Fish Health Program | 2003 - 2005

BRITISH COLUMBIA
The Best Place on Earth

Ministry of Agriculture and Lands

1 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.

Between 2003 and 2005 the BC Ministry of Agriculture and Lands (BC MAL) conducted 339 salmon farm audits and collected diagnostic samples for disease analysis from 1909 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 these losses have no obvious cause of mortality ("fresh silvers/silvers") - usually less than 1%. It is this group of dead fish which is sub-sampled and tested by BCMAL specifically for infectious disease.

All disease findings, from the audit of aquaculture sites, have been previously reported in British Columbia from wild, hatchery-reared, or research salmonids. On Atlantic salmon farms, 76% of the fish sampled from audited farms were free from infectious disease; of the remaining fish examined, the primary disease diagnoses were myxobacteriosis (7%) and bacterial kidney disease (6%). On Pacific salmon farms 62% of the fish examined were free from infectious disease, and the primary disease diagnoses were bacterial kidney disease (24%) and *Loma salmonae* (9%).

Audits of sea lice abundance were conducted in addition to the farm site visits for fish health. In 2004 and 2005 BCMAL conducted lice counts at 96 farms assessing 5493 fish. Triggers for monitoring and management of sea lice were implemented in 2004 and industry has complied with the requirements of this program.

The Agriculture and Lands fish health program provides regulators with a comprehensive understanding of the health status of fish stocks on salmon farms. The program allows for the regulation of fish disease and addresses health concerns related to farmed fish in British Columbia.

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 management of health and disease of fish cultured at private and public facilities in B.C.

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 over the last five years has served to improve the regulation of 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. These plans encompass all aspects of farming that can affect the health of the animals being farmed. As of 2003 all private companies and public fish culture facilities are required to develop and maintain a current Fish Health Management Plan (FHMP) specific to their facilities. 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 health and 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[1]. In addition quarterly reports of the health status are provided to government and posted for public viewing on the BC Ministry of Agriculture and Lands website. Health monitoring and reporting of disease status is a requirement under the FHMP and compliance monitoring is built-in to the system.

This report provides a detailed synopsis of the findings from the Fish Health Audit and Surveillance Program since 2003.

[1] Fish Health Event 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 is to provide the best possible health conditions for cultured fish in British Columbia. All operators of fish culture facilities must develop and maintain a current Fish Health Management Plan (FHMP) specific to their facilities. The plans are written at the company level and the practices 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 Fish Health Management Plan (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 (FHMP) became a condition of license in 2003. To allow for development and implementation of the FHMP process, all salmonid facilities were required to have an approved FHMP in place by November 2004. In 2004, all major private facilities excluding three small producers were in compliance with approved FHMPs. This represented 99% of the fish biomass produced and 82 % compliance with the FHMP requirement. In 2005 all but two facilities had approved FHMPs (87.5% compliance rate) and in 2006, all salmonid producers with fish on marine sites had approved FHMPs (100% compliance).

With respect to public enhancement facilities, in 2004 all provincial public facilities had approved FHMPs. To date federal enhancement facilities do not yet have FHMPs.

Industry FHMPs are reviewed annually by BCMAL. Letters are sent to all FHMP holders requesting changes to the FHMP as required. 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 the 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

As part of the Fish Health Management Plan, all companies operating in British Columbia must monitor and report to the industry database monthly the results on health status of their fish. These monitoring results are aggregated and reported to BCMAL quarterly by fish health zone. The reports are standardized and include total mortality and both infectious and non infectious causes of that mortality for all farms. The definitions of the various causes of mortality are included in Appendix 7.1. In addition, private sector veterinarians report Fish Health Events when their intervention is required. Fish Health Events (FHE) account for the diseases that occur on farms on a quarterly basis. Together these reports provide an ongoing assessment of the health status of all aquaculture sites in British Columbia. To ensure public confidence and validate industry information BCMAL audits the farm sites sampling specifically for endemic diseases. A description of the Audit program is outlined below.

2.2.1 Third Party Audit 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). For sea lice all data are required on the 10th day of the month post sampling. For example January data is due February 10th. If a company does not comply with the reporting requirements, they have 10 days to come into compliance. If by the 20th of the month a company is not in compliance 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. A description of the provincial audit system is described below.

3 Section 3 Fish Health Auditing and Surveillance

3.1 Fish Health Auditing and Surveillance Program

The BC Fish Health Auditing and Surveillance program is comprised of a number of components including 1) Visits by fish health technicians to marine salmon net pen sites to monitor activities and review health related records outlined in Fish Health Management Plans; 2). Collection of samples from farmed fish for active surveillance for bacteria, virus and parasites and determination of farm level disease events; and 3) Comparison of the audit results with the reports generated through the BC Salmon Farmers Database. The fish health auditing and surveillance program serves to not only audit industry activities but also to monitor for endemic and emerging pathogens of concern.

3.2 Methodology

3.2.1 Zonation

For the fish health audit and surveillance program, 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 the West Coast of 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 farms reports are summarized by zone and sub zone; Pacific salmon farms are reported by zone; this occurs because of the small number of Pacific salmon farms. A summary of the fish health zones is provided in Table 1 and a map of the fish zones is located in Appendix 7.2.

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

Zone	Sub Zone	Geographical Description
Atlantic Salmon Reporting Zones		
2	3	West Coast of Vancouver Island, Southern Area
2	4	West Coast of Vancouver Island, Northern Area
3	1	South East Coast Vancouver Island + Sunshine Coast
3	2	Inside Passage - Campbell River
3	3	Broughton Area
3	4	Port Hardy
3	5	North Coast
Pacific Salmon Reporting Zones		
2		West of Vancouver Island
3		East of Vancouver Island

3.2.2 Sampling Methodology

BCMAL uses a multistage sampling system with the unit of concern being the zone. All sites within a zone are assigned a random number (Primary unit). 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 – that is, 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. For economic reasons, maximum sample size is 30 farms per quarter. The aim is to have 120 sites audited 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. Between 2003 and 2005 the number of active sites available for audit each quarter ranged from 53 to 65 (mean = 60) (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 46 to 56% 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 mortalities; 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 Tables 3a, 3b and 3c, Figures 1a and 1b).

Occasionally, site audits have to be cancelled due to weather conditions, overriding 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 mortality collection dives conducted by industry. Mortalities are categorised according to protocols agreed upon with industry health experts (See Appendix 7.1 for definitions). A random selection of the "fresh or fresh silver"

[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.

mortalities[3] are sampled for routine histopathology, bacteriology, and virology. As the intent of the program is establish the occurrence of endemic disease on farms and use the information to compare to the industry reported health information, mortality sampling enhances the likelihood of detection of disease.

Within the "fresh silver" category, fish health bio-technicians select fish of diagnostic value, to a maximum of 30 fish per farm (Secondary unit). Sampling is aimed at achieving a 95% confidence of detection of 2% disease prevalence. The sample population is the diagnostically valuable portion of the "fresh silver" category or that portion of the population that was not attributable to a known cause. Sampling targets the "dead from unknown cause" portion of the population. This inherent "bias" means an increased likelihood of detection of disease should it occur. It should be noted that as sampling is limited by availability of diagnostically valuable samples, thus the total number of fish actually sampled varies with each site visit. The number of fish sampled each year from 2003 to 2005 was 648 (162 per quarter), 675 (169 per quarter), and 586 (149 per quarter). For the quarterly breakdown of samples see Tables 4a, 4b and 4c.

3.2.5 Diagnostic Testing

Samples are sent to the BCMAL Animal Health Centre in Abbotsford for evaluation. The Animal Health Centre is an AAVLD (American Association of Veterinary Laboratory Diagnosticians) certified diagnostic laboratory; the use of a certified 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 analysis. For bacteriology, kidney tissue from each individual fish examined is swabbed onto Trypticase Soya Agar and Blood agar plates. Biochemical analysis and or gene sequencing are used to confirm the identity of bacterial agents.

Samples for virology are collected from each individual fish sampled and submitted to the AHC laboratory for analysis. Tissues collected 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 taken as required. Virology samples are pooled to a maximum of five fish per sample and screened using standard Polymerase Chain Reaction (PCR) technique for the following pathogens:

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

[3] Fresh or fresh silver means that the sample has bright red or pink gills and/or no visual signs of tissue autolysis.

If there is a PCR positive finding or a suspect viral septicaemia on clinical examination, the samples are cultured on appropriate cell lines or other diagnostic gold standard test method for confirmation of the diagnosis. Standard cell lines include CHSE 214, EPC, RTG, and FHM.

All histopathology samples are examined for disease lesions and cause of mortality. The Fish Pathologist at the Animal Health Centre has a Doctorate of Veterinary Medicine and is certified by the American College of Veterinary Pathologists as a 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 fish health staff assess farm records to check the mortality numbers and the breakdown of those mortalities, 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 dive activities, frequency of the dives to collect mortalities and biosecurity protocols used during mortality handling. In 2006/07 the fish health program will include a checklist for evaluation of 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 fish health versus sea lice. 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.

Table 2. Average Number of Active Salmon Farm Sites 2003* - 2005

Atlantic Salmon	2003 Oct-Dec*	2004	2005
Zone 2.3 SW Vancouver Island	6	6	8
Zone 2.4 NW Vancouver Island	5	7	6
Zone 3.1 Sunshine Coast	0	2	3
Zone 3.2 Campbell River	4	7	11
Zone 3.3 Broughton	9	11	12
Zone 3.4 Pt Hardy	3	5	6
Zone 3.5 North Coast	0	1	2

Pacific Salmon	2003 Oct-Dec*	2004	2005
Zone 2 West of Vancouver Island	10	8	5
Zone 3 East of Vancouver Island	17	13	9

NB: For Fish Health Audit Broodstock are not sampled. BCSFA reports sites with any inventory and will almost always show higher numbers of sites.
*Audit program database was under development in 2003 so information on the active sites for the first three quarters is not readily available.

Table 3a: Number of Salmon Farms Chosen for Audit and Site Visit Completed During Each Quarter of 2003

Location	Jan - March	April - June	July - Sept	Oct - Dec	2003 Totals
Zone 2.3 SW Vancouver Island	4	6 (5)	4	3	17 (16)
Zone 2.4 NW Vancouver Island	3	4	3	3	13
Zone 3.1 Sunshine Coast	0	2	1	0	3
Zone 3.2 Campbell River	4 (2)	2	4	2	12 (10)
Zone 3.3 Broughton	6 (5)	4	5	5	20 (19)
Zone 3.4 Pt Hardy	3	4 (3)	3	2	12 (11)
Zone 3.5 North Coast	0	0	0	0	0
Atlantic Sub Total	20 (17)	22 (20)	20	15	77 (72)
Zone 2 West of Vancouver Island	4 (2)	5 (4)	4	6 (5)	19 (15)
Zone 3 East of Vancouver Island	6 (4)	6 (5)	6	9 (8)	27 (23)
Pacific Sub Total	10 (6)	11 (9)	10	15 (13)	46 (38)
Grand Total	30 (23)	33 (29)	30	30 (28)	123 (110)

NB: If there is only one number present in the square, the number of sites chosen for audit and number of sites visited are equal. Where a number in brackets is included it reflects the actual number of site visits completed.

Table 3b: Number of Salmon Farms Chosen for Audit and Site Visits Completed During Each Quarter of 2004

Location	Jan – March	April - June	July - Sept	Oct - Dec	2004 Totals
Zone 2.3 SW Vancouver Island	4	3	3	3	13
Zone 2.4 NW Vancouver Island	4	4	3 (2)	3	14 (13)
Zone 3.1 Sunshine Coast	1	3	3	1	8
Zone 3.2 Campbell River	2	2	4	5	13
Zone 3.3 Broughton	6	6	5	5	22
Zone 3.4 Pt Hardy	1	2	3	3	9
Zone 3.5 North Coast	0	0	0	1	1
Atlantic Sub Total	18	20	21 (20)	21	80 (79)
Zone 2.0 West of Vancouver Island	5	4	3 (2)	3	15 (14)
Zone 3.0 East of Vancouver Island	7 (6)	6	6	5	24 (23)
Pacific Sub Total	12 (11)	10	9 (8)	8	39 (37)
Grand Total	30 (29)	30	30 (28)	29	119 (116)

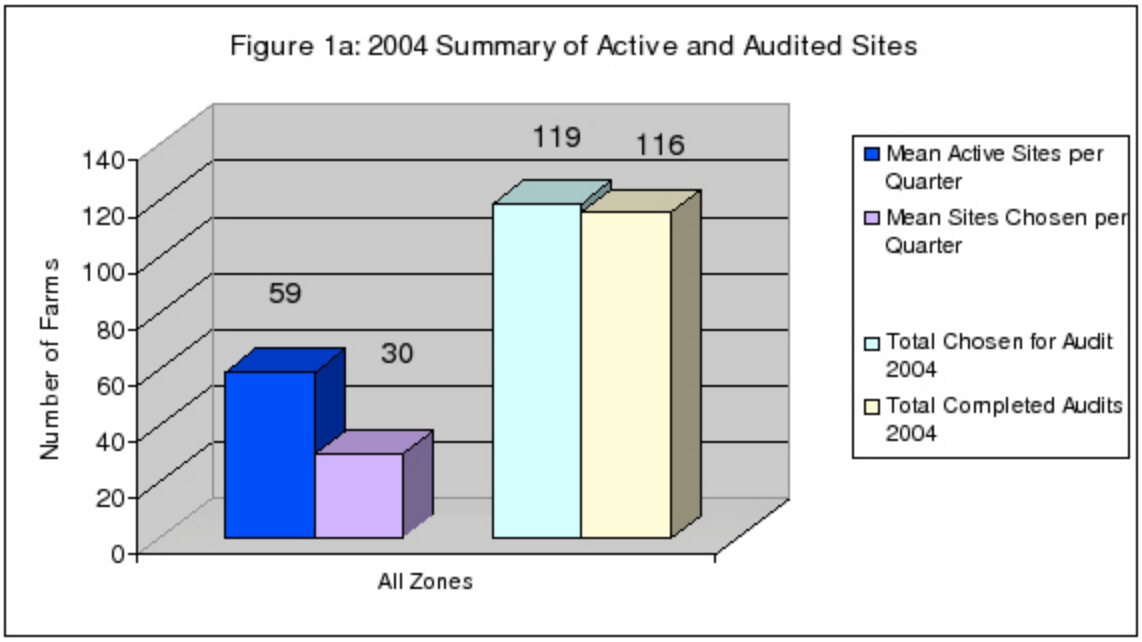
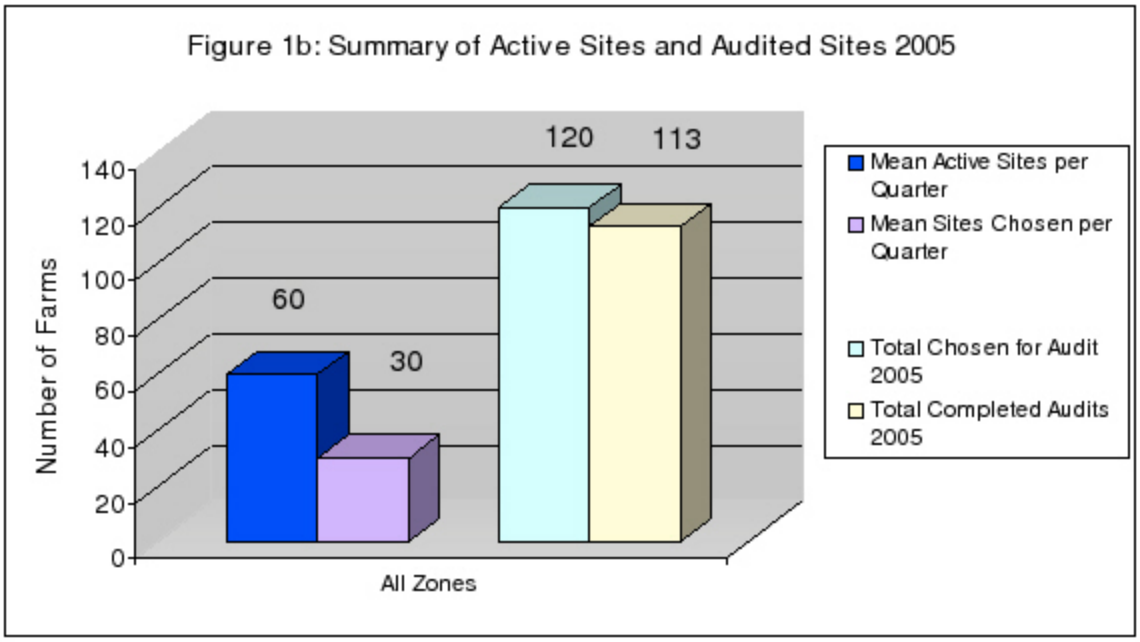


Table 3c: Number of Salmon Farms Chosen for Audit and Site Visits Conducted During Each Quarter of 2005

Location	Jan - March	April - June	July - Sept	Oct - Dec	2005 Totals
Zone 2.3 SW Vancouver Island	4	4	4	3	15
Zone 2.4 NW Vancouver Island	4	2	3	3	12
Zone 3.1 Sunshine Coast	2	3	2	2 (0)	9 (7)
Zone 3.2 Campbell River	4	5	5	5 (4)	19 (18)
Zone 3.3 Broughton	5	7	6	6	24
Zone 3.4 Pt Hardy	2	2	3	4	11
Zone 3.5 North Coast	1	1	1	1 (0)	4 (3)
Atlantic Sub Total	22	24	24	24 (20)	94 (90)
Zone 2 West of Vancouver Island	3	2 (1)	1	2	8 (7)
Zone 3 East of Vancouver Island	5	4	5	4 (2)	18 (16)
Pacific Sub Total	8	6 (5)	6	6 (4)	26 (23)
Grand Total	30	30 (29)	30	30 (24)	120 (113)



3.3.2 Number of Fish Sampled

Hundreds 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 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 rare instances (2% of site visits) there are no fish available or suitable for sampling; when this occurs all other aspects of the audit are still conducted including assessment of mortality records and dive procedures. During 2003 through 2005, 339 site audits were conducted and samples were collected on 333 of those site audits. The detailed breakdown of samples collected by zone sub zone and quarter is provided in Tables 4a, 4b, and 4c.

Table 4a : Number of Fish Sampled During Each Quarter of 2003

Location	Jan - March	April - June	July - Sept	Oct - Dec	2003 Totals
Zone 2.3 SW Vancouver Island	38	31	22	16	107
Zone 2.4 NW Vancouver Island	17	28	7	10	62
Zone 3.1 Sunshine Coast	0	5	2	0	7
Zone 3.2 Campbell River	6	16	20	7	49
Zone 3.3 Broughton	37	20	26	31	114
Zone 3.4 Pt Hardy	27	22	20	15	84
Zone 3.5 North Coast	0	0	0	0	0

Atlantic Sub Total	125	122	97	79	423
Zone 2 West of Vancouver Island	10	27	16	20	73
Zone 3 East of Vancouver Island	28	44	42	38	152
Pacific Sub Total	38	71	58	58	225
Grand Total	163	193	155	137	648

Table 4b : Number of Fish Sampled During Each Quarter of 2004

Location	Jan - March	April - June	July - Sept	Oct - Dec	2004 Totals
Zone 2.3 SW Vancouver Island	22	17	10	22	71
Zone 2.4 NW Vancouver Island	28	31	23	6	88
Zone 3.1 Sunshine Coast	3	11	10	6	30
Zone 3.2 Campbell River	11	20	31	24	86
Zone 3.3 Broughton	44	36	27	32	139
Zone 3.4 Pt Hardy	8	10	13	7	38
Zone 3.5 North Coast	0	0	0	5	5
Atlantic Sub Total	116	125	114	102	457
Zone 2 West of Vancouver Island	38	21	14	4	77
Zone 3 East of Vancouver Island	34	44	22	41	141
Pacific Sub Total	72	65	36	45	218
Grand Total	188	190	150	147	675

Table 4c : Number of Fish Sampled During Each Quarter of 2005

Location	Jan-March	April-June	July - Sept	Oct-Dec	2005 Totals
Zone 2.3 SW Vancouver Island	27	19	14	7	67
Zone 2.4 NW Vancouver Island	16	16	13	14	59
Zone 3.1 Sunshine Coast	3	12	15	0	30
Zone 3.2 Campbell River	13	29	26	21	89
Zone 3.3 Broughton	31	49	39	33	152
Zone 3.4 Pt Hardy	4	5	17	21	47
Zone 3.5 North Coast	0	4	5	0	9
Atlantic Sub Total	94	134	129	96	453
Zone 2 West of Vancouver Island	17	5	3	8	33
Zone 3 East of Vancouver Island	41	26	21	12	100
Pacific Sub Total	58	31	24	20	133
Grand Total	152	165	153	116	586

3.3.3 Bacteriology

Tables 5a, 5b and 5c contain information on all bacteriology findings from the BCMAL audit program since 2003. The data represents the findings from the fish examined on audited farms within each zone and sub zone. It includes only those finding of organisms that are pathogenic or can cause disease in fish.

In the majority of fish sampled no bacterial pathogens were cultured. From 2003 to 2005 a total of 1909 fish were sampled for the presence of bacterial agents yet only 3.2% (62 fish) of the fish had a recognized pathogen cultured.

Bacteriology 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 sampling results by zone, sub zone, quarter and annual summary are provided in Appendix 7.4; this includes the names of the pathogens and non-pathogenic agents that have been cultured.

Table 5a: 2003 Total farms, numbers of fish sampled by quarter and number of fish with positive cultures

	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Annual
# farms audited (and sampled)	23	29 (27)	30 (28)	28 (27)	110 (105)
# fish sampled	163	193	155	137	648
# fish with a pathogen cultured	5	9	9	5	28

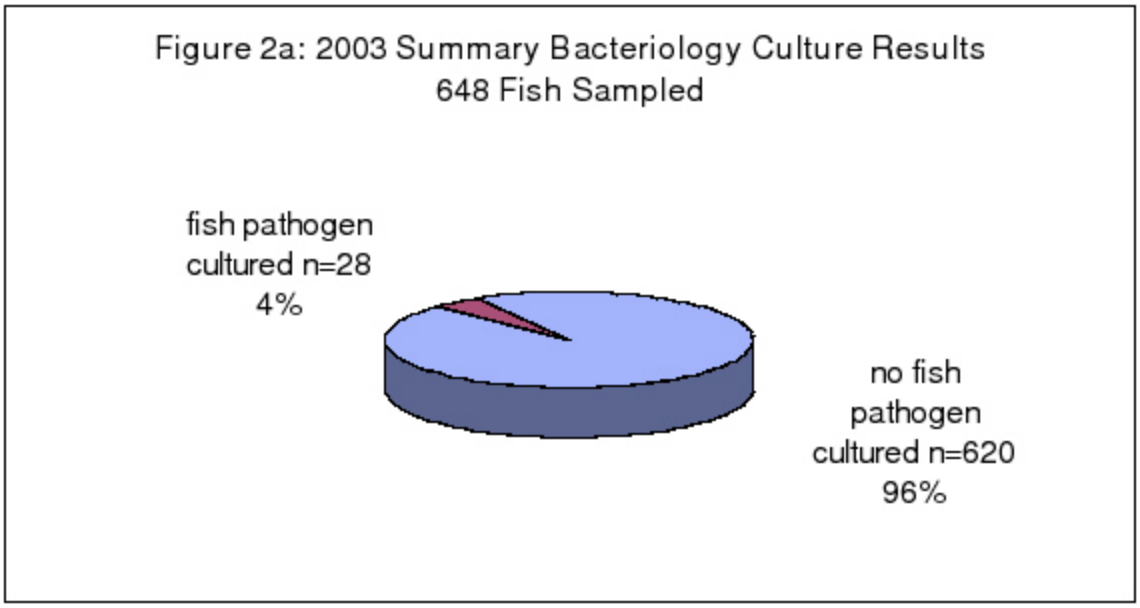


Table 5b: 2004 Total farms, numbers of fish sampled by quarter and number of fish with positive cultures

	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Annual
# farms audited (and sampled)	29	30	28	29	116
# fish sampled	188	190	150	147	675
# fish with a fish pathogen cultured	2	9	6	6	23

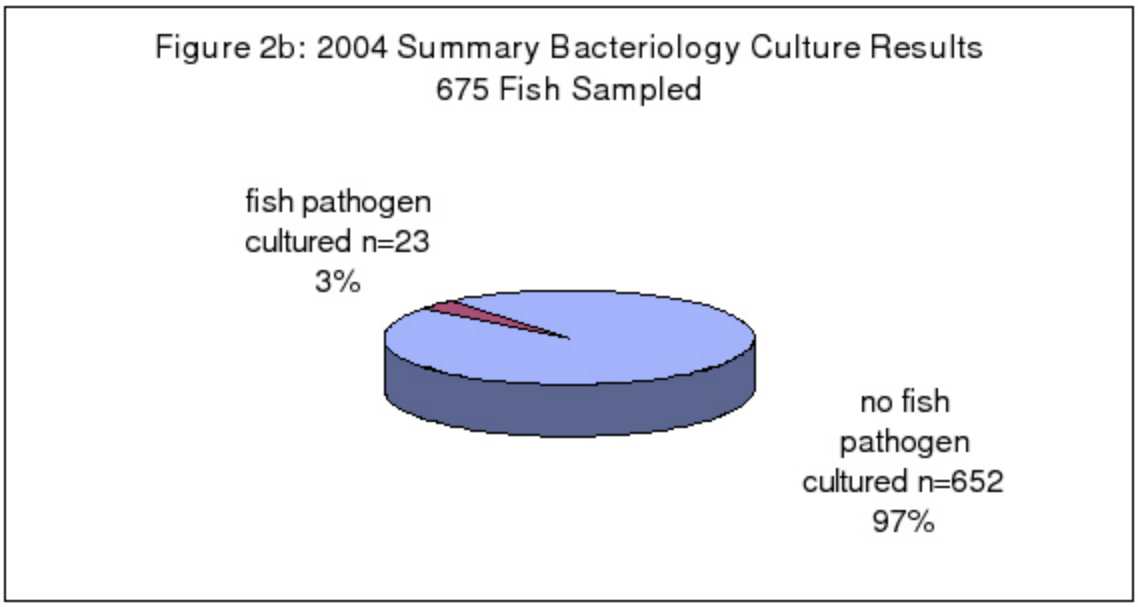
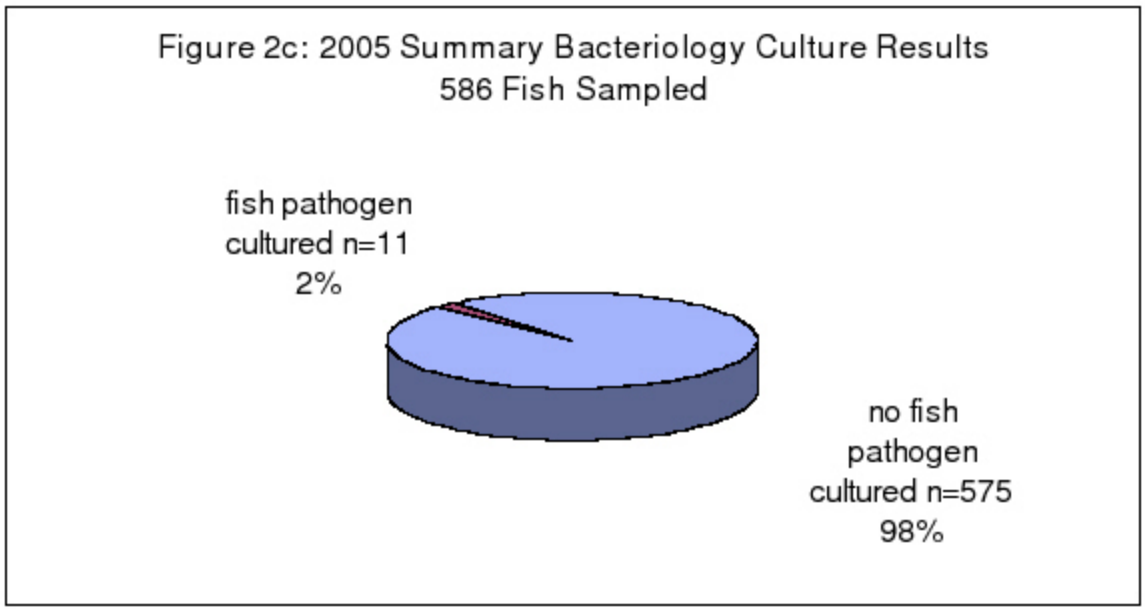


Figure 2b: 2004 Summary Bacteriology Culture Results
675 Fish Sampled
fish pathogen cultured n=23 3%
no fish pathogen cultured n=652 97%

Table 5c: 2005 Total farms, numbers of fish sampled by quarter and number of fish with positive cultures.

	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Annual
# farms audited (and sampled)	30	29	30	24	113
# fish sampled	152	165	153	116	586
# fish with a pathogen cultured	5	5	0	1	11



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 North American Strain (VHSV NAS), Infectious Salmon Anaemia virus (ISAv) and *Piscirickettsia salmonis*.

From 2003 to 2005, a total of 1909 fish were tested and tissue samples examined using molecular diagnostics techniques (PCR). The majority of fish showed no signs of disease and were unaffected by any fish pathogen. Samples are collected from individual fish but sub-samples of each group are pooled for testing. If a molecular test positive result is found, further evaluation is completed using more highly specific tissue culture techniques to determine if viable virus is present. As fish sampled as pooled, resulted are summarized at the farm rather

than fish level. A summary of the annual findings of molecular diagnostics is provided in Table 6a, 6b and 6c and Figure 3a, 3b and 3c. Complete results of all testing completed in each zone/sub zone, by quarter and annually are provided in Appendix 7.5. Of the total 328 sites sampled during 2003 – 2005, 27 had a positive PCR test result; hence 92% of sites sampled showed no detectable viral agents or *Piscirickettsia*.

Table 6a: 2003 Total farms audited, sampling completed, numbers of fish sampled and number of farms with a positive PCR result by quarter.

	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Annual
# farms audited (and sampled)	23	29 (27)	30 (28)	28 (27)	110 (105)
# fish sampled	163	193	155	137	648
# farms with a positive PCR	6	2	1	3	12

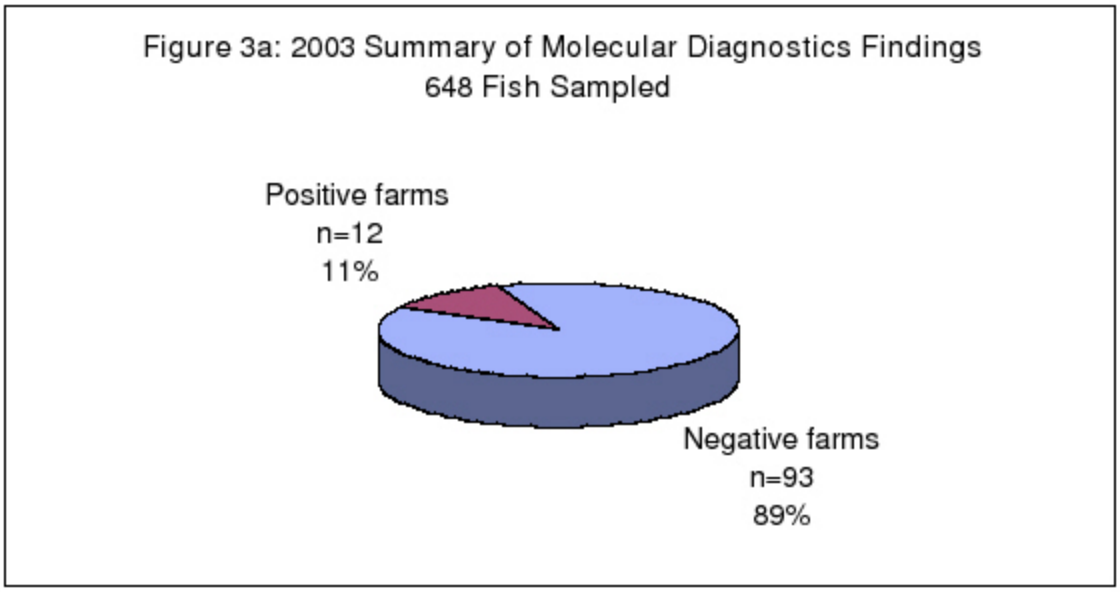


Table 6b: 2004 Total farms and numbers of fish sampled by quarter and number of positive PCR tests.

	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Annual
# farms audited (and sampled)	29	30	28	29	116
# fish sampled	188	190	150	147	675
# farms with a positive PCR	1	0	2	3	6

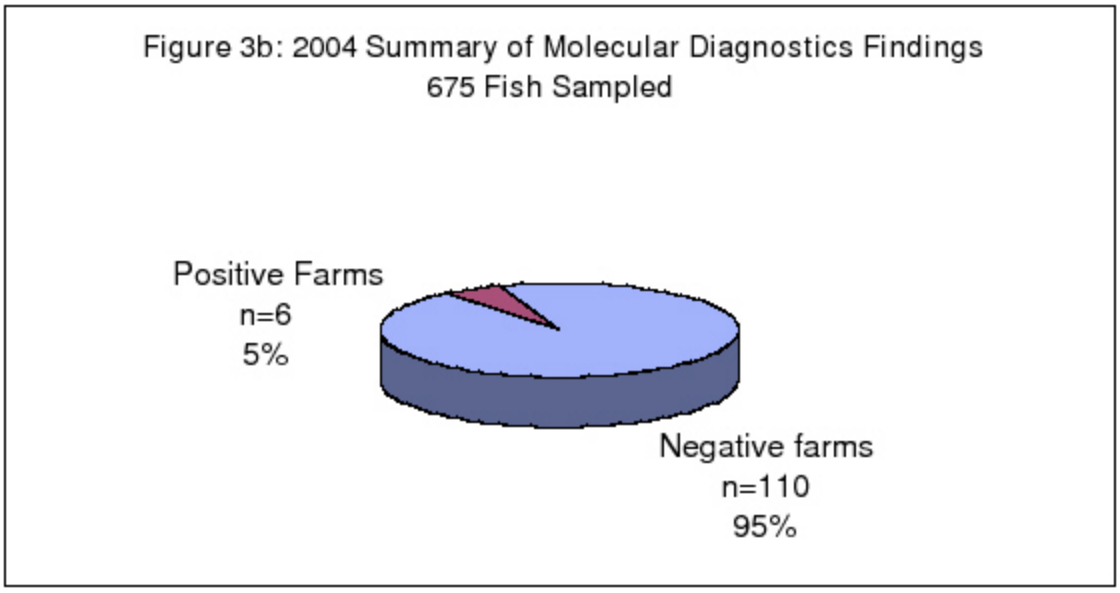
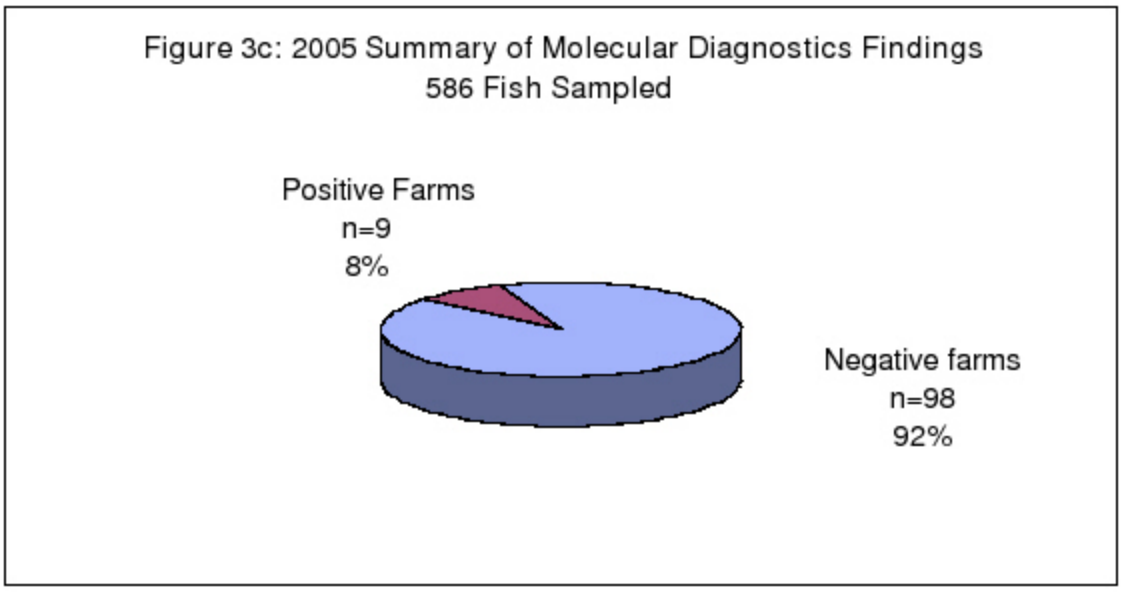


Table 6c: 2005 Total farms and numbers of fish sampled by quarter					
	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Annual
# farms audited (and sampled)	30 (29)	29	30 (28)	24 (21)	113 (107)
# fish sampled	152	165	153	116	586
# farms with positive PCR Test	2	3	2	2	9



3.3.5 Histopathology

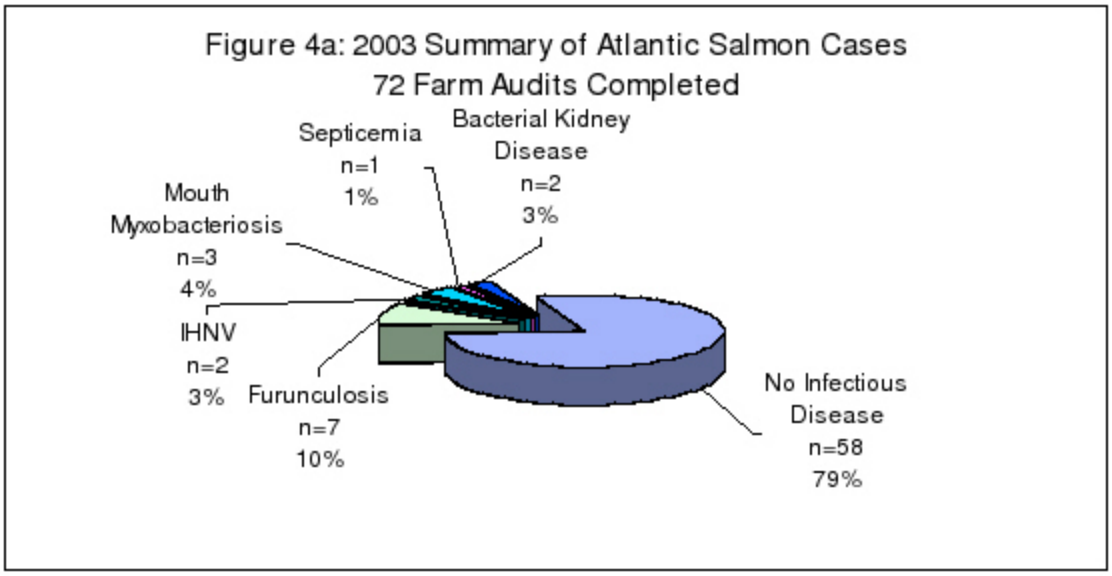
Tissue samples (anterior and posterior kidney, liver, spleen and heart and occasionally gill) are collected for microscopic examination by a board-certified veterinary pathologist. Additional tissues samples may also be taken if there are any lesions or suspect disease causing agents present. Histopathology 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 professional veterinary review of all the information collected and recorded during the 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 necessarily translate into a clinical disease event in a population. To ensure accurate interpretation of the information gathered, diagnoses must be made by veterinary professionals 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 pathogens have been identified diagnostically; however, this does not necessarily correspond to a farm level diagnosis of disease attributable to that particular agent. As well, there can be more than one diagnosis per farm audit and thus the number of cases is not necessarily equivalent to the number of audits.

Tables 7a, 7b, and 7c summarize the farm level diagnoses of disease based on all audits conducted annually. Case definitions are provided in Appendix 7.6

Table 7a: 2003 Summary of Audit Diagnoses	
Atlantic Salmon	**Number of Cases**
No Infectious Disease	58
Furunculosis	7
IHN	2
Mouth Myxobacteriosis	3
Septicaemia	1
Bacterial Kidney Disease	2
Pacific Salmon	**Number of Cases**
No Infectious Disease	30
Bacterial Kidney Disease	7
Loma	1



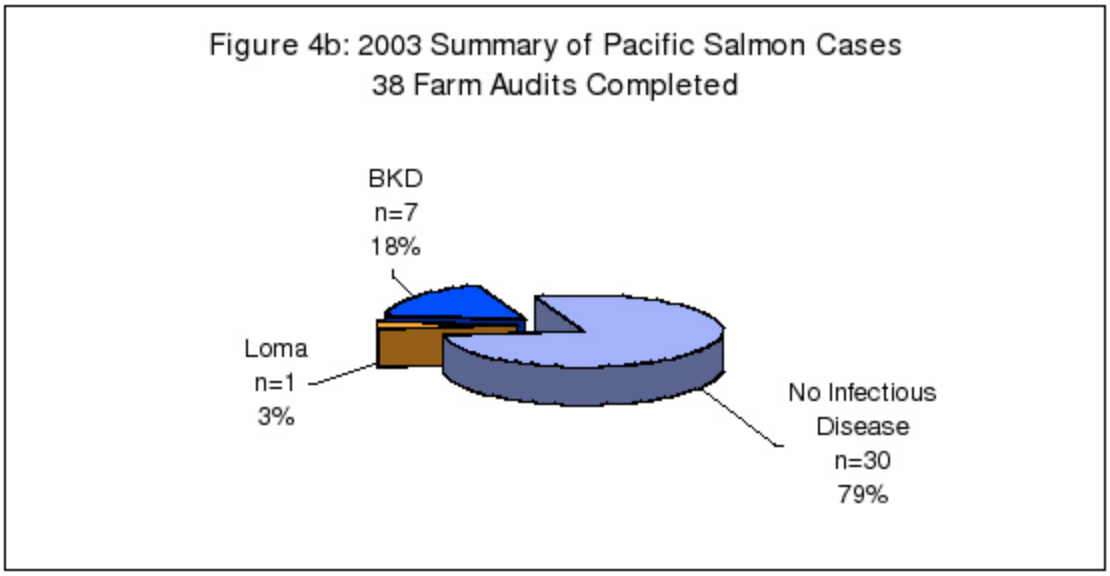


Table 7b: 2004 Summary of Audit Diagnoses	
Atlantic Salmon	**Number of Cases**
No Infectious Disease	61
Mouth Myxobacteriosis	6
Bacterial Kidney Disease	5
VHS (NAS)	4
Rickettsiosis	3
Bacteraemia	1
Pacific Salmon	**Number of Cases**
No Infectious Disease	18
Bacterial Kidney Disease	15
Loma	3
Bacteraemia	1
Marine Anaemia	1

Figure 4c: 2004 Summary of Atlantic Salmon Cases
79 Farm Audits Completed

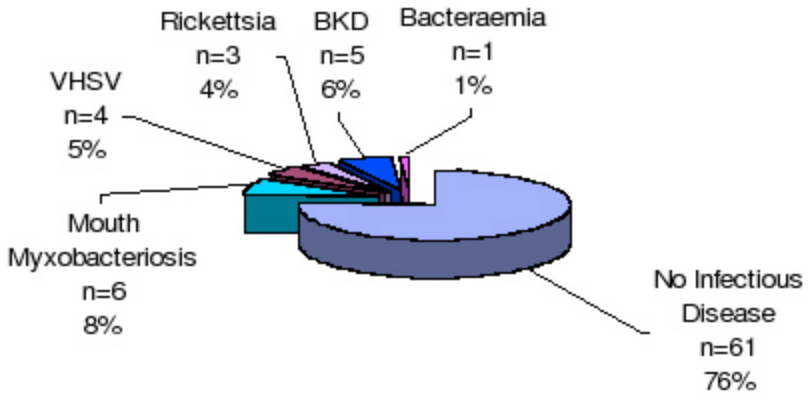


Figure 4d: 2004 Summary of Pacific Salmon Cases
38 Farm Audits Completed

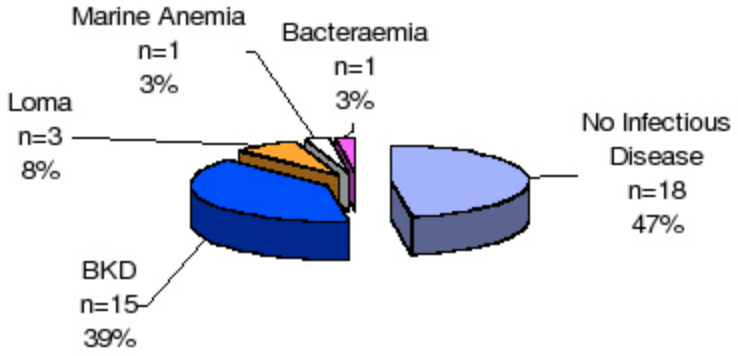


Table 7c: 2005 Summary of Audit Diagnoses	
Atlantic Salmon	**Number of Cases**
No Infectious Disease	64
Mouth Myxobacteriosis	7
Bacterial Kidney Disease	8
VHS (NAS)	4
Rickettsiosis	7
Furunculosis	1
Pacific Salmon	**Number of Cases**
No Infectious Disease	13
Bacterial Kidney Disease	2
Loma	5
VHS (NAS)	3
Marine Anaemia	2

Figure 4e: 2005 Summary of Atlantic Salmon Cases
90 Farm Audits Completed

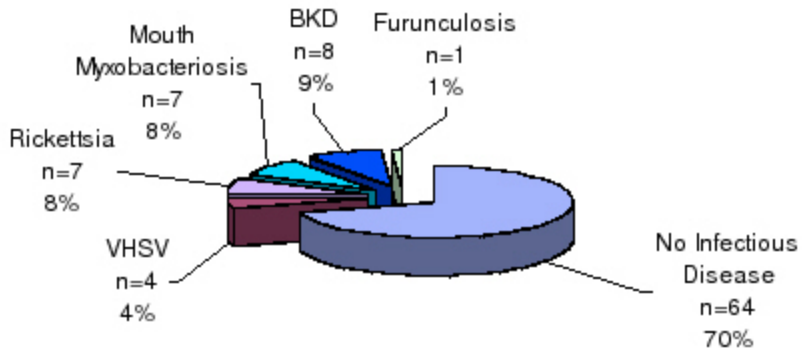
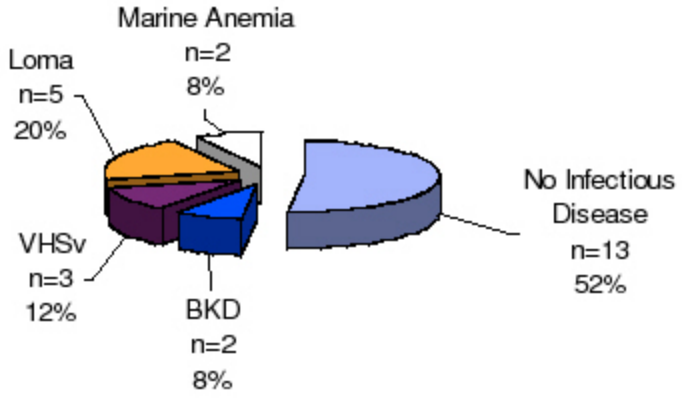


Figure 4f: 2005 Summary of Pacific Salmon Cases
23 Farm Audits Completed



3.3.7 Annual Summary of Diagnosis of Disease by Species, Zone and Sub Zone

The majority of farm sites have a very low level of naturally occurring diseases 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 licensed and approved therapeutants for fish or in some cases are self limiting events. Proper health management of stocks allows farms to maintain the low occurrence of disease and yet when disease does occur, it can and is treated quickly. The total mortality due to disease in the aquaculture sector is very low; on average less than 1% of all mortality (categorized as fresh silver) can be attributed to infectious disease agents (BCSFA data).

The following information is a snapshot of the diseases found on farms that were sampled for audit. When examining the data, it must be remembered that the audit information does not represent the total number of cases of disease amongst industry sites but instead 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 in the Fish Health Events documents on the MAL website. Comparison and analysis of the findings between the audit and industry 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 one or more farm had multiple diagnoses from a single audit. For example, during 2004 in Zone 2-3, one Atlantic salmon farm was diagnosed with both VHSv and Mouth Myxobacteriosis on the same site audit. A breakdown of diagnoses by year and zone/ sub zone is provided in 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 Zone/Sub Zone 2.3 South West Vancouver Island

Table 8a. 2003 Diagnoses for Zone 2.3 (South West Vancouver Island) Atlantic Salmon Farms		
Number of Farm Audits	Number of Cases[4]	Farm Level Diagnoses
16	12	No Infectious Disease
	2	Furunculosis
	1	IHN
	1	Mouth Myxobacteriosis

Table 8b. 2004 Diagnoses for Zone 2.3 (South West Vancouver Island) Atlantic Salmon Farms		
Number of Farm Audits	Number of Cases	Farm Level Diagnoses
13	6	No Infectious Disease
	3	Mouth Myxobacteriosis
	3	VHS (NAS)
	2	Rickettsiosis

Table 8c. 2005 Diagnoses for Zone 2.3 (South West Vancouver Island) Atlantic Salmon Farms		
Number of Farm Audits	Number of Cases	Farm Level Diagnoses
15	9	No Infectious Disease
	4	VHS (NAS)
	2	Rickettsiosis

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

Figure 5a: South West Vancouver Island (Zone 2-3)
Case Summary 2003

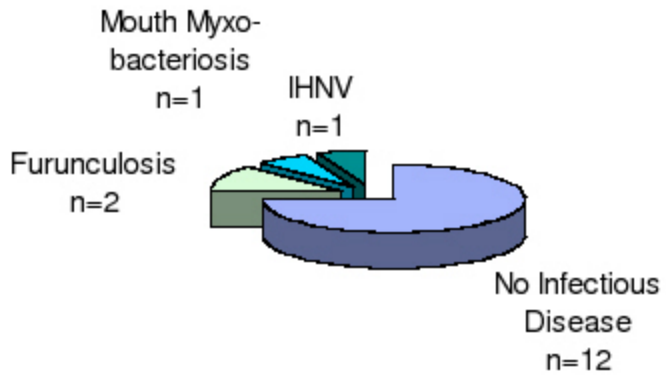


Figure 5b: South West Vancouver Island (Zone 2-3)
Case Summary 2004

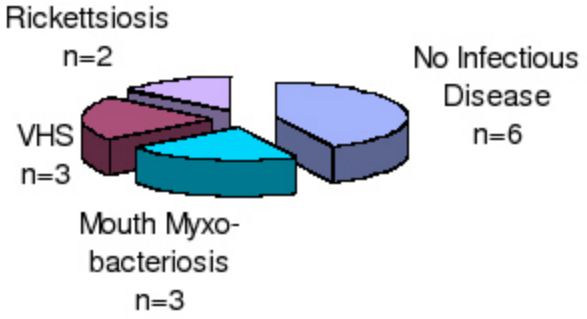
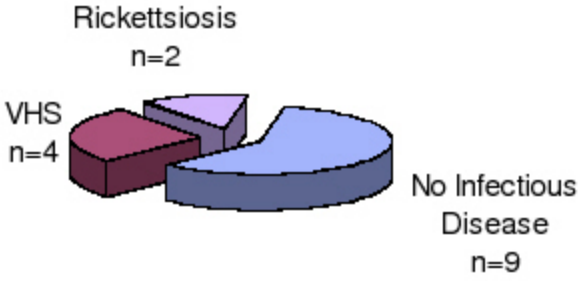


Figure 5c: South West Vancouver Island (Zone 2.3)
Case Summary 2005



3.3.7.1.2 Zone/Sub Zone 2.4 North West Vancouver Island

Table 9a. 2003 Diagnoses for Zone 2.4 (North West Vancouver Island) Atlantic Salmon Farms		
Number of Farm Audits	Number of Cases	Farm Level Diagnoses
13	9	No Infectious Disease
	2	Furunculosis
	1	Mouth Myxobacteriosis
	1	Septicaemia

Table 9b. 2004 Diagnoses for Zone 2.4 (North West Vancouver Island) Atlantic Salmon Farms		
Number of Farm Audits	Number of Cases	Farm Level Diagnoses
13	12	No Infectious Disease
	1	VHS (NAS)

Table 9c. 2005 Diagnoses for Zone 2.4 (North West Vancouver Island) Atlantic Salmon Farms		
Number of Farm Audits	Number of Cases	Farm Level Diagnoses
12	10	No Infectious Disease
	2	Mouth Myxobacteriosis

Figure 6a: North West Vancouver Island (Zone 2-4)
Case Summary 2003

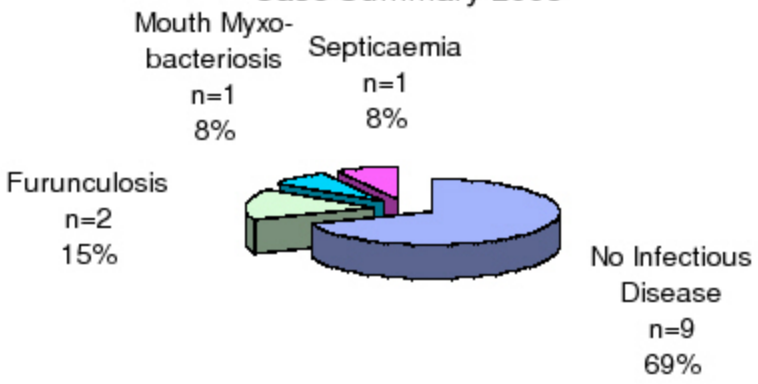


Figure 6b: North West Vancouver Island (Zone 2-4)
Case Summary 2004

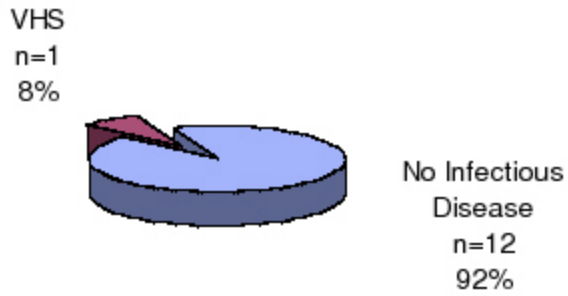
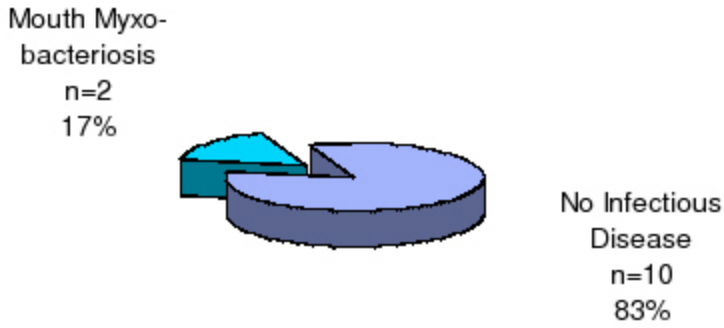


Figure 6c: North West Vancouver Island (Zone2-4)
Case Summary 2005



3.3.7.1.3 Zone/Sub Zone 3.1 Sunshine Coast

Table 10a. 2003 Diagnoses for Zone 3.1 (Sunshine Coast) Atlantic Salmon Farms		
Number of Farm Audits	Number of Cases	Farm Level Diagnoses
3	3	No Infectious Disease

Table 10b. 2004 Diagnoses for Zone 3.1 (Sunshine Coast) Atlantic Salmon Farms		
Number of Farm Audits	Number of Cases	Farm Level Diagnoses
8	6	No Infectious Disease
	1	Bacterial Kidney Disease
	1	Rickettsiosis

Table 10c. 2005 Diagnoses for Zone 3.1 (Sunshine Coast) Atlantic Salmon Farms		
Number of Farm Audits	Number of Cases	Farm Level Diagnoses
7	5	No Infectious Disease
	2	Rickettsiosis

Figure 7a: Sunshine Coast (Zone 3.1) Summary 2003

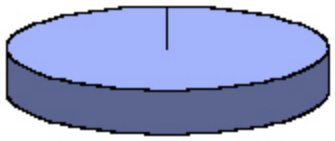


Figure 7b: Sunshine Coast (Zone 3.1) Summary 2004

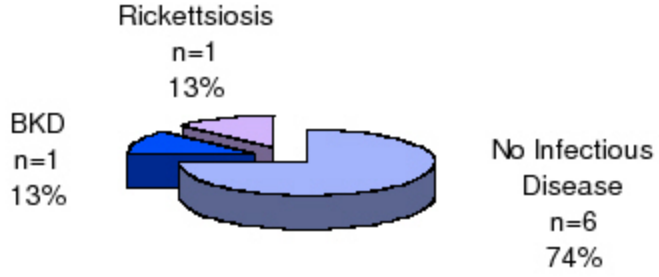
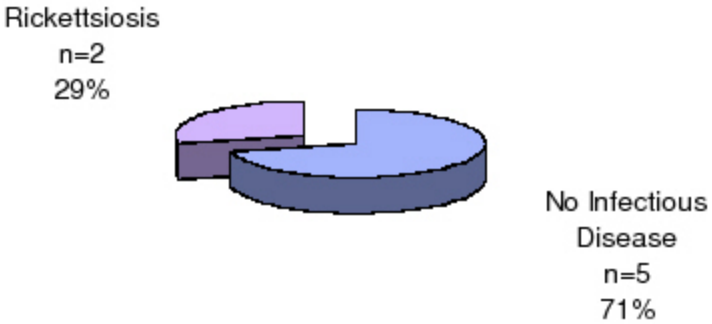


Figure 7c: Sunshine Coast (Zone 3.1) Summary 2005



3.3.7.1.4 Zone/Sub Zone 3.2 Campbell River

Table 11a. 2003 Diagnoses for Zone 3.2 (Campbell River) Atlantic Salmon Farms		
Number of Farm Audits	Number of Cases	Farm Level Diagnoses
10	10	No Infectious Disease

Table 11b. 2004 Diagnoses for Zone 3.2 (Campbell River) Atlantic Salmon Farms		
Number of Farm Audits	Number of Cases	Farm Level Diagnoses
13	11	No Infectious Disease
	1	Bacterial Kidney Disease
	1	Bacteraemia

Table 11c. 2005 Diagnoses for Zone 3.2 (Campbell River) Atlantic Salmon Farms		
Number of Farm Audits	Number of Cases	Farm Level Diagnoses
18	13	No Infectious Disease
	3	Bacterial Kidney Disease
	2	Mouth Myxobacteriosis

Figure 8a: Campbell River (Zone 3-2) Summary 2003

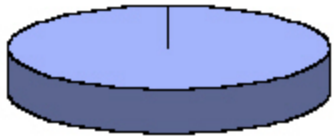
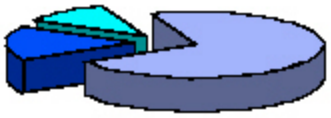


Figure 8b: Campbell River (Zone 3-2) Summary 2004

Figure 8c: Campbell River (Zone 3.2) Summary 2005



3.3.7.1.5 Zone/Sub Zone 3.3 Broughton Area

Table 12a. 2003 Diagnoses for Zone 3.3 (Broughton) Atlantic Salmon Farms

Number of Farm Audits	Number of Cases	Farm Level Diagnoses
19	16	No Infectious Disease
	1	Bacterial Kidney Disease
	1	Furunculosis
	1	Mouth Myxobacteriosis

Table 12b. 2004 Diagnoses for Zone 3.3 (Broughton) Atlantic Salmon Farms

Number of Farm Audits	Number of Cases	Farm Level Diagnoses
22	17	No Infectious Disease
	3	Bacterial Kidney Disease
	2	Mouth Myxobacteriosis

Table 12c. 2005 Diagnoses for Zone 3.3 (Broughton) Atlantic Salmon Farms

Number of Farm Audits	Number of Cases	Farm Level Diagnoses
24	14	No Infectious Disease
	5	Bacterial Kidney Disease
	3	Rickettsiosis
	2	Mouth Myxobacteriosis
	1	Furunculosis

Figure 9a: Broughton (Zone 3-3) Summary 2003

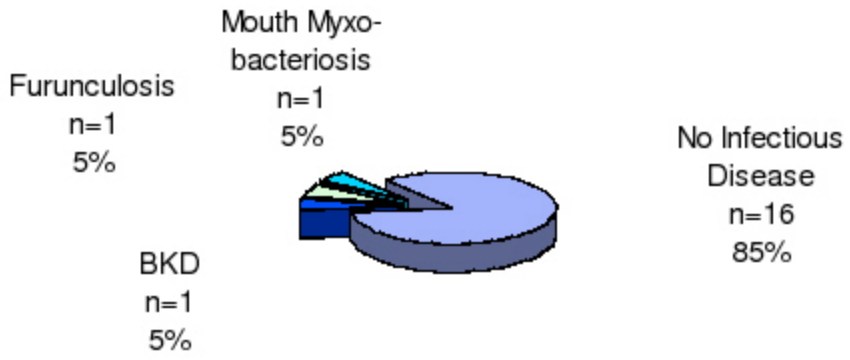


Figure 9b: Broughton (Zone 3-3) Summary 2004

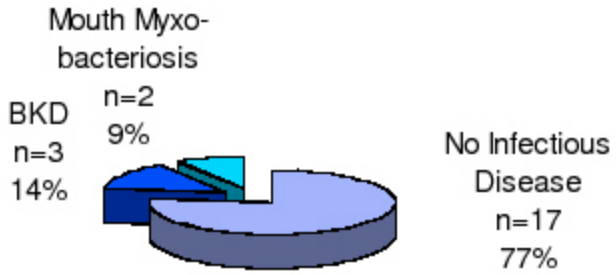
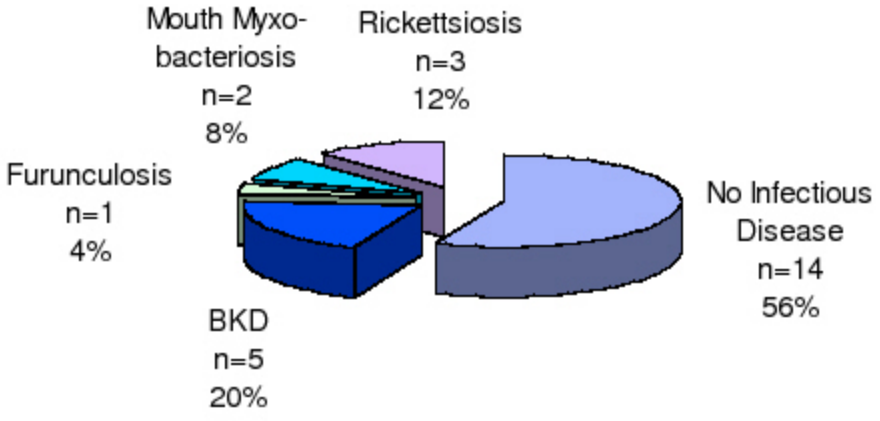


Figure 9c: Broughton (Zone 3-3) Summary 2005



3.3.7.1.6 Zone/Sub Zone 3.4 Port Hardy

Table 13a. 2003 Diagnoses for Zone 3.4 (Pt Hardy) Atlantic Salmon Farms		
Number of Farm Audits	Number of Cases	Farm Level Diagnoses
11	7	No Infectious Disease
	2	Furunculosis
	1	Bacterial Kidney Disease
	1	IHN

Table 13b. 2004 Diagnoses for Zone 3.4 (Pt Hardy) Atlantic Salmon Farms		
Number of Farm Audits	Number of Cases	Farm Level Diagnoses
9	8	No Infectious Disease
	1	Mouth Myxobacteriosis

Table 13c. 2005 Diagnoses for Zone 3.4 (Pt Hardy) Atlantic Salmon Farms		
Number of Farm Audits	Number of Cases	Farm Level Diagnoses
11	11	No Infectious Disease

Figure 10a: Pt Hardy (Zone 3-4) Summary 2003

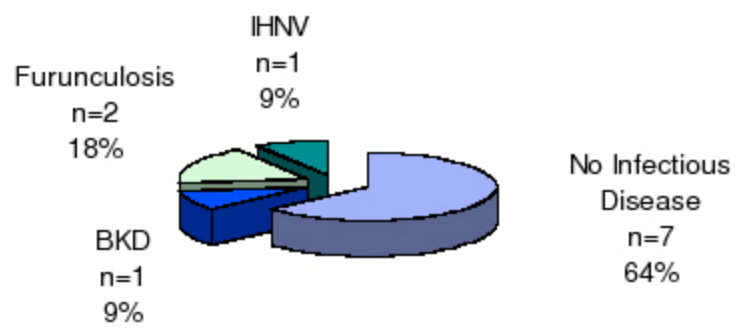


Figure 10b: Pt Hardy (Zone 3-4) Summary 2004

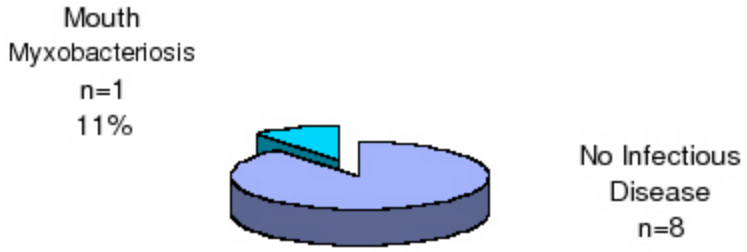
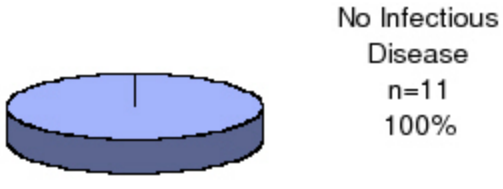


Figure 10c: Pt Hardy (Zone 3-4) Summary 2005



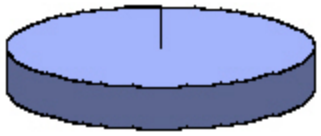
3.3.7.1.7 Zone/Sub Zone 3.5 North Coast

Table 14a. 2003 Diagnoses for Zone 3.5 (North Coast) Atlantic Salmon Farms		
Number of Farm Audits	Number of Cases	Farm Level Diagnoses
0	0	Not applicable

Table 14b. 2004 Diagnoses for Zone 3.5 (North Coast) Atlantic Salmon Farms		
Number of Farm Audits	Number of Cases	Farm Level Diagnoses
1	1	No Infectious Disease

Table 14c. 2005 Diagnoses for Zone 3.5 (North Coast) Atlantic Salmon Farms		
Number of Farm Audits	Number of Cases	Farm Level Diagnoses
3	2	No Infectious Disease
	1	Mouth Myxobacteriosis

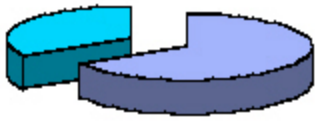
Figure 11a: North Coast (Zone 3-5) Summary 2004



No Infectious Disease
n=1
100%

Figure 11b: North Coast (Zone 3-5) Summary 2005

Mouth Myxo-bacteriosis
n=1
33%



No Infectious Disease
n=2
67%

3.3.7.2 Pacific Salmon

3.3.7.2.1 Zone 2.0 West Coast of Vancouver Island

Table 15a. 2003 Diagnoses for Zone 2 (West Coast of Vancouver Island) Pacific Salmon Farms		
Number of Farm Audits	Number of Cases	Farm Level Diagnoses
15	14	No Infectious Disease
	1	Loma

Table 15b. 2004 Diagnoses for Zone 2 (West Coast of Vancouver Island) Pacific Salmon Farms		
Number of Farm Audits	Number of Cases	Farm Level Diagnoses
14	6	Bacterial Kidney Disease
	5	No Infectious Disease
	2	Loma
	1	Marine Anaemia

Table 15c. 2005 Diagnoses for Zone 2 (West Coast of Vancouver Island) Pacific Salmon Farms		
Number of Farm Audits	Number of Cases	Farm Level Diagnoses
7	3	Loma
	2	Bacterial Kidney Disease
	2	VHSv (NAS)
	1	No Infectious Disease

Figure 12a: West Coast of Vancouver Island (Zone2)
Summary 2003

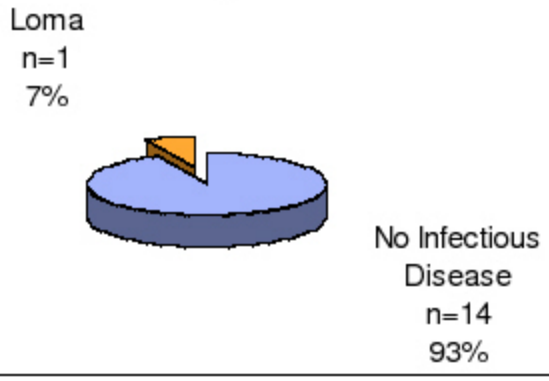


Figure 12b: West Coast of Vancouver Island (Zone2)
Summary 2004

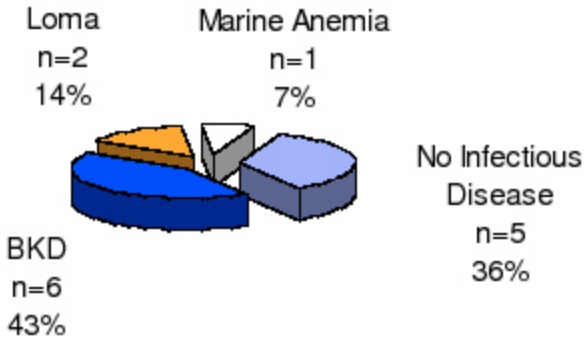
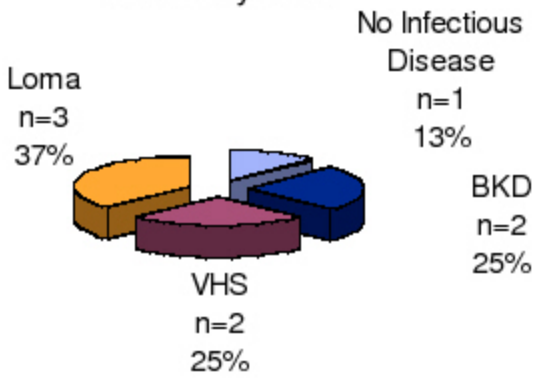


Figure 12c: West Coast of Vancouver Island (Zone2)
Summary 2005



3.3.7.2.2 Zone 3.0 East Coast of Vancouver Island

Table 16a. 2003 Diagnoses for Zone 3 (East Coast of Vancouver Island) Pacific Salmon Farms		
Number of Farm Audits	Number of Cases	Farm Level Diagnoses
23	16	No Infectious Disease
	7	Bacterial Kidney Disease

Table 16b. 2004 Diagnoses for Zone 3 (East Coast of Vancouver Island) Pacific Salmon Farms		
Number of Farm Audits	Number of Cases	Farm Level Diagnoses
23	13	No Infectious Disease
	9	Bacterial Kidney Disease
	1	Loma
	1	Bacteraemia

Table 16c. 2005 Diagnoses for Zone 3 (East Coast of Vancouver Island) Pacific Salmon Farms		
Number of Farm Audits	Number of Cases	Farm Level Diagnoses
16	12	No Infectious Disease
	2	Loma
	2	Marine Anaemia
	1	VHSv (NAS)

Figure 13a: East of Vancouver Island (Zone 3)
Summary 2003

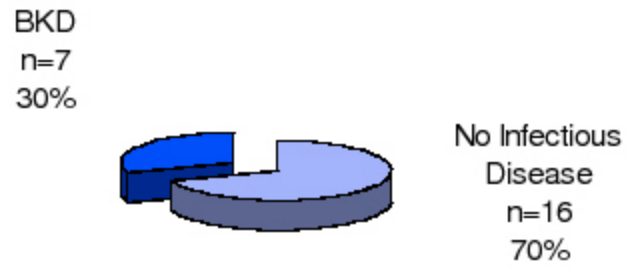


Figure 13b: East of Vancouver Island (Zone 3)
Summary 2004

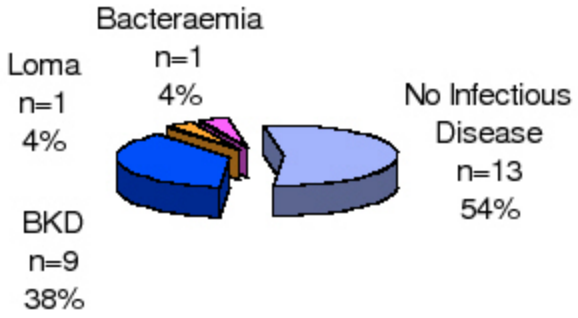


Figure 13c: East of Vancouver Island (Zone 3)
Summary 2005

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. The audit provides a "snapshot" to which the more complete picture of industry's reports can be compared. 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 all the time. This information is captured in the required industry reports as part of their Fish Health Management Plans and presented publicly on the BCMAL website http://www.al.gov.bc.ca/ahc/fish_health/index.htm. The audit allows for randomized validation of the reported information with targeted disease testing. The industry reports encompass all sites hence provide a total picture of the health status of farmed salmon.

