COMMISSION OF INQUIRY INTO THE DECLINE OF SOCKEYE SALMON IN THE FRASER RIVER

In the matter of Her Excellency the Governor General in Council, on the recommendation of the Prime Minister, directing that a commission do issue under Part I of the *Inquiries Act* and under the Great Seal of Canada appointing the Honourable Bruce Cohen as Commissioner to conduct an inquiry into the decline of sockeye salmon in the Fraser River

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B.C. SALMON FARMERS ASSOCIATION

FINAL SUBMISSIONS

Notes

- Page references ("p.") are to the printed page and not the electronic page unless otherwise noted. Where a page number does not appear on an exhibit, the citation to the electronic page number will be given ("PDF").

- Exhibit document titles are provided as they appear on the Commission of Inquiry website, www.cohencommission.ca.

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EXECUTIVE SUMMARY

The B.C. Salmon Farmers' Association ("**BCSFA**") submits that the weight of scientific evidence provided to the Commission indicates that the risk posed to the Fraser River sockeye salmon by the aquaculture industry is minimal. There was no reliable evidence submitted that claimed otherwise. Salmon aquaculture operations are stringently regulated, carefully monitored, and properly managed in a precautious, environmentally conscious manner.

The strong contrast in Fraser River sockeye salmon returns in 2009 and 2010, and above average returns expected in 2011, despite conditions on salmon farms remaining constant, means that any effect by salmon farms on wild stocks would have been easily detected by the analysis the Commission's Technical and Scientific Project 5 researchers. Simultaneously, experts such as Dr. Beamish, and Dr. McKinnell, reported different if not anomalous ocean conditions and food abundance in 2007 and more favourable conditions in 2008, which would have affected the 2009 and 2010 returns. The BCSFA argues that the evidence does not establish a significant relationship between salmon farming and Fraser River sockeye salmon productivity.

I. Other Factors

Changes to the climate and regime shifts have been shown to have affected returns of salmon throughout the hemisphere for hundreds, if not thousands of years. Ocean warming and changes to the freshwater and marine ecosystems are very likely to have been a major cause of the decline of sockeye salmon. Ocean acidification was also identified as a potentially significant issue that may be affecting Fraser River sockeye salmon directly and indirectly, but which has not been researched.

Conditions in the marine environment including food abundance are a likely cause of the overall Fraser River sockeye decline, as well as the 2009 return. The year 2007 when the 2009 Fraser River sockeye salmon run was heading out to sea, was an anomalously warm year, with poor conditions for sockeye salmon growth and survival in both the Strait of Georgia ("**SOG**") and Queen Charlotte Sound ("**QCS**"). The year 2008, when the 2010 run was heading out to sea, was much cooler, with the coolest conditions observed in the Gulf of Alaska in 35 years. Harmful algae blooms are another likely cause for the long term and more recent declines in productivity. Predators remain a possible cause.

II. Precautionary Approach & Regulation and Management

Salmon Aquaculture in British Columbia has been stringently regulated by both the Province of British Columbia (the "**Province**") and the Federal Government of Canada ("**Canada**"), and is responsibly managed by the industry.

Under the Province's direction, salmon aquaculture underwent a lengthy environmental assessment, the Salmon Aquaculture Review, which deemed aquaculture a "low risk" to the environment and made a series of recommendations to fill knowledge gaps and to improve the regulation and management of the industry.

Fisheries and Oceans Canada ("**DFO**") applies adaptive management and the precautionary approach to aquaculture to ensure that notwithstanding scientific uncertainty, decisions are made on the basis of scientific knowledge to address and manage risks.

When Canada assumed jurisdiction of the industry on December 18, 2010, it integrated many of these adaptive and precautionary measures into its new regulatory regime. The BCSFA's members also apply the precautionary approach to their management of farms.

Professionally accredited veterinarians employed by the companies conduct fish health monitoring on an ongoing basis and submitted this data to the Province in monthly reports which were subjected to regular audits. The audit and surveillance program has been continued under DFO.

Science-based management decisions must be based on credible scientific evidence and a weighing of socio-economic factors. There is evidence before the Commission that in addition to providing significant socioeconomic benefits, properly managed aquaculture is a low risk and may in fact reduce pressures on wild salmon stocks.

III. Protection of Wild Salmon on Migration Route

The aquaculture industry is stringently regulated, properly managed, and poses a minimal risk to Fraser River sockeye salmon. Government and industry both protect the migration route of wild salmon through siting criteria and Environmental Assessment processes which take risks to fish populations into consideration. The presence of salmon farms on Pacific salmon migration routes has no impact on salmon abundance, as pink and chum salmon are increasing in abundance, whereas salmon that do not migrate past salmon farms are in decline.

Salmon farms were uniformly ruled out by the Commission's Science and Technical Report Project 5 researchers as the potential cause for the dramatic contrast between the Sockeye salmon returns in 2009 and 2010. They determined there was no significant relationship between salmon farms and sockeye salmon declines, and that most pathways of effect by which farms have historically been considered to pose the greatest risks wild salmon, such as escapes, benthic effects, and sea lice, do not affect Pacific salmon populations. A detailed analysis of disease on a farm-by-farm basis showed disease events were very unlikely to have had an impact on Fraser River sockeye salmon. A long-term analysis suggested a possible association of salmon farms with several other factors, although problems with the analysis limits its usefulness.

Sea lice expert witnesses testified that sea lice from salmon farms are unlikely to have contributed to the overall decline in Fraser River sockeye salmon productivity or the 2009 return. B.C.'s farmed salmon are treated for sea lice for the precautionary purpose of protecting wild fish from potential harm and not because of damage being done to farmed fish by the lice.

Aquaculture companies employ a suite of preventative measures to keep farmed fish healthy which reduces risks to wild salmon, including improved siting, brood stock

programs, stocking densities, improved husbandry, and vaccinations. Fish densities are maintained to support optimal rearing from a fish welfare perspective and to provide a rearing environment suitable for the physiological needs of the fish. This reduces results in improved health and resistance to endemic pathogens. The monitoring and mitigation measures are enforceable as conditions of licence.

All diseases affecting aquaculture facilities are naturally occurring and endemic in B.C., and are carefully monitored and reported under regular auditing and surveillance by the industry's regulators. A genomic signature recently identified in wild salmon, possibly associated with a pathogen, is more prevalent in salmon as they leave freshwater, particularly in those with the longest freshwater residency times, and is not thought to be transmitted from salmon farms. No exotic diseases have been introduced into B.C. through salmon aquaculture, and the risk of future introductions by the importation of eggs is very low to remote due to the stringent controls in place.

There are numerous areas of high priority research including early marine mortality, effects of climate change and ocean acidification, understanding plankton and algae blooms in the marine environment, competition with hatchery fish, and pathogens in wild and hatchery fish. Continued analysis of aquaculture data and developing new mitigation tools and practices to improve fish health should remain an ongoing area of research by DFO.

IV. Recommendations

- Legislative review, modernization and consolidation.

- Standardized data collection required for all freshwater hatcheries releasing fish.

- A single standard of fish health management plans for all fish producers in B.C., including all aquaculture sites, salmon enhancement programs and hatcheries (including PIPs and CEDPs).

- Research funding to encourage enhancement facilities and aquaculture to work on collaborative projects (one example is the Canadian Agri-Science Clusters initiative of Agriculture and Agri-Food Canada (AAFC) to mobilize the scientific and technical resources needed to support innovation and competitiveness in its sector).

- Ensure DFO Science is equipped to provide prompt communications on research findings, issues and education materials about aquaculture.

- DFO and the Province should collaborate to set up long term program for wild fish monitoring and research in both freshwater and the marine environment with a focus on health of wild stocks, and epidemiology of disease in wild sockeye.

- DFO to publish their research and fish management findings in peer reviewed journals on all species as a condition of continued program funding.

- Consistent and seamless jurisdictional interface between the Province and the Federal Government in the management and regulation of the aquaculture industry in B.C.

- Increased data collection and public reporting on bycatch by commercial fishing on a vessel by vessel basis.

- DFO support for access to more modern therapeutants to increase our level of Fish health and further decrease risk to wild stocks.

- DFO support for quick access to ocean tenures from Cape Caution to Prince Rupert to allow site relocation for environmental sustainability to continue.

- Research on heterosigma blooms including prediction and mitigation measures.

- Long-term funding for Wild Salmon Policy implementation.

- Continue collecting fish health data from salmon farms for data analysis

- An independent working group to assemble existing information for salmon farm data analysis.

BCSFA FINAL SUBMISSIONS: ARGUMENT

1. Aquaculture is the only industry named in the Commission's Terms of Reference to be examined to determine if it may be a possible cause of the decline of sockeye salmon in the Fraser River. Given the long history of polarized debate over salmon farming in British Columbia ("**B.C**."), and the iconic nature of the sockeye salmon, it is no surprise that some of the public attention and submissions to the Commission were focused on this issue. As numerous media publications outside the Commission demonstrated, the Commission sometimes appeared to be "about" aquaculture even when the hearings themselves were addressing other issues of serious import to the Fraser River sockeye salmon.

Terms of Reference for the Commission of Inquiry into the Decline of Sockeye Salmon in the Fraser River, P.C. 2009-1860, C. Gaz. 2009.I.3498;
see e.g. McKenzie, Transcript, August 31, 2011, p. 79, ll. 18-29

2. Salmon farming B.C. is stringently regulated by both the Province and Canada, and is responsibly managed by the industry. Both the provincial Ministry of Agriculture and Lands ("**BCMAL**") and Fisheries and Oceans Canada ("**DFO**") apply adaptive management and the precautionary approach to aquaculture to ensure that notwithstanding scientific uncertainty, decisions are made on the basis of scientific knowledge to address and manage risks.

3. As a result of the decision of Justice Hinkson of the B.C. Supreme Court in 2009, the aquaculture industry in B.C. is unique in Canada in that it is regulated by Canada as a fishery, rather than as a form of agriculture under shared Canada-provincial jurisdiction as remains the case in Atlantic Canada. The BCSFA says that this transition is providing numerous opportunities for a streamlined regulatory system with minimal jurisdictional overlap between Canada and the Province, and specific measures that ensure good environmental performance and monitoring built into the individual licences under which each farm operates. Ongoing research and dialogue between DFO Science, the aquaculture industry, academics, and not-for-profit groups will inform DFO's management of salmon farming in B.C. to continue its sustainability and minimize risks to wild salmon.

Morton v. British Columbia (Minister of Agriculture & Lands), 2009 BCSC 136 (the "***Morton* Decision**")

4. As the evidence led in this Commission shows, salmon farming is not cause of the overall decline of Fraser River sockeye salmon. There is no correlation between salmon farms and the 2009 return. In light of the near record run in 2010 and projected above-average return in 2011 during which time salmon farming has been continuously practiced, the BCSFA submits that any risks to Fraser River sockeye salmon are minimal and have been mitigated against through precautionary regulations and industry management practices. As explored below, Commission's Project 5 Technical Reports establish that there is no

reliable statistical support to the hypothesis that salmon farms are a cause of the decline.

Exhibit 1851, *Annual variation in total Fraser River sockeye productivity*

5. There is more information available about pathogens on salmon farms than in wild salmon. Captive salmon populations such as in aquaculture facilities have been more intensely studied than pathogens in wild fish. Mr. Marmorek himself drew a distinction between exposure of Fraser sockeye to diseases, and the likelihood of pathogens in salmon farms, as being possible primary factors. The BCSFA argues that salmon farming, as it is practiced in B.C., has been identified as an unlikely cause of the decline.

Kent, Transcript August 22, 2011, p. 10 ll. 24 – 47;
Marmorek, Transcript September 19, 2011, p. 8 ll. 39-45

I. Factors likely to have caused overall declines and 2009

A. Climate Change and the Marine Environment

6. The BCSFA observes that there are numerous factors that have been considered by the Commission's Technical Reports which are more likely to have caused the decline of sockeye salmon than salmon farming in B.C. There are also many issues which those reports did not address, some of which were raised in the Commission's hearings. The BCSFA will address several of those causes which may affect the aquaculture industry itself, or with which a potential relationship has been suggested.

7. Climate change and marine environment are the only two factors identified by the Commission's Technical Reports as likely primary factors in the declines of Fraser River sockeye salmon productivity for the entire life cycle over the past two decades. Other factors such as predation remain possible contributors:

> … We found **only two factors (marine conditions and climate change) which were *likely* to have been a primary factor in the observed declines in Fraser sockeye productivity (recruits/spawner) over the last two decades**. While en route mortality has definitely had an impact on the sockeye fishery and numbers of fish reaching the spawning ground, it is ***unlikely*** to have affected total productivity, since en route mortality is already included in the calculation of total recruits …. The effects of **predators during the marine phase of the salmon life cycle (stages 3 and 4 in Table 4.7-1) were judged to be *possible* primary contributors to these declines**.

Exhibit 1896, *Marmorek et al., Cohen Commission Technical Report 6 - FRSS: Data Synthesis and Cumulative Impacts*, Apr 2011 ("**Exhibit 1896, Marmorek et al. *Technical Report 6*, 2011")** p. 88

8. There are other factors not considered by the Commission's Technical Reports that are also very likely to have caused the long term decline, notably heterosigma which shows strong correlation between blooms and long term declines as well as the 2009 return.

