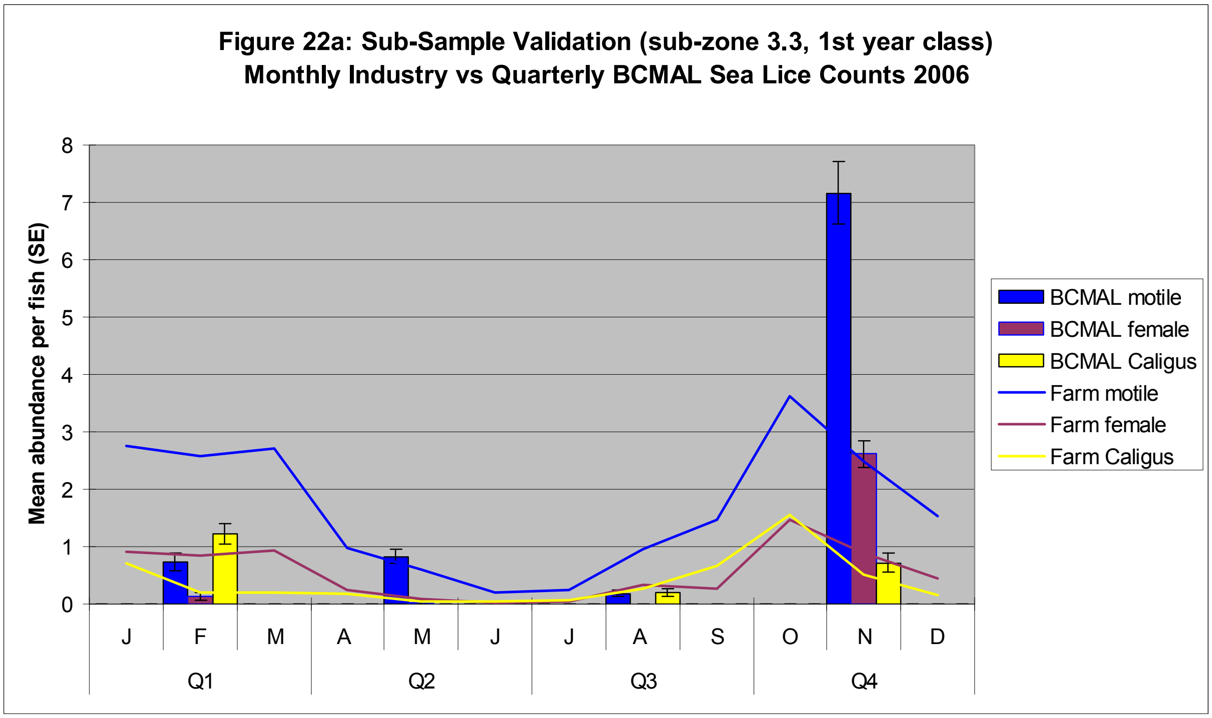


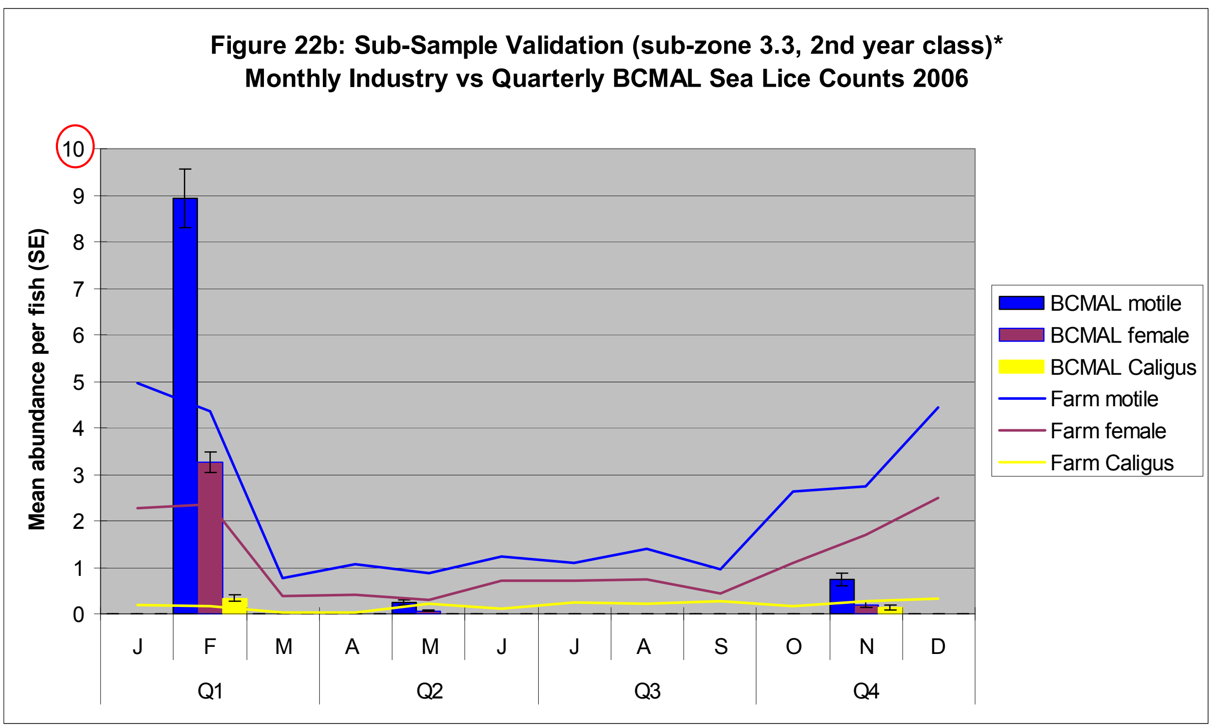
Figure 20b: Sub-Sample Validation (sub-zone 3.1, 2nd year class)
Monthly Industry vs Quarterly BCMAL Sea Lice Counts 2006
Mean abundance per fish (SE)
0
1
2
3
4
5
6
7
8
J
F
M
A
M
J
J
A
S
O
N
D
Q1
Q2
Q3
Q4
BCMAL motile
BCMAL female
BCMAL Caligus
Farm motile
Farm female
Farm Caligus





NB. Farm monitoring and audit activity identified a unique abundance of *Caligus* lice species in sub-zone 3.2 in quarters 2, 3 and 4. *Caligus* species are common on non-salmonid fishes. Their presence in 2006 is attributable to wild herring and pilchard populations near salmon farms. *Caligus* lice are considered opportunists and incidental on salmon, nevertheless monitoring is useful.





* The y-axis 'abundance scale' has been adjusted to 10 to accommodate this dataset.

Figure 23a: Sub-Sample Validation (sub-zone 3.4, 1st year class)
Monthly Industry vs Quarterly BCMAL Sea Lice Counts 2006

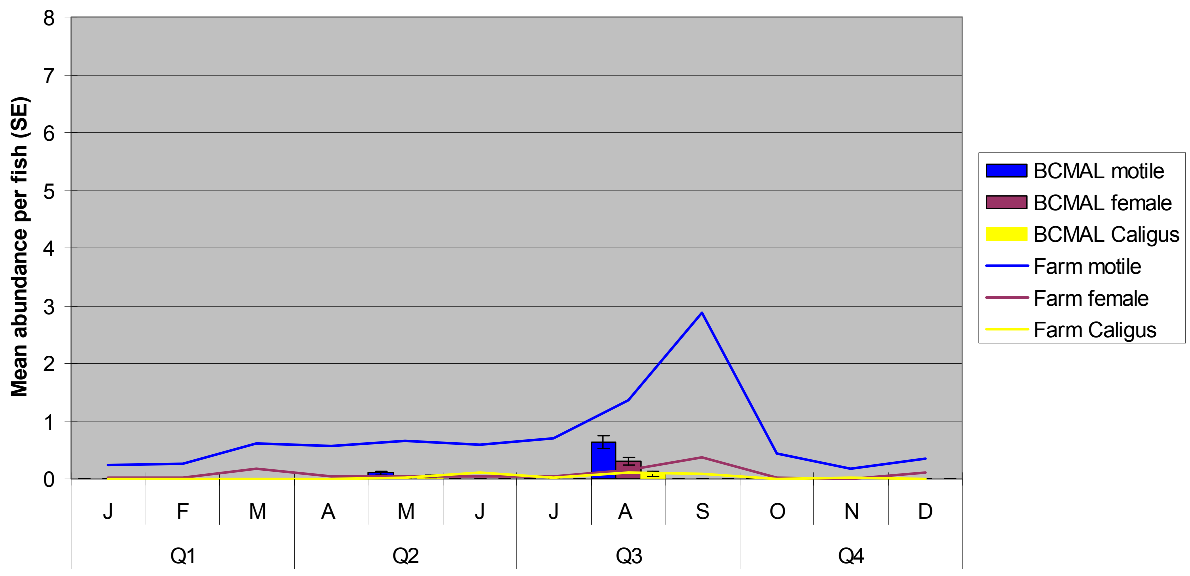
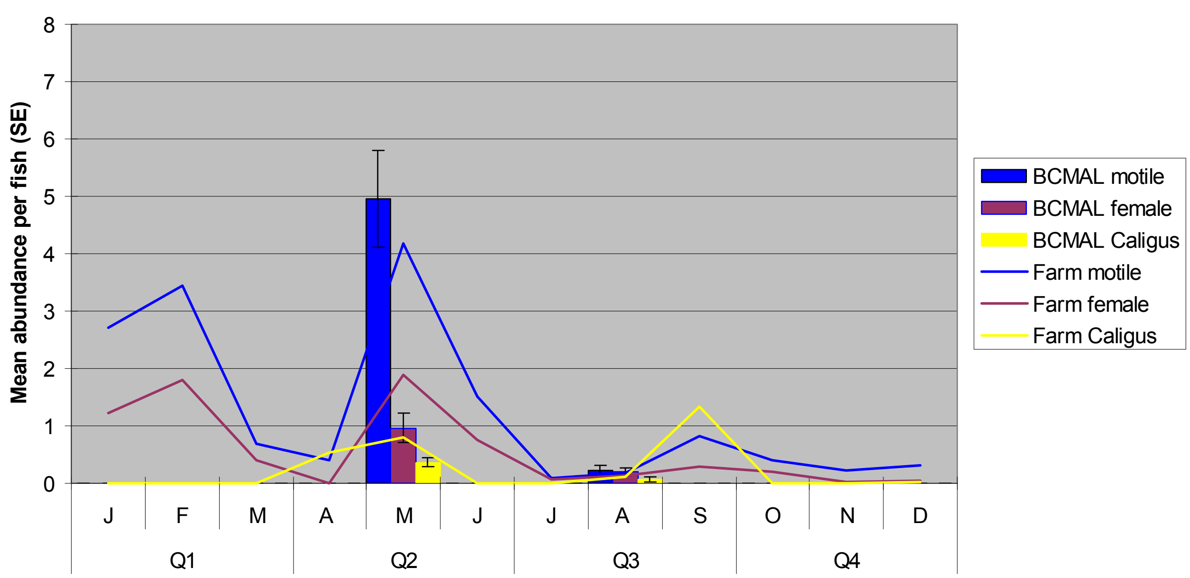


Figure 23b: Sub-Sample Validation (sub-zone 3.4, 2nd year class)
Monthly Industry vs Quarterly BCMAL Sea Lice Counts 2006



NB. A marked rise in motile sea lice abundance in May 2006 was reported by producers and corroborated by BCMAL audit within sub-zone 3.4. It was attributed to a wild fish migration event. Regardless, the abundance surpassed the 3 motile per fish trigger point. The affected farms were managed accordingly and the lice levels declined promptly.

Figure 24a: Sub-Sample Validation (sub-zone 3.5, 1st year class)
Monthly Industry vs Quarterly BCMAL Sea Lice Counts 2006

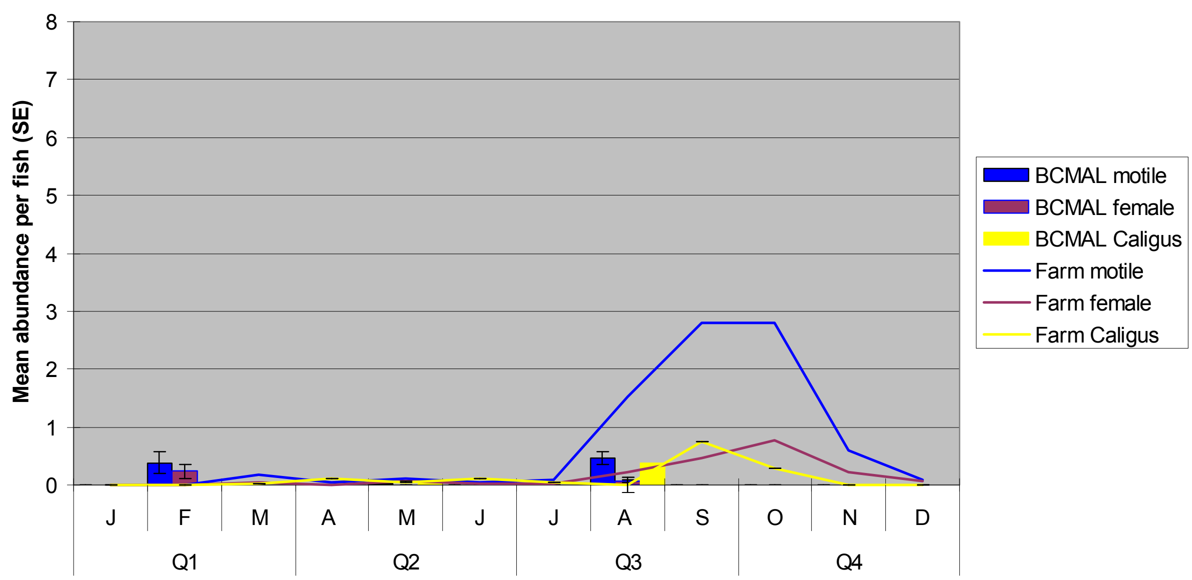
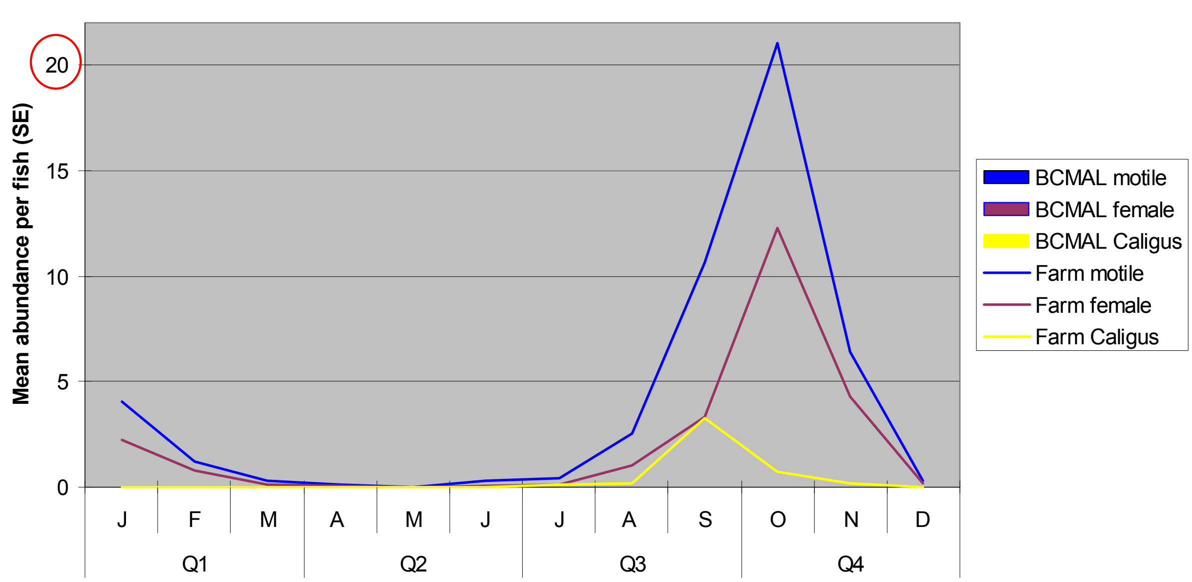


Figure 24b: Sub-Sample Validation (sub-zone 3.5, 2nd year class*)
Monthly Industry vs Quarterly BCMAL Sea Lice Counts 2006



* The y-axis 'abundance scale' has been adjusted to 22 to accommodate this dataset. Audit counts were performed in quarter 2; the mean abundance was 0.016 motile per fish at that time (see Appendix 7.11, Table 7.11.7). The marked rise in abundance of sea lice in sub-zone 3.5 in quarter 3 is an annual seasonal phenomenon. Environmental factors and producers manage the abundance accordingly each winter.

4.6 Rationale for the Three Motile Lice Trigger

In 2002 there were no data on sea lice or the potential impact on wild stocks in BC. As a result, BC initiated an on-farm lice monitoring pilot project in the Broughton Archipelago. A plan was devised to establish trigger levels based on international data and information. After examining the data available in the published literature and from government sources in other jurisdictions, trigger levels of 3 motile sea lice during out migration and 6 motile lice for remainder of the year, was viewed as rational and precautionary based on the existing science at that time.

In 2003 the sea lice monitoring program was extended beyond the Broughton to include the entire BC industry. Government has since implemented the monitoring program as a part of the Fish Health Management Plans and has also instituted the audit and verification program.

In 2004/05 all the data collected from farm and the government audit programs were evaluated. Based on this information, a conservative on-farm trigger level of three (3) motile lice per fish was assigned throughout the year. During the autumn inward migration of adult wild salmon, the net abundance of sea lice can be higher on wild fish than is found on farms. Treatment, in the face of increased background levels of sea lice and recruitment of the parasites from wild sources, would reduce the efficacy of treatment hence, during the autumn, sea lice levels on farms tend to be higher than the trigger value of three (3). In this case an increased level of monitoring is required at the affected farm sites..

The treatment available for control of sea lice, emamectin benzoate (SLICE®) has a known efficacy period. As part of an integrated management approach to pest control if treatment is strategically timed in the late autumn or winter (i.e. after the return of adult wild salmon), this results in low lice abundance on farms during the critical wild juvenile out-migration time. BCMAL and Fisheries and Oceans Canada (DFO) continue to work with the aquaculture sector to ensure the necessary data is gathered to integrate findings with the farm management programs.

4.7 Comparison to Other Countries

Atlantic salmon and trout are considered the fish species most susceptible to the effects of sea lice. These farmed populations serve as ‘sentinels’ of the marine environment, whereby any detrimental effect from sea lice would first appear in farmed Atlantic salmon. Yet ill effects have yet to be observed in the farmed fish of BC. In Norway trout and Atlantic salmon are considered most vulnerable to lice due to wild stock declines over the years, hence the accumulation of lice on farmed fish raised in the Atlantic ocean. Europe also has fewer wild salmon, the natural hosts of sea lice, than does British Columbia. The trigger levels for treatment of lice in Norway are 0.5 gravid females and/or 4 motile lice per fish during the juvenile migration period, increasing to 2 gravid females and 10 motile lice for the remainder of the year. These values are imposed to deal with the higher risk of impact from sea lice in the Norwegian circumstance. To our knowledge, neither Scotland nor Chile has assigned trigger values for lice management.

While it is important to take into consideration the experiences of other countries regarding sea lice, it is equally important to understand sea lice dynamics in the context of local conditions in British Columbia. BC has far larger wild salmon populations than those found in many countries. In addition, the clinical effects of Pacific ocean sea lice on BC farmed fish are significantly different than what has been observed in other locations. A summary of the different jurisdictions is provided in Table 19 below.

Table 19: Comparison of Trigger Levels in Salmon Farming Jurisdictions

Country	Time of Year	Trigger Level	Action
Norway	Dec 1 – Jul 1	0.5 gravid females; 5 motile lice	Treatment required
	Jul 1 – Dec 1	2 gravid females; 10 motile lice	
Scotland	No action level		Area Management
Ireland	March 1 – May 1	0.3 - 0.5 egg-producing adult female	Treatment required
	May 1 – March 1	2 egg-producing adult female lice per fish	
Chile	No trigger levels		
BC Canada	Mar 1- Jul 1	3 motile lice	Treatment/Harvest
	Jul 1 – Mar 1		Increased Monitoring, Treatment or Harvest

4.8 Synopsis of Industry Sea Lice Results - 2006

A synopsis of the 2003 to 2005 audit program data is available in the reference document: Fish Health Report 2003 – 2005 (December 2006).

The following information is a review of the temporal and spatial occurrence of lice on farms by way of BCMAL audits and the examination of industry sea lice reports submitted to government in 2006.

Summary:

- **The trigger level of three motile lice per fish is a conservative monitoring and management value**. There is no indication in the susceptible and sentinel Atlantic salmon of outward signs of disease or ill health even when afflicted by relatively high numbers of lice. Sea lice are natural parasites of fish in sea water.

- **Abundance of lice in 2006 during the out-migration period of wild fry (April to July) was well below the trigger level of 3 motile lice per fish in all but two sub-zones.** In general, the lice concentration at the salmon farms had declined by February however the average lice counts in sub-zones 3.4 (Port Hardy area) and 2.3 (Tofino area) did report greater than three lice per fish during the out-migration period. The one month elevation at affected farm(s) in sub-zone 3.4 was controlled efficiently. In sub-zone 2.3, the average abundance of lice in March was 1.11 per fish. There was no indication that therapeutic management was required yet a unique and abrupt elevation occurred in April. The affected companies promptly increased monitoring frequency, harvested fish and medicated other group(s). Consequently, the lice counts remained slightly elevated (between three and 6.6) for a period of four months (April through July).

- **Lice levels vary between year classes.** The overall abundance of lice on farmed salmon is lower on fish in sea water for one year (juveniles) compared to two year fish (adults). The risk factor associated with this difference appears to be length of time in sea water.

- **Lice levels vary significantly between areas.** Data collected on a site-by-site basis from industry and submitted to government clearly shows that there are areas where lice levels have consistently been very low for years. For example, area 3.1 (Sechelt) has not had its lice abundance exceed the trigger point since monitoring began. With the exception of the winter months (October through January), most other areas also exhibit lice counts that average fewer than 3 motiles per fish.

- **Abundance of lice varies between years**. Data has now been collected over a four year period (2004 -2007 inclusive) using a standardised protocol and reporting structure. Annual comparisons interest some, yet upward or downward trends continue to be points of debate. Direct comparisons are difficult since the location of 'active' and reporting farm sites does change from year-to-year as production cycles end. Annual variation in average lice abundance in all sub-zones is to be expected.

- **Sea lice are naturally occurring parasites of wild fish**. Data collected from wild stocks shows that returning adult salmon can be infected with high numbers of sea lice. Undoubtedly this is part of the natural life history of this parasite with its native salmon host. Concurrent with the coastal migration of wild salmon, Atlantic salmon farms experience a net increase in sea lice. This increased abundance of lice on farmed fish is associated with wild sources and, while the timing can vary by area and timing of the wild salmon migration, generally lice levels on farms predictably increase in the autumn (September to December). Lice levels are generally not seen to decline until mid-winter (January to March) likely due to a number of factors, including: salinity, temperature, lice medication and diminished recruitment from wild salmon.

- **Environmental conditions can affect the occurrence and level of infection on farms.** Information on environmental conditions and their impact on lice survival and reproduction has been documented world wide (Heuch T, J Nordhagen, T Schram 2000; Revie C.W., Gattinby K., Treasurer J.W., Rae G.H., Clarke N. 2002; Tucker C.S., Sommerville S., WootenR., 2000). The two most important factors are temperature and salinity; in general, higher temperature and elevated salinity favours the survival and reproduction of sea lice.

4.9 Sea Lice Abundance on Farmed Atlantic Salmon in the Broughton Archipelago

In 2006, the Pacific Salmon Forum provided research funding to combine the wild salmon and the farm salmon datasets managed by Fisheries and Oceans Canada (DFO) and industry in order to complete a retrospective analysis of spatial and temporal variations in sea lice abundance on farmed salmon and out-migrating wild juvenile salmon in the Broughton Archipelago. This study is not designed to determine causation; however it will provide critical information that is required to further the current knowledge on the spatial and temporal patterns of sea lice levels on farmed and wild salmon and whether or not the patterns are associated. Determining the degree of association will be a key first step to assessing whether there is a causal link between sea lice found on farmed salmon and on wild juvenile salmon in the Broughton Archipelago. The release of the BC Pacific Salmon Forum Final Report is anticipated in early 2008.

In general, the average abundance of motile sea lice on both 1st and 2nd year class Atlantic salmon raised in the Broughton area were well below trigger levels during the wild salmon out-migration season (quarter 2). Figures 22a, 22b and corresponding Tables 7.11.5 and 7.12.5 in the appendices reflect the relevant information pertaining to sub-zone 3.3.

In 2006:

- Two species of lice were most common on farmed salmon: *Lepeophtheirus salmonis, (L. salmonis)* and *Caligus clemensi* (*C. clemensi*).
- The typical seasonal pattern of increasing abundance of motile lice in the fall-winter began in September.

5 Section 5: Therapeutant Use and Monitoring

5.1 Therapeutant Use and Monitoring

The Ministry of Agriculture and Lands monitors the use of therapeutants in food fish production by requiring feed mills to report all prescription orders on an annual basis. In-feed medication is the only available practical method of delivering therapeutants to fish; bath treatments are not permitted in British Columbia.