Three reports are provided to government quarterly by the industry:

1. Average mortality by species and Fish Health Zone for fresh and salt water sites
2. Proportional Mortality by Infectious and Non-infectious Cause
3. Fish Health Events

The first two reports allow for evaluation of the losses and common causes of losses. There are many reasons why fish may be lost from a culture system; however few are due to infectious disease. Each site must examine and categorize their mortalities. Amongst the categories is a group called "fresh" or "fresh silver" – those fish that are recently dead for no apparent reason or may be showing signs of suspect disease. These would be the same grouping of fish that are sampled by the BCMAL fish health staff during routine audit.

Fish Health Events (FHE) are those occurrences of disease where veterinary intervention is required. In other words, the FHEs occur when there has been a significant effect on the health of the animals or a disease event has occurred which requires treatment or husbandry changes. 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 database reports are found on the BC Ministry of Agriculture and Lands Website. An annual summary of all the fish health diagnoses and the audit diagnoses shows that the same diseases reported to occur on salmon farms also were also diagnosed through the audit. Proportionally the number of farms where no infectious disease was found ranged between 60 and 80 % through audit and industry reporting. In addition the common fish health events reported as requiring intervention amongst farms were verified through the audit process.

The BC Salmon Farmers Database is a more complete data set which has information from all farms. 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 values in Figure 15 below are not as representative of the actual disease occurrences as are the values in Figure 14. However, the audit data has greater specificity (lower probability of false negatives) than the farm data.

Viral Hemorrhagic Septicaemia (VHS North American Strain), *Loma salmonae* and Marine anaemia were also occasionally found during the audit process. While these pathogens are also reported by the salmon farmers database they represent less than two percent of the findings and thus are not included in Figure 14 below. Further, these pathogens do not necessarily result in veterinary intervention or management changes on farms as they are endemic organisms for which no treatments exist.

Figure 14: Percentage of each type of fish health event per calendar quarter (Quarter 4, 2002 through Quarter 1, 2006) for all zones from the BC Salmon Farmers Database (only those Fish Health Events that are greater than two percent of the total findings are included).

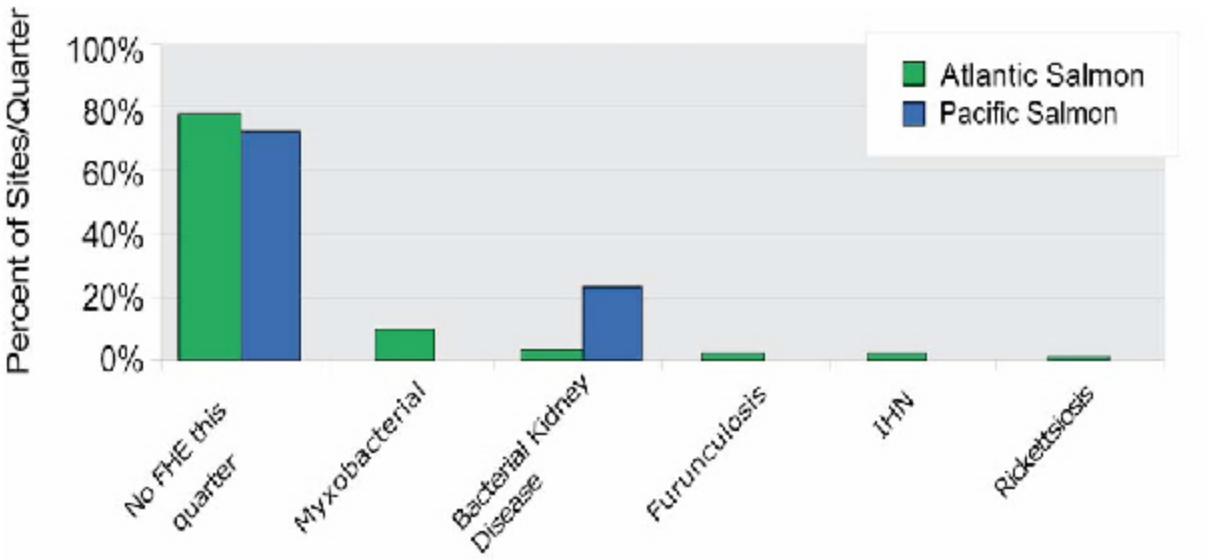
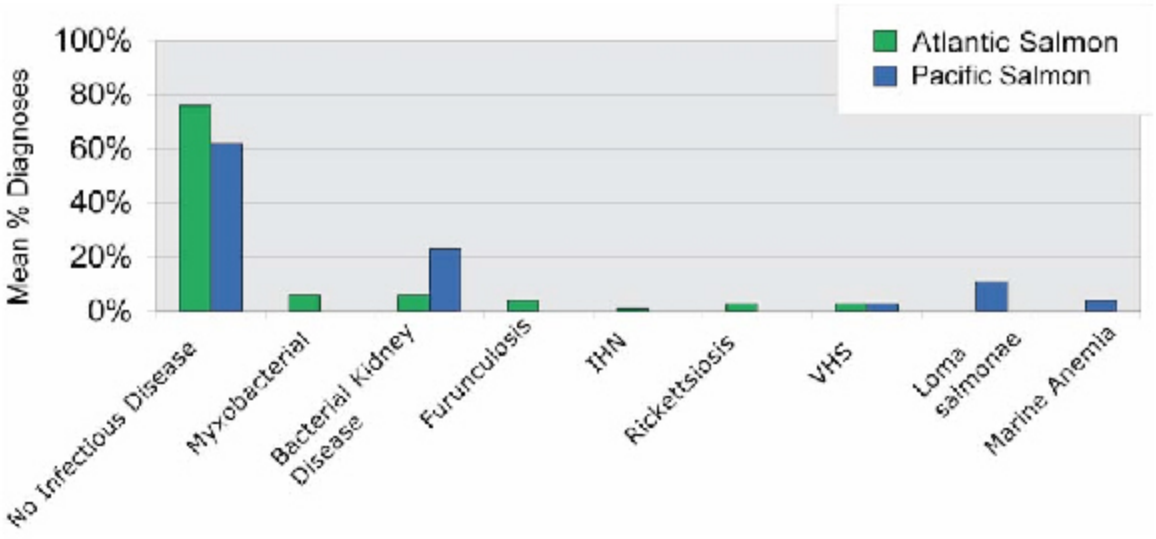


Figure 15: Average percentage of audit diagnoses per calendar quarter (quarter 1, 2003 through Quarter 4, 2005) for all zones. (Only those findings that are greater than two percent of the total findings are included)



4 Section 4 Sea Lice Audit and Surveillance Program

4.1 Mandate

Sea lice are parasitic copepods that can affect the health of farmed and wild fish stocks. Sea lice monitoring conducted on salmon farms provides information for effective management and treatment decisions at the farm level. The program gathers information from the monitoring of lice on all farms within specific fish health zones/areas to determine trends in lice levels, the management of sea lice on farmed salmon and integration 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 over the last three years. In 2003/04, the sea lice management strategy was integrated into the provincial Fish Health Management Plans and the associated Sea Lice Auditing program was extended to include the entire British Columbia aquaculture industry. As part of the reporting requirements of the Fish Health Management Plans, industry information is provided to government monthly and posted to the Ministry website. In addition, the Ministry has audited industry lice counts to verify the accuracy of the reporting. In 2004 and 2005, 96 sites were audited for sea lice with 5493 fish evaluated for their lice levels. The objective of both programs is to provide validated information on the changing status of sea lice infestations on BC salmon farms.

4.3 Provincial Sea Lice Monitoring

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

1. Industry on farm monitoring and reporting, and
2. BC Agriculture and Lands audit of these procedures.

As part of the Fish Health Management Plans, the Ministry of Agriculture and Lands requires monthly sea lice sampling and reporting of aggregate, monthly data by fish health zone. In 2004 trigger values were set and actions required to control sea lice were established by BCMAL and made a condition of license through the FHMP. In 2004, sea lice trigger levels were set at 3 motile lice from March 1 to July 1 and 6 for the remainder of the year. For 2005 those numbers were reduced to 3 motile lice year round. Actions that were required are 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 of lice see Appendix 7.10

4.4.1 Atlantic Salmon Farms

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

Monthly sampling intensity is increased to twice monthly when the action level of 3 motile lice per fish is reached anytime throughout the year. During juvenile wild salmon out migration times (March to July) action (treatment or harvest) must be taken to reduce lice levels if the farm reaches the trigger of 3 motile lice per fish. During 2004, the established trigger levels for action were 3 motile lice per fish from March to July and 6 motile lice per fish from July to March. Review of the data collected in 2004 lead to the reduction in trigger values in 2005 to 3 motile lice year-round. Continued review of the sea lice data from wild and farmed fish stocks will lead to refinement of the lice control strategies in each different farming area.

4.4.2 Sampling Regimen

Monthly sampling at each site is conducted in three pens; a total of 20 fish per pen (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) and two randomly selected pens per sample period.

Fish are captured using a seine or other method that ensures representative sampling of the population. Fish are placed in anaesthetic bath or humanely euthanized before examination. Handling is minimized to avoid loss of lice and the method of handling is recorded. All fish selected are examined for the presence of lice regardless of fish health status. 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

2. Monitoring of sea lice in zone 3-1 will be required only if there is a visible increase in lice levels on the farms detected through routine health monitoring programs.

4.4.3 Reporting

All farms report monthly to BCSFA Database which in turn provides aggregate monthly reports to BCMAL by specific fish health zones/areas. In 2004/05, action levels for control of sea lice were set at 3 motile lice; from March to June this meant that once this level was reached, immediate action (either harvest or treatment) to reduce lice levels was required. 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 audit program is designed to verify the industry reported results and provide government with knowledge of sea lice levels on BC Salmon farms. The sea lice auditing program follows the model for the fish health auditing 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 multistage sampling system for sea lice audit as is used with the fish health audit program. The unit of concern is the zone. All sites within a 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 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 treatments that may have been conducted during that quarter. Bio-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 Bio-technicians are experienced in fish handling and follow standard operating procedures for fish handling, anaesthesia and lice counts.

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) and two randomly selected pens per sample period.

Fish are captured using a seine or other method that ensures representative sampling of the population. Fish are placed in anaesthetic bath or humanely euthanized before examination. Handling is minimized to avoid loss of lice and the method of handling is recorded. All fish selected are examined for the presence of lice regardless of fish health status. Fish may be culled or otherwise removed from the population, if appropriate, once lice counts have been recorded.

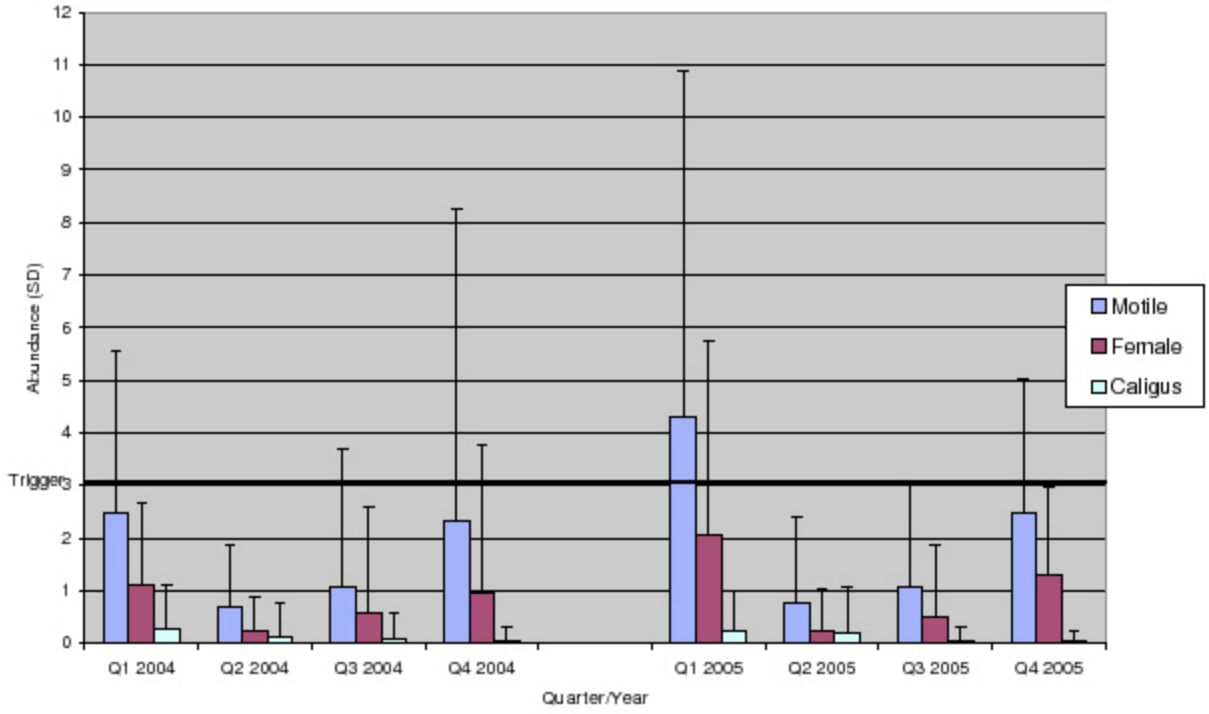
Twenty fish from each of 3 net pens are sampled as is required for a standard industry sea lice count.10 of the fish from each pen are evaluated by the BC Agriculture and Lands Bio-technician and 10 by an industry staff member. The fish are systematically examined by the Bio-technician and lice numbers enumerated and classified as described in Appendix 7.10. BC Agriculture and Lands staff may also collect lice samples from anaesthetized or euthanized fish for periodic evaluation and confirmation of lice species and life-stage. All lice that may fall off in the anaesthetic bath are added to the total lice for the site count to ensure accuracy.

4.5.5 Analysis of Sea Lice Data: Atlantic Salmon Farms

In 2004/05 25% of all active sites were audited from June until March and 50% of all active Atlantic salmon sites were audited from March to June. BCMAL staff inspect and count lice numbers on a sub- sample of fish the same pen during the industry monthly sampling period; these average numbers can then be compared at the farm level to determine if farm staff accurately count and identify the sea lice for reporting. Comparing the two "sampler" results of the mean abundance of lice counted on different fish from the same pen, plus observing lice identification procedures, allows for validation of the reported information. This on-farm method of concurrent lice counting and examination of records represents a compliance audit and provides a "snapshot" of farms at time of the audit. Table 17 and Figure 16 show the BCMAL average abundance of sea lice on Atlantic salmon farms for all zones for 2004 and 2005. For a more detailed breakdown of mean sea lice abundance on audited farms in each zone/sub-zone refer to Appendix 7.11.

Table 17. Mean Abundance of Motile, Female *L. Salmonis* and Chalimus Sea Lice and Motile *Caligus clemensi* on Atlantic Salmon Farm Audits Per Quarter 2004 and 2005				
2004 Mean abundance	Q1	Q2	Q3	Q4
Number of Farms Audited (n)	8	7	11	10
Motile	2.46	0.69	1.08	2.34
Standard Deviation (SD)	3.10	1.17	2.63	5.93
Female	1.09	0.24	0.58	0.97
SD	1.56	0.66	2.00	2.81
Chalimus	0.59	0.80	5.48	2.15
SD	1.16	1.65	23.17	6.28
Caligus Motile	0.26	0.12	0.08	0.05
SD	0.85	0.64	0.48	0.25
2005 Mean Abundance	Q1	Q2	Q3	Q4
Number of Farms Audited (n)	11	25	9	7
Motile	4.31	0.76	1.06	2.46
SD	6.59	1.64	2.00	2.57
Female	2.07	0.22	0.52	1.30
SD	3.66	0.79	1.34	1.67
Chalimus	1.90	1.37	0.52	0.30
SD	3.53	3.66	1.31	0.75
Caligus Motile	0.24	0.21	0.06	0.04
SD	0.73	0.86	0.27	0.20

Figure 16: Mean Abundance of Motile and Female Lice on BCMAL Audits 2004 & 2005



Audit data is also examined statistically to look for variation in lice levels within and between farms for audited farms only. The purpose of this evaluation is to ensure at the farm level, industry is properly identifying, calculating and recording sea lice numbers. This protocol allows the ministry to verify that sea louse sampling is completed in a scientifically valid manner. The analysis is completed using Microsoft Statistix 8.

Given the variation that occurs in lice numbers on a farm by farm basis and the audit occurs on only 25 to 50% of farms, abundance estimates provided from these BCMAL are not directly comparable to the inclusive abundance estimates (100% reporting by all farms) provided by the industry monthly. To determine if the overall mean abundance reported by industry is accurate, BCMAL audit information on a zone/sub-zone level is expected to fall within the reported confidence intervals of the mean abundance reported from the industry wide dataset. A comparison of the findings for the last two years is provided below.

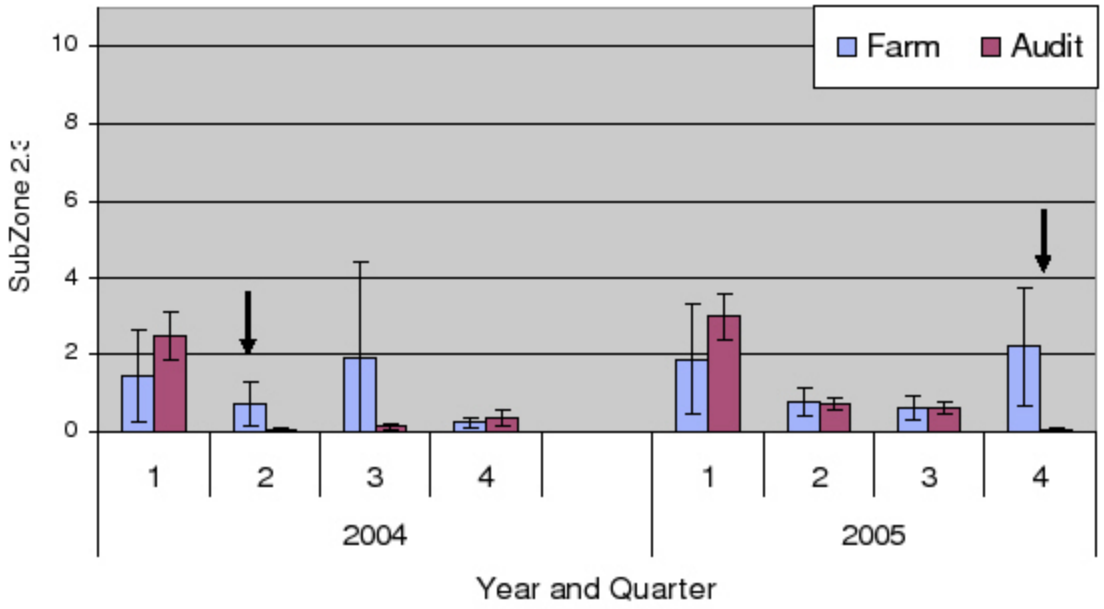
Results from sampling Pacific salmon in 2004 confirmed scientific information from previous studies that farmed Pacific salmon are not as susceptible to increased lice levels as Atlantic salmon. As a result, MAFF only conducted audits on 7 farms in 2003 to confirm industry reporting and in 2005 they were no longer required to report. However, Pacific salmon producers visually monitor for sea lice for example during regular daily or weekly mortality observations, weight sampling or at times when lice have historically been documented (harvest fish or yearclass two fish in the Fall of the year). This information must be available for audit review to MAFF fish health staff upon request.

4.5.6 Evaluation and Comparison to Industry

Verification of the sea lice levels is completed by comparing the industry reported mean abundance with the calculated mean abundance through the audit process. As the audit consists of only 25 to 50% of the sites a direct comparison of the means is not statistically valid; however, as the audit is a subset of the means, it would be expected that the confidence intervals of the mean abundance calculated from the audit should overlap with the confidence intervals of the mean of the industry audit.

Between 2004 and 2005, there was a statistically significant difference in 24% of the comparisons between confidence intervals reported by industry and BCMAL, of those differences, 12% (6 counts) of the time the BCMAL mean audit abundance was higher than industry while the other 12% (6 counts) the audit mean abundance was lower than industry. The results for each zone and sub zone per calendar quarter are presented in Figures 17 – 23 (↓arrows on the graphs indicate when counts are significantly different). Reasons for the difference can be explained by differences in numbers of counts conducted, the difference in number of each year class of fish examined and treatment effect. Lice abundance in both datasets showed that sea lice are higher in the Fall Quarter 4 and early winter Quarter 1.

Figure 17: Comparison of Zone/Sub Zone 2.3 Farm and BCMAL Motile Sea Lice Counts



↓ Arrow indicates statistically significant difference between BCMAL audit and industry counts.

Figure 18: Comparison of Zone/SubZone 2.4 Farm and BCMAL Motile Sea Lice Counts

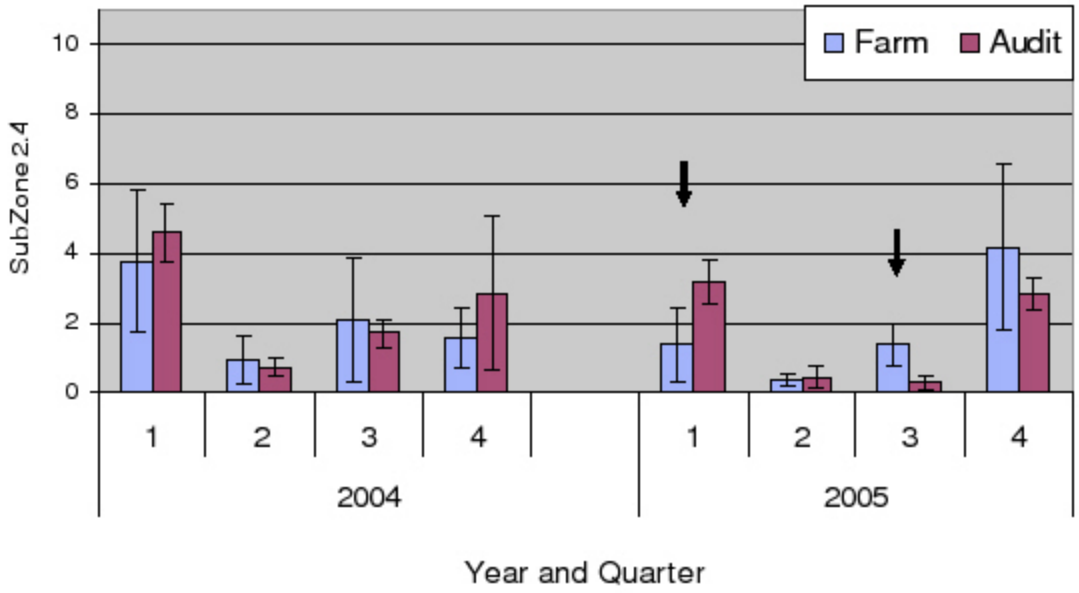


Figure 19: Comparison of Zone/Sub Zone 3.1 Farm and BCMAL Motile Sea Lice Counts

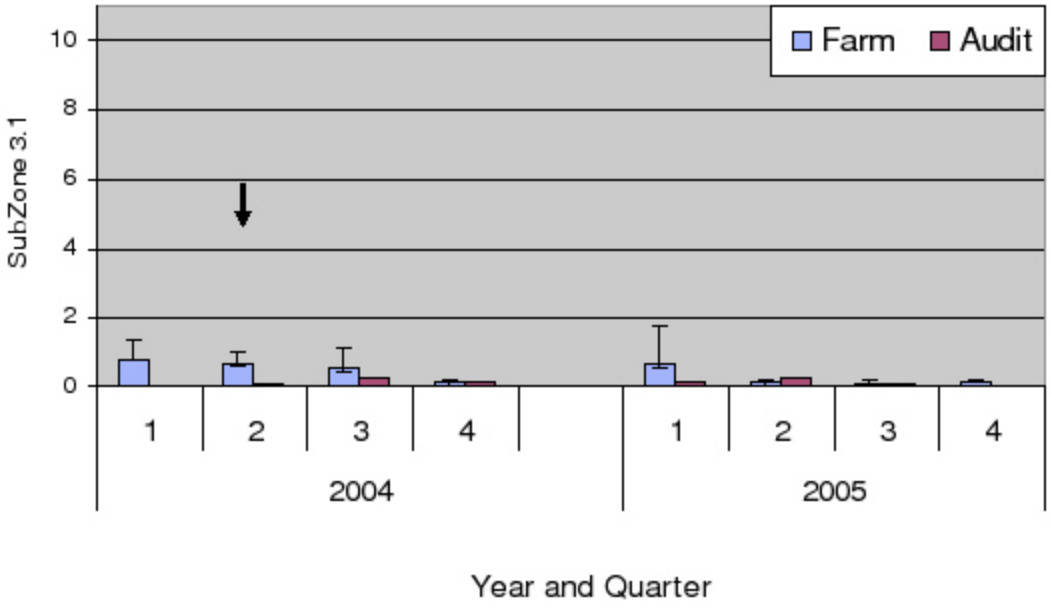


Figure 20: Comparison of Zone/Sub Zone 3.2 Farm and BCMAL Motile Sea Lice Counts

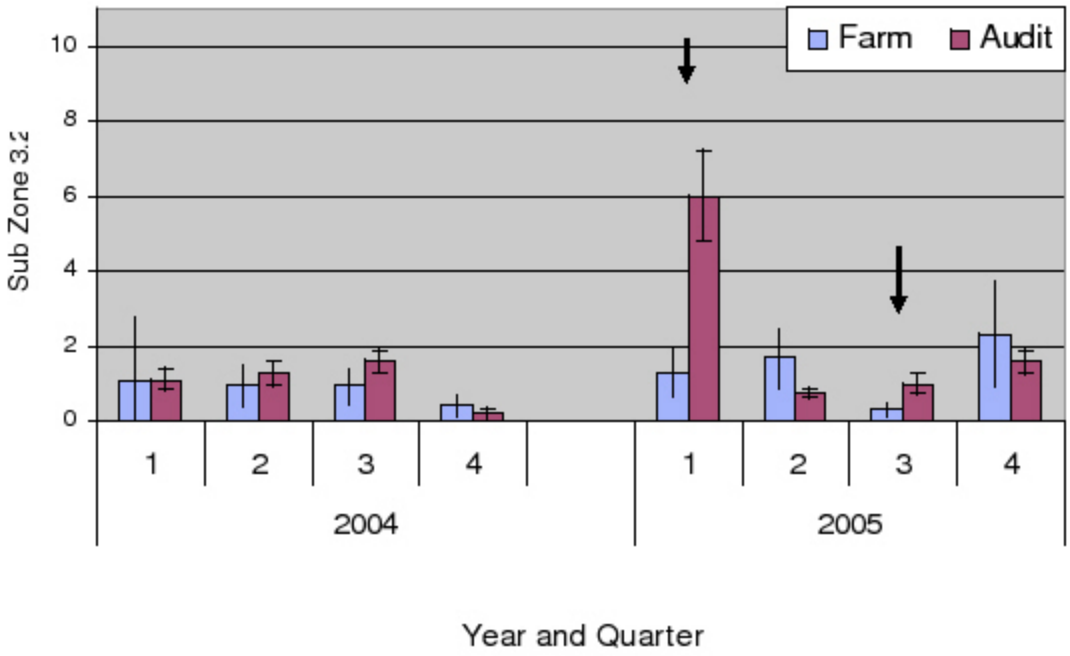


Figure 21: Comparison of Zone/Sub Zone 3.3 Farm and BCMAL Motile Sea Lice Counts

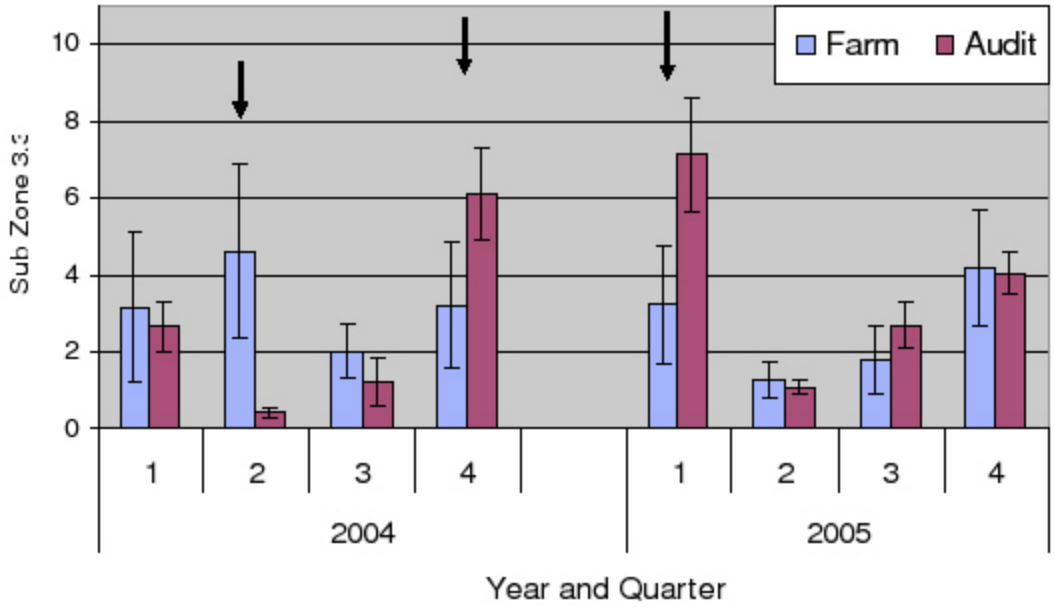


Figure 22: Comparison of Zone/Sub Zone 3.4 Farm and BCMAL Motile Sea Lice Counts

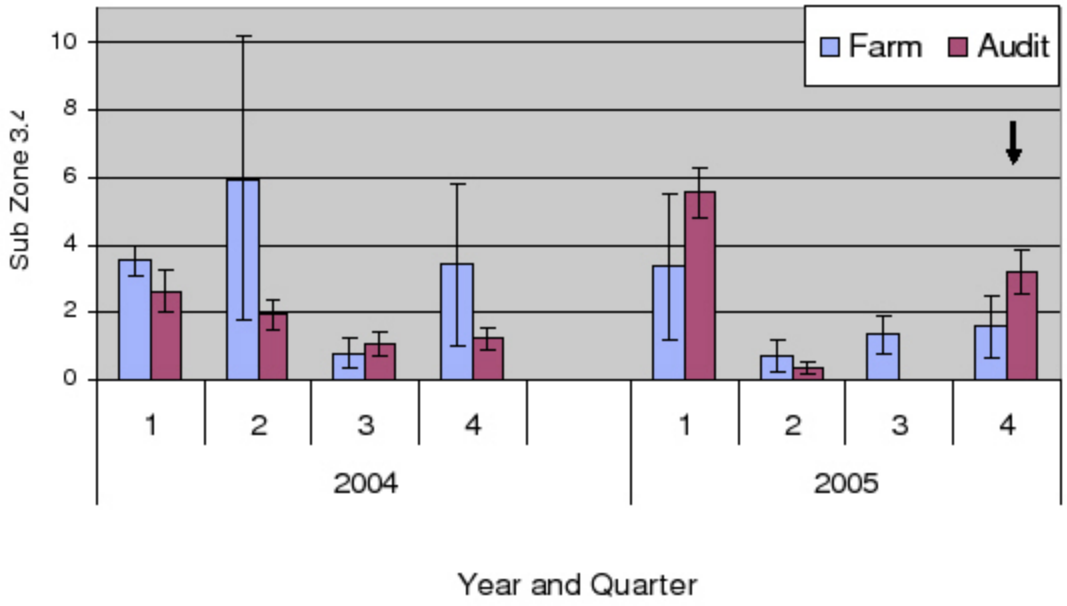
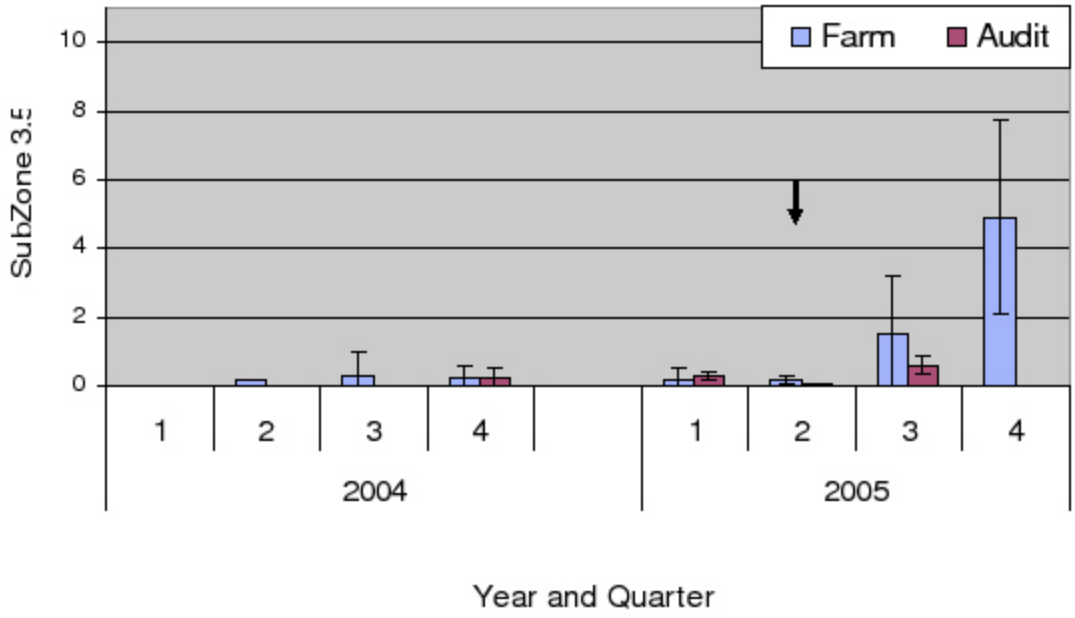


Figure 23: Comparison of Zone/Sub Zone 3.5 Farm and BCMAL Motile Sea Lice Counts



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 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, on-farm trigger levels were reduced to three (3) motile lice 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 from wild sources would reduce the success of treatment; hence, during the fall, sea lice levels on farms may be higher than the trigger value of three. In this case an increased level of monitoring is required.

The treatment available for control of sea lice, emamectin benzoate (SLICE®) has a known efficacy period. If treatment is strategically timed in the Fall subsequent to the return of adult wild salmon, this will result in low lice abundance on farms during the critical wild juvenile migration time. After instituting the mandatory Provincial sea lice trigger levels, data from DFO on pink stock abundance in 2004 and 2005 showed improvements for pink salmon numbers in the Broughton. Data from farms in other areas of British Columbia show that lice levels are variable; in some cases lice levels are lower both on wild and farmed stocks than in the Broughton. MAL and DFO continue to work with the aquaculture sector to ensure the necessary data is gathered to evaluate and integrate findings into the farm management program.

4.7 Comparison to Other Jurisdictions

Atlantic salmon and trout are considered the species most susceptible to the effects of sea lice. In Norway these species are considered most vulnerable due to stock declines over the years. Europe also has fewer wild salmon, the natural host species of sea lice, than does British Columbia. As a result, the trigger levels for treatment of lice in Norway are 0.5 gravid females and/or 4 motile lice 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. Neither Scotland nor Chile has trigger values.

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 sea lice on farmed fish are significantly different than in other locations. A summary from the different jurisdictions is provided in Table 18 below.

Table 18: 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		
Canada (BC)	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 from 2003 – 2005

The following is a synopsis of the conclusions drawn from examination of the 2003 to 2005 audit program data, the information provided by the aquaculture sector, an in-depth review of the information with the fish health technical review committee and review of the scientific literature.

Over each of the last several years, the data provided to BCMAL was examined to determine whether or not the mitigative measures imposed on farms were being adhered to and to examine the effectiveness of these measures at maintaining lice levels at or below the expected trigger levels. Examination of this information revealed the risk factors affecting farm lice levels; this information has been examined statistically with a more in-depth review of the Broughton area (Saksida, Constantine and Karreman, ACRDP Technical Report 2006). These risk factors include age or year class of fish and length of time in seawater. The Broughton study showed that area or location was also a risk factor for occurrence of lice.

The following information is a review of the temporal and spatial occurrence of lice on farms from examination of the industry sea lice reports to government since October 2003.

Summary:

- Abundance of lice in 2004 was greater in specific areas than 2005 and overall abundance appears to have been higher in 2004 than 2005. When examining the information provided from the aquaculture sector reports it is clear that there were higher levels of lice on farms in 2004 in zones 2-4 Northwest coast of Vancouver Island, 3.3 Broughton Archipelago and 3.4 North East Vancouver island. Whether these differences were statistically significant was examined only for the Broughton. For this area there was a statistically significant difference in lice levels comparing to 2004 to 2005.

- Lice levels vary between year classes. The overall abundance of lice on farmed salmon is lower on fish in sea water for one year compared to two years. Statistically, this spatial association was tested and held true for the Broughton where lice abundance was higher on year class two fish. The risk factor associated with this difference appears to be length of time in sea water. During the time period of the out-migration of smolt however, lice levels in the Broughton were higher in 2005 on year class one fish than year class two. The sites still maintained lice levels below the treatment trigger value of three motile lice during the smolt outmigration. This may be a result of treatment effect, where actions to control lice may result in lower abundance of lice overall.

- 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 extremely very low for the past two years.

Area 3-1 has not had lice levels exceeding the trigger during the last three years. Other areas such as 2-3 and 3-2 have had low lice levels (less than 4 mobiles) for most of this time. Levels of lice in other areas varied within and between years.

- Abundance of lice varies between years. Data has now been collected over a two and a half year period which allows for only a limited examination for inter-annual variation in lice levels in all areas monitored. Gross examination of all the data it appears to demonstrate a difference in lice abundance between 2004 and 2005.

- Sea lice are a naturally occurring parasite of wild fish. Data collected from wild stocks shows that returning adult salmon can be infected with extremely high numbers of sea lice; this is likely part of the natural life history of this parasite with its native host. Concurrent with the inward migration of wild salmon, salmon farms experience a net increase in sea lice. This increase abundance of lice on farms 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 will increase in the Fall (September to December). As there is lag time between treatment administration and effect, decreases in lice levels are generally not seen until early winter (January to February).

- 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 salinities favour the survival and reproduction of sea lice; lower temperature and salinity do not. The information collected from farms over the last three years clearly follows this trend.

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

In 2004, in addition to the overall lice monitoring conducted on all farms in BC, additional research was conducted on sites in the Broughton Archipelago examining the site levels of sea lice in more detail. BCMAL contributed to this research and these data have been reported as part of the Aquaculture Collaborative Research and Development Program (ACRDP). This information was used to inform the decisions on lice management related to interactions between wild and farmed salmon in this area.

The study was conducted on all farms in the Broughton from February 2003 to February 2005. Twenty three thousand fish were examined and lice numbers enumerated into the various categories used for management of lice levels on farms. Twenty farms were active during the course of the study; all were single year class sites with the exception of two broodstock sites. Sea lice abundance was enumerated on all sites and examined for differences with respect to species of lice, year class of fish (length of time in sea water), life stage of the parasite, interannual variation, and effects of treatments. The findings of this study can be summarized:

- Two species of lice were most commonly on farmed salmon: *Lepeophtheirus salmonis, (L. salmonis)* and *Caligus clemensi* (*C. clemensi*)
- Overall abundance of lice was low – mean mobile L. salmonis 3.19 (sd 5.27) and mean *C. clemensi* 1.00 (sd 2.64)
- There was a statistically significant difference in mean abundance of *L. salmonis* between 2003 and 2005 compared to 2004 with a higher abundance of L. salmonis in 2004
- There was a statistically significant difference in mean abundance of mobile *C. clemensi* levels with 2 fold greater levels in 2003 compared to 2004
- Abundance of mobile *L. salmonis* and *C. clemensi* was statistically higher on year class two (mean abundance 4.3 and 4.38 for 2003/04) compared to year class one fish (mean abundance of 0.86 and 2.65 for 2003/04)
- Amongst year class two fish the abundance of *L. salmonis* was not statistically different between 2003 and 2004
- During wild stock migration time, pattern of infection was the same with *L. salmonis* abundance higher in 2004 compared to 2003
- Farms treated on average 1.4 times during the study period. When examining sites with full production cycle, the average number of treatments per cycle was 1.75.
- Treatment is very efficacious with lice levels remaining significantly lower than pre-treatment levels for five months.
- A Generalized Linear Model looked at risk factors and geographical area was found to be a significant risk factor for occurrence of lice on farms.

In 2006 the Pacific Salmon Forum has provided research funding to combine the wild salmon and the farm salmon datasets of DFO and industry and 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.

5 Section 5 Therapeutant Use and Monitoring

5.1 Therapeutant Use and Monitoring

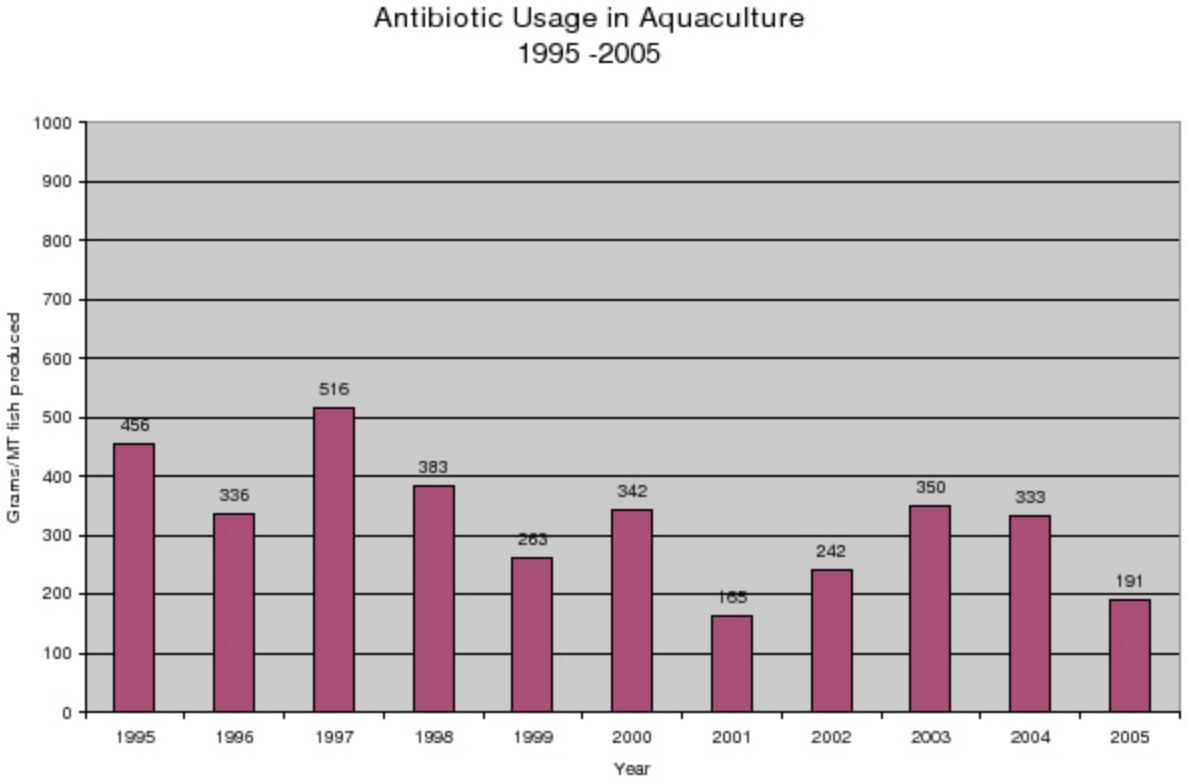
The Ministry of Agriculture and Lands monitors the use of therapeutants in food fish production by requiring feed mills to report all prescriptions incorporated into fish feed. In-feed treatment is the only available practical method of delivering therapeutants to fish; bath treatments are not permitted 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 treated with different drugs and may also receive injectable antibiotics, however, these fish are not included in the human food chain; feed mills will still report the addition of antibiotics to the feed of broodstock but the use of injectable products is not tracked. Feed mills report all additions of prescription medications in feed to the Ministry on an annual basis.

Over the last decade antibiotic use has ranged from a high of 516 grams of drug per metric tonne of fish, to a low of 165 grams of drug per metric tonne of fish. Fish are not treated with antibiotics prophylactically; these drugs are used only in the event of a bacterial disease event.

Figure 24: Summary of Antibiotic Usage in Aquaculture 1995 – 2005

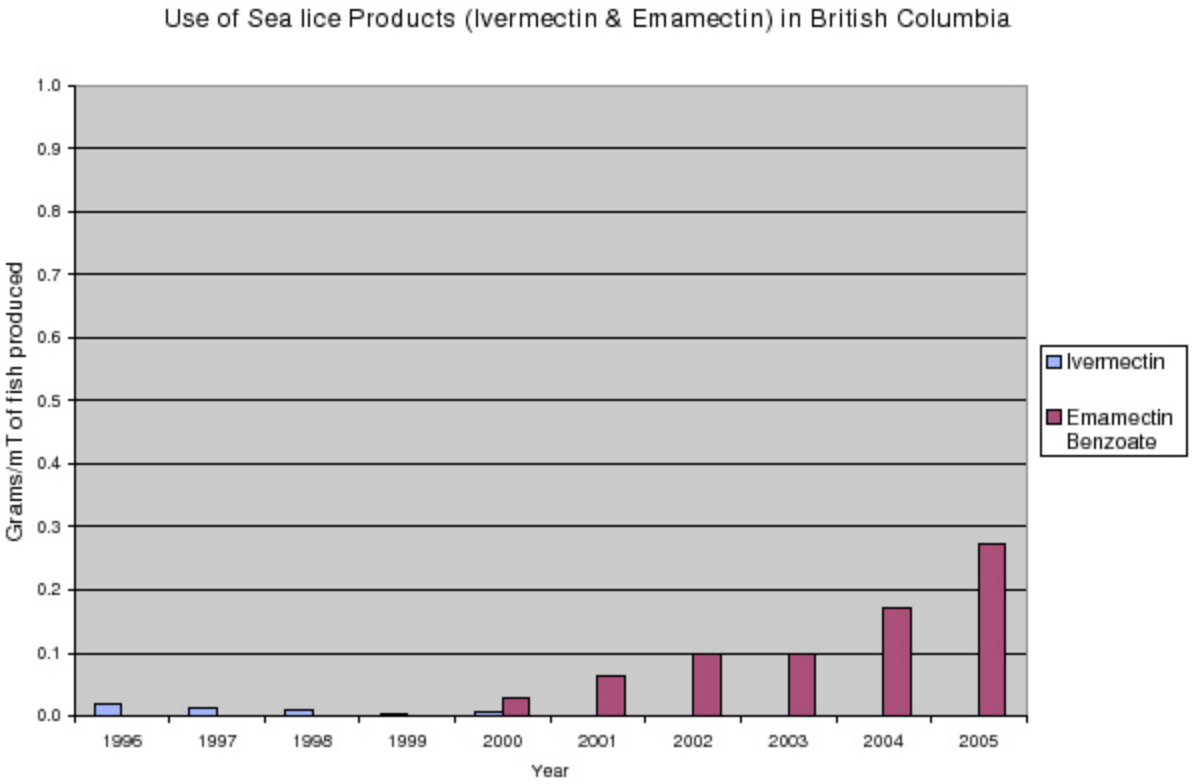


5.1.2 Sea Lice Treatments:

There is only one product available for treatment of sea lice in BC. Emamectin benzoate (SLICE®) is in the final stages of the approval process with Health Canada and is available through their Emergency Drug Release program. Emamectin is an extremely efficacious product for sea lice management and lice levels remain low for up to 5 months after treatment. Prior to 2000 sea lice treatments were limited to off label prescriptions of Ivermectin, however, with the availability of Emamectin off label use of Ivermectin has ceased.

Treatments for sea lice have increased since the implementation of the sea lice monitoring program. In the past, harvest sized fish would generally not have been treated for lice because the effects of the lice on the fish are minimal. With the implementation of the Provincial Sea Lice Management Program the larger fish are treated to prevent any potential effects on juvenile wild fish. In 2003 the amount of emamectin used was 0.1 g/metric tonne of fish, in 2004 0.17 g/mt and in 2005 0.27 g/mt.

Figure 25: Summary of Usage of Sea Lice Products in British Columbia Aquaculture 1996 - 2005



6 Summary and Conclusions

The BC MAL fish health program has been operating over the last 3 years. The program provides 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 at term and condition of licensure. As a requirement of the FHMP the marine salmon farmers must report on fish health events, mortality levels and causes and sea lice monitoring and management. Based on this review the following is a summary of the findings and conclusions:

The 2003 -2005 audit and surveillance data indicates that the majority of the time there is no evidence of infectious disease on fish farms. This is based on 339 farm visits and examination of 1909 fish. In 76% of Atlantic salmon farms and 62% of Pacific salmon farms sampled there were no infectious diseases.

When disease has been found on salmon farms in British Columbia, it has been an endemic (naturally occurring) or already identified disease of native Pacific salmon. The occurrence of disease on farms has not been associated with any disease in wild salmon; however the occurrence of disease in wild salmon has been associated with disease on farms. The audit and surveillance program demonstrates that no new disease has been introduced to British Columbia 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 confirm that the reported disease findings from the industry are the same as those reported by industry.

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's amongst marine salmon farms. Fish Health Management Plans are designed to ensure the highest standards for fish health management are achieved minimizing the risk of impact on or transfer of disease to wild stocks.

The objective of the sea lice audit is to provide validated information on the changing status of sea lice infestations on BC salmon farms. Of the 96 audit counts (5493 salmon) that were conducted since 2004, differences in mean abundance (measures of lice infestation) between BCMAL and industry occurred 12 times. In only 6 cases was the level reported by industry higher than BCMAL; only once was the industry reported level above the trigger of 3. This means that the industry is accurately reporting information on sea lice levels on farms. Detailed data is available for viewing on the Ministry's website.

The industry has been in compliance with the Ministry's requirements for sea lice monitoring over the last two years. Lice levels on farms have been below 3 during the juvenile out

migration or if they rose above 3 were treated and reduced the number of lice within one month.

Salmon transferred to marine sites are free of sea lice; infestations occur as a result of exposure to sea lice from wild salmon and other marine fishes. Concerns have been expressed with the impact of sea lice from salmon farms on wild juvenile pink salmon. After instituting the mandatory Provincial sea lice trigger levels in 2003, data from DFO on pink stock abundance for 2004 and 2005 showed improvements in pink salmon abundance in the Broughton. Data from farms in other areas of British Columbia show that lice levels are variable; in some cases lice levels are lower both on wild and farmed stocks than in the Broughton. The Province will continue to work with DFO, the Pacific Salmon Forum and other researchers to ensure that continued monitoring of sea lice and integration of 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. In this regard the BC MAL has commissioned two independent studies to evaluate the Fish Health program with respect to meeting the objectives including monitoring for endemic disease and the value of the program with respect to surveillance for exotic or foreign diseases. The goal is to ensure that the British Columbia aquaculture sector continues to strive for the achieving the highest standards of fish health management.