Exhibit 1359, *Rensel et al., FRSS Marine Decline and Harmful Blooms of Heterosigma akashiwo,* 2010*,* Figure 6, p. 107

1. Climate Change

9. The BCSFA says that the observed declines in sockeye salmon abundance since the mid 1990s is best explained by climate-driven changes in the marine environment and not by existence of salmon farming in the marine environment. Exhibit 553, Hinch & Martins*, Cohen Commission Technical Report 9 - Climate Change - Feb 2011* ("**Exhibit 553, *Hinch & Martins Report 9,* 2011**") observes that sockeye salmon are particularly sensitive to changes in climate because its anadromous life cycle exposes them to a variety of climate-driven stressors in both marine and freshwater environments. Exhibit 553 explains there have been large shifts in sockeye abundances over the past 2,200 years during "major changes in the climate of the northeastern Pacific Ocean" and "decadal-scale fluctuations in sea surface temperature (**SST**) over most of the past 300 years", noting these fluctuations have been well documented and linked to climate-driven changes in the marine environment occurring every 20-30 years. Furthermore, productivity increased dramatically in the 1970s, reached "historic high abundance in the early 1990s", and then declined to recent low levels. Fluctuations are likely to continue into the future, and that research into ocean productivity and the freshwater freshet should be taken to better understand these fluctuations.

Exhibit 553, *Hinch & Martins Report 9*, 2011, p. 16-17;
see also Hinch, Transcript March 8, 2011 p. 6 ll. 40 – p. 7 ll. 35

10. Exhibit 553, *Hinch & Martins Report 9,* 2011 concludes that climate change may have effected both the long-term decline and the variability in returns between 2009 and 2010:

> Overall, the **weight of the evidence** on the adverse effects of recent warming on survival of some individual life stages, as well as its possible cumulative effects across life stages, suggest that **climate change has been a possible contributor to the observed declining trend in abundance and productivity of Fraser River sockeye salmon over the past 20 years**. It also seems that **interannual variability in climate conditions have contributed to the extreme variations in the abundance of returning adults that were observed in 2009 (much lower than average) and 2010 (much higher than average).** The cohort of fish returning in 2009 entered the marine environment in **2007 when an El Niño early that year was possibly responsible for some unusual climatic events** leading to unfavourable conditions for sockeye salmon migrating along the British Columbia coast - **warm water temperatures that may have resulted in high energetic costs compounded by low availability/quality of food resulting from extreme salinity and wind anomalies (McKinnell et al. 2011).** On the other hand, the cohort of fish returning in 2010 entered the marine environment in **2008, a year that was characterized by cooler**

> **ocean temperatures and presumably better food conditions (STTS 2010).**
>
> Exhibit 553, *Hinch & Martins Report 9, 2011* p. 53 [emphasis added]

11. Commercial aquaculture began in the 1970s and expanded in the 1980s, at a time that sockeye salmon productivity was increasing dramatically. Approximately 20 years after the increase in sockeye productivity, it began to decline. The coincident timing of the increase in commercial aquaculture in B.C. and a shift in climate around 1989 or 1990 makes it relatively easy to speculate that aquaculture is linked to the overall declines of Fraser River sockeye salmon. This debate was well-articulated by Drs. Donald Noakes, Richard Beamish, and Michael Kent in Exhibit 779, Noakes et al. *On the decline of Pacific salmon and speculative links to salmon farming in British Columbia*, 2000, in which they sought to extend the scope of the Salmon Aquaculture Review by the B.C. Environmental Assessment Office by considering other various factors that could have contributed to the decline, specifically climate change, salmon enhancement, and salmon farming. The authors say that although the reasons for the sharp decline in salmon production are not clear, "the most likely causes are believed to be climate change, overfishing, and the loss of productive freshwater habitat", and suggests a "more holistic ecosystem approach" to understand the complex interactions and impacts of salmon enhancement. It concludes that "salmon aquaculture in British Columbia has not had a significant impact especially when viewed in the context of the other factors that have likely contributed to the decline." Regarding climate change the authors say:

> It is clear that a complex set of factors led to the decline of wild and hatchery Pacific salmon stocks in Canada. **A regime shift in 1977 resulted in a period of high productivity** in the North Pacific Ocean and an increase in the abundance of **sockeye, pink, and chum** stocks. **Another regime shift in 1989/1990 resulted in a change in the ecosystem to one that was less favorable to salmon production** and, in general, a **decline in salmon production of all species particularly at the southern limits of their freshwater distribution**. Overfishing during this decline likely also contributed to the problem. **In addition to these natural shifts in climate, global warming induced by human activity may be occurring and this will also impact biological systems in the future.** There is, however, insufficient information to separate the two climate effects (Corti et al., 1999; Hasselmann, 1999). In addition to a general warming of our oceans, **most scientists expect to see, as a result of global warming, more intense climatic extremes** that will trigger or result in major changes in the ecosystem. The intense El Niño in 1997 and the La Niña in 1998 are examples of such extremes.
>
> PPR #20, *Aquaculture Regulation in British Columbia*, para. 20 ("**PPR #20**");
> Exhibit 779, Noakes et al. *On the decline of Pacific salmon and*

speculative links to salmon farming in British Columbia, 2000, p. 365, p. 368, 381-382

12. Exhibit 553, *Hinch & Martins Report 2011* also discusses phenological changes as a response to climate change, meaning the timing of events such as seaward migration and return migration change. As observed by Mr. Marmorek and Drs. Saksida, McKinley, and Welch in Exhibit 1325, Chittenden, Saksida, Welch, McKinley *et al., Recent Salmon Decline, Result of Lost Feeding Opportunities Due to Bad Timing?*, such changes can result in the mismatched timing of sockeye ocean entry and their food source, plankton blooms, which could lead to food shortages.

Exhibit 553, *Hinch & Martins Report 9, 2011* p. 3-4;
Marmorek, Transcript September 19, 2011, p. 71 ll. 12-45;
Exhibit 1325, Chittenden, Saksida, Welch, McKinley *et al., Recent Salmon Decline, Result of Lost Feeding Opportunities Due to Bad Timing?* Aug 27 2010 ("**Exhibit 1325, Chittenden *et al.* *Recent Salmon Decline***") p. 1

13. Exhibit 553, *Hinch & Martins Report, 2011* also notes the decreased time Late-run sockeye populations are holding in the Strait of Georgia, a trend which the report says began in 1995, although Dr. Hinch said it began in 1992 in his testimony. The report says that the "early entry" behaviour exposes segments of all Late-run populations to temperatures well above historical norms, and speculates on some potential causes of the behaviour. Importantly, the authors also propose adaptation strategies that they say could be used to mitigate impacts of climate change on Pacific salmon.

Exhibit 553, *Hinch & Martins Report 9, 2011* p. 37-38

14. When asked whether climate change had been occurring steadily over 60 years, Dr. Hinch replied that he couldn't agree it was consistent, noting climate variability could be caused by several factors such as Pacific decadal oscillations, El Niño greenhouse gas related issues which do not work together in a linear fashion, and that these could combine to create "the perfect storm of poor survivorship". Counsel for the Aquaculture Coalition then asked whether Dr. Hinch had knowledge of an abrupt change in a specific year, 1992. Dr. Hinch said that he was not aware of an abrupt change in 1992.

Hinch, Transcript March 8, 2011, p. 66 ll. 46 – p. 67 ll. 47

15. However, Exhibit 1291, McKinnell et al. *Cohen Commission Technical Report 4 - Marine Ecology - Feb 2011* ("**Exhibit 1291, *McKinnell Report 4*, 2011**"), shows there is in fact evidence of an abrupt change in the marine ecosystem in 1992. Based on the Mackas Ecosystem Productivity Index (MEPI) which "integrates ecological observations (physical, chemical and biological) related to the productivity of the ocean on the Southwest coast of Vancouver Island" the report

concludes that in 1992 a warm and unproductive period in the coastal ocean began, Subarctic copepods were replaced with more southerly species which altered the makeup of the food web, there were shifts in species abundance at various trophic levels, and "the return, after more than a 40 year absence, of the sardine (*Sardinops sagax*) to the West coast of Vancouver Island." This shows significant changes in the marine environment in fact occurred in the early 1990s, potentially in the precise year 1992.

Exhibit 1291, *McKinnell et al. Report 4*, 2011, p. 144

16. Furthermore, the BCSFA notes the Aquaculture Coalition's entire line of questioning of Dr. Hinch revolved around the proposition that a disease is the cause of early entry behaviour of Late-run sockeye. Dr. Hinch repeatedly said it was not his area of expertise. The BCSFA says that Dr. Hinch's testimony in response to propositions made by the Aquaculture Coalition about the potential involvement of a retrovirus or plasmacytoid leukemia is not expert opinion, is pure "conjecture" as Dr. Hinch himself described it, and should be accorded no weight.

Hinch, Transcript March 8, 2011, p. 71 ll. 25-37, p. 79 ll. 43;
Ibid., p. 76 ll. 12 – p. 83 ll.44

17. Dr. Hinch, as co-author of Exhibit 558, *Genomic Signatures Predict Migration and Spawning Failure in Wild Canadian Salmon*, 2011with Dr. Miller's, referred to the Mortality-Related Signature ("**MRS**") in Exhibit 553, *Hinch & Martins Report, 2011* in connection to early entry timing, suggesting a hypothetical link between MRS and early entry. When first asked about this aspect of Exhibit 558, Dr. Hinch testified that he is "not a virus specialist" and that as he understood it they could not prove a virus, only an indication of immune suppression. Dr. Hinch further clarified under cross-examination by the Province that the potential viral infection is a hypothesis and that it could be explained by other stress-related factors. The BCSFA notes that the testimony of Dr. Miller, Dr. Garver, and Dr. Saksida all show it is speculative if not outright doubtful that the MRS is a retrovirus, that it is related to plasmacytoid leukemia, and that it may be vertically transmitted. The MRS may not even be an infective disease. This evidence is reviewed in detail below.

Exhibit 558, *Genomic Signatures Predict Migration and Spawning Failure in Wild Canadian Salmon*, 2011;
Hinch, Transcript March 8, p. 76 ll. 12 – p. 83 ll.44;
Hinch, Transcript March 9, 2011, p. 7, ll. 42 – p. 8 ll. 4

18. The BCSFA also says that if the MRS is involved with early entry migration, it is important to note that Dr. Miller testified that she believes "salmon aquaculture is not likely a main route of transmission to wild salmon". In fact, the main time point of transmission is occurring in freshwater, and the fish that spend less time in freshwater tend to be doing better than those that spend more. Dr. Miller noted

that while Harrison River sockeye do not have the MRS, the signature is found in salmon that migrate on either side of Vancouver Island. The BCSFA says that this disproves any speculative links between salmon farming and early entry timing. This evidence will be reviewed more thoroughly in the section on diseases, below.

Miller, Transcript, August 24, 2011, p. 84 ll. 18 – p. 85 ll. 6:
Ibid. p. 81 ll. 24 – 35, p. 82 ll. 3 – p. 83 ll. 13;
Miller, Transcript, August 25, 2011 p. 25 ll. 3 – p. 26 ll. 18

19. The BCSFA also notes that many long term impacts of climate change, such as ocean acidification, are not well understood. Ken Ashley, one of the peer reviewers of Exhibit 553, *Hinch & Martins Report, 2011* noted "increasing acidity of the open ocean is particularly worrisome, as this may negatively affect planktonic organisms that ocean feeding sockeye rely on for growth and maturation". As explained by Drs. Hinch and Martins, it is possible that acidification may be affecting food abundance for salmon and salmon olfactory systems which may interfere with perception of environment and predator detection. The BCSFA says that this increases the likelihood that those factors are having significant effects on salmon population declines, although more research is necessary to determine whether acidification is having an actual effect.

Richards, Transcript Sept 23, 2011 p. 73 ll. 22 – p. 74 ll. 3;
Hinch & Martins, Transcript March 9, 2011, p. 12, ll. 6 – 44;
Exhibit 553, *Hinch & Martins Report 9, 2011* p. 114-115

20. As Drs. Hinch and Martins explain, climate change and warming waters can have a number of direct and indirect effects on sockeye salmon survival in the marine environment. The BCSFA suggests that based on the salmon farm data, these potential causes of mortality in the marine environment are more likely to have caused or contributed to the decline of sockeye in the Fraser River than salmon farming.

Exhibit 553, Hinch & Martins Report 9, 2011 p. 23

2. Marine Environment (SOG & QCS) including food abundance

21. The BCSFA suggests that there was in fact a "perfect storm" as termed by Dr. Hinch. This is established by the evidence given by Dr. Beamish and Dr. McKinnell in the Marine Environment hearings. Although in their testimony on July 7, 2011 they seemed unable to reach agreement that the ocean conditions in both the SOG and QCS acted together to cause the low return of Fraser River sockeye in 2009, Mr. Marmorek noted that recent research "seems to indicate that both are important".

Marmorek, Transcript Sept 19, p. 89 ll. 33 – 90 ll. 24

22. Similarly, Exhibit 1294, *Beacham et al., Ocean Conditions Inside and Outside the Strait of Georgia are Important Contributors to the Fraser Sockeye Situation, April 2011* is a powerpoint presentation summarizing research by a number of DFO scientists as well as the Exhibit 1291 *McKinnell et al. Report 4.* It notes, for example, that new genomic research by Dr. Miller supports Dr. Beamish's theory of slower growth in the marine environment in 2007 than 2008. It summarizes the four central issues relating to the marine conditions as "Triple Jeopardy?":

> - Physiologically compromised in freshwater and in the marine environment (i.e. genomics).
> - Poor ocean conditions in the Strait of Georgia (coho, Chinook, Herring, Chum, Sockeye).
> - Poor ocean conditions in Queen Charlotte Sound (i.e. anomalous winds, salinity, production).
> - Harrison River sockeye utilize the Strait of Georgia differently (i.e. timing)

Exhibit 1294, *Beacham et al., Ocean Conditions Inside and Outside the Strait of Georgia are Important Contributors to the Fraser Sockeye Situation, April 2011* p. 44-46, 49

23. As explained in Exhibit 553, *Hinch & Martins Report,* 2011, there is evidence that warm sea surface temperatures are creating "low food availability (i.e. zooplankton) for young sockeye salmon" by altering the peak timing of zooplankton blooms in the SOG, noting observations that "early marine growth of Fraser River sockeye salmon is reduced when coastal SST is warm." When ocean water is warm not only do salmon use more energy when migrating but the zooplankton that is available is also of lower caloric value, whereas when SST is cool, the plankton that sockeye salmon eat is of higher quality.