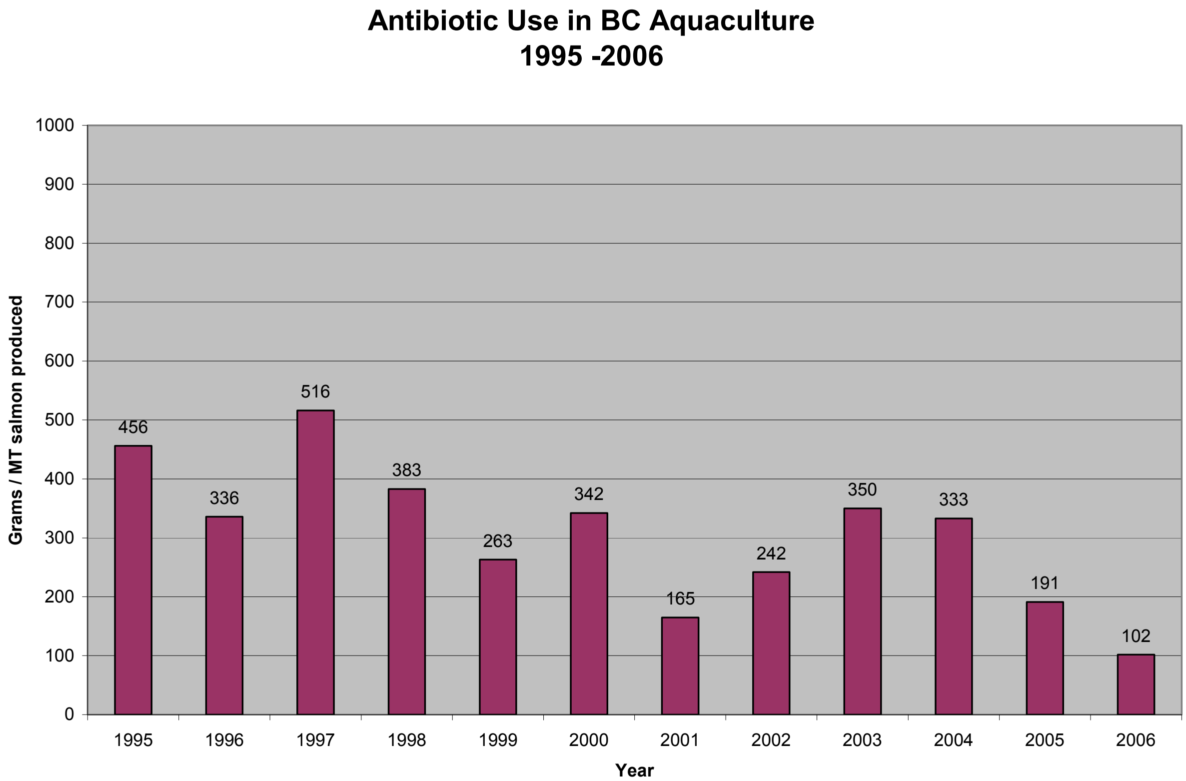
5.1.1 Antibiotics:

Very few drugs are available for use on food fish. Licensed antibiotics include: Terramycin Aqua® (oxytetracycline hydrochloride), Aquaflor® (florfenicol), Tribrissen® (trimethoprim and sulphadiazine), and Romet 30® (ormetoprim and sulphadimethoxine). Broodstock may be medicated using additional drugs if necessary and they may also receive injectable antibiotics, however these fish are not destined for human consumption. Feed mills also report the addition of antibiotics to broodstock diets but the use of injectable products is only tracked by attending veterinarians.

Over the last decade antibiotic use has ranged from a peak of 516 grams of active drug per metric tonne of fish (1997), to a low of 102 grams of drug per metric tonne of fish (2006). It is noteworthy that these annual "grams per metric tonne of fish produced" values include the volume of antibiotics fed to broodstock, meaning that the marketed fish are, in reality, exposed to lower amounts of antibiotic than shown on the bar graph.

Fish do not receive antibiotics in the absence of disease but medications are used to minimise bacterial disease events that may arise seasonally or following a stressor.

Figure 25: Summary of Antibiotic Use in Aquaculture 1995 – 2006 (includes use within broodstock populations).

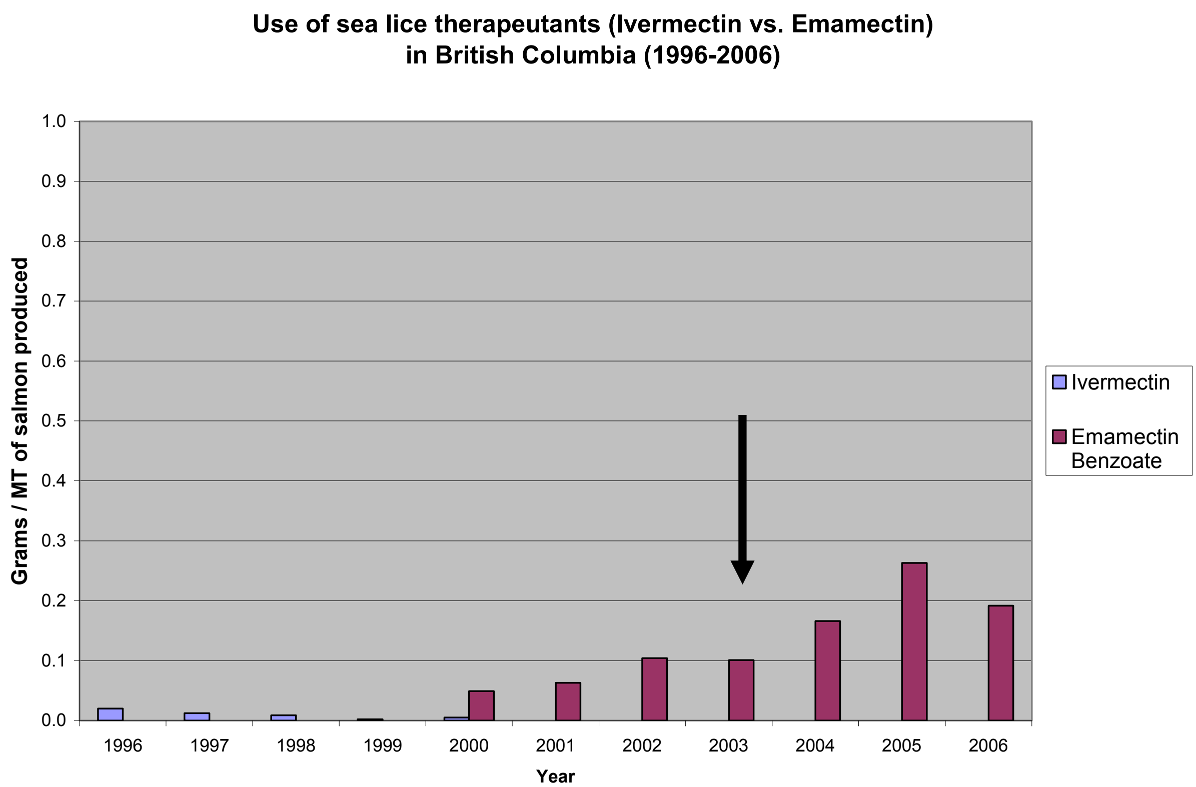


5.1.2 Sea Lice Treatments:

There is only one product available for treatment of sea lice in BC: emamectin benzoate, known as SLICE®. The therapeutant remains in its final stages of the federal approval process under the authority of Health Canada. Currently it is available through an Emergency Drug Release (EDR) program. Emamectin benzoate is an extremely efficacious product for sea lice management in BC and lice levels often remain low for up to 5 months following treatment.

It is noteworthy that treatments for sea lice have increased slightly since the implementation of the sea lice monitoring program and the assignment of a trigger level in 2003. In the past, harvest sized fish would generally not have been treated for lice because the presence of lice on fish causes no measurable ill-effect. With the implementation of the Provincial Sea Lice Management strategy the larger fish are now treated only to minimise any potential effect the lice may have on wild fish fry.

Figure 26: Summary of Use of Sea Lice Products in BC Aquaculture 1996 – 2006, including use within broodstock populations.



(The arrow indicates when the trigger level of 3 motile lice per fish was assigned and subsequently influenced the volume and frequency of therapeutic management)

6 Summary and Conclusions

Since 2003 the BC MAL fish health program has provided an overview of the health of salmon on fish farms in British Columbia and provides regulators with an avenue to enforce disease management on the farms. The basis of the program is the Fish Health Management Plan (FHMP) which is enforceable as a term and condition of licensure. The FHMP requires that marine salmon farmers report on fish health events, mortality levels and causes, and sea lice monitoring and management. Based on this review the following summarizes the findings and conclusions:

The 2006 audit and surveillance data indicates when disease is detected on salmon farms in British Columbia, it has been endemic (naturally occurring) and historically identified in free-ranging wild Pacific salmon. Disease on farms has not been associated with any disease in wild salmon. On the other hand, the occurrence of disease in wild salmon has been the cause of some diseases on farms; for example: IHN virus, Vibriosis. The audit and surveillance program demonstrates that no new disease has been introduced arising from the farming of salmonids in BC waters.

One objective of the audit and surveillance program is to ensure accurate and verifiable data on the health and disease status of cultured fish stocks. This is accomplished by requiring farms to report quarterly on mortality and fish health events that occur amongst farm stocks. The findings of the audit program show strong agreement with BCSFA's Fish Health Event reports in 2006.

Compliance with the Fish Health Management Plans is monitored through on-site inspection and record review during the audit process. There is currently 100% compliance with FHMP on marine salmon farms. Fish Health Management Plans are designed to ensure the highest standards for fish health management are achieved thus minimizing the risk of impact on or transfer of disease to wild stocks.

The objective of the sea lice audit is to provide validated on-site counting protocols and to verify information on the changing status of sea lice infestations on BC salmon farms. Detailed data is available for viewing on the Ministry's website and Appendix 7.11.

The industry has embraced the sea lice management program and has fully complied with the Ministry's requirements for sea lice monitoring. Lice abundance on farms have been below the three motile lice per fish average during the juvenile out-migration or, if greater than the trigger level, the fish were managed accordingly to reduced the number of lice as quickly as possible.

Salmon transferred to marine sites are free of sea lice; marine infestations occur as a result of exposure to sea lice from wild salmon and other marine fishes. Atlantic salmon are known to be one of the most susceptible fishes to sea lice infestations, thus farmed salmon serve as the appropriate sentinel population in British Columbia to indicate any onset of sea lice-induced fish illness or mortality. In other words, any lice-related problems would first arise within marine net pens. Regardless, concerns have been expressed about the impact that sea lice from salmon farms may have on wild juvenile pink salmon, particularly in the Broughton Archipelego. The Province will continue to work with Fisheries and Oceans Canada, the Pacific Salmon Forum and other researchers to continue sea lice monitoring and integrating information into sea lice control strategies.

The Province is committed to continued review and improvement to the Fish Health program through integration of sound scientific information and independent review. The goal is to ensure that the British Columbia aquaculture sector remains productive and sustainable and continues to achieve the highest standards of sea food quality and wholesomeness through fish health management while ensuring the continuing environmental sustainability of wild fish stocks.

7 APPENDICES

7.1 Appendix: List of Mortality Classifications

7.2 Appendix: Map of Fish Health Zones in British Columbia

7.3 Appendix: Active Farm Sites 2006

7.4 Appendix: Bacteriology Findings 2006

7.5 Appendix: Molecular Diagnostics Findings 2006

7.6 Appendix: Disease Case Definitions

7.7 Appendix: Audit Diagnoses 2006

7.8 Appendix: BCSFA Mortality Reports 2006

7.9 Appendix: BCSFA Fish Health Events 2006

7.10 Appendix: Definitions of Sea Lice Stages for Industry Monitoring and Audit Purposes

7.11 Appendix: Sea Lice Audit Tables 2006

7.12 Appendix: Sea Lice BCSFA Reports 2006

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 mortalities 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 indicates the average mortality rate for all Pacific salmon cultured in all zones in fresh water.

Proportional Mortality Rate by Cause

The proportional mortality rate by cause is intended to provide a breakdown of the average mortality rate into the various causes of mortality. The proportional mortality rate should indicate what proportion of the average mortality is due to each of the causes provided. As these reasons vary in fresh and saltwater and by species, reports reflect these differential causes.

Mortality Causes – Freshwater

Data entry starts at the EYED EGG stage and is reported in monthly intervals to the 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.
  - vandalism and acute human induced toxicological events
- Background mortality: Rolled up category that includes all causes that are not culls, systems-related or fresh mortalities, 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
  - Predators

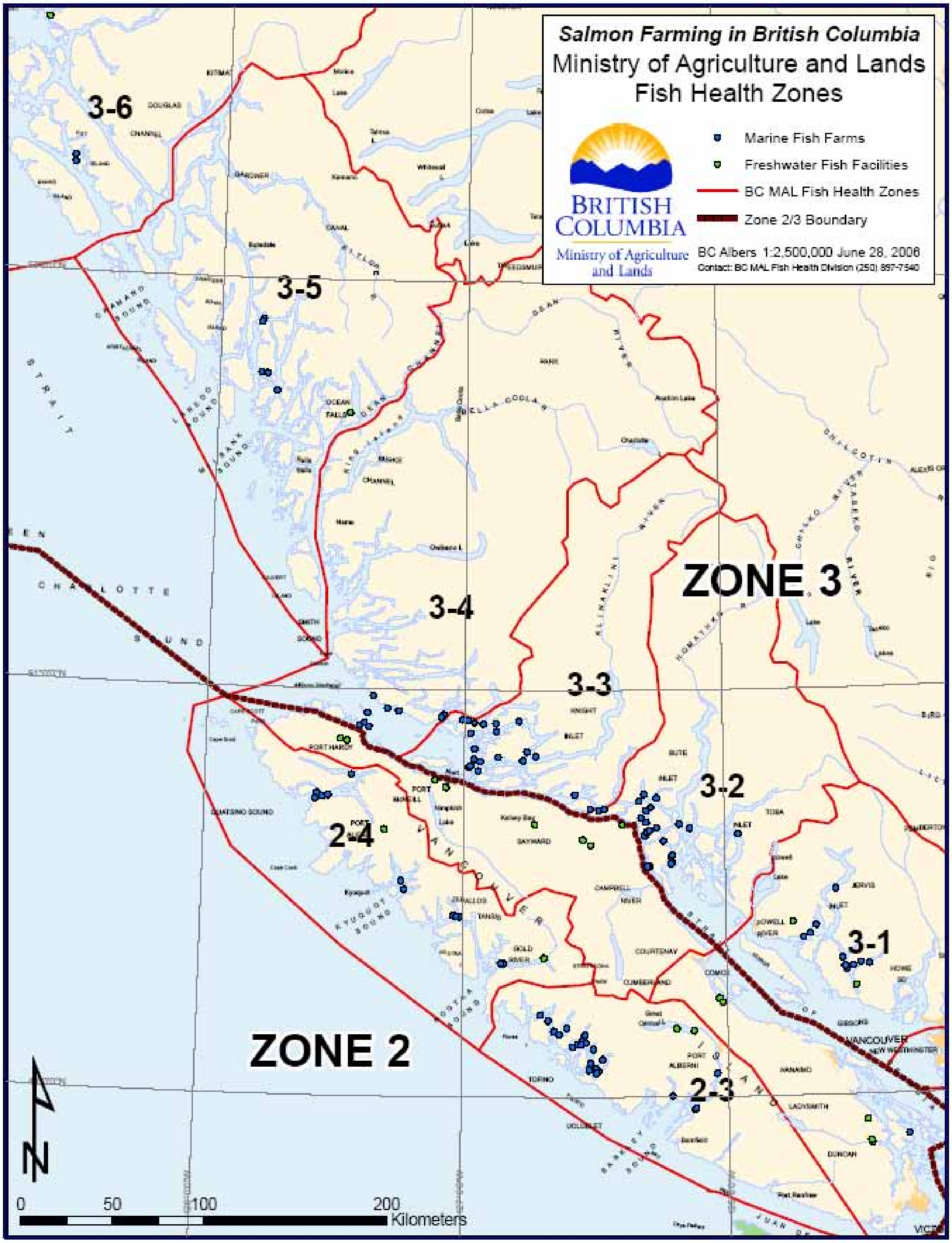
- Fisheries and Oceans Canada (DFO) divides the background mortality category into:
    - Husbandry related- including feed/feeding problems, handling, treatment errors
    - Routine/ daily: mortalities—fungus, predators etc…
- Fresh: Rolled up category that includes total number of "fresh" mortalities
    - Mortalities due to suspected disease
    - Unexplained mortalities
    - Mortalities "of concern"
- DFO puts all fresh morts with unexpectedly high mortality levels and all suspect mortalities – including BGD, parasites, and other disease - into this category.

Mortality Causes – Saltwater

This applies to all seawater farm sites, captive brood stock (DFO) and preliminary rearing of select stocks prior to saltwater release (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 mortalities due to predators
- Environmental: Total number of mortalities due to environment (e.g. algae, low D.O)
- Poor Performers: Total number of mortalities due to poor performers (includes precocious and maturing males and poor performers)
- Handling/Transport: Total number of mortalities due to handling, transport or mechanical damage
- Old: Total number of mortalities not of diagnostic quality (no reliable histological diagnosis)
- Fresh "silvers": Total number of fresh mortalities which may include suspected disease and/or parasite problems (fish sampled by the site/facility, BC Agriculture and Lands or DFO would be included in this category).
- Matures: Jacks – Pacific Species only.

APPENDIX 7.2 Map of Fish Health Zones in British Columbia.



APPENDIX 7.3 Active Farm Sites 2006

Table 7.3.1 Active Salmon Farm Sites 2006

Atlantic Salmon	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Average
Sub-zone 2.3 SW Vancouver. Island	9	9	4	8	7.5 = 8
Sub-zone 2.4 NW Vancouver. Island	6	6	6	7	6.25 = 6
Sub-zone 3.1 Sunshine Coast	3	3	2	2	2.5 = 3
Sub-zone 3.2 Campbell River	7	7	9	11	8.5 = 9
Sub-zone 3.3 Broughton	13	11	9	11	11
Sub-zone 3.4 Pt Hardy	5	6	8	7	6.5 = 7
Sub-zone 3.5 North Coast	4	4	3	3	3.5 = 4
Pacific Salmon					
Zone 2 Vancouver Island	4	3	3	4	3.5 = 4
Zone 3 East of Vancouver Island	9	9	8	5	7.75 = 8
Totals	**60**	**58**	**52**	**59**	**57.3 = 57**

APPENDIX 7.4 Bacteriology Findings 2006

Table 7.4.1: Bacterial Findings for Sub-zone 2.3 (South West Vancouver Island) Atlantic Salmon Farm Audits 2006

Quarter	# farms sampled*	# fish sampled	# of farms with bacteria cultured	Number of positive fish per bacteria^	Bacteria cultured (see pathogen list in Table 7.4.10)
1 Jan - Mar	5	24	0	0	No bacteria cultured
2 Apr – Jun	5	23	2	2	*Carnobacterium gallinarum*
3 July – Sept	2	10	0	0	No bacteria cultured
4 Oct – Dec	4	27	1	2	*Yersinia ruckeri*
Totals	16	84	3	4	

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

^ Not all bacteria cultured are pathogenic, many are opportunists. For a complete listing of the species cultured and their classification as a pathogen or opportunist see Table 7.4.10 of this Appendix.

Figure 7.4.1: Summary of Bacterial Findings from Sub-zone 2.3 Atlantic Salmon Farm Audits 2006

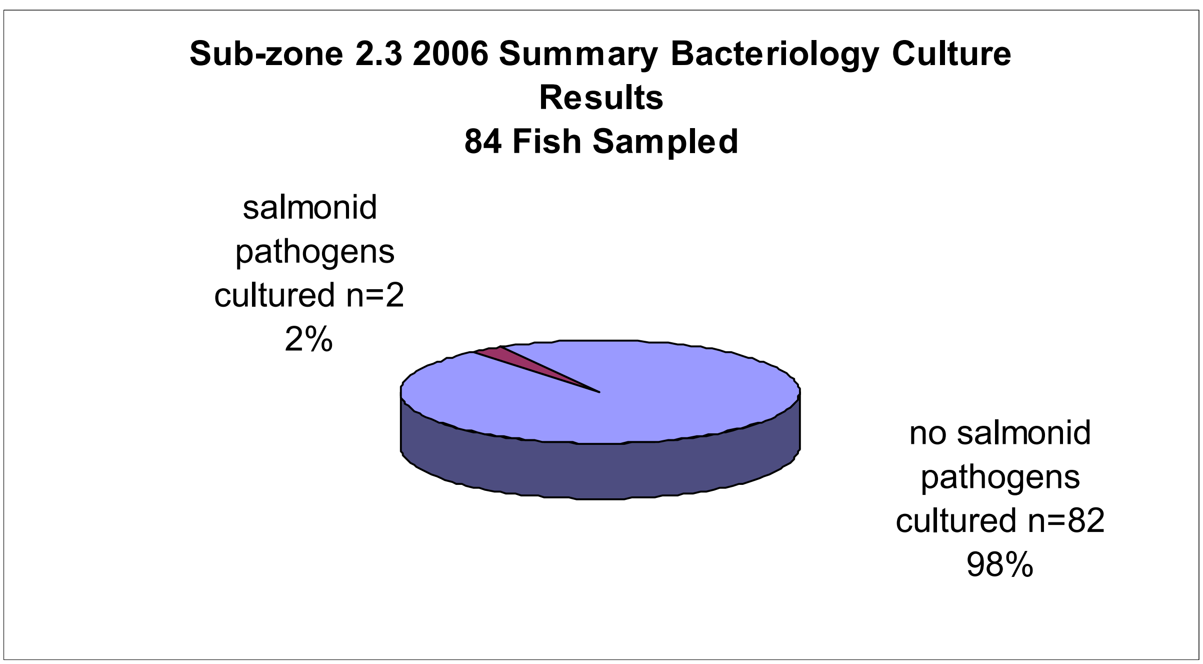


Table 7.4.2 : Bacterial Findings for Sub-zone 2.4 (North West Vancouver Island) Atlantic Salmon Farm Audits 2006					
Quarter	**# farms sampled**	**# fish sampled**	**# of farms with bacteria cultured**	**Number of positive fish per bacteria**	**Bacteria cultured**
1 Jan - Mar	3	18	1	1	*Aeromonas salmonicida*
2 Apr - Jun	3	15	0	0	No bacteria cultured
3 July - Sept	4	28	0	0	No bacteria cultured
4 Oct - Dec	3	22	1	1	*Aeromonas salmonicida*
				1	*Vibrio logei*
				1	*Photobacterium leiognathi*
Totals	13	83	2	4	

Figure 7.4.2: Summary of Bacterial Findings from Sub-zone 2.4 Atlantic Salmon Farm Audits 2006

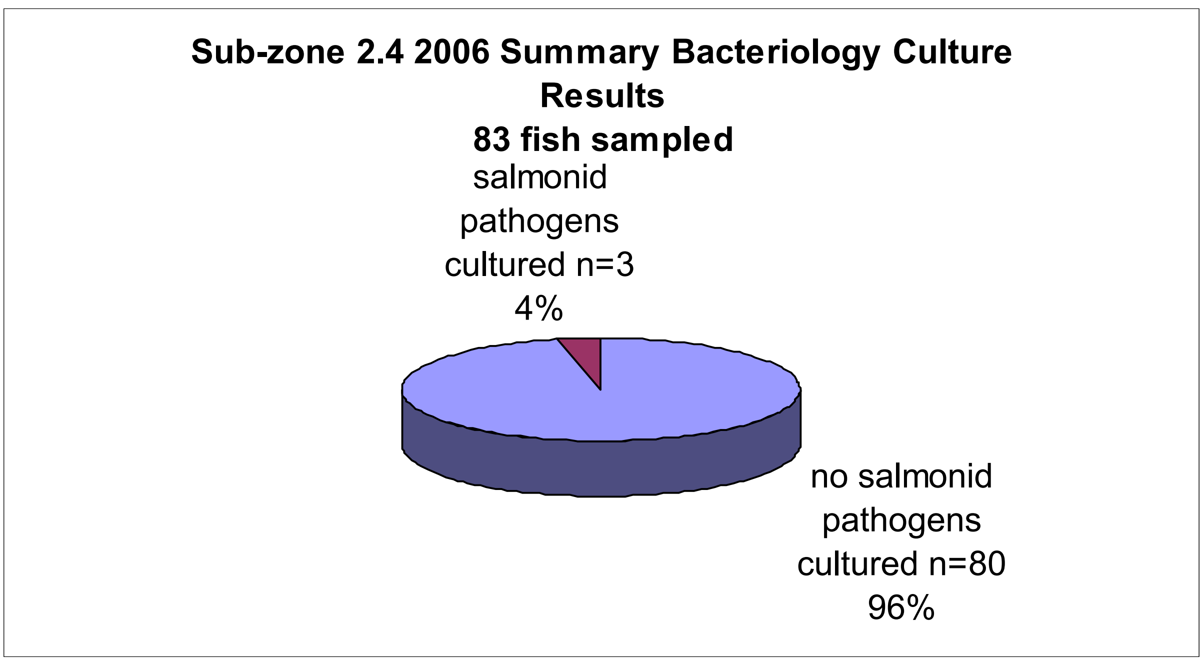


Table 7.4.3: Bacterial Findings for Sub-zone 3.1 (Sunshine Coast) Atlantic Salmon Farm Audits 2006					
Quarter	**# farms sampled**	**# fish sampled**	**# of farms with bacteria cultured**	**Number of positive fish per bacteria**	**Bacteria cultured**
1 Jan – Mar	2 (1)	1	0	0	No bacteria cultured
2 Apr – Jun	1	4	0	0	No bacteria cultured
3 July – Sept	1 (0)	0	0	0	No bacteria cultured
4 Oct – Dec	1 (0)	0	0	0	No bacteria cultured
Totals	2	5	0	0	

Figure 7.4.3: Summary of Bacterial Findings from Sub-zone 3.1 Atlantic Salmon Farm Audits 2006

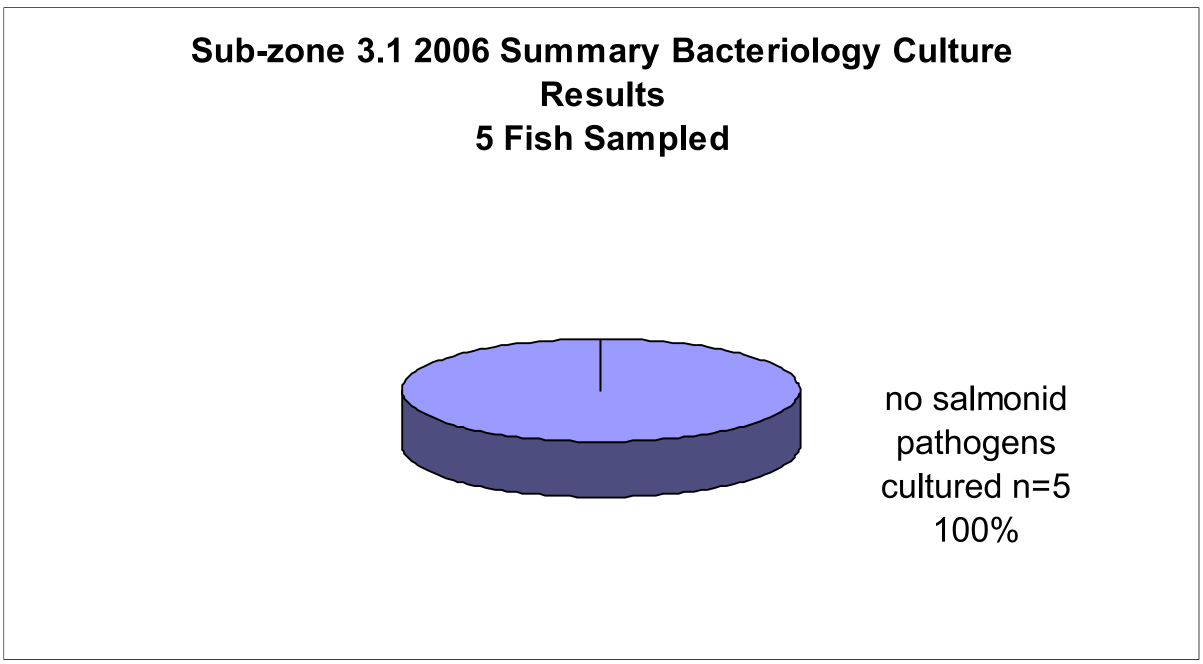


Table 7.4.4: Bacterial Findings for Sub-zone 3.2 (Campbell River) Atlantic Salmon Farm Audits 2006