7 APPENDICES

7.1 Appendix 1: 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 by Cause

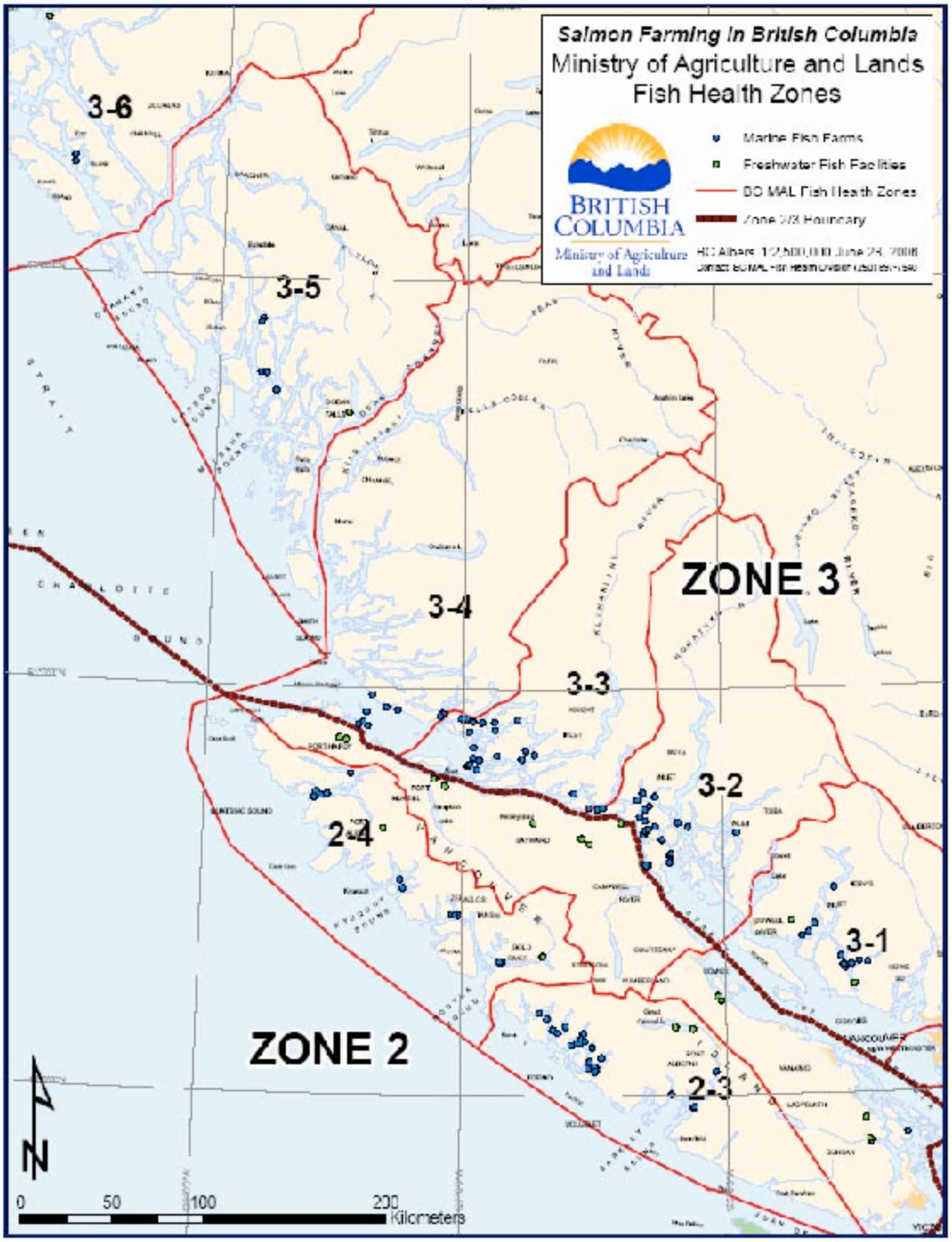
The proportional mortality rate by cause is intended to provide a breakdown of the average mortality rate into the various causes of mortality. The proportional mortality rate should indicate what proportion of the average mortality is due to each of the causes provided. As these reasons vary in fresh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

7.2 APPENDIX 2: Map of Fish Health Zones in British Columbia.



7.3 APPENDIX 3: Detailed Summary of Active Sites 2004 and 2005

Table 1 Active Salmon Farm Sites 2004

Atlantic Salmon	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Average
Zone 2.3 SW Vancouver Island	7	6	7	5	6.25 (6)
Zone 2.4 NW Vancouver Island	7	7	7	6	6.75 (7)
Zone 3.1 Sunshine Coast	1	4	4	3	3
Zone 3.2 Campbell River	4	5	5	8	5.5 (6)
Zone 3.3 Broughton	11	11	11	10	10.75 (11)
Zone 3.4 Pt Hardy	2	4	4	6	4
Zone 3.5 North Coast	0	0	0	2	0.5 (1)
Pacific Salmon					
Zone 2 West of Vancouver Island	10	8	8	7	8.25 (8)
Zone 3 East of Vancouver Island	14	13	13	12	13
Totals	56	58	59	59	58 (59)

Table 2 Active Salmon Farm Sites 2005

Atlantic Salmon	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Average
Zone 2.3 SW Vancouver Island	8	9	8	6	7.75 (8)
Zone 2.4 NW Vancouver Island	9	5	5	5	6
Zone 3.1 Sunshine Coast	3	4	4	2	3.25 (3)
Zone 3.2 Campbell River	9	11	10	10	10
Zone 3.3 Broughton	11	14	12	10	11.75 (12)
Zone 3.4 Pt Hardy	5	5	5	7	5.5 (6)
Zone 3.5 North Coast	2	2	2	2	2
Pacific Salmon					
Zone 2 West of Vancouver Island	7	4	3	4	4.5 (5)
Zone 3 East of Vancouver Island	11	9	9	7	9
Totals	65	63	58	53	59.75 (60)

7.4 APPENDIX 4

Detailed Summary of Bacteriology Findings for All Zones/Sub Zones by Fish Species 2003 – 2005

Table 1a: Bacterial Findings for Sub Zone 2.3 (South West Vancouver Island) Atlantic Salmon Farm Audits 2003					
Quarter	# farms sampled*	# fish sampled	# of farms with bacteria cultured	Number of positive fish per bacteria^	Bacterial species cultured
1 Jan - Mar	4	38	3	4	*Brevundimonas vesicularis*
				3	*Aeromonas hydrophila*
2 Apr – Jun	5 (4)	31	0	0	No bacteria cultured
3 July – Sept	4	22	1	1	*Aeromonas salmonicida*
4 Oct – Dec	3	16	1	1	*Aeromonas salmonicida*
Totals	16 (15)	107	5	9	

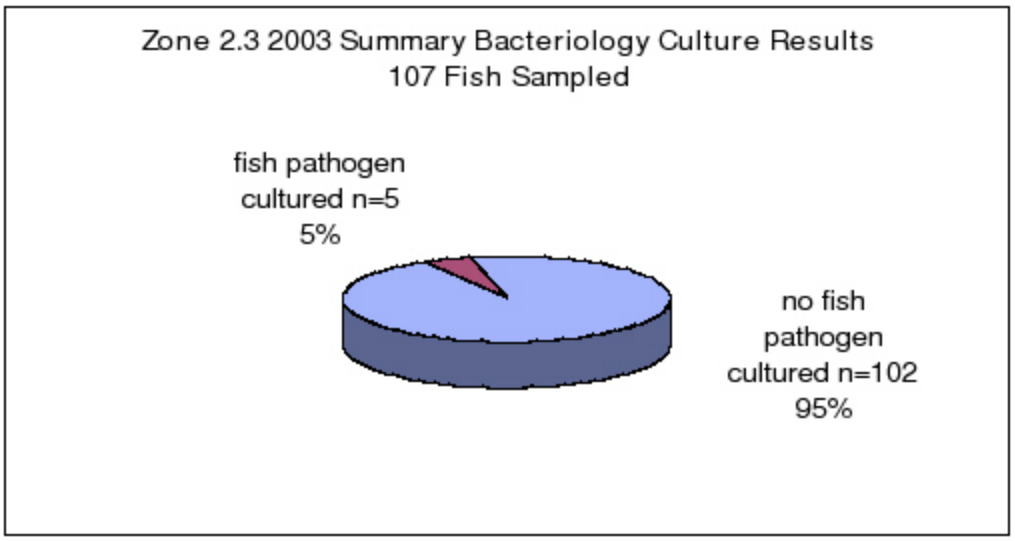
Table 1b: Bacterial Findings for Sub Zone 2.3 (South West Vancouver Island) Atlantic Salmon Farm Audits 2004					
Quarter	# farms sampled	# fish sampled	# of farms with bacteria cultured	Number of positive fish per bacteria	Bacterial species cultured
1 Jan – Mar	4	22	0	0	No bacteria cultured
2 Apr – Jun	3	17	2	2	*Aeromonas salmonicida*
				1	*Carnobacterium pisiciola*
				1	*Carnobacterium gallinarum*
3 July – Sept	3	10	1	1	*Vibrio sp.*
4 Oct – Dec	3	22	0	0	No bacteria cultured
Totals	13	71	3	5	

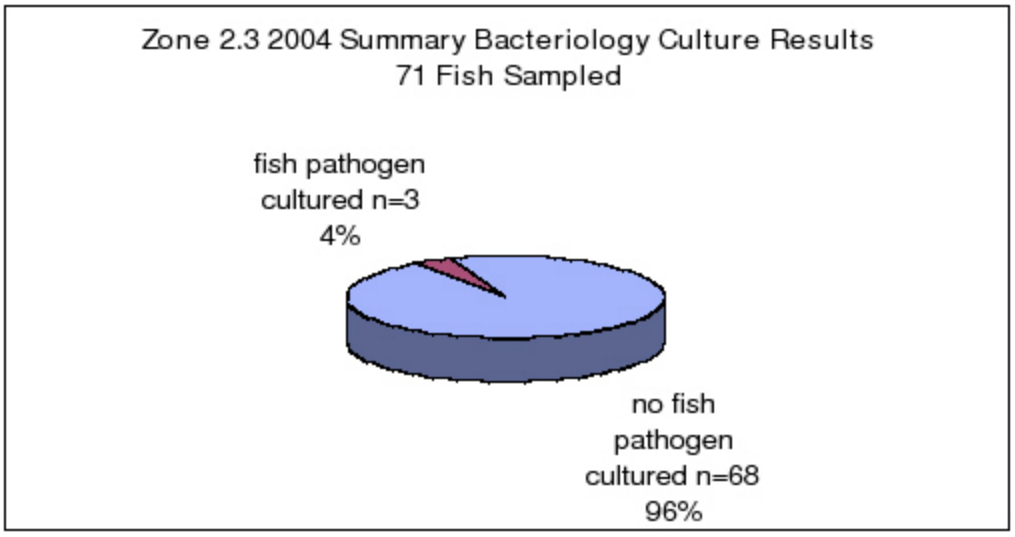
* Occasionally there are no fish available or suitable for sampling on a farm. When a site audit is conducted but no samples were taken, the number of farms where samples were collected is indicated in brackets (e.g. 5(4) indicates that 5 farms were visited but samples were only available on 4 of the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

^ Not all bacteria cultured are pathogenic, many are opportunists or contaminants. For a complete listing of the species cultured and their classification as a pathogen, opportunist or contaminant see Table 10 of this Appendix.

Table 1c: Bacterial Findings for Sub Zone 2.3 (South West Vancouver Island) Atlantic Salmon Farm Audits 2005					
Quarter	# farms sampled	# fish sampled	# of farms with bacteria cultured	Number of positive fish per bacteria	Bacterial species cultured
1 Jan – Mar	4	27	1	1	*Yersinia ruckerii*
				1	*Vibrio logei*
2 Apr – Jun	4	19	1	1	*Aeromonas salmonicida*
3 July – Sept	4(3)	14	0	0	No bacteria cultured
4 Oct – Dec	3 (2)	7	0	0	No bacteria cultured
Totals	15 (13)	67	2	3	

Figure 1a–1c: Summary of Bacterial Findings from Sub Zone 2.3 Atlantic Salmon Farm Audits 2003 - 2005





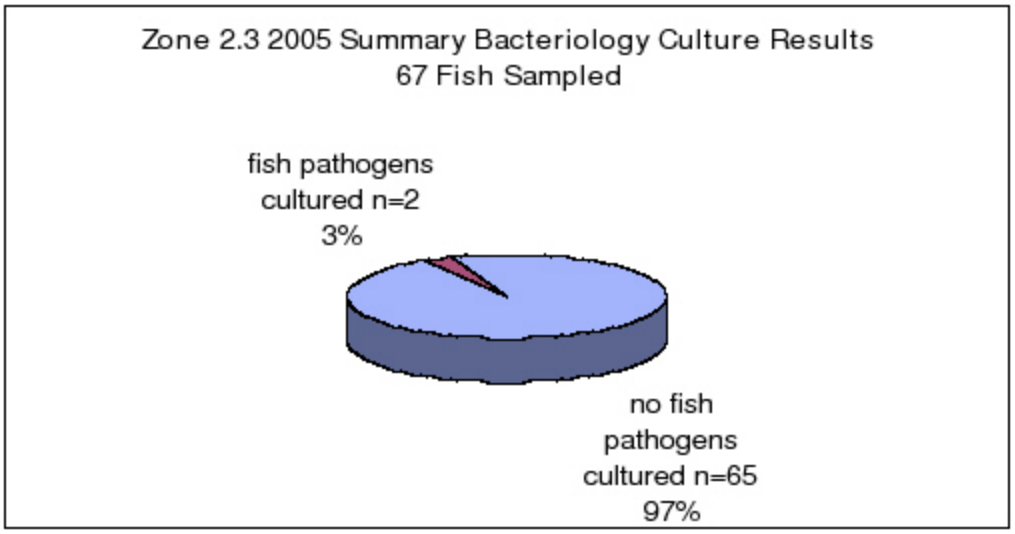


Table 2a : Bacterial Findings for Sub Zone 2.4 (North West Vancouver Island) Atlantic Salmon Farm Audits 2003

Quarter	# farms sampled	# fish sampled	# of farms with bacteria cultured	Number of positive fish per bacteria	Bacterial species cultured
1 Jan - Mar	3	17	1	1	*Vibrio vulnificus*
2 Apr - Jun	4	28	4	1	*Vibrio wodanis*
				1	*Aeromonas salmonicida*
				1	*Vibrio vulnificus*
3 July - Sept	3 (2)	7	1	1	*Photobacter damselae*
4 Oct - Dec	3	10	1	1	*Aeromonas salmonicida*
Totals	13 (12)	62	7	6	

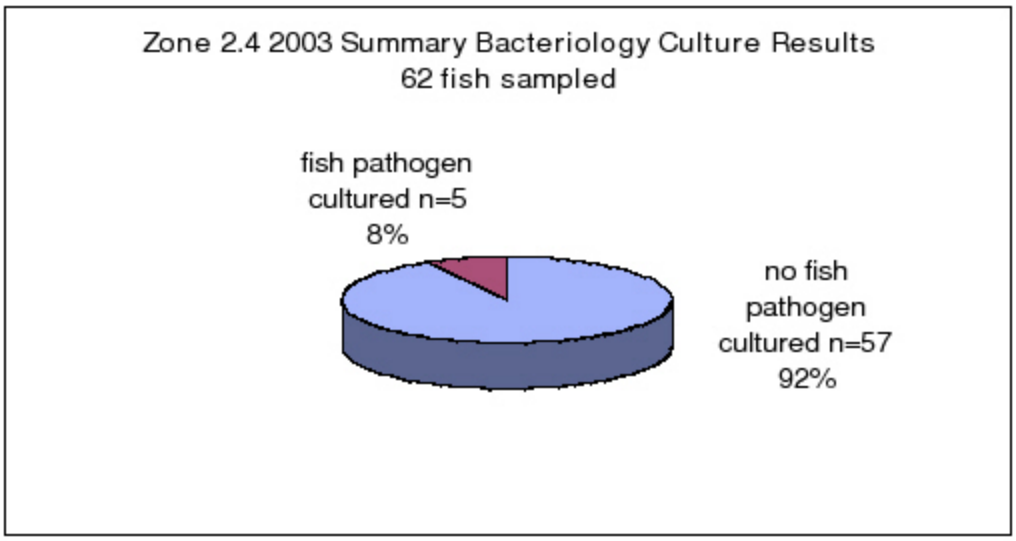
Table 2b : Bacterial Findings for Sub Zone 2.4 (North West Vancouver Island) Atlantic Salmon Farm Audits 2004

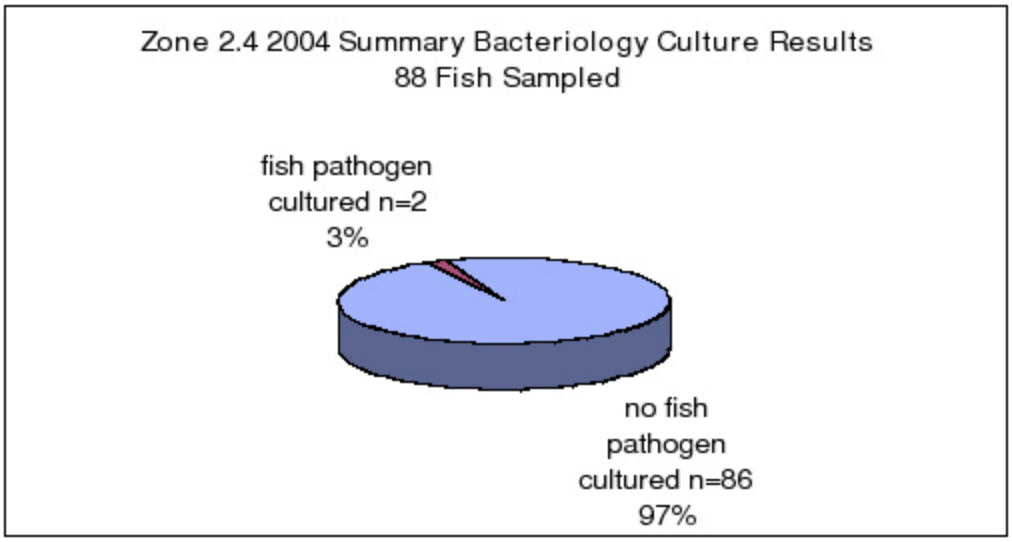
Quarter	# farms sampled	# fish sampled	# of farms with bacteria cultured	Number of positive fish per bacteria	Bacterial species cultured
1 Jan – Mar	4	28	0	0	No bacteria cultured
2 Apr – Jun	4	31	1	1	*Vibrio splendidus*
3 July – Sept	2	23	1	1	*Vibrio species*
4 Oct – Dec	3	6	1	1	*Aeromonas salmonicida*
				1	*Photobacterium angustum*
Totals	13	88	3	4	

Table 2c: Bacterial Findings for Sub Zone 2.4 (North West Vancouver Island) Atlantic Salmon Farm Audits 2005

Quarter	# farms sampled	# fish sampled	# of farms with bacteria cultured	Number of positive fish per bacteria	Bacterial species cultured
1 Jan – Mar	4	16	1	1	*Vibrio species*
2 Apr – Jun	2	16	1	1	*Aeromonas salmonicida*
3 July – Sept	3	13	0	0	No bacteria cultured
4 Oct – Dec	3	14	1	1	*Vibrio tasmaniensis*
Totals	12	59	3	3	

Figure 2a – 2c: Summary of Bacterial Findings from Sub Zone 2.4 Atlantic Salmon Farm Audits 2003 - 2005





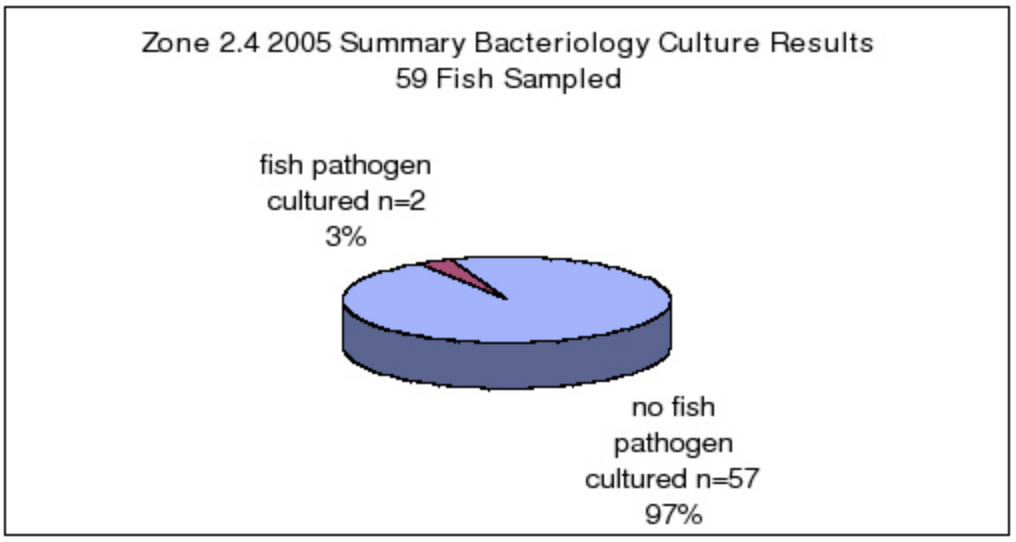


Table 3a: Bacterial Findings for Sub Zone 3.1 (Sunshine Coast) Atlantic Salmon Farm Audits 2003

Quarter	# farms sampled	# fish sampled	# of farms with bacteria cultured	Number of positive fish per bacteria	Bacterial species cultured
1 Jan – Mar	0	0	0	0	Not applicable
2 Apr – Jun	2	5	0	0	No bacteria cultured
3 July – Sept	1	2	0	0	No bacteria cultured
4 Oct – Dec	0	0	0	0	No bacteria cultured
Totals	3	7	0	0	

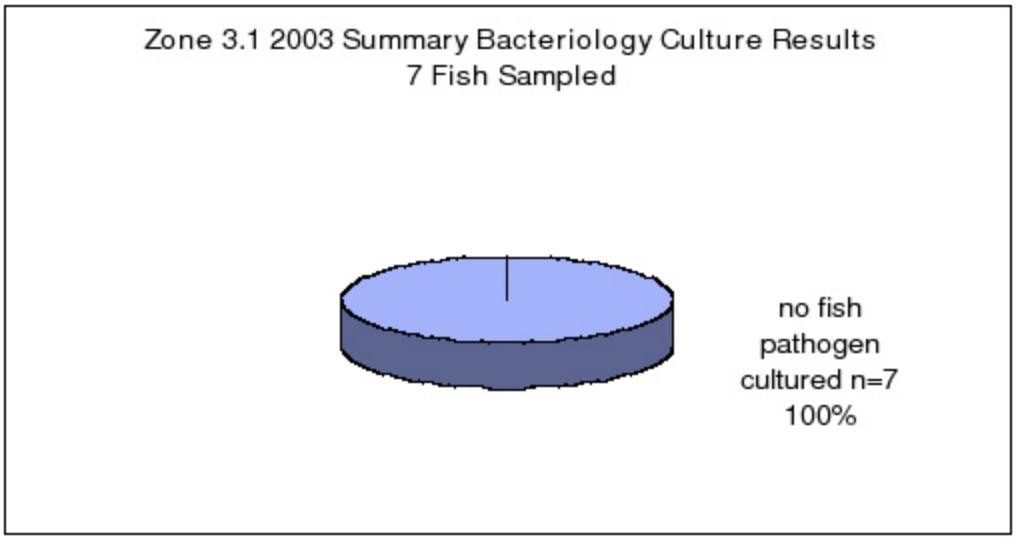
Table 3b: Bacterial Findings for Sub Zone 3.1 (Sunshine Coast) Atlantic Salmon Farm Audits 2004

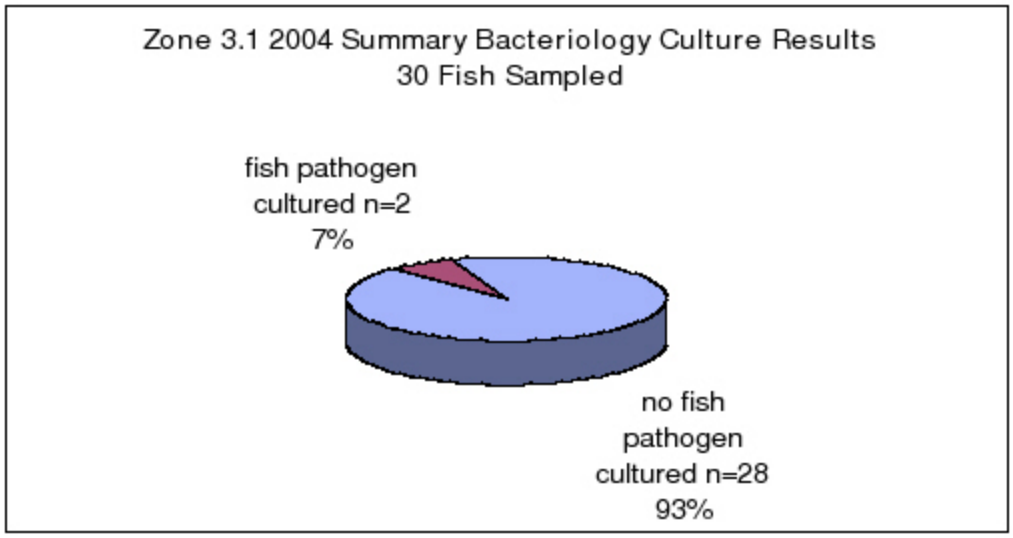
Quarter	# farms sampled	# fish sampled	# of farms with bacteria cultured	Number of positive fish per bacteria	Bacterial species cultured
1 Jan – Mar	1	3	0	0	Not applicable
2 Apr – Jun	3	11	1	1	*Vibrio ordali*
3 July – Sept	3	10	1	1	*Vibrio species*
4 Oct – Dec	1	6	0	0	No bacteria cultured
Totals	8	30	2	2	

Table 3c: Bacterial Findings for Sub Zone 3.1 (Sunshine Coast) Atlantic Salmon Farm Audits 2005

Quarter	# farms sampled	# fish sampled	# of farms with bacteria cultured	Number of positive fish per bacteria	Bacterial species cultured
1 Jan – Mar	2	3	0	0	No bacteria cultured
2 Apr – Jun	3	12	0	0	No bacteria cultured
3 July – Sept	2	15	0	0	No bacteria cultured
4 Oct – Dec	0	0	0	0	Not applicable
Totals	7	30	0	0	

Figure 3a – 3c: Summary of Bacterial Findings from Sub Zone 3.1 Atlantic Salmon Farm Audits 2003 - 2005





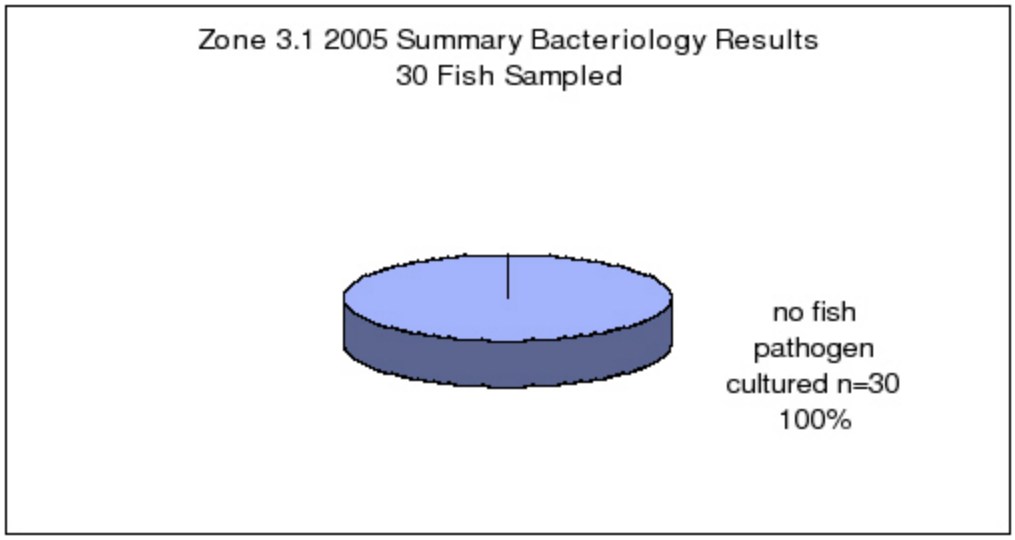


Table 4a: Bacterial Findings for Sub Zone 3.2 (Campbell River) Atlantic Salmon Farm Audits 2003

Quarter	# farms sampled	# fish sampled	# of farms with bacteria cultured	Number of positive fish per bacteria	Bacterial species cultured
1 Jan – Mar	2	6	1	1	*Listonella anguillarum*
2 Apr – Jun	2	16	0	0	No bacteria cultured
3 July – Sept	4	20	0	0	No bacteria cultured
4 Oct – Dec	2	7	0	0	No bacteria cultured
Totals	10	49	1	1	

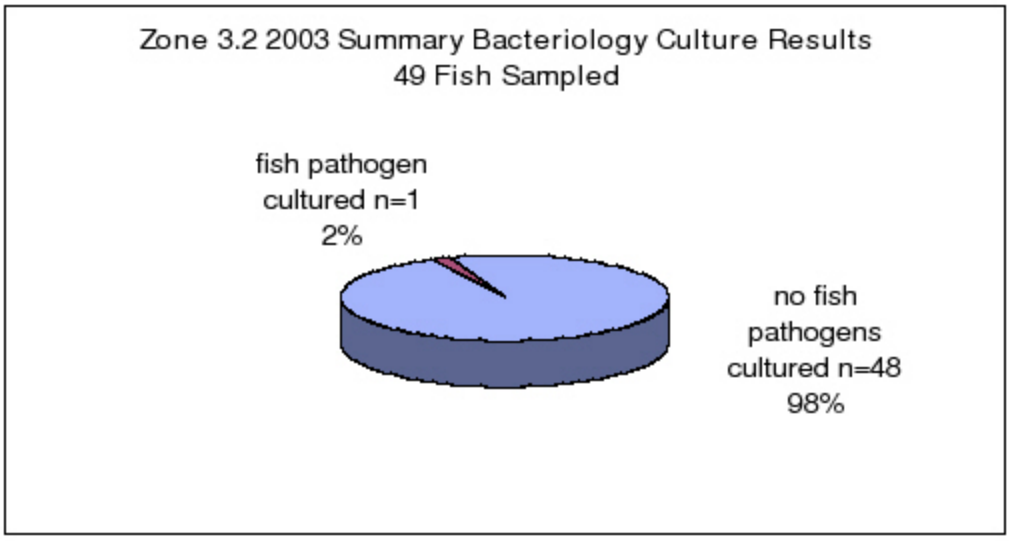
Table 4b: Bacterial Findings for Sub Zone 3.2 (Campbell River) Atlantic Salmon Farm Audits 2004

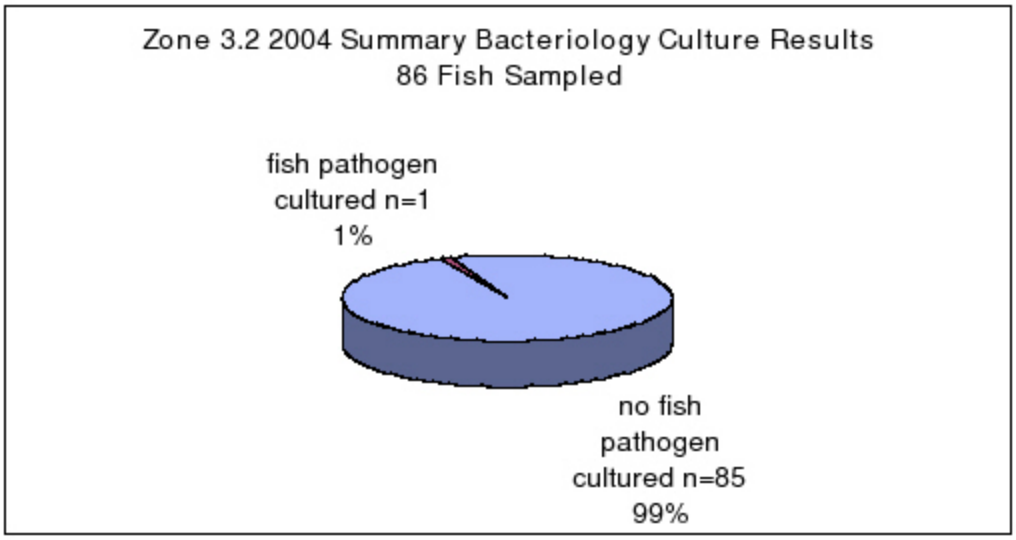
Quarter	# farms sampled	# fish sampled	# of farms with bacteria cultured	Number of positive fish per bacteria	Bacterial species cultured
1 Jan – Mar	2	11	1	2	*Photobacterium phosphoreum*
2 Apr – Jun	2	20	0	0	No bacteria cultured
3 July – Sept	4	31	0	0	No bacteria cultured
4 Oct – Dec	5	24	3	2	*Psychrobacter immobilis*
				1	*Microbacterium species*
				1	*Vibrio species*
Totals	13	86	4	6	

Table 4c: Bacterial Findings for Sub Zone 3.2 (Campbell River) Atlantic Salmon Farm Audits 2005

Quarter	# farms sampled	# fish sampled	# of farms with bacteria cultured	Number of positive fish per bacteria	Bacterial species cultured
1 Jan – Mar	4	13	1	1	*Vibrio wodanis*
2 Apr – Jun	5	29	1	1	*Bronchothrix thermospacta*
3 July – Sept	5	26	0	0	No bacteria cultured
4 Oct – Dec	4	21	1	1	*Vibrio logei*
Totals	18	89	3	3	

Figure 4a – 4c: Summary of Bacterial Findings from Sub Zone 3.2 Atlantic Salmon Farm Audits 2003 - 2005





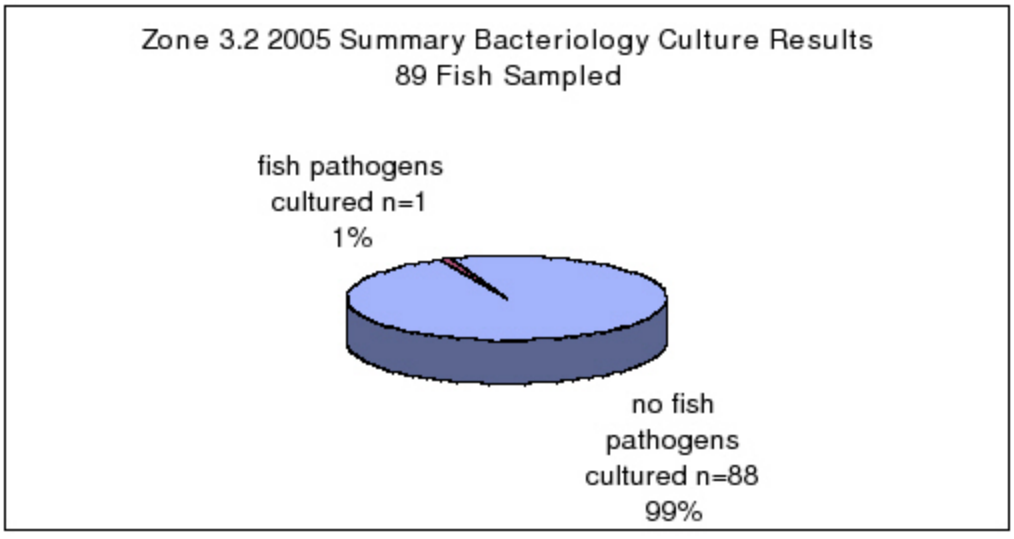


Table 5a: Bacterial Findings for Sub Zone 3.3 (Broughton) Atlantic Salmon Farm Audits 2003

Quarter	# farms sampled	# fish sampled	# of farms with bacteria cultured	Number of positive fish per bacteria	Bacterial species cultured
1 Jan – Mar	5	37	1	1	*Vibrio logei*
2 Apr – Jun	4 (3)	20	1	1	*Vibrio wodanis*
3 July – Sept	5	26	6	5	*Aeromonas hydrophila*
				1	*Aeromonas salmonicida*
4 Oct – Dec	5	31	0	0	No bacteria cultured
Totals	19(18)	114	8	8	

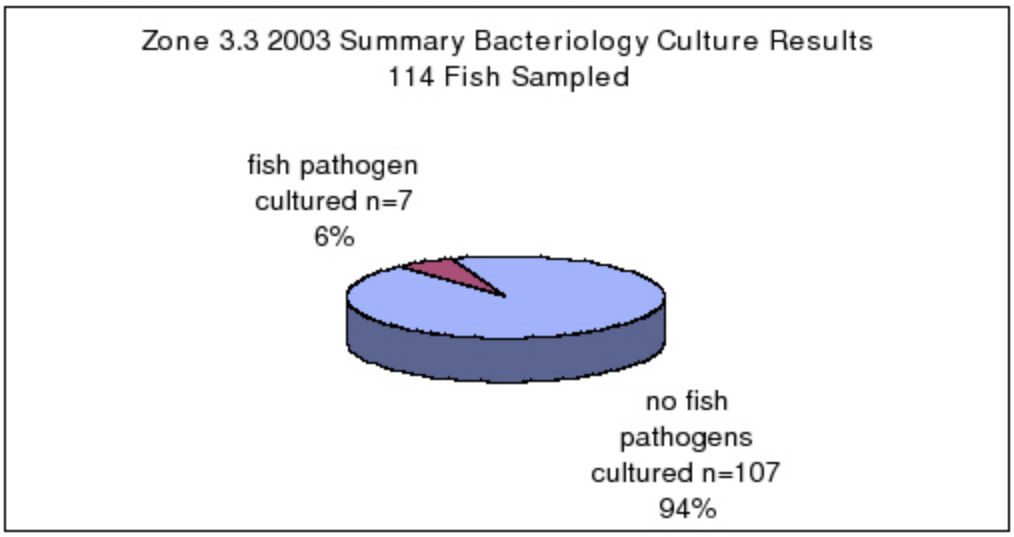
Table 5b: Bacterial Findings for Sub Zone 3.3 (Broughton) Atlantic Salmon Farm Audits 2004

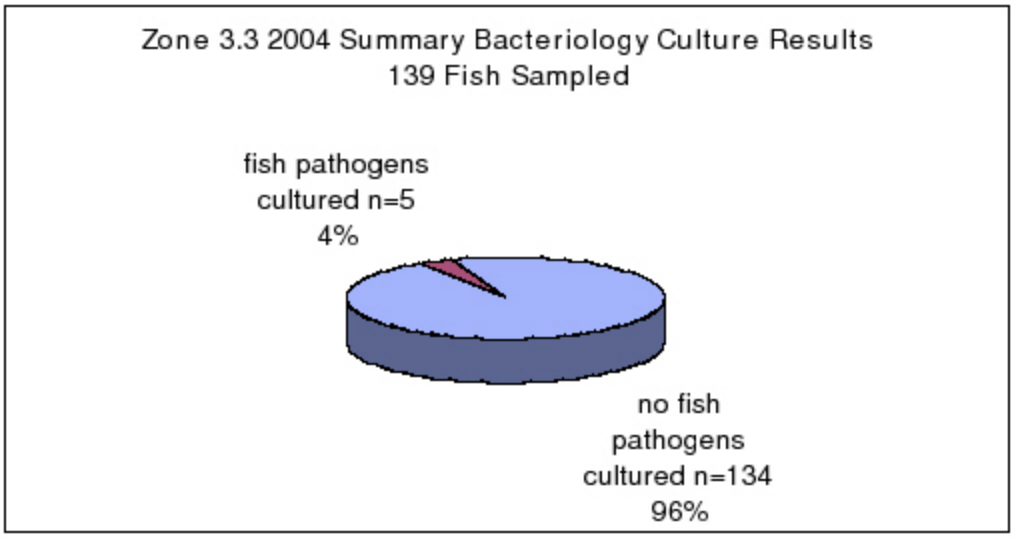
Quarter	# farms sampled	# fish sampled	# of farms with bacteria cultured	Number of positive fish per bacteria	Bacterial species cultured
1 Jan – Mar	6	44	3	2	*Vibrio splendidus*
				2	*Vibrio logei*
				1	*Aeromonas salmonicida*
2 Apr – Jun	6	36	2	1	*Aeromonas species*
				1	*Vibrio harveyi*
3 July – Sept	5	27	3	3	*Aeromonas species*
				1	*Pseudoalteromonas species*
4 Oct – Dec	5	32	1	0	*Photobacterium phosphoreum*
Totals	22	139	9	11	

Table 5c: Bacterial Findings for Sub Zone 3.3 (Broughton) Atlantic Salmon Farm Audits 2005

Quarter	# farms sampled	# fish sampled	# of farms with bacteria cultured	Number of positive fish per bacteria	Bacterial species cultured
1 Jan – Mar	5	31	2	5	*Photobacterium phosphoreum*
2 Apr – Jun	7	49	2	1	*Photobacterium phosphoreum*
				1	*Yersinia ruckerii*
3 July – Sept	6	39	0	0	No bacteria cultured
4 Oct – Dec	6	33	0	0	No bacteria cultured
Totals	24	152	4	7	

Figure 5a – 5c: Summary of Bacterial Findings from Sub Zone 3.3 Atlantic Salmon Farm Audits 2003 - 2005





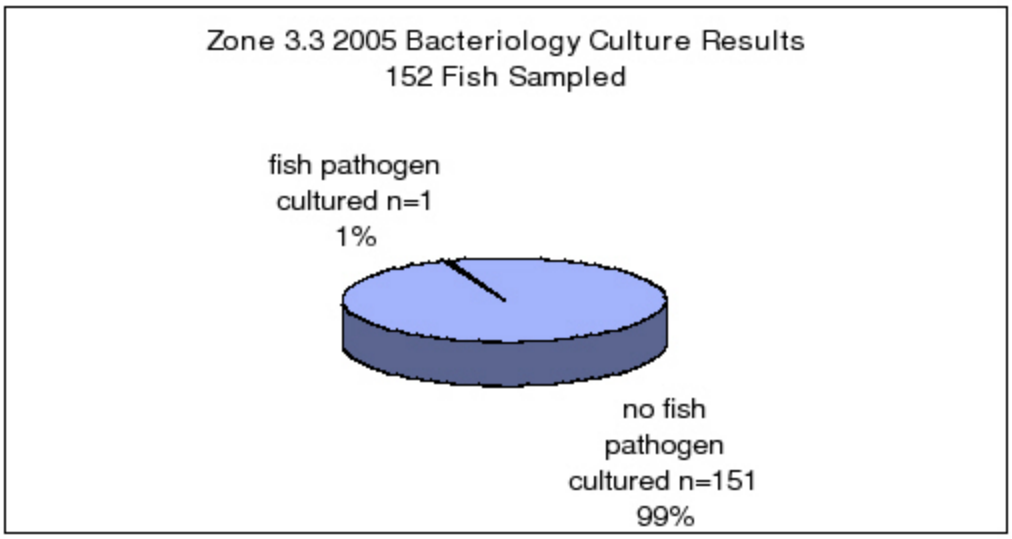


Table 6a: Bacterial Findings for Sub Zone 3.4 (Pt Hardy) Atlantic Salmon Farm Audits 2003

Quarter	# farms sampled	# fish sampled	# of farms with bacteria cultured	Number of positive fish per bacteria	Bacterial species cultured
1 Jan – Mar	3	27	1	1	*Photobacter damselae*
2 Apr – Jun	3	22	1	1	*Aeromonas salmonicida*
3 July – Sept	3	20	1	1	*Staphylococcus sp.*
4 Oct – Dec	2	15	1	1	*Vibrio wodanis*
Totals	11	84	4	4	

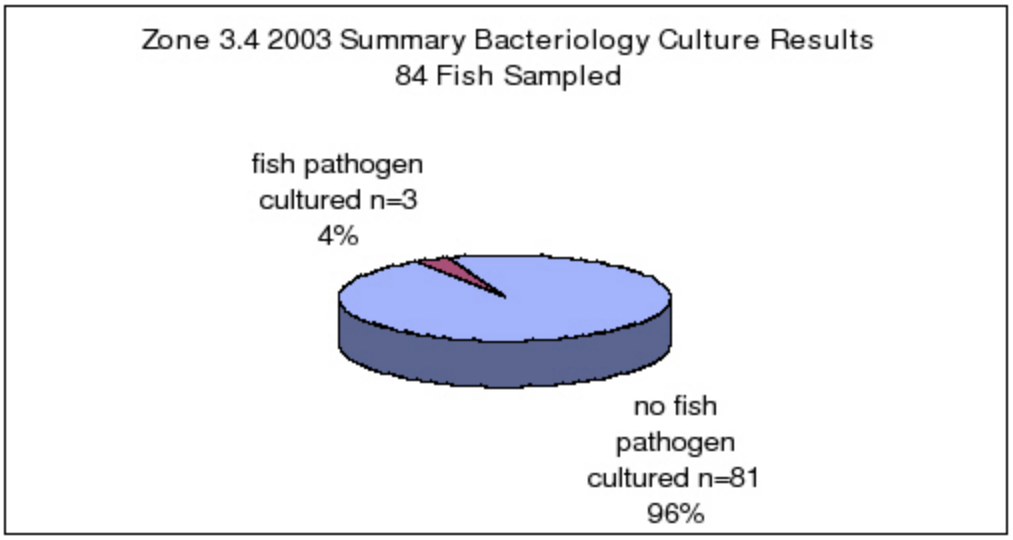
Table 6b: Bacterial Findings for Sub Zone 3.4 (Port Hardy) Atlantic Salmon Farm Audits 2004

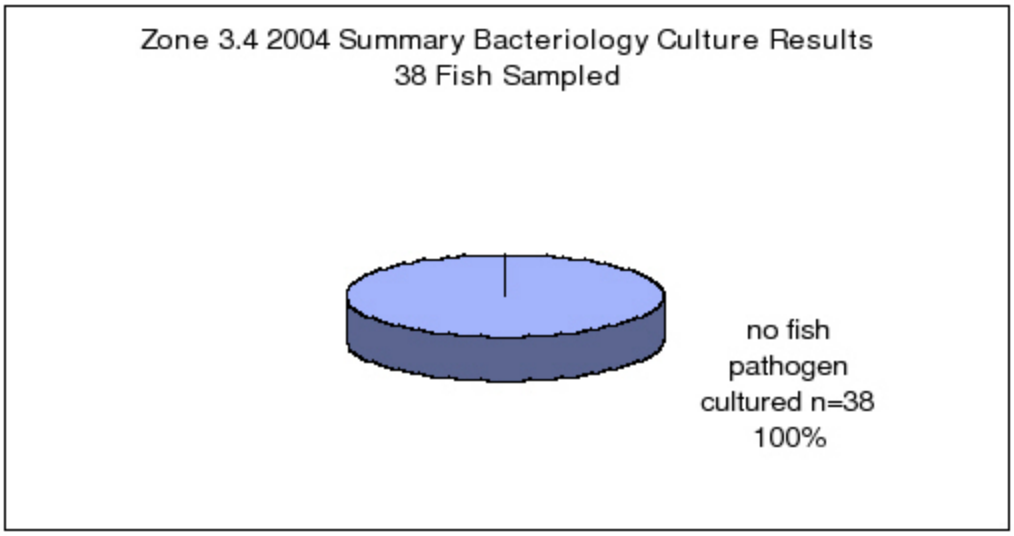
Quarter	# farms sampled	# fish sampled	# of farms with bacteria cultured	Number of positive fish per bacteria	Bacterial species cultured
1 Jan – Mar	1	8	0	0	No bacteria cultured
2 Apr – Jun	2	10	0	0	No bacteria cultured
3 July – Sept	3	13	0	0	No bacteria cultured
4 Oct – Dec	3	7	0	0	No bacteria cultured
Totals	9	38	0	0	

Table 6c: Bacterial Findings for Sub Zone 3.4 (Port Hardy) Atlantic Salmon Farm Audits 2005

Quarter	# farms sampled	# fish sampled	# of farms with bacteria cultured	Number of positive fish per bacteria	Bacterial species cultured
1 Jan – Mar	2	4	0	0	No bacteria cultured
2 Apr – Jun	2	5	0	0	No bacteria cultured
3 July – Sept	3	17	0	0	No bacteria cultured
4 Oct – Dec	4 (3)	21	1	1	*Pseudoalteromonas porphyrae*
				1	*Photobacter species*
				1	*Photobacter phosphoreum*
Totals	11 (10)	47	1	3	

Figure 6a – 6c: Summary of Bacterial findings from Sub Zone 3.4 Atlantic Salmon Farm Audits 2003 - 2005





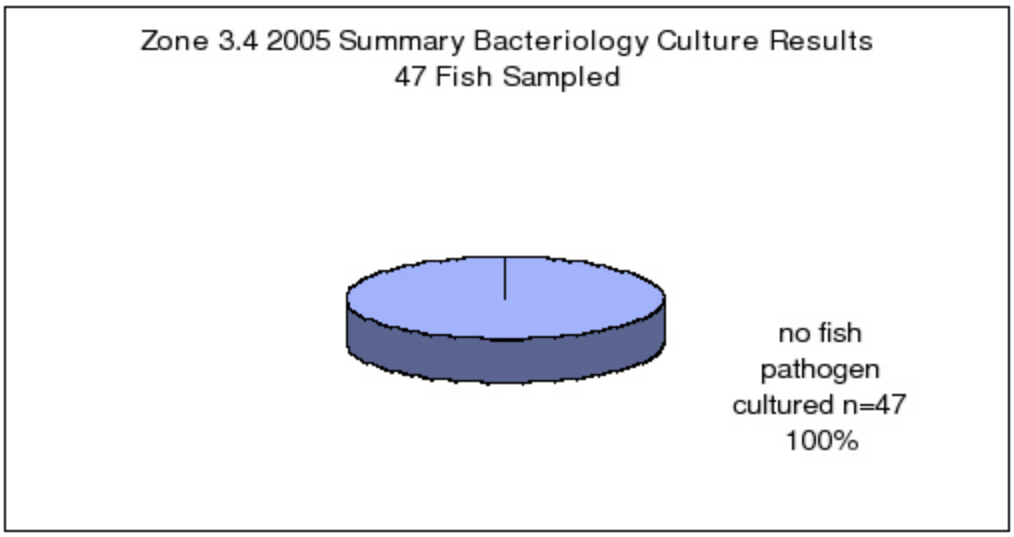


Table 7a : Bacterial Findings for Sub Zone 3.5 (North Coast) Atlantic Salmon Farm Audits 2003

Quarter	# farms sampled	# fish sampled	# of farms with bacteria cultured	Number of positive fish per bacteria	Bacterial species cultured
1 Jan – Mar	0	0	0	0	Not applicable
2 Apr – Jun	0	0	0	0	Not applicable
3 July – Sept	0	0	0	0	Not applicable
4 Oct – Dec	0	0	0	0	Not applicable
Totals	0	0	0	0	

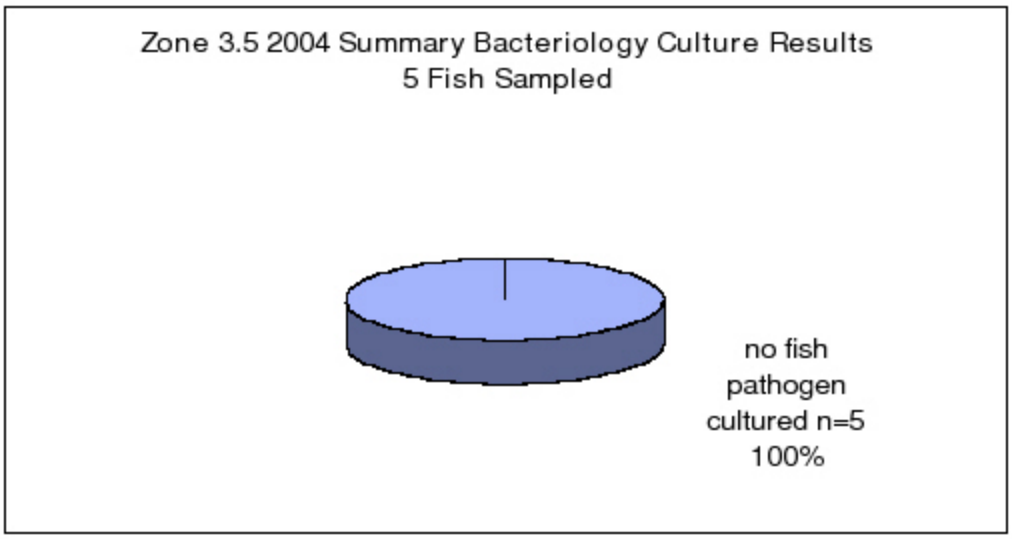
Table 7b: Bacterial Findings for Sub Zone 3.5 (North Coast) Atlantic Salmon Farm Audits 2004

Quarter	# farms sampled	# fish sampled	# of farms with bacteria cultured	Number of positive fish per bacteria	Bacterial species cultured
1 Jan – Mar	0	0	0	0	Not applicable
2 Apr – Jun	0	0	0	0	Not applicable
3 July – Sept	0	0	0	0	Not applicable
4 Oct – Dec	1	5	0	0	No bacteria cultured
Totals	1	5	0	0	

Table 7c: Bacterial Findings for Sub Zone 3.5 (North Coast) Atlantic Salmon Farm Audits 2005

Quarter	# farms sampled	# fish sampled	# of farms with bacteria cultured	Number of positive fish per bacteria	Bacterial species cultured
1 Jan – Mar	1 (0)	0	0	0	No bacteria cultured
2 Apr – Jun	1	4	0	0	No bacteria cultured
3 July – Sept	1	5	0	0	No bacteria cultured
4 Oct – Dec	0	0	0	0	Not applicable
Totals	3 (2)	9	0	0	

Figure 7a – 7c: Summary of Bacterial Findings from Sub Zone 3.5 Atlantic Salmon Farm Audits 2003 - 2005



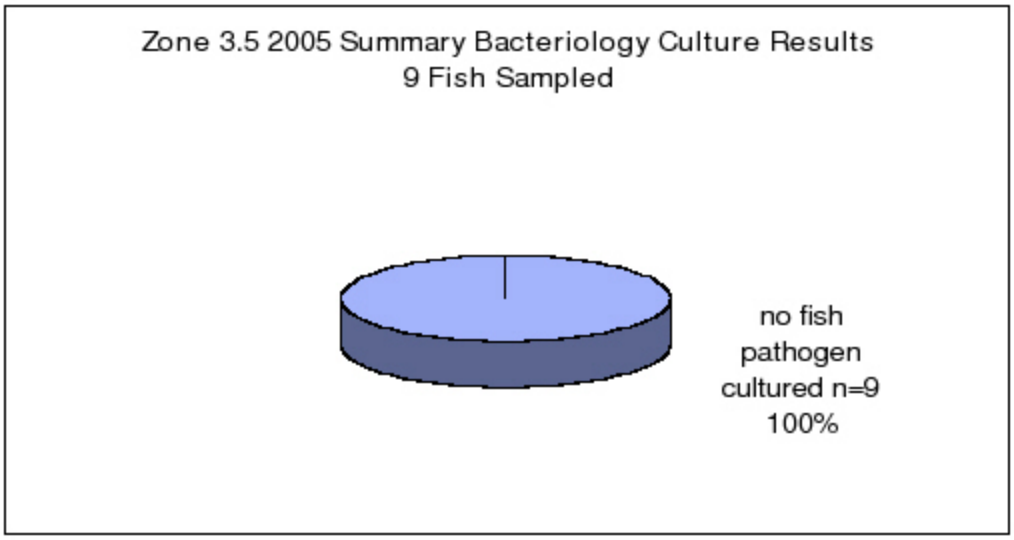


Table 8a: Bacterial Findings for Zone 2 (West Coast of Vancouver Island) Pacific Salmon Farm Audits 2003

Quarter	# farms sampled	# fish sampled	# of farms with bacteria cultured	Number of positive fish per bacteria	Bacterial species cultured
1 Jan – Mar	2	10	1	2	*Vibrio parahemolyticus*
2 Apr – Jun	4	27	1	1	*Vibrio logei*
				1	*Pseudomonas fluorescens*
3 July –Sept	4 (3)	16	1	1	*Vibrio tubashii*
4 Oct – Dec	5	20	2	2	*Aeromonas species*
Totals	15 (14)	73	5	7	

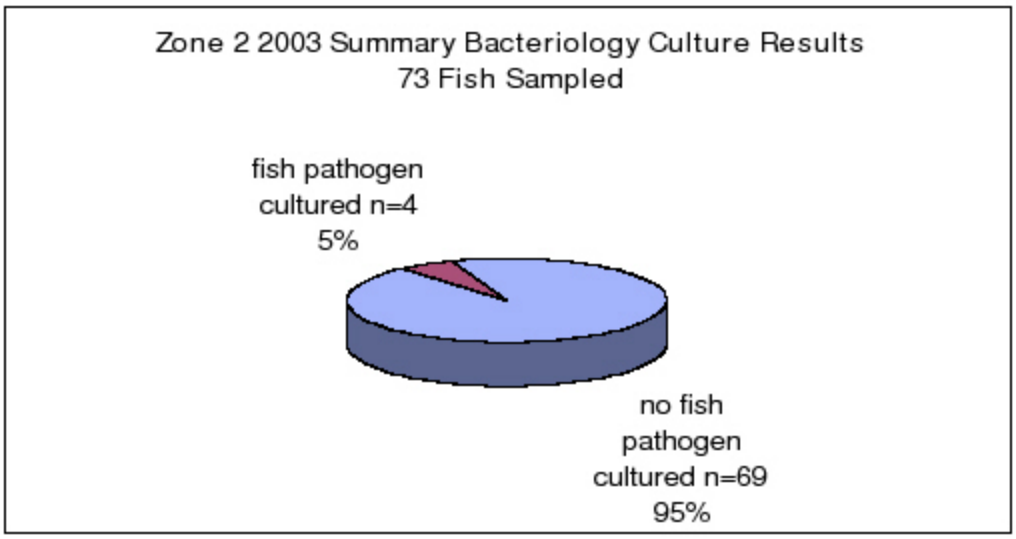
Table 8b: Bacterial Findings for Zone 2 (West Coast of Vancouver Island) Pacific Salmon Farm Audits 2004

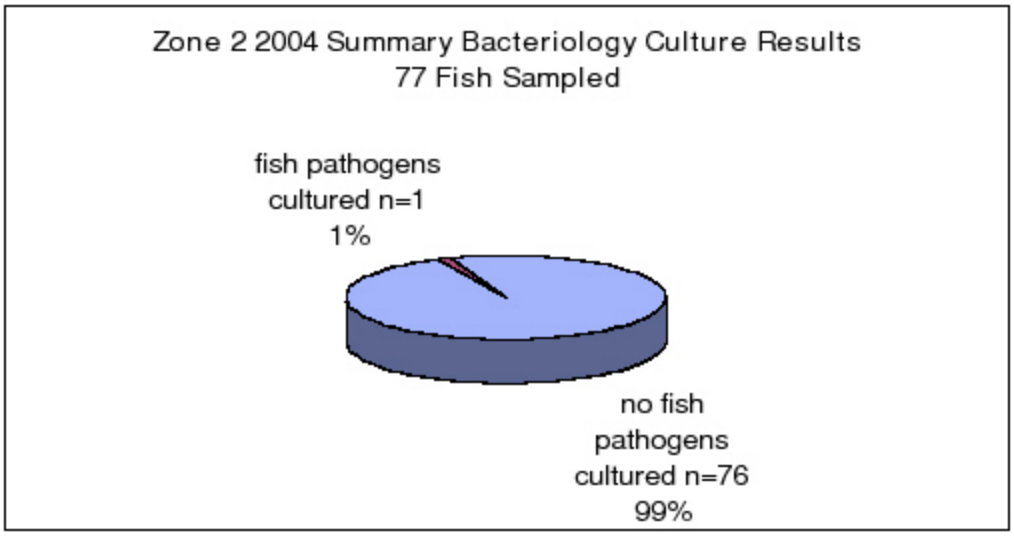
Quarter	# farms sampled	# fish sampled	# of farms with bacteria cultured	Number of positive fish per bacteria	Bacterial species cultured
1 Jan – Mar	5	38	1	1	*Aeromonas species*
2 Apr – Jun	4	21	1	1	*Pseudomonas species*
3 July – Sept	2	14	0	0	No bacteria cultured
4 Oct – Dec	3	4	0	0	No bacteria cultured
Totals	14	77	2	2	

Table 8c: Bacterial Findings for Zone 2 (West Coast of Vancouver Island) Pacific Salmon Farm Audits 2005

Quarter	# farms sampled	# fish sampled	# of farms with bacteria cultured	Number of positive fish per bacteria	Bacterial species cultured
1 Jan – Mar	3	17	0	0	No bacteria cultured
2 Apr – Jun	1	5	1	2	*Vibrio wodanis*
				2	*Vibrio splendidus*
3 July – Sept	1	3	0	0	No bacteria cultured
4 Oct – Dec	2	8	0	0	No bacteria cultured
Totals	7	33	1	4	

Figure 8a–8c: Summary of Bacterial Findings from Zone 2 Pacific Salmon Farm Audits 2003 - 2005





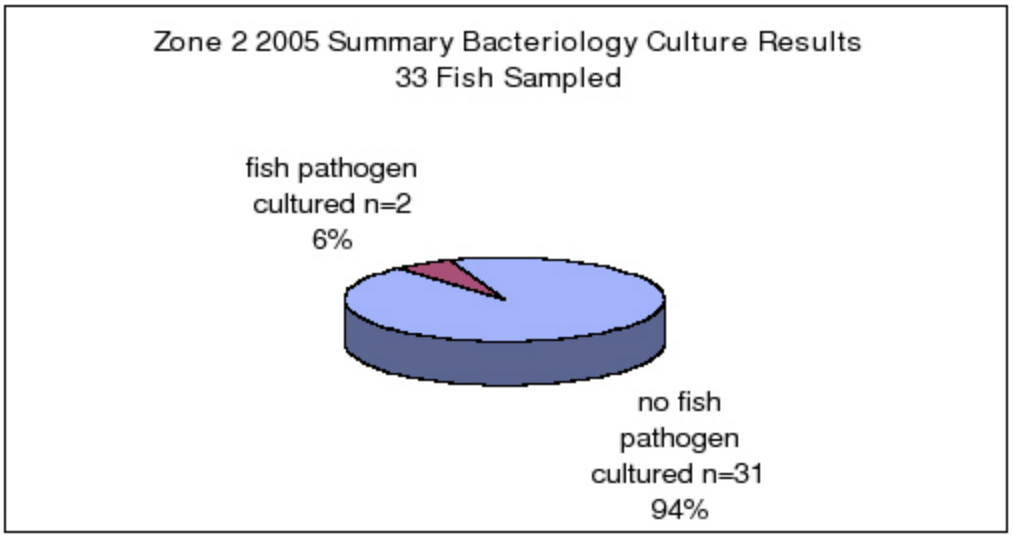


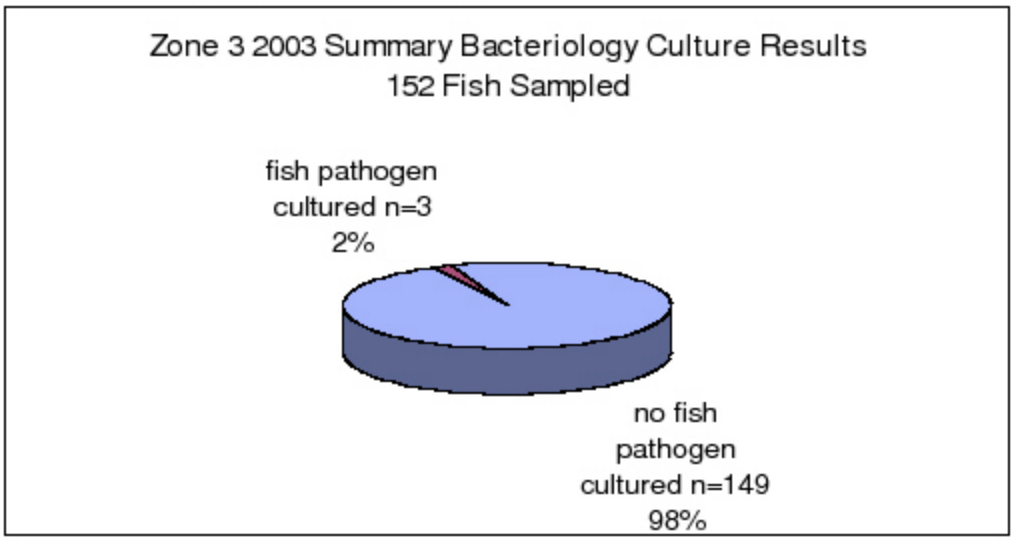
Table 9a: Bacterial Findings for Zone 3 (East Coast of Vancouver Island) Pacific Salmon Farm Audits 2003					
Quarter	# farms sampled	# fish sampled	# of farms with bacteria cultured	Number of positive fish per bacteria	Bacterial species cultured
1 Jan – Mar	4	28	0	0	Not applicable
2 Apr - Jun	5	44	3	4	*Vibrio vulnificus*
				3	*Vibrio alginolyticus*
				2	*Pasteurella sp*
				1	*Carnobacterium alterfundi*
				1	*Aeromonas hydrophila*
3 July – Sept	6	42	1	1	*Capnocytophaga canimor*
4 Oct – Dec	8 (7)	38	2	1	*Vibrio aestuarianus*
				1	*Vibrio proteolyticus*
Totals	23 (22)	152	6	14	

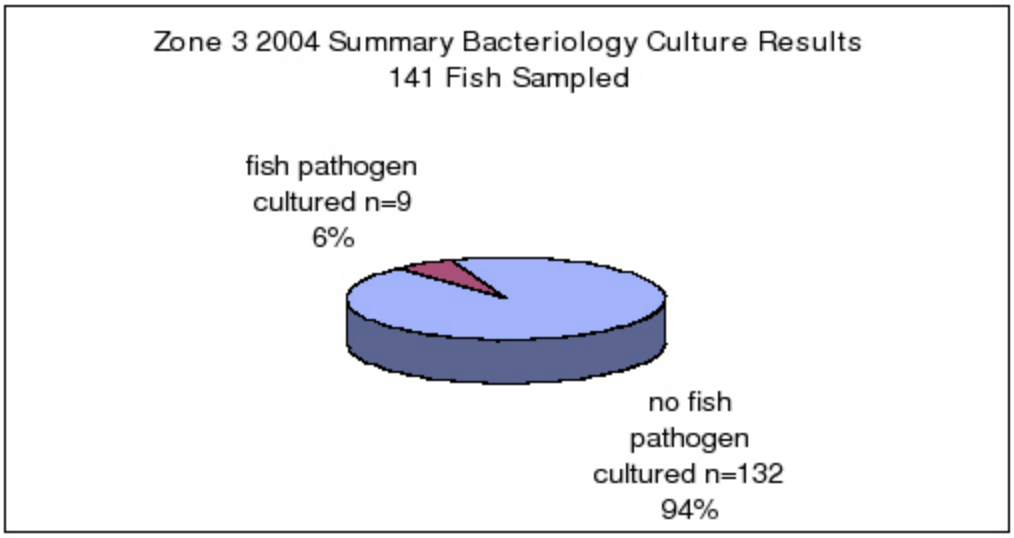
Table 9b: Bacterial Findings for Zone 3 (East Coast of Vancouver Island) Pacific Salmon Farm Audits 2004					
Quarter	# farms sampled	# fish sampled	# of farms with bacteria cultured	Number of positive fish per bacteria	Bacterial species cultured
1 Jan – Mar	6	34	2	1	*Vibrio logei*
				1	*Psychrobacter immobilis*
2 Apr – Jun	6	44	4	3	*Aeromonas salmonicida*
				1	*Psychrobacter species*
				1	*Aeromonas sobria*
				1	*Vibrio aestuarianus*
				1	*Vibrio ordali*
				1	*Vibrio proteolyticus*
3 July – Sept	6	22	1	1	*Arthrobacter species*
4 Oct – Dec	5	41	2	3	*Vibrio ordali*
				1	*Pseudomonas fluorescens*
Totals	23	141	9	15	

Table 9c: Bacterial Findings for Zone 3 (East Coast of Vancouver Island) Pacific Salmon Farm Audits 2005

Quarter	# farms sampled	# fish sampled	# of farms with bacteria cultured	Number of positive fish per bacteria	Bacterial species cultured
1 Jan – Mar	5	41	2	1	*Listonella anguillarum*
				1	*Aeromonas salmonicida*
2 Apr – Jun	4	26	0	0	No bacteria cultured
3 July – Sept	5	21	0	0	No bacteria cultured
4 Oct – Dec	2	12	1	1	*Listonella anguillarum*
Totals	16	100	3	3	

Figure 9a–9c: Summary of Bacterial Findings from Zone 3 Pacific Salmon Farm Audits 2003 - 2005