Welch, Transcript July 7, 2011, p. 87, ll. 9-28;
Exhibit 1326: Crawford & Irvine, *State of the Pacific Ocean 2009* p. 11-12;
Exhibit 1360, *Crawford et al., State of Physical, Biological and Selected Fishery Resources of Pacific Canadian Marine Ecosystems*, p. 8.

24. A paper published by several authors including Drs. Welch and Saksida suggests that the change in zooplankton timing which Drs. Hinch and Martins noted in their report means that selection pressures may be favouring the species of salmon that leave natal streams earlier, and there is some evidence the peak out-migration period for some wild Pacific salmon has already advanced. Dr. Saksida explained that they undertook the study to investigate why hatchery returns had declined from 10% in the 1980s to less than one percent, specifically trying to determine whether the timing of the release was mismatched to the available food:

> 46 So this is actually a coho project, not a
> 47 sockeye project but they both eat the same thing.
> 1 So you can see in this figure what we've done is
> 2 we've looked at the last 2007/2008, we've actually

> 3 continued on the project. We have '09 and '10 and
> 4 you can see right here on this low bar right here,
> 5 that's 2007 compared to 2009. So there was large
> 6 spikes of zooplankton in -- sorry, 2008 compared
> 7 to what was going on in 2007. So our theory - and
> 8 it actually seems to be coming through with the
> 9 coho, is that if you mismatch or there isn't good
> 10 food or abundant food, that you're not going to
> 11 get the fish back. And that sort of falls into
> 12 what Dick Beamish has touted, is that early marine

Exhibit 1325, Chittenden Saksida Welch McKinley *et al., Recent Salmon Declines*, supra p. 1;
Welch, Transcript, July 7, 2011 p. 85 ll. 18 – p. 86 ll. 29;
Saksida, Transcript September 6, 2011, P. 58 ll. 37 – P. 59 ll. 14

25. Mr. Marmorek noted that timing of smolt emigration towards the estuary and arrival in the Strait of Georgia, relative to the timing of zooplankton blooms, is an important factor to consider, as it determines whether food is available to those smolts. He agreed that climate change can affect the timing of both the smolt outmigration as well as the timing of the blooms, which could be changing in different directions.

Marmorek, Transcript September 20, 2011, p. 73 ll. 5-6

26. As Dr. Beamish hypothesizes in Exhibit 1308, Beamish *et al., A Critical Size and Period Hypothesis to Explain Natural Regulation of Salmon Abundance and the Linkage to Climate and Climate Change* 2001, poor growth of juvenile salmon at a critical time in their life cycle and the failure to reach a critical size by the end of their first marine summer decreases their chance of survival and is an important factor in determining year class strength. He suggests that "link between total mortality and climate could be operating via the availability of nutrients regulating the food supply and hence competition for food (i.e. bottom–up regulation)". Furthermore, in Exhibit 1309, *Beamish et al., Evidence of Synchronous Failure in Juvenile Pacific Salmon and Herring Production in the SOG in Spring 2007* ("**Exhibit 1309, *Beamish et al., Synchronous Failure***"), Dr. Beamish et al. report "poor survival or poor growth or both" of all juvenile Pacific salmon and herring in the SOG. Catches of juvenile sockeye salmon, he notes, were small, and those fish caught were in poor condition. They conclude:

> The synchronous response of virtually all of the major species in the surface waters of the Strait of Georgia in the spring of 2007 indicates that there was a collapse of the production of prey for these species. It is likely that climate and ocean conditions within the Strait of Georgia were responsible for the synchronous very poor production of prey and resulting poor survival of Pacific salmon and herring.

Exhibit 1308, Beamish *et al., A Critical Size and Period Hypothesis to Explain Natural Regulation of Salmon Abundance and the Linkage to Climate and Climate Change* 2001, p. 423;
Exhibit 1309, Beamish *et al., Evidence of Synchronous Failure*, p. 2-3

27. There is independent evidence that support the theory that there was low food abundance in the Strait of Georgia in 2007, both due to changes in zooplankton timing as reported by Dr. Welch and Dr. Saksida, and Dr. Miller's genomic research. For example, Dr. Miller's recent research shows genomic signatures suggestive of stress, hypoxia possibly due to heterosigma blooms, and low growth:

> Most 2007 Fraser fish are at the extreme PC1 positive end—the slow growth end; higher variability existed in 2008 and for 2007 WCV
>
> Genomic data are consistent with the purported slower growth of Fraser sockeye post-smolts in the ocean, relative to 2008 post-smolts

Exhibit 1325, Chittenden Saksida Welch McKinley *et al., Recent Salmon Declines*, supra p. 1;
Exhibit 1294, *Beacham et al., Ocean Conditions Inside and Outside the Strait of Georgia are Important Contributors to the Fraser Sockeye Situation, April 2011* p. 44-46

28. Dr. Beamish's recent research, presented during the Commission's hearings on the issue of the marine environment, notes that late-entry salmon populations appear to have higher productivity. This is not inconsistent with the research by Drs. Saksida and Welch showing changes in zooplankton timing, as Dr. Beamish notes the conditions in the SOG are expected to change from the timing of early ocean entry to late ocean entry, and that feeding conditions may improve after other Pacific salmon have left the SOG or died.

Exhibit 1307, *Beamish et al., A Late Ocean Entry Life History Type Has Improved Survival for Sockeye and Chinook Salmon in Recent Years in the SOG*, p. 2

29. The finding of temperature anomalies in the Queen Charlotte Strait by Dr. McKinnell is also significant in that Dr. Welch's acoustic tagging research shows the tagged fish died after they passed through that same environment. In a public submission 0127-KRC_204530 written on behalf of Kintama Research Corporation, Dr. Welch wrote that the 2009 run failure likely occurred 20-30 days after exiting Queen Charlotte Strait which is "consistent with either a direct effect of environmental conditions occurring in Queen Charlotte Sound in spring 2007 or a delayed effect due to disease transfer from fish farms in the Discovery Passage/Broughton Archipelago region." However, Dr. Welch testified that he had no idea when the salmon died after they passed QCS, and he is not an expert

on disease. The BCSFA argues that between the Project 5 reports by Drs. Noakes, Dill, Korman and Connors, showing no correlation between diseases on salmon farms and the 2009 return, and that of Exhibit 1291, McKinnell et al. *Technical Report 4*, 2011, showing extreme environmental anomalies in QCS at the time the Fraser River sockeye smolts were migrating, Dr. Welch's public submission should be taken to support Dr. McKinnell's theory but be accorded no weight with respect to its speculation on diseases.

Welch, Transcript July 7, 2011, p. 78, ll. 33 – p. 79 ll. 6

30. The BCSFA argues that the historic return of sockeye salmon in 2010, and the return expected for 2011, is further evidence that salmon farming, which has been continually practiced throughout this time at substantially the same level of production, is unlikely to be related to the declines. The graph at Exhibit 1851 shows annual variation in total Fraser River salmon productivity from 1950 to 2011. Mr. Marmorek noted the increase in productivity in 2010 and 2011, and that conditions in Gulf of Alaska in 2008 were the coolest they had been in 35 years, and that La Niña in 2009 meant cooler conditions as well. This suggests factors other than salmon farms are significantly more important to their survival.

Marmorek, Transcript, Sept 19 p. 54 ll. 8 – p. 55 ll. 4;
Exhibit 1851, *Annual Variation in Total Fraser River Sockeye Productivity,* August 2011

3. Harmful Algae Blooms

31. Heterosigma is highly correlated with Fraser River sockeye survival and is currently considered to be one of the "most likely" causes for the poor returns in 2009. As explained by Dr. Irvine and Dr. Rensel, Heterosigma has been detected in B.C. coastal waters for about 50 years, regularly appearing "in late spring in the English Bay since 1967" long before the aquaculture industry began in B.C..

Irvine, Transcript July 8, 2011, p. 116 ll. 28 – p. 117 ll. 6;
Exhibit 1371 "Briefing Memo for the Minister re Update on Factors Affecting the 2009 FRS Return (For Info), Jun 16 2011 p. 2;
Exhibit 1359, Rensel *et al., Fraser river sockeye salmon marine survival decline and harmful blooms of Heterosigma akashiwo*, 2010, ("**Exhibit 1359, Rensel *et al., FRSS marine survival decline and Heterosigma*, 2010**") p. 100

32. The largest heterosigma blooms are found in areas where there are no salmon farms. As Dr. Rensel noted, most of what is presently known about heterosigma is due to the Harmful Algal Monitoring Program operated by Nicky Haigh and funded entirely by the aquaculture industry. DFO is currently not funding research. However, Dr. Rensel noted the aquaculture industry collects samples further north, whereas there is not much monitoring in the south SOG where

major blooms occur., meaning research in areas without salmon farms is necessary.

Rensel, Transcript August 17, 2011, p. 9 ll. 15-19, p. 22 ll. 3-5, p. 32, ll. 1 - 9

33. Dr. Rensel also testified that the exact pathway of effect of heterosigma is not presently known. For example, he noted it could cause mortality, acute mortality, chronic mortality, or there may be a food web effect, or all of the above in some combination.

Rensel, Transcript August 17, 2011, p. 6 ll. 26-30

34. Heterosigma can occur naturally in shallow bays as well as across entire basins. Although Dr. Rensel said he had no firsthand knowledge as to nutrient sensitivities of salmon farm sites in B.C., he agreed that shallow bays in which blooms start are poor locations for fish farms. The "important point" he later said, is that "the worst place for Heterosigma by far, and it was shown in our paper, and that's not speculation, it's true, that the south Strait of Georgia is the problem area primarily, apparently, and there are no commercial fish farms there, of course."

Rensel, Transcript August 17, 2011, p. 21 ll. 44 – p. 22 ll. 9, p. 24 ll. 4 – 25;
Exhibit 1366, *Watson, Questions and Answers on Salmon Aquaculture in British Columbia, Volume 2, August 16, 2011*
("**Exhibit 1366, Watson, *Questions and Answers*, 2011**") p. 50;
Transcript August 17, 2011, p. 42 ll. 31-39

35. The BCSFA also notes that Dr. Rensel was asked by counsel for the Conservation Coalition to comment on a paper which suggested a potential role of aquaculture and harmful algae blooms, but that he was not shown the entire paper. Dr. Rensel said that discharged nitrogen or phosphorous could be incorporated into either beneficial or harmful algae, but corrected a misleading statement which suggested 70% of fish food goes to the bottom – which he said was "off quite a bit". Significantly, while he was reading the paragraph counsel he was being asked to agree with, he was asked to stop reading mid-way through a paragraph. What was not put to the witness was a subsequent paragraph which reads:

> **The preceding discussion would lead one to believe that human activities and the associated increase in nutrient loadings are likely the primary reason for HABs occurring in our world's oceans.** In fact, **this is not the case**, and the scientific community has a responsibility to indicate the importance of natural events in bloom formation.

Exhibit 1370 Sellner *et al.,* Harmful Algal Blooms: Causes, Impacts and Detection, Jul 30 2003, p. 386

36. The BCSFA furthermore notes that Exhibit 1536, *Cohen Commission Technical Report 5C - Noakes, Impacts of Salmon Farms on FRSS: Results of the Noakes*

Investigation, June 2011 ("**Exhibit 1536, *Noakes Report 5C*, 2011**"), says the aquaculture industry "regularly monitors water quality at their farms for their own purposes" and cites correspondence from Steve Cross, suggesting that in B.C. "dissolved nitrogen added to the water column from salmon farms was not measurable above background levels more than 10m from the farm…". The BCSFA argues that natural processes in the southern Strait of Georgia play a far more significant role in contributing to heterosigma blooms, and that the industry sites farms so as to avoid nutrient loading that could contribute to these natural events, meaning the nutrient load from farms is infinitesimal relative to natural sources.

Exhibit 1536, *Noakes Report 5C*, 2011, p. 15

4. Predation

37. The BCSFA notes that predation remains a possible factor in the decline which may be exacerbated by climate change. As Dr. Hinch and Martins explain in Exhibit 553, *Hinch & Martins Report,* 2011, reduced growth due to changes in food availability and high metabolic rates means juvenile salmon are more vulnerable to predation mortality, and "[c]ompounding matters is the observation that the abundance of non-resident predatory fish in coastal waters off British Columbia increases in warm years and the possibility that resident predatory fish increase food consumption so as to offset high metabolic rates incurred by warm waters."

Exhibit 553, Hinch & Martins Report, 2011 p. 23

II. Precautionary Approach & Regulation and Management

38. The BCSFA argues that the precautionary approach does not require the absolute elimination of risk, such as through the closure of an industry, such as commercial fishery or aquaculture where adaptive management is implemented and effective. A brief review of the law and policies expressing the precautionary approach will inform the discussion of whether aquaculture, as presently regulated and managed, is consistent with the precautionary approach.

A. Informing the Debate on the Precautionary Approach

1. Defining the Precautionary Approach

39. The Commission's second Policy and Practice Report ("**PPR**"), International Law Relevant To Conservation And Management ("**PPR #2**") defines the precautionary principle as follows:

> 17. The precautionary principle, also known as the precautionary approach, is a central principle of international environmental law. The most well-known and widely accepted definition of the principle is found in the Rio Declaration:
>
> > In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.
>
> …
>
> 19. Precaution has, as a central object, the prevention of environmental damage. The precautionary principle is intended to address situations involving scientific uncertainty regarding the existence or extent of an environmental risk. Where scientists are uncertain about the environmental consequences of an activity, a precautionary approach promotes implementing measures to prevent environmental harm. Regulatory inaction cannot be justified simply because the nature or magnitude of potential significant environmental harm is uncertain.