Quarter	# farms sampled	# fish sampled	# of farms with bacteria cultured	Number of positive fish per bacteria	Bacteria cultured
1 Jan – Mar	4	23	1	1	*Carnobacterium sp.*
2 Apr – Jun	4 (3)	27	2	1	*Vibrio tasmaniensis*
				1	*Carnobacterium sp*
3 July – Sept	5	36	0	0	No bacteria cultured
4 Oct – Dec	5	58	2	3	*Yersinia ruckeri*
				2	*Vibrio aestuarianus*
				1	*Shewanella putrefaciens*
				1	*Aeromonas hydrophila*
Totals	17	144	5	1	

Figure 7.4.4: Summary of Bacterial Findings from Sub-zone 3.2 Atlantic Salmon Farm Audits 2006

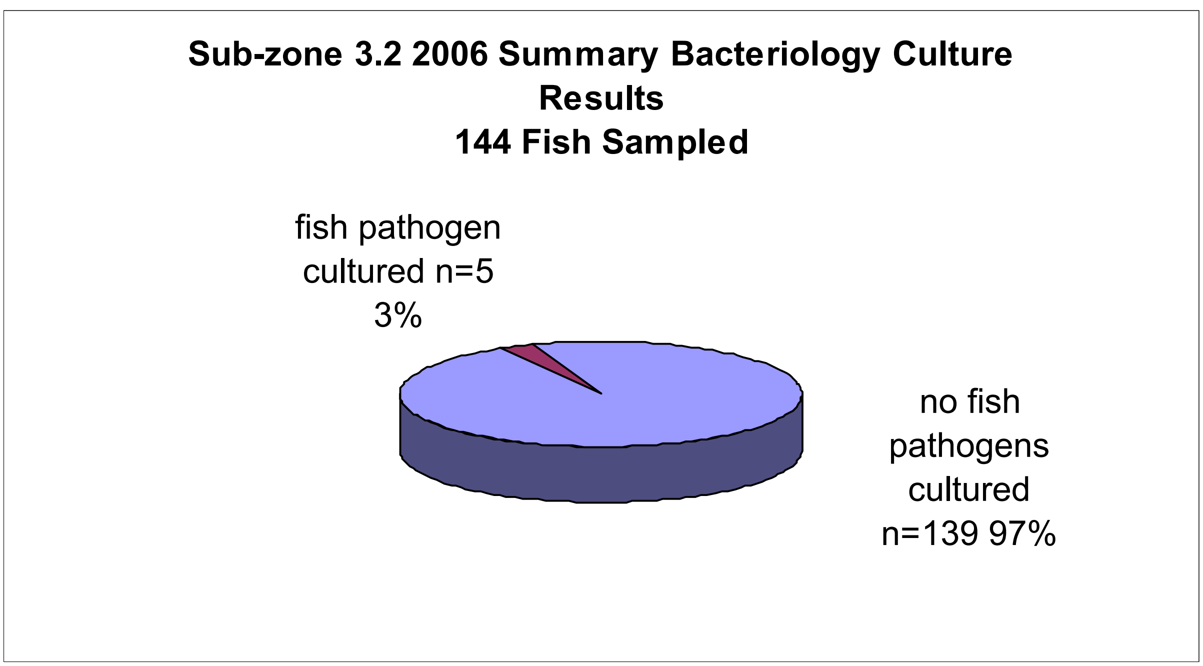


Table 7.4.5: Bacterial Findings for Sub-zone 3.3 (Broughton) Atlantic Salmon Farm Audits 2006

Quarter	# farms sampled	# fish sampled	# of farms with bacteria cultured	Number of positive fish per bacteria	Bacteria cultured
1 Jan – Mar	7	38	2	4	*Yersinia ruckeri*
				1	*Vibrio logei*
2 Apr – Jun	6	25	0	0	No bacteria cultured
3 July – Sept	5 (3)	11	1	1	*Vibrio fluvialis*
				1	*Listonella anguillarum*
4 Oct – Dec	6	47	3	1	*Bacillus psychrosaccharolyticus*
				1	*Photobacterium phosphoreum*
				1	*Rahnella aquatalis*
				1	*Shewanella hanedai*
				1	*Vibrio fischeri*
Totals	22	121	6	8	

Figure 7.4.5: Summary of Bacterial Findings from Sub-zone 3.3 Atlantic Salmon Farm Audits 2006

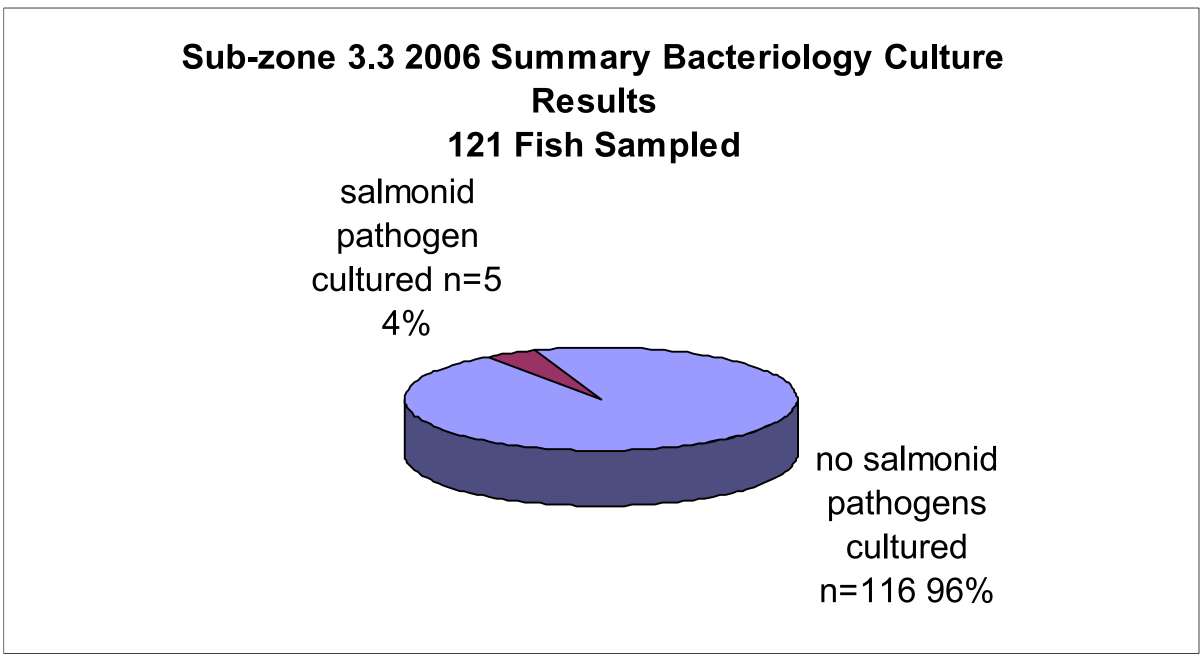


Table 7.4.6: Bacterial Findings for Sub-zone 3.4 (Port Hardy) Atlantic Salmon Farm Audits 2006					
Quarter	**# farms sampled**	**# fish sampled**	**# of farms with bacteria cultured**	**Number of positive fish per bacteria**	**Bacteria cultured**
1 Jan – Mar	2 (1)	6	1	1	*Pseudomonas fluorescens*
2 Apr – Jun	3 (2)	11	0	0	No bacteria cultured
3 July – Sept	5 (4)	30	0	0	No bacteria cultured
4 Oct – Dec	3 (0)	0	0	0	NA
Totals	7	47	1	1	

Figure 7.4.6: Summary of Bacterial Findings from Sub-zone 3.4 Atlantic Salmon Farm Audits 2006

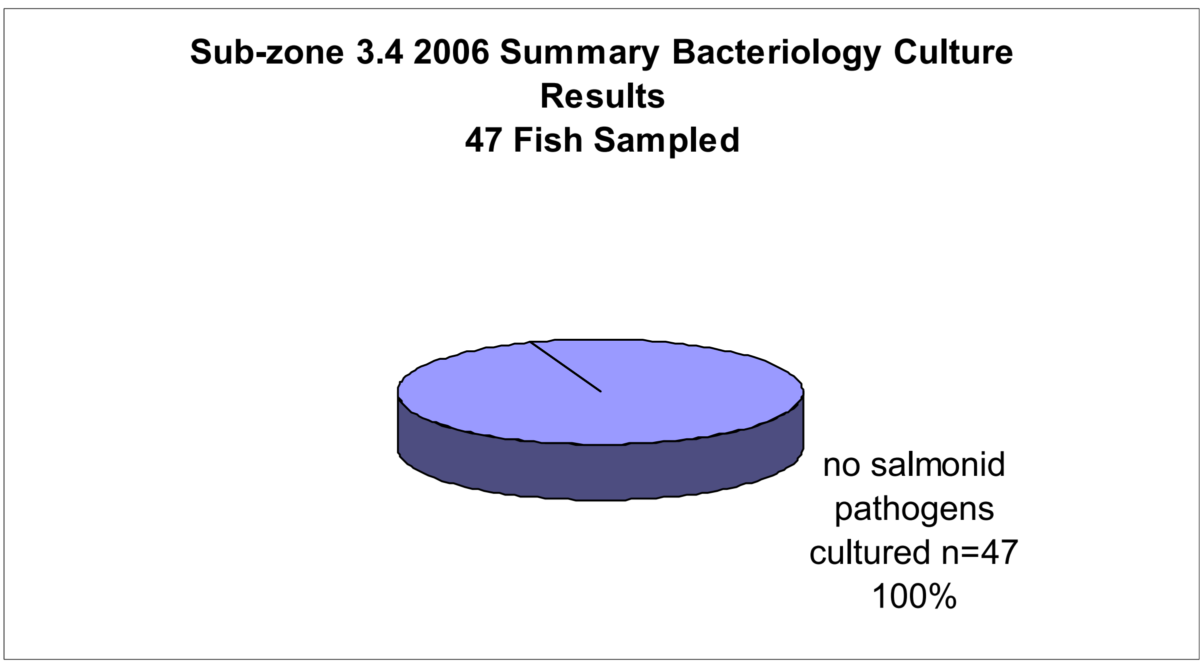


Table 7.4.7: Bacterial Findings for Sub-zone 3.5 (Central Coast) Atlantic Salmon Farm Audits 2006					
Quarter	**# farms sampled**	**# fish sampled**	**# of farms with bacteria cultured**	**Number of positive fish per bacteria**	**Bacteria cultured**
1 Jan – Mar	2	5	0	0	No bacteria cultured
2 Apr – Jun	2	11	0	0	No bacteria cultured
3 July – Sept	2	10	0	0	No bacteria cultured
4 Oct – Dec	2 (0)	0	0	0	Not applicable
Totals	6	26	0	0	

Figure 7.4.7: Summary of Bacterial Findings from Sub-zone 3.5 Atlantic Salmon Farm Audits 2006

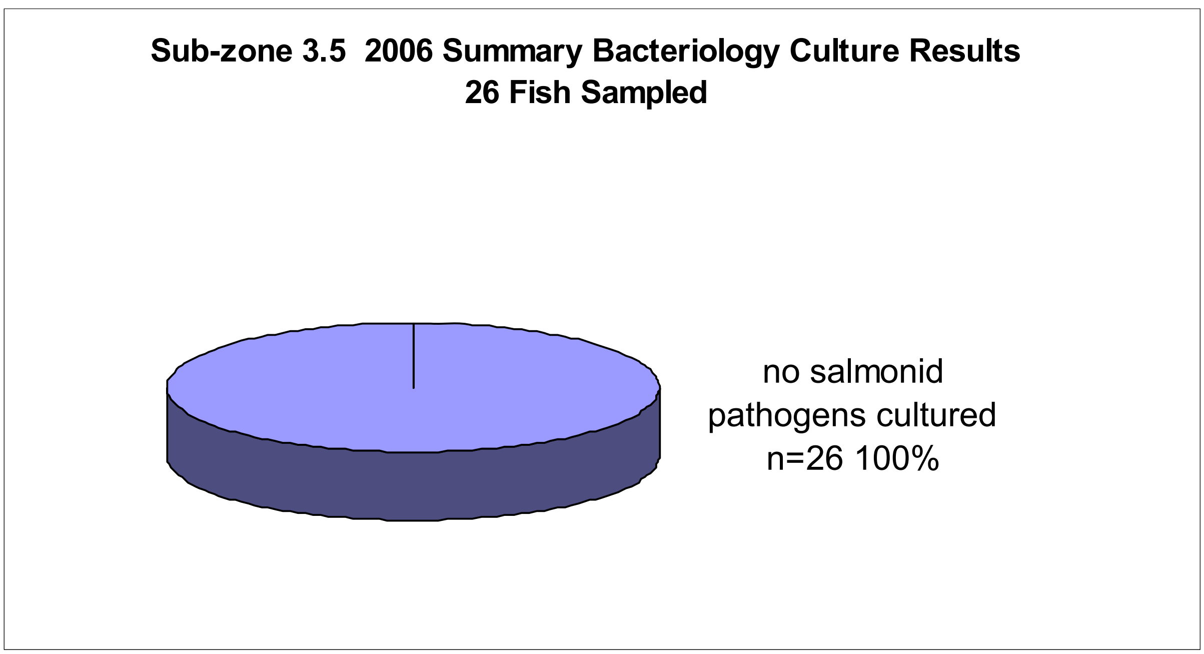


Table 7.4.8: Bacterial Findings for Zone 2 (Vancouver Island) Pacific Salmon Farm Audits 2006

Quarter	# farms sampled	# fish sampled	# of farms with bacteria cultured	Number of positive fish per bacteria	Bacteria cultured
1 Jan – Mar	2 (1)	4	0	0	No bacteria cultured
2 Apr – Jun	1	3	0	0	No bacteria cultured
3 July –Sept	2 (1)	7	0	0	No bacteria cultured
4 Oct – Dec	2	29	1	1	*Photobacterium phosphoreum*
Totals	5	43	1	1	

Figure 7.4.8: Summary of Bacterial Findings from Zone 2 Pacific Salmon Farm Audits 2006

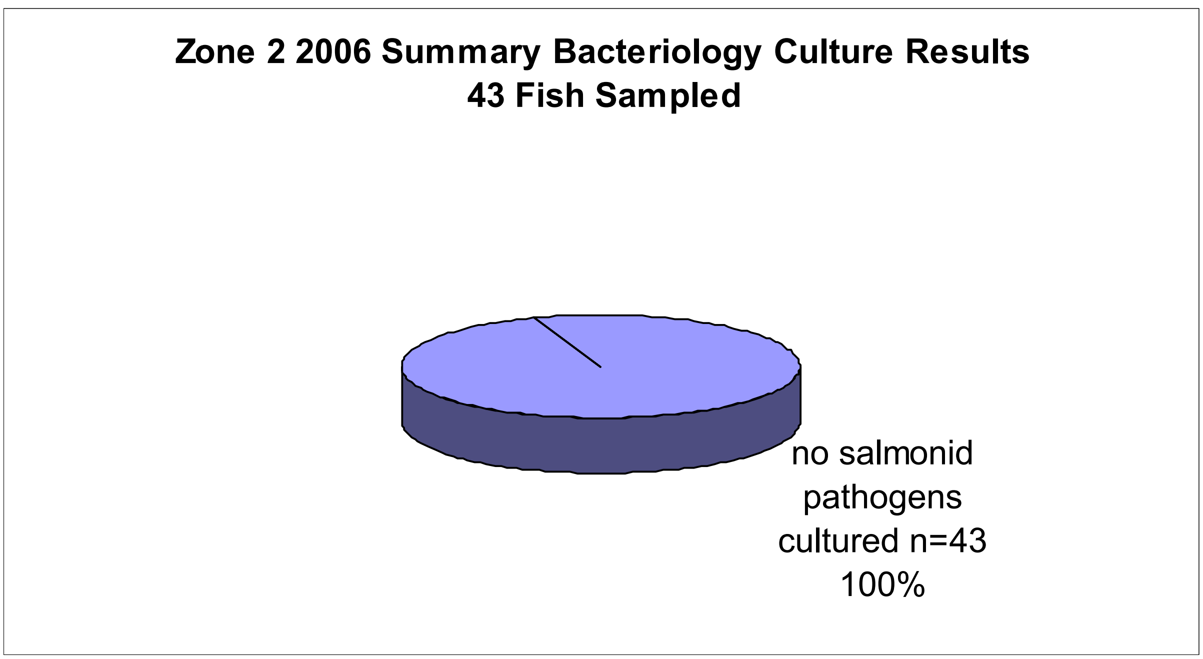


Table 7.4.9: Bacterial Findings for Zone 3 (East of Vancouver Island) Pacific Salmon Farm Audits 2006					
Quarter	**# farms sampled**	**# fish sampled**	**# of farms with bacteria cultured**	**Number of positive fish per bacteria**	**Bacteria cultured**
1 Jan – Mar	4 (3)	16	1	1	*Carnobacterium sp.*
				1	*Vibrio logei*
2 Apr - Jun	5	26	1	1	*Listonella anguillarum*
3 July – Sept	4 (2)	9	0	0	No bacteria cultured
4 Oct – Dec	4	40	1	1	*Vibrio proteolyticus*
Totals	14	91	3	4	

Figure 7.4.9: Summary of Bacterial Findings from Zone 3 Pacific Salmon Farm Audits 2006

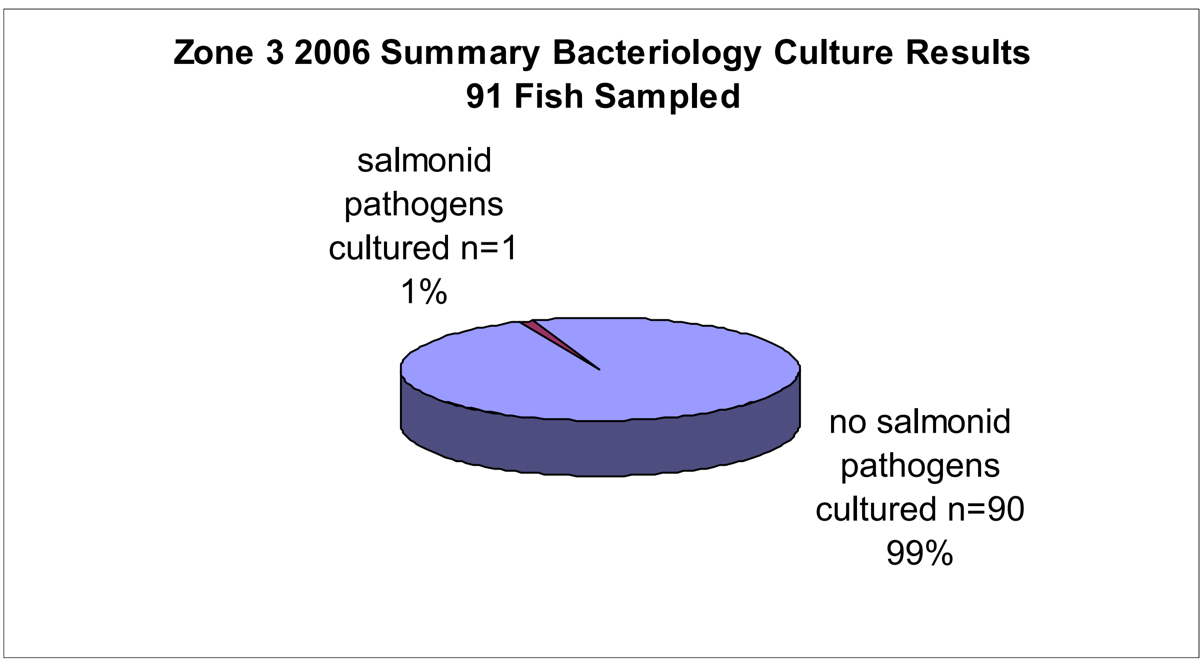


Table 7.4.10: Summary of Bacteria Cultured 2006	
Salmon Pathogens	**Opportunists / Environmental**
Aeromonas salmonicida *Aeromonas hydrophila*	*Carnobacterium sp.* *Carnobacterium gallinaru*
Listonella anguillarum	*Vibrio logei* *Vibrio fischeri* *Vibrio aestuarianus* *Vibrio proteolyticus* *Vibrio tasmaniensis* *Vibrio fluvialis* *Photobacterium leiognathi* *Photobacterium phosphoreum*
Yersinia ruckeri	*Bacillus psychrosaccharolyticus* *Rahnella aquatalis* *Shewanella putrefaciens* *Shewanella hanedai* *Pseudomonas fluorescens*

APPENDIX 7.5 Molecular Diagnostics Findings 2006

Table 7.5.1: Molecular Testing Results for Sub-zone 2.3 (SW Vancouver Island) Atlantic Salmon Farm Audits 2006

Quarter	# farms sampled	# fish sampled	Number of Molecular Tests					Positive Sites	Organism Identified
			IHNV	IPNV	ISAV	Ricke t-tsia	VHSv-NAS		
1 Jan-Mar	5	24	9	9	9	9	9	3	VHSv NAS
2 Apr-Jun	5	23	6	6	6	6	6	0	None
3 Jul-Sep	2	10	4	4	4	4	4	0	None
4 Oct-Dec	4	27	7	7	7	7	7	1	*Piscirickettsia salmonis*
								1	VHSv NAS
Totals	**16**	**84**	26	26	26	26	26	**5**	

Figure 7.5.1: Summary of Molecular Diagnostics Findings from Sub-zone 2.3 Atlantic Salmon Farm Audits 2006

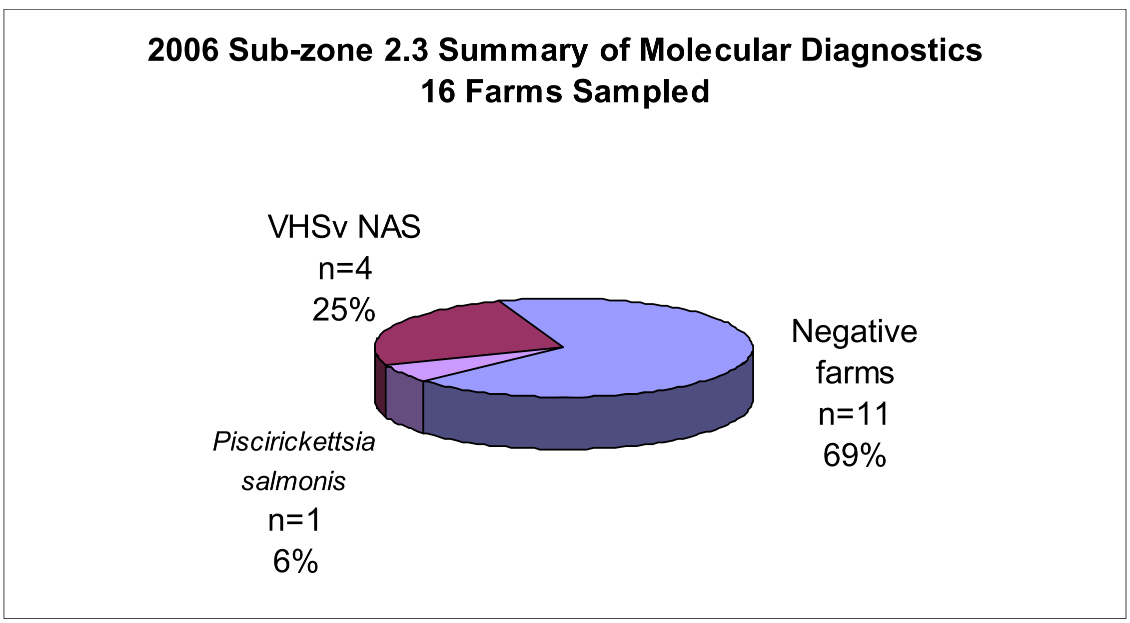


Table 7.5.2: Molecular Testing Results for Sub-zone 2.4 (North West Vancouver Island) Atlantic Salmon Farm Audits 2006										
Quarter	# farms sampled	# fish sampled	Number of Molecular Tests					Positive Sites	Organism Identified
			IHNV	IPNV	ISAV	Ricket-tsia	VHSv-NAS		
1 Jan-Mar	3	18	6	6	6	6	6	0	None
2 Apr-Jun	3	15	6	6	6	6	6	0	None
3 Jul-Sep	4	28	9	9	9	9	9	1	*Piscirickettsia salmonis*
4 Oct-Dec	3	22	6	6	6	6	6	0	None
Totals	**13**	**83**	27	27	27	27	27	**1**	

Figure 7.5.2: Summary of Molecular Diagnostics Findings from Sub-zone 2.4 Atlantic Salmon Farm Audits 2006

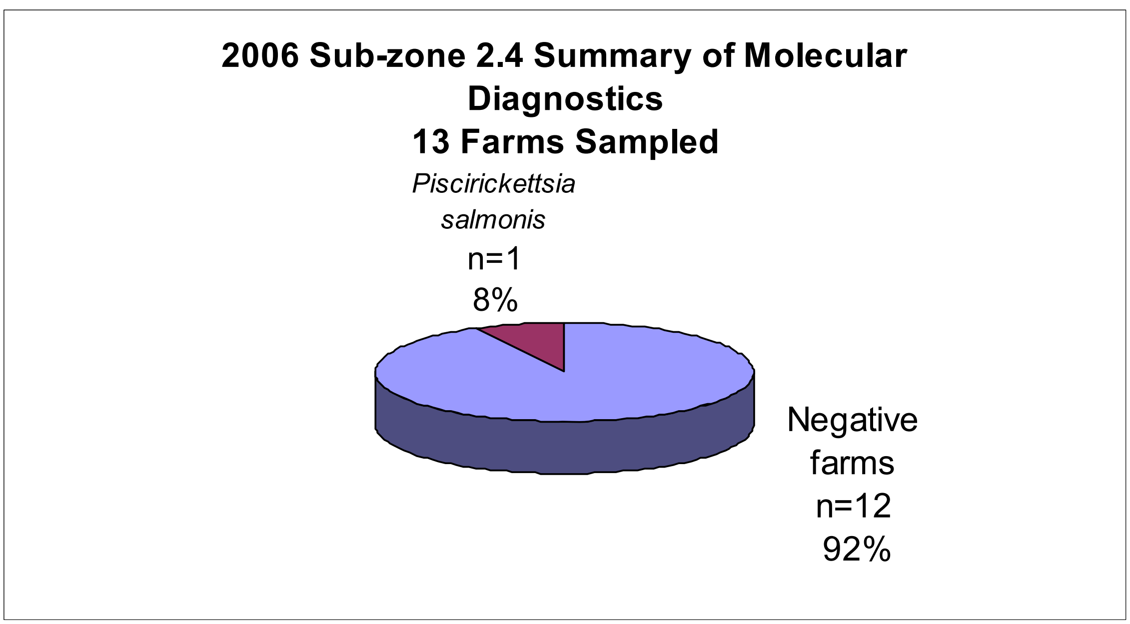


Table 7.5.3: Molecular Testing Results for Sub-zone 3.1 (Sunshine Coast) Atlantic Salmon Farm Audits 2006									
Quarter	**# farms sampled**	**# fish sampled**	**Number of Molecular Tests**					**Positive Sites**	**Organism Identified**
			IHNV	**IPNV**	**ISAV**	**Ricke t-tsia**	**VHSv-NAS**		
1 Jan-Mar	1	1	1	1	1	1	1	0	None
2 Apr-Jun	1	4	2	2	2	2	2	0	None
3 Jul-Sep	0	0	0	0	0	0	0	0	None
4 Oct-Dec	0	0	0	0	0	0	0	0	None
Totals	**2**	**5**	3	3	3	3	3	**0**	