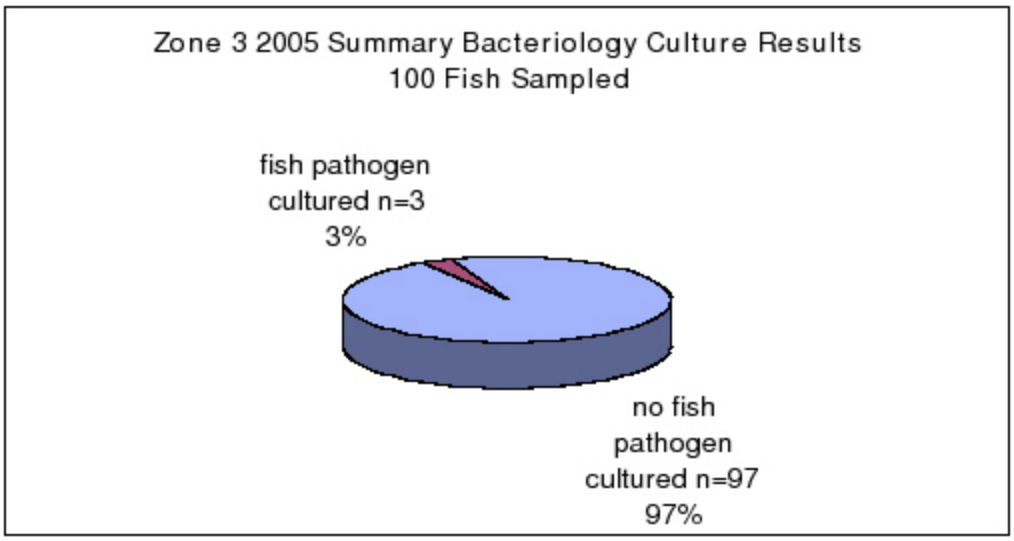


Table 10: Summary of Bacterial Organisms Cultured 2003 – 2005	
Fish Pathogens	Opportunists and Contaminants
Aeromonas salmonicida *Aeromonas sobria* *Aeromonas hydrophila* *Aeromonas sp.*	*Arthrobacter sp.* *Bronchothrix thermospacta* *Brevundimonas vesicularis* *Carnobacterium alterfundi* *Carnobacterium pisiciola* *Capnocytophaga canimor*
Vibrio wodanis *Vibrio tubashii* *Vibrio ordali* *Listonella anguillarum* *Vibrio sp*	*Vibrio logei* *Vibrio alginolyticus* *Vibrio aestuarianus* *Vibrio parahemolyticus* *Vibrio proteolyticus* *Vibrio splendidus* *Vibrio harveyi* *Vibrio tasmaniensis* *Vibrio vulnificus*
Pasteurella sp. *Photobacterium damselae* *Pseudomonas fluorescens* *Yersinia ruckerii*	*Staphylococcus species* *Microbacterium species* *Pseudomonas species* *Pseudoalteromonas porphyrae* *Pseudoalteromonas sp* *Psychrobacter immobilis* *Psychrobacter sp.*
	Photobacterium angustum *Photobacterium phosphoreum* *Photobacter sp*

7.5 APPENDIX 5:

Detailed Summary of Molecular Diagnostics Findings for All Zones/Sub Zones by Species 2003 – 2005

Table 1a : Molecular Testing Results for Sub Zone 2.3 (South West Vancouver Island) Atlantic Salmon Farm Audits 2003

Quarter	# farms sampled*	# fish sampled	Number of Molecular Tests					Positive Sites	Organism Identified
			IHNV	IPNV	ISAV	Ricket -tsia	VHSv-NAS		
1 Jan-Mar	4	38	10	10	10	10	10	2	IHNv
								1	*Piscirickettsia salmonis*
2 Apr-Jun	5 (4)	31	8	8	8	8	8	1	IHNv
3 Jul-Sep	4	22	7	7	7	7	7	1	*Piscirickettsia salmonis*
4 Oct-Dec	3	16	5	5	5	5	5	0	None
Totals	16 (15)	107	30	30	30	30	30	5	

Table 1b: Molecular Testing Results for Sub Zone 2.3 (South West Vancouver Island) Atlantic Salmon Farm Audits 2004

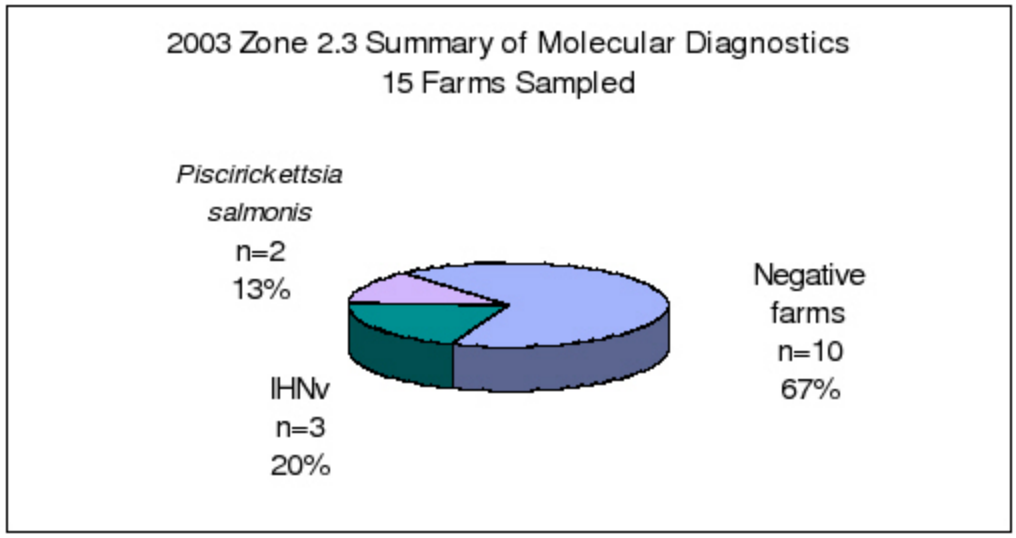
Quarter	# farms sampled	# fish sampled	Number of Molecular Tests					Positive Sites	Organism Identified
			IHNV	IPNV	ISAV	Ricket -tsia	VHSv-NAS		
1 Jan-Mar	4	22	7	7	7	7	7	1	VHSv NAS
2 Apr-Jun	3	17	17	17	17	17	17	0	None
3 Jul-Sep	3	10	4	4	4	4	4	1	VHSv NAS
4 Oct-Dec	3	22	6	6	6	6	6	2	*Piscirickettsia salmonis*
Totals	13	71	34	34	34	34	34	4	

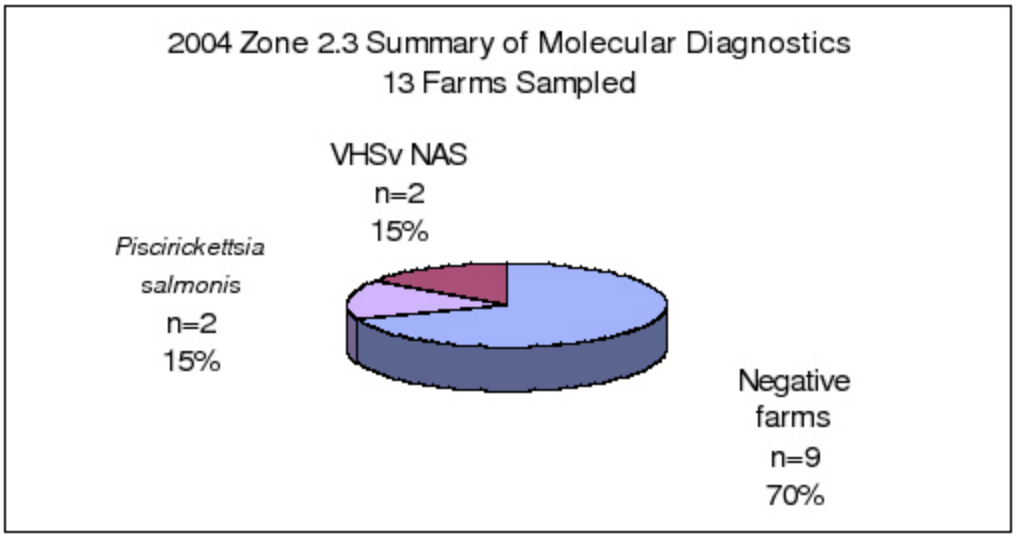
* Occasionally there are no fish available or suitable for sampling on a farm. When a site audit is conducted but no samples were taken, the number of farms where samples were collected is indicated in brackets (e.g. 5(4) indicates that 5 farms were visited but samples were only available on 4 of the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

Table 1c: Molecular Testing Results for Zone 2.3 (South West Vancouver Island) Atlantic Salmon Farm Audits 2005

Quarter	# farms sampled	# fish sampled	Number of Molecular Tests					Positive Sites	Organism Identified
			IHNv	IPNv	ISAv	Ricket -tsia	VHS-NAS		
1 Jan-Mar	4	27	8	8	8	8	8	0	None
2 Apr-Jun	4	19	8	8	8	8	8	2	VHSv NAS
3 Jul-Sep	(4) 3	14	6	6	6	6	6	0	None
4 Oct–Dec	(3) 2	7	3	3	3	3	3	1	*Piscirickettsia salmonis*
Totals	(15) 13	67	25	25	25	25	25	3	

Figure 1a–1c: Summary of Molecular Diagnostics Findings from Sub Zone 2.3 Atlantic Salmon Farm Audits 2003 – 2005





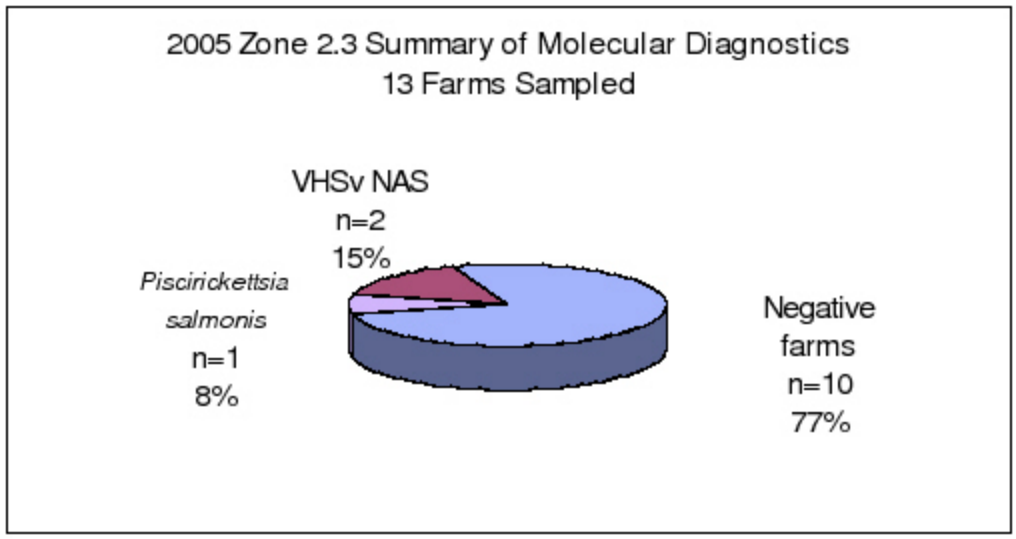


Table 2a: Molecular Testing Results for Sub Zone 2.4 (North West Vancouver Island) Atlantic Salmon Farm Audits 2003

Quarter	# farms sampled	# fish sampled	Number of Molecular Tests					Positive Sites	Organism Identified
			IHNV	IPNV	ISAV	Ricket-tsia	VHSv-NAS		
1 Jan-Mar	3	17	5	5	5	5	5	0	None
2 Apr-Jun	4	28	7	7	7	7	7	0	None
3 Jul-Sep	3 (2)	7	3	3	3	3	3	0	None
4 Oct-Dec	3	10	5	5	5	5	5	0	None
Totals	13 (12)	62	20	20	20	20	20	0	

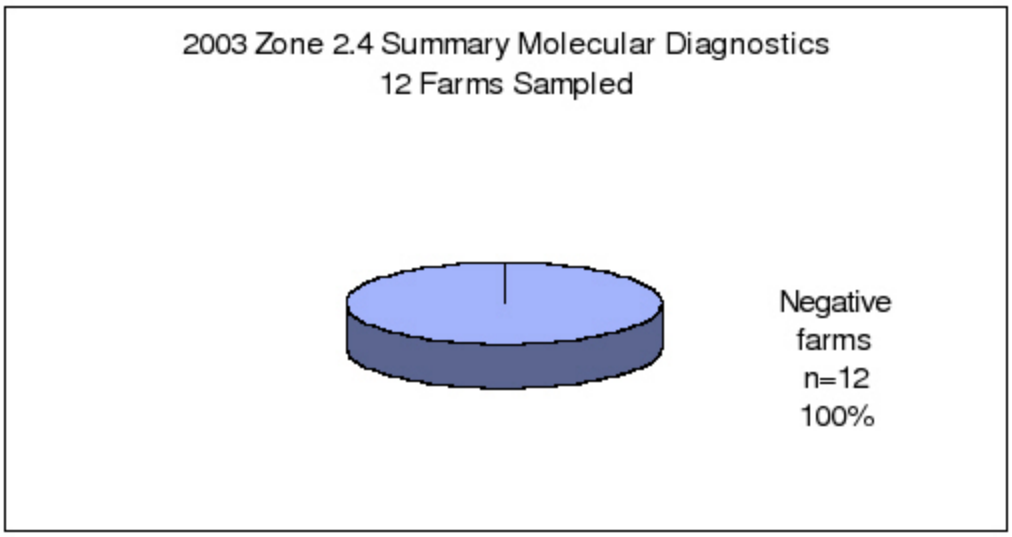
Table 2b: Molecular Testing Results for Sub Zone 2.4 (North West Vancouver Island) Atlantic Salmon Farm Audits 2004

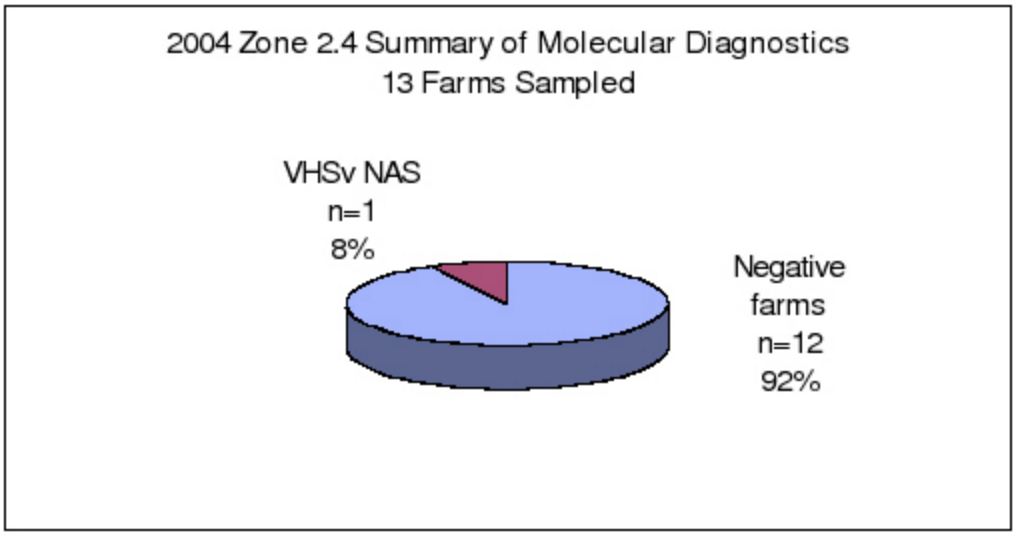
Quarter	# farms sampled	# fish sampled	Number of Molecular Tests					Positive Sites	Organism Identified
			IHNV	IPNV	ISAV	Ricket-tsia	VHSv-NAS		
1 Jan-Mar	4	28	7	7	7	7	7	0	None
2 Apr-Jun	4	31	8	8	8	8	8	0	None
3 Jul-Sep	2	23	5	5	5	5	5	1	VHSv NAS
4 Oct-Dec	3	6	4	4	4	4	4	0	None
Totals	13	88	24	24	24	24	24	1	

Table 2c: Molecular Testing Results for Sub Zone 2.4 (North West Vancouver Island) Atlantic Salmon Farm Audits 2005

Quarter	# farms sampled	# fish sampled	Number of Molecular Tests					Positive Sites	Organism Identified
			IHNV	IPNV	ISAV	Ricket-tsia	VHSv-NAS		
1 Jan-Mar	4	16	5	5	5	5	5	0	None
2 Apr-Jun	2	16	5	5	5	5	5	0	None
3 Jul-Sep	3	13	5	5	5	5	5	0	None
4 Oct-Dec	3	14	5	5	5	5	5	0	None
Totals	12	59	19	19	19	19	19	0	

Figure 2a – 2c: Summary of Molecular Diagnostics Findings from Sub Zone 2.4 Atlantic Salmon Farm Audits 2003 – 2005





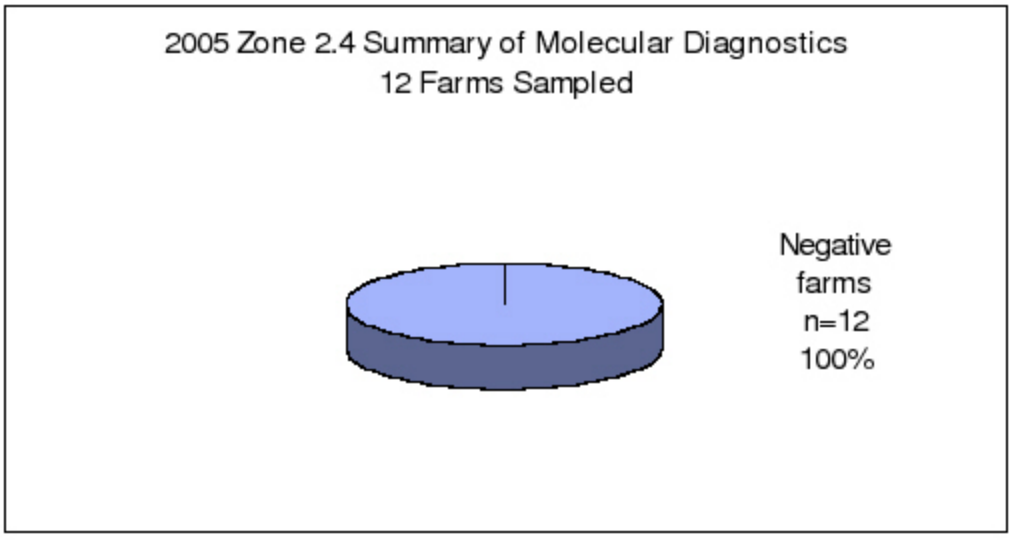


Table 3a: Molecular Testing Results for Sub Zone 3.1 (Sunshine Coast) Atlantic Salmon Farm Audits 2003

Quarter	# farms sampled	# fish sampled	Number of Molecular Tests					Positive Sites	Organism Identified
			IHNV	IPNV	ISAV	Ricket-tsia	VHSv-NAS		
1 Jan-Mar	0	0	0	0	0	0	0	0	None
2 Apr-Jun	2	5	2	2	2	2	2	0	None
3 Jul-Sep	1	2	1	1	1	1	1	0	None
4 Oct-Dec	0	0	0	0	0	0	0	0	None
Totals	3	7	3	3	3	3	3	0	

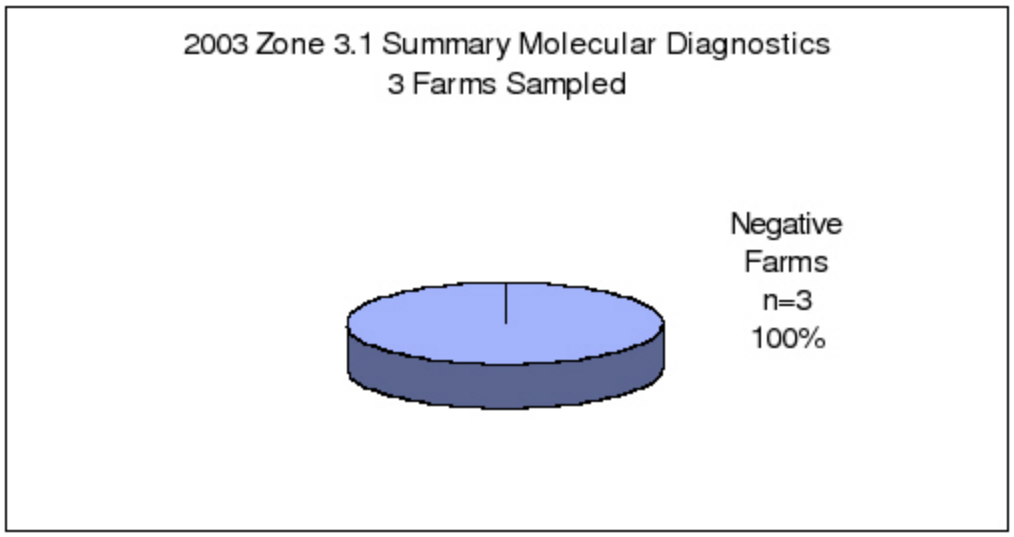
Table 3b: Molecular Testing Results for Sub Zone 3.1 (Sunshine Coast) Atlantic Salmon Farm Audits 2004

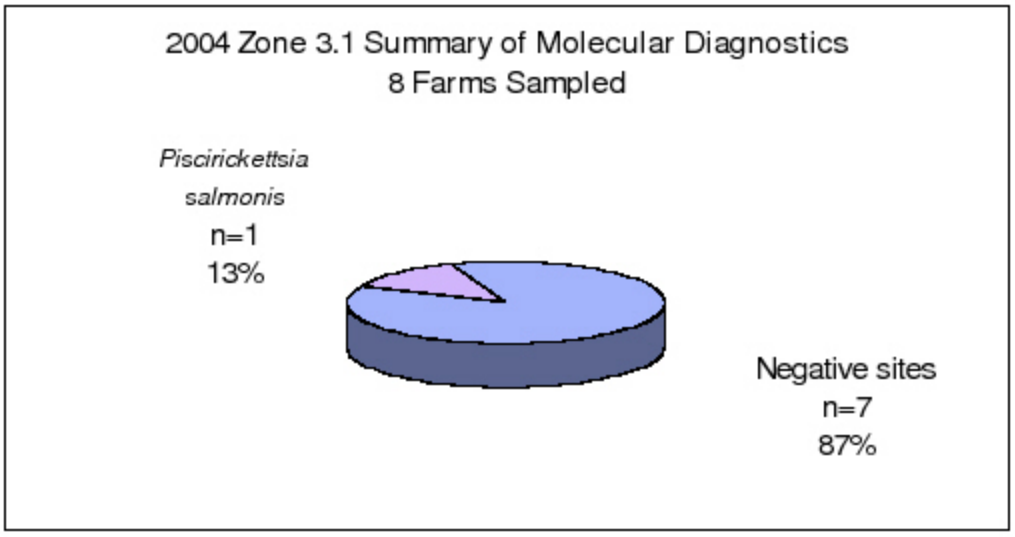
Quarter	# farms sampled	# fish sampled	Number of Molecular Tests					Positive Sites	Organism Identified
			IHNV	IPNV	ISAV	Ricket-tsia	VHSv-NAS		
1 Jan-Mar	1	3	1	1	1	1	1	0	None
2 Apr-Jun	3	11	4	4	4	4	4	0	None
3 Jul-Sep	3	10	4	4	4	4	4	0	None
4 Oct-Dec	1	6	2	2	2	2	2	1	*Piscirickettsia salmonis*
Totals	8	30	11	11	11	11	11	1	

Table 3c: Molecular Testing Results for Sub Zone 3.1 (Sunshine Coast) Atlantic Salmon Farm Audits 2005

Quarter	# farms sampled	# fish sampled	Number of Molecular Tests					Positive Sites	Organism Identified
			IHNV	IPNV	ISAV	Ricket tsia	VHSv-NAS		
1 Jan-Mar	2	3	2	2	2	2	2	0	None
2 Apr-Jun	3	12	5	5	5	5	5	1	*Piscirickettsia salmonis*
3 Jul-Sep	2	15	4	4	4	4	4	1	*Piscirickettsia salmonis*
4 Oct–Dec	0	0	0	0	0	0	0	0	None
Totals	7	30	11	11	11	11	11	2	

Figure 3a – 3c: Summary of Molecular Diagnostics Findings from Sub Zone 3.1 Atlantic Salmon Farm Audits 2003 – 2005





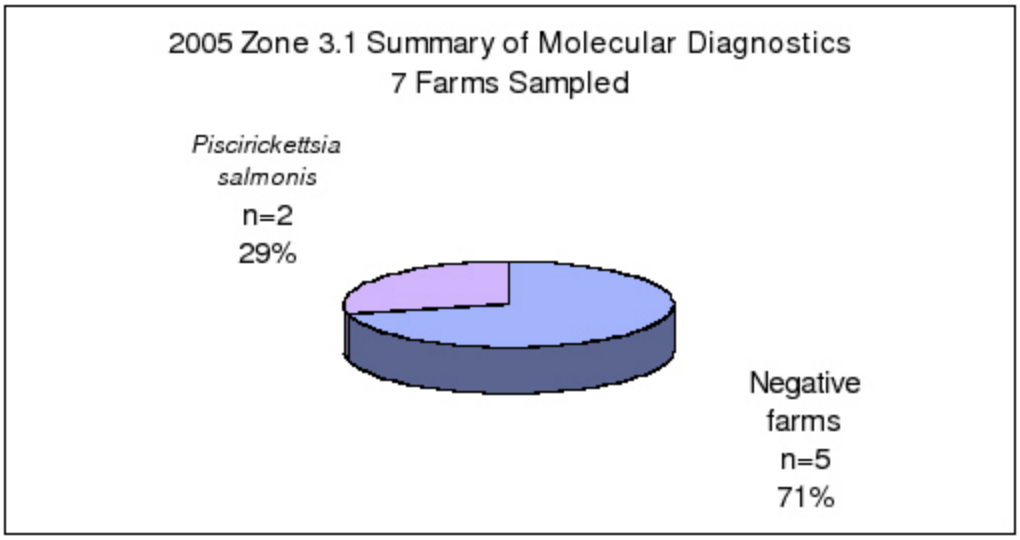


Table 4a : Molecular Testing Results for Sub Zone 3.2 (Campbell River) Atlantic Salmon Farm Audits 2003

Quarter	# farms sampled	# fish sampled	Number of Molecular Tests					Positive Sites	Organism Identified
			IHNV	IPNV	ISAV	Ricket -tsia	VHSv-NAS		
1 Jan-Mar	2	6	2	2	2	2	2	1	VHSv NAS
2 Apr-Jun	2	16	4	4	4	4	4	0	None
3 Jul-Sep	4	20	7	7	7	7	7	0	None
4 Oct–Dec	2	7	2	2	2	2	2	0	None
Totals	10	49	15	15	15	15	15	1	

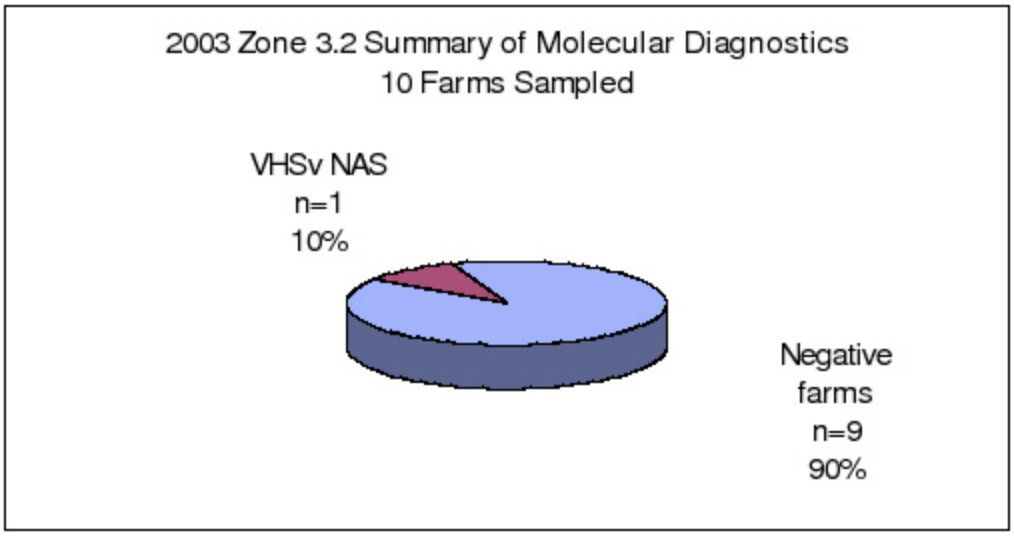
Table 4b: Molecular Testing Results for Sub Zone 3.2 (Campbell River) Atlantic Salmon Farm Audits 2004

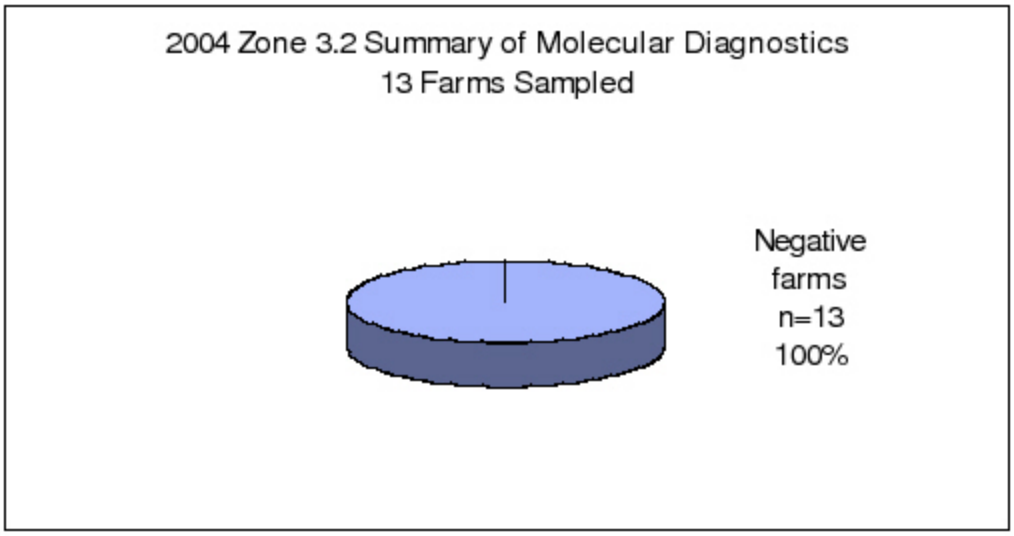
Quarter	# farms sampled	# fish sampled	Number of Molecular Tests					Positive Sites	Organism Identified
			IHNV	IPNV	ISAV	Ricket -tsia	VHSv-NAS		
1 Jan-Mar	2	11	11	11	11	11	11	0	None
2 Apr-Jun	2	20	11	11	11	11	11	0	None
3 Jul-Sep	4	31	8	8	8	8	8	0	None
4 Oct-Dec	5	24	10	10	10	10	10	0	None
Totals	13	86	50	50	50	50	50	0	

Table 4c: Molecular Testing Results for Sub Zone 3.2 (Campbell River) Atlantic Salmon Farm Audits 2005

Quarter	# farms sampled	# fish sampled	Number of Molecular Tests					Positive Sites	Organism Identified
			IHNV	IPNV	ISAV	Ricket -tsia	VHSv-NAS		
1 Jan-Mar	4	13	6	6	6	6	6	1	VHSv NAS
2 Apr-Jun	5	29	9	9	9	9	9	0	None
3 Jul-Sep	5	26	10	10	10	10	10	0	None
4 Oct-Dec	4	21	8	8	8	8	8	0	None
Totals	18	89	33	33	33	33	33	1	

Figure 4a–4c: Summary of Molecular Diagnostics Findings from Sub Zone 3.2 Atlantic Salmon Farm Audits 2003 – 2005





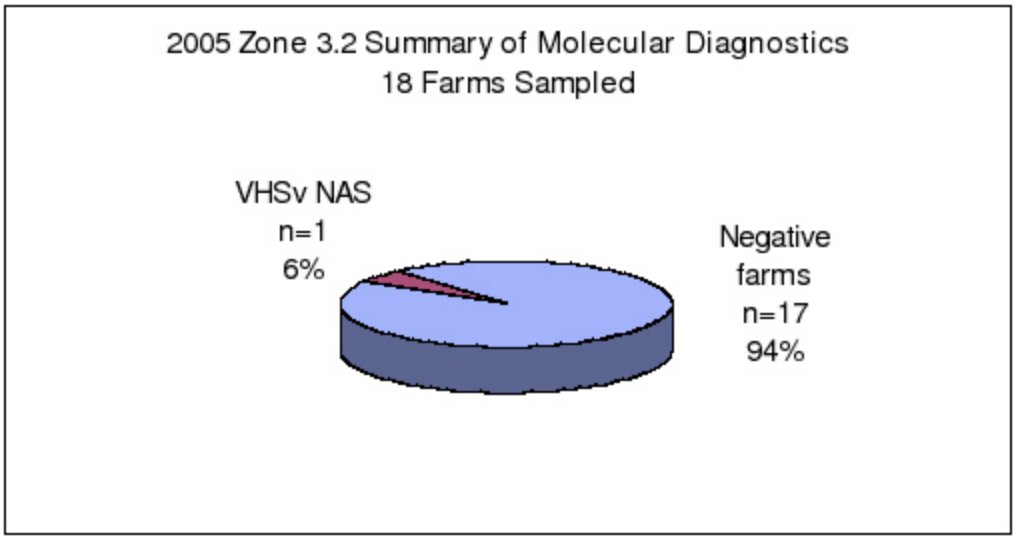


Table 5a: Molecular Testing Results for Sub Zone 3.3 (Broughton) Atlantic Salmon Farm Audits 2003

Quarter	# farms sampled	# fish sampled	Number of Molecular Tests					Positive Sites	Organism Identified
			IHNV	IPNV	ISAV	Ricket-tsia	VHSv-NAS		
1 Jan-Mar	5	37	10	10	10	10	10	1	VHSv NAS
2 Apr-Jun	4 (3)	20	5	5	5	5	5	0	None
3 Jul-Sep	5	26	9	9	9	9	9	0	None
4 Oct-Dec	5	31	9	9	9	9	9	0	None
Totals	19 (18)	114	33	33	33	33	33	1	

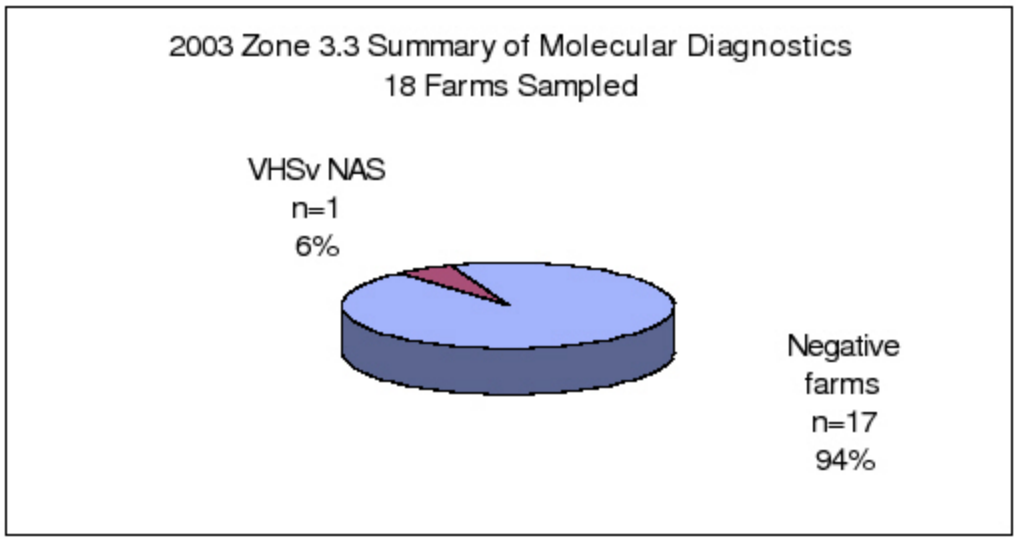
Table 5b: Molecular Testing Results for Sub Zone 3.3 (Broughton) Atlantic Salmon Farm Audits 2004

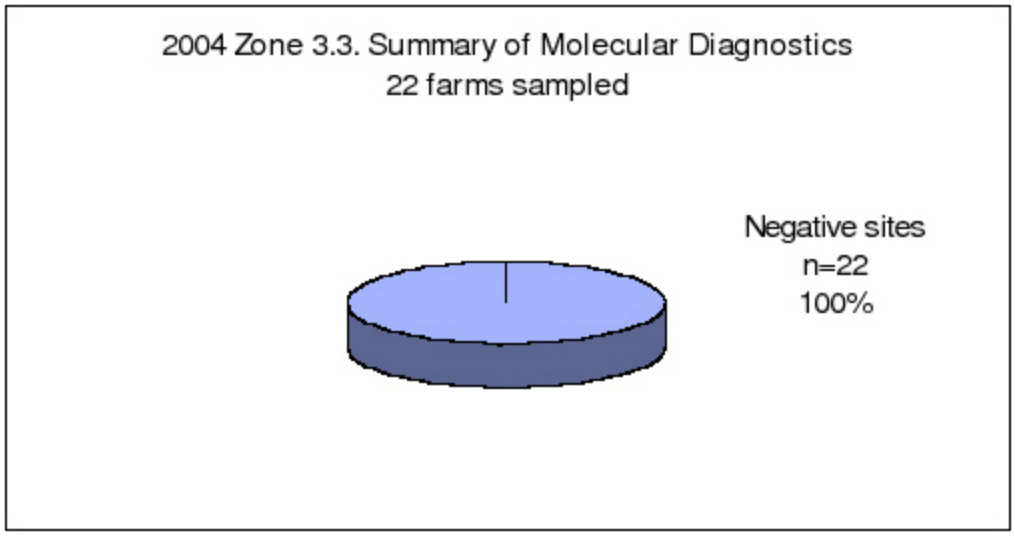
Quarter	# farms sampled	# fish sampled	Number of Molecular Tests					Positive Sites	Organism Identified
			IHNV	IPNV	ISAV	Ricket-tsia	VHSv-NAS		
1 Jan-Mar	6	44	12	12	12	12	12	0	None
2 Apr-Jun	6	36	12	12	12	12	12	0	None
3 Jul-Sep	5	27	9	9	9	9	9	0	None
4 Oct-Dec	5	32	8	8	8	8	8	0	None
Totals	22	139	41	41	41	41	41	0	

Table 5c: Molecular Testing Results for Sub Zone 3.3 (Broughton) Atlantic Salmon Farm Audits 2005

Quarter	# farms sampled	# fish sampled	Number of Molecular Tests					Positive Sites	Organism Identified
			IHNV	IPNV	ISAV	Ricket-tsia	VHSv-NAS		
1 Jan-Mar	5	31	8	8	8	8	8	0	None
2 Apr-Jun	7	49	13	13	13	13	13	0	None
3 Jul-Sep	6	39	13	13	13	13	13	1	*Piscirickettsia salmonis*
4 Oct-Dec	6	33	11	11	11	11	11	1	*Piscirickettsia salmonis*
Totals	24	152	45	45	45	45	45	2	

Figure 5a–5c: Summary of Molecular Diagnostics Findings from Sub Zone 3.3 Atlantic Salmon Farm Audits 2003 – 2005





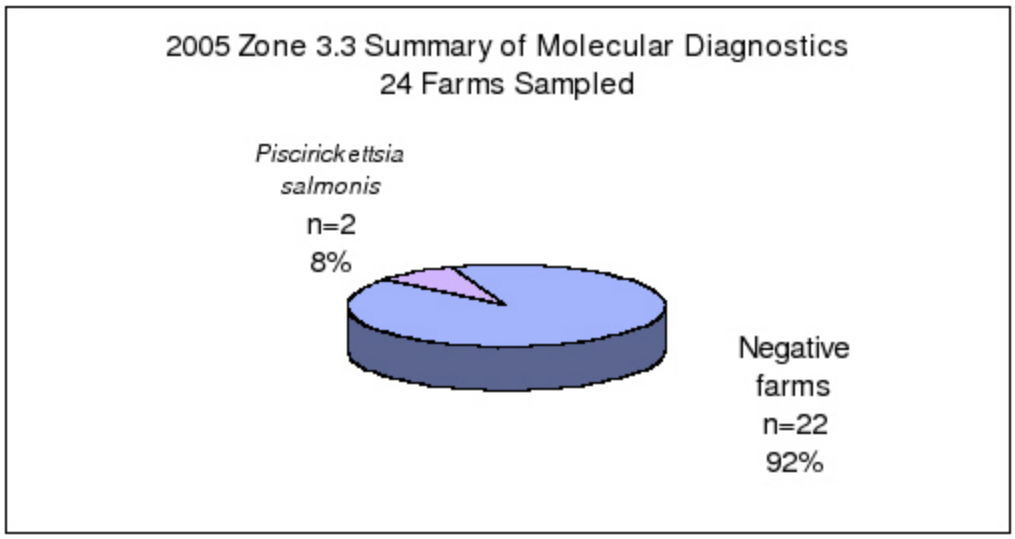


Table 6a: Molecular Testing Results for Sub Zone 3.4 (Port Hardy) Atlantic Salmon Farm Audits 2003

Quarter	# farms sampled	# fish sampled	Number of Molecular Tests					Positive Sites	Organism Identified
			IHNV	IPNV	ISAV	Ricket -tsia	VHSv NAS		
1 Jan-Mar	3	27	7	7	7	7	7	1	IHNv
2 Apr-Jun	3	22	6	6	6	6	6	1	IHNv
3 Jul-Sep	3	20	6	6	6	6	6	0	None
4 Oct-Dec	2	15	4	4	4	4	4	0	None
Totals	11	84	23	23	23	23	23	2	

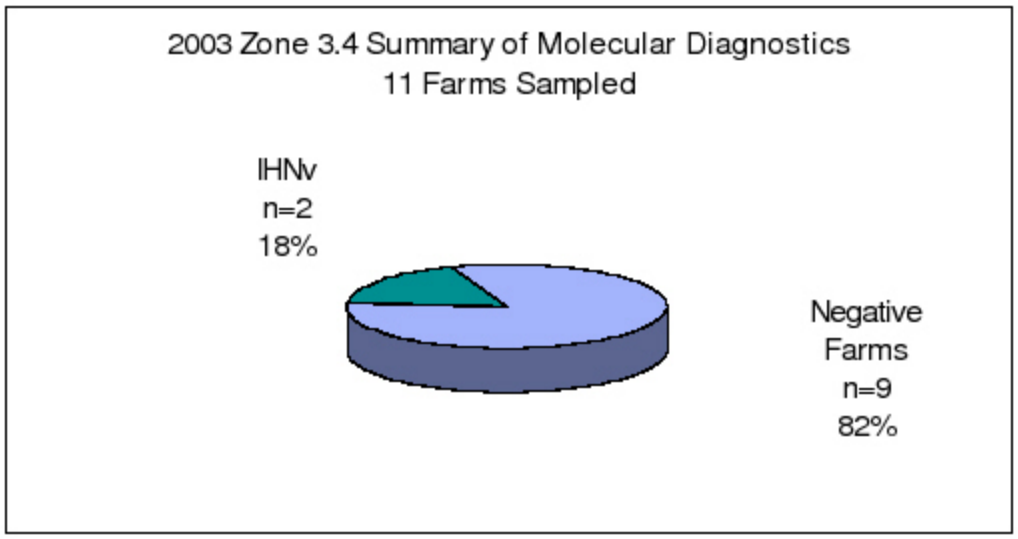
Table 6b: Molecular Testing Results for Sub Zone 3.4 (Port Hardy) Atlantic Salmon Farm Audits 2004

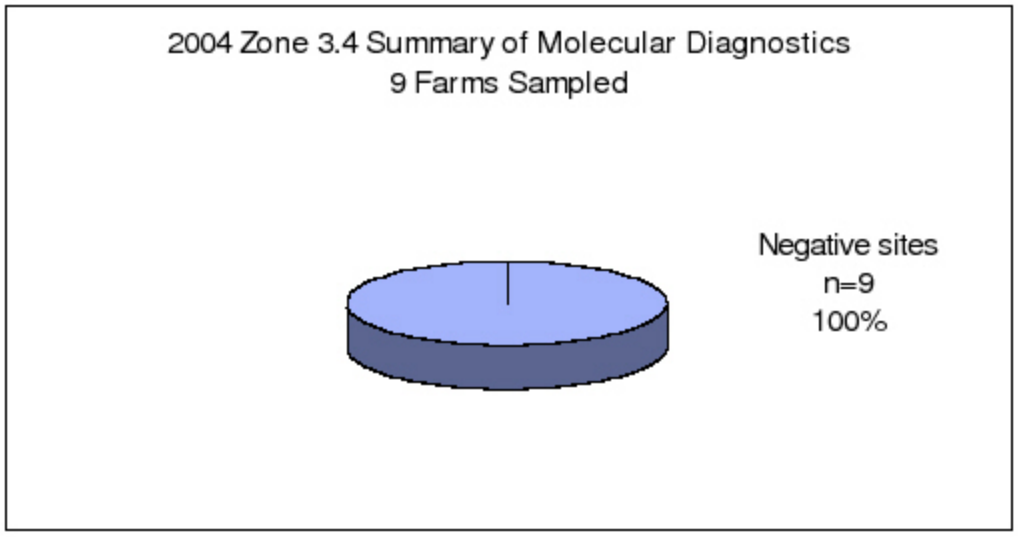
Quarter	# farms sampled	# fish sampled	Number of Molecular Tests					Positive Sites	Organism Identified
			IHNV	IPNV	ISAV	Ricket -tsia	VHSv NAS		
1 Jan-Mar	1	8	2	2	2	2	2	0	None
2 Apr-Jun	2	10	4	4	4	4	4	0	None
3 Jul-Sep	3	13	6	6	6	6	6	0	None
4 Oct-Dec	3	7	3	3	3	3	3	0	None
Totals	9	38	15	15	15	15	15	0	

Table 6c: Molecular Testing Results for Sub Zone 3.4 (Port Hardy) Atlantic Salmon Farm Audits 2005

Quarter	# farms sampled	# fish sampled	Number of Molecular Tests					Positive Sites	Organism Identified
			IHNV	IPNV	ISAV	Ricket -tsia	VHSv NAS		
1 Jan-Mar	2	4	2	2	2	2	2	0	None
2 Apr-Jun	2	5	2	2	2	2	2	0	None
3 Jul-Sep	3	17	7	7	7	7	7	0	None
4 Oct-Dec	4 (3)	21	6	6	6	6	6	0	None
Totals	11 (10)	47	17	17	17	17	17	0	

Figure 6a – 6c: Summary of Molecular Diagnostics Findings from Sub Zone 3.4 Atlantic Salmon Farm Audits 2003 – 2005





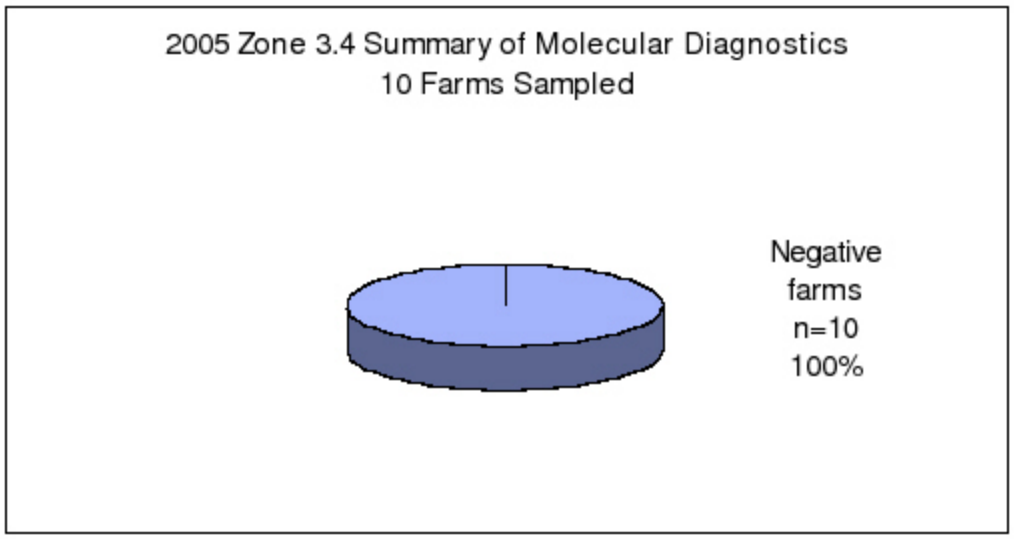


Table 7a: Molecular Testing Results for Sub Zone 3.5 (North Coast) Atlantic Salmon Farm Audits 2003

Quarter	# farms sampled	# fish sampled	Number of Molecular Tests					Positive Sites	Organism Identified
			IHNV	IPNV	ISAV	Ricket -tsia	VHSv NAS		
1 Jan-Mar	0	0	0	0	0	0	0	0	None
2 Apr-Jun	0	0	0	0	0	0	0	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	0	0	0	0	0	0	0	0	

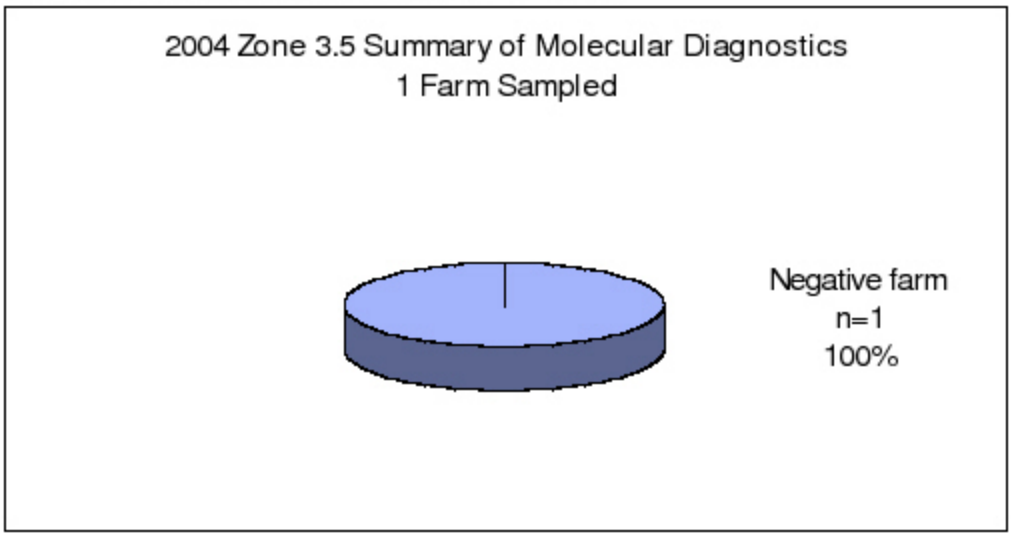
Table 7b: Molecular Testing Results for Sub Zone 3.5 (North Coast) Atlantic Salmon Farm Audits 2004

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

Table 7c: Molecular Testing Results for Sub Zone 3.5 (North Coast) Atlantic Salmon Farm Audits 2005

Quarter	# farms sampled	# fish sampled	Number of Molecular Tests					Positive Sites	Organism Identified
			IHNV	IPNV	ISAV	Ricket -tsia	VHSv-NAS		
1 Jan-Mar	1 (0)	0	0	0	0	0	0	0	None
2 Apr-Jun	1	4	2	2	2	2	2	0	None
3 Jul-Sep	1	5	2	2	2	2	2	0	None
4 Oct-Dec	0	0	0	0	0	0	0	0	None
Totals	3 (2)	9	4	4	4	4	4	0	

Figure 7a–7c: Summary of Molecular Diagnostics Findings from Sub Zone 3.5 Atlantic salmon Farm Audits 2003 – 2005



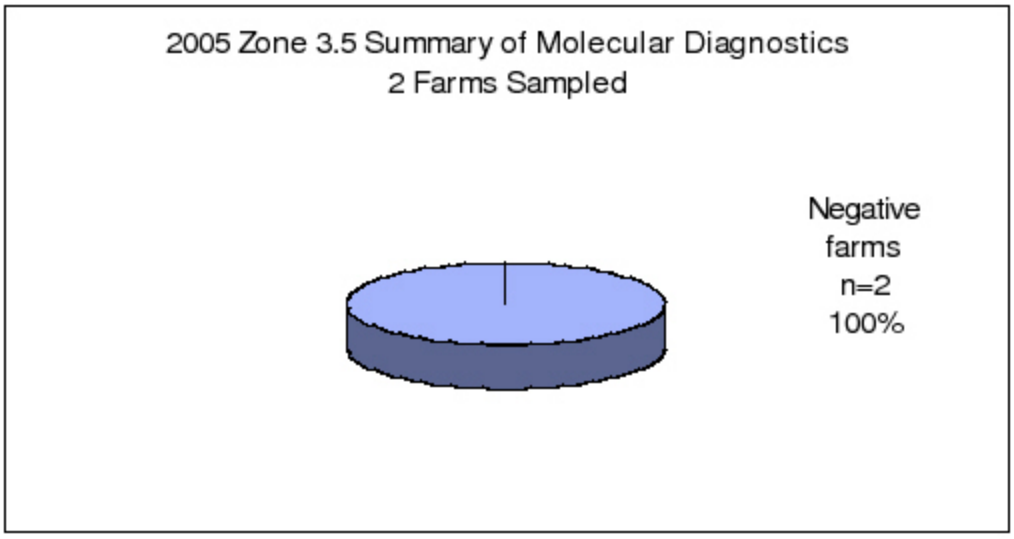


Table 8a: Molecular Testing Results for Zone 2 (West of Vancouver Island) Pacific Salmon Farm Audits 2003

Quarter	# farms sampled	# fish sampled	Number of Molecular Tests					Positive Sites	Organism Identified
			IHNV	IPNV	ISAV	Ricket-tsia	VHSv-NAS		
1 Jan-Mar	2	10	3	3	3	3	3	0	None
2 Apr-Jun	4	27	6	6	6	6	6	0	None
3 Jul-Sep	4 (3)	16	5	5	5	5	5	0	None
4 Oct-Dec	5	20	7	7	7	7	7	3	*Piscirickettsia salmonis*
Totals	15 (14)	73	21	21	21	21	21	3	

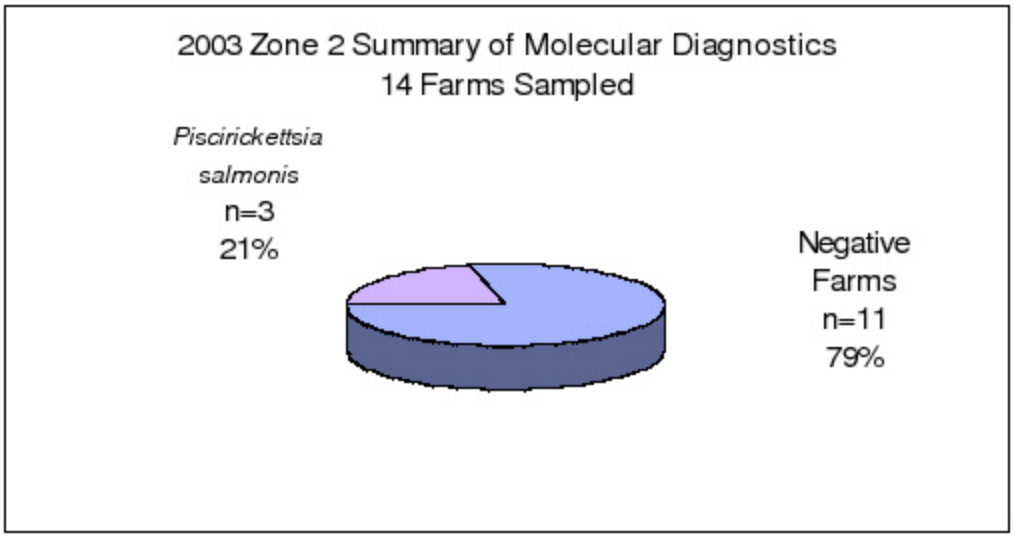
Table 8b: Molecular Testing Results for Zone 2 (West Coast of Vancouver Island) Pacific Salmon Farm Audits 2004

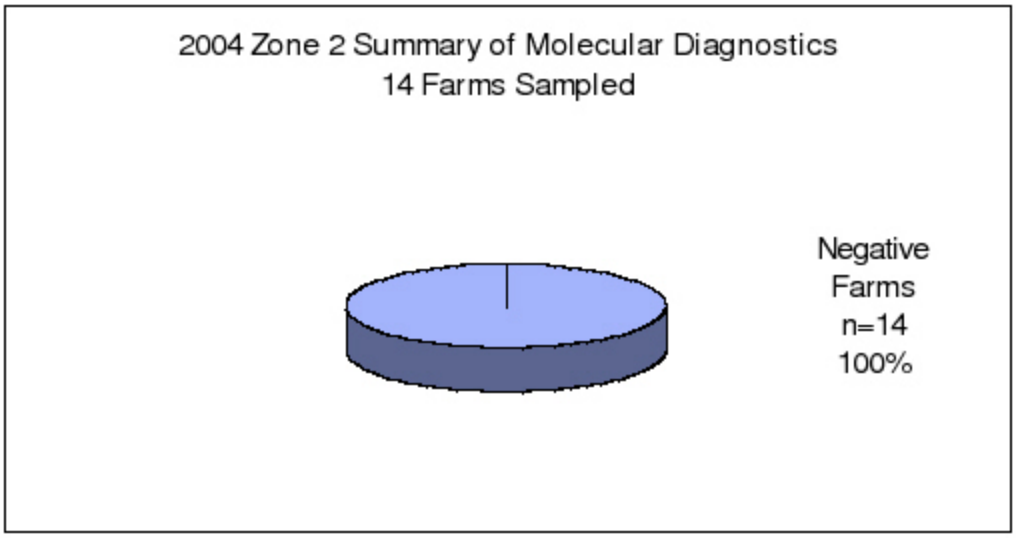
Quarter	# farms sampled	# fish sampled	Number of Molecular Tests					Positive Sites	Organism Identified
			IHNV	IPNV	ISAV	Ricket-tsia	VHSv-NAS		
1 Jan-Mar	5	38	10	10	10	10	10	0	None
2 Apr-Jun	4	21	5	5	5	5	5	0	None
3 Jul-Sep	2	14	4	4	4	4	4	0	None
4 Oct-Dec	3	4	2	2	2	2	2	0	None
Totals	14	77	21	21	21	21	21	0	

Table 8c: Molecular Testing Results for Zone 2 (West Coast of Vancouver Island) Pacific Salmon Farm Audits 2005

Quarter	# farms sampled	# fish sampled	Number of Molecular Tests					Positive Sites	Organism Identified
			IHNV	IPNV	ISAV	Ricket-tsia	VHS-NAs		
1 Jan-Mar	3	17	6	6	6	6	6	1	VHSv NAS
2 Apr-Jun	1	5	2	2	2	2	2	0	None
3 Jul-Sep	1	3	1	1	1	1	1	0	None
4 Oct-Dec	2	8	4	4	4	4	4	0	None
Totals	7	33	13	13	13	13	13	1	

Figure 8a–8c: Summary of Molecular Diagnostics Findings from Zone 2 Pacific Salmon Farm Audits 2003 – 2005





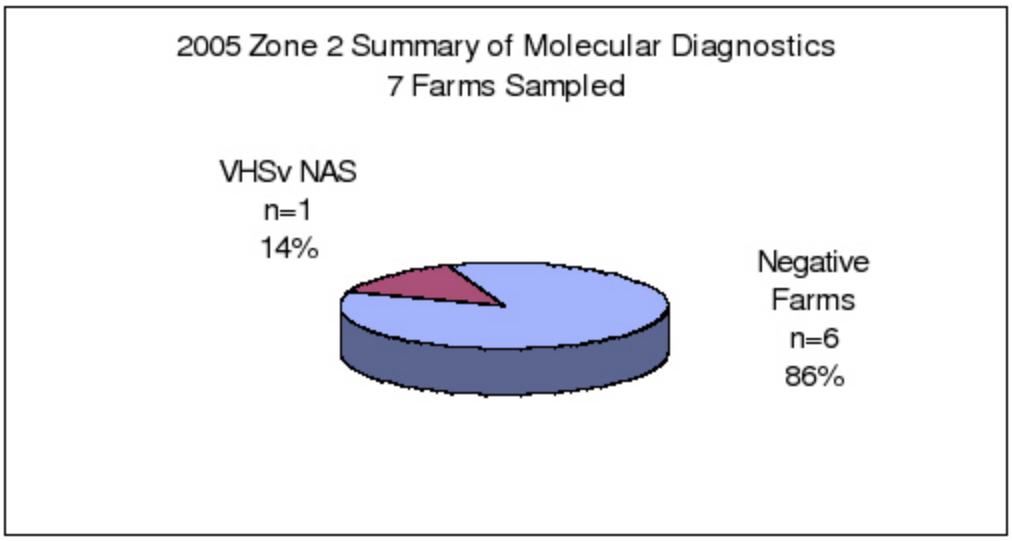


Table 9a: Molecular Testing Results for Zone 3 (East Coast of Vancouver Island) Pacific Salmon Farm Audits 2003

Quarter	# farms sampled	# fish sampled	Number of Molecular Tests					Positive Sites	Organism Identified
			IHNV	IPNV	ISAV	Ricket-tsia	VHSv-NAS		
1 Jan-Mar	4	28	8	8	8	8	8	0	None
2 Apr-Jun	5	44	11	11	11	11	11	0	None
3 Jul-Sep	6	42	13	13	13	13	13	0	None
4 Oct-Dec	8 (7)	38	13	13	13	13	13	0	None
Totals	23 (22)	152	45	45	45	45	45	0	

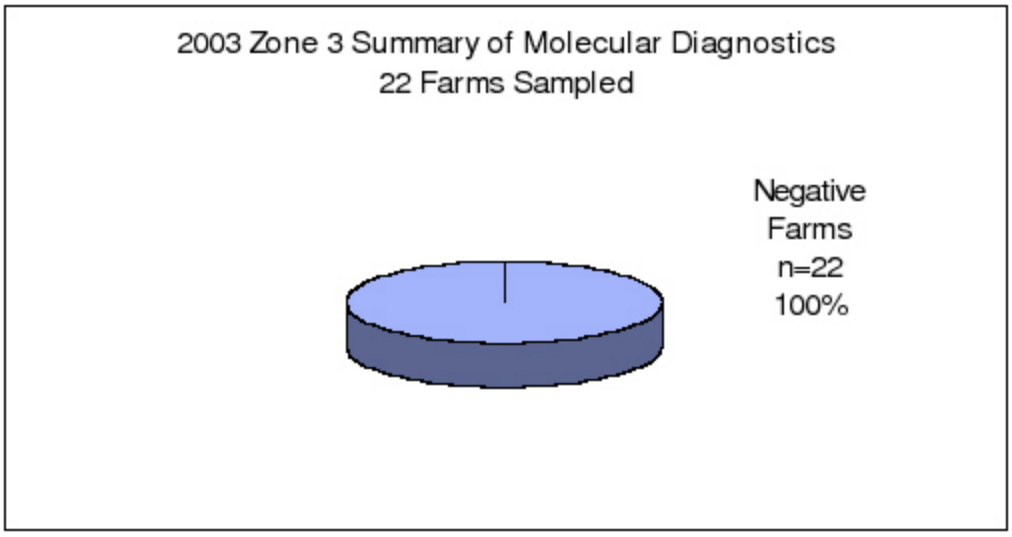
Table 9b: Molecular Testing Results for Zone 3 (East Coast of Vancouver Island) Pacific Salmon Farm Audits 2004

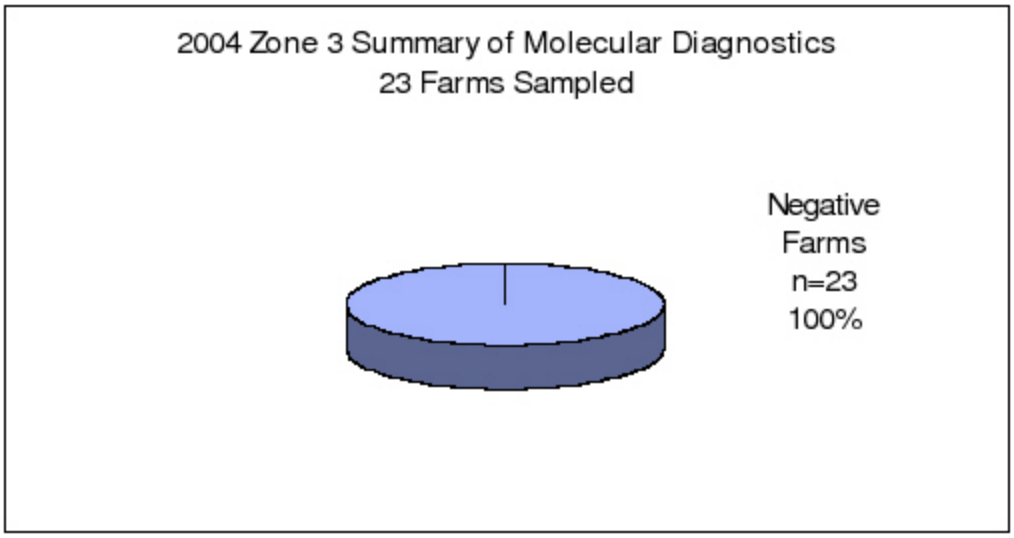
Quarter	# farms sampled	# fish sampled	Number of Molecular Tests					Positive Sites	Organism Identified
			IHNV	IPNV	ISAV	Ricket-tsia	VHSv-NAS		
1 Jan-Mar	6	34	10	10	10	10	10	0	None
2 Apr-Jun	6	44	21	21	21	21	21	0	None
3 Jul-Sep	6	22	7	7	7	7	7	0	None
4 Oct-Dec	5	41	11	12	12	12	12	0	None
Totals	23	141	49	49	49	49	49	0	

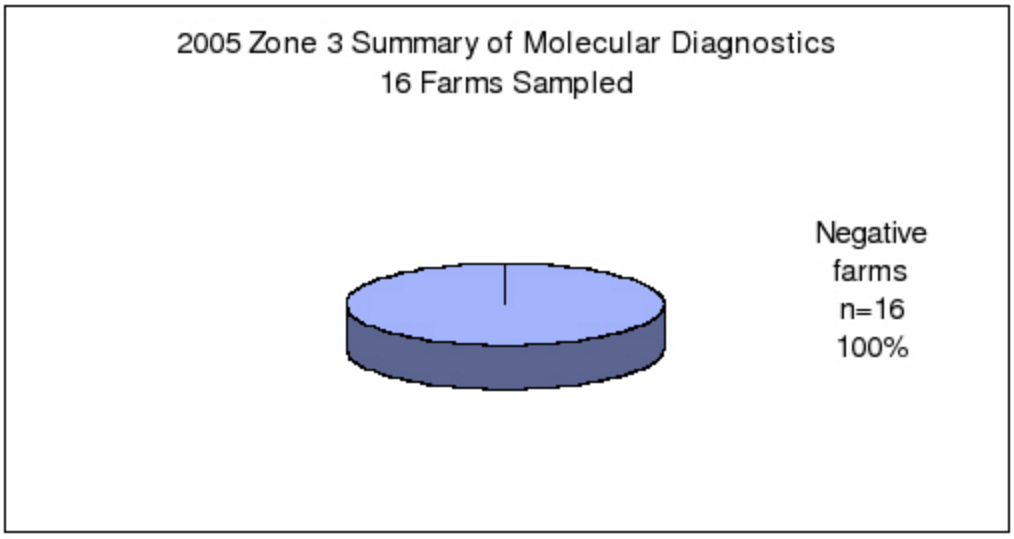
Table 9c: Molecular Testing Results for Zone 3 (East Coast of Vancouver Island) Pacific Salmon Farm Audits 2005

Quarter	# farms sampled	# fish sampled	Number of Molecular Tests					Positive Sites	Organism Identified
			IHNV	IPNV	ISAV	Ricket-tsia	VHSv-NAS		
1 Jan-Mar	5	41	11	11	11	11	11	0	None
2 Apr-Jun	4	26	7	7	7	7	7	0	None
3 Jul-Sep	5	21	7	7	7	7	7	0	None
4 Oct-Dec	2	12	4	4	4	4	4	0	None
Totals	16	100	29	29	29	29	29	0	

Figure 9a–9c: Summary of Molecular Diagnostics Findings from Zone 3 Pacific Salmon Farm Audits 2003 – 2005







7.6 Appendix 6:

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): 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 histopathological lesions consistent with VHSv infection.