PPR #2, para. 17, 19 citing Principle 15 of the Rio Declaration on Environment and Development, 3 June 1992, [1992] PITSE 11, UN Doc A/CONF.151/26 (Vol. I) [Rio Declaration] [citations omitted]

40. The precautionary approach as defined in the Rio Declaration requires regulators and the industry being examined to assume that a risk exists, and to implement of a suite of measures to prevent that potential environmental harm and to monitor and adapt management strategies to continue to identify, minimize and mitigate those risks. As explained by Ms. Mia Parker in the Aquaculture Perspectives Panel on September 7, 2011:

> Up on the screen is the declaration on the precautionary approach from Rio 1992. **The precautionary principle is, I think, very elegant, because it doesn't say when in doubt, don't. It says in the absence of scientific certainty of risk, proceed cautiously and put measures in place as though those risks exist and deal with them.**
>
> So I feel like it's a really elegant connection between **risk-based management** and **adaptive management**. So you have a scientific risk assessment that says there's potentially risk here. **We can't guarantee there's risk, we definitely can't guarantee there isn't risk**. So let's **put measures in place as though the risk exists.** Let's **collect information,** let's **do more research**, and then let's **adapt those measures that we put in place.**
>
> One of the things that I think is really brilliant about the precautionary approach is it's not about a single solution. **It's about a suite of measures that you put, so that you can be flexible in how you apply those precautionary measures.** If you look at the siting criteria that have been in place, both under the provincial regulatory regime and the federal regulatory regime, they carry them over consistently. And it doesn't mean that they won't change, and I think that's where that link we have with DFO **having science within DFO that we'll see more rapid evaluation of those, and we may see new ones put in place and old ones removed, or we may see the current ones applied differently. So that's also adaptive management.**
>
> So if you look at something like **the one-kilometre setback from a fish-bearing stream**, with that, that was put in place because adult spawners hold in streams, and out-migrating juveniles hold in the mouths of estuaries, that's where food is abundant. **So was there any knowledge that one kilometre was enough or too much, or that there was a definite risk there? No. But they applied the precautionary principle and put that setback in place.**

Transcript, September 7, 2011 *p.* 26 ll. 10 – p. 27 ll. 5

41. An apparent distinction between the precautionary *principle* and the precautionary *approach* was explained in detail by David Marmorek on September 20, 2011. Mr. Marmorek provided the Commission with a book chapter written by Randall Peterman describing the *principle* as being at the severe end of the spectrum where bans on human activities occur, versus the *approach* which permits activities provided that safety margins, monitoring and adjusting actions. In that chapter, Dr. Peterman writes: "there is a significant difference between the precautionary *principle* (which is generally analogous to complete closures of fisheries or stopping of human activities) and the precautionary *approach* (which allows some human activities but on a very cautious, limited scale to reduce risks)", and provides the following illustration:

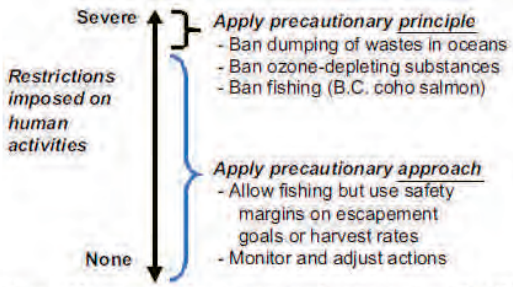

Figure 23.1 Schematic illustration of how applying a precautionary *principle* differs from applying a precautionary *approach*, in terms of the degree of restriction on human activities. Examples are provided.

Exhibit 1906, Peterman, *An Overview of the Precautionary Approach in the Fisheries and Some Suggested Extensions*, 2004, p. 239, 234

42. David Bevan was asked to comment on this description of the precautionary approach presented by Dr. Peterman's paper. Mr. Bevan explained DFO's view of the precautionary principle differed slightly from that of Dr. Peterman, as follows:

> But in this case, what he's suggesting is that the principle is where you're dealing with something like toxic waste dumping or some activity that is clearly extraordinarily high risk, huge consequences and consequences that could be very difficult to reverse or long-term in duration. So in that case you take draconian action.
>
> So we make a distinction, we don't share the same view, but in our view, as he suggested, precautionary approach, what we do there is we understand that there's a potential risk, we understand that we don't know the risk in absolute detail and that we can't quantify it down to a very precise level, but we take measures to

> 3 mitigate the risk, notwithstanding, and that we
> 4 endeavour to manage the activity, whether it's
> 5 aquaculture or fisheries or whatever, to ensure
> 6 that the impacts on the ecosystem are not severe
> 7 or irreversible.
>
> Bevan, Transcript September 26, 2011, p. 58 ll. 35 – p. 59 ll. 7

43. The BCSFA says that the regulation and management of aquaculture, including the siting of salmon farms, mitigation of identified and potential risks, the monitoring and reporting of impacts by the aquaculture industry, and adjustment of management actions are a suite of tools that are consistent with the precautionary approach.

2. Precautionary Approach in the Courts – the Legal Interpretation

44. The Federal Court of Appeal in *Canadian Parks & Wilderness Society v. Canada (Minister of Canadian Heritage)* explained that because the precautionary principle may have a paralyzing effect, adaptive management should be used as well to proceed while maintaining ecological integrity:

> **The concept of "adaptive management" responds to the difficulty, or impossibility, of predicting all the environmental consequences of a project on the basis of existing knowledge. It counters the potentially paralysing effects of the precautionary principle on otherwise socially and economically useful projects.** The precautionary principle states that a project should not be undertaken if it may have serious adverse environmental consequences, even if it is not possible to prove with any degree of certainty that these consequences will in fact materialise. **Adaptive management techniques and the precautionary principle are important tools for maintaining ecological integrity**.
>
> *Canadian Parks & Wilderness Society v. Canada (Minister of Canadian Heritage)*, 2003 FCA 197, (Fed. C.A.), (WLeC) at para. 24 [emphasis added]

45. The Federal Court in *Pembina Institute for Appropriate Development v. Canada (Attorney General)* elaborated on the adaptive management principle as follows:

> … in my opinion, adaptive management permits projects with uncertain, yet potentially adverse environmental impacts to proceed based on **flexible management strategies capable of adjusting to new information** regarding adverse environmental impacts where **sufficient information regarding those impacts and potential mitigation measures already exists**.
> …

> In sum, the *CEAA* represents a sophisticated legislative system for addressing the uncertainty surrounding environmental effects. **To this end, it mandates early assessment of adverse environmental consequences as well as mitigation measures, coupled with the flexibility of followup processes capable of adapting to new information and changed circumstances**. The dynamic and fluid nature of the process means that perfect certainty regarding environmental effects is not required.
>
> *Pembina Institute for Appropriate Development v. Canada (Attorney General)* 2008 FC 302 (WLeC) at paras. 32 – 34 [emphasis added]

46. Notably, in *Homalco Indian Band v. British Columbia (Minister of Agriculture, Food & Fisheries)* Justice Powers of the Supreme Court of B.C. was asked to consider the potential adverse impacts of salmon farms on wild salmon. The court referred to the *Salmon Aquaculture Review* ("***SAR***"), noting its application of the precautionary principle and adaptive management, and held that the precautionary principle meant balancing interests and concerns and a weighing of risks rather than halting all activity which may pose risks. Justice Powers wrote:

> The Salmon Aquaculture Review in its summary, Volume 1, p. 4 stated the following:
>
> > The technical advisory team concluded that salmon farming in B.C. as presently practised and at current production levels, presents a low overall risk to the environment. However, this general finding is tempered by certain reservations. …
> >
> > Science rarely has the ability to reach definitive conclusions on the risk or potential severity of the consequences of human interactions with complex ecosystems. **In the face of this uncertainty, governments still need to make land and resource management decisions.** Direction is provided by the **precautionary principle** which advocates the **consideration and anticipation of the potential negative impacts of any activity before it is approved.** Similarly, the concept of **preventative management allows government to manage, to prevent certain specific events even though not all potential outcomes can be predicted.** Where the risk of environmental impacts from an economically important activity is low but the consequences of damages may be significant, the **public interest may best be served by dealing with risk, by being precautionary and invoking a series of measures, including**: **preventative management, adaptive management, and performance-based standards**. **In the case of salmon farming, this means**

> **reducing risk by setting high standards for farm operations based on the best available knowledge, and rigorously enforcing the implementation of those standards**. And it means being prepared to alter management practices over time to take account of increased understanding of risk and different means of reducing it. This means that industry will be required to adapt to **evolving management schemes**.
>
> …
>
> The respondent's arguments are essentially that the precautionary principle does not require government action, but simply says that lack of scientific knowledge is not an excuse to fail to take action. **The respondents argue that the adaptive management approach that the government has taken is in line with precautionary principles and appropriate in this case.**
>
> …
>
> The respondents argue that the Homalco have misunderstood the precautionary principle. They argue that the principle really means that lack of scientific knowledge is not a basis for failing to pass regulations or controls to avoid potential serious or irreversible damage to the environment. They argue that **it does not mean, nor are governments bound, to prevent all activities which might cause such harm however low the risk might be, or however speculative the risk might be, until it is proven as a certainty that there is no risk.**
>
> **I agree with the respondents that the precautionary principle does not require governments to halt all activity which may pose some risk to the environment until that can be proven otherwise.** The decisions on what activity to allow and how to control it often require **a balancing of interests and concerns and a weighing of risks**. This is exactly the kind of situation which requires consultation, discussion, exchange of information, and perhaps accommodation.
>
> *Homalco Indian Band v. British Columbia (Minister of Agriculture, Food & Fisheries)* 2005 BCSC 283 (WLeC) at paras. 37, 41, 44, 45 [emphasis added]; see also *SAR*, PPR #20, *Aquaculture Regulation in British Columbia* ("**PPR #20**") para. 23

47. This decision clearly shows that the precautionary principle is served by implementing the suite of tools used by the Province and DFO to regulate the aquaculture industry, and that it furthermore requires decision-makers to integrate socio-economic considerations as well as environmental considerations in making science-based management decisions.

3. Applying the Precautionary Approach

48. When Wendy Watson-Wright introduced Exhibit 51, *A Framework For The Application Of Precaution In Science - Based Decision - Making About Risk* ("**Exhibit 51, *A Framework For The Application Of Precaution***"), into evidence she described it as "kind of a bible document in the Government of Canada" which "really set the stage for a lot of the work that was subsequently done within the department on the precautionary approach." David Bevan explained that the precautionary approach described in Exhibit 51 is more specific than the general precautionary principle in terms of "how to take decisions in the face of scientific uncertainty, and to be precautious in order to prevent irrevocable or significant harm to the stocks that we are responsible for managing."

Watson-Wright, Transcript, November 03 2010 p. 27 ll. 41 p. 28 ll.13;
Exhibit 51, *A Framework For The Application Of Precaution;*
Bevan, Transcript, September 23 2011, p. 63 ll. 45 to p. 64 ll. 3

49. Exhibit 51*, A Framework For The Application Of Precaution* explains several factors to consider in making sound judgments in the face of scientific uncertainty. These include determining what is sound or credible scientific evidence, what follow up activities such as research and scientific monitoring are warranted, who bears the burden of producing scientific data as the basis for decision making, and the inherent dynamics of science on decision making which recognizes that decisions will have to be made despite inconclusive science. Page 3 provides an overview of the principles described in the document. These are:

> Five General Principles of Application
>
> 4.1 The application of precaution is a legitimate and distinctive decision-making approach within risk management
> 4.2 It is legitimate that decisions be guided by society's chosen level of protection against risk
> 4.3 Sound scientific information and its evaluation must be the basis for applying precaution; the scientific information base and responsibility for producing it may shift as knowledge evolves
> 4.4 Mechanisms should exist for re-evaluating the basis for decisions and for providing a transparent process for further consideration
> 4.5 A high degree of transparency, clear accountability and meaningful public involvement are appropriate
>
> Five Principles for Precautionary Measures
>
> 4.6 Precautionary measures should be subject to reconsideration, on the basis of the evolution of science, technology and society's chosen level of protection

> 4.7 Precautionary measures should be proportional to the potential severity of the risk being addressed and to society's chosen level of protection
> 4.8 Precautionary measures should be non-discriminatory and consistent with measures taken in similar circumstances
> 4.9 Precautionary measures should be cost-effective, with the goal of generating (i) an overall net benefit for society at least cost, and (ii) efficiency in the choice of measures.
> 4.10 Where more than one option reasonably meets the above characteristics, then the least trade-restrictive measure should be applied
>
> Exhibit 51, *A Framework For The Application Of Precaution, supra p.* 3

50. The precautionary approach involves setting thresholds and prescribed management actions, ongoing monitoring to determine whether the threshold has been reached, and adaptive management to lessen the risk of reaching the threshold. The Provincial Government of British Columbia (the "Province") and the Federal Government of Canada ("Canada"), and the industry itself have all made decisions, taken actions and implemented measures to understand and prevent environmental degradation at the time of siting and licensing farms, to monitor and research impacts and risks as farms are operated, and to adjust management and regulation of the farms based on developing knowledge. In the fisheries context, David Bevan explains:

> 11 And in dealing with the risk management,
> 12 that's what we have been doing and that's what
> 13 we're reflecting in our decision rules in the
> 14 **precautionary approach** that we have applied in a
> 15 number of fisheries. So we have defined the areas
> 16 where the likelihood is that we'll be entering
> 17 into a zone where there's a **possibility of serious**
> **18 and irreversible harm**, and then we have **laid out**
> **19 decisions, rules that would guide management in**
> **20 the event we find ourselves in those**
> **21 circumstances.**
> …
> 31 …So in our vernacular, I
> 32 guess, when we think about a decision, we think
> 33 **about a decision leading to a set of rules that**
> **34 will be applied to a human activity,** and with the
> 35 understanding that **we have the authority under the**
> **36 *Fisheries Act* to take action to ensure that those**
> **37 decisions are, in fact, reflected in action**.
>
> Bevan, Transcript November 4, 2010, p. 58 ll. 11-21, p. 59 ll. 31-37 [emphasis added]

51. Principle 4.6 of Exhibit 51, *A Framework For The Application Of Precaution* explains that particularly in the case of natural resources, it may not be possible to resolve scientific uncertainty, and instead advises reviewing scientific knowledge as it evolves and conducting research an monitoring to reduce uncertainty and improve decision-making. Accordingly, the DFO takes a precautionary approach with aquaculture by mitigating against significant adverse environmental impacts through its licensing conditions, including the requirement to "provide information to the Department to demonstrate that they have the adequate controls to deal with parasites and disease and to maintain the ecosystem that they are using."