Figure 7.5.3: Summary of Molecular Diagnostics Findings from Sub-zone 3.1 Atlantic Salmon Farm Audits 2006

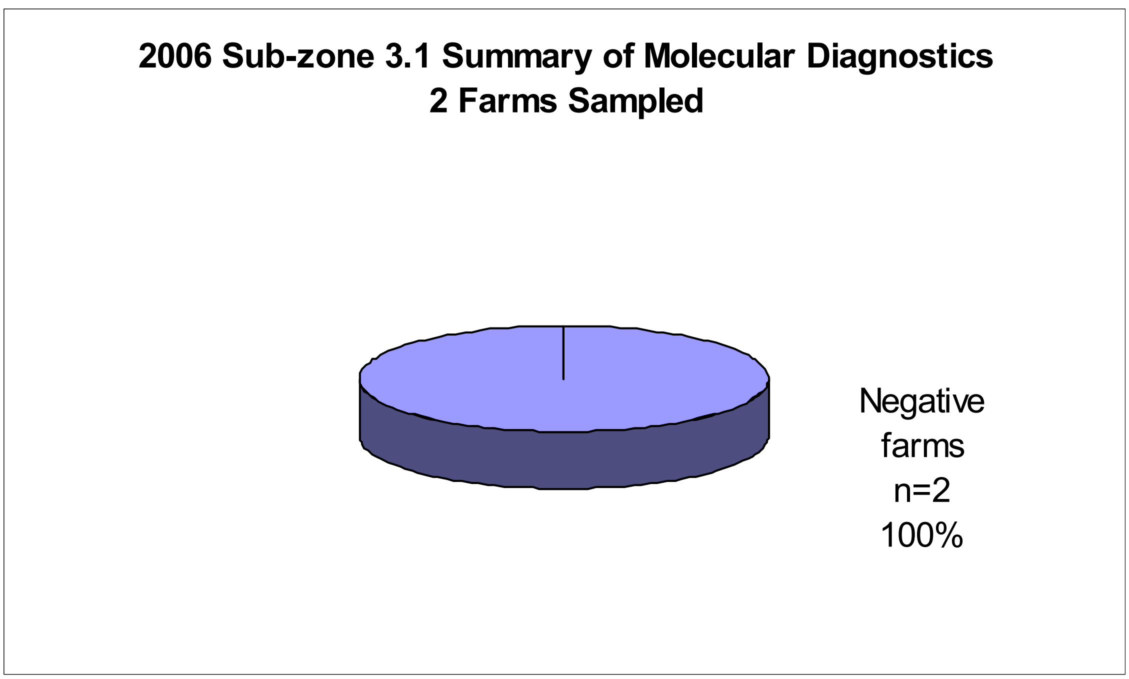


Table 7.5.4: Molecular Testing Results for Sub-zone 3.2 (Campbell River) Atlantic Salmon Farm Audits 2006									
Quarter	**# farms sampled**	**# fish sampled**	**Number of Molecular Tests**					**Positive Sites**	**Organism Identified**
			IHNV	**IPNV**	**ISAV**	**Ricket-tsia**	**VHSv-NAS**		
1 Jan-Mar	4	23	7	7	7	7	7	0	None
2 Apr-Jun	3	27	7	7	7	7	7	0	None
3 Jul-Sep	5	36	11	11	11	11	11	0	None
4 Oct–Dec	5	58	14	14	14	14	14	0	None
Totals	**17**	**144**	39	39	39	39	39	**0**	

Figure 7.5.4: Summary of Molecular Diagnostics Findings from Sub-zone 3.2 Atlantic Salmon Farm Audits 2006

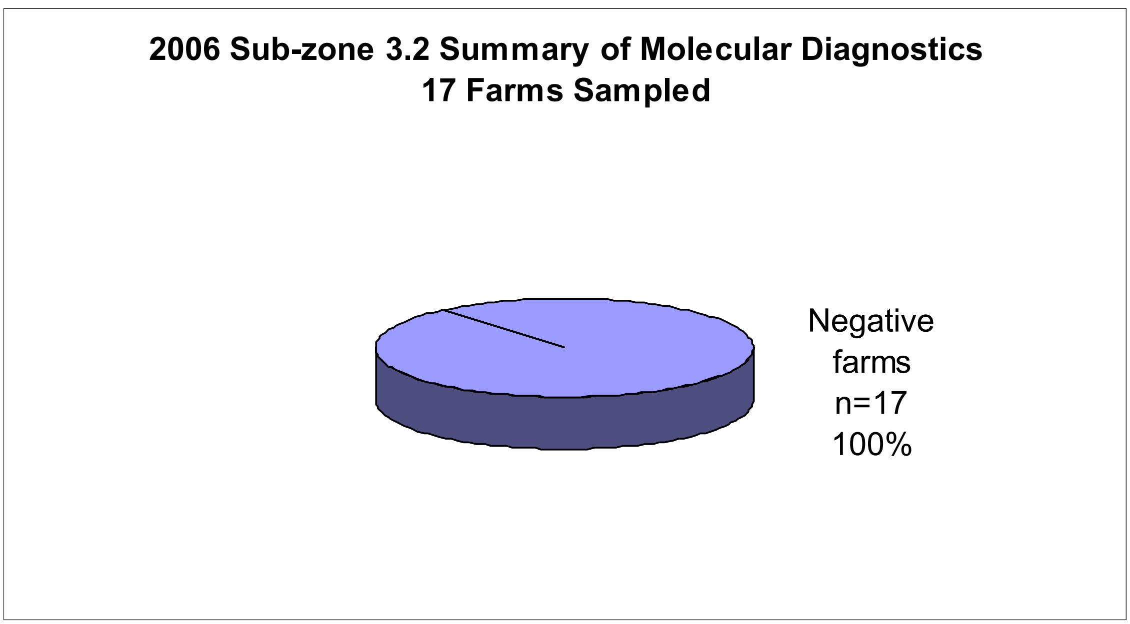


Table 7.5.5: Molecular Testing Results for Sub-zone 3.3 (Broughton) Atlantic Salmon Farm Audits 2006

Quarter	# farms sampled	# fish sampled	Number of Molecular Tests					Positive Sites	Organism Identified
			IHNV	IPNV	ISAV	Ricke t-tsia	VHSv-NAS		
1 Jan-Mar	7	38	13	13	13	13	13	0	None
2 Apr-Jun	6	25	10	10	10	10	10	0	None
3 Jul-Sep	3	11	4	4	4	4	4	0	None
4 Oct-Dec	6	47	12	12	12	12	12	0	None
Totals	**22**	**121**	39	39	39	39	39	**0**	

Figure 7.5.5: Summary of Molecular Diagnostics Findings from Sub-zone 3.3 Atlantic Salmon Farm Audits 2006

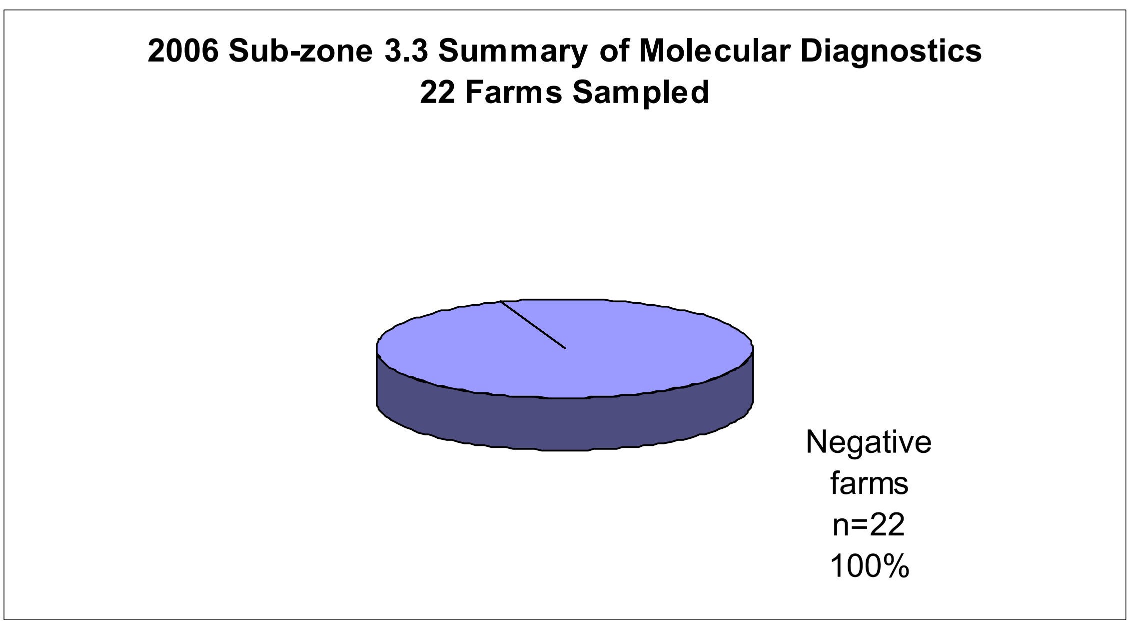


Table 7.5.6: Molecular Testing Results for Sub-zone 3.4 (Port Hardy) Atlantic Salmon Farm Audits 2006									
Quarter	# farms sampled	# fish sampled	Number of Molecular Tests					Positive Sites	Organism Identified
			IHNV	IPNV	ISAV	Ricket-tsia	VHSv NAS		
1 Jan-Mar	1	6	2	2	2	2	2	0	None
2 Apr-Jun	2	11	4	4	4	4	4	0	None
3 Jul-Sep	4	30	8	8	8	8	8	0	None
4 Oct-Dec	0	0	0	0	0	0	0	0	None
Totals	**7**	**47**	14	14	14	14	14	**0**	

Figure 7.5.6: Summary of Molecular Diagnostics Findings from Sub-zone 3.4 Atlantic Salmon Farm Audits 2006

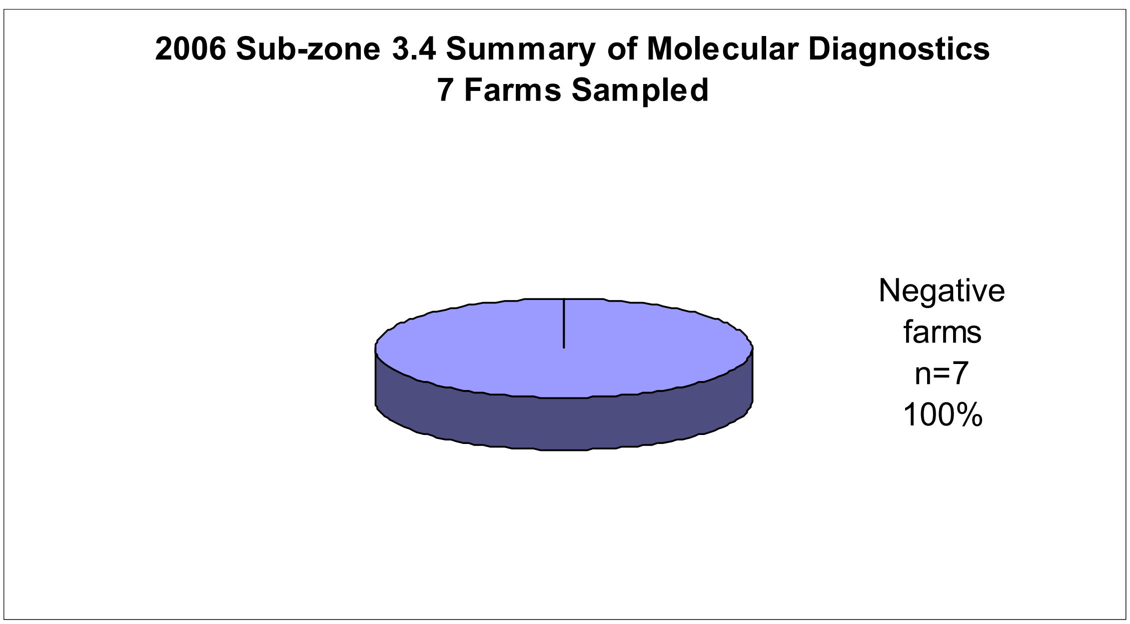


Table 7.5.7: Molecular Testing Results for Sub-zone 3.5 (Central Coast) Atlantic Salmon Farm Audits 2006

Quarter	# farms sampled	# fish sampled	Number of Molecular Tests					Positive Sites	Organism Identified
			IHNV	IPNV	ISAV	Ricket -tsia	VHSv NAS		
1 Jan-Mar	2	5	2	2	2	2	2	0	None
2 Apr-Jun	2	11	4	4	4	4	4	0	None
3 Jul-Sep	2	10	4	4	4	4	4	0	None
4 Oct-Dec	0	0	0	0	0	0	0	0	None
Totals	**6**	**26**	10	10	10	10	10	**0**	

Figure 7.5.7: Summary of Molecular Diagnostics Findings from Sub-zone 3.5 Atlantic Salmon Farm Audits 2006

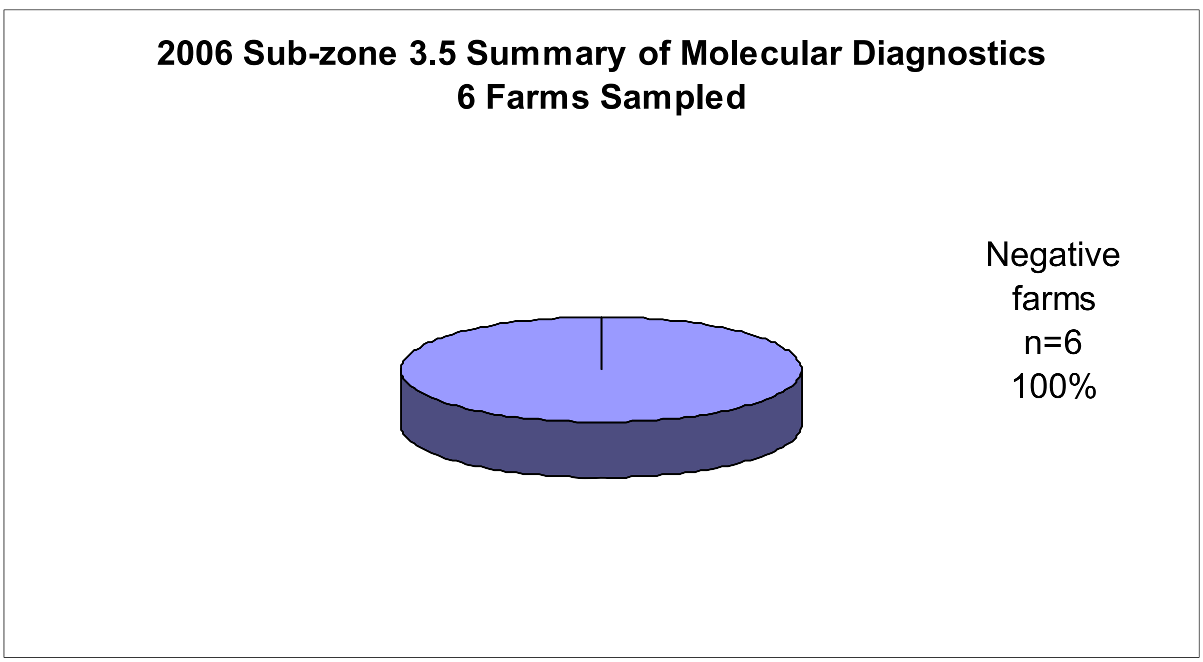


Table 7.5.8: Molecular Testing Results for Zone 2 (Vancouver Island) Pacific Salmon Farm Audits 2006									
Quarter	**# farms sampled**	**# fish sampled**	**Number of Molecular Tests**					**Positive Sites**	**Organism Identified**
			IHNV	**IPNV**	**ISAV**	**Ricke t-tsia**	**VHSv-NAS**		
1 Jan-Mar	1	4	2	2	2	2	2	0	None
2 Apr-Jun	1	3	1	1	1	1	1	0	None
3 Jul-Sep	1	7	2	2	2	2	2	1	*Piscirickettsia salmonis*
4 Oct-Dec	2	29	7	7	7	7	7	2	*Piscirickettsia salmonis*
Totals	**5**	**43**	12	12	12	12	12	**3**	

Figure 7.5.8: Summary of Molecular Diagnostics Findings from Zone 2 Pacific Salmon Farm Audits 2006

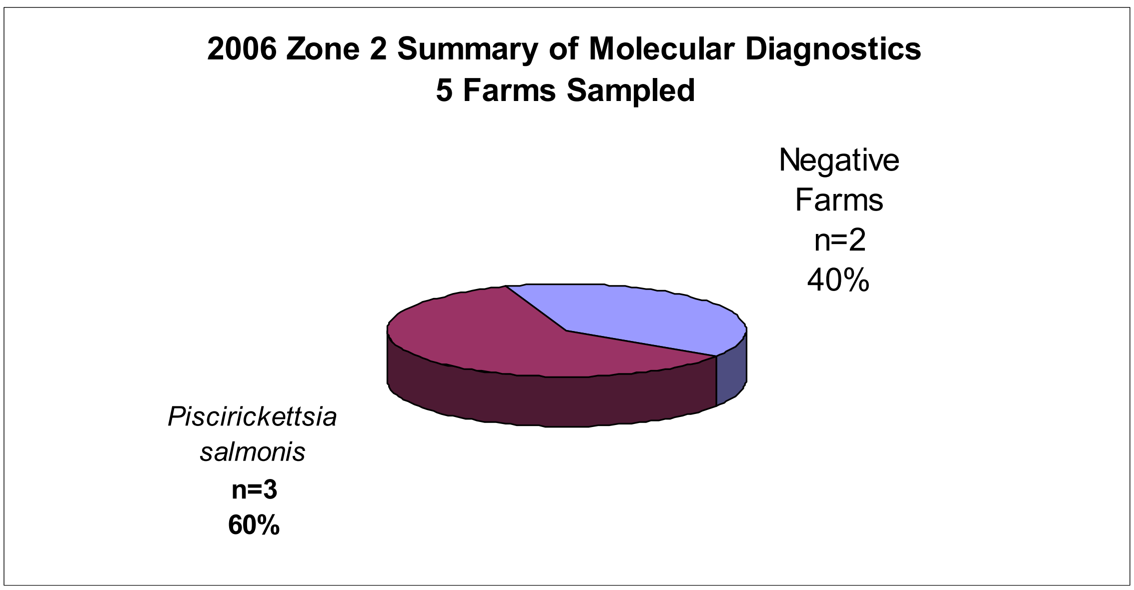
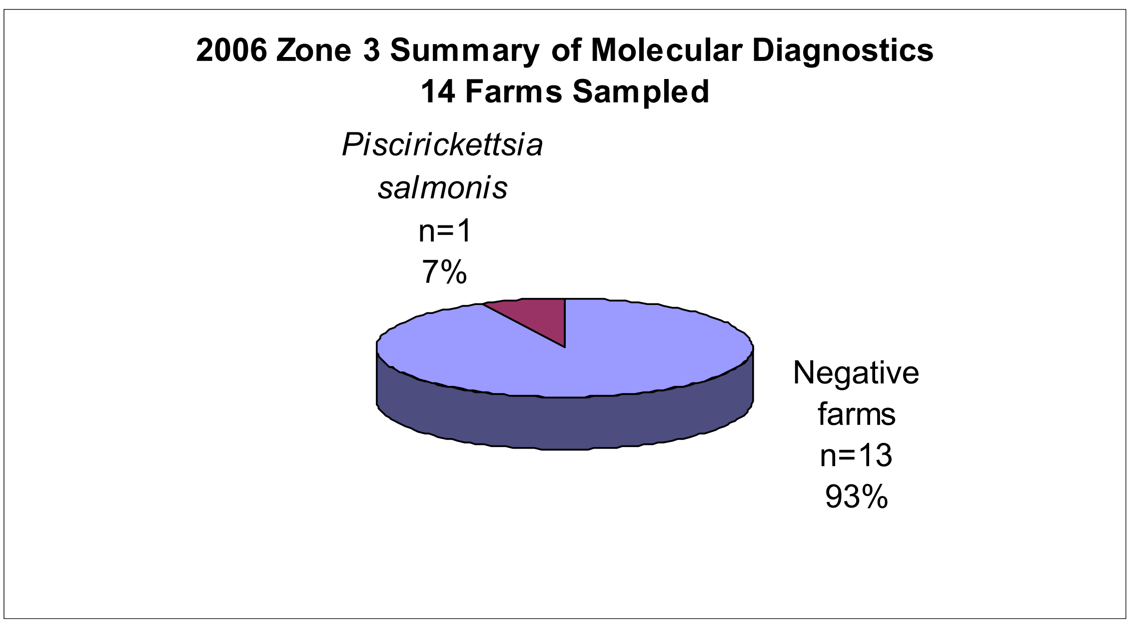


Table 7.5.9: Molecular Testing Results for Zone 3 (East Coast Vancouver Island) Pacific Salmon Farm Audits 2006

Quarter	# farms sampled	# fish sampled	Number of Molecular Tests					Positive Sites	Organism Identified
			IHNV	IPNV	ISAV	Ricke t-tsia	VHSv-NAS		
1 Jan-Mar	3	16	5	5	5	5	5	0	None
2 Apr-Jun	5	26	9	9	9	9	9	0	None
3 Jul-Sep	2	9	2	2	2	2	2	0	None
4 Oct-Dec	4	40	11	11	11	11	11	1	*Piscirickettsia salmonis*
Totals	**14**	**91**	27	27	27	27	27	**1**	

Figure 7.5.9: Summary of Molecular Diagnostics Findings from Zone 3 Pacific Salmon Farm Audits 2006



APPENDIX 7.6 Disease Case Definitions

Bacterial Kidney Disease: 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 and population level mortalities.

BKD is almost always found in Pacific Salmon Populations at some level. A Pacific salmon farm is diagnosed as positive for BKD if the farm is under treatment for the disease or 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 disease caused by a gram negative septicaemia with *Aeromonas salmonicida*. Furunculosis is diagnosed in an Atlantic salmon population when the site is under treatment for the disease or when sampled fish show septicaemia and population.

Furunculosis rarely occurs in farmed Pacific salmon populations however the definition would be the same as for Atlantic salmon with the disease.

Infectious Haematopoietic Necrosis: A viral septicaemia caused by a rhabdovirus. Atlantic salmon have no natural immunity to IHNv and it is diagnosed on a farm by a positive PCR for the pathogen and confirmation by cell culture. High level losses are evident within 7 to 10 days post initial infection. Farmed Chinook and Coho salmon are refractory to infection.

Loma salmonae: An endemic disease of Pacific Salmonids characterized by the presence of xenomas in the gill, pseudobranch, heart, kidney and splenic tissues. Loma is a microsporidian parasite found in fresh and saltwater populations of wild fish and in farmed Chinook salmon. Farmed Chinook can experience significant mortality due to this parasite especially when water temperatures are between 15 - 17C.

Marine Anaemia: An endemic disease of farmed Pacific salmon characterized by marked gill pallor, renosplenomegaly, ascites and exophthalmia. The cause of this disease is uncertain but it is thought to be associated with a retroviral infection. Marked hemoblast proliferation is the histopathological hallmark of the disease. Atlantic salmon are unaffected by marine anaemia.

Mouth Myxobacteriosis: A production disease that occurs in Atlantic salmon smolts upon entry to sea water; the disease is worse on spring entered smolts than it is for fall entered smolts. It is characterized by pinhole lesions in the mouth that can progress to mouth and face necrosis. *Flexibacter maritimus* is associated with the lesions but it is not know if it is the actually cause of the disease or an associated factor.

Net Pen Liver Disease: A liver condition of farmed Atlantic salmon thought to be associated with the algal toxin Microcystin LR. It is characterized by hepatic necrosis and hepatocellular megalocytosis.

Post Vaccination Peritonitis (PVP): The presence of adhesions and peritonitis in Atlantic and Pacific salmon subsequent to IP vaccination with oil based vaccines. PVP can decrease fish productivity and result in downgrades at harvest due to adhesions and flesh melanisation.

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

Viral Haemorrhagic Septicaemia (North American Strain, genotype IVa): A viral septicaemia caused a rhabdovirus. VHSv (NAS) is endemic in the herring populations in British Columbia and its finding on farms coincides with the herring migration. VHSv 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 of approximately 2% per month and histo-pathological lesions consistent with VHSv infection.

APPENDIX 7.7 Audit Diagnoses 2006

Table 7.7.1: 2006 Diagnoses from Sub-zone 2.3 (South West Vancouver Island) Atlantic Salmon Farm Audits

Quarter	Number of Farms Audited	Number of Cases^	Farm Level Diagnosis
1 Jan - Mar	5	4	No Infectious Disease *
		1	VHS (North American Strain, genotype IV)
2 Apr – June	5	5	No Infectious Disease
3 July – Sept	2	2	No Infectious Disease
4 Oct - Dec	4	3	No Infectious Disease
		1	Rickettsiosis

^ The number of farm-level diagnoses (or audit diagnoses) can be greater than the number of farms audited because, on occasion, the carcasses from one farm may exhibit more than one disease affecting that farm, such as: BKD and Mouth Myxo, which would result in 2 farm-level diagnoses at one site.

* No Infectious Disease (NID) includes: the cases where no identifiable cause for mortality was diagnosed from the carcasses collected, as well as the diseases: environmental, NPLD, enteritis and post-vaccination peritonitis; each of the latter diseases do exhibit lesions but the cause of death is not considered infectious.