7.7 APPENDIX 7:

Farm Level Diagnoses for All Zones/Sub Zones by Calendar Quarter and Fish Species 2003 – 2005

Table 1a: 2003 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	4	2	No Infectious Disease
		1	IHN
		1	Mouth Myxobacteriosis
2 Apr – June	5	5	No Infectious Disease
3 July – Sept	4	3	No Infectious Disease
		1	Furunculosis
4 Oct - Dec	3	2	No Infectious Disease
		1	Furunculosis

Table 1b: 2004 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	4	3	No Infectious Disease
		1	VHS (North American Strain – Genotype IV)
2 Apr – June	3	2	Mouth Myxobacteriosis
		1	VHS (North American Strain, genotype IV)
3 July – Sept	3	2	No Infectious Disease
		1	VHS (North American Strain, genotype IV)
		1	Mouth Myxobacteriosis
4 Oct - Dec	3	2	Rickettsiosis
		1	No Infectious Disease

Table 1c: 2005 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	4	3	VHS (North American Strain, genotype IV)
		1	No Infectious Disease
2 Apr – June	4	3	No Infectious Disease
		1	VHS (North American Strain, genotype IV)
3 July – Sept	4	4	No Infectious Disease
4 Oct - Dec	3	2	Rickettsiosis
		1	No Infectious Disease

Figure 1a – 1d: Diagnoses from Sub Zone 2-3 (South West Vancouver Island) 2003 Atlantic Salmon Farm Audits

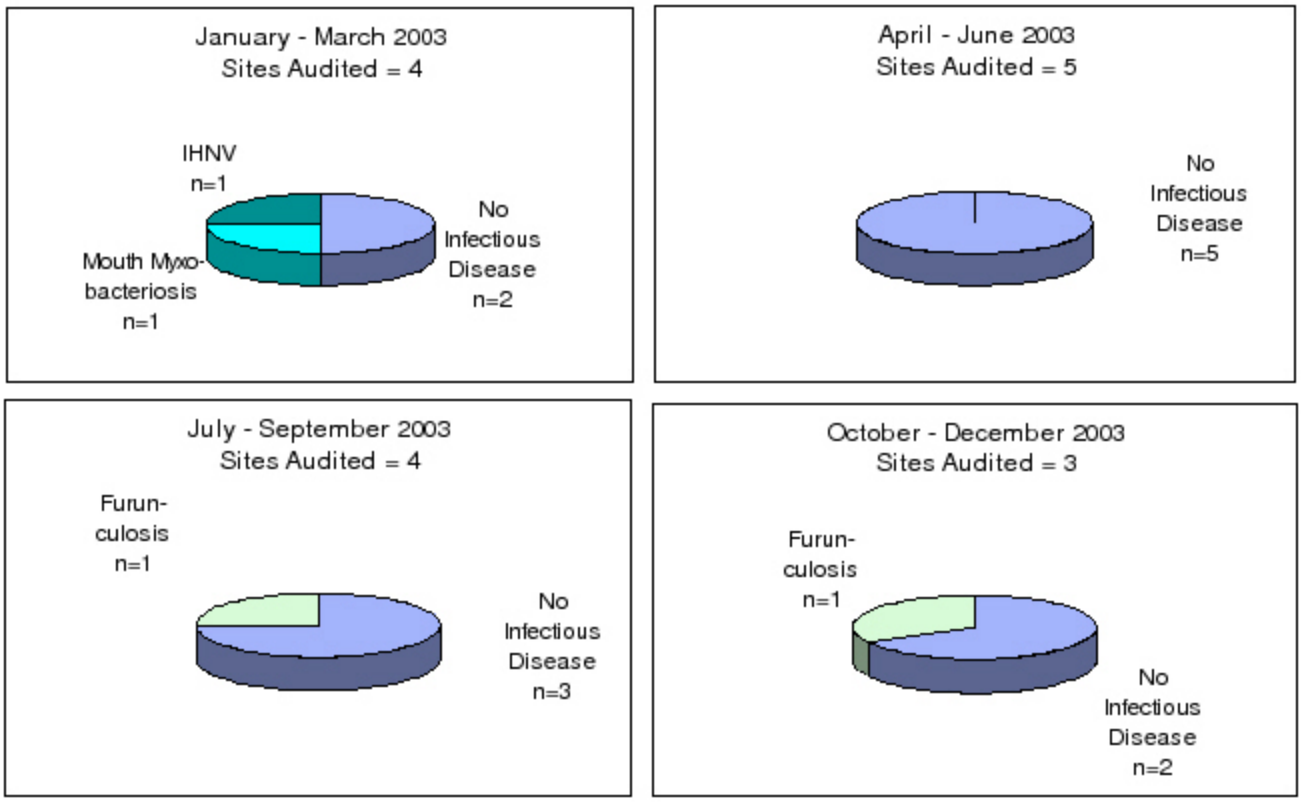


Figure 1e – 1h: Diagnoses from Sub Zone 2-3 (South West Vancouver Island) 2004 Atlantic Salmon Farm Audits

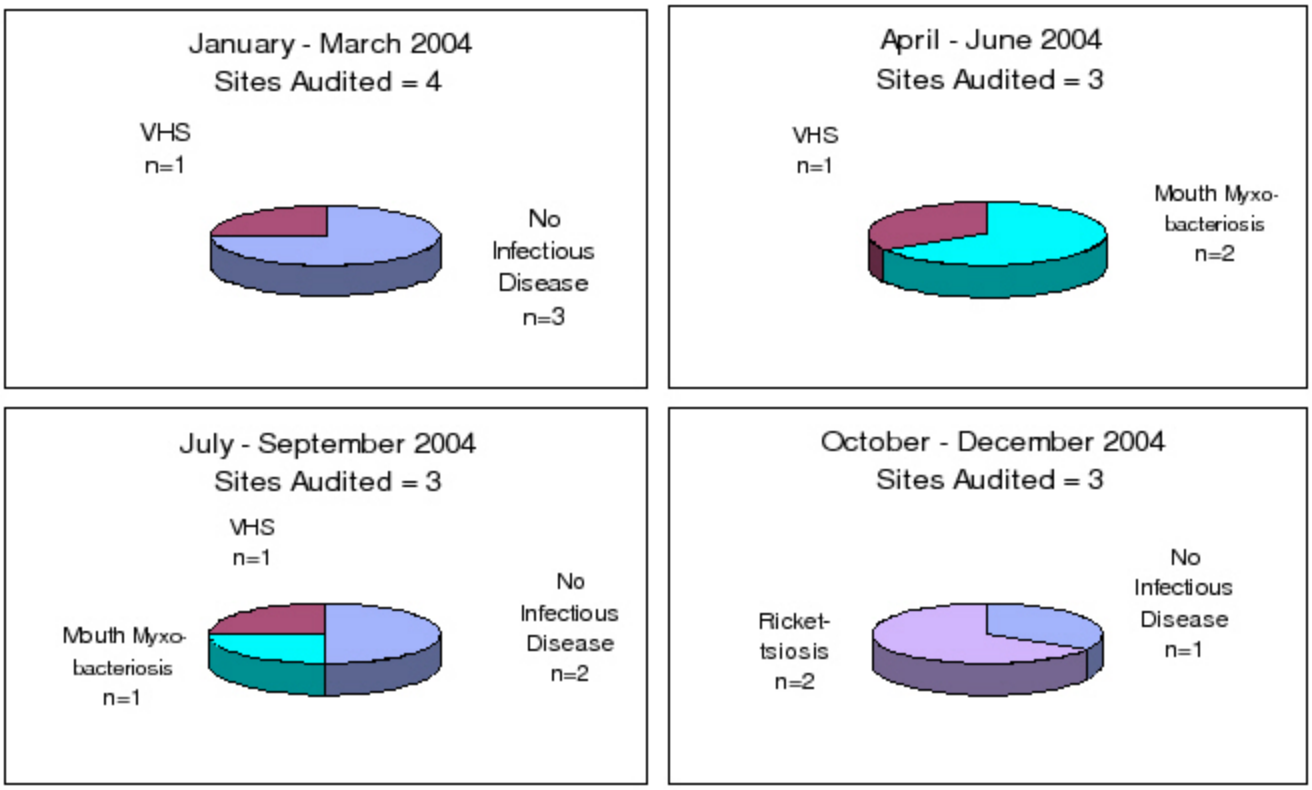


Figure 1i – 1l: Diagnoses from Sub Zone (South West Vancouver Island) Atlantic Salmon Farms 2005

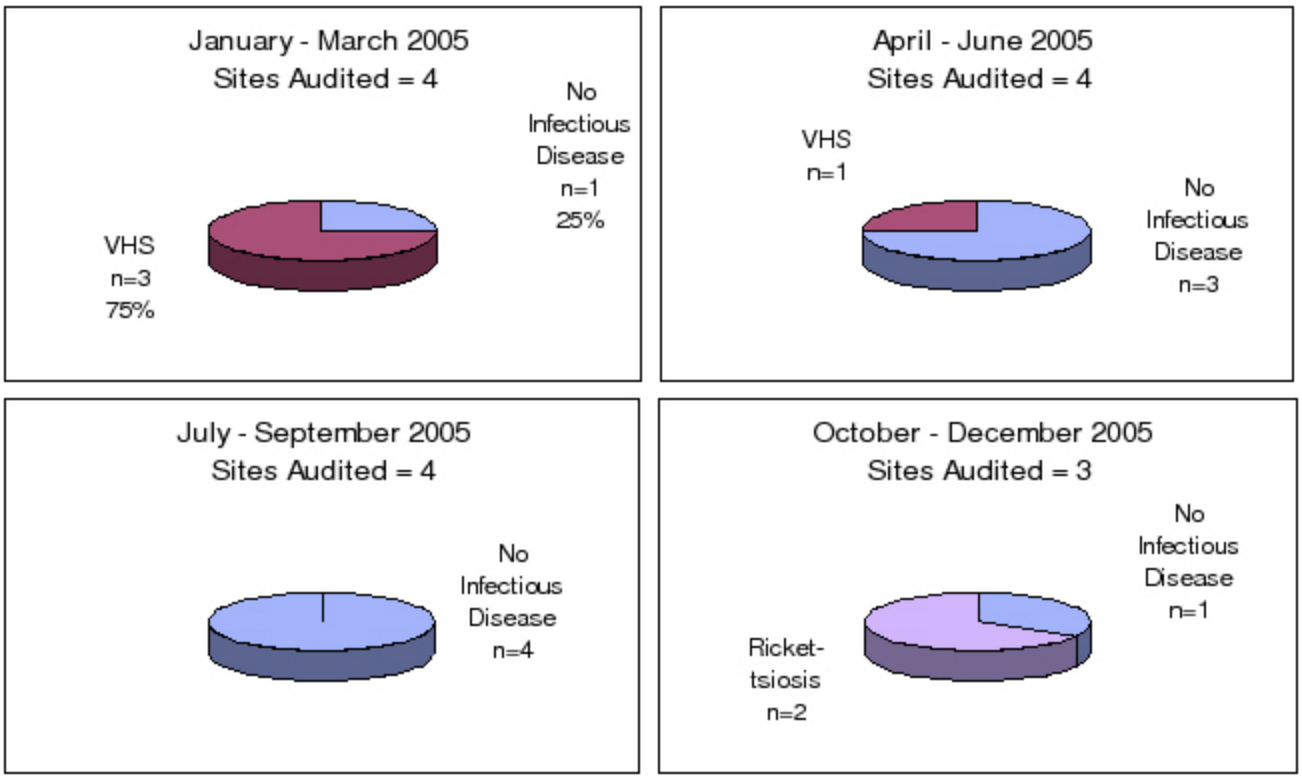


Table 2a: 2003 Diagnoses from Sub Zone 2.4 (North West Vancouver Island) Atlantic Salmon Farm Audits			
Quarter	Number of Farms Audited	Number of Cases	Farm Level Diagnosis
1 Jan - Mar	3	1	Mouth Myxobacteriosis
		1	No Infectious Disease
		1	Septicaemia
2 Apr – June	4	3	No Infectious Disease
		1	Furunculosis
3 July – Sept	3	3	No Infectious Disease
4 Oct - Dec	3	2	No Infectious Disease
		1	Furunculosis

Table 2b: 2004 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	4	4	No Infectious Disease
2 Apr – June	4	4	No Infectious Disease
3 July – Sept	2	1	No Infectious Disease
		1	VHS (North American Strain, genotype IV)
4 Oct - Dec	3	3	No Infectious Disease

Table 2c: 2005 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	4	3	No Infectious Disease
		1	Mouth Myxobacteriosis
2 Apr – June	2	2	No Infectious Disease
3 July – Sept	3	2	No Infectious Disease
		1	Mouth Myxobacteriosis
4 Oct - Dec	3	3	No Infectious Disease

Figure 2a – 2d: Diagnoses from Sub Zone 2.4 (North West Vancouver Island) Atlantic Salmon Farms Audits 2003

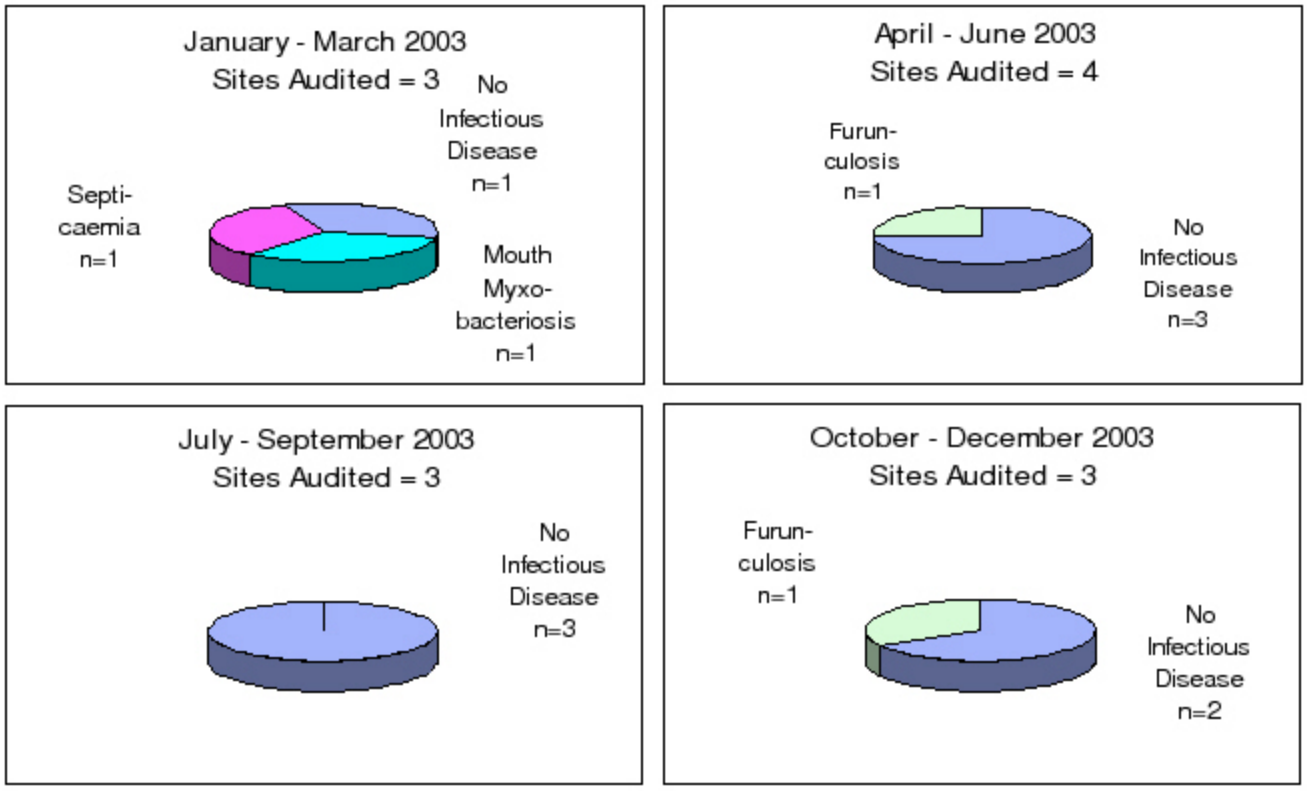


Figure 2e – 2h: Diagnoses from Sub Zone 2.4 (North West Vancouver Island) Atlantic Salmon Farms 2004

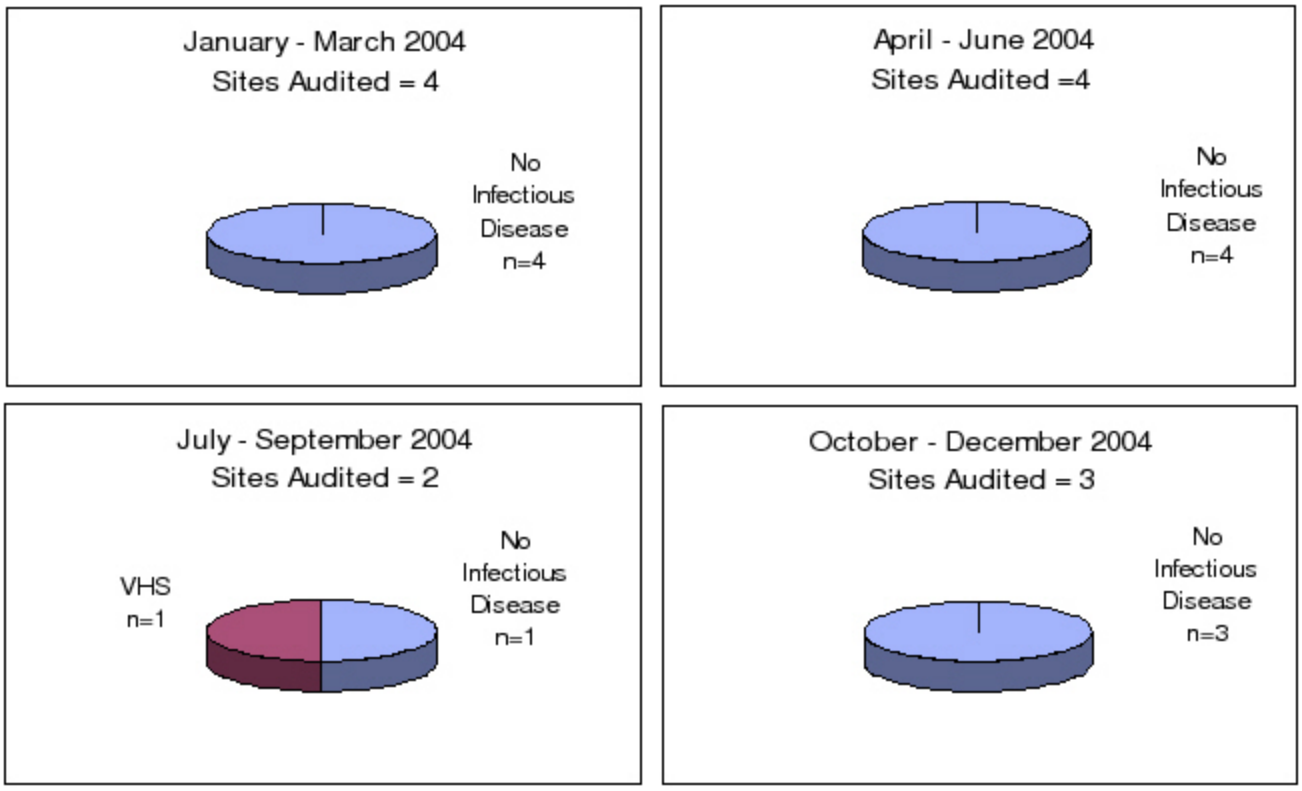


Figure 2i – 2l: Diagnoses from Sub Zone 2.4 (North West Vancouver Island) Atlantic Salmon Farm Audits 2005

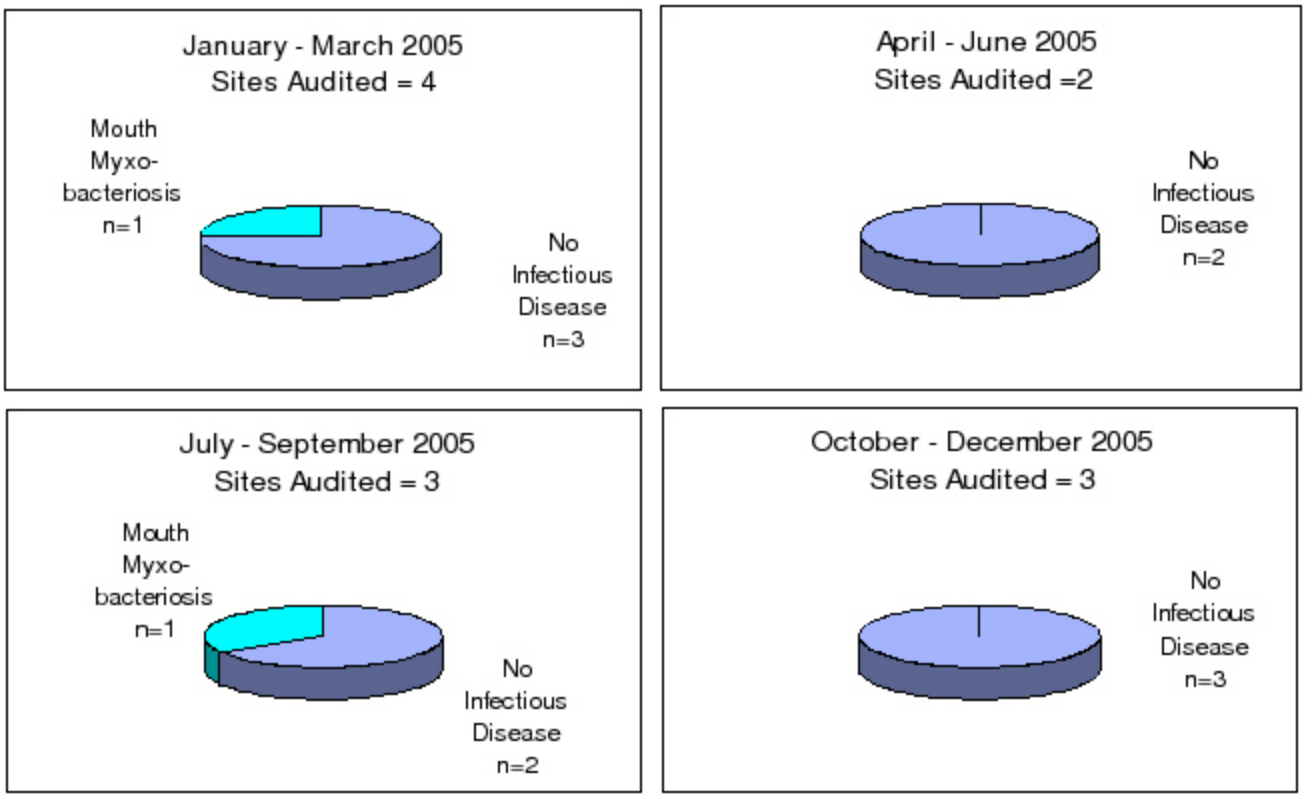


Table 3a: 2003 Diagnoses from Sub Zone 3.1 (Sunshine Coast) Atlantic Salmon Farm Audits			
Quarter	Number of Farms Audited	Number of Cases	Farm Level Diagnosis
1 Jan - Mar	0	0	Not applicable
2 Apr – June	2	2	No Infectious Disease
3 July – Sept	1	1	No Infectious Disease
4 Oct - Dec	0	0	Not Applicable

Table 3b: 2004 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	1	1	No Infectious Disease
2 Apr – June	3	2	No Infectious Disease
		1	Bacterial Kidney Disease
3 July – Sept	3	3	No Infectious Disease
4 Oct - Dec	1	1	Rickettsiosis

Table 3c: 2005 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	3	2	No Infectious Disease
		1	Rickettsiosis
3 July – Sept	2	1	No Infectious Disease
		1	Rickettsiosis
4 Oct - Dec	0	0	Not applicable

Figure 3a – 3b: Diagnoses from Sub Zone 3.1 (Sunshine Coast) Atlantic Salmon Farm Audits 2003

Figure 3c – 3f: Diagnoses from Sub Zone 3.1 (Sunshine Coast) Atlantic Salmon Farm Audits 2004

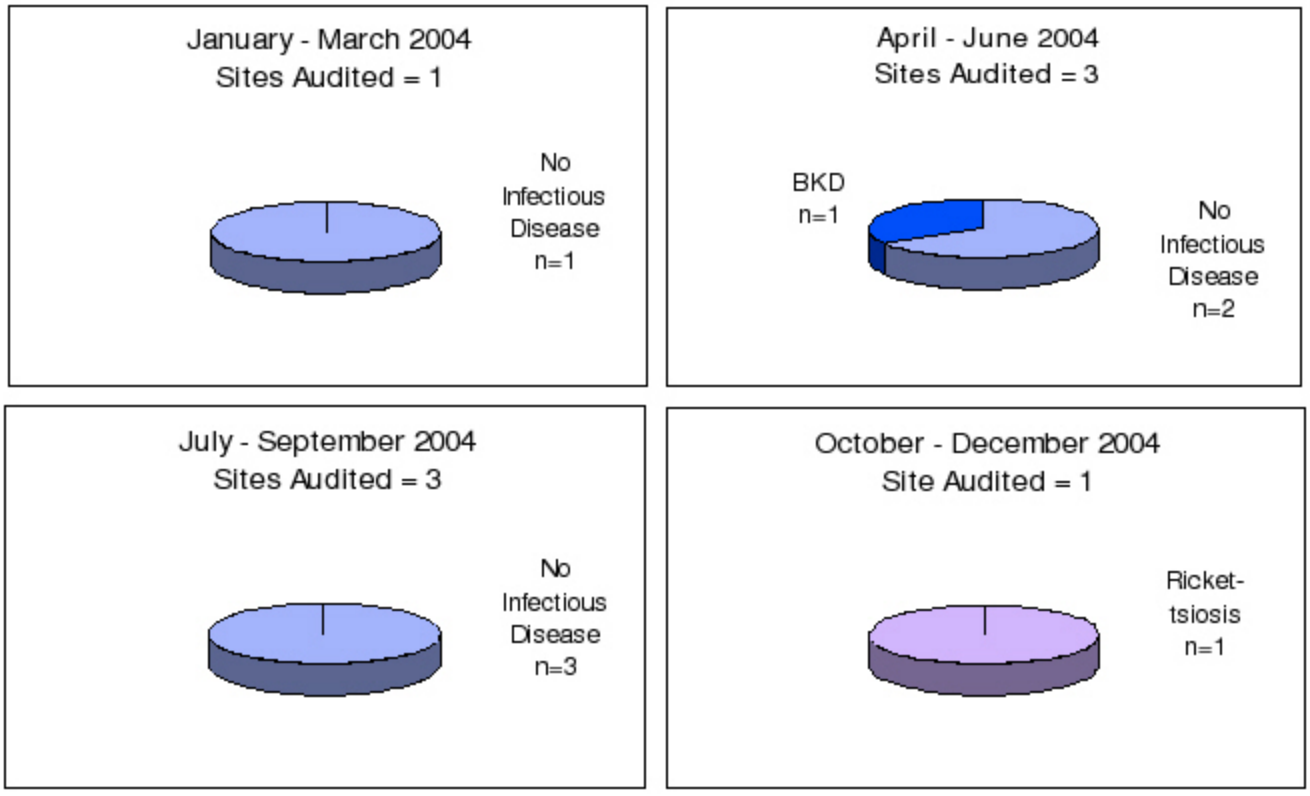
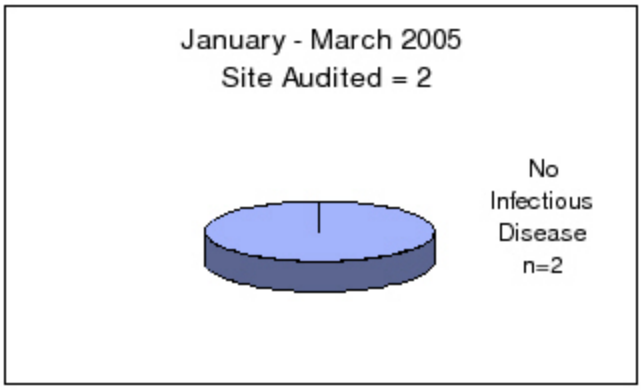
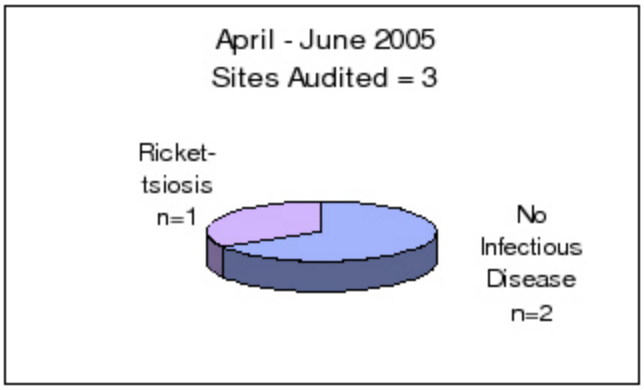


Figure 3g – 3i: Diagnoses from Sub Zone 3.1 (Sunshine Coast) Atlantic Salmon Farm Audits 2005





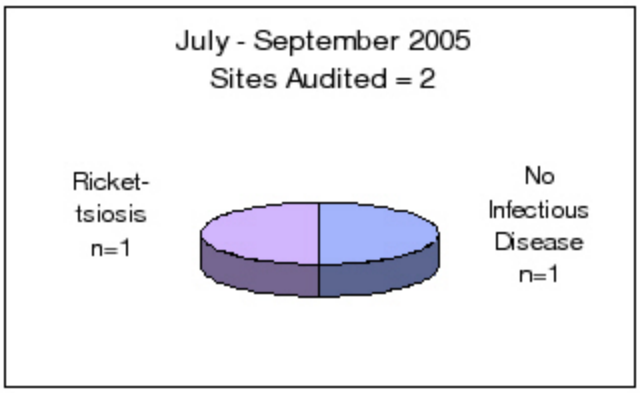


Table 4a: 2003 Diagnoses from Sub Zone 3.2 (Campbell River) Atlantic Salmon Farm Audits			
Quarter	Number of Farms Audited	Number of Cases	Farm Level Diagnosis
1 Jan - Mar	2	2	No Infectious Disease
2 Apr – June	2	2	No Infectious Disease
3 July – Sept	4	4	No Infectious Disease
4 Oct - Dec	2	2	No Infectious Disease

Table 4b: 2004 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	2	1	No Infectious Disease
		1	Bacteraemia
2 Apr – June	2	2	No Infectious Disease
3 July – Sept	4	3	No Infectious Disease
		1	Bacterial Kidney Disease
4 Oct - Dec	5	5	No Infectious Disease

Table 4c: 2005 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	5	4	No Infectious Disease
		1	Bacterial Kidney Disease
2 Apr – June	5	4	No Infectious Disease
		1	Bacterial Kidney Disease
3 July – Sept	5	2	No Infectious Disease
		2	Mouth Myxobacteriosis
		1	Bacterial Kidney Disease
4 Oct - Dec	4	4	No Infectious Disease

Figure 4a – 4d: Diagnoses from Sub Zone 3.2 (Campbell River) Atlantic Salmon Farm Audits 2003

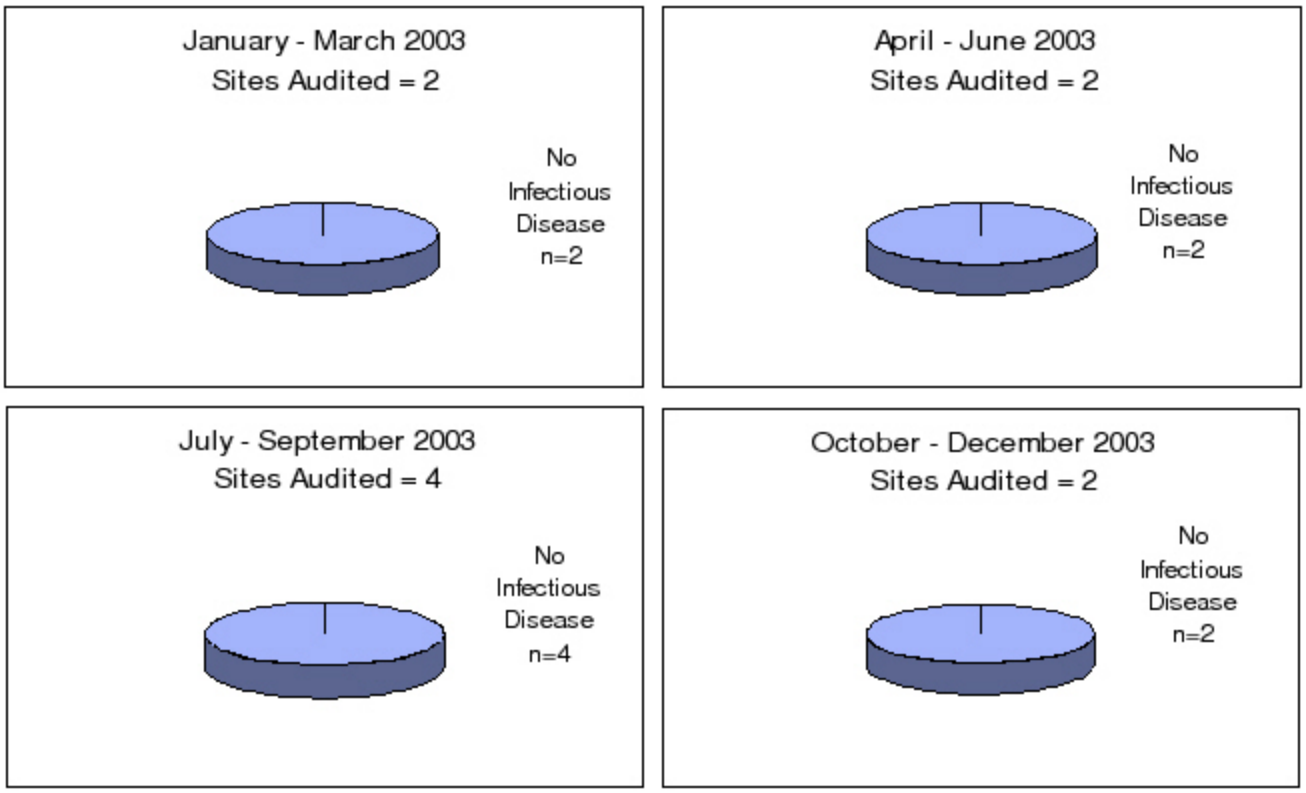


Figure 4e – 4h: Diagnoses from Sub Zone 3.2 (Campbell River) Atlantic Salmon Farm Audits 2004

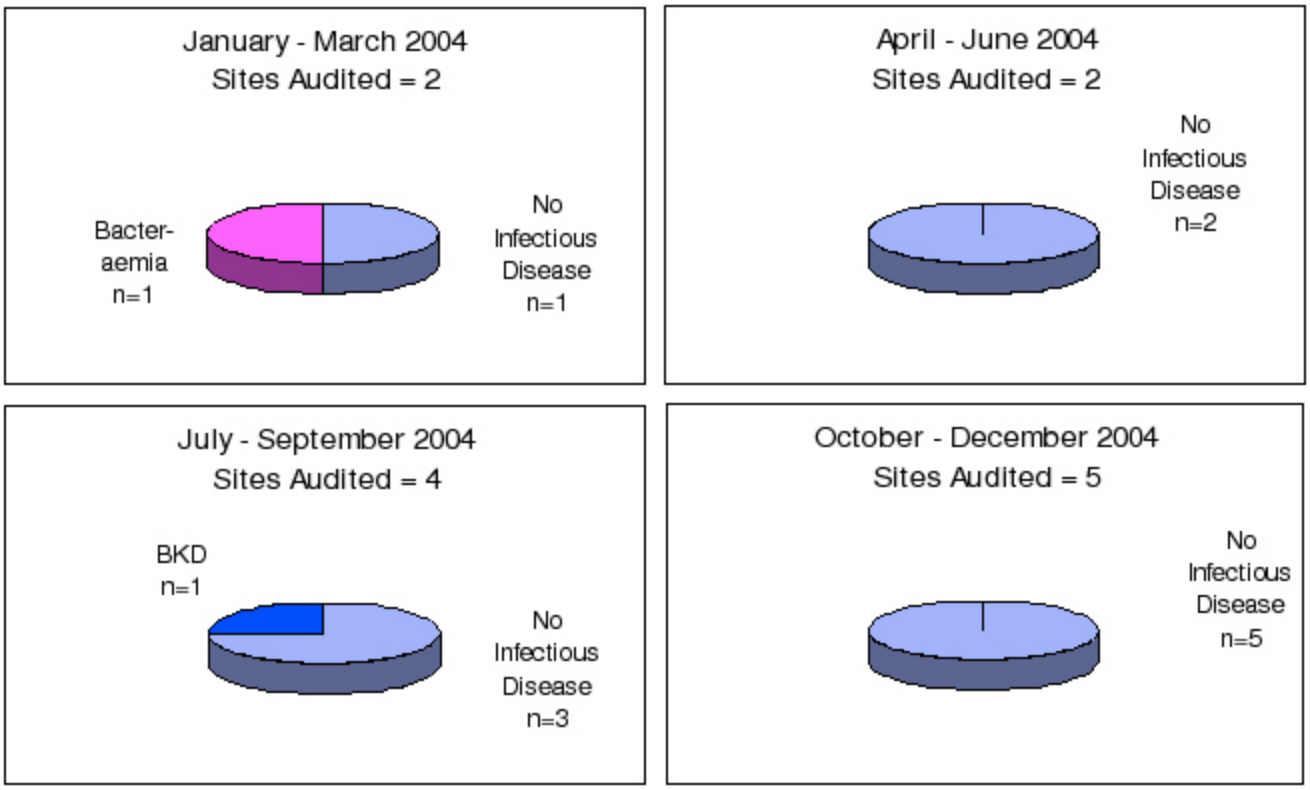


Figure 4i – 4l: Diagnoses from Sub Zone 3.2 (Campbell River) Atlantic Salmon Farm Audits 2005

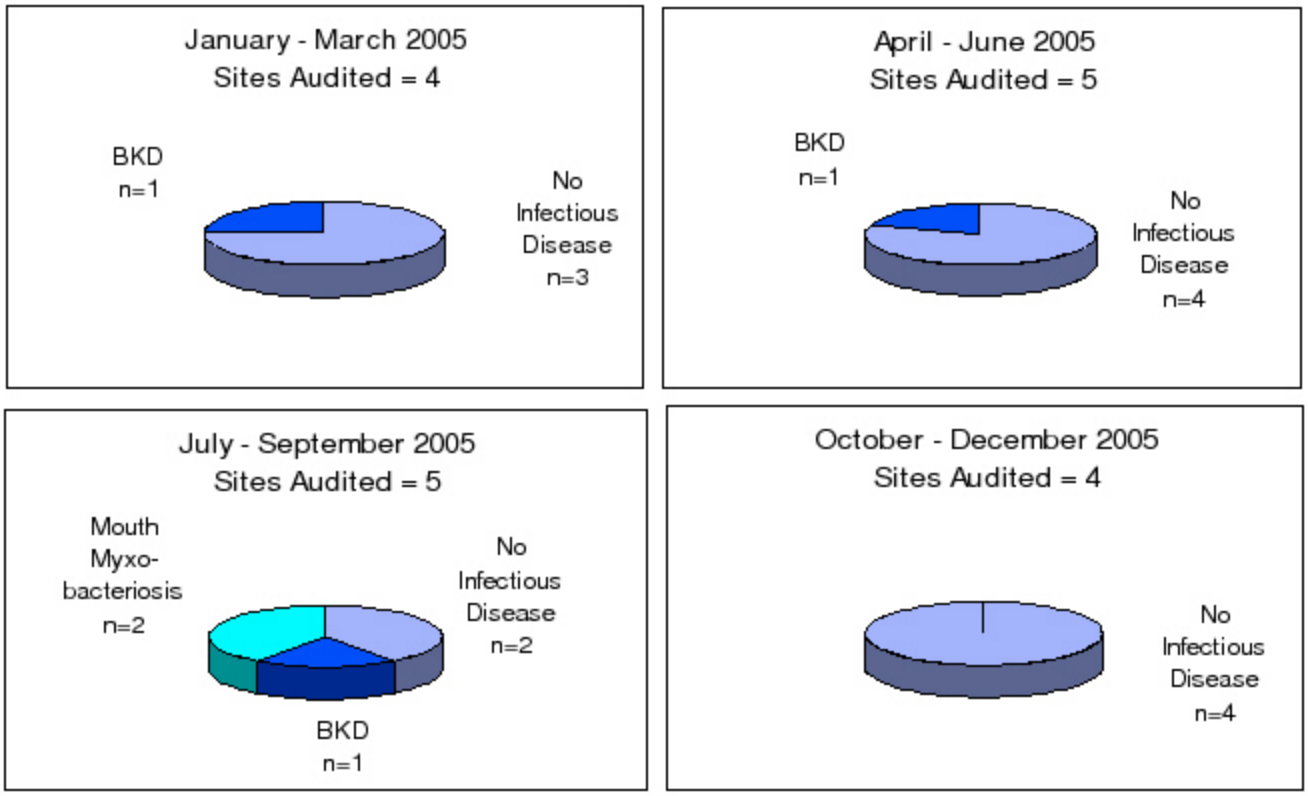


Table 5a: 2003 Diagnoses from Sub Zone 3.3 (Broughton) Atlantic Salmon Farm Audits

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

Table 5b: 2004 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	6	4	No Infectious Disease
		1	Mouth Myxobacteriosis
		1	Bacterial Kidney Disease
2 Apr – June	6	4	No Infectious Disease
		1	Bacterial Kidney Disease
		1	Mouth Myxobacteriosis
3 July – Sept	5	4	No Infectious Disease
		1	Bacterial Kidney Disease
4 Oct - Dec	5	5	No Infectious Disease

Table 5c: 2005 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	5	4	No Infectious Disease
		1	Bacterial Kidney Disease
2 Apr – June	7	3	No Infectious Disease
		3	Bacterial Kidney Disease
		2	Mouth Myxobacteriosis
3 July – Sept	6	2	No Infectious Disease
		2	Rickettsiosis
		1	Bacterial Kidney Disease
		1	Furunculosis
4 Oct - Dec	6	5	No Infectious Disease
		1	Rickettsiosis

Figure 5a – 5d: Diagnoses from Sub Zone 3.3 (Broughton) Atlantic Salmon Farm Audits 2003

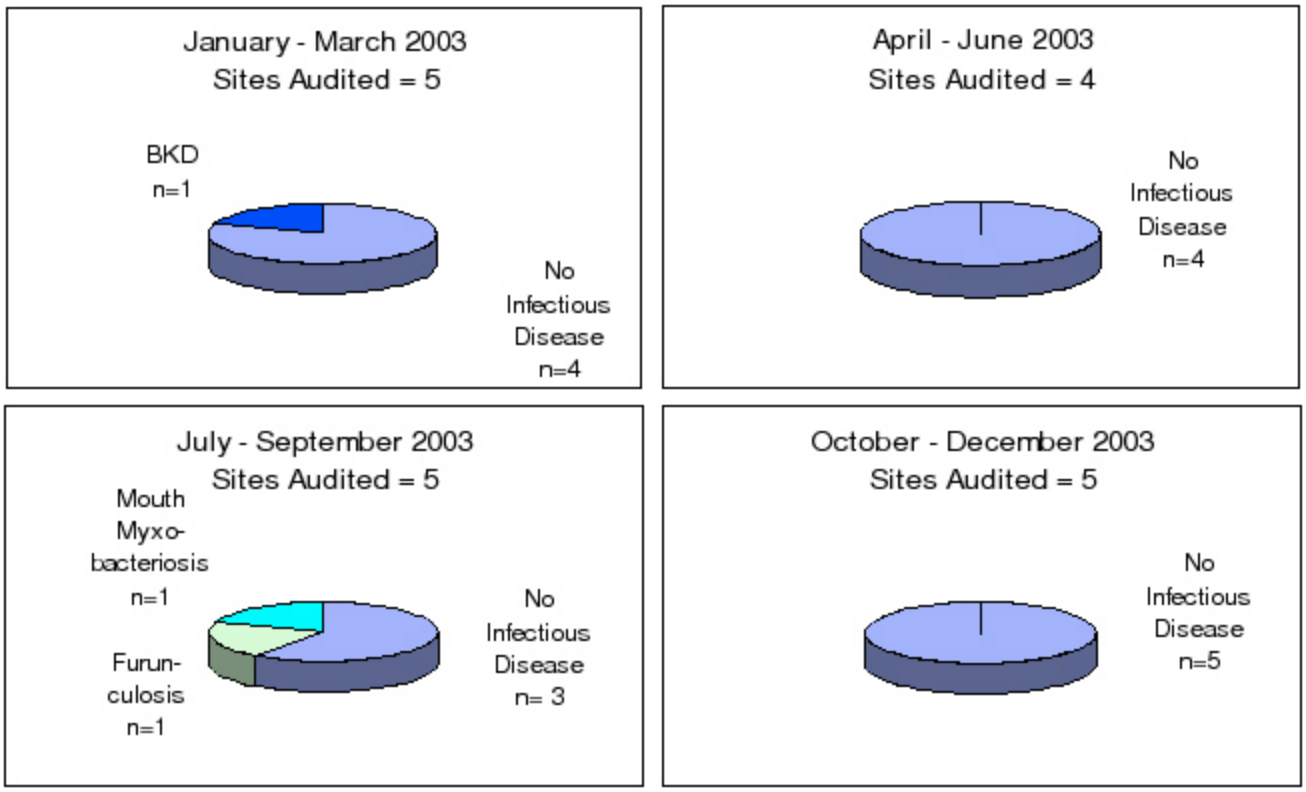


Figure 5e - 5h: Diagnoses from Sub Zone 3.3 (Broughton) Atlantic Salmon Farm Audits 2004

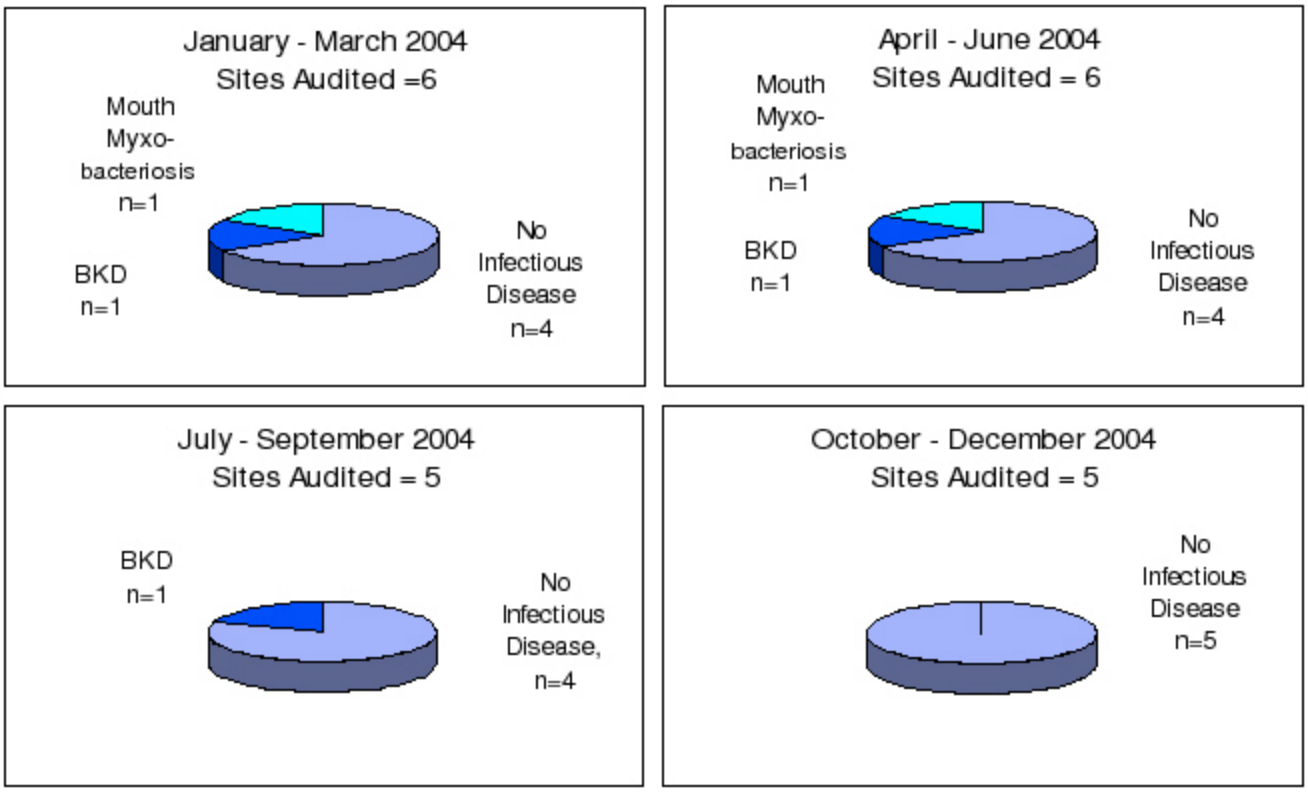


Figure 5i - 5l: Diagnoses from Sub Zone 3.3 (Broughton) Atlantic Salmon Farm Audits 2005

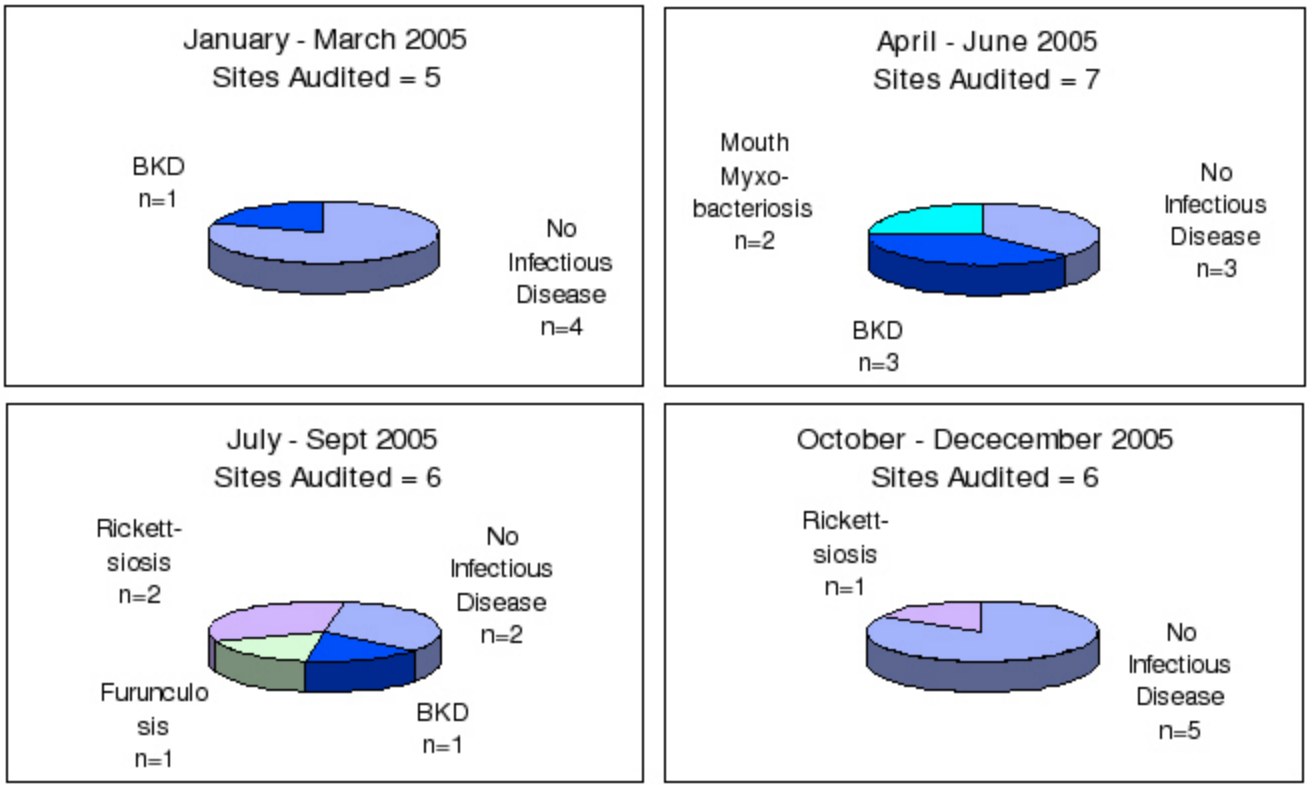


Table 6a: 2003 Diagnoses from Sub Zone 3.4 (Pt Hardy) Atlantic Salmon Farm Audits			
Quarter	Number of Farms Audited	Number of Cases	Farm Level Diagnosis
1 Jan - Mar	3	1	Furunculosis
		1	IHN
		1	No Infectious Disease
2 Apr – June	3	2	No Infectious Disease
		1	Furunculosis
3 July – Sept	3	3	No Infectious Disease
4 Oct - Dec	2	1	Bacterial Kidney Disease
		1	No Infectious Disease

Table 6b : 2004 Diagnoses from Sub Zone 3.4 (Pt 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	2	1	Mouth Myxobacteriosis
		1	No Infectious Disease
3 July – Sept	3	3	No Infectious Disease
4 Oct - Dec	3	3	No Infectious Disease

Table 6c: 2005 Diagnoses from Sub Zone 3.4 (Pt Hardy) 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	3	3	No Infectious Disease
4 Oct - Dec	4	4	No Infectious Disease

Figure 6a - 6d: Diagnoses from Sub Zone 3.4 (Port Hardy) Atlantic Salmon Farm Audits 2003

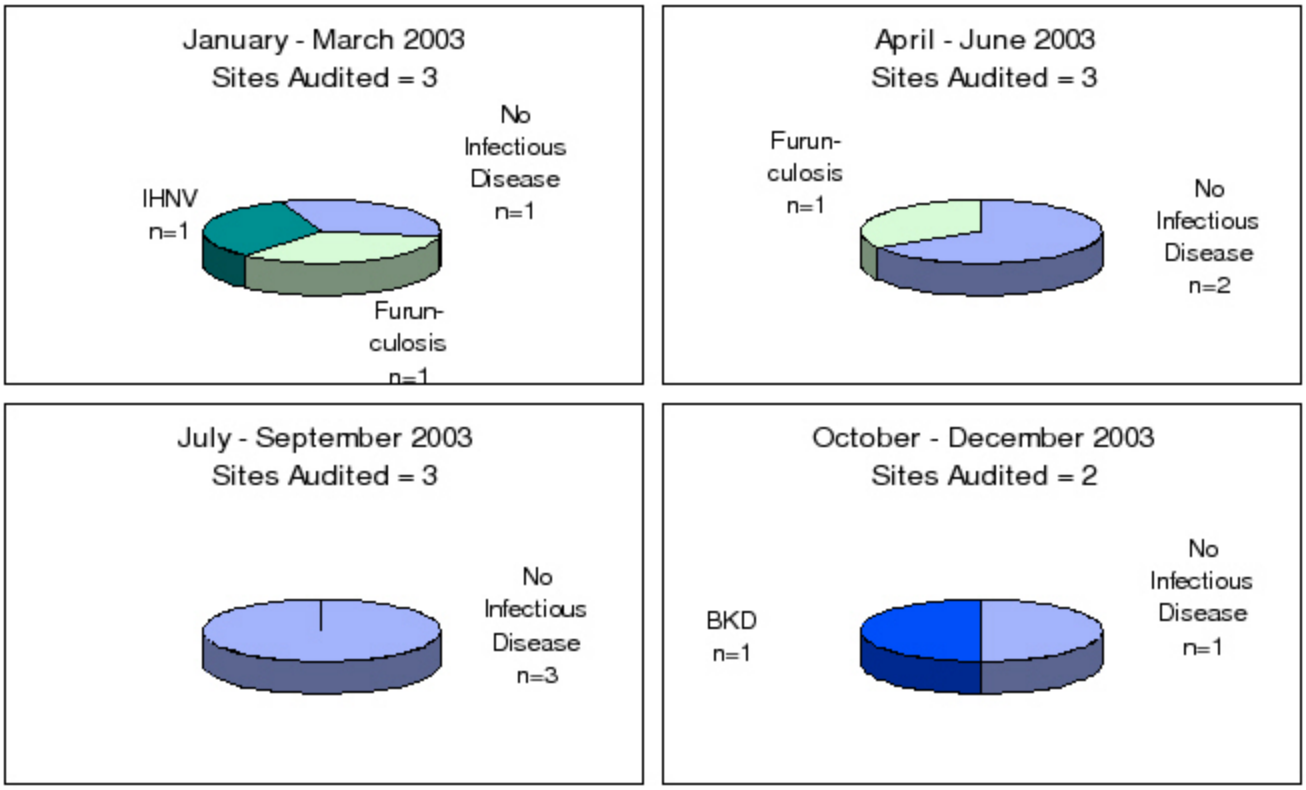


Figure 6e - 6h: Diagnoses from Sub Zone 3.4 (Pt Hardy) Atlantic Salmon Farm Audits 2004

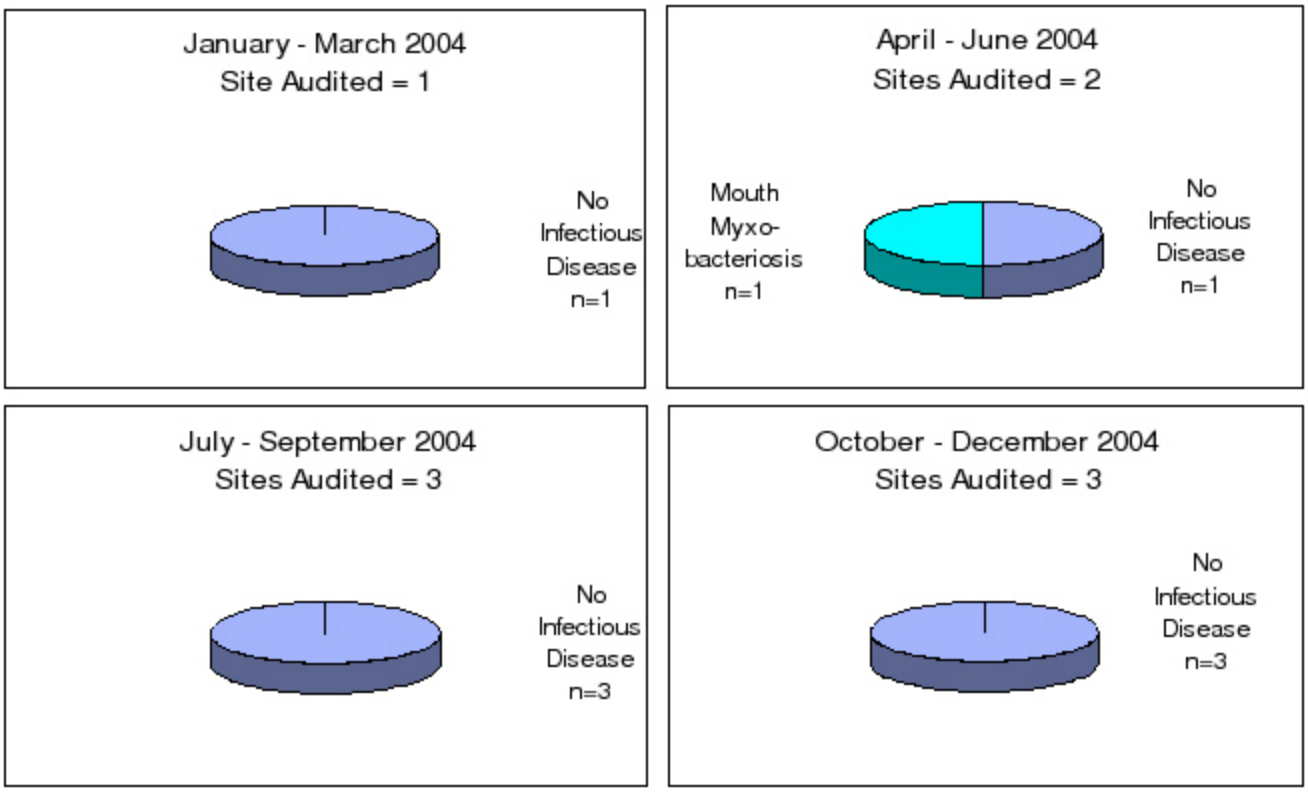


Figure 6i - 6l: Diagnoses from Sub Zone 3.4 (Port Hardy) Atlantic Salmon Farm Audits 2005