Exhibit 51, *A Framework For The Application Of Precaution* , *p.* 12;
D. Bevan, Transcript November 2, 2010, p. 26, ll. 18-25

4. Defining Government Actions

52. A key theme that frequently emerges in the context of the aquaculture debate is what "measures" or actions are necessary to satisfy the precautionary approach; specifically whether government must take draconian measures to eliminate risks by banning human activities which may pose risks, or adaptive management measures to determine what the risks are and to reduce them. Those who advocate the former generally demand "zero risk" to wild salmon and characterize incremental adaptive management actions as indecision. They suggest that "action" consists of radical measures such as the closure of fisheries or the abolition of salmon farming. For example, Ms. Catherine Stewart of the Coastal Alliance for Aquaculture Reform ("**CAAR**"), a member of the Conservation Coalition, referred to the precautionary principle and concluded "the weight of evidence continues to mount and our government continues to fail to act."

Stewart, Transcript Sept 8, 2011 p. 36, ll. 23-37

53. This perspective that only "draconian" measures, as described by Mr. Bevan, constitute action overlooks the fact that pursuant to the precautionary approach, government "acts" regularly and incrementally, making licensing decisions, passing regulations and policies, and monitoring and improving the management of the aquaculture industry pursuant to adaptive management. For example, when the DFO Organizational Structure panel was asked: "when do you reach a point where you have sufficient science that you take some sort of action", Paul Sprout replied "I understand from your question that you think we've taken no action", and proceeded to explain numerous actions already taken by the Province and DFO, despite a lack of consensus as to risks posed by salmon farms, to conduct research and to reduce disease transmission and control sea lice:

> 13 First of all, I think Dr. Richards could talk
> 14 about **the research that's been going on on**

Broughton Islands that's around trying to look at the issue of wild versus farmed interactions which has generated information which informs management decisions, which are actions.

…

…Well, from the Department's perspective, **our jurisdiction at this point is relatively narrow. It will expand considerably on December the 18th**, but the actions that we put into place include things like **environmental processes for site screening**, for determining whether farms can be located in certain sites given concerns around bottom deposition. The Province has a role in terms of **waste management**, in terms of **sea lice controls**, in terms of **monitoring**, and **all of these are actions**. So there's **research** under way and there's actions by both levels of government in terms of the management of this particular sector.

So it's not like as if there aren't things underway and are happening in terms of specific activities related to the management of this sector.

Now, if you're raising questions that there remains scientific uncertainty, that's a fair observation. It's also a fair observation to say that **further actions might be contemplated in the future based on further information from Science and Risk Assessment**. But I come to the observation and the question is when do we set the stage to recommend that we take actions? **I think the response is we have taken actions.**

Sprout, Transcript, November 4, 2010 p. 34 ll. 8 – p. 35 ll. 1

B. Aquaculture and the Precautionary Approach

1. Management and Regulation is precautionary, science-based and adaptive

54. Aquaculture is regulated and managed pursuant to the precautionary principle, both under the Province and now by Canada. Sue Farlinger described Exhibit 8, *Canada's Policy for the Conservation of Wild Pacific Salmon* ("**Exhibit 8, the *Wild Salmon Policy***") as "the expression of the very broad international and Canadian precautionary approach". Exhibit 8, the *Wild Salmon Policy* provides a broad overview of how aquaculture was jointly regulated by both Canada and the Province. It notes that the risks posed by salmon aquaculture facilities are "addressed through addressed through mitigation measures such as Fish Health Management Plans, improved cage structures and proper farm siting." Exhibit 8, the *Wild Salmon Policy* also refers to reviews for potential habitat effects from benthic depositions and subsequent monitoring, as well as *Canadian Environmental Assessment Act* ("***CEAA***") screenings for salmon farms which encompass "all the potential effects on the natural environment, including the impacts of disease and parasite transfers, escapes, waste discharges and impacts to wildlife." Significant impacts are addressed through mitigation measures, management plans, and adherence to Provincial regulations. It notes that only projects unlikely to have significant impacts following mitigation, including through cumulative effects of other projects in the same area, are approved.

Farlinger, Transcript Sept 23 2011, p. 55 ll. 44-46; p. 78 ll. 4 – p. 79 ll. 14;
Exhibit 8, the Wild Salmon Policy *p.* 15, 31

2. Provincial-Federal Jurisdiction and the Precautionary Approach

55. Under the Province's direction, salmon aquaculture underwent a lengthy environmental assessment, the Salmon Aquaculture Review, which deemed aquaculture a "low risk" to the environment and made a series of recommendations to fill knowledge gaps and to improve the regulation and management of the industry. The Province had implemented many of the Salmon Aquaculture Review recommendations when the B.C. Supreme Court ruled that Canada had exclusive jurisdiction over aquaculture.

PPR #20 para. 23;
Last, Transcript August 30, 2011 p. 48 ll. 3 – p. 53 ll. 42;
Exhibit 1615, *Province of BC Following Actions to Meet the Intent of the Salmon Aquaculture Review's Recommendations*.

56. Under the Province's regulatory oversight, numerous precautionary measures such as minimum setbacks from salmon bearing streams, sea lice management levels, fish health management plans, and fish health data auditing, were implemented to minimize the risk of potential impacts of salmon farming on the environment. Exhibit 1560, *Province of BC Annual Report Fish Health Program, 2009* explains that following the *SAR* in 1997, the Province implemented a comprehensive policy in 2001, the Fish Health Program, "to improve the monitoring of fish disease on salmon farms and to establish governance of health management in the aquaculture industry." This required salmon farmers to have documented Fish Health Management Plans ("**FHMP**") and to report fish health information to B.C. Ministry of Agriculture and Lands ("**BCMAL**") for auditing and monitoring. The objective of the program:

> … to **monitor and minimize the risks of disease in farmed fish**, and to facilitate public and agency confidence that aquaculture health management in BC occurs at a high standard. The cornerstone of this program is the salmon Health Management Plan (HMP). … Since 2003, all private companies and public salmon culture facilities have developed and maintained **a current HMP specific to their facility**. For private companies and the provincially licenced public facilities, the **HMP remains enforceable as a Term & Condition of an aquaculture licence**.

Exhibit 1560, *Province of BC Annual Report Fish Health Program, 2009 p.* 5 [emphasis added]

57. As an example of the precautionary approach being applied to aquaculture under the Province, Dr. McKenzie explained the aquaculture industry took part in the development of FHMPs in 2002 and 2003 through a comprehensive review process by a Province-led committee that involved DFO, Freshwater Fisheries Society, academia, and the provincial veterinarian. Dr. Sheppard noted FHMPs became a condition of licence for aquaculture under the Province. The use of FHMPs by the aquaculture industry have played a significant role in minimizing risks to wild salmon.

Dr. McKenzie, Dr. Sheppard, Transcript, August 31, 2011
p. 28, ll. 20 – p. 29 ll. 20

58. The precautionary approach of using reference limits was reflected in the Province's Finfish Aquaculture Waste Control Regulation which came into effect in 2002. As an example, Exhibit 1622, *Guide to Information Requirments* (*sic*.) *for Marine Finfish Aquaculture Applications, May 2003*, ("**Exhibit 1622, *Guide to Information Requirements*, 2003**") required aquaculture companies to collect and submit baseline data on what existed under a site prior to siting a salmon farm. As Mr. Last explained, that baseline data informed a performance based approach, under which a threshold for sulphides, considered a surrogate for diversity, was set which triggered management actions if exceeded. In the

Province's reply to Exhibit 1631, *Audit of the Management of Salmon Aquaculture for the Protection of Wild Salmon in BC*, May 9 2006, the Province criticized the audit for failing to consider a number of regulatory requirements, including the use of a performance-based rather than prescriptive approach to regulations by the Province:

> Aquaculture regulation in British Columbia is built on a performance-based and adaptive management approach. This approach flows from the recommendations of the Salmon Aquaculture Review, which concluded that:
>
> > "Where the risk of environmental impacts from an economically important activity is low but the consequences of damage may be significant, the public interest may best be served by dealing with risk by being precautionary and invoking a series of measures, including: preventative management, adaptive management, and performance-based standards. **In the case of salmon farming, this means reducing risk by setting high standards for farm operations based on the best available knowledge, and rigorously enforcing the implementation of those standards.** And it means being prepared to alter management practices over time to take account of increased understanding of risk and different means of reducing it. This means that industry will be required to adapt to evolving management schemes."
>
> The Province applies adaptive management as a systematic process for continually improving management policies and practices by learning from the outcomes of operational programs. BC incorporates ongoing redefinition and modification throughout the policy-making process together with ongoing stakeholder involvement.

Exhibit 1622, *Guide to Information Requirements*, 2003, *supra*;
Last, Transcript, August 30, 2011 p. 52, ll. 17-33;
Ibid. p. 54, ll. 31-43
Exhibit 1620, *Comprehensive MAL Response to BC Audit*, Apr 5 2006 [emphasis added]

59. The DFO applied the precautionary approach to its own management of aquaculture prior to the decision in *Morton v. British Columbia (Ministry of Agriculture and Lands)* (the "*Morton* Decision"). For example, Exhibit 216, *APF*, 2002, provides that "DFO's regulatory decisions supported by enhanced science, improved decision-making and management frameworks will be based on risk management approaches endorsed by the Government of Canada, including **adaptive management**, involving ongoing monitoring and, where

required, the **application of the precautionary approach** to reduce the likelihood of unacceptable outcomes."

Exhibit 216, Aquaculture Policy Framework (2002), ("**Exhibit 216, *APF***") page 27 [emphasis added]; *Morton v. British Columbia (Ministry of Agriculture and Lands)*, 2009 BCSC 136

3. Transition to Federal Jurisdiction and the Precautionary Approach

60. Since the *Morton* Decision, DFO has given further indication the precautionary approach will continue to apply to aquaculture. Exhibit 1602, *PAR. Ecosystem-Based Approach to Aquaculture Management*, for example, reaffirms "DFO's overall policy approach for aquaculture includes incorporation of the Precautionary Approach in decision making" and provides:

> Adopting a Precautionary Approach to fisheries and aquaculture management involves **setting biologically-based reference points** and establishing **pre-agreed risk-based actions to be taken at those reference points** well in advance of undertaking the activities to which such reference points apply. …
>
> **Science decisions will be informed through the state of knowledge including Pathways of Effects related to aquaculture interactions and other advice from the Canadian Science Advisory Secretariat (CSAS),** which coordinates the peer review of scientific issues for the Department of Fisheries and Oceans.
>
> The movement towards **ecosystem based management** will require that multiple issues be brought forward for **integrated management, and may require the development of new management tools, or adaptations of current practice.**

Exhibit 1602, DFO, PAR. *Ecosystem-Based Approach to Aquaculture Management p.*2 [emphasis added]

61. The BCSFA argues that the regulatory scheme proposed by DFO is rigorous and implements the precautionary approach. For example, as explained by Mr. Thomson, DFO is presently working on a new Sustainable Aquaculture Fisheries Framework ("**SAFF**"), a licensing approach, and the public reporting approach, and is reviewing the environmental management policies. The SAFF includes four elements, (1) Conservation, ecosystem and sustainable use policies; (2) Economic and Governance policies; (3) Planning, processes and regime performance monitoring tools; and (4) Operational implementation. These elements set our numerous environmental management plans, performance assessment plans, integrated management plans and risk management processes.

Thomson, Transcript August 30, 2011, p. 14 ll. 33 – p. 15 ll. 8
Exhibit 1588, BC Aquaculture Regulatory Program
Licensing Approach, Jun 17 2011, p. 14-16

62. As explained by Exhibit 1588, BC Aquaculture Regulatory Program Licensing Approach, Jun 17 2011, aquaculture licences, issued under the *Pacific Aquaculture Regulations* (Canada), are the "core management tool under the new regime, complemented by separate licensing of introductions and transfers for special conditions and other fisheries licencing". The new licensing and management regime will incorporate impacts to fish habitat and other environmental considerations into the process for approving new sites, managing aquaculture operations, and the area and cumulative effects analysis in the IMAP process. The BCSFA also notes that the DFO aquaculture licences, Exhibit 1594, provides that it is an offence under the *Fisheries Act* (Canada) to contravene a condition of licence, which demonstrates the DFO's commitment to ensure the aquaculture industry is complying with the precautionary measures put in place. As Mr. Thomson noted, the Province informed him during the regulatory transition that the aquaculture industry in B.C. has historically demonstrated a high level of compliance.

Exhibit 1588, BC Aquaculture Regulatory Program
Licensing Approach, Jun 17 2011, p. 4, 6;
Thomson, Transcript August 30, 2011, p. 47, ll. 25-44;
Exhibit 1716, *Regulatory Compliance of British Columbia's Marine Finfish Aquaculture Facilities 2009, Joint Report Ministry of Agriculture and Lands and Ministry of Environment (highlighted version)*, p. 5

63. As explained by Ms. Hoyseth DFO's aquaculture site application assessment process requires that the aquaculture industry collect and submit a large volume of detailed data to DFO for new farm sites. Exhibit 1589, Pacific Marine Finfish Aquaculture Application Form, for example, provides at Section C: Fish Habitat and Protection Measures that the industry model the predicted benthic footprint using DEPOMOD, foreshore transect surveys to obtain qualitative assessments of the physical of the physical and biological characteristics of fish and fish habitat, and juvenile wild salmon beach seine surveys to determine the average size and species of salmon in the area.