Figure 7.7.1: Diagnoses from Sub-zone 2.3 (SW Vancouver Island) Atlantic Salmon Farm Audits 2006

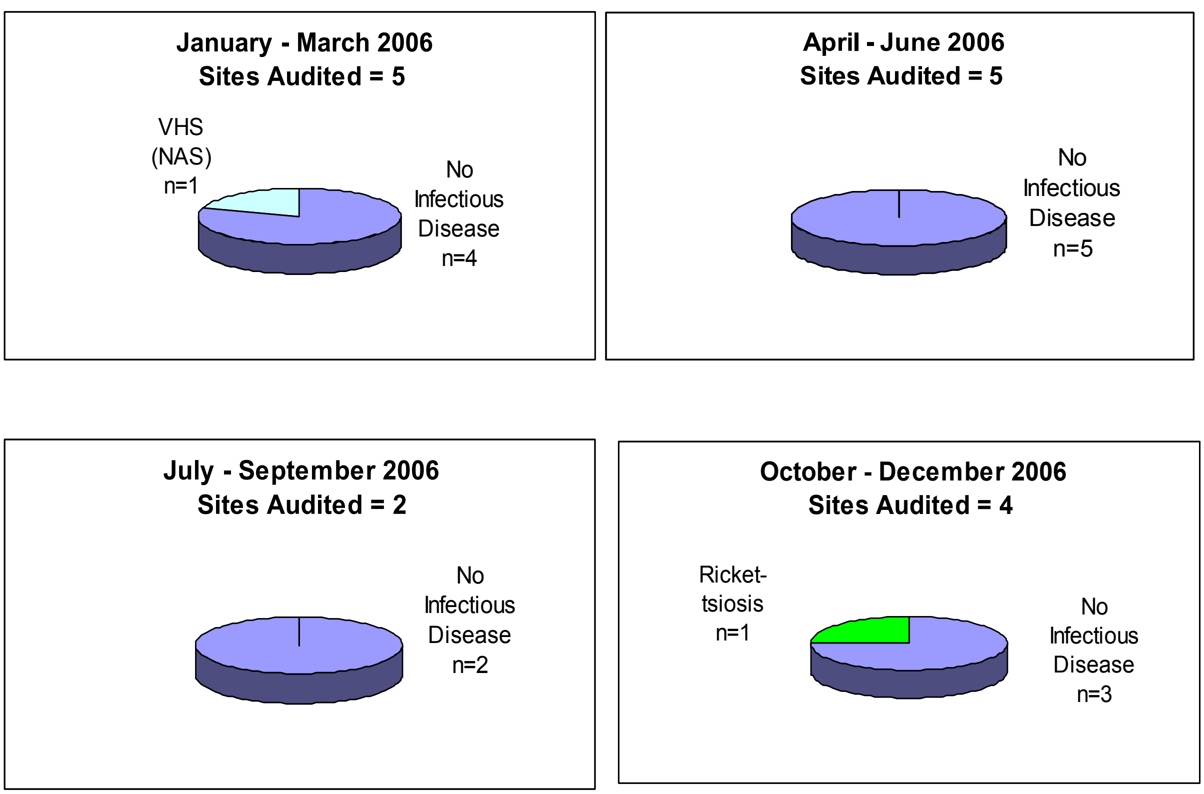


Table 7.7.2: 2006 Diagnoses from Sub-zone 2.4 (North West Vancouver Island) Atlantic Salmon Farm Audits

Quarter	Number of Farms Audited	Number of Cases	Farm Level Diagnosis
1 Jan - Mar	3	2	No Infectious Disease
		1	Mouth Myxobacteriosis
2 Apr – June	3	2	No Infectious Disease
		1	Mouth Myxobacteriosis
3 July – Sept	4	2	No Infectious Disease
		1	Mouth Myxobacteriosis
		1	Rickettsiosis
4 Oct - Dec	3	1	No Infectious Disease
		2	Bacterial Kidney Disease

Figure 7.7.2: Diagnoses from Sub-zone 2.4 (NW Vancouver Island) Atlantic Salmon Farms Audits 2006

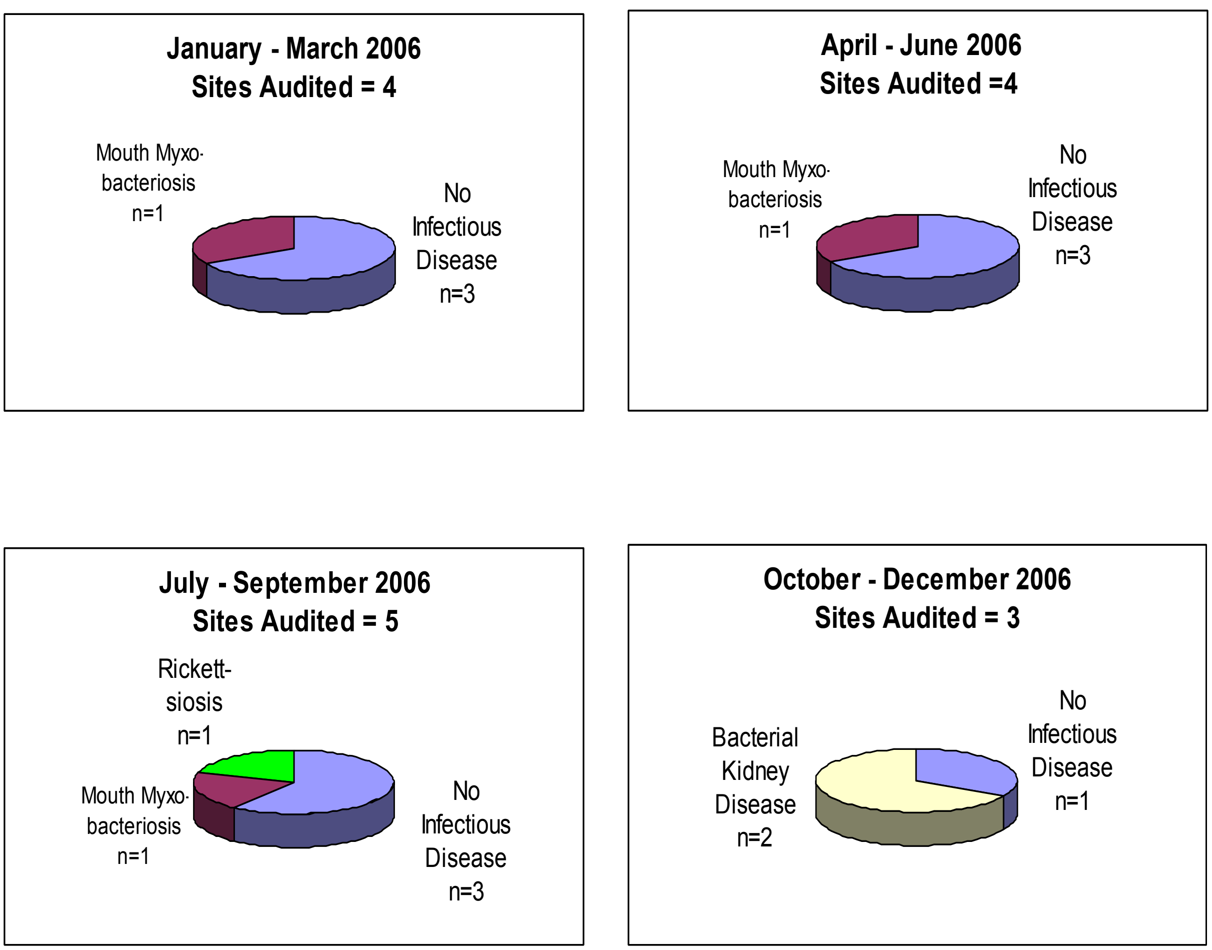
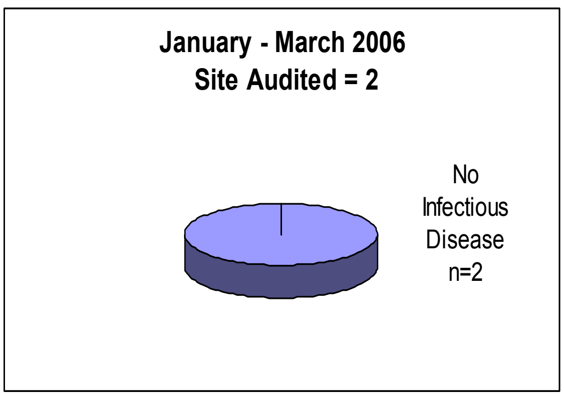
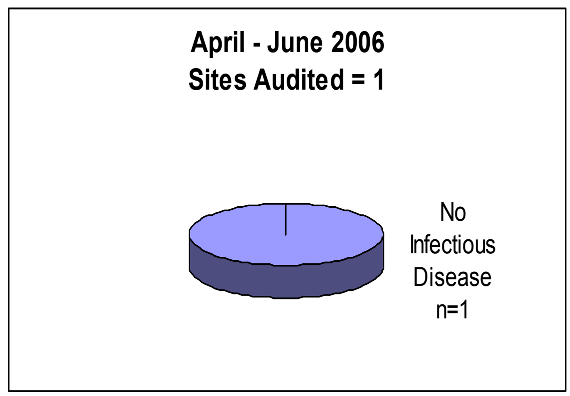


Table 7.7.3: 2006 Diagnoses from Sub-zone 3.1 (Sunshine Coast) Atlantic Salmon Farm Audits			
Quarter	**Number of Farms Audited**	**Number of Cases**	**Farm Level Diagnosis**
1 Jan - Mar	2	2	No Infectious Disease
2 Apr – June	1	1	No Infectious Disease
3 July – Sept	0	0	Not Applicable
4 Oct - Dec	1	1	No Infectious Disease

Figure 7.7.3: Diagnoses from Sub-zone 3.1 (Sunshine Coast) Atlantic Salmon Farm Audits 2006





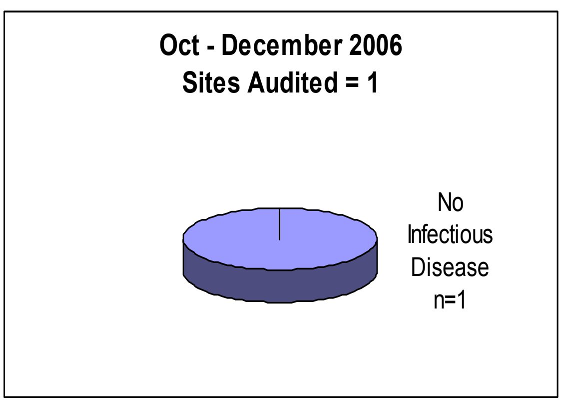


Table 7.7.4: 2006 Diagnoses from Sub-zone 3.2 (Campbell River) Atlantic Salmon Farm Audits

Quarter	Number of Farms Audited	Number of Cases	Farm Level Diagnosis
1 Jan - Mar	4	3	No Infectious Disease
		1	Bacterial Kidney Disease
2 Apr – June	4	2	No Infectious Disease
		2	Bacterial Kidney Disease
3 July – Sept	5	4	No Infectious Disease
		1	Mouth Myxobacteriosis
		1	Bacterial Kidney Disease
4 Oct - Dec	5	6	No Infectious Disease

Figure 7.7.4: Diagnoses from Sub-zone 3.2 (Campbell River) Atlantic Salmon Farm Audits 2006

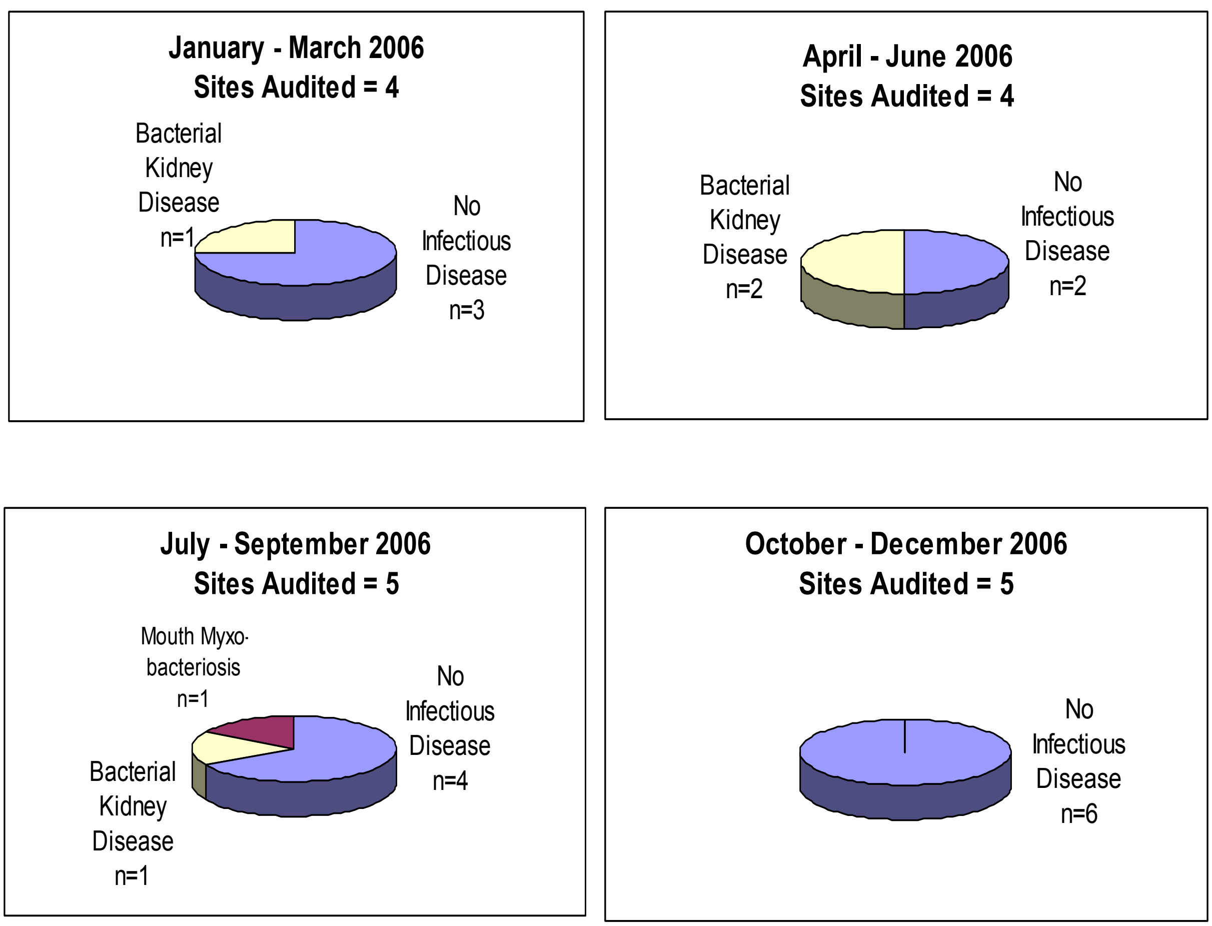


Table 7.7.5: 2006 Diagnoses from Sub-zone 3.3 (Broughton) Atlantic Salmon Farm Audits

Quarter	Number of Farms Audited	Number of Cases	Farm Level Diagnosis
1 Jan - Mar	7	5	No Infectious Disease
		1	Mouth Myxobacteriosis
		1	Enteric Red Mouth
2 Apr – June	6	5	No Infectious Disease
		1	Mouth Myxobacteriosis
		1	Rickettsiosis
3 July – Sept	3	3	No Infectious Disease
4 Oct - Dec	6	7	No Infectious Disease

Figure 7.7.5: Diagnoses from Sub-zone 3.3 (Broughton) Atlantic Salmon Farm Audits 2006

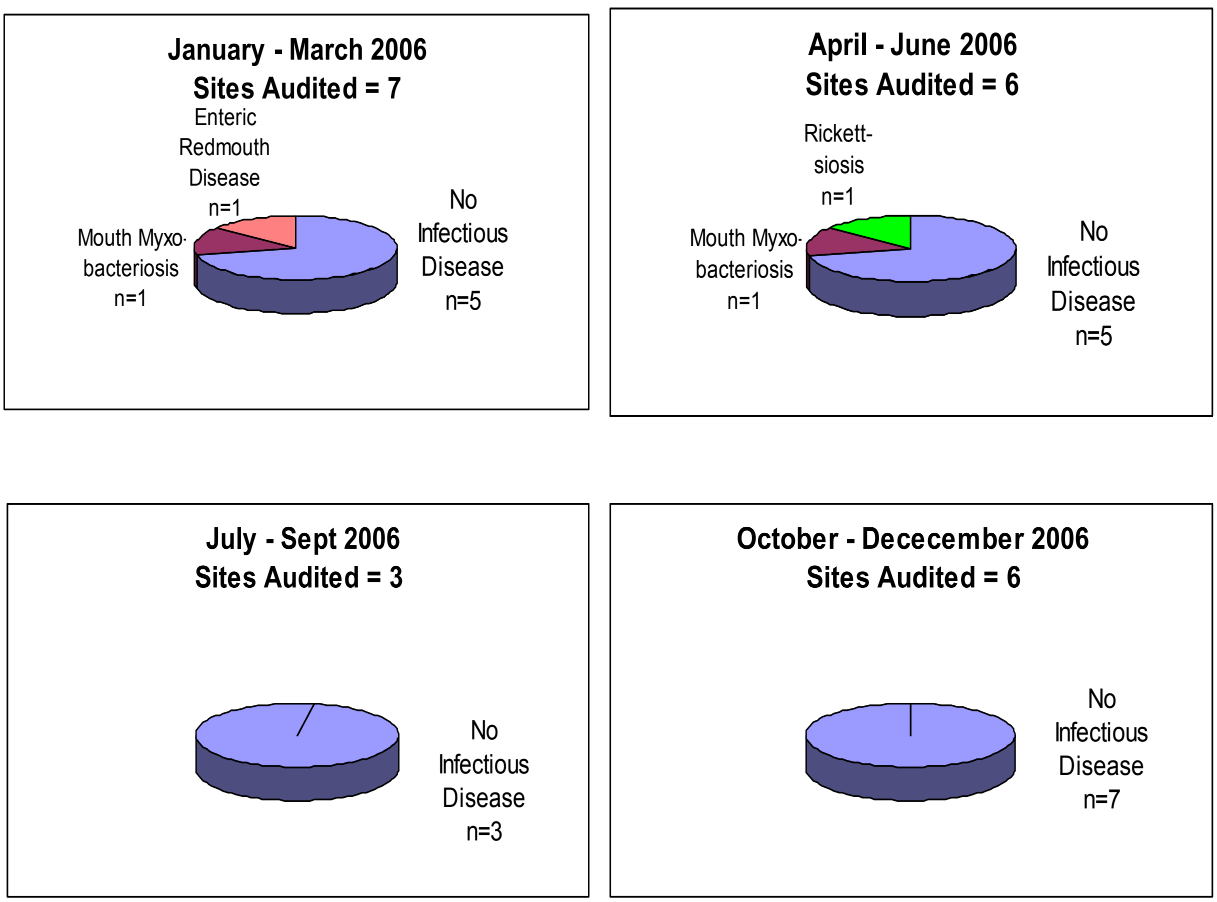
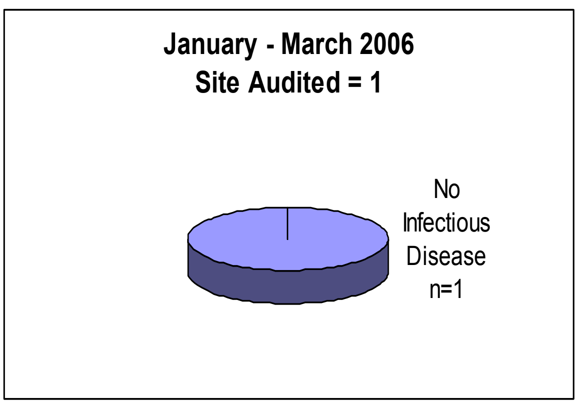
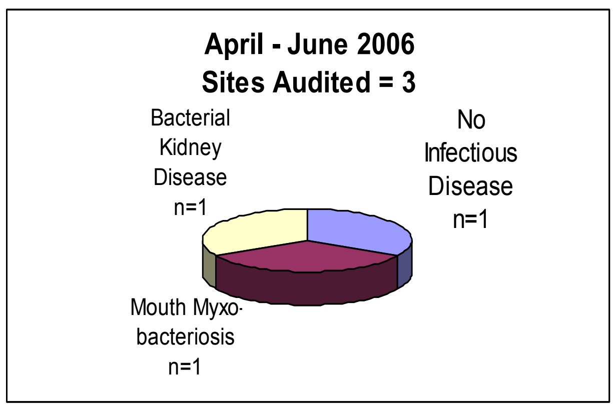


Table 7.7.6: 2006 Diagnoses from Sub-zone 3.4 (Port Hardy) Atlantic Salmon Farm Audits			
Quarter	**Number of Farms Audited**	**Number of Cases**	**Farm Level Diagnosis**
1 Jan - Mar	1	1	No Infectious Disease
2 Apr – June	3	1	No Infectious Disease
		1	Mouth Myxobacteriosis
		1	Bacterial Kidney Disease
3 July – Sept	4	4	No Infectious Disease
		1	Mouth Myxobacteriosis
		1	Bacterial Kidney Disease
4 Oct - Dec	0	0	Not Applicable

Figure 7.7.6: Diagnoses from Sub-zone 3.4 (Port Hardy) Atlantic Salmon Farm Audits 2006





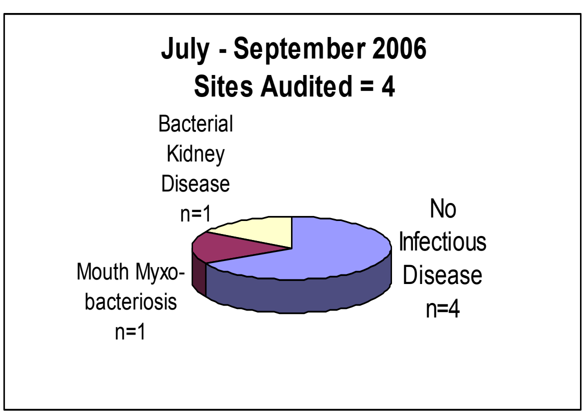
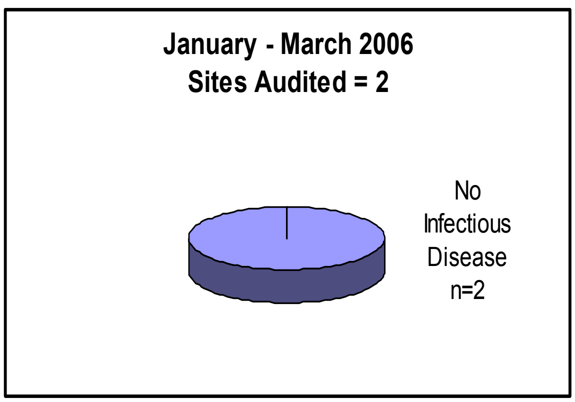
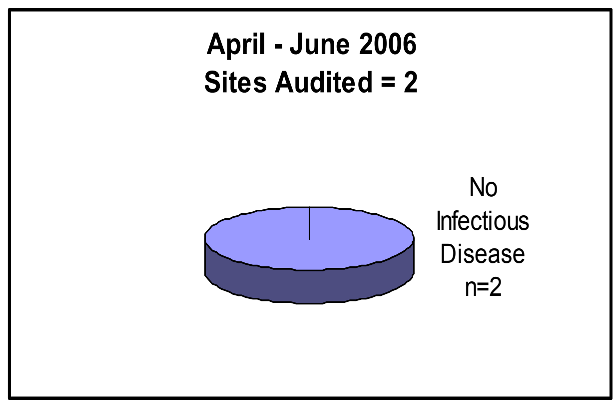


Table 7.7.7: 2006 Diagnoses from Sub-zone 3.5 (Central Coast) Atlantic Salmon Farm Audits			
Quarter	**Number of Farms Audited**	**Number of Cases**	**Farm Level Diagnosis**
1 Jan - Mar	2	2	No Infectious Disease
2 Apr – June	2	2	No Infectious Disease
3 July – Sept	2	2	No Infectious Disease
4 Oct - Dec	0	0	Not applicable

Figure 7.7.7: Diagnoses from Sub-zone 3.5 (Central Coast) Atlantic Salmon Farm Audits 2006





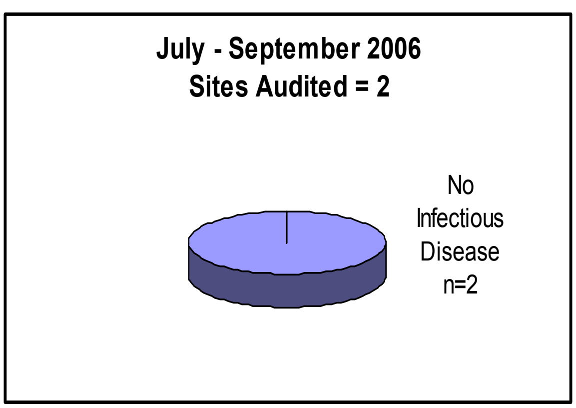
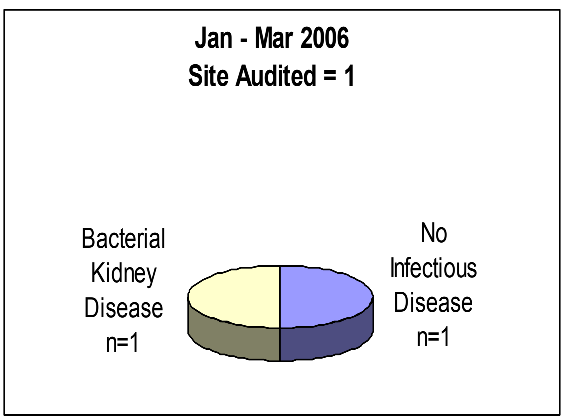
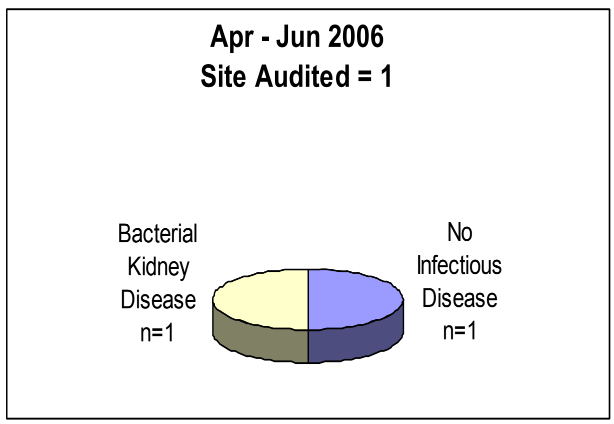
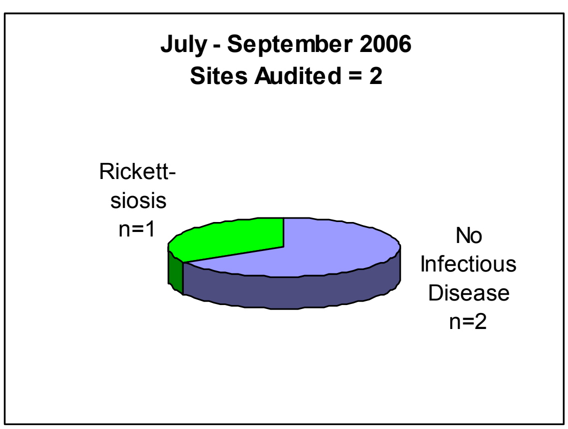