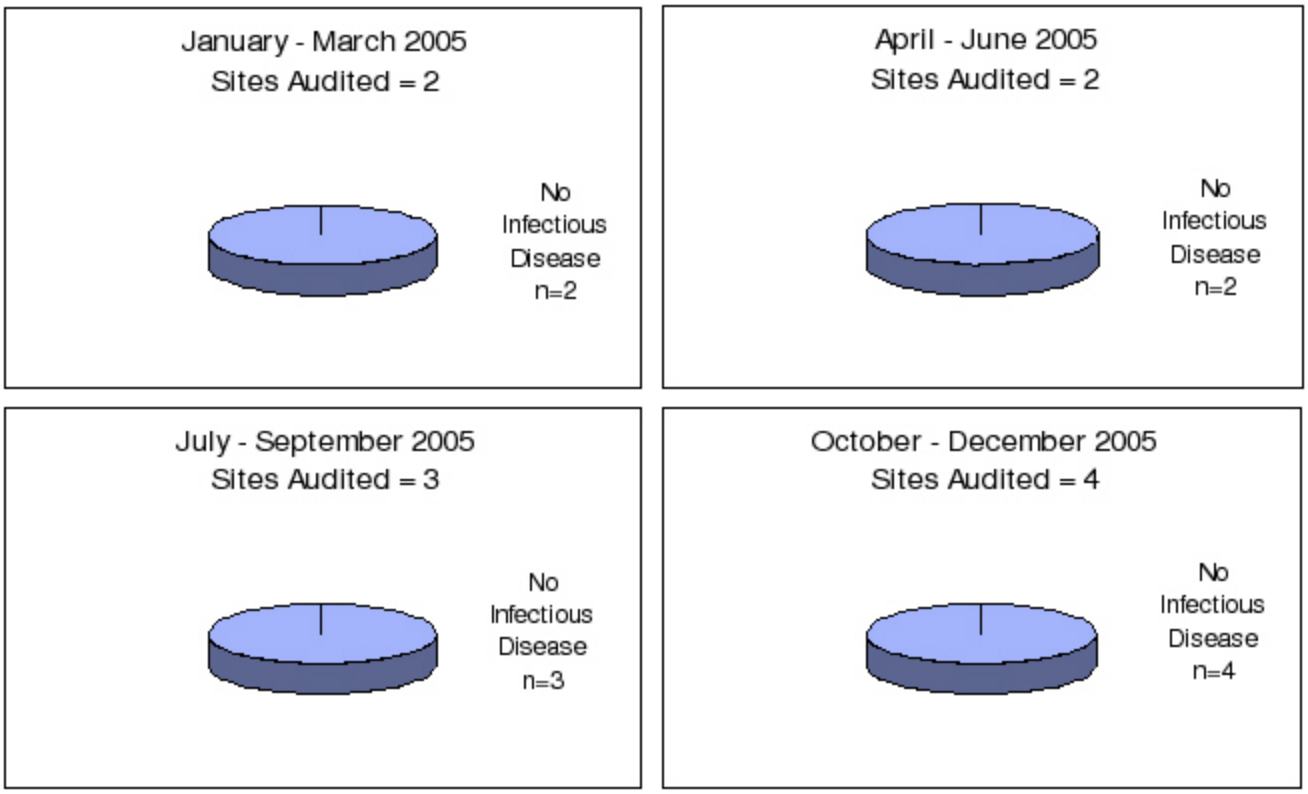


Table 7a: 2003 Diagnoses from Sub Zone 3.5 (North Coast) Atlantic Salmon Farm Audits			
Quarter	Number of Farms Audited	Number of Cases	Farm Level Diagnosis
1 Jan - Mar	0	0	Not applicable
2 Apr – June	0	0	Not applicable
3 July – Sept	0	0	Not applicable
4 Oct - Dec	0	0	Not applicable

Table 7b: 2004 Diagnoses from Sub Zone 3.5 (North Coast) Atlantic Salmon Farm Audits			
Quarter	Number of Farms Audited	Number of Cases	Farm Level Diagnosis
1 Jan - Mar	0	0	Not Applicable
2 Apr – June	0	0	Not Applicable
3 July – Sept	0	0	Not Applicable
4 Oct - Dec	1	1	No Infectious Disease

Table 7c: 2005 Diagnoses from Sub Zone 3.5 (North Coast) 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	1	1	No Infectious Disease
3 July – Sept	1	1	Mouth Myxobacteriosis
4 Oct - Dec	0	0	Not Applicable

Figure 7a: Diagnoses from Sub Zone 3.5 (North Coast) Atlantic Salmon Farm Audits 2004

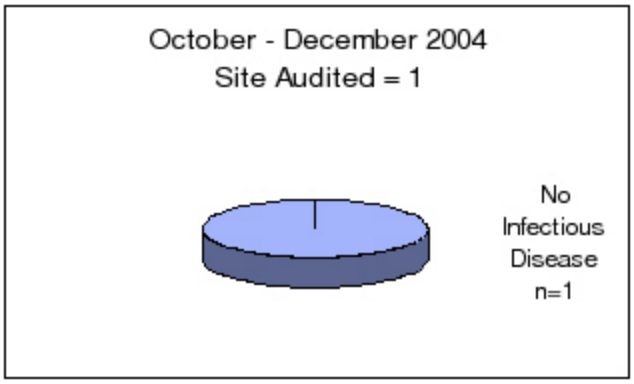
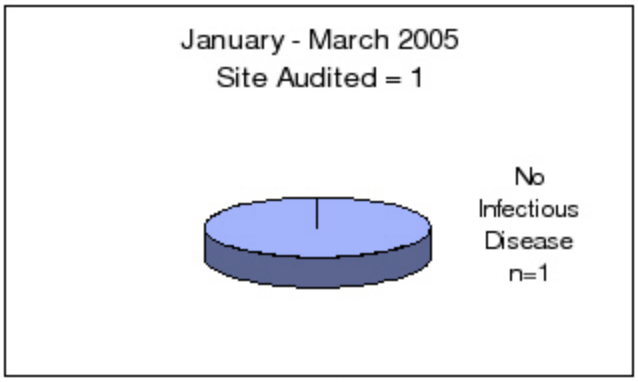
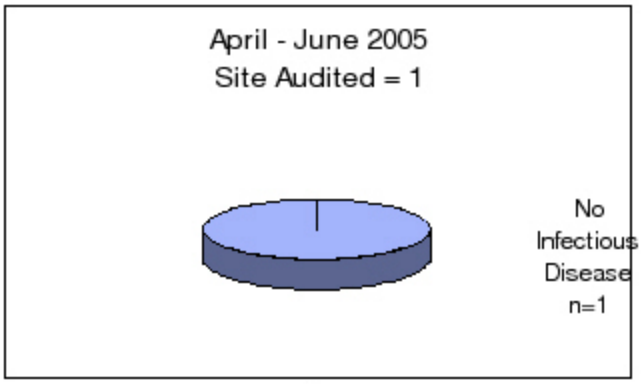


Figure 7b-7d: Diagnoses from Sub Zone 3.5 (North Coast) Atlantic Salmon Farms 2005





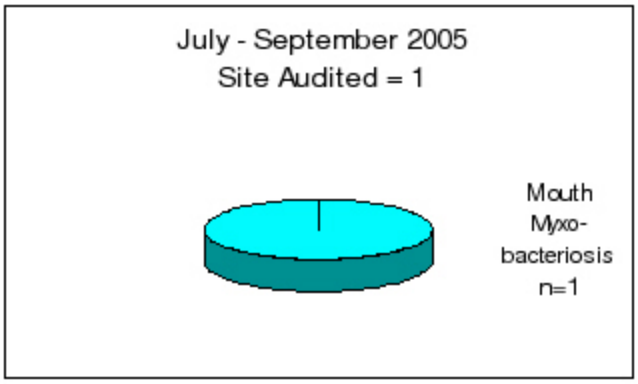


Table 8a: 2003 Diagnoses from Zone 2 (West Coast of Vancouver Island) Pacific Salmon Farm Audits			
Quarter	Number of Farms Audited	Number of Cases	Farm Level Diagnosis
1 Jan - Mar	2	2	No Infectious Disease
2 Apr – June	4	4	No Infectious Disease
3 July – Sept	4	3	No Infectious Disease
		1	Loma
4 Oct - Dec	5	5	No Infectious Disease

Table 8b: 2004 Diagnoses from Zone 2 (West Coast of Vancouver Island) Pacific Salmon Farm Audits			
Quarter	Number of Farms Audited	Number of Cases	Farm Level Diagnosis
1 Jan - Mar	5	3	Bacterial Kidney Disease
		1	No Infectious Disease
		1	Marine Anaemia
2 Apr – June	4	3	Bacterial Kidney Disease
		1	No Infectious Disease
3 July – Sept	2	2	Loma
4 Oct - Dec	3	3	No Infectious Disease

Table 8c: 2005 Diagnoses from Zone 2 (West Coast of Vancouver Island) Pacific Salmon Farms Audits			
Quarter	Number of Farms Audited	Number of Cases	Farm Level Diagnosis
1 Jan - Mar	3	2	VHS (North American)
		1	Loma
		1	No Infectious Disease
2 Apr – June	1	1	Loma
3 July – Sept	1	1	Loma
4 Oct - Dec	2	2	Bacterial Kidney Disease

Figure 8a - 8d: Diagnoses from Zone 2 (West Coast of Vancouver Island)
Pacific Salmon Farm Audits 2003

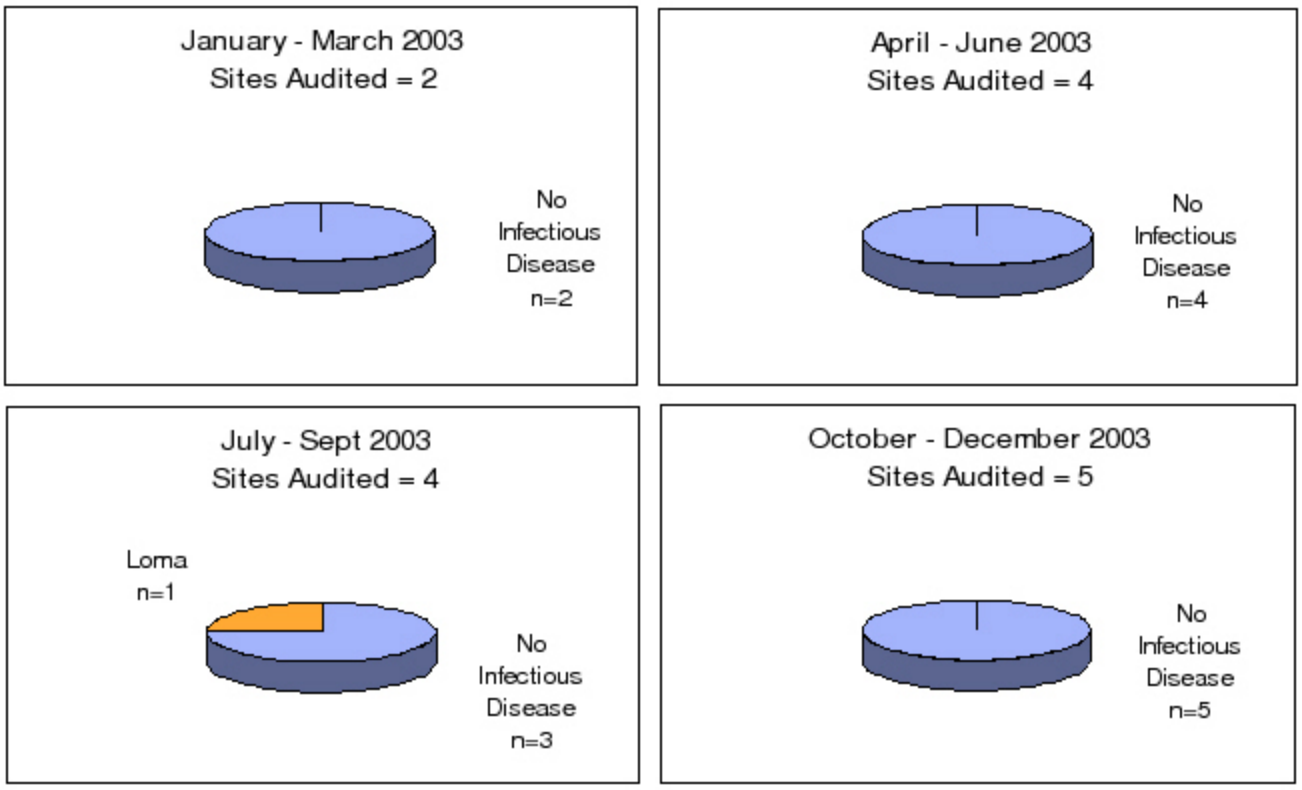


Figure 8e - 8h: Diagnoses from Zone 2.0 (West Coast of Vancouver Island)
Pacific Salmon Farms 2004

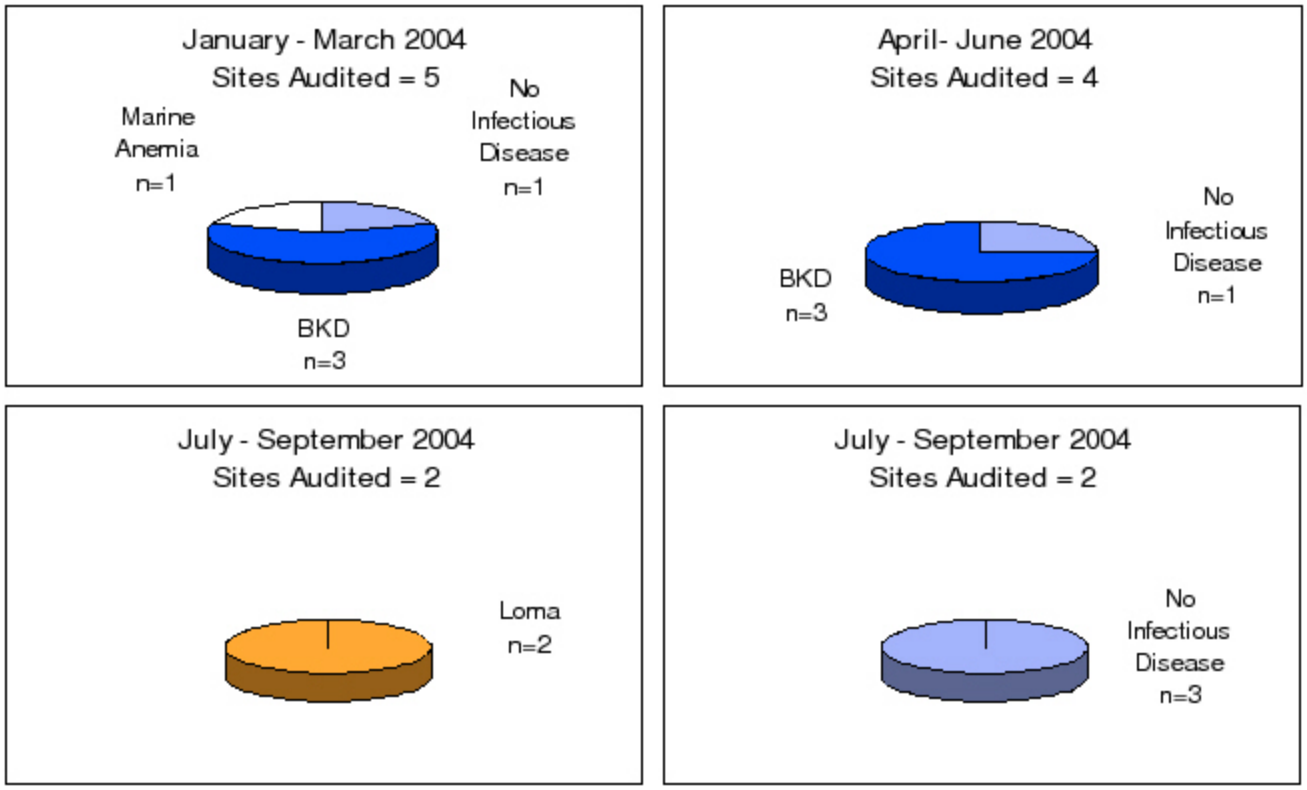


Figure 8i - 8l: Diagnoses from Zone 2 (West Coast of Vancouver Island)
Pacific Salmon Farm Audits 2005

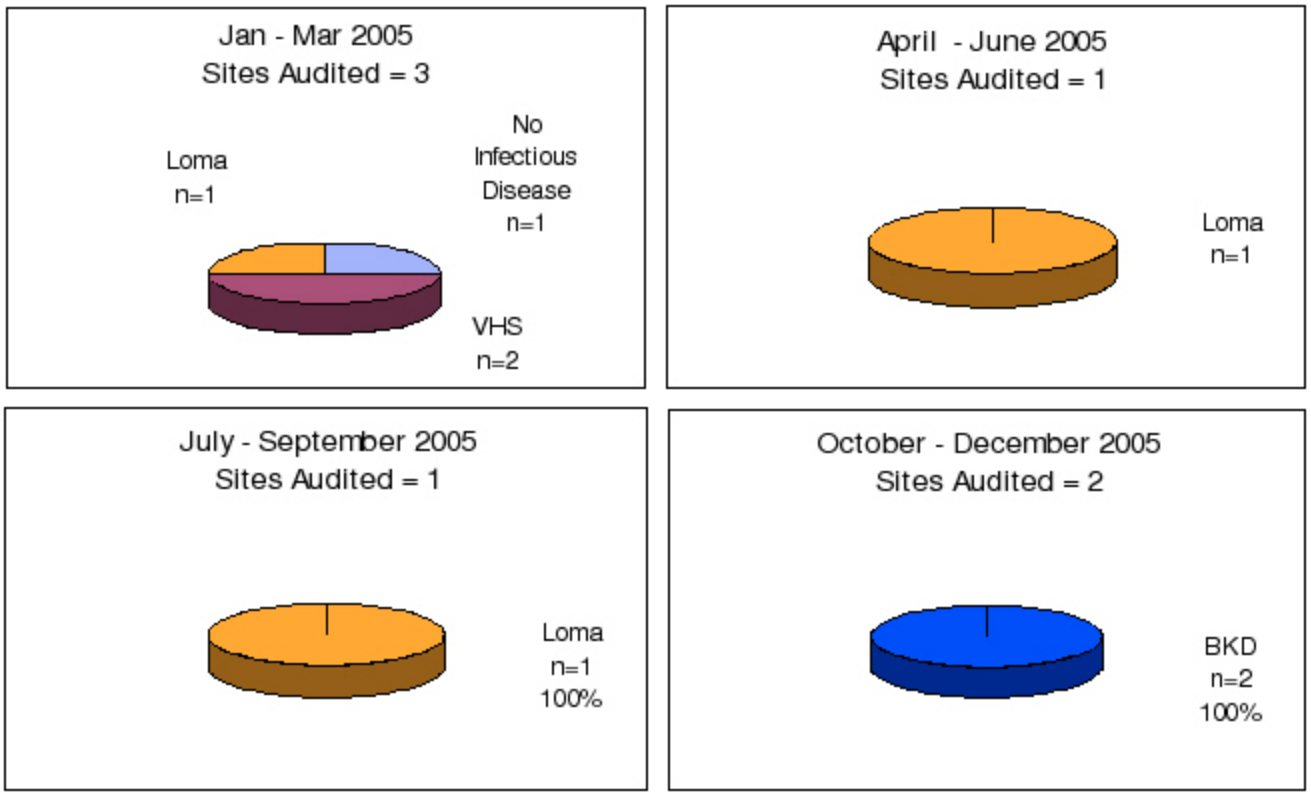


Table 9a: 2003 Diagnoses from Zone 3 (East Coast of Vancouver Island) Pacific Salmon Farm Audits			
Quarter	Number of Farms Audited	Number of Cases	Farm Level Diagnosis
1 Jan - Mar	4	3	No Infectious Disease
		1	Bacterial Kidney Disease
2 Apr – June	5	3	Bacterial Kidney Disease
		2	No Infectious Disease
3 July – Sept	6	5	No Infectious Disease
		1	Bacterial Kidney Disease
4 Oct - Dec	8	6	No Infectious Disease
		2	Bacterial Kidney Disease

Table 9b: 2004 Diagnoses from Zone 3 (East Coast of Vancouver Island) Pacific Salmon Farm Audits			
Quarter	Number of Farms Audited	Number of Cases	Farm Level Diagnosis
1 Jan - Mar	6	3	No Infectious Disease
		3	Bacterial Kidney Disease
2 Apr – June	6	3	No Infectious Disease
		3	Bacterial Kidney Disease
3 July – Sept	6	5	No Infectious Disease
		1	Bacterial Kidney Disease
4 Oct - Dec	5	2	Bacterial Kidney Disease
		2	No Infectious Disease
		1	Loma
		1	Bacteraemia

Table 9c: 2005 Diagnoses for Zone 3 (East Coast of Vancouver Island) Pacific 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)
2 Apr – June	4	3	No Infectious Disease
		1	Marine Anaemia
3 July – Sept	5	3	No Infectious Disease
		2	Loma
		1	Marine Anaemia
4 Oct - Dec	2	2	No Infectious Disease

Figure 9a – 9d: Diagnoses from Zone 3 (East Coast of Vancouver Island) Pacific Salmon Farm Audits 2003

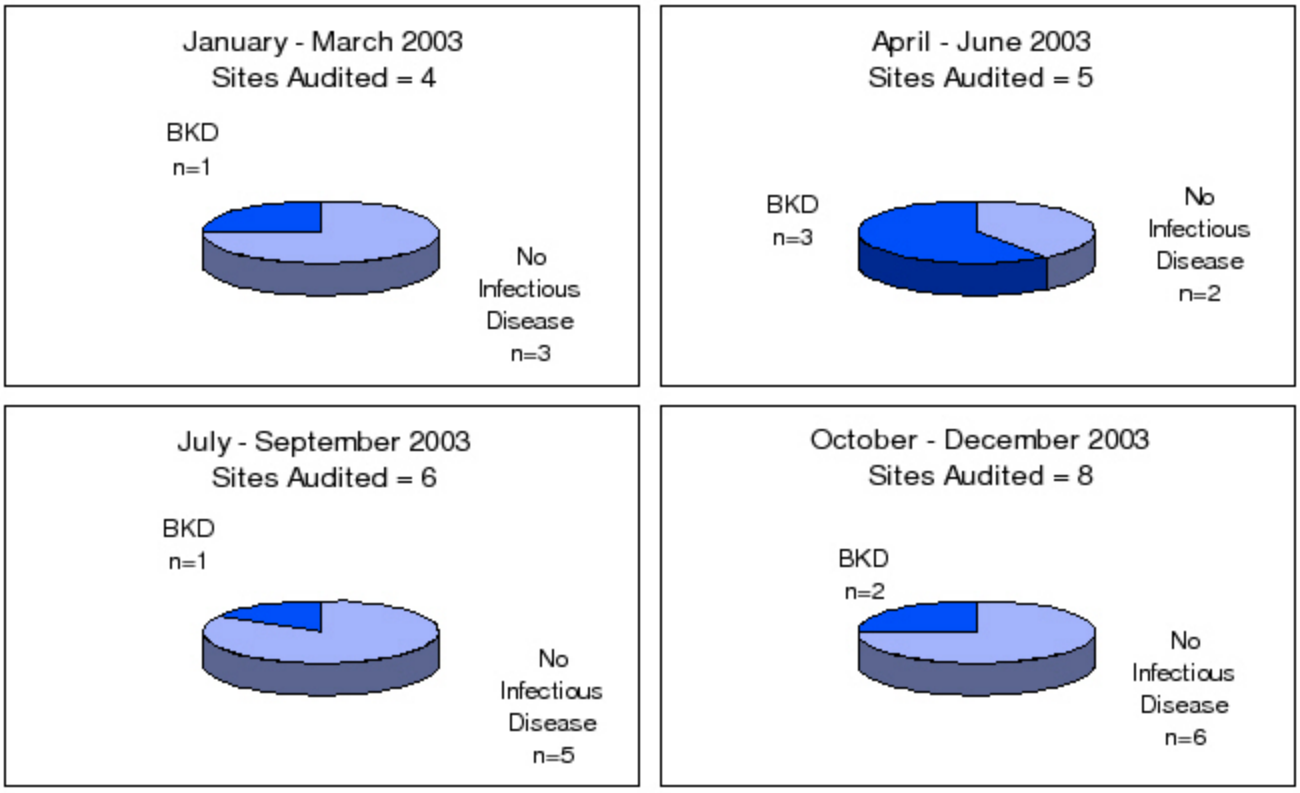


Figure 9e - 9h: Diagnoses from Zone 3 (East Coast of Vancouver Island)
Pacific Salmon Farm Audits 2004

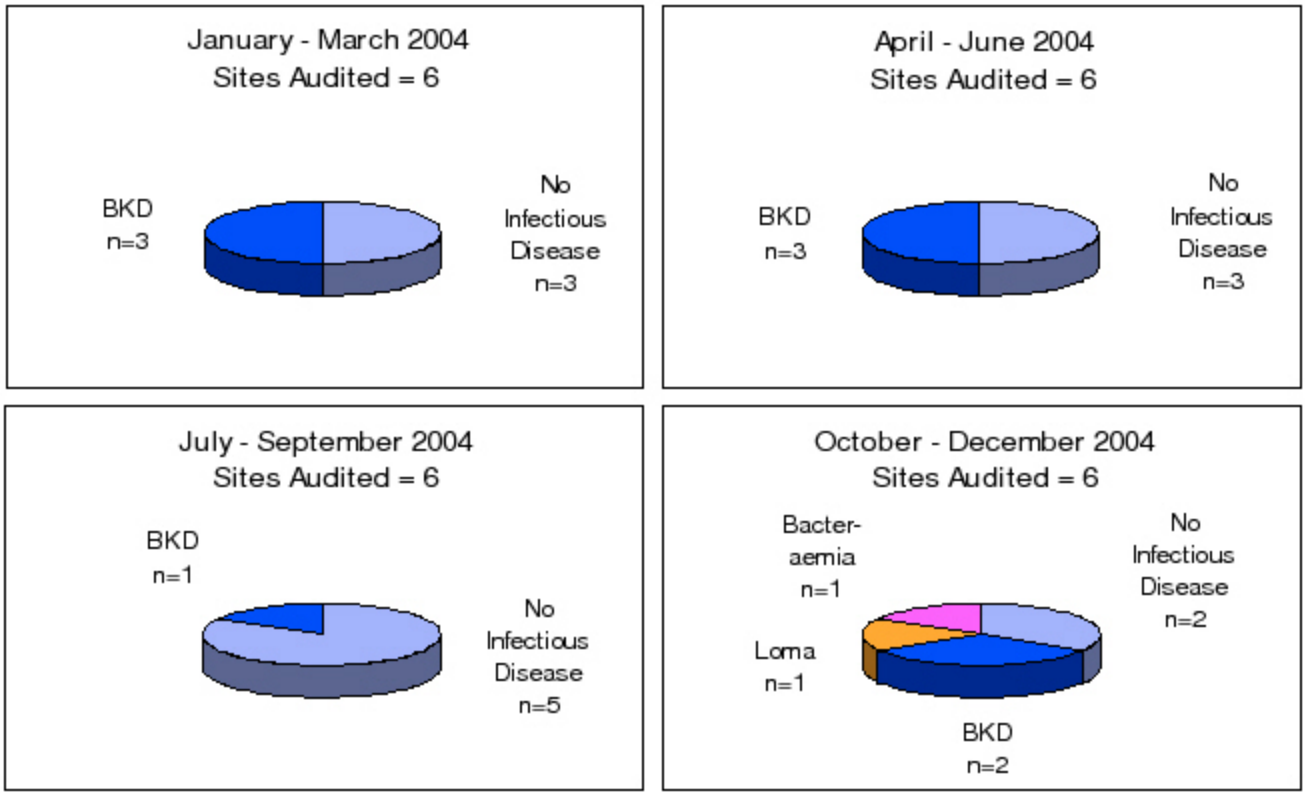
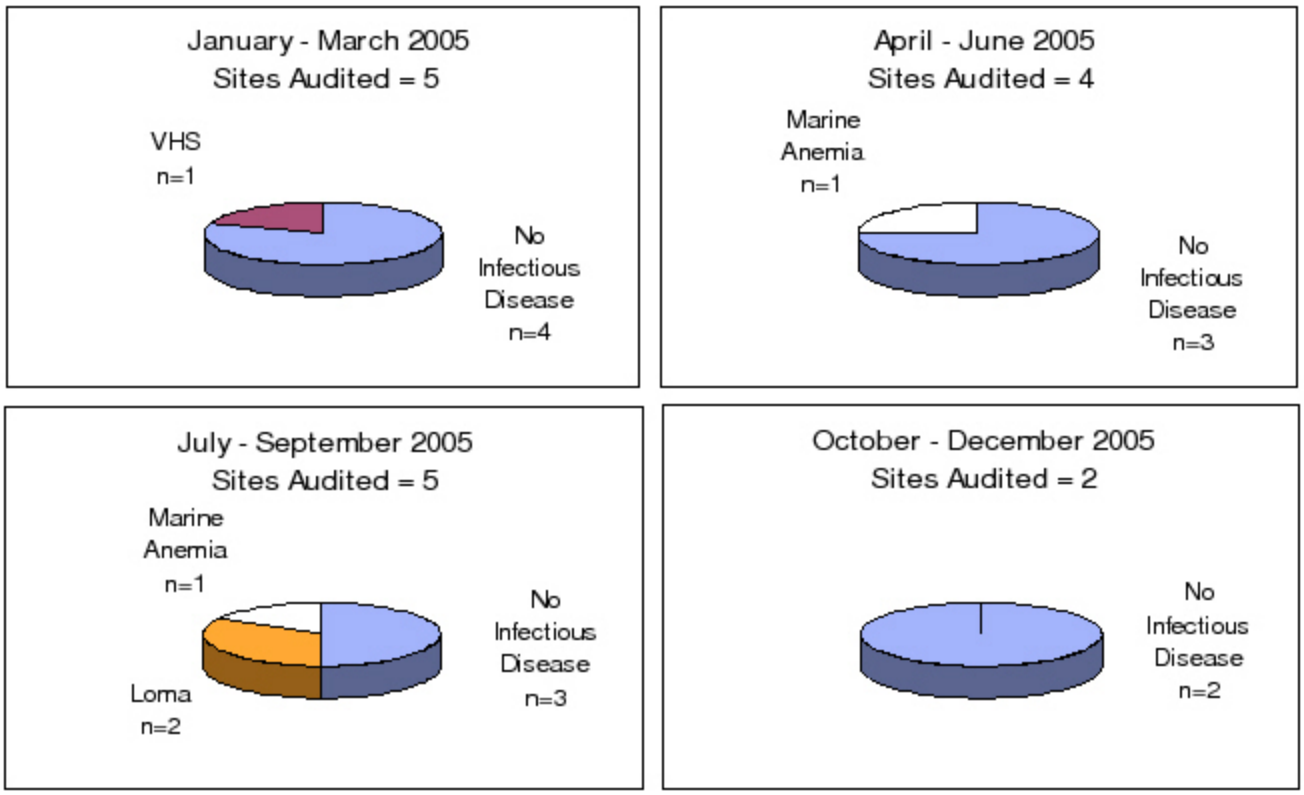
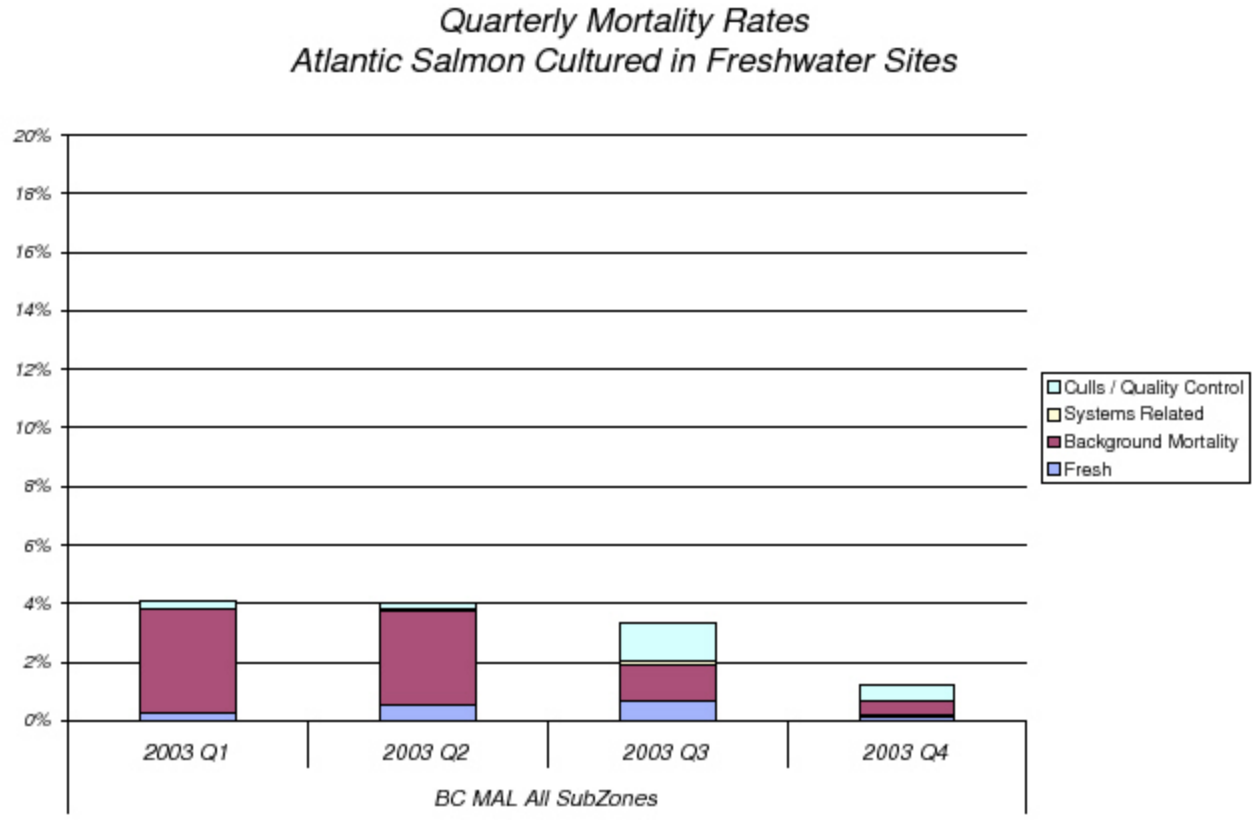


Figure 9i – 9l: Diagnoses from Zone 3 (East Coast of Vancouver Island)
Pacific Salmon Farm Audits 2005

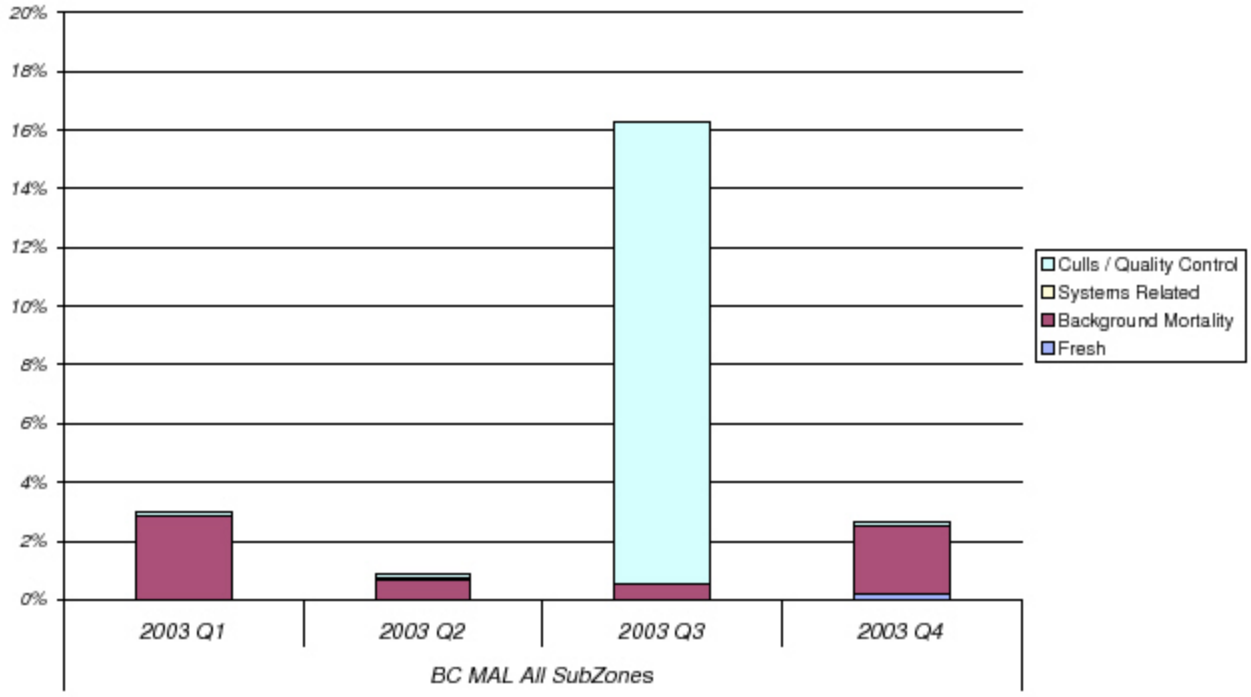


7.8 APPENDIX 8:

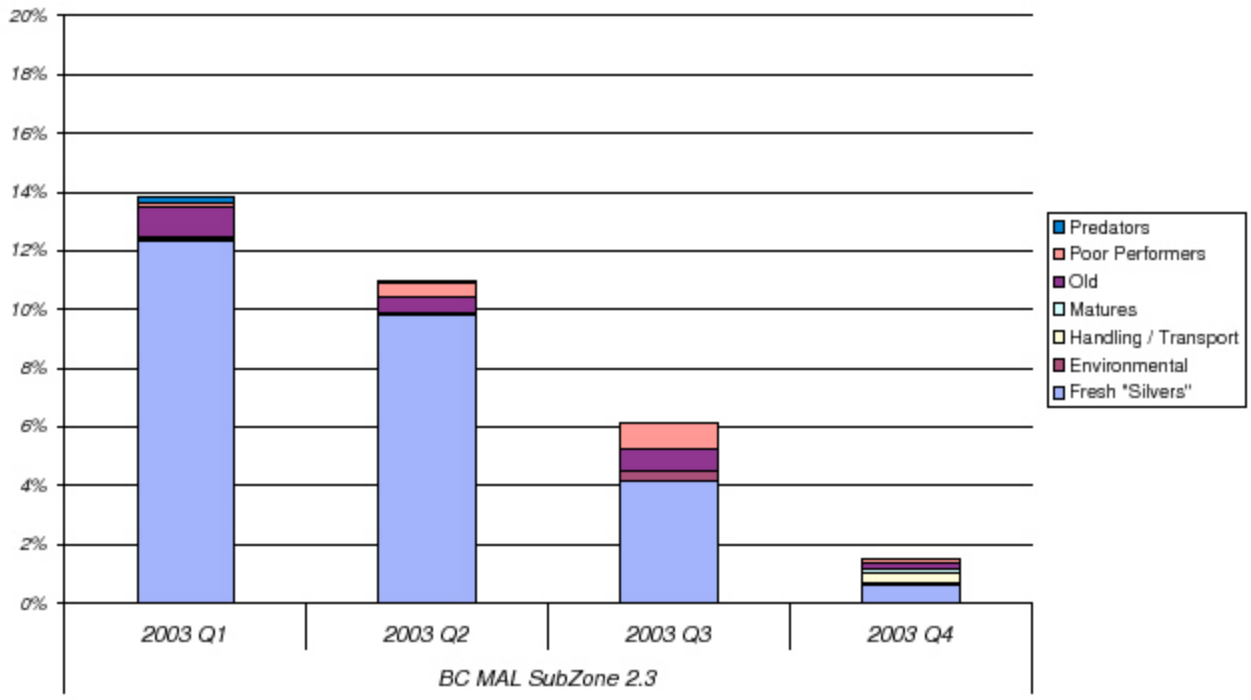
Summary of BCSFA Mortality Rates 2003 - 2005

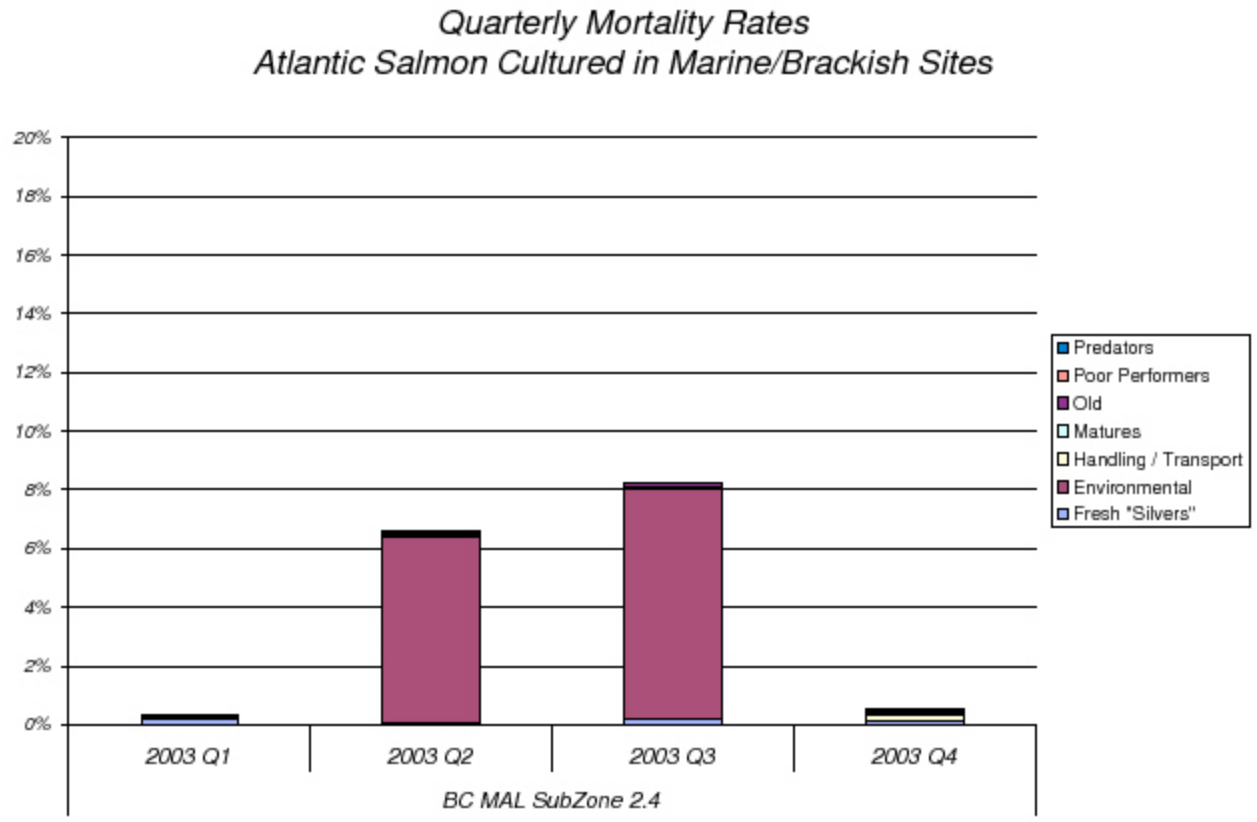


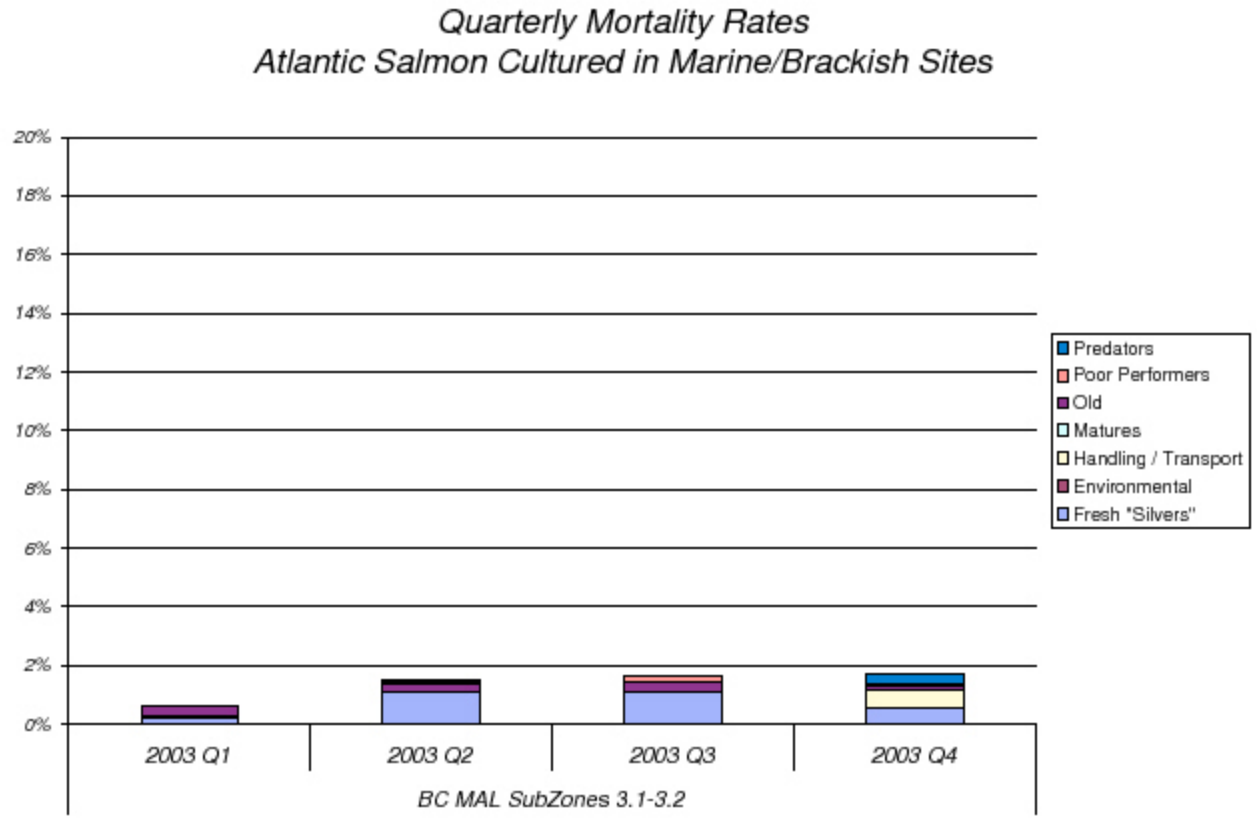
Quarterly Mortality Rates
Pacific Salmon Cultured in Freshwater Sites

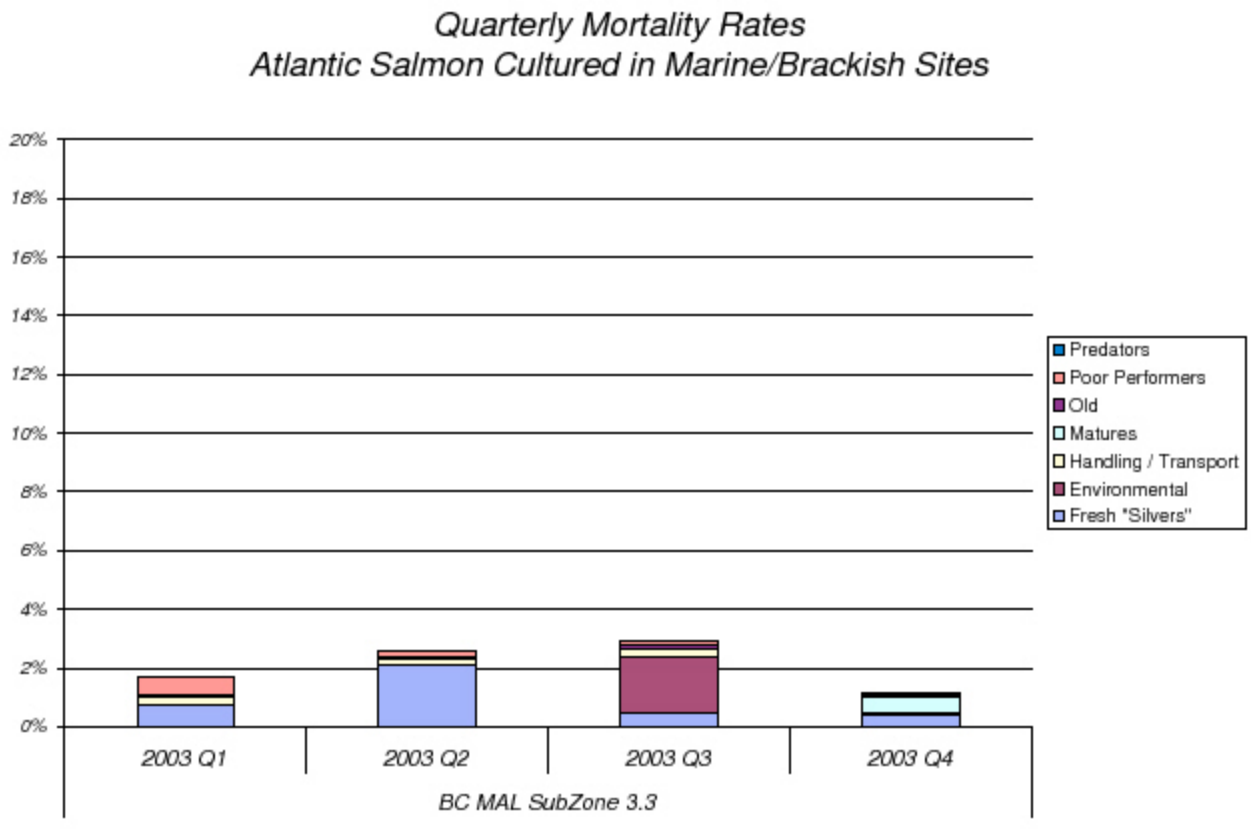


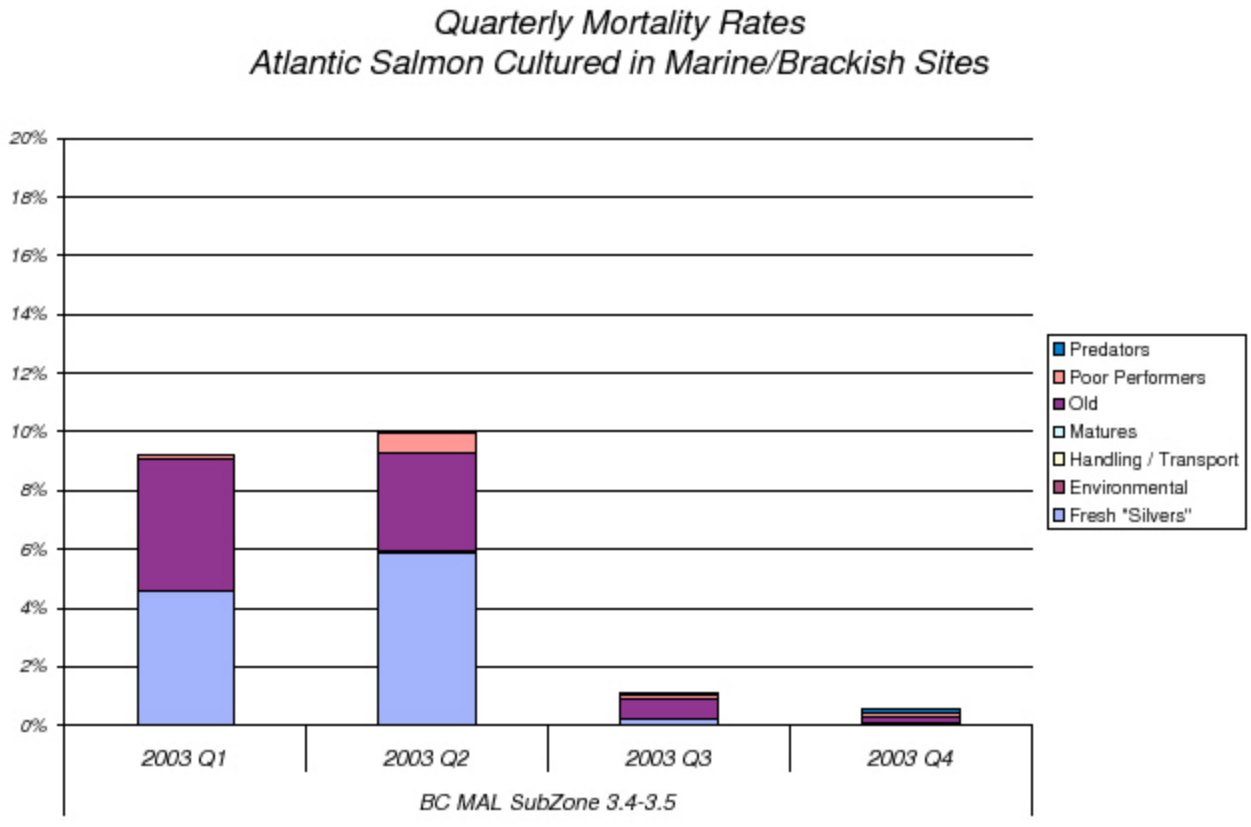
Quarterly Mortality Rates
Atlantic Salmon Cultured in Marine/Brackish Sites



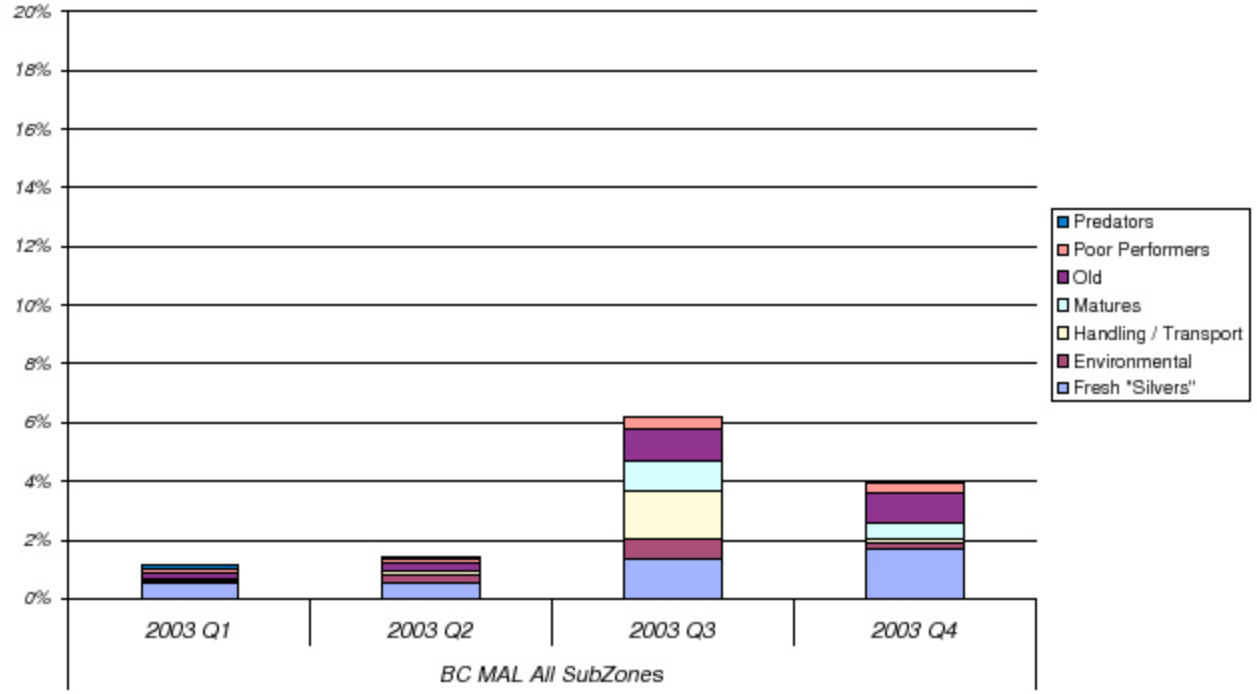

Quarterly Mortality Rates
Atlantic Salmon Cultured in Marine/Brackish Sites
20%
18%
16%
14%
12%
10%
8%
6%
4%
2%
0%
2003 Q1
2003 Q2
2003 Q3
2003 Q4
BC MAL SubZone 2.4
Predators
Poor Performers
Old
Matures
Handling / Transport
Environmental
Fresh "Silvers"


Quarterly Mortality Rates
Atlantic Salmon Cultured in Marine/Brackish Sites
20%
18%
16%
14%
12%
10%
8%
6%
4%
2%
0%
2003 Q1
2003 Q2
2003 Q3
2003 Q4
BC MAL SubZones 3.1-3.2
Predators
Poor Performers
Old
Matures
Handling / Transport
Environmental
Fresh "Silvers"

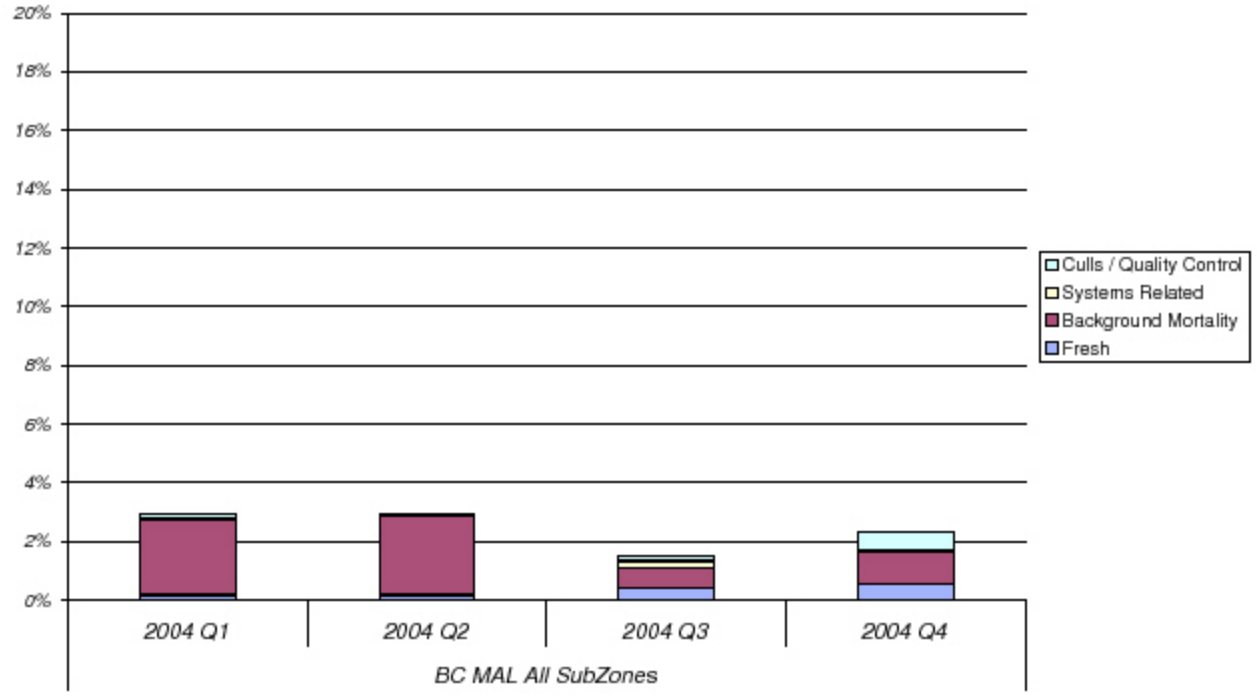

Quarterly Mortality Rates
Atlantic Salmon Cultured in Marine/Brackish Sites
20%
18%
16%
14%
12%
10%
8%
6%
4%
2%
0%
2003 Q1
2003 Q2
2003 Q3
2003 Q4
BC MAL SubZone 3.3
Predators
Poor Performers
Old
Matures
Handling / Transport
Environmental
Fresh "Silvers"


Quarterly Mortality Rates
Atlantic Salmon Cultured in Marine/Brackish Sites
20%
18%
16%
14%
12%
10%
8%
6%
4%
2%
0%
2003 Q1
2003 Q2
2003 Q3
2003 Q4
BC MAL SubZone 3.4-3.5
Predators
Poor Performers
Old
Matures
Handling / Transport
Environmental
Fresh "Silvers"

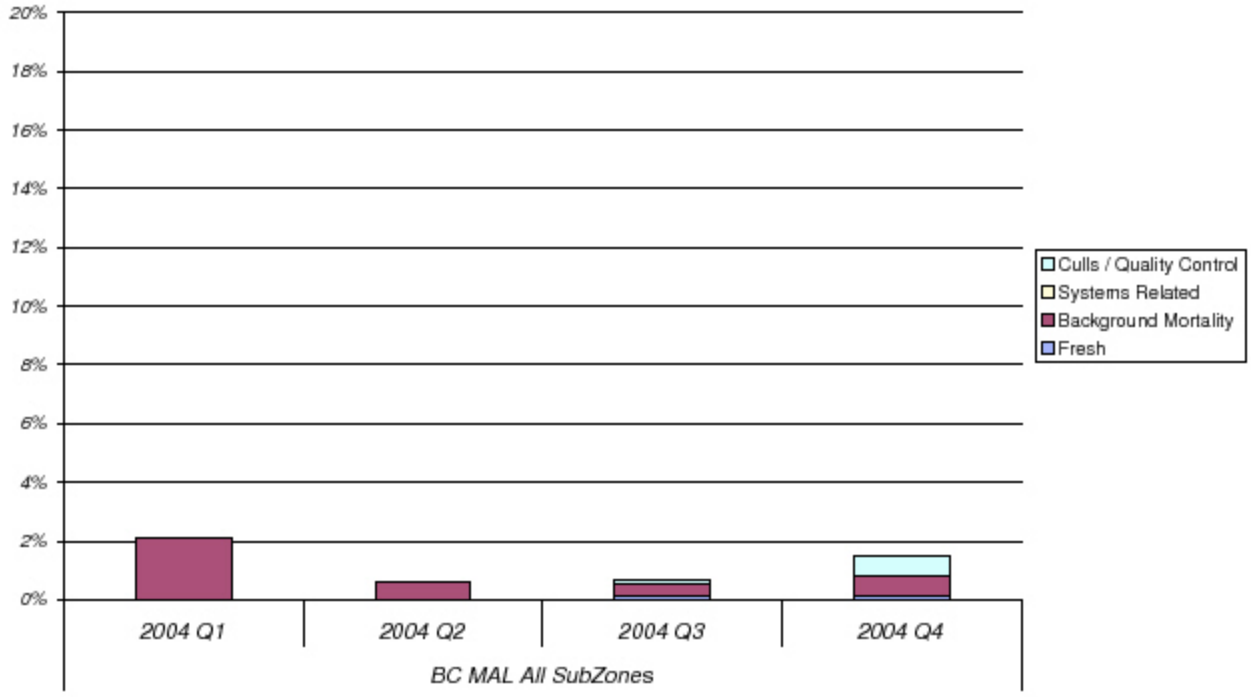
Quarterly Mortality Rates
Pacific Salmon Cultured in Marine/Brackish Sites



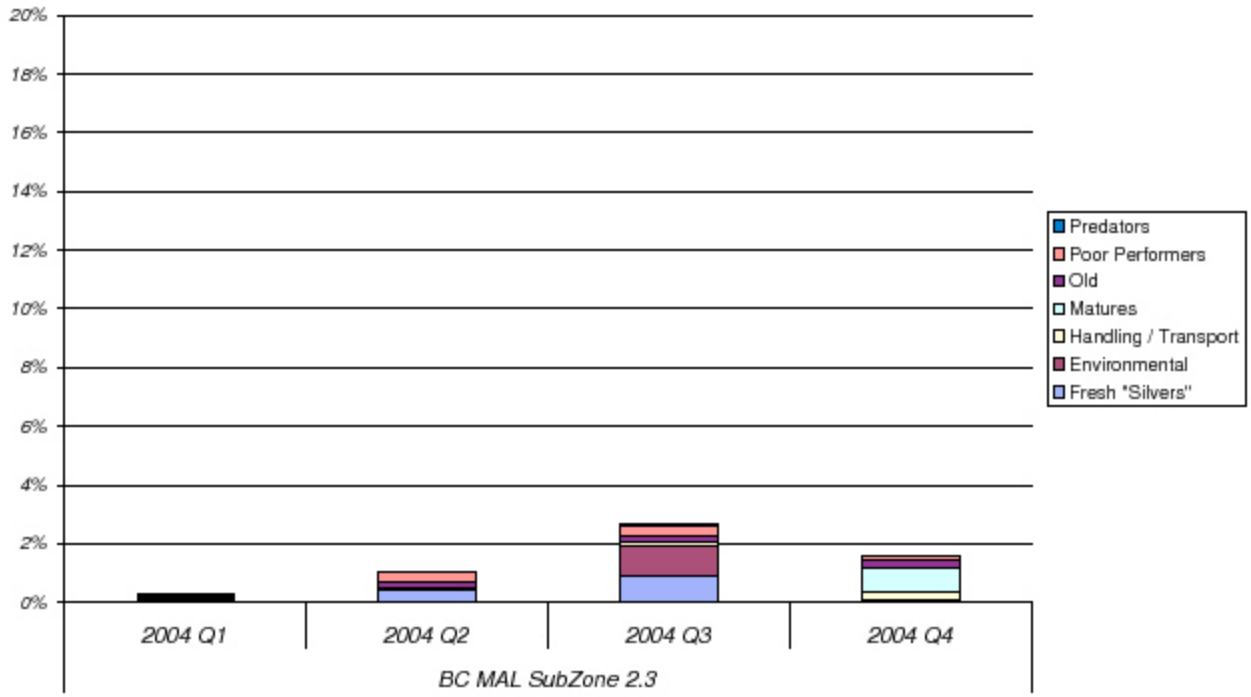
Quarterly Mortality Rates
Atlantic Salmon Cultured in Freshwater Sites