Hoyseth, Transcript September 1, 2011, p. 21 ll. 29 – p. 24 ll. 1

64. The first policy principle of Exhibit 216, APF requires DFO to support aquaculture development "in a manner consistent with its commitments to ecosystem-based and integrated management, as set out in departmental legislation, regulations and policies." As Mr. Thomson explained, the IMAP process now being undertaken by DFO pursuant to the regulatory transition is focused on implementing an "ecosystem-based approached, as opposed to the site-by-site-based approach", that will look at aquaculture activities "occurring in

defined geographic areas as part of the overall management of that area as opposed to looking at one individual site."

Thomson, Transcript August 30, p. 108 ll. 30 – p. 109 ll. 31

65. Exhibit 1386 *DFO Framework for Applying an Ecosystem Approach to Management,* Jul 28 2011, provides the following high-level explanation of what constitutes an ecosystem approach to management.

> *"An Ecosystem Approach to Management*
> *– Is an adaptive approach to managing human activities that is specific geographically,*
> *– Takes into account ecosystem knowledge and uncertainties,*
> *– Considers multiple external influences, and*
> *– Seeks to ensure the coexistence of healthy ecosystems and human activities"*

Exhibit 1386 *DFO Framework for Applying an Ecosystem Approach to Management,* Jul 28 2011, at PDF 12

66. Canada is taking the regulatory transition as an opportunity to improve the regulation of the aquaculture industry. For example, as noted by the Auditor General of Canada's *The Effects of Salmon Farming in B.C. on the Management of Wild Salmon Stocks (2000),* under the shared jurisdiction of the Province and Canada, the aquaculture industry was subject to multiple regulations and policies, some of which were in potential conflict with one another. As explained by Ms. Farlinger in response to Exhibit 1366, Watson, *Questions and Answers*, 2011, regulation of aquaculture under DFO will now be more straightforward. However, the idea of a separate *Aquaculture Act* (Canada) suggested by that document and by the industry was considered by Mr. Bevan to be less desirable than modernizing the *Fisheries Act* (Canada).

Farlinger, Transcript September 26, 2011, p. 46 ll. 2 – p. 46 ll. 18;
Exhibit 1366, Watson, *Questions and Answers*, 2011, *supra*, p. 21;
Exhibit 1626: CAIA, *An Aquaculture Act for Canadian Aquaculture (or separate Chapter in Fisheries Act);*
Exhibit 1627, Email From S. James To T. Swerdfager, Aquaculture Act, Apr 19 2010
Bevan, Transcript September 26, 2011, p. 49 ll. 5 – p. 51 ll. 13

67. DFO intends to use the transition to resolve some of the complexity of the former regulatory regime for aquaculture shared between the Province and DFO by providing more consistent and proactive regulations. Exhibit 1640, *Federal B.C. Aquaculture Regulation & Strategic Action Plan Initiative, Discussion Document* (2009) notes:

> The BCSC decision regarding aquaculture provides an opportunity for governments to review historic practices and approaches pertaining to aquaculture management in British

> Columbia and make earnest efforts to design and implement appropriate changes to create an aquaculture regulatory framework that is more effective, more transparent, more consistent and more responsive (Table 1)….

Table 1: Scope of change envisaged to establish an efficient, transparent and predictable aquaculture regulation

FROM:	TO:
▪ Fractured management regimes with many and varied regulations and policies	▪ A designed regime with more consistent regulation & policies while still managing significant risks
▪ Regimes lacking transparency and public credibility	▪ A regime that transparently demonstrates how the sector is managed and the basis for decisions on policy and individual sites
▪ Lethargic processes, not easily responsive to changes in knowledge, public expectations, etc.	▪ Proactive regulation, with rapid response to emerging issues / knowledge
▪ Repetitive evaluations of issues on a site by site basis	▪ Common tools for common issues

PPR #20, para. 250d;
Exhibit 1640, *Federal B.C. Aquaculture Regulation & Strategic Action Plan Initiative, Discussion Document* (2009) at PDF 7

68. As Claire Dansereau said, had DFO at any point determined that aquaculture posed an unacceptable risk to wild salmon or the environment, it could have taken extreme measures prior to the *Morton* Decision. In answer to question on whether DFO considered the risks of disease from aquaculture to salmon on migration route when rolling over aquaculture licences in 2010, Dansereau that if there were some threat posed to wild salmon, DFO would have worked with the Province to impose restrictions even before taking over jurisdiction. David Bevan furthermore explained that DFO has been monitoring local populations of returning salmon in the areas of salmon farms to determine whether any additional research was needed and had seen no evidence that they had missed such an issue, adding that the concerns relating to aquaculture had changed from sea lice to disease.

Dansereau, Transcript September 22, 2011 p. 77 ll. 1 – p. 78 ll. 8;
Bevan, Transcript September 26, 2011, p. 81 ll. 7 – 44

4. Aquaculture Industry and the Precautionary Approach

69. The BCSFA's members apply the precautionary approach to their management of farms. In addition to investing significant time, money and expertise to choose the best sites based on available scientific knowledge prior to making applications to the government, the aquaculture industry also vaccinates fish and engages in farm biosecurity, and treats for sea lice to avoid potential harm to wild fish.

70. Where the government has made decisions using the precautionary approach, the industry acts pursuant to the regulations and guidelines it implements. Fish Health Management Plans ("**FHMPs**") are an example of the precautionary approach applied to aquaculture, and were developed with the help of the aquaculture industry. FHMPs are subject to regular review to ensure best practices are maintained. Dr. Sheppard explained that the template FHMPs, for example Exhibit 1664*, Template for Development of Facility - Specific Fish Health Management Plans British Columbia Revised May 2006*, ("**Exhibit 1664, *FHMP Template 2006***"), provided the fundamental principles of health management such as collection of carcasses for early detection of fish health events, and the aquaculture companies then tailored the operating procedures to implement the FHMPs at their specific businesses and sites. Notably, Exhibit 1664, *FHMP Template 2006* provides that the FHMPs are subject to annual review by the veterinarian and periodic review by the regulator, and that changes may be made to the document as required.

Dr. Sheppard, Transcript, August 31, 2011, *p.* 26 ll. 24 – p. 27 ll. 29;
Exhibit 1664, *FHMP Template 2006*, *supra* at sections 1.5 – 1.6, p. 5

71. The elements of FHMPs outlined in Exhibit 1663, *Required Elements of a Fish Health Management Plan for Public and Commercial Fish Culture Facilities in British Columbia, June 2003*, show that FHMPs require aquaculture operators to implement numerous preventative measures to avoid disease and to have plans in place to implement should an outbreak be detected. A detailed list of "Fish Health Emergency Procedures" is provided in section 2.9 of Exhibit 1664, *FHMP Template 2006*, *supra* for example, which requires immediate notification of the veterinarian or Fish Health Management if any serious problem is suspected, and prescribes steps that must be taken should an outbreak occur, including specific steps for IHNV. FHMPs will be discussed in greater detail below.

1663, *Required Elements of a Fish Health Management Plan for Public and Commercial Fish Culture Facilities in British Columbia, June 2003 p.* 8
("**Exhibit 1663, *Required Elements of a FHMP***");
Exhibit 1664, *FHMP Template 2006, supra* at section 2.9, p. 23-29

72. The aquaculture industry has also taken a precautionary approach to farm siting applications, and exceeds the siting criteria developed by the Province which were themselves developed using the precautionary approach. The siting criteria, as explained by Mr. Last, contain a one kilometer setback from "significant" salmon bearing streams. This setback was not science-based, but was instead precautionary, and was chosen to exceed the standards used in other jurisdictions. As Mr. Swerdfager testified, these criteria are already "as or more stringent" than those elsewhere in Canada and internationally. The B.C. aquaculture industry in fact elected to avoid all salmon streams, not only those which are thought to be "significant", even prior to the *SAR*:

MS. PARKER: Well, it's actually a principle that's applied by both the regulator and by industry. Originally when it was applied, there was a two-tiered approach so that **there was a one-kilometre setback from "significant" streams, and a smaller setback for streams that were rearing habitat only**. But that's a fairly esoteric decision to make, so **the industry defaulted to just using a one-kilometre setback. It's simpler and it provides the maximum amount of protection without any haggling over what does "significant" mean.**

Q And is this a recent application of the principle, or did it exist from the early years of the industry in B.C.?

MS. PARKER: I think it was formal -- Clare has a longer industry -- Mr. Backman has a longer experience in the industry than I do, but **it was definitely in place before the Salmon Aquaculture Review, and it was formalized after that.**

Exhibit 1632, *Criteria for Siting New FinFish Aquaculture Facilities*;
Swerdfager, Transcript August 30, 2011, p. 21 ll. 1-23;
Parker, Transcript, September 7, 2011, p. 27, ll. 14-32

73. Furthermore, as Ms. Hoyseth testified, the aquaculture industry itself works to mitigate impacts in a number of ways independent of the government review or site applications. For example, she notes that aquaculture companies reduce the amount of waste feed and look at ways of managing the site to reduce environmental impacts. Ms. Hoyseth also said that the industry is careful to ensure that the benthic depositions predicted using DEPOMOD and anchoring locations according to bathemetry and depth of the site, water currents, and other factors will meet the necessary criteria before they make a site application.

Hoyseth, Transcript September 1, 2011, p. 22 ll. 12 – 23,
p. 22 ll. 37 – p. 23 ll. 26

74. The BCSFA says that the environmental performance of the aquaculture industry is continuously improving. As Mr. Backman noted, the precautionary principle uses the best available information and is adaptive as more information becomes available. He gave the example of the one kilometer distance between farms, and noted that no new information gathered through *CEAA* screenings and monitoring has shown it necessary to make a wider separation between farms. He said that if it were determined that a greater separation were necessary, the aquaculture industry would adjust accordingly.

Backman, Transcript September 8, 2011, p. 35 ll. 15 – p. 36 ll. 22

75. It is possible that some precautionary measures presently in place in B.C. could be reevaluated in light of new scientific knowledge, for example, the fact that sea

lice are not a significant threat to salmon as once thought. Dr. McKenzie said that regardless of sea lice levels, farms treat fish for sea lice in the spring out-migration periods "in order to ensure that the lice levels on our farms are as low as possible during the out-migration of wild stocks", but that prophylactic treatment goes against a veterinarian's better judgment. Based on his investigation into salmon farming, Dr. Noakes recommended the 3 lice per fish trigger for treating sea lice be maintained "only for the period March – June when the juvenile Fraser River sockeye salmon are migration past salmon farms" because "[a]dult salmon returning to spawn carry high levels of lice and treating sea lice on farms during the late summer and fall will not substantially reduce the risk of sea lice (*L. salmonis*) infection but increases the risk of the sea lice developing a resistance to SLICE."

Backman Transcript Sept 7, 2011 p. 52 ll. 36 – p. 53 ll. 43;
McKenzie, Transcript August 31 2011 p. 19 ll. 17 – p. 20 ll. 35;
Exhibit 1536 *Noakes Report 5C*, 2011 p. 35

C. Reliability of Farm data and Audit Program

76. The BCSFA says that the information reported by the aquaculture industry to its regulator has multiple levels of controls to ensure high confidence in what is reported. Pursuant to the FHMPs, the aquaculture industry developed a fish health database maintained by the BCSFA. Aquaculture companies reported fish health events to the database on a monthly basis, and the BCSFA submitted quarterly reports to the Province. These reports were compared to the results of the Province Fish Health Audit and Surveillance Program and reported on. During the regulatory transition from the Province to Canada, the BCSFA contracted the Centre for Aquatic Health Science ("**CAHS**") to audit the fish farms and post this information on its website. Significantly, Dr. Noakes observed that "approximately 35% (45 out of 130 per year) of the reported [fish health events] are associated with the use of anaesthetics and SLICE for the mandatory sea lice monitoring and control program (Table 6)."

PPR #20, paras. 67-69, 200;
Exhibit 1536, *Noakes Report 5C*, 2011, p. 24

77. The fish health data collected by the industry has numerous guarantees of trustworthiness. Qualified fish health professionals employed at each company conduct ongoing fish health monitoring, and this data is submitted to the regulator for compliance auditing by experts such as Dr. Marty and Dr. Sheppard. Exhibit 1663, *Required Elements of FHMP, 2003* defines a qualified fish health professional as follows:

> **Qualified Fish Health Professional**:
>
> A term used to describe those persons with adequate post-secondary training and experience in the recognition of diseases in fish to qualify them for certification by a recognized body.
>
> Current legislation only recognizes a veterinarian as being qualified to diagnose and prescribe treatment of fish diseases. Veterinarians therefore serve as qualified fish health professionals.

Exhibit 1663, *Required Elements of FHMP, 2003, supra p.* 5

78. As explained by Exhibit 1662, the "over-riding objectives of the provincial Fish Health Program are to monitor and minimize the risks of disease in farmed fish, and to facilitate public and agency confidence that aquaculture health management in BC occurs at a high standard". Each company's FHMPs required "on-site health monitoring and reporting of disease status" and compliance monitoring which was enforceable as a Term & Condition the provincial aquaculture licences.

79. Dr. Mark Sheppard explained the audit process set out in Exhibit 1662, *British Columbia Ministry of Agriculture & Lands Fish Audit and Surveillance Program (FHASP)*. That document sets out three "main tasks", and Dr. Sheppard explained there was a checklist used to verify each component. First, the provincial fish health bio-technicians would monitor and review fish health records of the industry to monitor compliance and implementation of the company's FHMP. Second, the bio-technicians would collect dead fish samples for audit and surveillance. Third, as explained by Dr. Sheppard, the provincial technicians would monitor sea lice levels using and independent algorithm to randomly choose farms to monitor. The results would then be compared to verify the salmon farmers were looking for the right things and reporting. Dr. Sheppard explained that 150 to 160 site visits would occur each year.