Table 7.7.8: 2006 Diagnoses from Zone 2 (Vancouver Island) Pacific Salmon Farm Audits			
Quarter	**Number of Farms Audited**	**Number of Cases**	**Farm Level Diagnosis**
1 Jan - Mar	1	1	No Infectious Disease
		1	Bacterial Kidney Disease
2 Apr – June	1	1	No Infectious Disease
		1	Bacterial Kidney Disease
3 July – Sept	2	2	No Infectious Disease
		1	Rickettsiosis
4 Oct - Dec	2	1	No Infectious Disease
		1	Loma
		2	Rickettsiosis

Figure 7.7.8: Diagnoses from Zone 2 (Vancouver Island) Pacific Salmon Farm Audits 2006







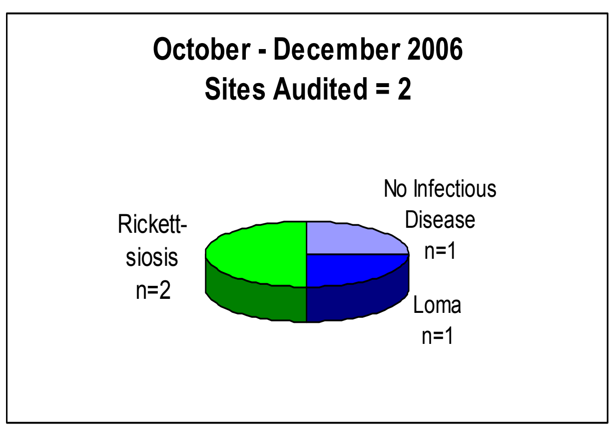
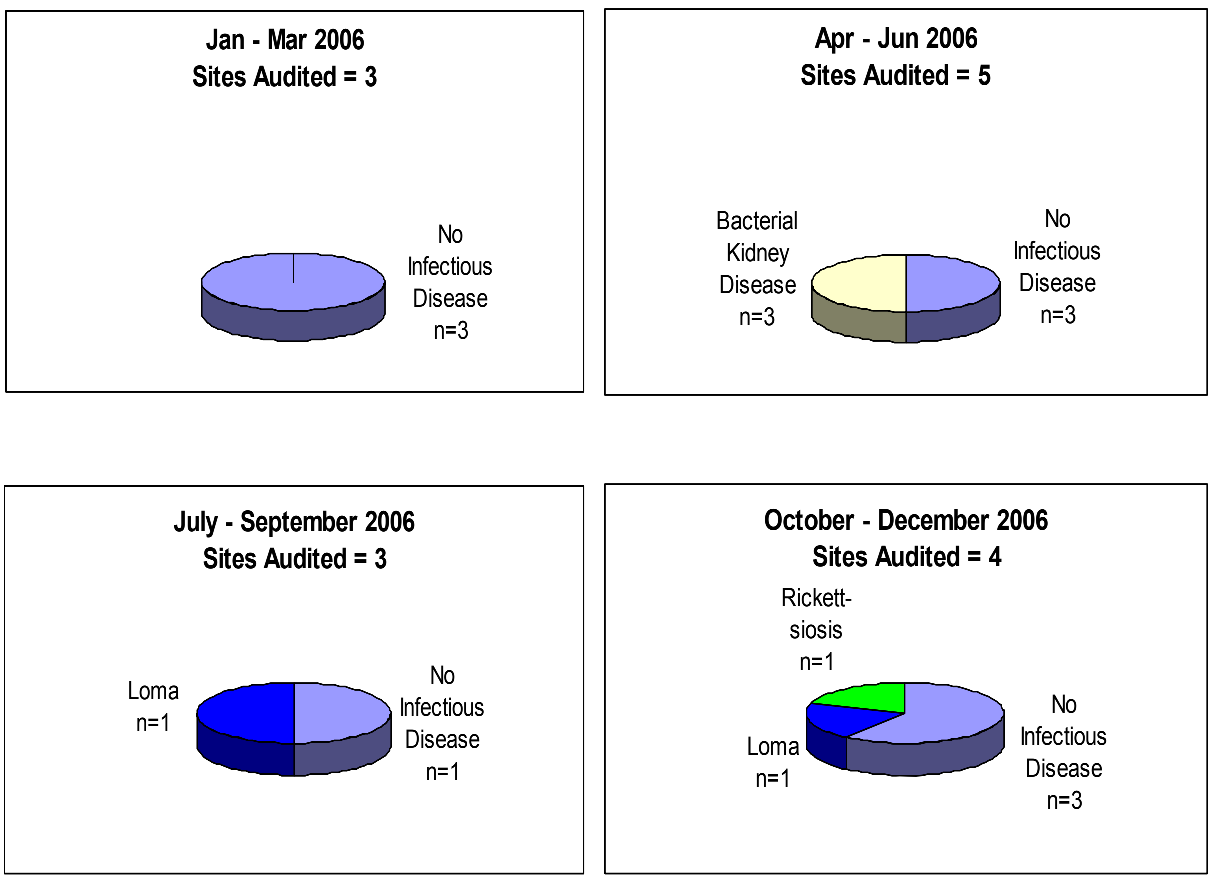


Table 7.7.9: 2006 Diagnoses from Zone 3 (East of Vancouver Island) Pacific Salmon Farm Audits

Quarter	Number of Farms Audited	Number of Cases	Farm Level Diagnosis
1 Jan - Mar	3	3	No Infectious Disease
2 Apr – June	5	3	No Infectious Disease
		3	Bacterial Kidney Disease
3 July – Sept	3	1	No Infectious Disease
		1	Loma
4 Oct - Dec	4	3	No Infectious Disease
		1	Loma
		1	Rickettsiosis

Figure 7.7.9: Diagnoses from Zone 3 (East of Vancouver Island) Pacific Salmon Farm Audits 2006



APPENDIX 7.8 BCSFA Mortality Reports 2006

Average Mortality Rate (2006 - First Quarter)					
DFO SubZone	Species	Life stages	# Fish Group	# Site	Rate
All Zones	Atlantic salmon	"Early"	25	17	2.70%
2-3	Atlantic salmon	"Later"	15	11	0.43%
2-4	Atlantic salmon	"Later"	8	8	0.31%
3-1 + 3-2	Atlantic salmon	"Later"	17	16	0.37%
3-3	Atlantic salmon	"Later"	22	18	6.14%
3-4 + 3-5	Atlantic salmon	"Later"	15	12	0.34%
All Zones [4]	Atlantic salmon	"Later"	81	66	2.90%
All Zones	Pacific salmon	"Early"	76	13	1.40%
All Zones	Pacific salmon	"Later"	29	16	1.49%

Notes

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

2 Defintions 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 Seafarms	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.

Proportional Mortality Rates by Cause (2006 - First Quarter) [1,2]						
Early Life stages						
DFO SubZone	Species	# Fish Groups	Background Mortality	Systems Related	Fresh	Culls / Quality Control
All Zones	Atlantic salmon	25	1.89%	0.03%	0.29%	0.49%
All Zones	Pacific salmon	76	1.07%	0.01%	0.12%	0.19%

Proportional Mortality Rates by Cause (2006 - First Quarter)									
Later Life stages									
DFO SubZone	Species	# Fish Groups	Environmental	Fresh "Silvers"	Handling / Transport	Matures	Old	Poor Performers	Predators
All Zones	Atlantic salmon	81	0.01%	0.24%	0.09%	2.14%	0.08%	0.29%	0.05%
2-3	Atlantic salmon	15	0.01%	0.12%	0.01%	0.01%	0.08%	0.06%	0.14%
2-4	Atlantic salmon	8	0.00%	0.10%	0.01%	0.00%	0.13%	0.02%	0.06%
3-1 + 3-2	Atlantic salmon	17	0.02%	0.03%	0.07%	0.03%	0.10%	0.05%	0.06%
3-3	Atlantic salmon	22	0.00%	0.53%	0.12%	5.31%	0.05%	0.12%	0.00%
3-4 + 3-5	Atlantic salmon	15	0.00%	0.13%	0.07%	0.00%	0.09%	0.02%	0.02%
All Zones	Pacific salmon	29	0.01%	0.46%	0.06%	0.45%	0.13%	0.04%	0.35%

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)

Average Mortality Rate (2006 - Second Quarter)					
DFO SubZone	Species	Life stages	# Fish Group	# Site	Rate
All Zones	Atlantic salmon	"Early"	22	16	3.50%
2-3	Atlantic salmon	"Later"	15	11	0.59%
2-4	Atlantic salmon	"Later"	12	11	0.39%
3-1 + 3-2	Atlantic salmon	"Later"	17	16	0.67%
3-3	Atlantic salmon	"Later"	23	17	1.06%
3-4 + 3-5	Atlantic salmon	"Later"	13	12	0.84%
All Zones [4]	Atlantic salmon	"Later"	83	68	0.92%
All Zones	Pacific salmon	"Early"	140	18	1.57%
All Zones	Pacific salmon	"Later"	46	17	1.64%

Notes

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

2 Defintions 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 subzones shown above.

Proportional Mortality Rates by Cause (2006 - Second Quarter) [1,2]						
Early Life stages						
DFO SubZone	Species	# Fish Groups	Background Mortality	Systems Related	Fresh	Culls / Quality Control
All Zones	Atlantic salmon	22	1.65%	0.03%	0.42%	1.41%
All Zones	Pacific salmon	140	1.09%	0.14%	0.03%	0.31%

Proportional Mortality Rates by Cause (2006 - Second Quarter)									
Later Life stages									
DFO SubZone	Species	# Fish Groups	Environmental	Fresh "Silvers"	Handling / Transport	Matures	Old	Poor Performers	Predators
All Zones	Atlantic salmon	83	0.04%	0.37%	0.07%	0.01%	0.24%	0.15%	0.04%
2-3	Atlantic salmon	15	0.02%	0.18%	0.01%	0.01%	0.19%	0.10%	0.09%
2-4	Atlantic salmon	12	0.15%	0.02%	0.05%	0.00%	0.11%	0.03%	0.03%
3-1 + 3-2	Atlantic salmon	17	0.04%	0.13%	0.09%	0.00%	0.21%	0.15%	0.05%
3-3	Atlantic salmon	23	0.02%	0.37%	0.14%	0.04%	0.38%	0.11%	0.00%
3-4 + 3-5	Atlantic salmon	13	0.00%	0.36%	0.01%	0.00%	0.31%	0.12%	0.04%
All Zones	Pacific salmon	46	0.01%	0.72%	0.13%	0.03%	0.35%	0.06%	0.33%

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)

Average Mortality Rate (2006 - Third Quarter)					
DFO SubZone	Species	Life stages	# Fish Group	# Site	Rate
All Zones	Atlantic salmon	"Early"	15	15	5.49%
2-3	Atlantic salmon	"Later"	13	10	0.83%
2-4	Atlantic salmon	"Later"	10	9	0.38%
3-1 + 3-2	Atlantic salmon	"Later"	12	12	2.38%
3-3	Atlantic salmon	"Later"	23	17	1.21%
3-4 + 3-5	Atlantic salmon	"Later"	13	13	0.72%
All Zones [4]	Atlantic salmon	"Later"	128	63	1.18%
All Zones	Pacific salmon	"Early"	43	11	1.31%
All Zones	Pacific salmon	"Later"	20	7	6.66%

Notes

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

2 Defintions 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 Seafarms	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 (Third Quarter - 2006) [1,2]						
Early Life stages						
Fish Health SubZone	Species	# Fish Groups	Background Mortality	Systems Related	Fresh	Culls / Quality Control
All Zones	Atlantic salmon	15	0.92%	0.07%	0.27%	4.23%
All Zones	Pacific salmon	43	0.73%	0.04%	0.01%	0.53%

Mortality Rates by Cause (Third Quarter - 2006)									
Later Life stages									
Fish Healtjh SubZone	Species	# Fish Groups	Environmental	Fresh "Silvers"	Handling / Transport	Matures	Old	Poor Performers	Predators
All Zones	Atlantic salmon	89	0.33%	0.25%	0.05%	0.09%	0.26%	0.21%	0.01%
2-3	Atlantic salmon	15	0.02%	0.17%	0.00%	0.04%	0.37%	0.20%	0.04%
2-4	Atlantic salmon	10	0.05%	0.03%	0.03%	0.00%	0.22%	0.05%	0.00%
3-1 + 3-2	Atlantic salmon	12	1.81%	0.19%	0.05%	0.00%	0.19%	0.13%	0.01%
3-3	Atlantic salmon	23	0.03%	0.27%	7.00%	0.26%	0.29%	0.28%	0.00%
3-4 + 3-5	Atlantic salmon	13	0.13%	0.13%	0.01%	0.00%	0.28%	0.15%	0.02%
All Zones	Pacific salmon	20	3.60%	1.41%	0.72%	0.14%	0.51%	0.23%	0.02%

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, 2006

Average Mortality Rate (Quarter)					
DFO SubZone	Species	Life stages	# Fish Group	# Site	Rate
All Zones	Atlantic salmon	"Early"	17	16	3.54%
2-3	Atlantic salmon	"Later"	35	30	0.71%
2-4	Atlantic salmon	"Later"	20	19	0.96%
3-1 + 3-2	Atlantic salmon	"Later"	18	18	1.95%
3-3	Atlantic salmon	"Later"	23	18	3.17%
3-4 + 3-5	Atlantic salmon	"Later"	13	13	0.22%
All Zones [4]	Atlantic salmon	"Later"	109	98	3.17%
All Zones	Pacific salmon	"Early"	45	11	0.31%
All Zones	Pacific salmon	"Later"	43	15	1.44%

Notes

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

2 Defintions 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 subzones shown above.

Proportional Mortality Rates by Cause (Quarter) [1,2]						
Early Life stages						
DFO SubZone	Species	# Fish Groups	Background Mortality	Systems Related	Fresh	Culls / Quality Control
All Zones	Atlantic salmon	17	1.14%	0.10%	0.28%	2.01%
All Zones	Pacific salmon	45	0.25%	0.06%	0.00%	0.00%

Proportional Mortality Rates by Cause (Quarter)									
Later Life stages									
DFO SubZone	Species	# Fish Groups	Environmental	Fresh "Silvers"	Handling / Transport	Matures	Old	Poor Performers	Predators
All Zones	Atlantic salmon	109	0.03%	0.37%	0.04%	1.42%	0.37%	0.27%	0.03%
2-3	Atlantic salmon	35	0.10%	0.18%	0.10%	0.04%	0.23%	0.05%	0.03%
2-4	Atlantic salmon	20	0.00%	0.21%	0.11%	0.01%	0.54%	0.04%	0.06%
3-1 + 3-2	Atlantic salmon	18	1.07%	0.11%	0.02%	0.00%	0.13%	0.11%	0.06%
3-3	Atlantic salmon	23	1.07%	0.49%	0.03%	0.66%	0.73%	0.19%	0.00%
3-4 + 3-5	Atlantic salmon	13	0.01%	0.04%	0.00%	0.00%	0.13%	0.03%	0.00%
All Zones	Pacific salmon	43	0.01%	0.42%	0.02%	0.20%	0.13%	0.34%	0.36%

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 7.9 BCSFA Fish Health Events 2006

Fish Health Events (2006 - First Quarter)

DFO SubZone	Species	Life Stage	Veterinary Diagnosis	Count of Fish Health Events [1,2,3]		
				New	Ongoing/ Recurring	Relapsing
All	Atlantic Salmon	"Early"	Aeromonas salmonicida Infection	1	0	0
			Renibacterium salmoninarum Infection	1	0	0
All zones	Atlantic Salmon	"Later"	(see Subzones below)			
2-3	Atlantic Salmon	"Later"	Viral Haemorrhagic Septicemia Virus Infection	1	0	0
2-4	Atlantic Salmon	"Later"	Lepeophtheirus Infestation	3	0	0
			Myxobacterial Infection	2	0	0
3-1 + 3-2	Atlantic Salmon	"Later"	Lepeophtheirus Infection	2	1	2
3-3	Atlantic Salmon	"Later"	Lepeophtheirus Infection	7	4	0
			Piscirickettsia salmonis Infection	0	2	0
			Yersinia ruckeri Infection	1	0	0
3-4 + 3-5	Atlantic Salmon	"Later"	Lepeophtheirus Infection	0	1	0
			Myxobacterial Infection	1	1	0
			Renibacterium salmoninarum Infection	2	0	0
All zones	Pacific Salmonids	"Early"	Aeromonas hydrophila Infection	3	0	0
			Myxobacterial Infection	3	0	0
All zones	Pacific Salmonids	"Later"	Loma Infection	0	2	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.

Fish Health Events (2006 - Second Quarter)

DFO SubZone	Species	Life Stage	Veterinary Diagnosis	Count of Fish Health Events [1,2,3]		
				New	Ongoing/ Recurring	Relapsing
All	Atlantic Salmon	"Early"	Yersinia ruckeri Infection	2	0	0
All zones [5]	Atlantic Salmon	"Later"	Renibacterium salmoninarum Infection	0	1	0
2-3	Atlantic Salmon	"Later"	Lepeophtheirus Infection	3	0	0
			Myxobacterial Infection	4	0	0
2-4	Atlantic Salmon	"Later"	Myxobacterial Infection	1	0	0
3-1 + 3-2	Atlantic Salmon	"Later"	Lepeophtheirus Infection	3	1	0
			Myxobacterial Infection	2	0	0
3-3	Atlantic Salmon	"Later"	Aeromonas salmonicida Infection	1	0	0
			Lepeophtheirus Infection	2	0	0
			Myxobacterial Infection	3	0	0
			Piscirickettsia salmonis Infection	0	2	0
			Renibacterium salmoninarum Infection	4	0	0
3-4 + 3-5	Atlantic Salmon	"Later"	Lepeophtheirus Infection	2	0	0
			Myxobacterial Infection	2	2	1
			Renibacterium salmoninarum Infection	1	0	0
All zones	Pacific Salmonids	"Early"	Aeromonas hydrophila Infection	0	2	0
			Case worked up but no diagnosis [4]	1	1	0
			Costia Infection	2	0	0
			Fusiform Bacteria Infection	1	0	0
			Myxobacterial Infection	1	0	0
			Saprolegnia Infection	1	0	0
All zones	Pacific Salmonids	"Later"	Renibacterium salmoninarum Infection	0	1	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.

BCSFA Fish Health Event Reports: Quarters 3 and 4, 2006

Fish Health Events (2006 - Third Quarter)						
DFO SubZone	Species	Life Stage	Veterinary Diagnosis	Count of Fish Health Events [1,2,3]		
				New	Ongoing/ Recurring	Relapsing
All	Atlantic Salmon	"Early"	Yersinia ruckeri Infection	0	0	0
All zones [5]	Atlantic Salmon	"Later"	Renibacterium salmoninarum Infection	0	0	0
2-3	Atlantic Salmon	"Later"	Lepeophtheirus Infection	2	0	0
			Myxobacterial Infection	0	1	0
3-1 + 3-2	Atlantic Salmon	"Later"	Lepeophtheirus Infection	1	2	0
3-4 + 3-5	Atlantic Salmon	"Later"	Lepeophtheirus Infection	5	0	0
All zones	Pacific Salmonids	"Early"	Case worked up but no diagnosis [4]	1	0	0
			Myxobacterial Infection	5	1	0
All zones	Pacific Salmonids	"Later"	Renibacterium salmoninarum Infection	1	0	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)						
DFO 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"	Myxobacterial Infection	2	0	0
			Yersinia ruckeri Infection	1	0	0
			Piscirickettsia salmonis Infection	2	0	0
2-4	Atlantic Salmon	"Later"	Lepeophtheirus Infection	5	0	0
			Myxobacterial Infection	2	0	0
3-1 + 3-2	Atlantic Salmon	"Later"	Lepeophtheirus Infection	4	0	0
			Myxobacterial Infection	5	0	0
3-3	Atlantic Salmon	"Later"	Lepeophtheirus Infection	3	0	0
			Myxobacterial Infection	1	0	0
3-4 + 3-5	Atlantic Salmon	"Later"	Lepeophtheirus Infection	4	5	0
All zones	Pacific Salmonids	"Early"		0	0	0
All zones	Pacific Salmonids	"Later"		0	0	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.

APPENDIX 7.10 Definitions of Sea Lice Stages for Industry Monitoring and Audit Purposes

***Lepeophtheirus salmonis*:**

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

Mobile/Motile Lice – includes all motile stages: adult females (as above) plus adult male and pre-adults male/female lice.

Caligus – total numbers of motile *Caligus clemensi*

Chalimus - attached immature stages of both *Caligus* and *Lepeophtheirus* species. Both species are combined as louse identification at very early stages is not practically possible.

Year class – age of fish in saltwater.

- Year class one is defined as the date of saltwater entry for the first fish on site plus 12 months.
- Year class two is defined as the remaining time in saltwater.
- Broodstock held in saltwater would be included in the year two group, up to March 1st of the year in which eggs are to be taken. See Broodstock section for more detail. For broodstock taken into freshwater, information on health will be included in freshwater section of the database reports.

APPENDIX 7.11 Sea Lice Audit Tables 2006

Table 7.11.1 Quarterly Mean and Median Abundance of Motile and Female *Lepeophtheirus salmonis*, Chalimus (*L. salmonis* and *Caligus clemensi*) and Motile *C. clemensi* on Atlantic Salmon. **Sub-zone 2.3** (BCMAL Audits 2006)

Year Class 1 - 2006	**Q1**		**Q2**		**Q3**		**Q4**	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Number of Farms Audited (n)	0		3		1		0	
Motile	0	0	1.19	1	0.15	0	0	0
Standard Deviation (SD)			1.50		0.444			
Female	0	0	0.189	0	0	0	0	0
SD			0.526					
Chalimus	0	0	0.255	0	0.25	0	0	0
SD			0.555		1.31			
Caligus Motile	0	0	0.1	0	0.033	0	0	0
SD			0.336		0.181			
Year Class 2 - 2006	**Q1**		**Q2**		**Q3**		**Q4**	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Number of Farms Audited (n)	0		2		0		0	
Motile	0	0	2.29	2	0	0	0	0
SD			2.15					
Female	0	0	0.780	0	0	0	0	0
SD			1.084					
Chalimus	0	0	0.247	0	0	0	0	0
SD			0.610					
Caligus Motile	0	0	0.052	0	0	0	0	0
SD			0.223					

Table 7.11.2 Quarterly Mean and Median Abundance of Motile and Female *Lepeophtheirus salmonis*, Chalimus (*L. salmonis* and *Caligus clemensi*) and Motile *C. clemensi* on Atlantic Salmon. **Sub-zone 2.4** (BCMAL Audits 2006)

Year Class 1 - 2006	**Q1**		**Q2**		**Q3**		**Q4**	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Number of Farms Audited (n)	0		1		0		0	
Motile	0	0	0.5	0	0	0	0	0
Standard Deviation (SD)			0.748					
Female	0	0	0.033	0	0	0	0	0
SD			0.181					
Chalimus	0	0	0.1	0	0	0	0	0
SD			0.354					
Caligus Motile	0	0	0.117	0	0	0	0	0
SD			0.324					

Year Class 2 - 2006	**Q1**		**Q2**		**Q3**		**Q4**	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Number of Farms Audited (n)	1		2		0		1	
Motile	0.233	0	1.833	2	0	0	6.52	6
SD	0.647		1.793				3.72	
Female	0.167	0	0.492	0	0	0	4.717	4
SD	0.493		0.733				3.13	
Chalimus	0.617	0	0.675	0	0	0	0	0
SD	0.976		0.980					
Caligus Motile	0.033	0	0.183	0	0	0	0	0
SD	0.181		0.449					

Table 7.11.3 Quarterly Mean and Median Abundance of Motile and Female *Lepeophtheirus salmonis*, Chalimus (*L. salmonis* and *Caligus clemensi*) and Motile *C. clemensi* on Atlantic Salmon. **Sub-zone 3.1** (BCMAL Audits 2006)

Year Class 1 - 2006	**Q1**		**Q2**		**Q3**		**Q4**	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Number of Farms Audited (n)	1		0		0		0	
Motile	0.017	0	0	0	0	0	0	0
Standard Deviation (SD)	0.129							
Female	0	0	0	0	0	0	0	0
SD								
Chalimus	0.4	0	0	0	0	0	0	0
SD	0.906							
Caligus Motile	0.467	0	0	0	0	0	0	0
SD	0.929							
Year Class 2 - 2006	**Q1**		**Q2**		**Q3**		**Q4**	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Number of Farms Audited (n)	0		1		0		1	
Motile	0	0	0.017	0	0	0	0.3	0
SD			0.129				0.497	
Female	0	0	0	0	0	0	0.167	0
SD							0.376	
Chalimus	0	0	0	0	0	0	0.017	0
SD							0.129	
Caligus Motile	0	0	0	0	0	0	0.033	0
SD							0.181	

Table 7.11.4 Quarterly Mean and Median Abundance of Motile and Female *Lepeophtheirus salmonis*, Chalimus (*L. salmonis* and *Caligus clemensi*) and Motile *C. clemensi* on Atlantic Salmon. **Sub-zone 3.2** (BCMAL Audits 2006)

Year Class 1 - 2006	**Q1**		**Q2**		**Q3**		**Q4**	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Number of Farms Audited (n)	0		3		0		0	
Motile	0	0	1.278	1	0	0	0	0
Standard Deviation (SD)			1.701					
Female	0	0	0.455	0	0	0	0	0
SD			0.965					
Chalimus	0	0	1.289	1	0	0	0	0
SD			1.751					
Caligus Motile	0	0	0.117	0	0	0	0	0
SD			0.413					
Year Class 2 - 2006	**Q1**		**Q2**		**Q3**		**Q4**	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Number of Farms Audited (n)	1		3		2		1	
Motile	1.533	1	1.239	0	1.125	0	1.35	1
SD	1.662		2.152		1.637		1.735	
Female	0.9	1	0.428	0	0.45	0	0.45	0
SD	0.969		0.963		0.808		0.982	
Chalimus	0.533	0	0.361	0	3.308	2	7.067	5
SD	0.853		0.9902		3.636		5.467	
Caligus Motile	0.033	0	0.111	0	0.867	0	1.033	1
SD	0.181		0.558		1.390		1.402	

Table 7.11.5 Quarterly Mean and Median Abundance of Motile and Female *Lepeophtheirus salmonis*, Chalimus (*L. salmonis* and *Caligus clemensi*) and Motile *C. clemensi* on Atlantic Salmon. **Sub-zone 3.3** (BCMAL Audits 2006)

Year Class 1 - 2006	**Q1**		**Q2**		**Q3**		**Q4**	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Number of Farms Audited (n)	1		1		1		1	
Motile	0.733	0	0.833	1	0.183	0	7.167	6
Standard Deviation (SD)	1.219		0.867		0.431		4.239	
Female	0.133	0	0.033	0	0	0	2.617	2
SD	0.430		0.181				1.842	
Chalimus	1.467	1	0.233	0	2.067	2	11.667	10
SD	1.578		0.532		1.716		8.276	
Caligus Motile	1.217	1	0	0	0.2	0	0.716	0
SD	1.342				0.433		1.329	
Year Class 2 - 2006	**Q1**		**Q2**		**Q3**		**Q4**	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Number of Farms Audited (n)	2		4		0		1	
Motile	8.942	7	0.242	0	0	0	0.733	0
SD	6.91		0.703				1.006	
Female	3.258	3	0.0661	0	0	0	0.2	0
SD	2.33		0.312				0.4801	
Chalimus	1.917	1	0.991	0	0	0	0.283	0
SD	3.237		2.762				0.825	
Caligus Motile	0.342	0	0	0	0	0	0.133	0
SD	0.739						0.389	