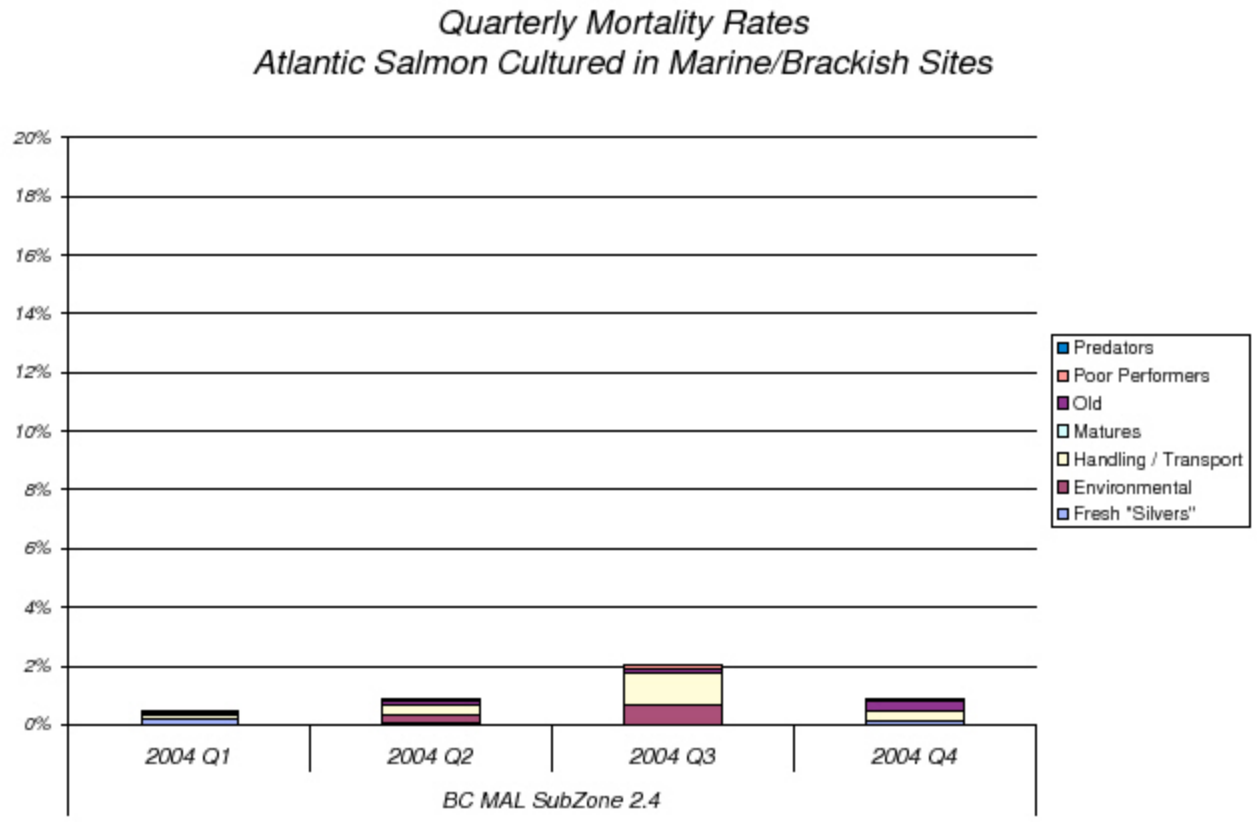


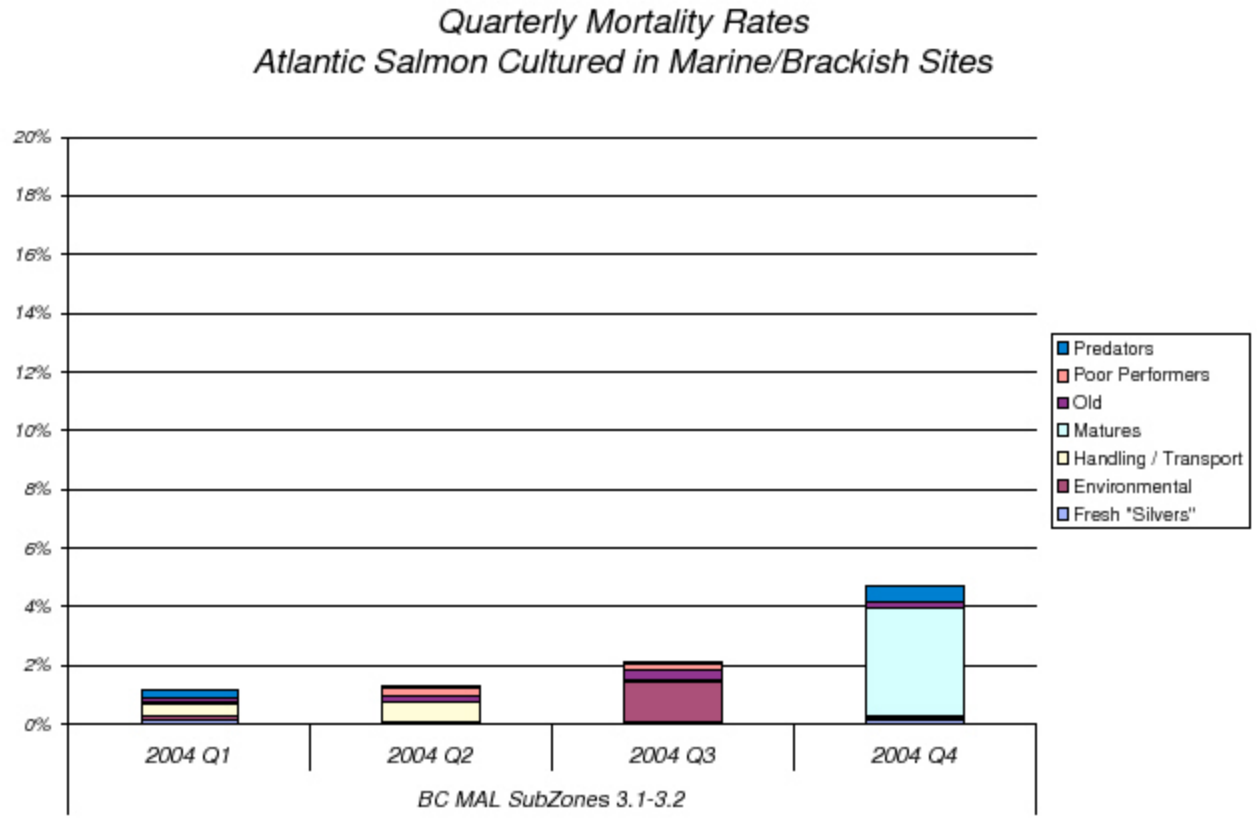
Quarterly Mortality Rates
Pacific Salmon Cultured in Freshwater Sites

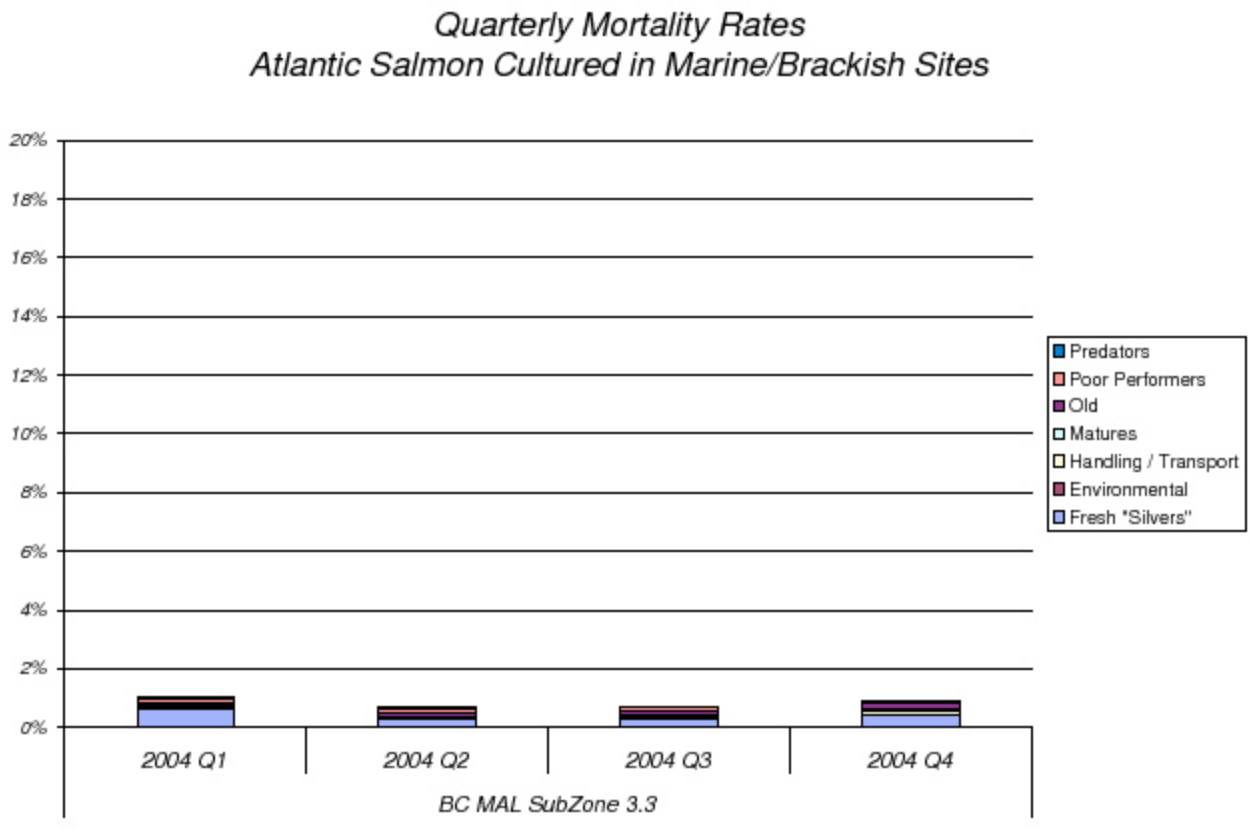


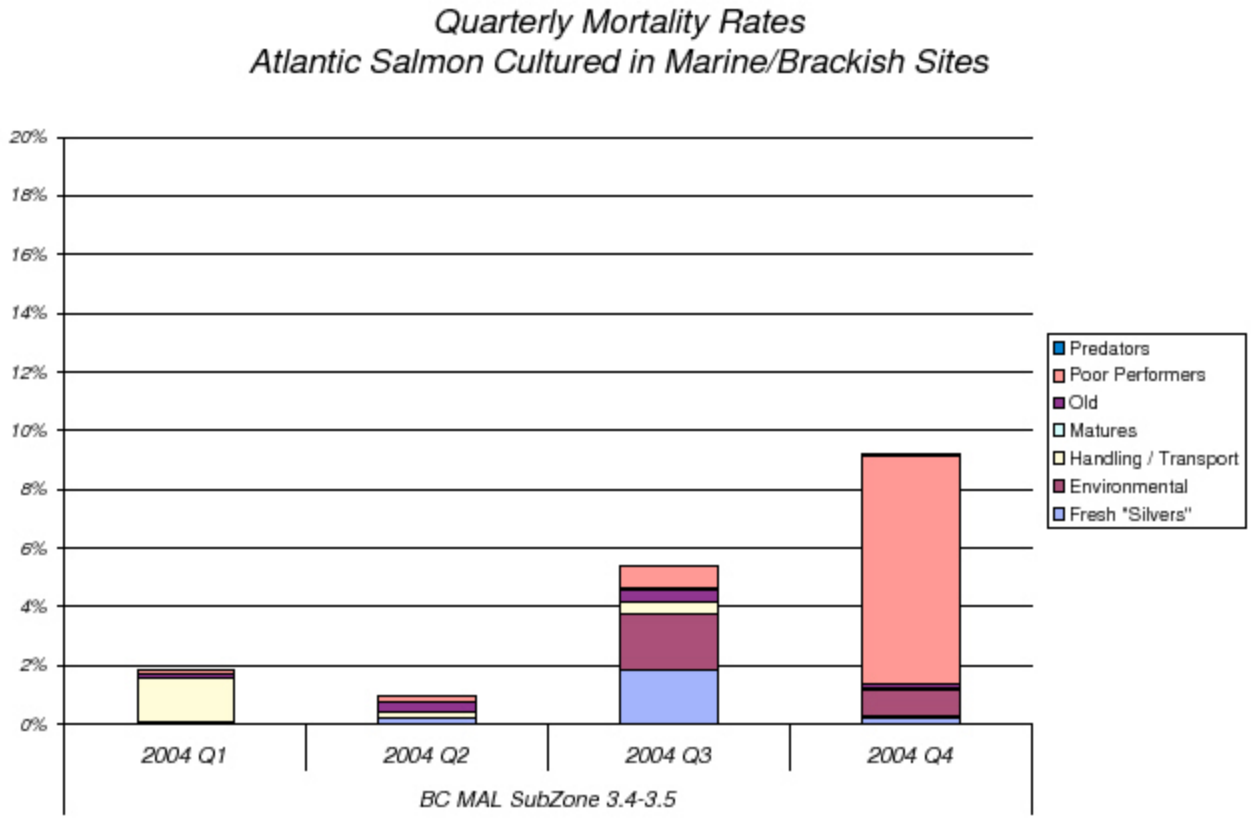
Quarterly Mortality Rates
Atlantic Salmon Cultured in Marine/Brackish Sites



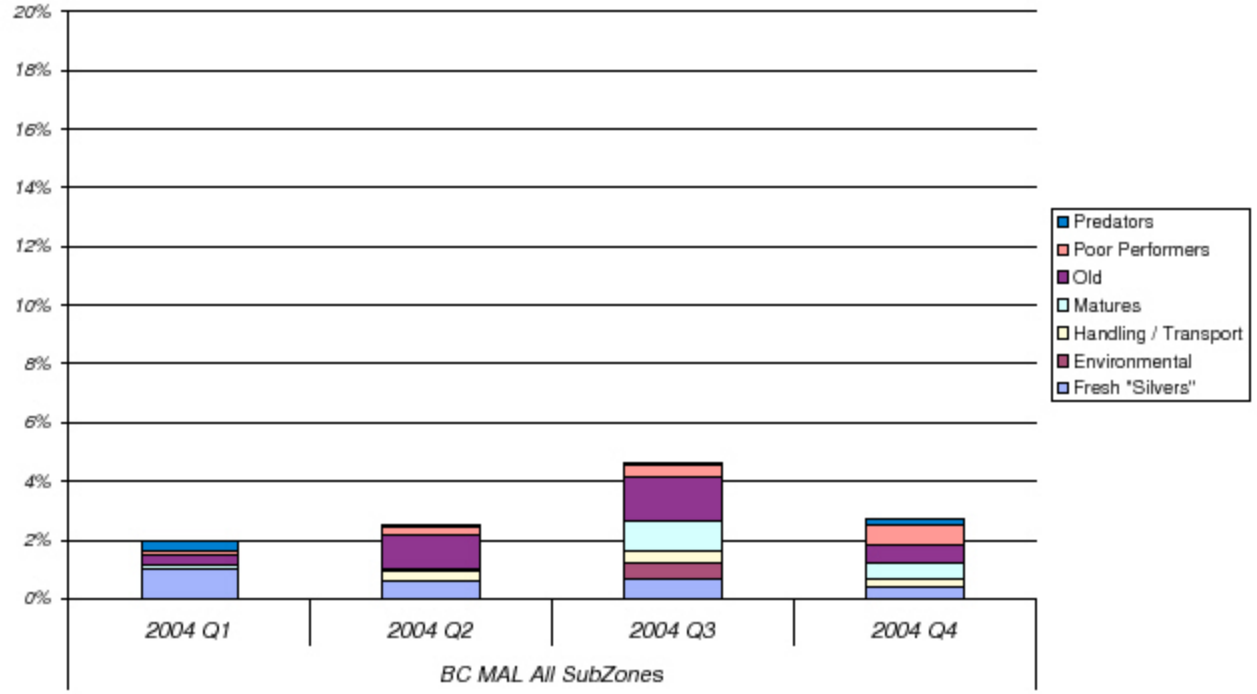

Quarterly Mortality Rates
Atlantic Salmon Cultured in Marine/Brackish Sites
20%
18%
16%
14%
12%
10%
8%
6%
4%
2%
0%
2004 Q1
2004 Q2
2004 Q3
2004 Q4
BC MAL SubZone 2.4
Predators
Poor Performers
Old
Matures
Handling / Transport
Environmental
Fresh "Silvers"


Quarterly Mortality Rates
Atlantic Salmon Cultured in Marine/Brackish Sites
20%
18%
16%
14%
12%
10%
8%
6%
4%
2%
0%
2004 Q1
2004 Q2
2004 Q3
2004 Q4
BC MAL SubZones 3.1-3.2
Predators
Poor Performers
Old
Matures
Handling / Transport
Environmental
Fresh "Silvers"

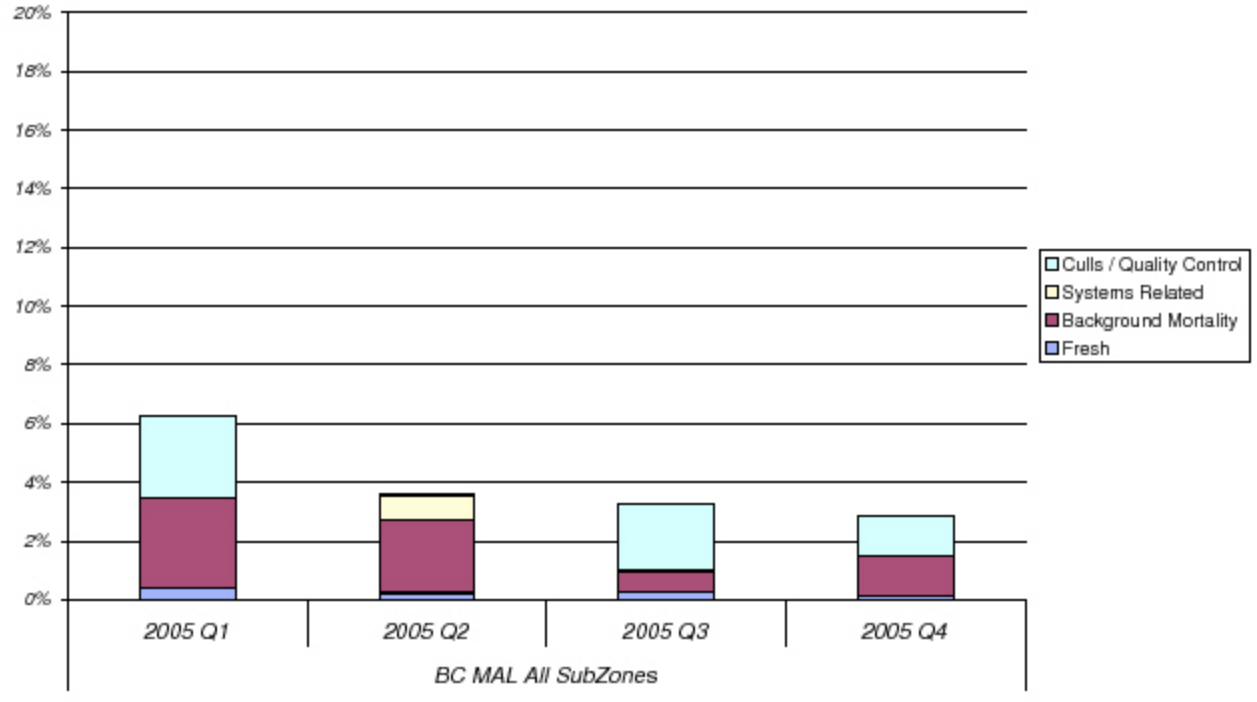

Quarterly Mortality Rates
Atlantic Salmon Cultured in Marine/Brackish Sites
20%
18%
16%
14%
12%
10%
8%
6%
4%
2%
0%
2004 Q1
2004 Q2
2004 Q3
2004 Q4
BC MAL SubZone 3.3
Predators
Poor Performers
Old
Matures
Handling / Transport
Environmental
Fresh "Silvers"


Quarterly Mortality Rates
Atlantic Salmon Cultured in Marine/Brackish Sites
20%
18%
16%
14%
12%
10%
8%
6%
4%
2%
0%
2004 Q1
2004 Q2
2004 Q3
2004 Q4
BC MAL SubZone 3.4-3.5
Predators
Poor Performers
Old
Matures
Handling / Transport
Environmental
Fresh "Silvers"

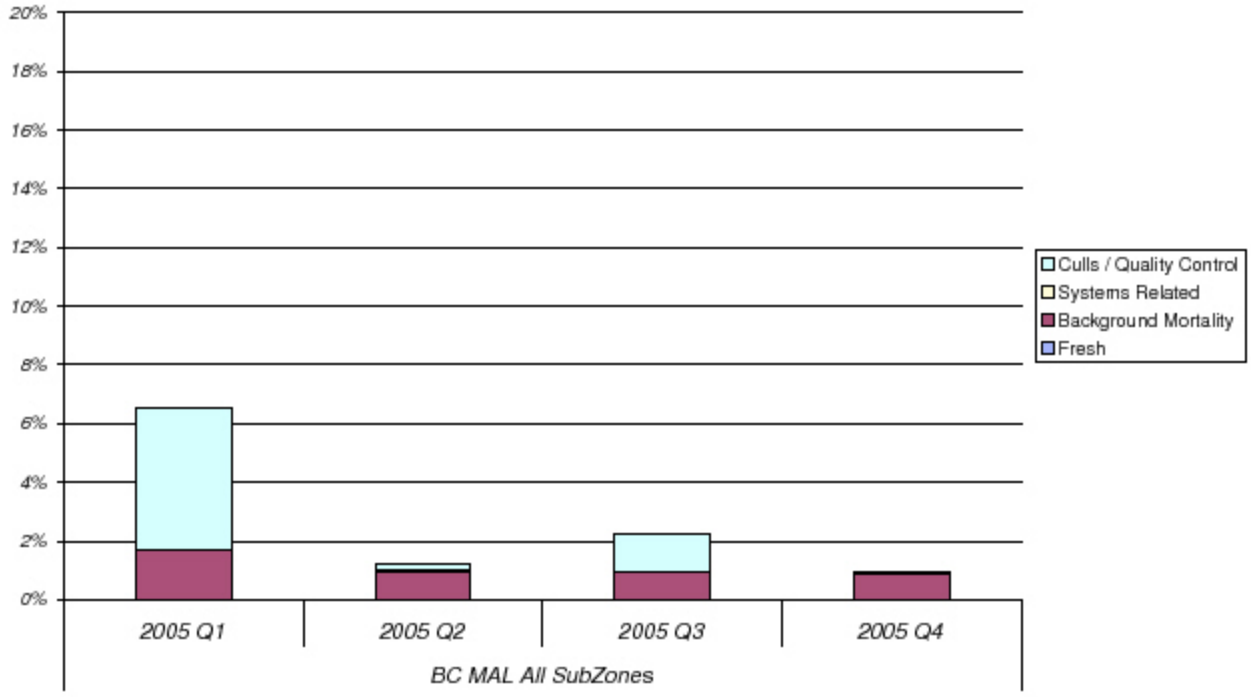
Quarterly Mortality Rates
Pacific Salmon Cultured in Marine/Brackish Sites



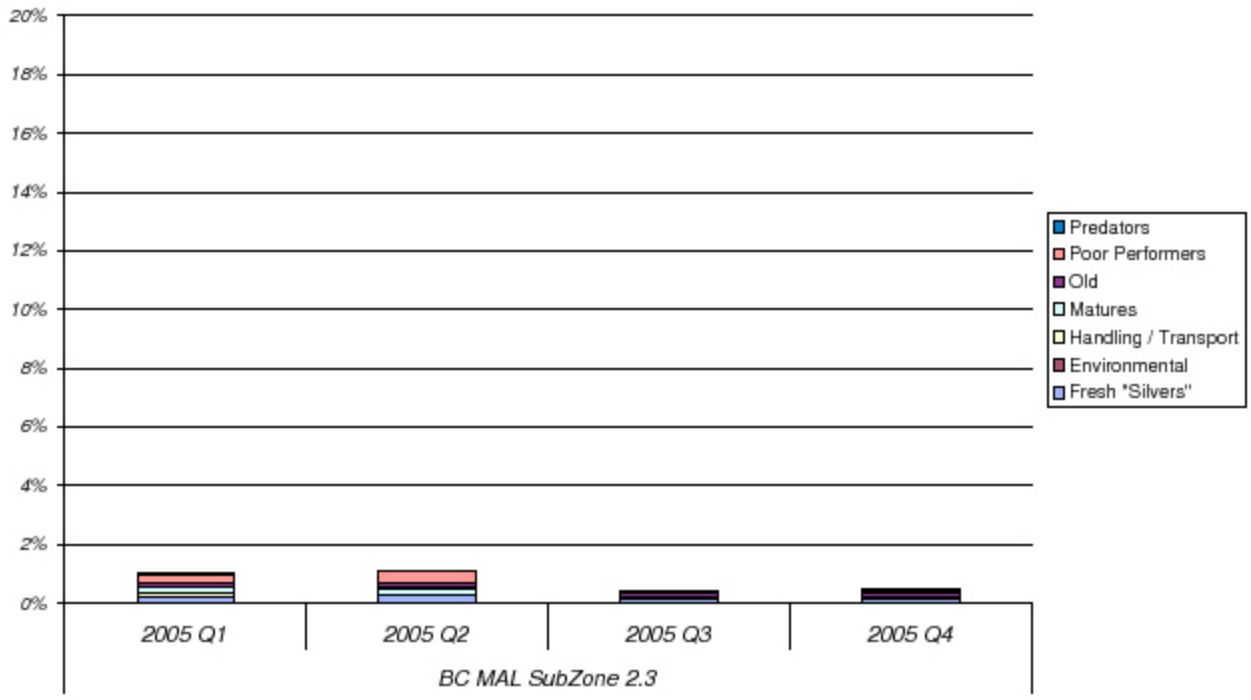
Quarterly Mortality Rates
Atlantic Salmon Cultured in Freshwater Sites

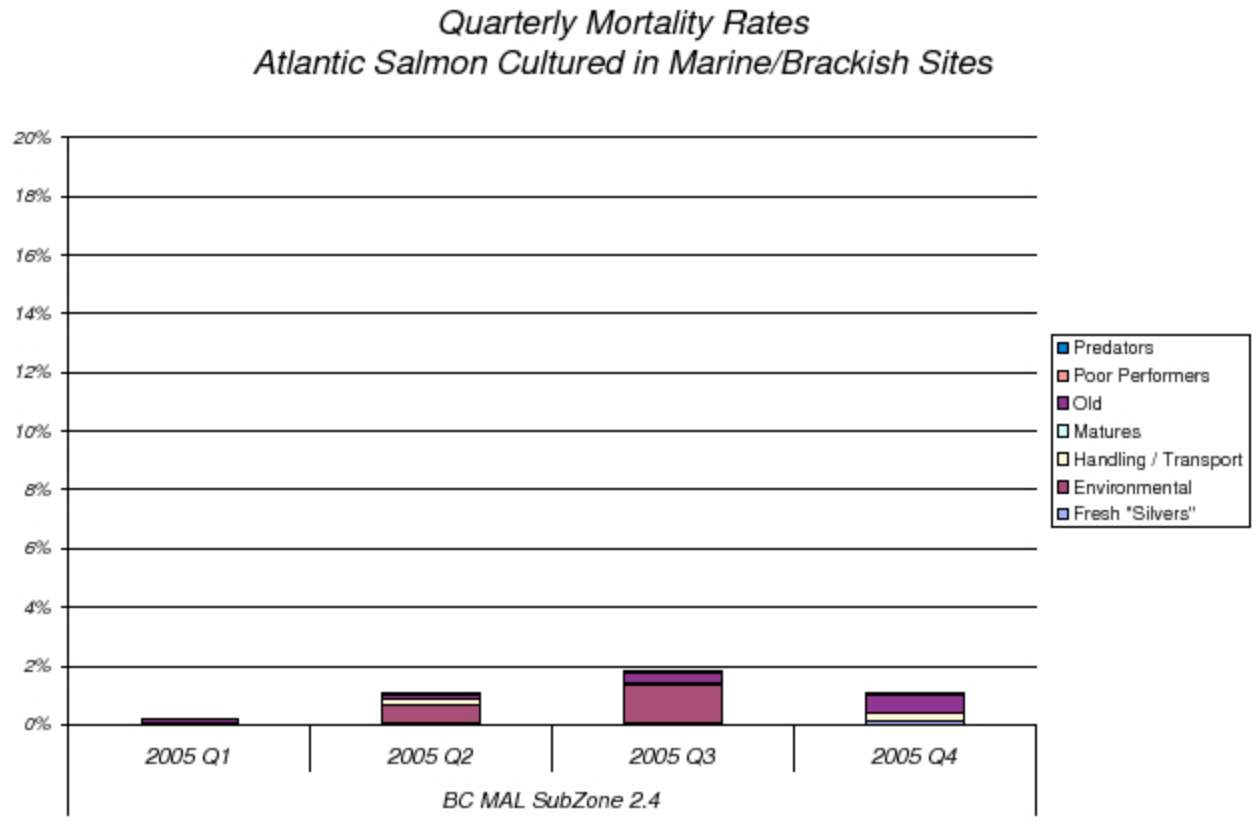


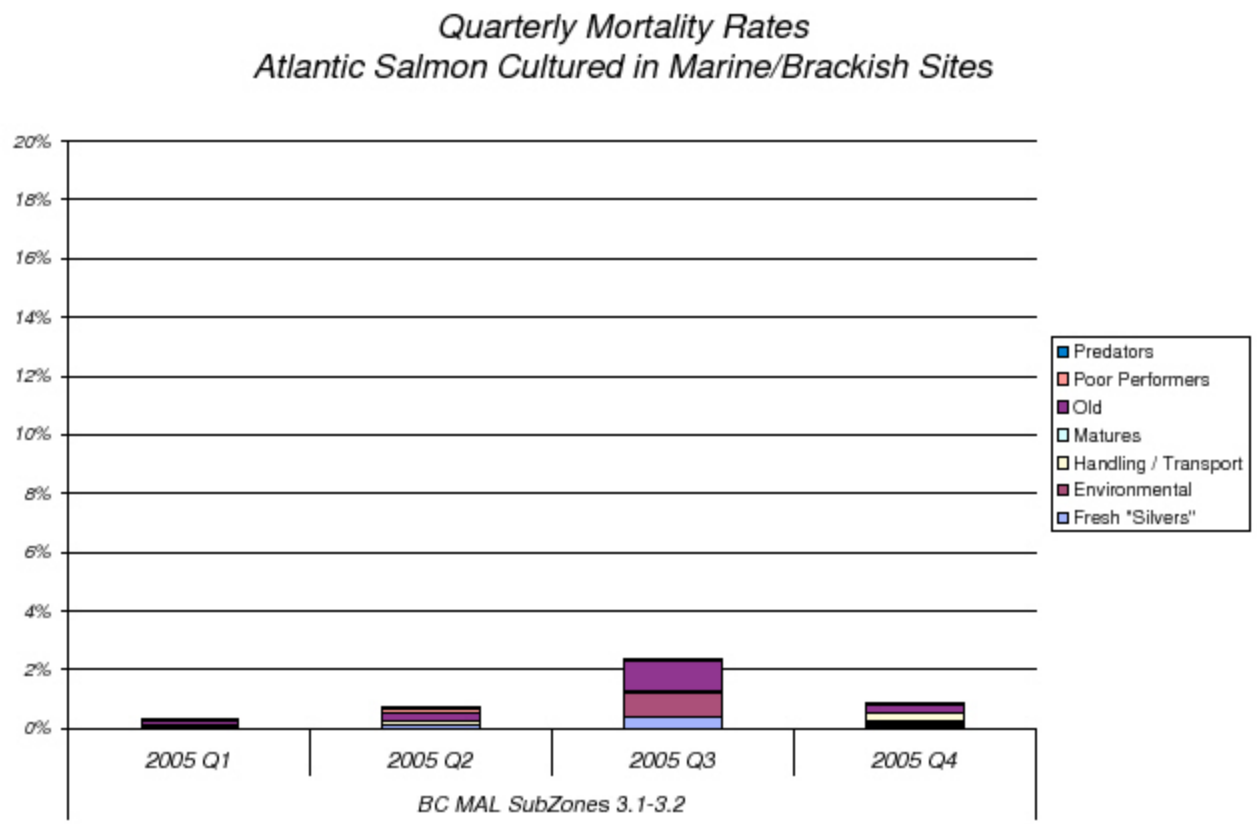
Quarterly Mortality Rates
Pacific Salmon Cultured in Freshwater Sites

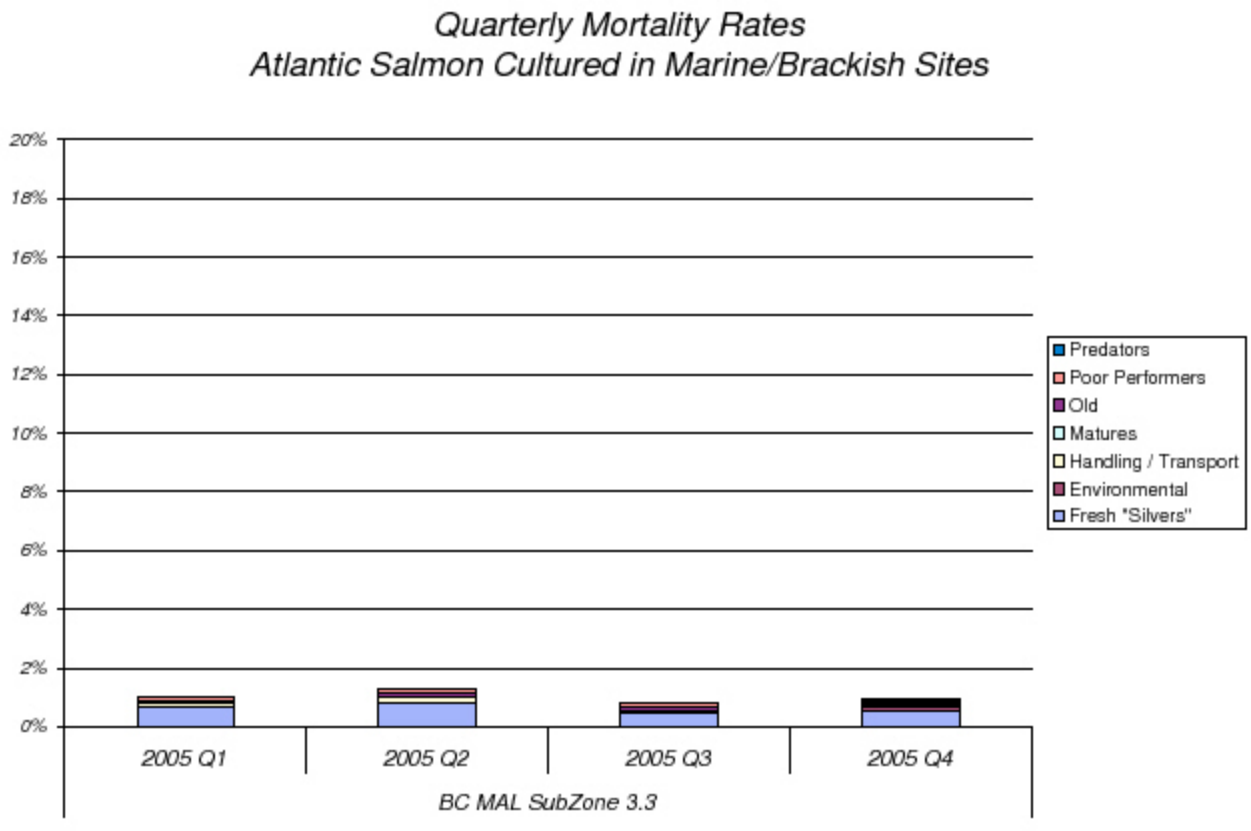


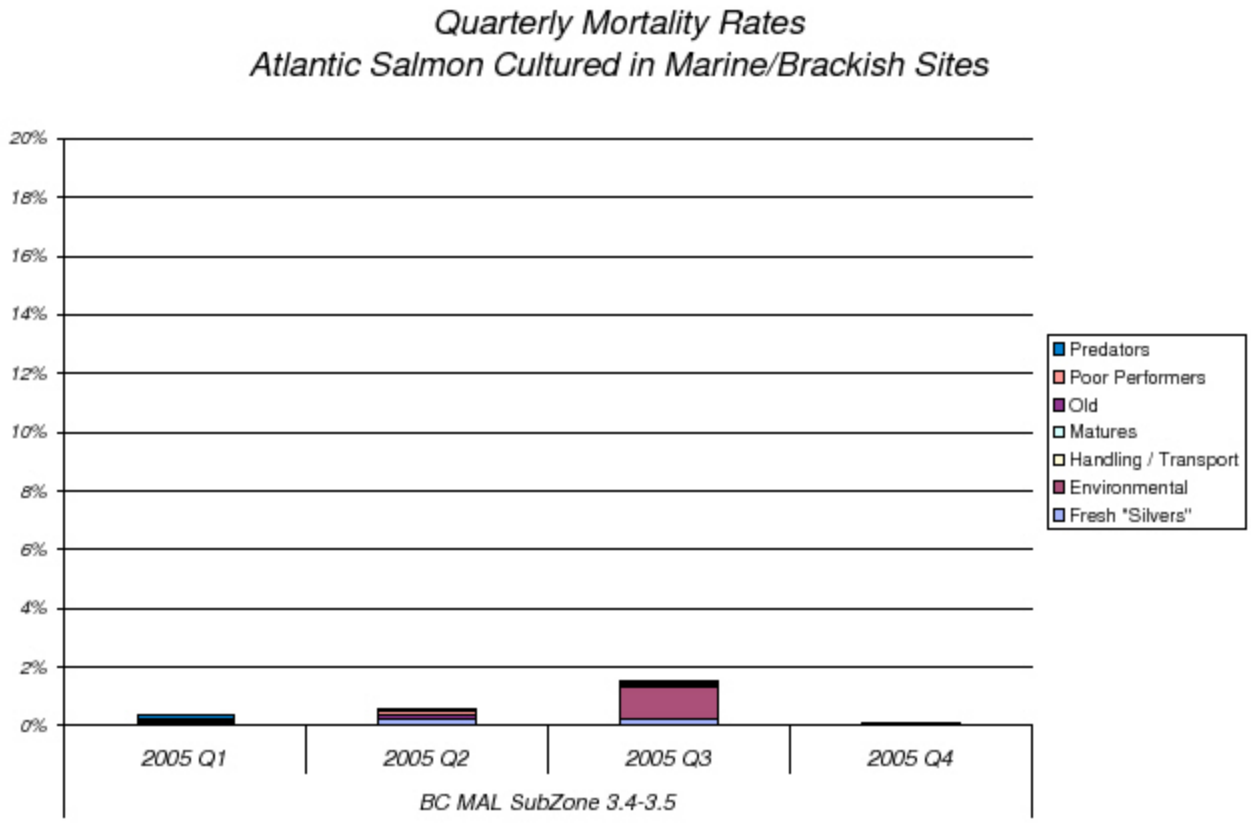
Quarterly Mortality Rates
Atlantic Salmon Cultured in Marine/Brackish Sites

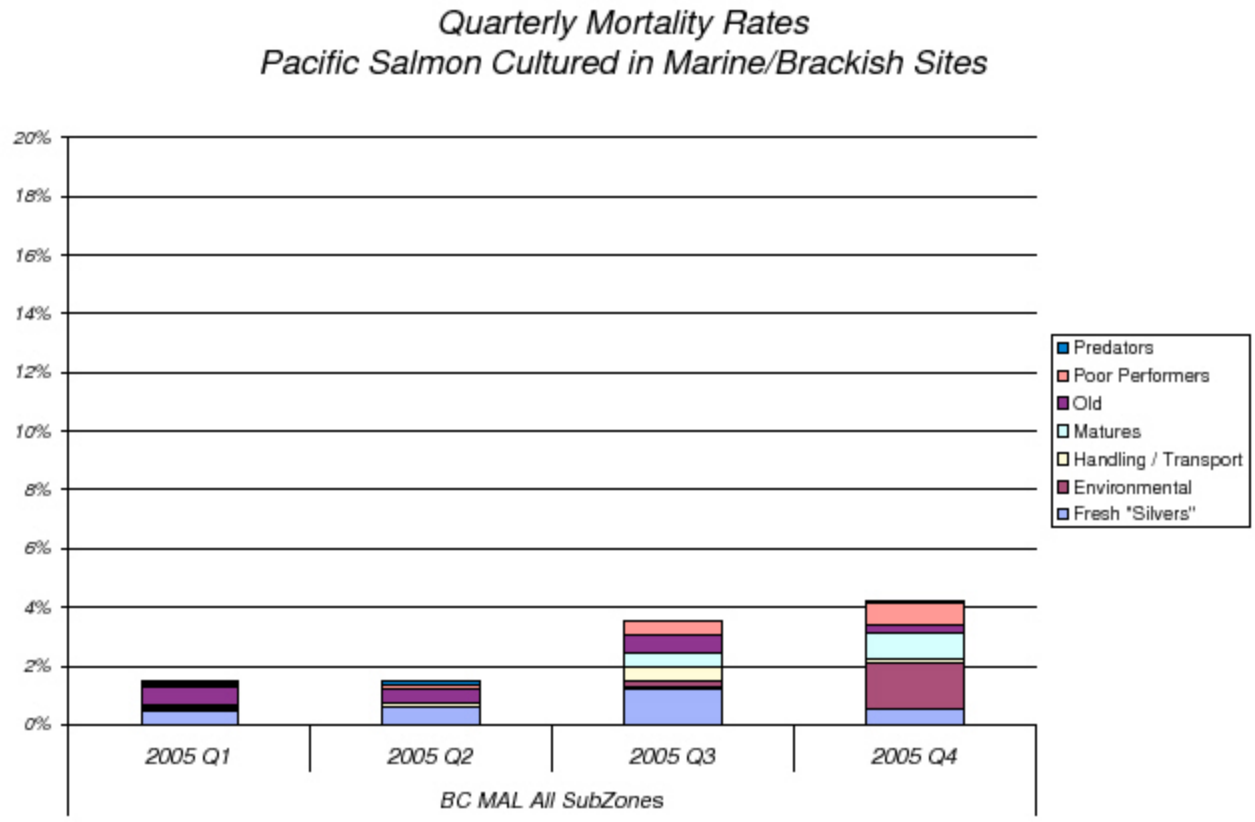



Quarterly Mortality Rates
Atlantic Salmon Cultured in Marine/Brackish Sites
20%
18%
16%
14%
12%
10%
8%
6%
4%
2%
0%
2005 Q1
2005 Q2
2005 Q3
2005 Q4
BC MAL SubZone 2.4
Predators
Poor Performers
Old
Matures
Handling / Transport
Environmental
Fresh "Silvers"


Quarterly Mortality Rates
Atlantic Salmon Cultured in Marine/Brackish Sites
20%
18%
16%
14%
12%
10%
8%
6%
4%
2%
0%
2005 Q1
2005 Q2
2005 Q3
2005 Q4
BC MAL SubZones 3.1-3.2
Predators
Poor Performers
Old
Matures
Handling / Transport
Environmental
Fresh "Silvers"


Quarterly Mortality Rates
Atlantic Salmon Cultured in Marine/Brackish Sites
20%
18%
16%
14%
12%
10%
8%
6%
4%
2%
0%
2005 Q1
2005 Q2
2005 Q3
2005 Q4
BC MAL SubZone 3.3
Predators
Poor Performers
Old
Matures
Handling / Transport
Environmental
Fresh "Silvers"

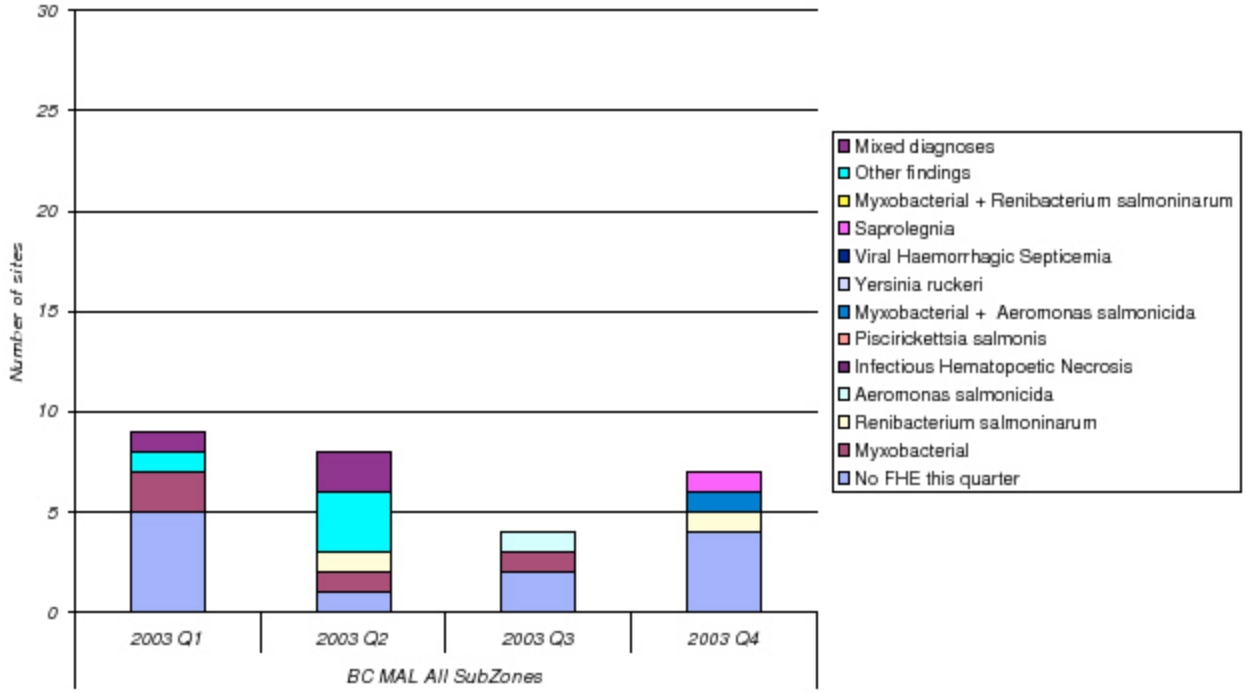

Quarterly Mortality Rates
Atlantic Salmon Cultured in Marine/Brackish Sites
20%
18%
16%
14%
12%
10%
8%
6%
4%
2%
0%
2005 Q1
2005 Q2
2005 Q3
2005 Q4
BC MAL SubZone 3.4-3.5
Predators
Poor Performers
Old
Matures
Handling / Transport
Environmental
Fresh "Silvers"


Quarterly Mortality Rates
Pacific Salmon Cultured in Marine/Brackish Sites
20%
18%
16%
14%
12%
10%
8%
6%
4%
2%
0%
2005 Q1
2005 Q2
2005 Q3
2005 Q4
BC MAL All SubZones
Predators
Poor Performers
Old
Matures
Handling / Transport
Environmental
Fresh "Silvers"

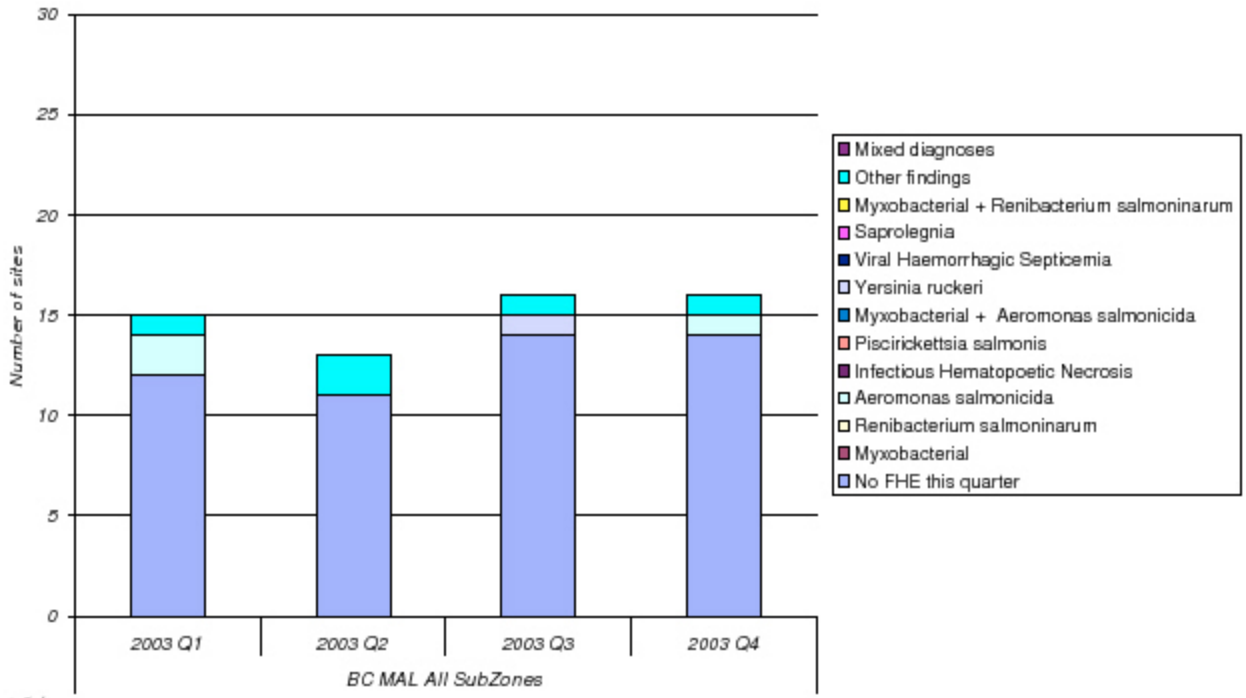
7.9 APPENDIX 9:

Summary of BCSFA Fish Health Events 2003 - 2005

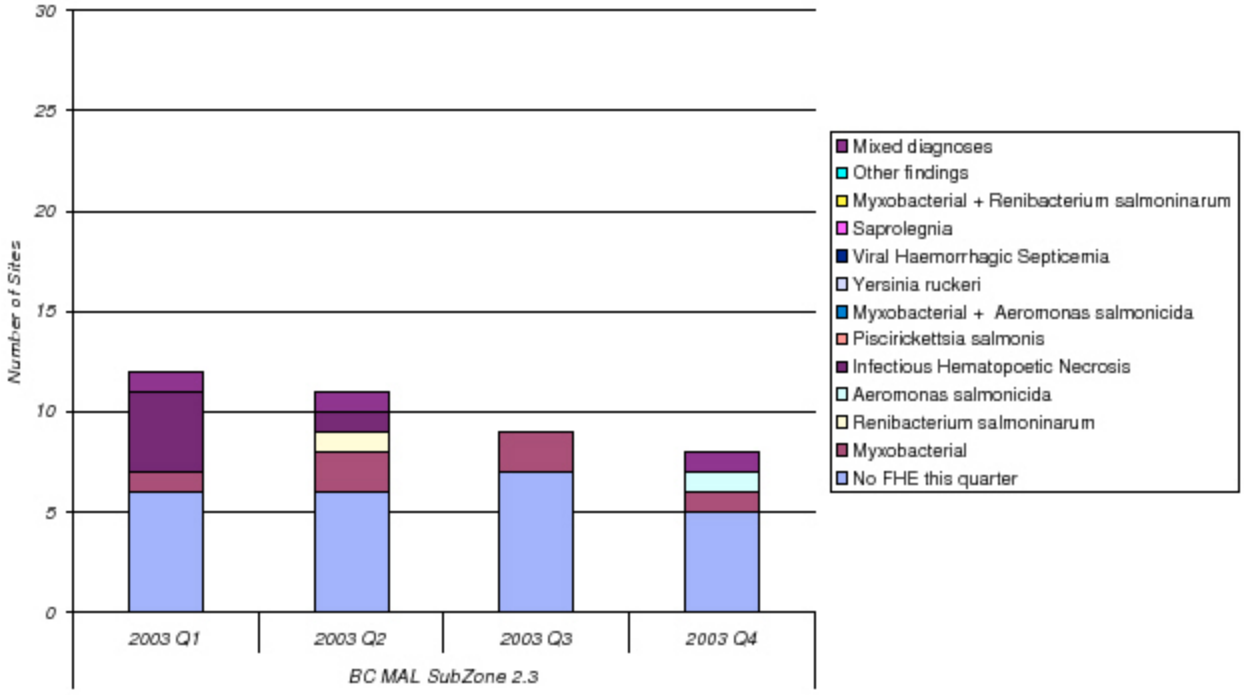
Fish Health Events
Pacific Salmon Cultured in Freshwater Sites



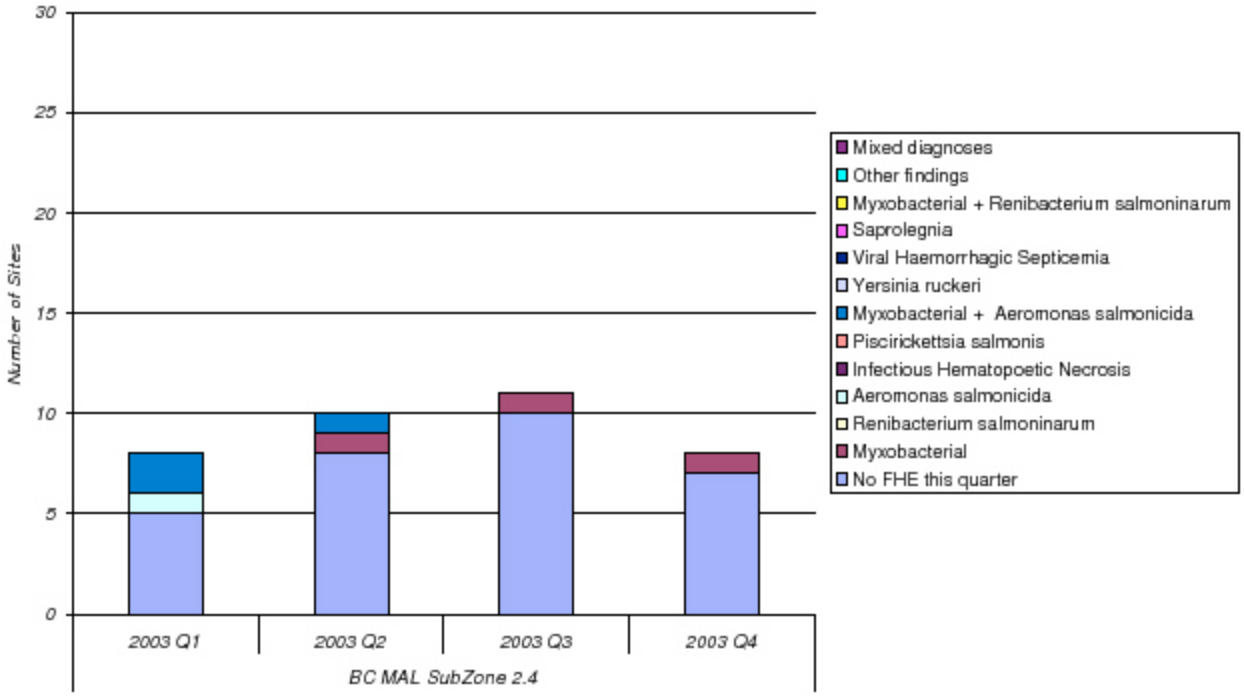
Fish Health Events
Atlantic Salmon Cultured in Freshwater Sites

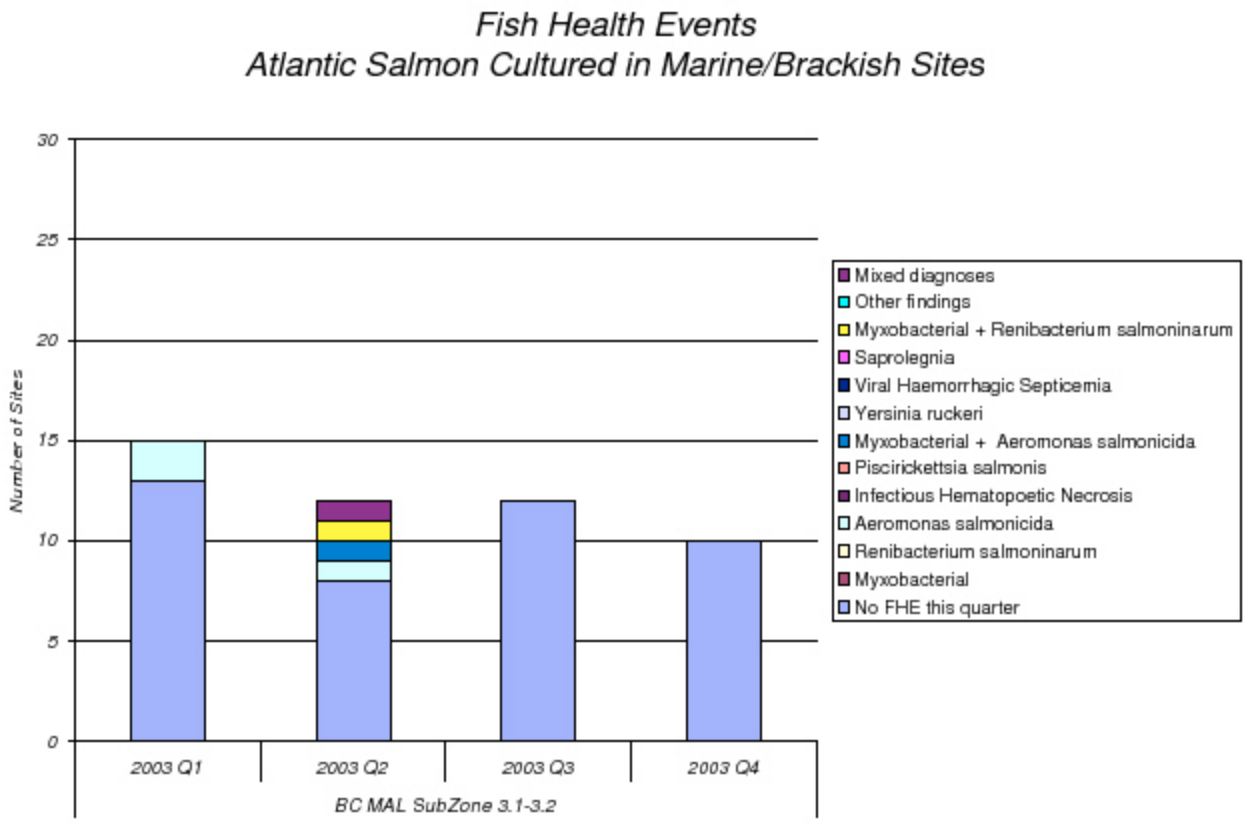


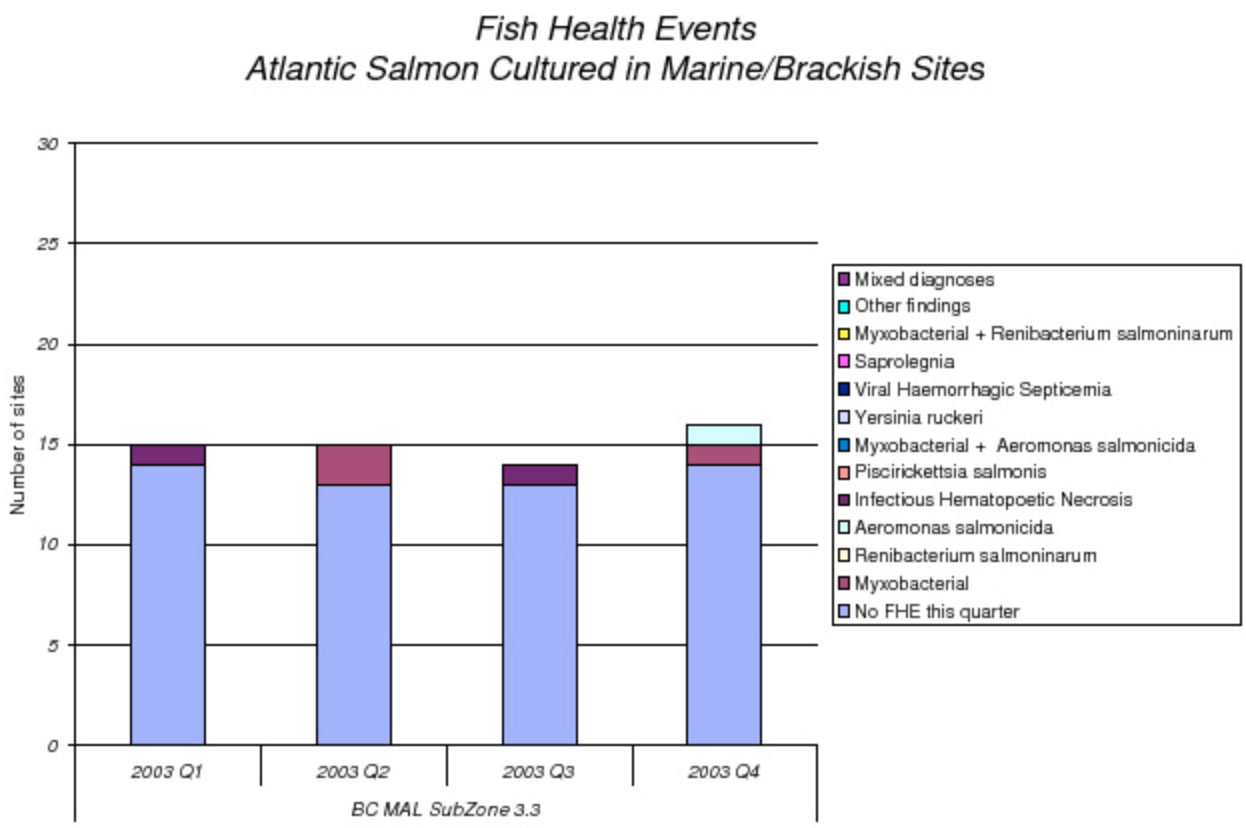
Fish Health Events
Atlantic Salmon Cultured in Marine/Brackish Sites