Sheppard, Transcript August 31, 2011, p. 38 ll. 11 – p. 39 ll. 12, p. 39 ll. 36 – p. 40 ll. 30;
Exhibit 1662, *British Columbia Ministry of Agriculture & Lands Fish Audit and Surveillance Program (FHASP);*
also see Exhibit 1665*, Health Management & Mortality Management Plan (HMP) Inspection*

80. Having reviewed and interpreted the data provided by the BCSFA to the Cohen Commission, Dr. Korman concluded: "The combined government-industry monitoring program is **impressive** in terms of the fraction of farms that are audited, the number of pathogens that are tested for, the intensity of industry-based sampling and reporting, and the annual reporting and comparison of audit and industry-based results by regulators." When asked about comparing this data to sockeye returns, Dr. Korman testified that the sample size was small because the BCSFA database only began "in a robust way in about 2003 to 2004".

Exhibit 1543, (*formerly SS) - Korman, Cohen Commission Technical Report 5A, Summary of Info for Evaluating Impacts of Salmon Farms on Survival of FRSS*, May 2011 p. 9 (**"Exhibit 1543m *Korman Report* 5A, 2011"**);
Korman, Transcript, August 25, 2011, p. 82 ll. 27 – p. 83 ll. 41, p. 86, ll. 29-41

81. The Province's Fish Health Audit and Surveillance Program ("**FHASP**") consisted of reviewing the fish health records of salmon farms, colleting samples of recently dead or moribund fish to analyse, and comparing the audit reports to the BCSFA database reports. Quarterly reports and an annual Fish Health Report, such as Exhibit 1560, *Province of BC Annual Report Fish Health Program, 2009*, were generated and provided to the public. These reports, like Canada's more comprehensive release of data, helped put much of the raw data into context. For example, in 2009, "[o]f the 144 FHEs reported as requiring husbandry or veterinary management in Atlantic salmon: almost 50% was sea lice monitoring activity.

PPR # 20, paras. 68-69;

Exhibit 1560, Province of BC Annual Report Fish Health Program, 2009 ("Exhibit 1560, *BC Fish Health Report 2009*"), *p.* 31

82. The audit program is meant to give confidence in the fish health reporting by aquaculture companies, not to mirror it perfectly. Dr Sheppard testified that the audit program was meant to be "snapshots in time" whereas "the information collected and submitted by the industry is much more voluminous and much more frequent, and the veterinarians and the Fish Health Management staff for those corporations were -- had their finger on the pulse most of the time." Referring to figures 4 and 4a and figure 15 of Exhibit 1560, *BC Fish Health Report 2009*, Dr. Sheppard noted that by comparing them, the categories of findings "almost overlapped completely in every case", and that he recalled "only one time that the audit information did not find something that the industry had actually reported."

Transcript, August 31, 2011 p. 52 ll. 39 – p. 53 ll. 17

83. An audit of the Province's FHASP program by Dr. Parmley of the Centre for Coastal Health concluded the Province's audit program exceeded international standards. It also noted the level of monitoring is "more comprehensive" than other salmon farming regions of the world. Dr. Parmley said that the audit process can both instill public confidence and improve disease detection through site visits and "the number of fish observed and tested". He concluded: "[t]he data collected as part of the BC FHASP exceed international standards to demonstrate freedom of disease and the level of fish health monitoring in BC is more comprehensive than in other parts of Canada and other salmon producing regions of the world." He recommended maintaining the current program, with some "minor adjustments, will go a long way towards maintaining Canada's international reputation for disease freedom and control."

Exhibit 1668, *A Review of the British Columbia Ministry of Agriculture and Land's Fish Health Audit and Surveillance Program*, **("Exhibit 1688, *Review of BCMAL FHASP*")** p. 3

84. The two minor adjustments Dr. Parmley identified should be addressed were the need for "specific and measurable objectives for the [FHASP] program, including specific thresholds for action", and "a plan for routine and ongoing analysis, interpretation and communication of the results to those who need to know in time to act." Dr. Stephen contested the conclusion a communication scheme was not already in place because findings are immediately communicated to the attending veterinarian:

> … in fact I would contest
> that statement, because if we make a finding,
> whether it be at the histopathological cellular
> level, or whether it's at the farm level when
> we're observing the animals, **there is and has been**
> **an immediate communication with the attending**
> **veterinarian** to assure us and assure them that

> 32 they have been monitoring this, or is it in fact
> 33 that we have found the first case. **More often**
> **34 than not, the attending veterinarian is well aware**
> **35 of what's going on and is well into the management**
> **36 of the situation**.

Sheppard, Transcript, August 31, 2011, p. 93 ll. 25 – 36;
Exhibit 1668, *Review of BCMAL FHASP*, supra, p. 3

85. Several questions were directed by counsel for the Aquaculture Coalition to Dr. Korman on what an "open diagnosis" meant in the fish health data produced by the BCSFA and the Province for the Commission's Project 5 Technical Report. Dr. Korman replied that those questions would be better put to a fish health professional. Dr. Sheppard took counsel for the Aquaculture Coalition to one of the fish health database spreadsheets to explain the meaning of an "open diagnosis." Dr. Sheppard explained that the lab findings were of "very little relevance to the population as a whole", and also that an open diagnosis would be made once all of the evidence had been considered and there were "no significant findings, or no findings in the laboratory at all".

Sheppard, August 31, 2011, p. 85 ll. 22 – p. 86 ll. 32

86. The BCSFA fish health data is robust and reliable. While discussing the high confidence that ISA is not present in BC due to testing, Dr. McKenzie noted that because the audit program is in addition to the daily farm sampling program, it is a robust system that gives confidence in the results. The reason for the high confidence in the program, he said, is because the Provincial audit of silver fish is a biased sample that will show a higher percentage of disease than the healthy fish swimming in the population. Similarly, as Dr. Korman suggested, problems on farms in terms of fish health would be easily found in the data, observing that because farms are required by their licences to report all fish health events, that a large die-off to disease would have to be reported, particularly because "it would be tricky to hide something like that because they're very likely going to be audited in that quarter or the second quarter."

McKenzie, Transcript August 31, 2011, p. 56 ll. 7-41;
Korman, Transcript, August 29, 2011, p. 28 ll. 46 – p. 29, ll. 6

87. Because decision-making about risk is based on society's tolerance for risks as informed by science, Principle 4.5 of Exhibit 51, *A Framework For The Application Of Precaution* notes the need for transparency, accountability and meaningful public involvement. Correspondingly, Mr. Swerdfager noted "one of the principles that guided the development of the Pacific Aquaculture Regulation was to substantially enhance the transparency of the aquaculture industry in British Columbia" and the "very strong emphasis on the provision of information to the Department by the industry operators."

Exhibit 51, *A Framework For The Application Of Precaution*, *supra p.* 11;
Swerdfager, Transcript August 30, 2011, p. 22, ll. 22-29.

88. The DFO intends to make information collected from the aquaculture industry, either submitted pursuant to their federal licences, collected through inspections, or as part of compliance audits, available to the public subject to some legal restrictions and time lags. Like the Provincial Fish Health Program Annual Report, for example Exhibit 1560, *Province of BC Annual Report Fish Health Program, 2009,* which gave context to the data received from salmon farms, raw data will be provided in an appropriate context to ensure the public has "sufficient information about the source and meaning of the data." This increased transparency is intended to better inform the public about salmon farming and improve public confidence.

Exhibit 1599, *British Columbia Aquaculture Regulatory Regime, Public Reporting of Regulatory Information, Under the British Columbia Aquaculture Regulatory Regime (DRAFT), Jun 29 2011 p.* 4, p. 2.;
Exhibit 1560, *Province of BC Annual Report Fish Health Program, 2009*

89. Mr. Backman of Marine Harvest noted the new public reporting requirements under the Pacific Aquaculture Regulation, and commented that the industry welcomes the increase in transparency. He said that the public release of data will demonstrate two things:

> … one, a lot of
> the concerns are much lower than maybe are
> popularly thought. The other thing is it allows
> us to demonstrate a trend over time of continuing
> to reduce these concerns.

Backman, Transcript September 7, 2011, p. 16 ll. 10 – p. 17 ll. 16

D. Resource Management Decision-making & Sustainable Development

90. The precautionary approach as enunciated in the *Rio Declaration* is provided in the context of sustainable development. As PPR #2 explains, the Rio declaration is built around the concept of sustainable development, meaning that that environmental protection and development are "interdependent and must be regulated in an integrated manner" rather than as opposing objectives. The BCSFA therefore says that the precautionary approach as it is stated in the Rio Declaration must be interpreted in the context of a weighing of costs and benefits, both environmental, social, and economic.

PPR #2 at paras. 41 – 43

1. DFO Science and Management

91. Decisions using the precautionary approach necessitate the weighing of credible science and socio-economic factors. For example, Ms. Watson-Wright adopted from Exhibit 46, *DFO Science Mgmt Board - Minutes Oct 27 – 2009* the statement that "[t]he precautionary approach should be the guiding principle in balancing economic prosperity and environmental protection to achieve sustainable development." The minutes of that meeting say that decisions relating to aquaculture must be informed by science, and by the precautionary principle as a guiding principle to balance "economic prosperity and environmental protection to achieve sustainable development."

W. Watson-Wright, Transcript, Nov 4, 2010, p. 14 ll. 36 – p. 15 ll. 5;
Exhibit 46 DFO Science Mgmt Board - Minutes Oct 27 – 2009 p. 2, p. 5

92. The BCSFA also says that Exhibit 8, the *Wild Salmon Policy* expressly recognizes that decisions involving tradeoffs must be informed by a collaborative process under Strategy 4. Strategy 4, it says, "requires the integration of biological, social, and economic information to produce long term strategic plans for salmon and habitat management for each conservation unit." Notably, it explains under Principle 3, Sustainable Use:

> **Social, economic, and biological considerations will inform decisions on salmon, their habitats, and their ecosystems** consistent with the priorities assigned to Principles 1 and 2. **Conservation decisions cannot be based solely on biological information.** The maintenance of biodiversity and healthy ecosystems must be considered in the context of human needs for use now and in the future. **Decisions will not be taken without regard to their cost or social consequences**.

Exhibit 8, *Canada's Policy For Conservation Of Wild Pacific Salmon* ("**Wild Salmon Policy**") p. 14, 16 [emphasis added]

93. Mr. Bevan suggests that in face of high levels of uncertainty, decisions must be reasonable and balanced between opportunities to fish, meaning economic opportunities, and caution and not taking too high a risk, especially in the face of uncertainty. Similarly, principle 4.7 of Exhibit 51 notes in part:

> While judgments should be based on scientific evidence to the fullest extent, decision makers should also consider other factors such as societal values and willingness to accept risk and economic and international considerations. This would allow for a clearer assessment of the proportionality of the measure and ultimately help maintain credibility in the application of precaution.

Bevan, Transcript September 23, 2011 p. 77 ll. 34 – 44;
Exhibit 51, *A Framework For The Application Of Precaution p.* 13

94. An important aspect to the precautionary approach is society's acceptance of risk as informed by credible science. For instance, Exhibit 51, *A Framework For The Application Of Precaution* reads "[w]hile societal values and public willingness to accept risk are key in determining the level of protection, in all cases sound scientific evidence is a fundamental prerequisite to applying the precautionary approach." It furthermore notes, "[d]ecision making should identify potential costs and benefits as explicitly and as soon as possible, and distinguish what risk the public is prepared to accept on the basis of sound and reasonable, albeit incomplete, scientific evidence." These costs and benefits include social, economic, and other relevant factors.

Exhibit 51, *A Framework For The Application Of Precaution p.* 9; 14

95. A critical point in the discussion that relates to aquaculture is whether scientific evidence is sufficiently credible. For example, Exhibit 51 suggests that the quality of the science is more important than quantity, and that reports should: "summarize the existing state of knowledge, provide scientific views on the reliability of the assessment and address remaining uncertainties and areas for further scientific research or monitoring." The BCSFA observes that some of the science presented that suggests a link between aquaculture and sockeye salmon declines is overly selective and does not adequately summarize the existing state of knowledge. As addressed later, Dr. Dill's report to the Commission, Exhibit 1540, Cohen Commission Technical Report 5D - Dill, Impacts of Salmon Farms on FRSS: Results of the Dill Investigation, June 2011 ("**Exhibit 1540, *Dill Report 5D*, 2011**") presents a number of problems that tend to decrease its credibility.

Exhibit 51, *A Framework For The Application Of Precaution p.* 9; 14

2. Aquaculture and Sustainability

96. The BCSFA argues that aquaculture is a sustainable fishery which presents the unique opportunity to provide enormous socio-economic benefits as well as reduce harvesting pressures on wild salmon stocks. The DFO is presently working on a Sustainable Aquaculture Framework that is intended to provide stronger environmental regulation components and a focus on third party certification. This framework, along with ecosystem based management and IMAPs will ensure the aquaculture industry continues to be regulated according to the highest environmental standards.

see e.g. Swerdfager, Transcript August 30, 2011, p. 84 ll. 10-21

97. As noted above, because it is necessary to weigh socio-economic benefits and costs when making decisions pursuant to the precautionary approach, a zero-risk approach is generally inconsistent with how Canadian courts and government interprets and applies the precautionary approach, particularly as expressed in *Homalco Indian Band v. British Columbia (Minister of Agriculture, Food & Fisheries), supra*. For example, Paul Sprout noted that the aquaculture issue is a matter of the perception of risk. He explained that fishing itself is known to kill "millions of salmon", yet it continues to be permitted, and suggested the solution to the aquaculture debate is sharing knowledge and engaging in dialogue to reach consensus.

Transcript November 4, 2010 p. 77 ll. 29 – p. 78 ll. 7

98. According to the Province, aquaculture is "a significant contributor to the British Columbia economy" with a landed value of $406 million in 2008, providing 6,000 direct and indirect jobs. As noted by Mr. Backman, the actual experienced income, on average, for First Nations people working in aquaculture processing plants is approximately double the annual minimum wage at $32,000, whereas working on the farm sites averages $48,000 per year. According to a report prepared for the Aboriginal Aquaculture Association, "108 aboriginals employed in salmon farming operations earn $5,441,000 annually", and "[t]he 178 aboriginals employed in salmon processing operations earn $5,557,000 annually."