Table 7.11.6 Quarterly Mean and Median Abundance of Motile and Female *Lepeophtheirus salmonis*, Chalimus (*L. salmonis* and *Caligus clemensi*) and Motile *C. clemensi* on Atlantic Salmon. **Sub-zone 3.4** (BCMAL Audits 2006)

Year Class 1 - 2006	**Q1**		**Q2**		**Q3**		**Q4**	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Number of Farms Audited (n)	0		2		1		0	
Motile	0	0	0.1	0	0.633	0	0	0
Standard Deviation (SD)			0.328		0.843			
Female	0	0	0	0	0.3	0	0	0
SD					0.497			
Chalimus	0	0	0.483	0	0.867	0	0	0
SD			0.9073		1.142			
Caligus Motile	0	0	0.05	0	0.0833	0	0	0
SD			0.254		0.334			
Year Class 2 - 2006	**Q1**		**Q2**		**Q3**		**Q4**	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Number of Farms Audited (n)	0		1		1		0	
Motile	0	0	4.95	2	0.233	0	0	0
SD			6.549		0.563			
Female	0	0	0.967	0	0.2	0	0	0
SD			2.025		0.514			
Chalimus	0	0	0.883	1	0.533	0	0	0
SD			1.027		1.186			
Caligus Motile	0	0	0.367	0	0.0667	0	0	0
SD			0.61		0.312			

Table 7.11.7 Quarterly Mean and Median Abundance of Motile and Female *Lepeophtheirus salmonis*, Chalimus (*L. salmonis* and *Caligus clemensi*) and Motile *C. clemensi* on Atlantic Salmon. **Sub-zone 3.5** (BCMAL Audits 2006)

Year Class 1 - 2006	**Q1**		**Q2**		**Q3**		**Q4**	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Number of Farms Audited (n)	1		1		1		0	
Motile	0.383	0	0.0167	0	0.467	0	0	0
Standard Deviation (SD)	1.439		0.129		0.853			
Female	0.233	0	0	0	0.0667	0	0	0
SD	0.945				0.252			
Chalimus	0.067	0	0.0833	0	1.583	1	0	0
SD	0.312		0.279		1.555			
Caligus Motile	0	0	0.167	0	0.383	0	0	0
SD			0.129		0.993			
Year Class 2 - 2006	**Q1**		**Q2**		**Q3**		**Q4**	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Number of Farms Audited (n)	0		1		0		0	
Motile	0	0	0.0167	0	0	0	0	0
SD			0.129					
Female	0	0	0.0167	0	0	0	0	0
SD			0.129					
Chalimus	0	0	0.85	0	0	0	0	0
SD			1.482					
Caligus Motile	0	0	0.0167	0	0	0	0	0
SD			0.12					

APPENDIX 7.12 Sea Lice BCSFA Reports 2006

2006 Atlantic Salmon Sea Lice Abundance (BCSFA report)

Yearclass 1

ZONE/SUBZONE 2.3		Motile	Female	Caligus	n
Nov-05		3.54	1.33	0.18	5
	std error	1.55	0.73	0.06	
Dec-05		0.38	0.11	0.14	3
	std error	0.28	0.10	0.05	
Jan-06		0.93	0.34	0.07	4
	std error	0.46	0.19	0.05	
Feb-06		0.96	0.44	0.06	4
	std error	0.76	0.38	0.05	
Mar-06		0.30	0.07	0.15	2
	std error	0.10	0.04	0.03	
Apr-06		1.33	0.14	0.04	3
	std error	0.70	0.10	0.02	
May-06		2.26	0.497	0.26	4
	std error	0.72	0.26	0.11	
Jun-06		1.19	0.29	0.24	4
	std error	0.89	0.23	0.15	
Jul-06		1.18	0.31	0.50	4
	std error	0.44	0.13	0.20	
Aug-06		1.47	0.42	0.55	4
	std error	0.61	0.16	0.27	
Sep-06		0.54	0.20	0.17	5
	std error	0.24	0.09	0.08	
Oct-06		0.28	0.12	0.04	4
	std error	0.12	0.04	0.03	
Nov-06		0.62	0.23	0.39	6
	std error	0.21	0.09	0.09	
Dec-06		0.69	0.27	0.10	3
	std error	0.12	0.12	0.01	

Yearclass 2

ZONE/SUBZONE 2.3		Motile	Female	Caligus	n
Nov-05		1.25	0.87	0.00	1
	std error				
Dec-05		4.23	1.01	0.13	2
	std error	3.37	0.77	0.13	
Jan-06		1.18	0.68	0.02	2
	std error	0.28	0.11	0.02	
Feb-06		0.42	0.24	0.01	3
	std error	0.2	0.12	0.01	
Mar-06		1.11	0.37	0.10	4(5)
	std error	0.42	0.21	0.05	
Apr-06		3.68	1.25	0.01	4
	std error	0.64	0.16	0.04	
May-06		4.02	1.65	0.00	1
	std error				
Jun-06		2.06	1.03	0.01	3
	std error	1.07	0.54	0.01	
Jul-06		6.68	3.38	0.68	1
	std error				
Aug-06		*	*	*	
	std error				
Sep-06		0.57	0.48	0.00	1
	std error				
Oct-06		0.18	0.16	0.01	2
	std error	0.15	0.16	0.01	
Nov-06		0.00	0.00	0.00	1
	std error	0.00	0.00	0.00	
Dec-06		0.09	0.07	0.01	2
	std error	0.09	0.07	0.01	

2006 Atlantic Salmon Sea Lice Abundance (BCSFA report)

Yearclass 1

ZONE/SUBZONE 2.4		Motile	Female	Caligus	n
Nov-05		*	*	*	*
	std error				
Dec-05		*	*	*	*
	std error				
Jan-06		0.17	0.04	0.00	2(3)
	std error	0.17	0.04	0.00	
Feb-06		0.26	0.11	0.00	2(3)
	std error	0.26	0.11	0.00	
Mar-06		0.14	0.04	0.01	3
	std error	0.13	0.04	0.01	
Apr-06		0.24	0.01	0.00	3(4)
	std error	0.22	0.01	0.00	
May-06		0.13	0.02	0.05	3(5)
	std error	0.12	0.01	0.05	
Jun-06		0.16	0.05	0.06	3
	std error	0.11	0.05	0.03	
Jul-06		0.72	0.27	0.34	4(5)
	std error	0.29	0.13	0.21	
Aug-06		1.59	0.64	0.91	2(5)
	std error	0.88	0.39	0.21	
Sep-06		2.12	0.73	0.30	4(5)
	std error	0.47	0.31	0.32	
Oct-06		3.33	1.29	0.39	4(6)
	std error	0.54	0.20	0.22	
Nov-06		2.62	1.43	0.00	1(2)
	std error				
Dec-06		0.31	0.01	0.00	2
	std error	0.04	0.01	0.00	

Yearclass 2

ZONE/SUBZONE 2.4		Motile	Female	Caligus	n
Nov-05		4.73	2.28	0.00	3
	std error	1.67	0.64	0.00	
Dec-05		5.64	2.40	0.02	4
	std error	2.60	1.13	0.02	
Jan-06		3.55	1.85	0.00	5(6)
	std error	1.74	0.86	0.00	
Feb-06		1.59	1.02	0.04	3
	std error	1.04	0.85	0.02	
Mar-06		0.75	0.46	0.44	4
	std error	0.21	0.13	0.26	
Apr-06		1.03	0.51	0.44	3
	std error	0.28	0.18	0.44	
May-06		1.30	0.49	0.12	4(5)
	std error	0.41	0.17	0.09	
Jun-06		1.18	0.73	0.07	4
	std error	0.37	0.22	0.06	
Jul-06		0.57	0.28	0.02	2
	std error	0.29	0.13	0.02	
Aug-06		0.84	0.51	0.00	2
	std error	0.04	0.11	0.00	
Sep-06		1.73	1.15	0.00	1
	std error				
Oct-06		1.05	0.53	0.00	1
	std error				
Nov-06		3.88	1.70	0.05	4(5)
	std error	1.40	0.80	0.02	
Dec-06		2.29	1.13	0.01	4(5)
	std error	1.24	0.63	0.01	

2006 Atlantic Salmon Sea Lice Abundance (BCSFA report)

Yearclass 1

ZONE/SUBZONE 3.1		Motile	Female	Caligus	n
Nov-05		0.10	0.00	0.00	1
	std error				
Dec-05		0.04	0.00	0.00	1
	std error				
Jan-06		0.05	0.00	0.00	1
	std error				
Feb-06		0.02	0.00	0.05	1
	std error				
Mar-06		0.08	0.08	0.02	1
	std error				
Apr-06		0.07	0.00	0.00	1
	std error				
May-06		0.05	0.00	0.00	1
	std error				
Jun-06		0.05	0.02	0.03	1
	std error				
Jul-06		0.07	0.03	0.00	1
	std error				
Aug-06		*	*	*	
	std error				
Sep-06		*	*	*	
	std error				
Oct-06		*	*	*	
	std error				
Nov-06		*	*	*	
	std error				
Dec-06		*	*	*	
	std error				

Yearclass 2

ZONE/SUBZONE 3.1		Motile	Female	Caligus	n
Nov-05		0.10	0.10	0.10	1
	std error				
Dec-05		0.17	0.07	0.00	1
	std error				
Jan-06		0.29	0.11	0.00	2
	std error	0.06	0.03	0.00	
Feb-06		0.45	0.13	0.01	3
	std error	0.22	0.06	0.01	
Mar-06		0.20	0.07	0.00	1
	std error				
Apr-06		0.51	0.33	0.00	2
	std error	0.28	0.20	0.00	
May-06		0.20	0.08	0.02	1
	std error				
Jun-06		0.22	0.10	0.00	1
	std error				
Jul-06		0.23	0.15	0.00	1
	std error				
Aug-06		*	*	*	
	std error				
Sep-06		*	*	*	
	std error				
Oct-06		*	*	*	
	std error				
Nov-06		*	*	*	
	std error				
Dec-06		*	*	*	
	std error				

2006 Atlantic Salmon Sea Lice Abundance (BCSFA report)

Yearclass 1

ZONE/SUBZONE 3.2		Motile	Female	Caligus	n
Nov-05		1.23	0.45	0.09	5(6)
	std error	0.58	0.32	0.06	
Dec-05		1.12	0.44	0.20	3
	std error	0.78	0.39	0.11	
Jan-06		1.73	0.82	0.00	1
	std error				
Feb-06		3.35	1.08	0.00	1
	std error				
Mar-06		4.90	2.20	0.00	1
	std error				
Apr-06		0.72	0.04	0.02	3
	std error	0.52	0.02	0.02	
May-06		0.59	0.05	0.03	4(6)
	std error	0.15	0.01	0.09	
Jun-06		1.16	0.34	0.81	5(6)
	std error	0.48	0.19	0.58	
Jul-06		0.48	0.06	0.40	4(6)
	std error	0.13	0.02	0.22	
Aug-06		0.63	0.17	3.54	5(10)
	std error	0.13	0.04	1.58	
Sep-06		0.51	0.16	2.31	4
	std error	0.34	0.12	0.90	
Oct-06		1.15	0.37	1.61	4(5)
	std error	0.56	0.28	0.82	
Nov-06		1.91	0.38	1.48	4
	std error	0.63	0.31	0.43	
Dec-06		1.56	0.67	1.33	6
	std error	0.78	0.53	0.69	

Yearclass 2

ZONE/SUBZONE 3.2		Motile	Female	Caligus	n
Nov-05		6.52	2.83	0.07	4
	std error	3.61	1.63	0.07	
Dec-05		2.40	1.11	1.00	4
	std error				
Jan-06		3.25	1.61	0.09	5(6)
	std error	0.85	0.51	0.09	
Feb-06		4.02	2.42	0.05	5
	std error	1.67	1.05	0.05	
Mar-06		1.86	0.71	0.05	5
	std error	1.12	0.55	0.03	
Apr-06		1.88	0.57	0.08	4(8)
	std error	1.49	0.35	0.06	
May-06		1.05	0.51	0.02	6(10)
	std error	0.88	0.43	0.01	
Jun-06		0.40	0.20	0.00	4(5)
	std error	0.28	0.16	0.00	
Jul-06		0.40	0.11	0.02	5
	std error	0.06	0.05	0.01	
Aug-06		0.34	0.15	0.19	5
	std error	0.15	0.07	0.16	
Sep-06		0.50	0.23	0.67	4
	std error	0.11	0.05	0.63	
Oct-06		2.90	1.08	0.66	4
	std error	1.09	0.44	0.32	
Nov-06		2.75	1.33	0.01	4
	std error	1.24	0.64	0.01	
Dec-06		3.97	2.43	0.32	4(5)
	std error	1.75	1.03	0.30	

2006 Atlantic Salmon Sea Lice Abundance (BCSFA report)

ZONE/SUBZONE 3.3		Yearclass 1 Motile	Female	Caligus	n
Nov-05		2.55	1.02	0.36	8(9)
	std error	0.90	0.46	0.22	
Dec-05		1.48	0.70	0.13	7
	std error	0.59	0.28	0.10	
Jan-06		2.76	0.92	0.72	8(9)
	std error	1.71	0.42	0.40	
Feb-06		2.57	0.84	0.20	8(10)
	std error	0.84	0.33	0.09	
Mar-06		2.71	0.94	0.21	8(10)
	std error	1.04	0.41	0.09	
Apr-06		0.97	0.24	0.18	5(6)
	std error	0.38	0.12	0.14	
May-06		0.61	0.08	0.04	4(5)
	std error	0.18	0.03	0.02	
Jun-06		0.20	0.03	0.04	3(5)
	std error	0.14	0.02	0.04	
Jul-06		0.24	0.04	0.07	5(6)
	std error	0.09	0.01	0.04	
Aug-06		0.95	0.34	0.27	5
	std error	0.76	0.31	0.16	
Sep-06		1.46	0.26	0.67	6(7)
	std error	0.75	0.11	0.38	
Oct-06		3.62	1.47	1.55	7(8)
	std error	1.32	0.56	0.80	
Nov-06		2.49	0.88	0.52	7(9)
	std error	0.90	0.39	0.26	
Dec-06		1.53	0.44	0.16	5
	std error	0.41	0.27	0.03	

ZONE/SUBZONE 3.3		Yearclass 2 Motile	Female	Caligus	n
Nov-05		5.10	3.09	0.80	6
	std error	1.50	0.84	0.64	
Dec-05		9.37	6.10	1.35	6
	std error	3.04	2.25	1.15	
Jan-06		4.96	2.27	0.19	7(8)
	std error	1.77	0.65	0.10	
Feb-06		4.35	2.36	0.17	6
	std error	2.47	1.35	0.06	
Mar-06		0.76	0.37	0.04	7(9)
	std error	0.24	0.11	0.01	
Apr-06		1.07	0.40	0.04	9(12)
	std error	0.67	0.31	0.02	
May-06		0.89	0.30	0.22	9(16)
	std error	0.38	0.11	0.18	
Jun-06		1.22	0.71	0.11	7(17)
	std error	0.69	0.38	0.08	
Jul-06		1.10	0.70	0.24	7(8)
	std error	0.55	0.39	0.20	
Aug-06		1.41	0.75	0.21	6(9)
	std error	0.70	0.39	0.17	
Sep-06		0.95	0.45	0.28	5(7)
	std error	0.95	0.45	0.28	
Oct-06		2.63	1.10	0.16	5(7)
	std error	1.34	0.78	0.16	
Nov-06		2.74	1.69	0.28	6
	std error	1.65	1.03	0.15	
Dec-06		4.44	2.50	0.32	10(11)
	std error	1.85	1.13	0.22	

2006 Atlantic Salmon Sea Lice Abundance (BCSFA report)

ZONE/SUBZONE 3.4		Yearclass 1 Motile	Female	Caligus	n
Nov-05		1.96	0.98	0.28	2
	std error	1.28	0.98	0.28	
Dec-05		0.95	0.46	0.15	3
	std error	0.69	0.45	0.10	
Jan-06		0.25	0.03	0.00	3
	std error	0.06	0.03	0.00	
Feb-06		0.27	0.02	0.01	4
	std error	0.19	0.02	0.01	
Mar-06		0.61	0.17	0.00	3
	std error	0.40	0.01	0.00	
Apr-06		0.57	0.04	0.00	4
	std error	0.43	0.02	0.00	
May-06		0.67	0.05	0.02	5(6)
	std error	0.55	0.03	0.01	
Jun-06		0.60	0.05	0.10	6
	std error	0.12	0.03	0.10	
Jul-06		0.70	0.04	0.03	6(7)
	std error	0.16	0.02	0.03	
Aug-06		1.37	0.16	0.11	7
	std error	0.24	0.09	0.08	
Sep-06		2.89	0.37	0.09	7(8)
	std error	0.69	0.15	0.09	
Oct-06		0.45	0.02	0.00	5
	std error	0.11	0.01	0.00	
Nov-06		0.17	0.00	0.03	5
	std error	0.05	0.00	0.03	
Dec-06		0.36	0.11	0.01	3
	std error	0.35	0.11	0.01	

ZONE/SUBZONE 3.4		Yearclass 2 Motile	Female	Caligus	n
Nov-05		1.14	0.50	0.01	5
	std error	0.71	0.50	0.01	
Dec-05		2.08	0.99	0.00	3
	std error	1.01	0.55	0.00	
Jan-06		2.70	1.23	0.00	1
	std error				
Feb-06		3.45	1.80	0.00	1
	std error				
Mar-06		0.70	0.40	0.00	3
	std error	0.69	0.39	0.00	
Apr-06		0.41	0.01	0.53	2
	std error	0.18	0.01	0.06	
May-06		4.18	1.88	0.79	2
	std error	0.80	0.47	0.44	
Jun-06		1.52	0.76	0.01	2
	std error	0.30	0.19	0.00	
Jul-06		0.09	0.06	0.00	2
	std error	0.04	0.04	0.00	
Aug-06		0.18	0.13	0.12	2
	std error	0.07	0.08	0.07	
Sep-06		0.83	0.30	1.33	1
	std error				
Oct-06		0.40	0.20	0.00	1
	std error				
Nov-06		0.22	0.02	0.00	2
	std error	0.20	0.02	0.00	
Dec-06		0.32	0.05	0.02	2
	std error	0.27	0.05	0.00	

2006 Atlantic Salmon Sea Lice Abundance (BCSFA report)

Yearclass 1

ZONE/SUBZONE 3.5		Motile	Female	Caligus	n
Nov-05		3.23	1.96	0.03	1(2)
	std error				
Dec-05		*	*	*	
	std error				
Jan-06		*	*	*	
	std error				
Feb-06		*	*	*	
	std error				
Mar-06		0.17	0.05	0.03	1
	std error				
Apr-06		0.05	0.01	0.10	2
	std error	0.05	0.01	0.03	
May-06		0.10	0.06	0.05	2
	std error	0.03	0.01	0.00	
Jun-06		0.04	0.03	0.10	2
	std error	0.01	0.03	0.07	
Jul-06		0.09	0.03	0.04	2
	std error	0.04	0.03	0.04	
Aug-06		1.52	0.23	0.00	2
	std error	0.08	0.10	0.00	
Sep-06		2.80	0.47	0.75	2(3)
	std error	0.60	0.34	0.50	
Oct-06		2.79	0.78	0.28	2(4)
	std error	0.62	0.16	0.05	
Nov-06		0.59	0.21	0.00	2
	std error	0.24	0.14	0.00	
Dec-06		0.08	0.06	0.00	2
	std error	0.01	0.01	0.00	

Yearclass 2

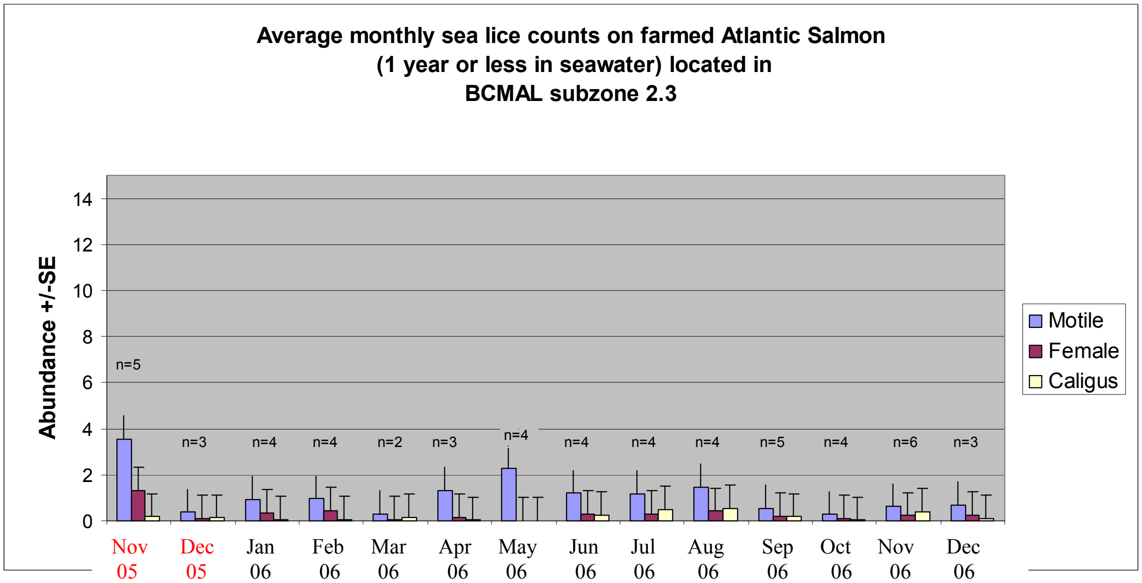
ZONE/SUBZONE 3.5		Motile	Female	Caligus	n
Nov-05		8.77	5.62	0.07	1
	std error				
Dec-05		4.12	2.29	0.15	2
	std error	1.80	0.51	0.15	
Jan-06		4.07	2.21	0.01	2
	std error	1.32	1.09	0.01	
Feb-06		1.22	0.78	0.00	2
	std error	0.98	0.74	0.00	
Mar-06		0.30	0.15	0.01	2
	std error	0.23	0.13	0.01	
Apr-06		0.10	0.08	0.00	1
	std error				
May-06		0.02	0.00	0.00	1
	std error				
Jun-06		0.28	0.08	0.00	1
	std error				
Jul-06		0.44	0.15	0.12	2
	std error	0.14	0.07	0.09	
Aug-06		2.52	1.03	0.21	2
	std error	0.33	0.17	0.04	
Sep-06		10.65	3.32	3.24	2
	std error	1.13	0.29	0.27	
Oct-06		21.04	12.28	0.70	2(3)
	std error	5.51	2.95	0.54	
Nov-06		6.39	4.32	0.16	2(3)
	std error	3.19	1.45	0.09	
Dec-06		0.29	0.21	0.00	2
	std error	0.09	0.08	0.00	

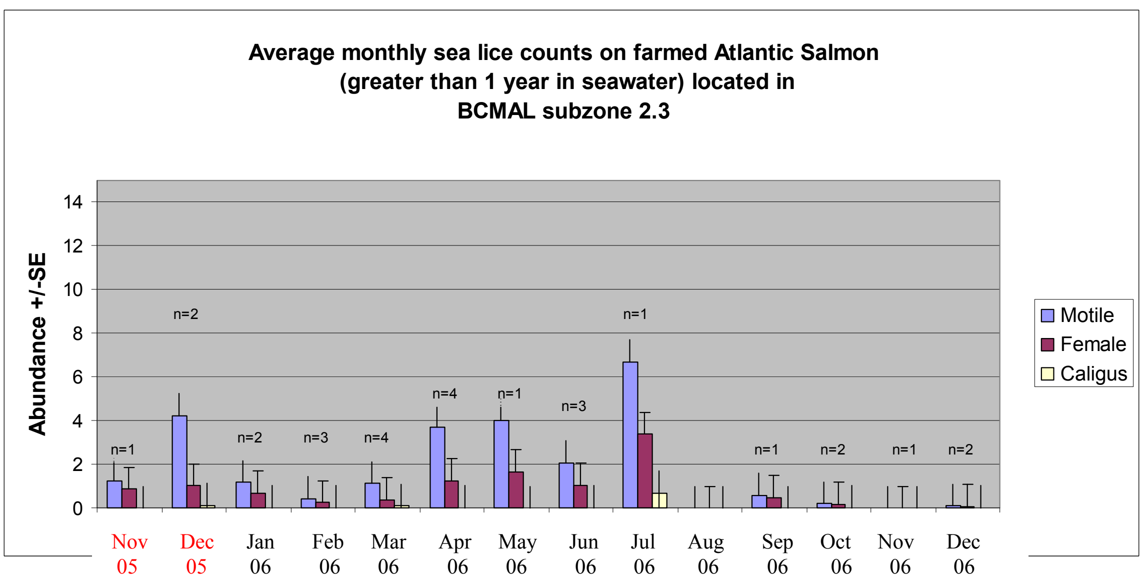
() - total number of site counts for months where two counts have been requested.

*** Reasons for missing site 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 problem
~Fish could not be handled due to environmental concerns, e.g. low DO

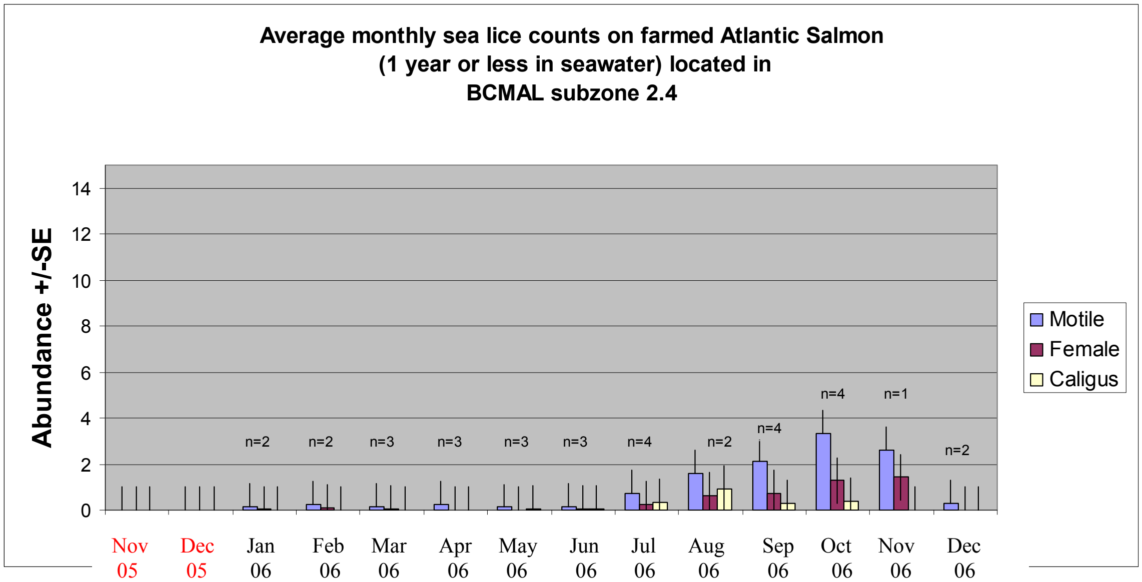
Figure 7.12.1 Monthly mean abundance of motile and female *Lepeophtheirus salmonis*, and motile *C. clemensi* on farmed Atlantic Salmon in sub-zone 2.3[7] as submitted to BCMAL by the BC Salmon Farmers Association (BCSFA) in 2006.