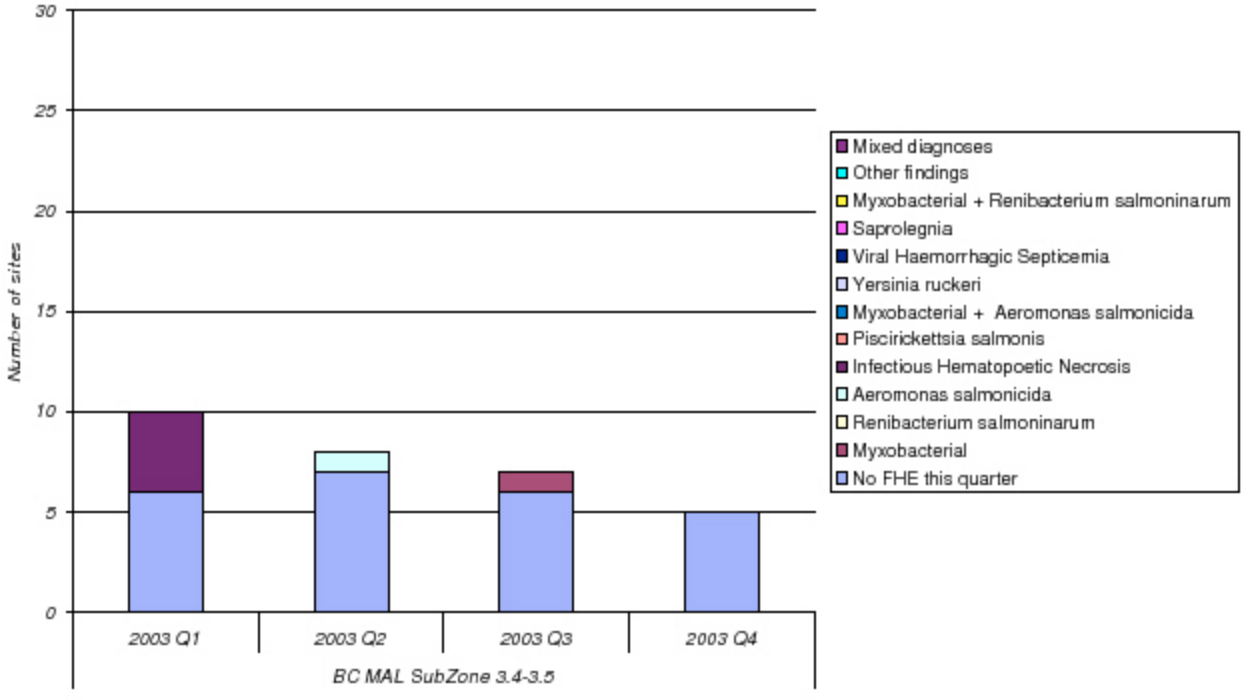
Fish Health Events
Atlantic Salmon Cultured in Marine/Brackish Sites



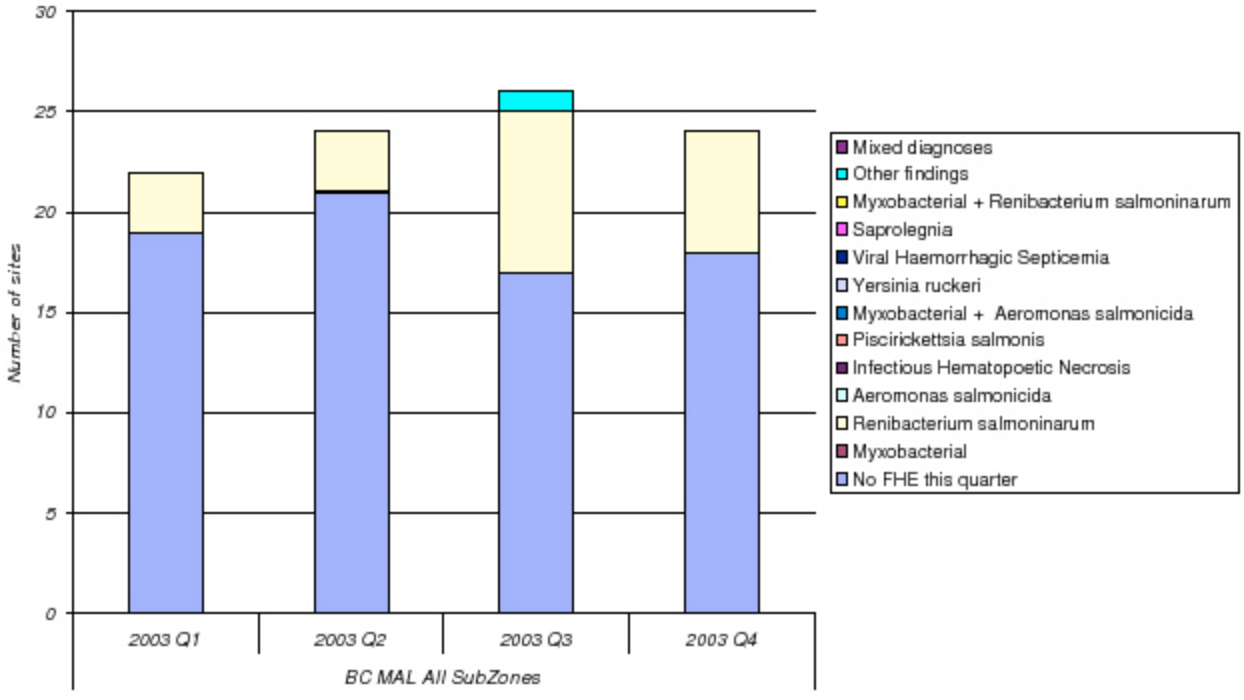

Fish Health Events
Atlantic Salmon Cultured in Marine/Brackish Sites
Number of Sites
30
25
20
15
10
5
0
2003 Q1
2003 Q2
2003 Q3
2003 Q4
BC MAL SubZone 3.1-3.2
Mixed diagnoses
Other findings
Myxobacterial + Renibacterium salmoninarum
Saprolegnia
Viral Haemorrhagic Septicemia
Yersinia ruckeri
Myxobacterial + Aeromonas salmonicida
Piscirickettsia salmonis
Infectious Hematopoetic Necrosis
Aeromonas salmonicida
Renibacterium salmoninarum
Myxobacterial
No FHE this quarter


Fish Health Events
Atlantic Salmon Cultured in Marine/Brackish Sites
Number of sites
30
25
20
15
10
5
0
2003 Q1
2003 Q2
2003 Q3
2003 Q4
BC MAL SubZone 3.3
Mixed diagnoses
Other findings
Myxobacterial + Renibacterium salmoninarum
Saprolegnia
Viral Haemorrhagic Septicemia
Yersinia ruckeri
Myxobacterial + Aeromonas salmonicida
Piscirickettsia salmonis
Infectious Hematopoetic Necrosis
Aeromonas salmonicida
Renibacterium salmoninarum
Myxobacterial
No FHE this quarter

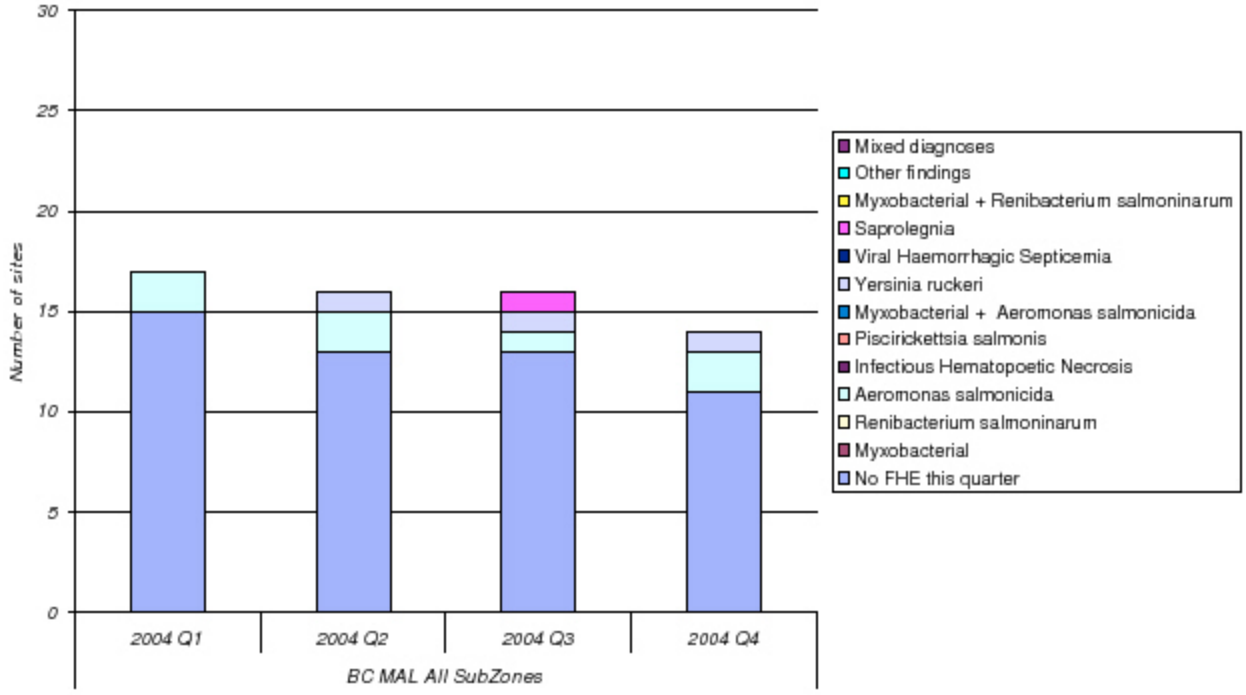
Fish Health Events
Atlantic Salmon Cultured in Marine/Brackish Sites



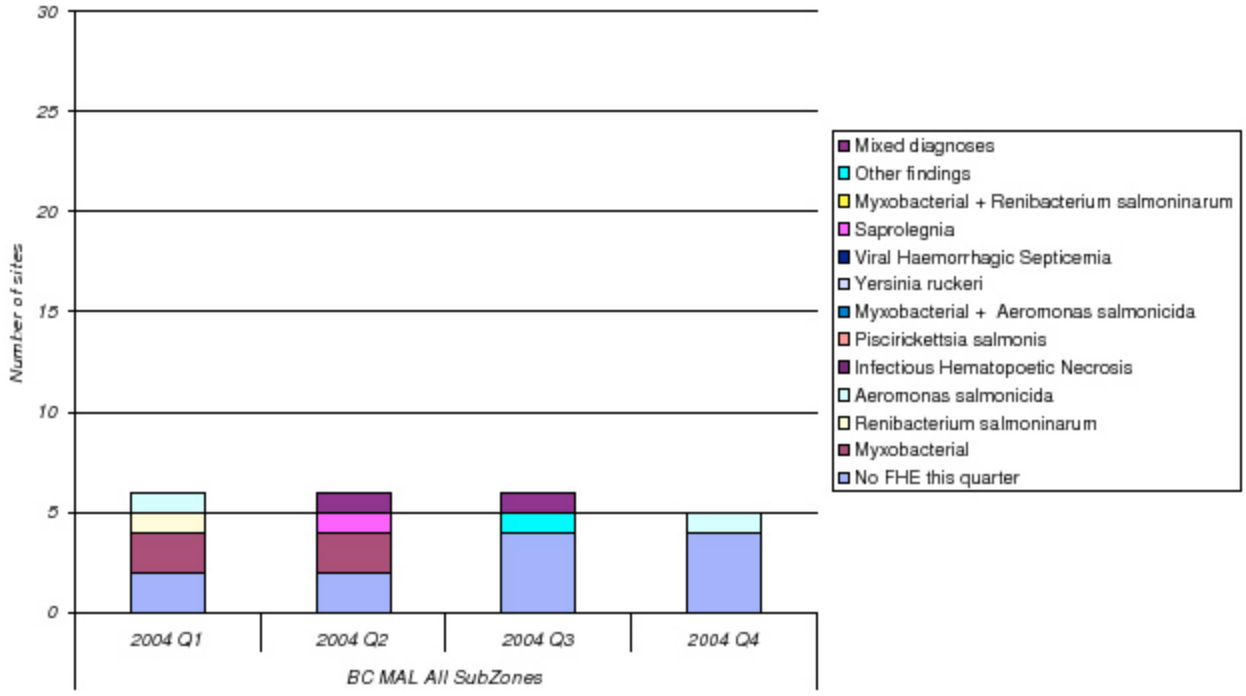
Fish Health Events
Pacific Salmon Cultured in Marine/Brackish Sites



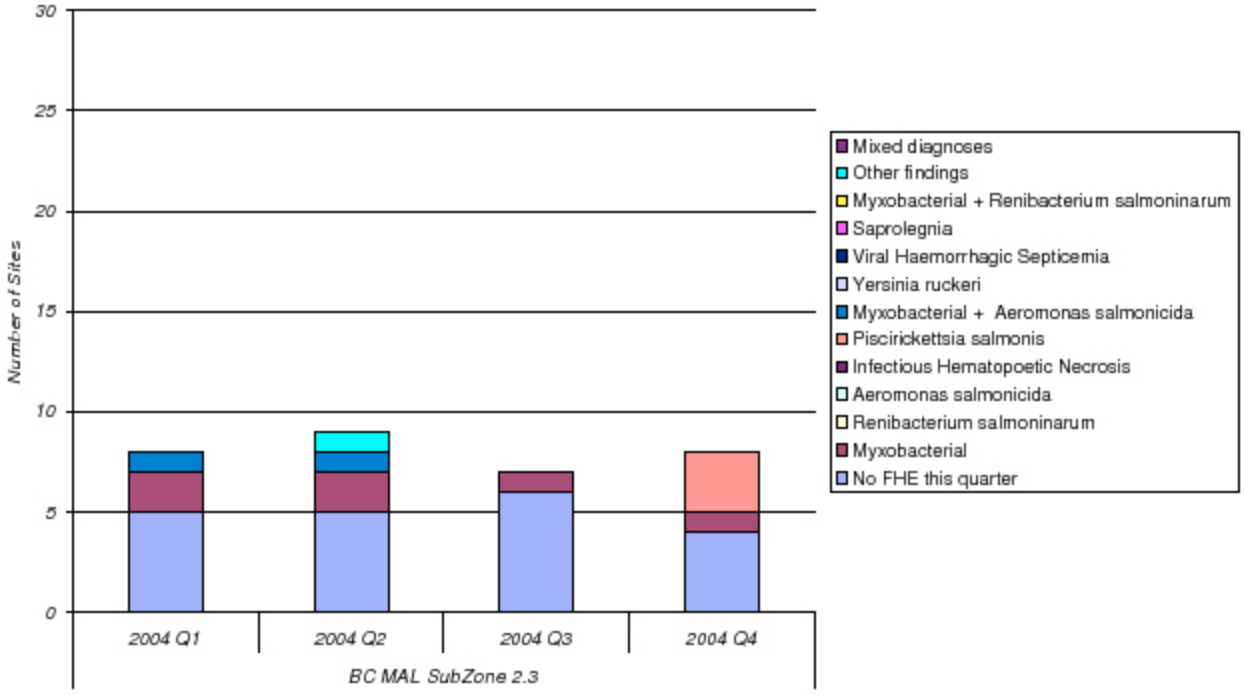
Fish Health Events
Atlantic Salmon Cultured in Freshwater Sites



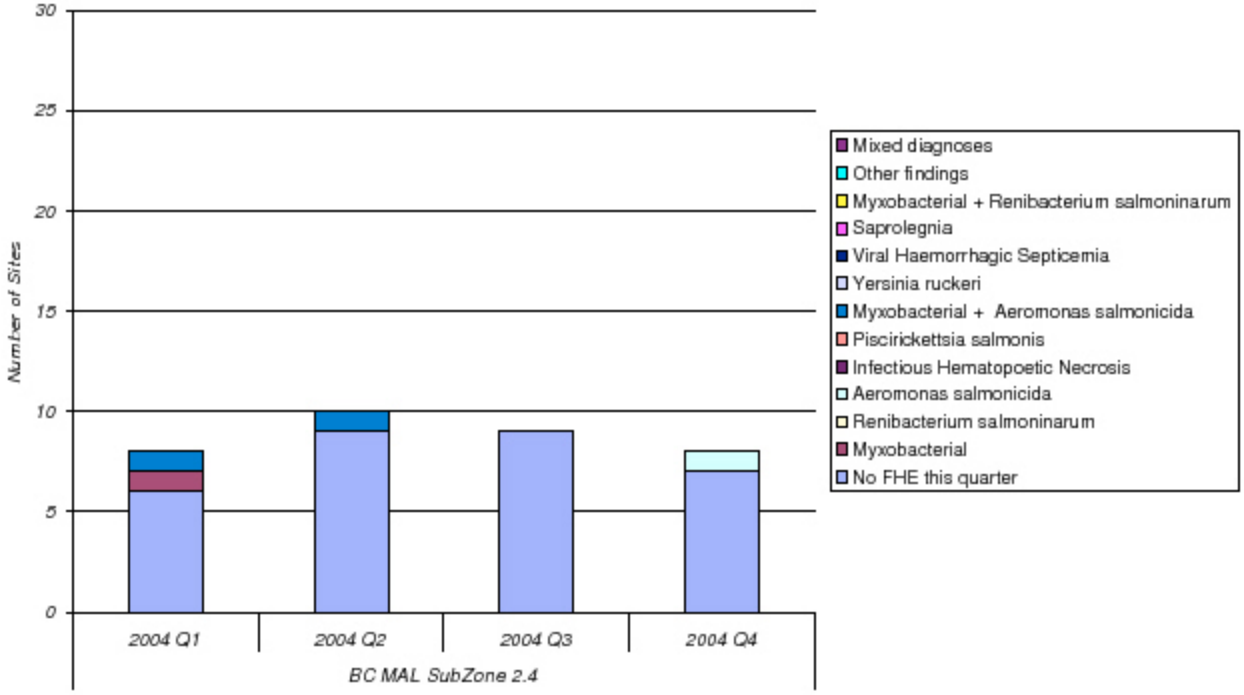
Fish Health Events
Pacific Salmon Cultured in Freshwater Sites

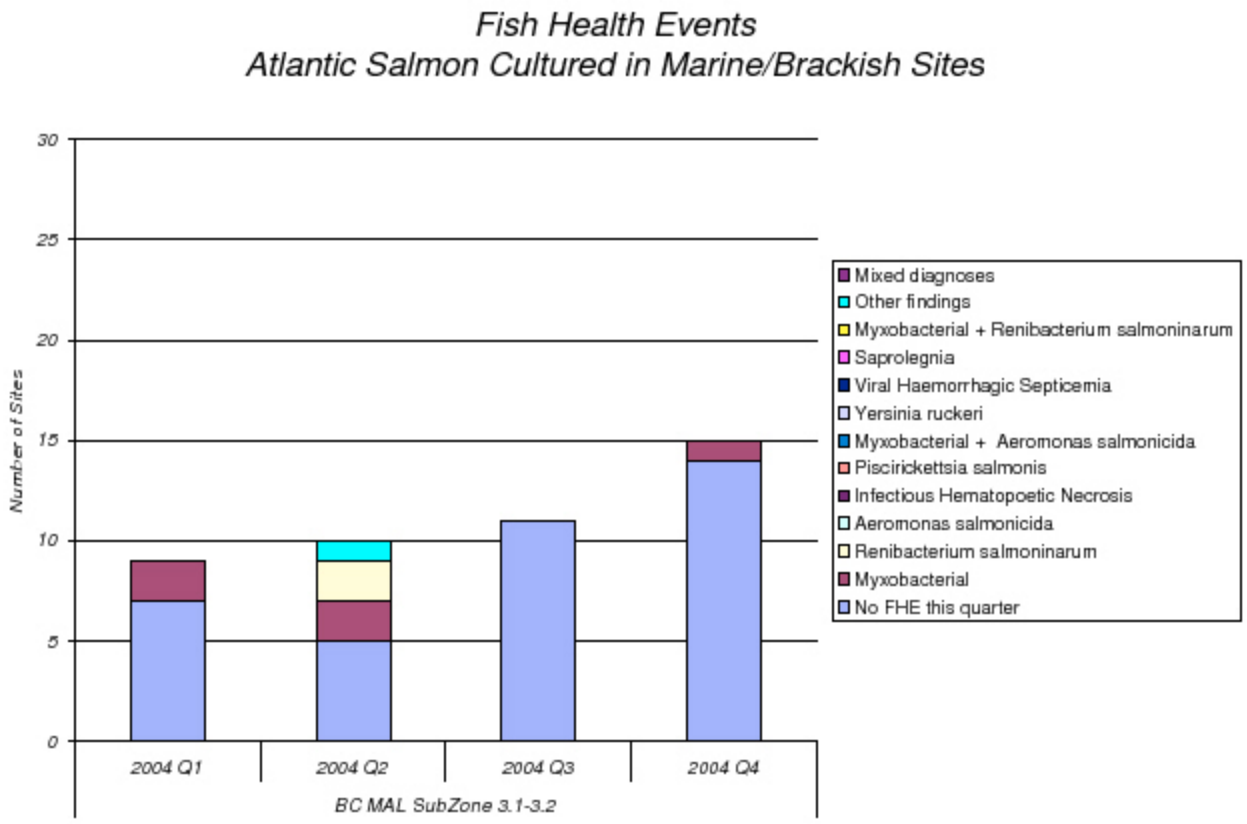


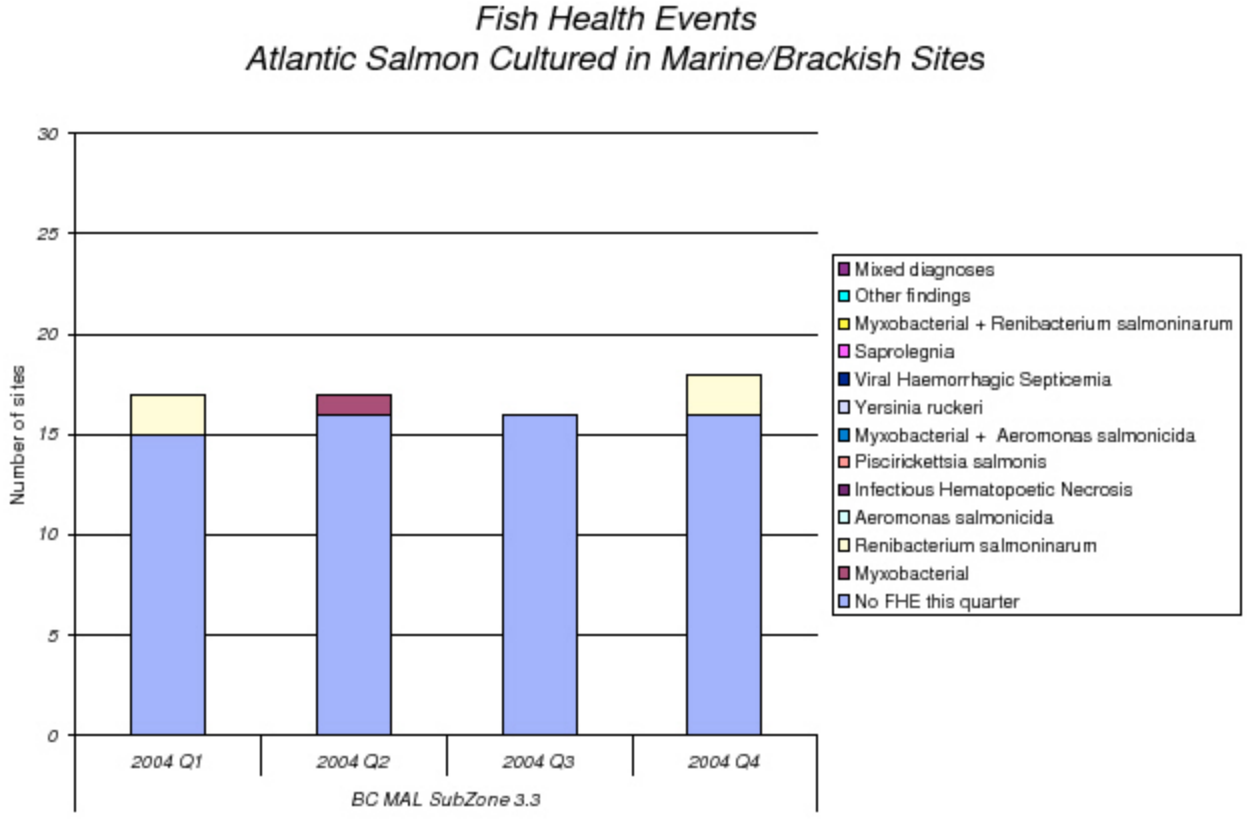
Fish Health Events
Atlantic Salmon Cultured in Marine/Brackish Sites



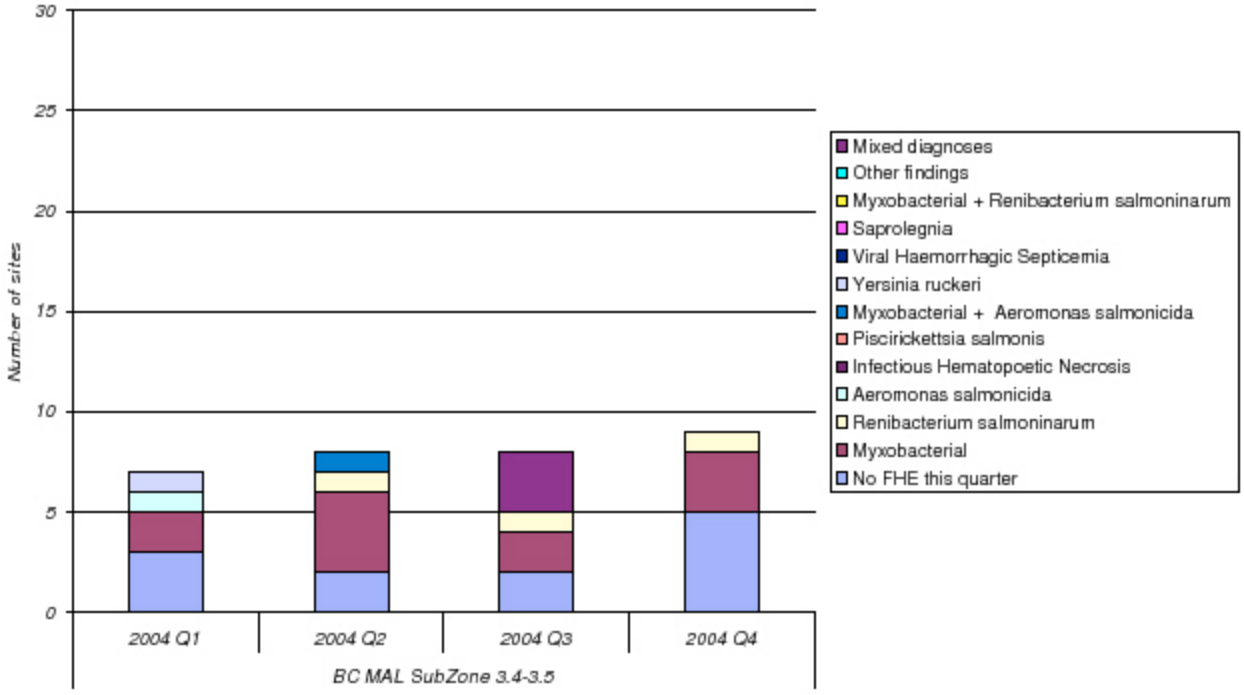
Fish Health Events
Atlantic Salmon Cultured in Marine/Brackish Sites



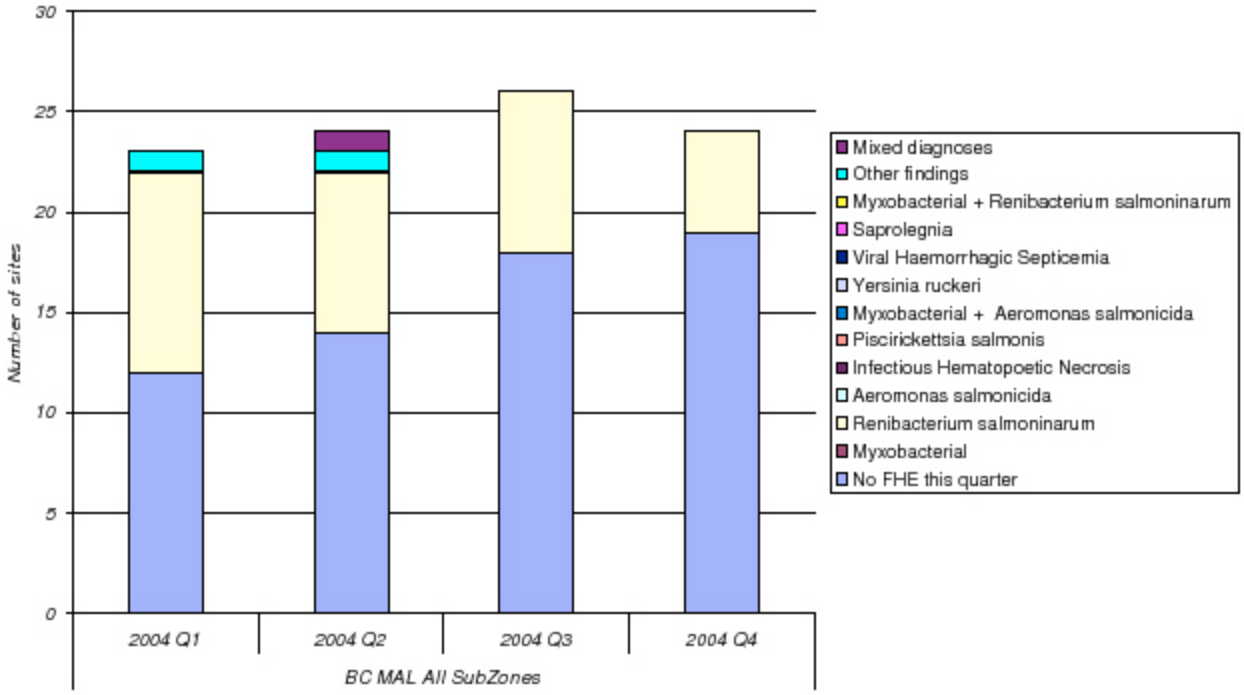

Fish Health Events
Atlantic Salmon Cultured in Marine/Brackish Sites
Number of Sites
30
25
20
15
10
5
0
2004 Q1
2004 Q2
2004 Q3
2004 Q4
BC MAL SubZone 3.1-3.2
Mixed diagnoses
Other findings
Myxobacterial + Renibacterium salmoninarum
Saprolegnia
Viral Haemorrhagic Septicemia
Yersinia ruckeri
Myxobacterial + Aeromonas salmonicida
Piscirickettsia salmonis
Infectious Hematopoetic Necrosis
Aeromonas salmonicida
Renibacterium salmoninarum
Myxobacterial
No FHE this quarter


Fish Health Events
Atlantic Salmon Cultured in Marine/Brackish Sites
Number of sites
30
25
20
15
10
5
0
2004 Q1
2004 Q2
2004 Q3
2004 Q4
BC MAL SubZone 3.3
Mixed diagnoses
Other findings
Myxobacterial + Renibacterium salmoninarum
Saprolegnia
Viral Haemorrhagic Septicemia
Yersinia ruckeri
Myxobacterial + Aeromonas salmonicida
Piscirickettsia salmonis
Infectious Hematopoetic Necrosis
Aeromonas salmonicida
Renibacterium salmoninarum
Myxobacterial
No FHE this quarter

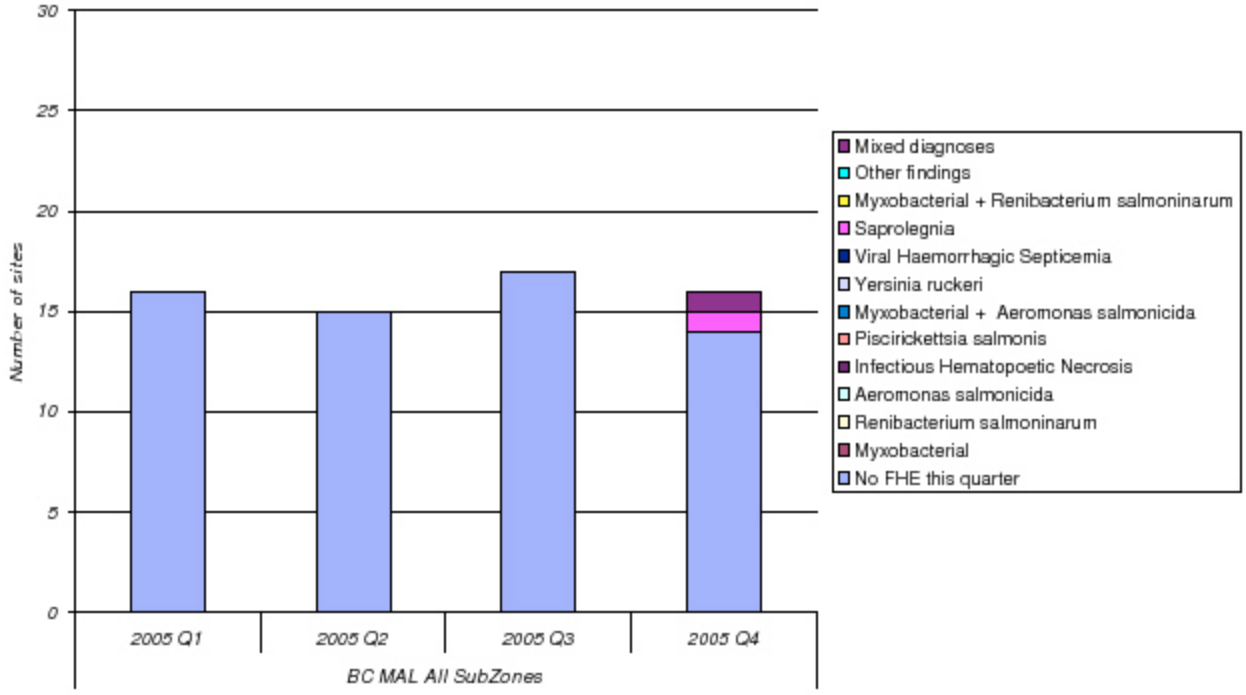
Fish Health Events
Atlantic Salmon Cultured in Marine/Brackish Sites



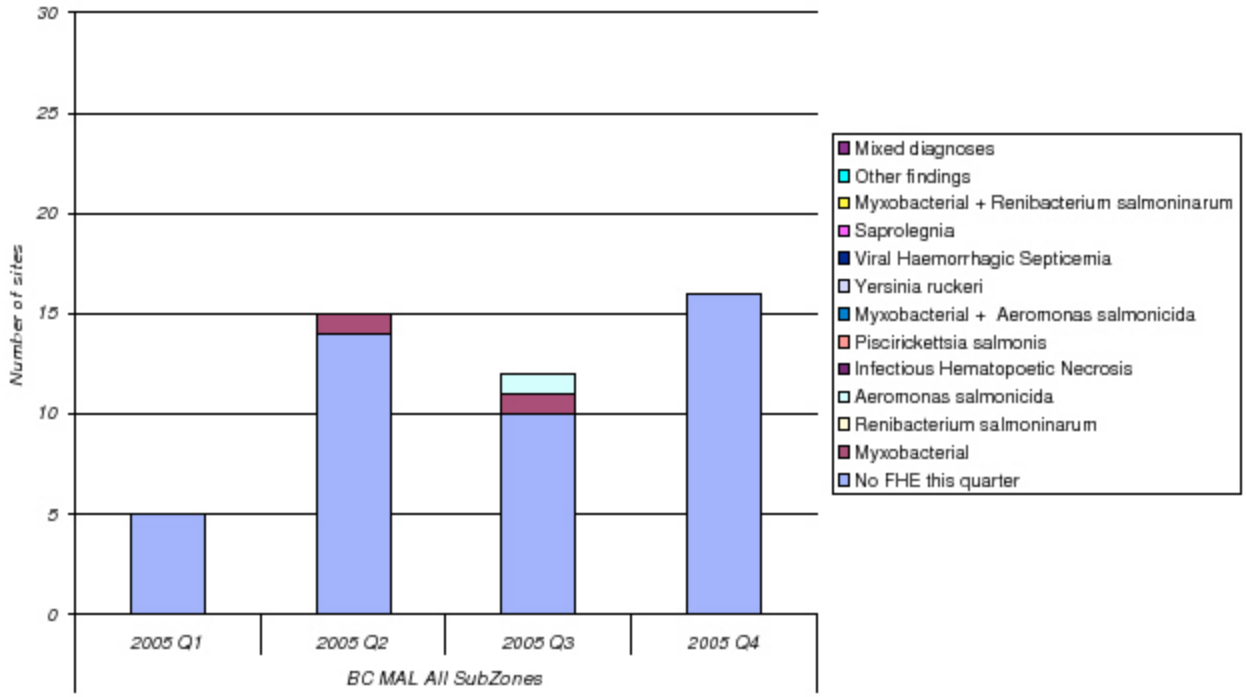
Fish Health Events
Pacific Salmon Cultured in Marine/Brackish Sites



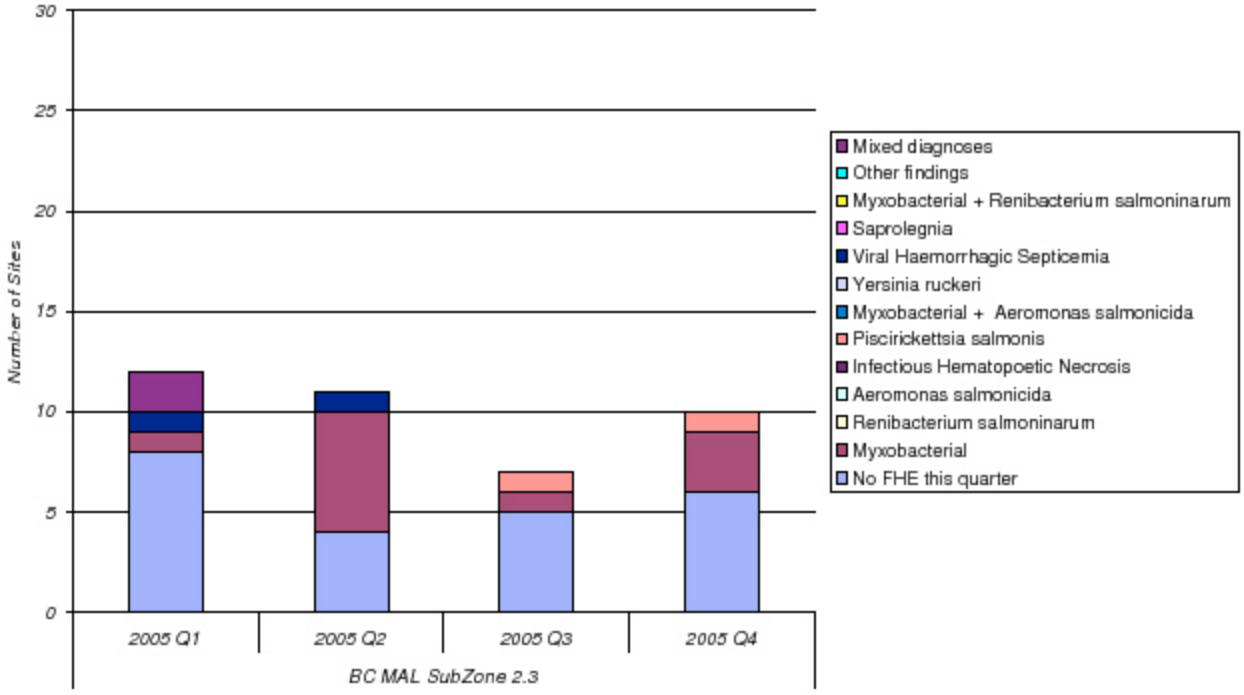
Fish Health Events
Atlantic Salmon Cultured in Freshwater Sites



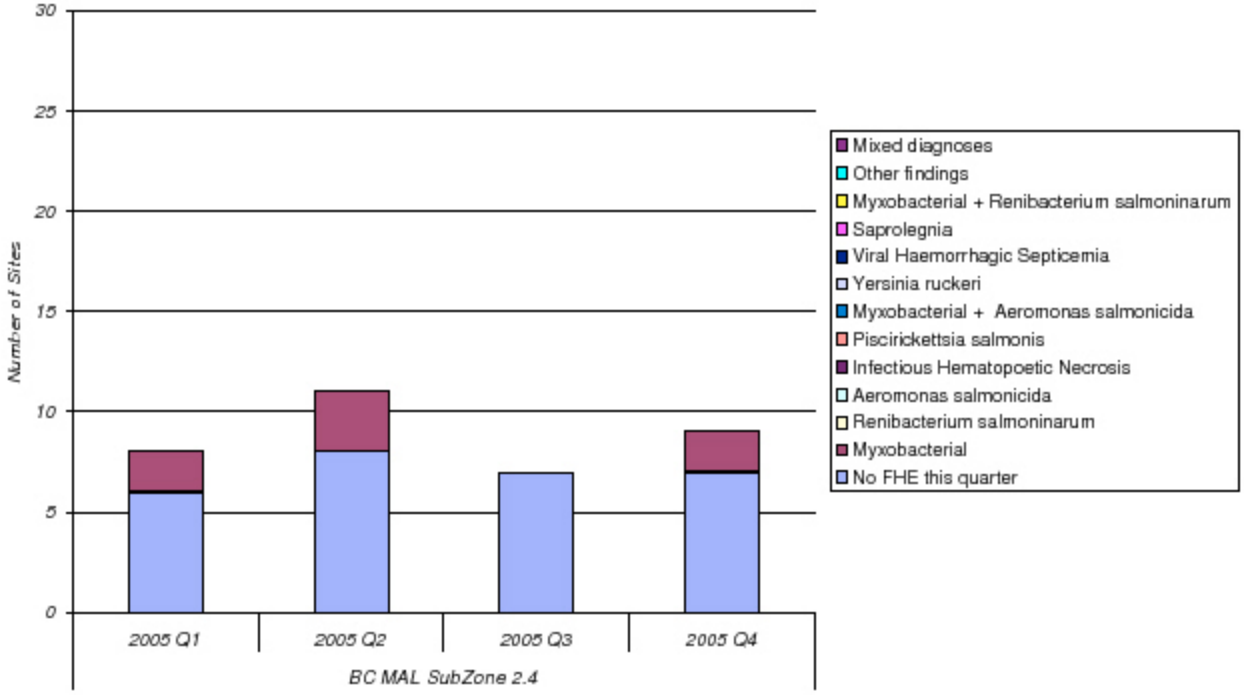
Fish Health Events
Pacific Salmon Cultured in Freshwater Sites

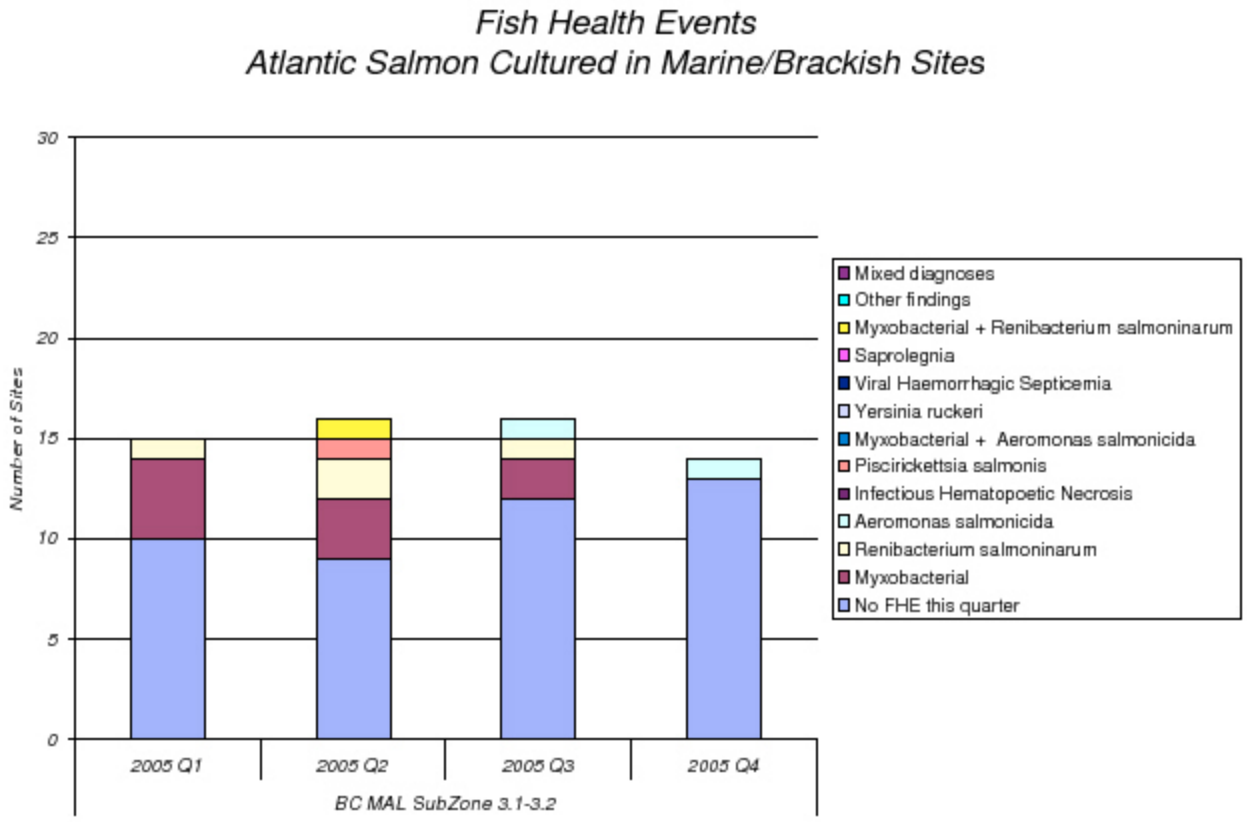


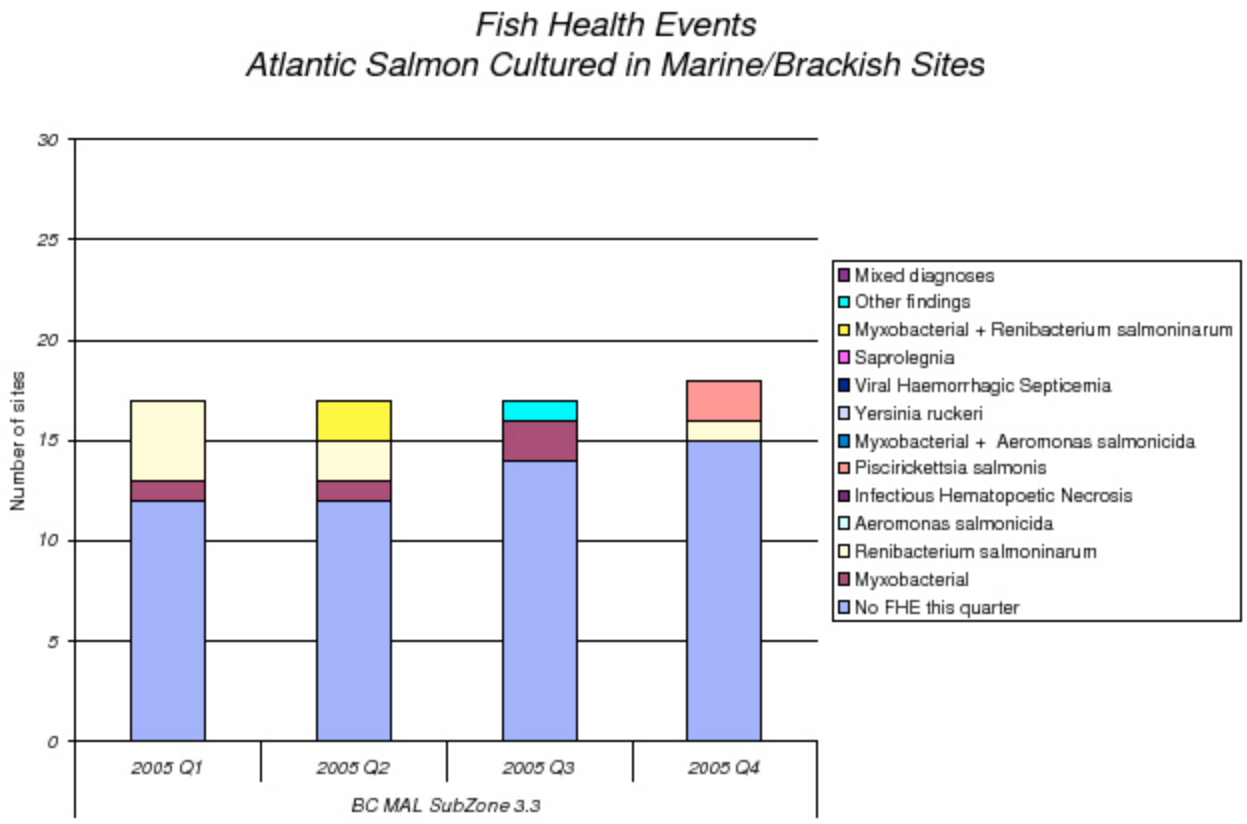
Fish Health Events
Atlantic Salmon Cultured in Marine/Brackish Sites



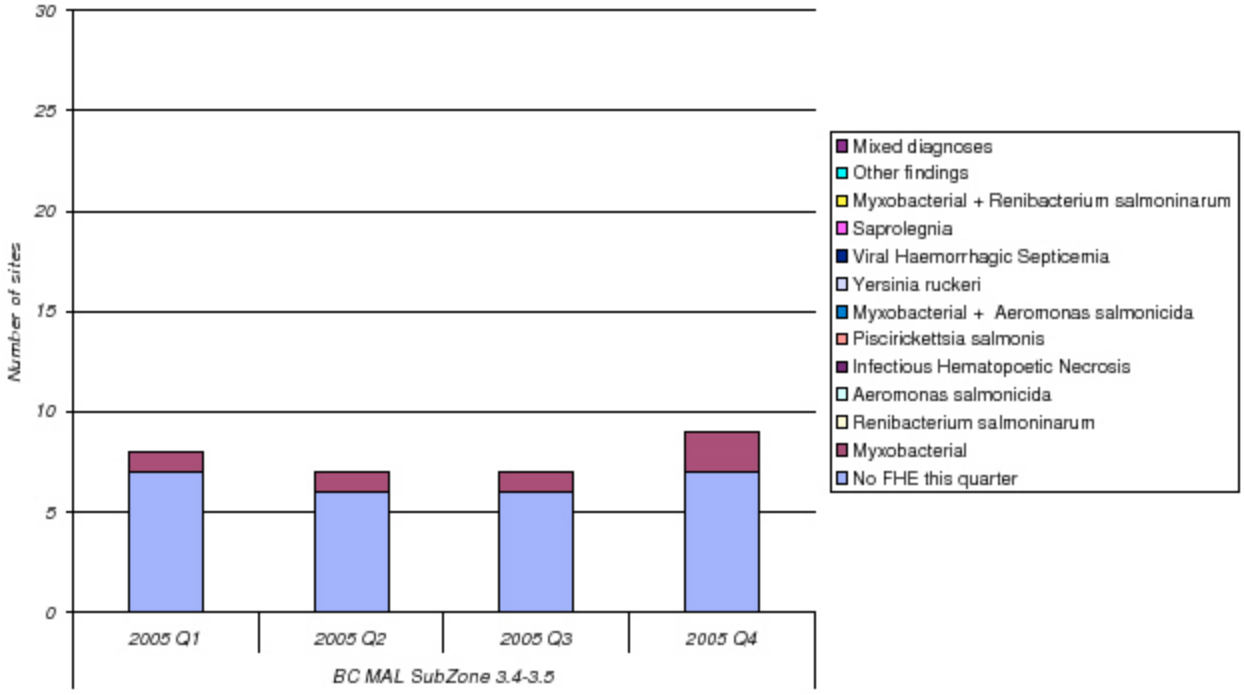
Fish Health Events
Atlantic Salmon Cultured in Marine/Brackish Sites



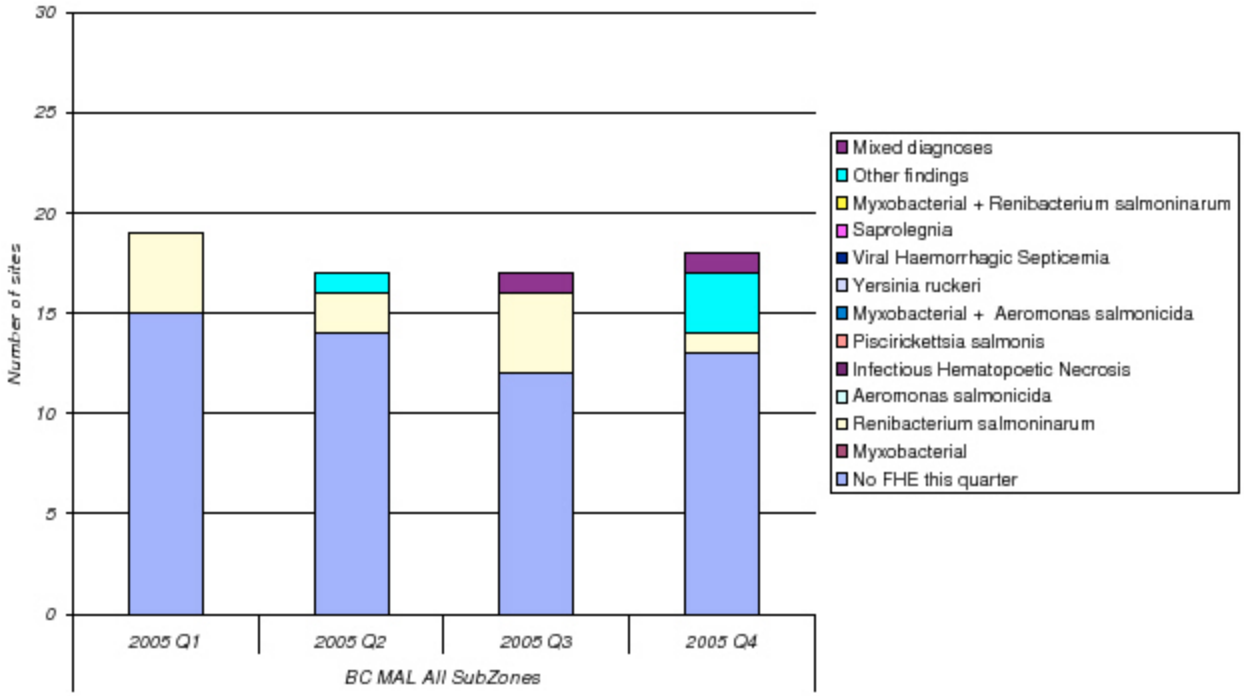

Fish Health Events
Atlantic Salmon Cultured in Marine/Brackish Sites
Number of Sites
30
25
20
15
10
5
0
2005 Q1
2005 Q2
2005 Q3
2005 Q4
BC MAL SubZone 3.1-3.2
Mixed diagnoses
Other findings
Myxobacterial + Renibacterium salmoninarum
Saprolegnia
Viral Haemorrhagic Septicemia
Yersinia ruckeri
Myxobacterial + Aeromonas salmonicida
Piscirickettsia salmonis
Infectious Hematopoetic Necrosis
Aeromonas salmonicida
Renibacterium salmoninarum
Myxobacterial
No FHE this quarter


Fish Health Events
Atlantic Salmon Cultured in Marine/Brackish Sites
Number of sites
30
25
20
15
10
5
0
2005 Q1
2005 Q2
2005 Q3
2005 Q4
BC MAL SubZone 3.3
Mixed diagnoses
Other findings
Myxobacterial + Renibacterium salmoninarum
Saprolegnia
Viral Haemorrhagic Septicemia
Yersinia ruckeri
Myxobacterial + Aeromonas salmonicida
Piscirickettsia salmonis
Infectious Hematopoetic Necrosis
Aeromonas salmonicida
Renibacterium salmoninarum
Myxobacterial
No FHE this quarter

Fish Health Events
Atlantic Salmon Cultured in Marine/Brackish Sites



Fish Health Events
Pacific Salmon Cultured in Marine/Brackish Sites



7.10 Appendix 10:

Definitions of Terms used in Sea Lice Reports

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.

7.11 Appendix 11:

Sea Lice Data by Subzones

Table 1. Mean and Median Abundance of Motile and Female *Lepeophtheirus salmonis*, Chalimus (*L. salmonis* and *Caligus clemensi*) and Motile *C. clemensi* on Atlantic Salmon Farm Audits Per Quarter in 2004 and 2005 in Sub Zone 2.3

2004	Q1		Q2		Q3		Q4	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Number of Farms Audited (n)	2		1		2		1	
Motile	2.48	1.00	0.05	0	0.13	0	0.37	0
Standard Deviation (SD)	3.36		0.22		0.39		0.78	
Female	1.08	0	0.05	0	0.08	0	0.07	0
SD	1.65		0.22		0.29		0.25	
Chalimus	0.14	0	0	0	0.03	0	0	0
SD	0.40		0		0.22		0	
Caligus Motile	0.13	0	0	0	0.03	0	0	0
SD	0.38		0		0.16		0	
2005	Q1		Q2		Q3		Q4	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Number of Farms Audited (n)	2		5		2		1	
Motile	2.98	1.50	0.73	0	0.62	0	0.05	0
SD	3.26		1.01		0.93		0.22	
Female	1.62	1.00	0.12	0	0.22	0	0.02	0
SD	1.91		0.36		0.51		0.13	
Chalimus	0.70	0	0.29	0	0.05	0	0	0
SD	1.18		0.65		0.22		0	
Caligus Motile	0.30	0	0.28	0	0.05	0	0	0
SD	0.71		0.72		0.22		0	

Table 2. Mean and Median Abundance of Motile and Female *Lepeophtheirus salmonis*, Chalimus (*L. salmonis* and *Caligus clemensi*) and Motile *C. clemensi* on Atlantic Salmon Farm Audits Per Quarter in 2004 and 2005 in Sub Zone 2.4

2004	Q1		Q2		Q3		Q4	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Number of Farms Audited (n)	1		1		2		1	
Motile	4.62	3.5	0.70	0	1.70	0	2.86	0
Standard Deviation (SD)	3.13		1.06		2.36		8.76	
Female	1.55	1	0.48	0	0.08	0	1.25	0
SD	1.63		0.85		0.31		3.85	
Chalimus	1.55	1	0.08	0	28.58	1	0	0
SD	1.98		0.28		48.04		0	
Caligus Motile	0.02	0	0.03	0	0.38	0	0	0
SD	0.13		0.18		1.03		0	
2005	Q1		Q2		Q3		Q4	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Number of Farms Audited (n)	2		2		1		1	
Motile	3.21	2	0.43	0	0.27	0	2.85	2
SD	3.62		1.74		0.73		1.75	
Female	1.33	1	0.13	0	0.17	0	1.33	1
SD	1.92		0.77		0.49		1.07	
Chalimus	1.04	0	0.14	0	0.02	0	0.05	0
SD	1.46		0.78		0.13		0.22	
Caligus Motile	0.10	0	0	0	0	0	0	0
SD	0.38		0		0		0	

Table 3. Mean and Median Abundance of Motile and Female *Lepeophtheirus salmonis*, Chalimus (*L. salmonis* and *Caligus clemensi*) and Motile *C. clemensi* on Atlantic Salmon Farm Audits Per Quarter in 2004 and 2005 in Sub Zone 3.1

2004	Q1		Q2		Q3		Q4	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Number of Farms Audited (n)	0		1		1		1	
Motile			0.03	0	0.23	0	0.10	0
Standard Deviation (SD)			0.18		0.46		0.30	
Female			0	0	0.22	0	0.05	0
SD			0		0.42		0.22	
Chalimus			0.02	0	0.05	0	0	0
SD			0.13		0.22		0	
Caligus Motile			0	0	0.02	0	0	0
SD			0		0.13		0	
2005	Q1		Q2		Q3		Q4	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Number of Farms Audited (n)	1		1		1		0	
Motile	0.10	0	0.23	0	0.03	0		
SD	0.30		0.42		0.18			
Female	0.03	0	0.23	0	0.03	0		
SD	0.18		0.42		0.18			
Chalimus	0	0	0	0	0	0		
SD	0		0		0			
Caligus Motile	0	0	0	0	0	0		
SD	0		0		0			

Table 4. Mean and Median Abundance of Motile and Female *Lepeophtheirus salmonis*, Chalimus (*L. salmonis* and *Caligus clemensi*) and Motile *C. clemensi* on Atlantic Salmon Farm Audits Per Quarter in 2004 and 2005 in Sub Zone 3.2

2004	Q1		Q2		Q3		Q4	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Number of Farms Audited (n)	0		1		1		2	
Motile	1.08	0	1.23	1	1.58	1	0.14	0
Standard Deviation (SD)	1.62		1.19		1.67		0.96	
Female	0.44	0	1.10	1	1.03	1	0.03	0
SD	0.87		1.07		1.27		0.20	
Chalimus	0.46	0	0.03	0	0.63	0	0.83	0
SD	0.74		0.18		1.20		1.96	
Caligus Motile	0.29	0	0.03	0	0.06	0	0.04	0
SD	0.74		0.18		0.30		0.24	
2005	Q1		Q2		Q3		Q4	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Number of Farms Audited (n)	2		6		2		2	
Motile	6.00	4	0.74	0	0.98	0	1.54	1
SD	6.72		1.29		1.50		1.81	
Female	3.39	1	0.15	0	0.05	0	0.63	0
SD	4.34		0.70		0.22		0.10	
Chalimus	3.79	3	2.11	1	1.93	1	0.59	0
SD	4.21		3.42		2.12		0.97	
Caligus Motile	0.46	0	0.36	0	0.13	0	0.11	0
SD	1.31		1.22		0.42		0.35	

Table 5. Mean and Median Abundance of Motile and Female *Lepeophtheirus salmonis*, Chalimus (*L. salmonis* and *Caligus clemensi*) and Motile *C. clemensi* on Atlantic Salmon Farm Audits Per Quarter in 2004 and 2005 in Sub Zone 3.3

2004	Q1		Q2		Q3		Q4	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Number of Farms Audited (n)	2		2		3		3	
Motile	2.67	0	0.45	0	1.23	0	6.11	1.5
Standard Deviation (SD)	3.60		0.77		4.21		8.25	
Female	1.22	0	0.02	0	0.91	0	2.64	0
SD	1.76		0.18		3.48		4.10	
Chalimus	0.57	0	1.53	1	0.02	0	4.80	1
SD	1.12		2.33		0.25		10.44	
Caligus Motile	0.48	0	0.38	0	0	0	0.14	0
SD	1.35		1.15		0		0.40	
2005	Q1		Q2		Q3		Q4	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Number of Farms Audited (n)	3		8		2		2	
Motile	7.08	1	1.11	0	2.71	2	4.05	3.5
SD	10.09		2.26		3.18		2.96	
Female	3.27	0	0.36	0	1.79	1	2.27	2
SD	5.39		1.04		2.29		1.93	
Chalimus	3.20	1	2.34	0	0.27	0	0.41	0
SD	5.22		5.36		0.66		0.89	
Caligus Motile	0.28	0	0.21	0	0	0	0.01	0
SD	0.64		0.92		0		0.09	

Table 6. Mean and Median Abundance of Motile and Female *Lepeophtheirus salmonis*, Chalimus (*L. salmonis* and *Caligus clemensi*) and Motile *C. clemensi* on Atlantic Salmon Farm Audits Per Quarter in 2004 and 2005 in Sub Zone 3.4

2004	Q1		Q2		Q3		Q4	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Number of Farms Audited (n)	1		1		1		1	
Motile	2.62	2	1.92	1.5	1.07	1	1.22	1
Standard Deviation (SD)	2.29		1.77		1.42		1.32	
Female	1.71	1	0	0	1.07	1	0.22	0
SD	1.55		0		1.42		0.56	
Chalimus	0.80	0	2.4	2	1.67	1	2.71	2
SD	1.30		1.43		2.72		2.34	
Caligus Motile	0.32	0	0	0	0	0	0.02	0
SD	0.77		0		0		0.13	
2005	Q1		Q2		Q3		Q4	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Number of Farms Audited (n)	1		2		0		1	
Motile	5.58	5	0.36	0			3.17	3
SD	2.88		0.99				2.45	
Female	2.18	2	0.30	0			1.97	2
SD	1.66		0.91				2.02	
Chalimus	1.65	1	0.41	0			0.07	0
SD	1.82		1.13				0.31	
Caligus Motile	0.22	0	0	0			0.02	0
SD	0.52		0				0.13	

Table 7. Mean and Median Abundance of Motile and Female *Lepeophtheirus salmonis*, Chalimus (*L. salmonis* and *Caligus clemensi*) and Motile *C. clemensi* on Atlantic Salmon Farm Audits Per Quarter in 2004 and 2005 in Sub Zone 3.5

2004	Q1		Q2		Q3		Q4	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Number of Farms Audited (n)	0		0		0		1	
Motile							0.25	0
Standard Deviation (SD)							0.97	
Female							0.08	0
SD							0.33	
Chalimus							2.75	1
SD							4.01	
Caligus Motile							0	0
SD							0	
2005	Q1		Q2		Q3		Q4	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Number of Farms Audited (n)	1		1		1		0	
Motile	0.27	0	0.03	0	0.60	0		
SD	0.48		0.18		0.99			
Female	0	0	0	0	0.30	0		
SD	0		0		0.70			
Chalimus	0.47	0	0.18	0	0.10	0		
SD	0.81		0.47		0.30			
Caligus Motile	0.05	0	0.02	0	0.18	0		
SD	0.22		0.13		0.39			


BRITISH
COLUMBIA
The Best Place on Earth