[7] Lice abundance in sub-zone 2.3 exceeded the trigger level of three (3) motile lice per fish in quarter 2 (Apr-May) due to various factors: a) in Q1 there was no foreseeable need to medicate fish, b) the unexpected rise in Q2 initiated both management controls, medication of some fish and harvest of other groups; and c) in Q2 and Q3 environmental events such as seasonally low dissolved oxygen and harmful algae blooms resulted in limited opportunities to apply lice medication.

Figure 7.12.2 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 2006.



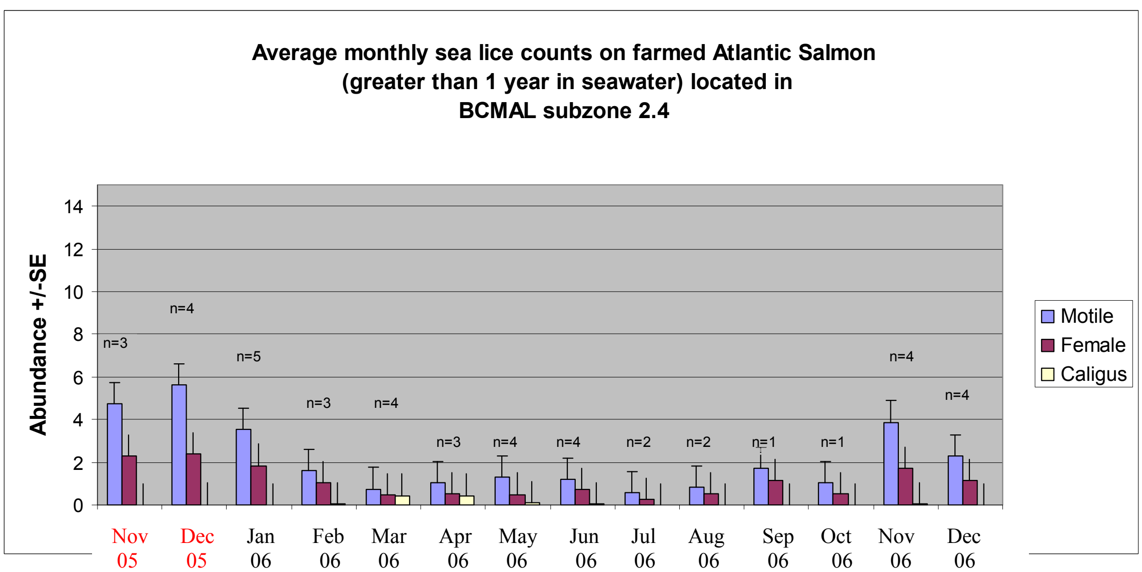
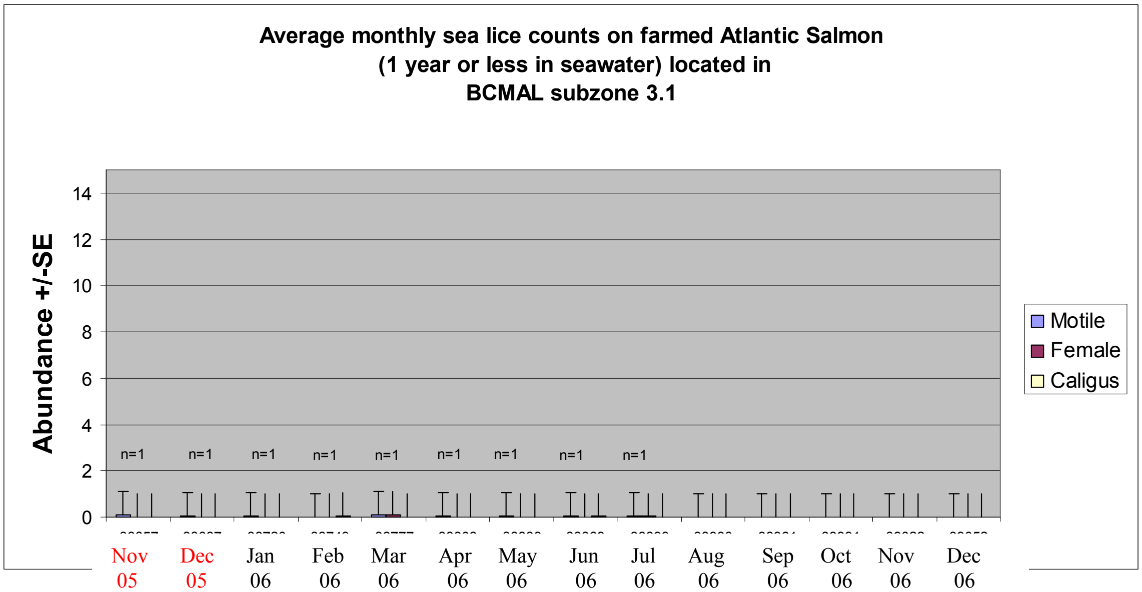
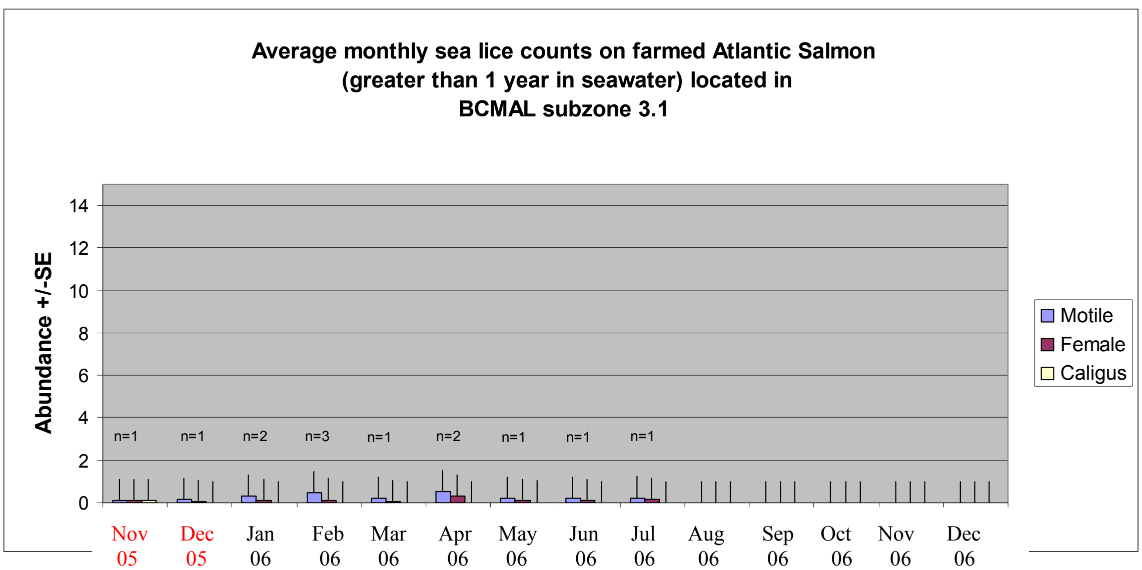


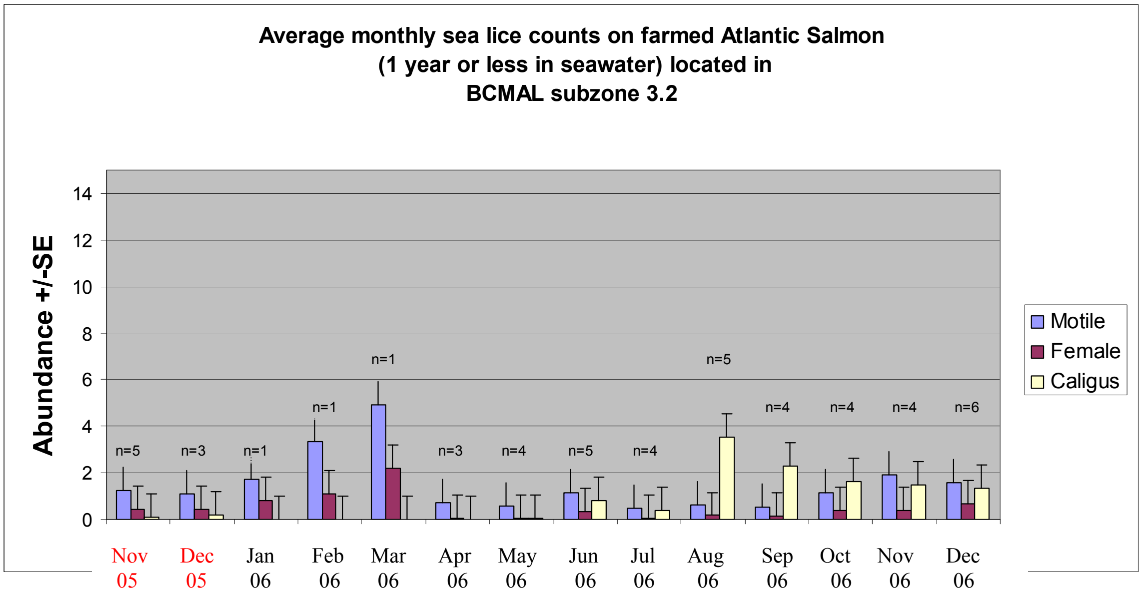
Figure 7.12.3 Monthly mean abundance of motile and female *Lepeophtheirus salmonis*, and motile *C. clemensi* on Farmed Atlantic Salmon in sub-zone 3.1[8] as submitted to BCMAL by the BC Salmon Farmers Association (BCSFA) in 2006.

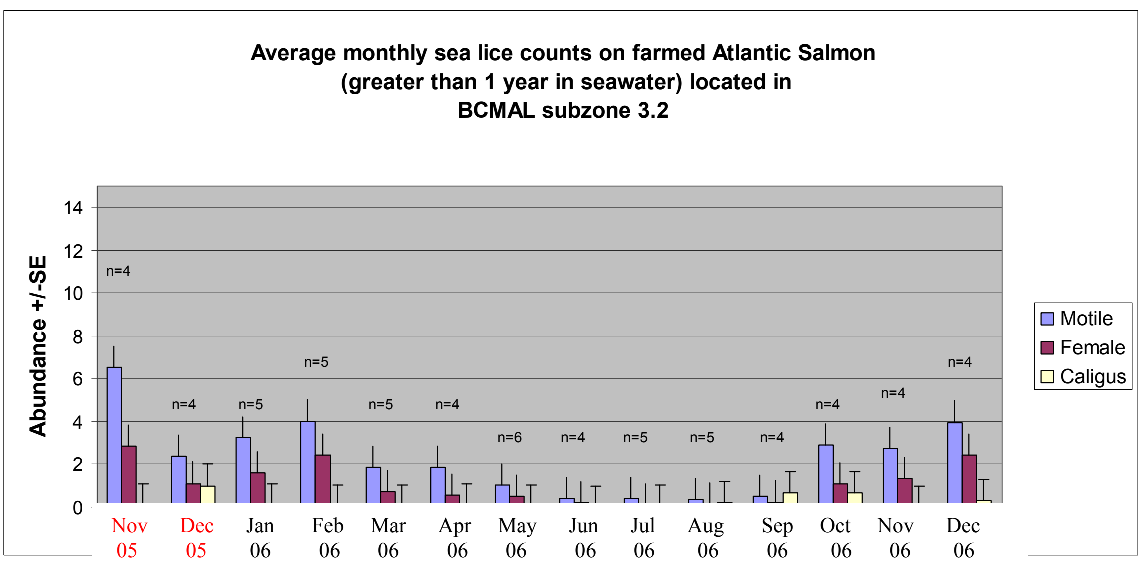




[8] Sea lice abundance on salmon raised within sub-zone 3.1 has been so low since monitoring began that the handling of fish alone was deemed to be more harmful than useful. Consequently, this area was granted a reprieve from routine sea lice counts yet opportune counts are conducted by farm staff whenever possible. Audit counts by BCMAL continue.

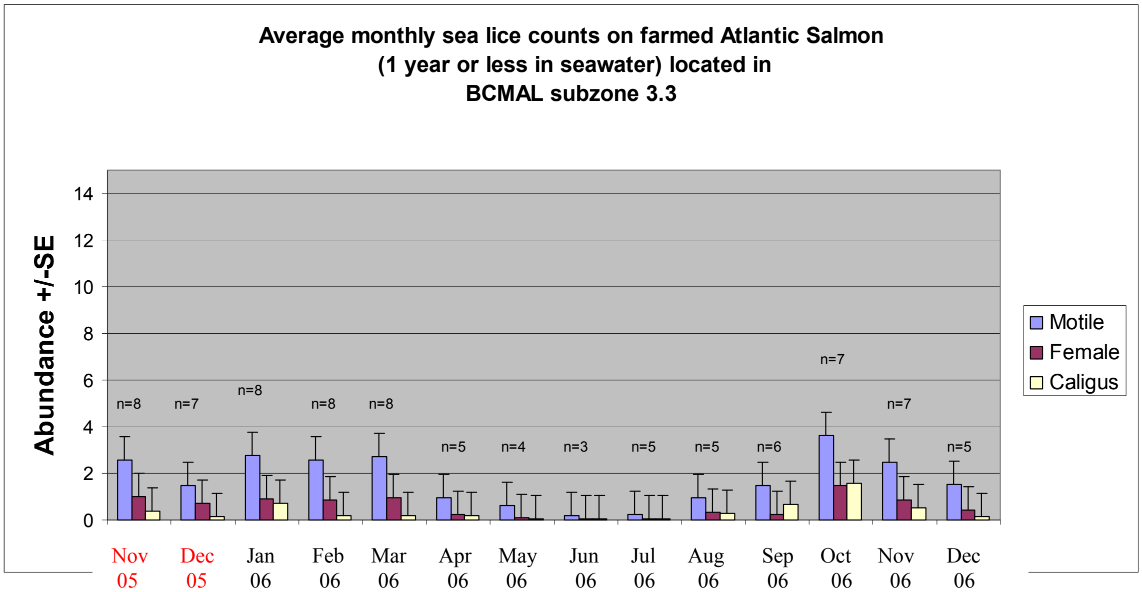
Figure 7.12.4 Monthly mean abundance of motile and female *Lepeophtheirus salmonis*, and motile *C. clemensi* on Farmed Atlantic Salmon in sub-zone 3.2[9] as submitted to BCMAL by the BC Salmon Farmers Association (BCSFA) in 2006.





[9] A unique rise in sea lice abundance in juvenile Atlantic salmon of sub-zone 3.2 began in June. It was detected both by farm personnel and by BCMAL audits. This elevated abundance of motile *Caligus* species continued for the remainder of 2006. Fish health and behaviour remained normal and the *L.salmonis* abundance remained at its typical seasonal levels without incident.

Figure 7.12.5 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 2006.



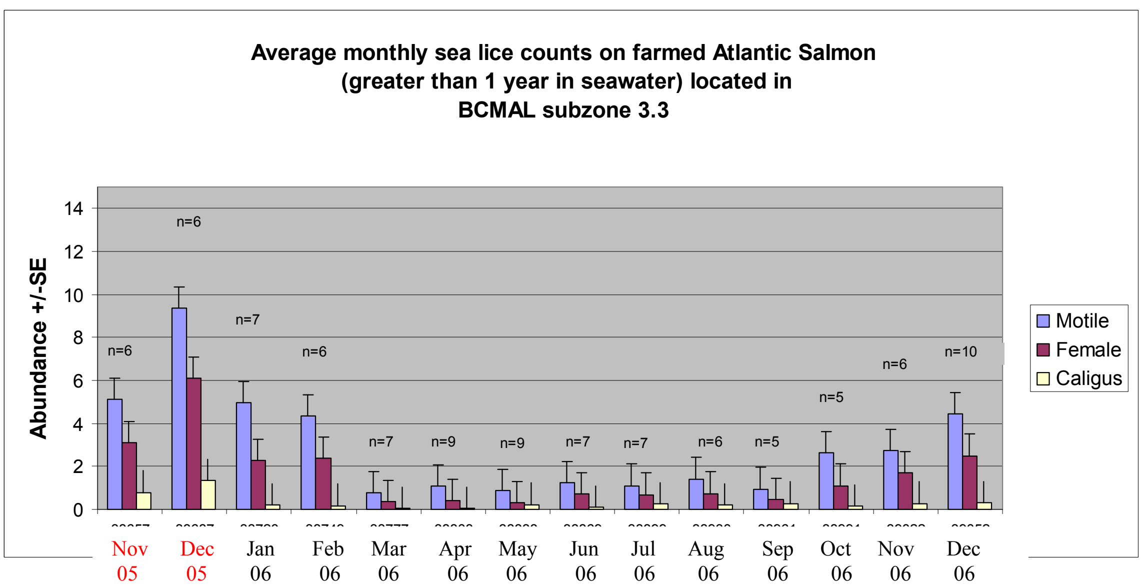
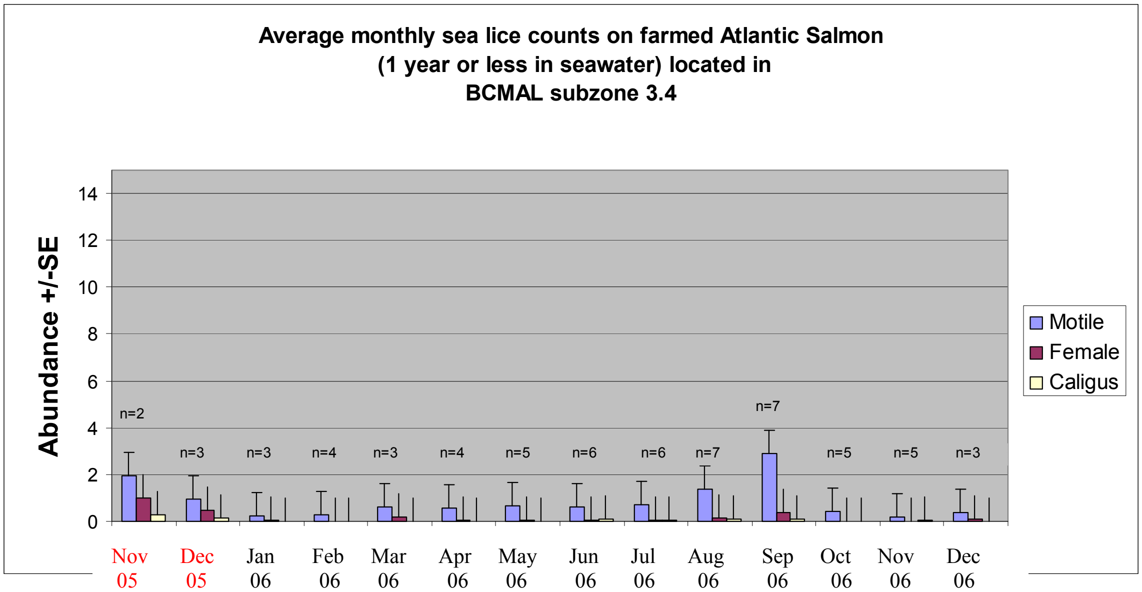
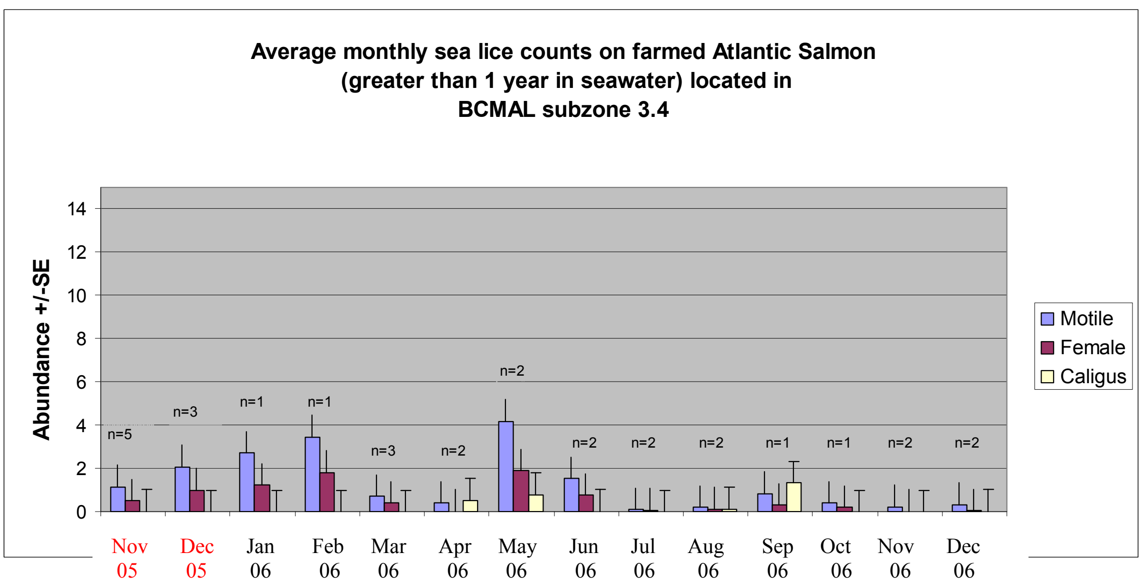


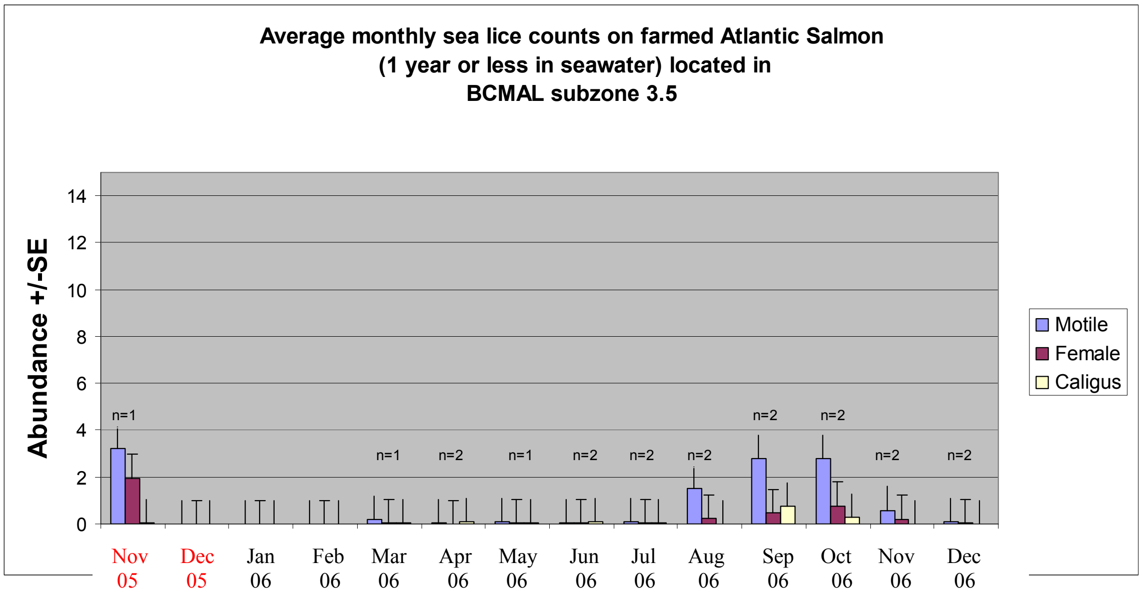
Figure 7.12.6 Monthly mean abundance of motile and female *Lepeophtheirus salmonis*, and motile *C. clemensi* on Farmed Atlantic Salmon in sub-zone 3.4[10] as submitted to BCMAL by the BC Salmon Farmers Association (BCSFA) in 2006.

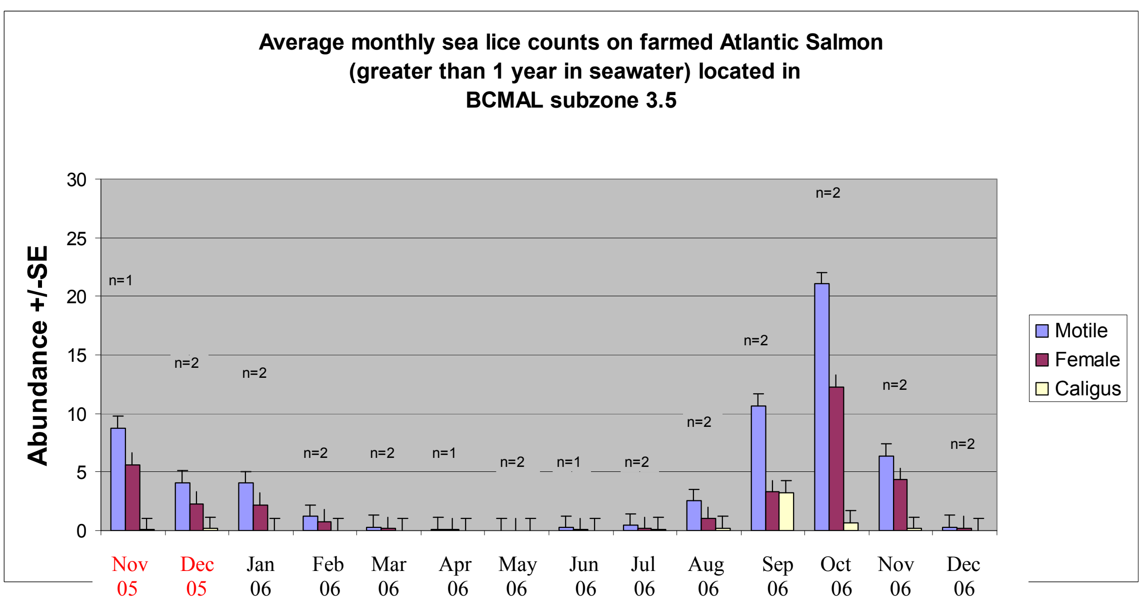




[10] A marked rise in motile sea lice abundance in May 2006 was reported by producers in sub-zone 3.4. It was attributed (speculated) to a wild migration event. Regardless, the abundance surpassed the 3 motile per fish trigger point, the affected farms were managed accordingly and the lice levels declined immediately.

Figure 7.12.7 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 2006.





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