Exhibit 1716, *Regulatory Compliance of British Columbia's Marine Finfish Aquaculture Facilities 2009, Joint Report Ministry of Agriculture and Lands and Ministry of Environment (highlighted version)* p. 5;
Backman Transcript, September 7, 2011, p. 44 ll. 28-41, p. 101 ll. 3 – p. 103 ll. 28;

99. It is important to note that Aquaculture presents more than merely economic benefits that must be weighed in deciding on the acceptable level of risk. There is the further consideration that Exhibit 216, *APF*, notes that the annual demand for seafood will soon exceed the maximum capture potential, and suggests that aquaculture can reduce pressure on wild fish stocks helping them to sustain and enhance the wild fishery. Dr. Hyatt agreed that aquaculture, if "properly assessed and rigorously managed" could "reduce the pressure on wild fish stocks in aggregate."

Exhibit 216, *APF p.* 15-16*;*
Transcript, December 8, 2010, p. 9 ll. 44 – p. 10 ll. 46

100. According Exhibit 8, the *Wild Salmon Policy*, the DFO's role is to "manage aquaculture so that it is environmentally sustainable, socially responsible, and economically viable", in a manner "consistent with other human activities that may adversely affect salmon or their habitat". Although Dr. Irvine explained the *Wild Salmon Policy* "is not about aquaculture", he agreed that unlike other human activities such as enhancement or nutrient enrichment, it can ameliorate impacts on wild salmon for example by alleviating stress through overfishing:

> … The Wild Salmon Policy is about wild salmon. And aquaculture is considered the same as other human activities in terms of -- of their impact on wild salmon. Sustainable development, sustainability is an important objective, as articulated in the Wild Salmon Policy. **But really, aquaculture is just one of many potential impacts on -- on wild salmon. So that really, the Wild Salmon Policy doesn't -- doesn't articulate anything really about the development of aquaculture**.
>
> Q So aquaculture is just like any other human activity except for the fact that Dr. Hyatt has actually agreed with me **that aquaculture can, in fact, help alleviate some of the stresses on wild stocks through overfishing**.
>
> DR. IRVINE: **Yeah, as can enhancement, as can nutrient enrichment. There's many different ways that one can ameliorate impacts on wild salmon**.

Transcript, December 8, 2010, p. 17, ll. 8 – 26 [emphasis added]

101. The economic benefits and potential ecological benefits of salmon farming, including reducing pressures on wild stocks, are summarized in Exhibit 1769, *Beamish et al., The Winter Infection of Sea Lice on Salmon in Farms in a Coastal Inlet in British Columbia and Possible Causes*. It says that salmon farming "provides direct full time employment to about 2800 people and is valued at $406.1 million (cultured value in Canadian dollars in 2008) which may be

compared to a value of $20.3 million for the commercial wild Pacific salmon industry (landed value in Canadian dollars in 2008)", provides employment in coastal communities and it "reduces the pressure on Pacific salmon (*Oncorhynchus* spp.) stocks at a time when a warming climate is complicating the management of wild Pacific salmon stocks."

Exhibit 1769, *Beamish et al., The Winter Infection of Sea Lice on Salmon in Farms in a Coastal Inlet in British Columbia and Possible Causes*, p. 1 [citations omitted]

102. In a recent book chapter, Drs. Noakes and Beamish noted that due to the controversy surrounding it, the aquaculture industry has undergone a "substantial improvement in environmental performance (sustainability) with significant economic and social benefits for coastal communities (BCPSF 2007)." Noting the *Morton* decision, they write that aquaculture has "flourished" in other jurisdictions were one level of government is the regulator, although the say "the regulatory regime remains onerous and some rationalization is required". Drs. Noakes and Beamish recommend reaching consensus on tenure issues with First Nations as an "important step towards sustainability".

Exhibit 1324, Noakes & Beamish, *Shifting the Balance: Towards Sustainable Salmon Populations and Fisheries of the Future* ("**Exhibit 1324, Noakes & Beamish, *Shifting the Balance*, 2011**" *p.* 45

3. Science Advice, Closed Containment & Coordinated Fallowing

103. The BCSFA says that the Commission has heard from a significant number of experts who believe that salmon farming is stringently regulated, thoroughly monitored, and that the acknowledged risks have been appropriately managed. Pursuant to science-based decision making about risk, these opinions should inform any findings or recommendations made by the Commission. It is significant to note that the vast majority of qualified experts called to testify before the Commission have said that it is not necessary to remove salmon farms to other locations, whether simply off the migration route or onto land-based closed containment systems. The BCSFA argues that closed containment technology is currently not commercially viable, and that requiring an immediate transition to land is not justified by the evidence before the Commission.

104. As noted above, the precautionary approach as it is defined in the *Rio Declaration*, Exhibit 51, *A Framework for the Application of Precaution*, and Exhibit 8, the Wild Salmon Policy, necessitates a consideration of socio-economic impacts when making decisions. The BCSFA submits that the evidence relating to salmon farming shows the industry was not a factor in the 2009 returns and is an unlikely factor in the long term declines. As such, it would be unreasonable to advise a rapid transition to what is presently a non-viable and untested technology such as closed containment. A "zero-risk" approach is inconsistent with the

precautionary approach, and the improved sockeye salmon returns in 2010 and 2011 suggest such extreme measures are unwarranted.

105. Provided that rigorous biosecurity and best management practices are in place, numerous experts called before the Commission including Dr. Kent, Dr. Stephen Dr. Noakes, Dr. Dill, Dr. Korman, Dr. Connors, Dr. Saksida, and Dr. Jones testified that salmon farms can co-exist with wild salmon. Ms. Parker and Mr. Backman, also confirmed their view that salmon farms and wild salmon can coexist. Several papers published by experts called to testify before the commission, including one by Dr. Beamish and one by both Dr. Marty and Dr. Saksida also express this opinion.

Korman, Connors, Noakes, Dill, Transcript August 29, 2011, p. 101 ll. 17 – p. 102 ll. 8;
Saksida Transcript September 6, 2011, p. 99 ll. 19 – 37;
Jones, Transcript September 6, 2011, p. 99 ll. 40 – p. 100 ll. 9;
Parker & Backman, Transcript September 7, 2011 p. 103 ll. 39 – p. 105 ll. 25;
Exhibit 1775: *Exceptional marine survival of pink salmon that entered the marine environment in 2003 suggests that farmed Atlantic salmon and Pacific salmon can coexist successfully in a marine ecosystem on the Pacific coast of Canada*, 2006;
Exhibit 1555, Marty et al. *Relationship of Farm Salmon, Sea Lice and Wild Salmon Populations*, 2010 ("**Exhibit 1555, *Marty et al., Relationship of Farm Salmon*, 2010**"),

106. Fish health professionals agree that biosecurity and FHMPs are an effective way to ensure the risks of pathogen transfer from salmon farms is minimized. The experts who testified before the Commission on August 31, 2011, namely Dr. Marty, Dr. McKenzie, and Dr. Sheppard unanimously agreed that they had "as experts in the area of management of fish health and aquaculture" they had "a high confidence that the risk of disease in salmon farms is manageable with appropriate care and attention". Mr. Swerdfager agreed with the proposition from the management perspective.

Transcript, August 31, 2011 p. 66, ll. 23 - 36

107. The BCSFA notes that qualified fish health professionals don't advise moving farms. When Dr. Stephen was asked about moving salmon farms to protect wild stocks, he suggested implementing "robust systems and bio-security". Similarly, Dr. Garver was asked whether it would be precautionary to make sure no new exchange of pathogens was occurring on migration routes, he said strict biosecurity is "one of the first and foremost things that you implement" as well as avoiding factors that contribute to disease. Although not a fish health professional, when asked about the risk of pathogens, Mr. Last suggested veterinarians can recommend husbandry practices that mitigate risks as well.

Stephen, Transcript August 23, 2011, p. 74 line 13-17;
Garver, Transcript August 25, 2011, p. 32 ll. 30 - p. 33 ll. 42;
Last, Transcript August 30, 2011, p. 88 line 11-21

108. It is informative to contrast the expert opinions of fish health professionals and veterinarians on the issue of biosecurity with that of Ms. Morton. The aquaculture industry has raised concerns with the DFO on several occasions that Ms. Morton was breaching farm biosecurity with her boat and by participating in protests in which people swim around salmon farm pens. In Exhibit 1714, *Email from Lewis to Robson re FW: Alexandra Morton Proposed itinerary* April 23 2010, Ms. Morton is reported to have told Mr. Lewis, a DFO Compliance and Prevention officer, that she "does not believe in biosecurity" and that the "rights of free navigation supercede (*sic*.) farms perceived rights." The BCSFA submits that a self-professed expert in disease would be more conscious of biosecurity and appreciate the aquaculture industry's efforts to protect the health of farmed and wild fish pursuant to their FHMPs.

Exhibit 1714, *Email from Lewis to Robson re FW: Alexandra Morton Proposed itinerary*, April 23 2010

109. On the question of whether disease is affecting sockeye salmon, Dr. Kent noted that because of an absence of evidence, he could not conclude there is not an infectious agent or disease phenomenon playing an important role in the survival of sockeye salmon. He suggested a prudent approach would be to collect the necessary data. However, when asked whether the "looming question" not covered in his report was the relationship between salmon farms and disease in wild fish, Dr. Kent gave his expert opinion based on his knowledge and experience that disease from salmon farms is "not the looming question" as to the Fraser River sockeye salmon decline. He said:

> 9 If you want my subjective opinion on this, I
> 10 agree that **that is not the looming question as the**
> **11 demise of the sockeye salmon. In my opinion, I**
> **12 think it's certainly on the radar, but it wouldn't**
> **13 be the most looming question and concern**.
> 14 I think where -- I see where you're going
> 15 with this, that **you're trying to emphasize that**
> **16 fish farms are a much more important role in the**
> **17 sockeye salmon than I've particularly -- based on**
> **18 my experience and knowledge, would believe**. And
> 19 that's basically -- of course the bias in my
> 20 report is directed towards my general feeling,
> 21 that the **fish farms are not the primary source**
> **22 based on the evidence at this point, of the demise**
> **23 of the sockeye salmon.**

Transcript, August 22, 2011 p. 20 ll. 6-9;
Transcript August 23, 2011 p. 27 ll. 9-23 [emphasis added]

110. Furthermore, a paper co-authored by Dr. Marty and Dr. Saksida, Exhibit 1555, Marty *et al., Relationship of Farm Salmon*, 2010, supra, two fish health professionals called to testify before the Commission, concluded that coordinated fallowing and closed containment are not necessary to protect wild salmon from salmon farms. Dr. Saksida, who is an independent fish health veterinarian that works for Centre for Aquatic Health Sciences and is also considered an expert on plasmacytoid leukemia, confirmed in her testimony that she continues to hold that opinion. Significantly, Dr. Saksida also noted that a recent paper by Morton *et al.,* Exhibit 1557 *Sea Lice Dispersion and Salmon Survival in Relation to Salmon Farm Activity in the Broughton Archipelago,* shows that fallowing of farms did not make a difference to a salmon population; it in fact had poorer returns in an area that had been fallowed.

Exhibit 1555, Marty *et al., Relationship of Farm Salmon*, 2010, supra;
Saksida Transcript, September 6, 2011, p. 66 ll. 29 – p. 67 ll. 38,
p. 73, ll. 37 – p. 74 ll. 34;
Exhibit 1557, Morton *et al., Sea Lice Dispersion and Salmon Survival in Relation to Salmon Farm Activity in the Broughton Archipelago*

111. The existing evidence does not support the drastic action of shutting down salmon farms along the migratory route or moving them to closed containment. which would effectively render the industry "non-viable". Although he acknowledged his limited expertise, Mr. Price of the Raincoast Conservation Foundation, a member of the Conservation Coalition, said that based on available knowledge he would not condemn the industry. When asked whether salmon farms should be relocated pursuant to the precautionary principle or precautionary approach, David Marmorek instead recommended continuing to collect data from wild fish prior to making any management decisions.

Noakes, Transcript August 29, 2011, p. 78 ll. 38— p. 79 ll. 1;
Korman, Transcript, August 29, 2011, page 80 ll. 13 – 20;
Price, Transcript September 6, 2011, p. 101 ll. 36 – p. 102 ll. 6;
Marmorek, Transcript September 20, 2011, p. 9 ll. 13-28

112. In reply to being asked whether it is necessary to move the aquaculture industry to closed containment, Dr. Noakes gave the opinion that while it is useful for the companies to be researching closed containment, the data does not support closing salmon farms and that husbandry and health management minimize risks to wild salmon. He noted, "if you look at the balance in terms of what the risks are, I don't think it warrants that drastic an action". Dr. Dill agreed that improvements to husbandry can reduce risks, but noted only a zero-tolerance approach could eliminate the risk entirely. As established above, the precautionary approach does not require zero-risk, particularly where the evidence suggests the risks are being well managed.

Transcript August 29, 2011 p. 78, ll. 38 – p. 79 ll. 33

113. During the DFO Organizational Structure panel, David Bevan testified that the DFO has a "high degree of confidence" that "the aquaculture risk posed to the ecosystem wasn't that high", but that due to a different external perception the DFO conducted research to be sure that it wasn't making an error in its assessment. He furthermore suggested that pending a determination by the Commission as to the exact causes, the DFO's scientific knowledge of aquaculture has not pointed out a problem that would warrant radical steps proposed by others, presumably such as movement to closed containment:

> We have a new set of tools that we will be able to use in British Columbia for fin fish aquaculture after December, but **at this point, some of the actions suggested by certain people are -- we don't think they are actually warranted because the risk that's been identified by Science to us, as decision makers, hasn't pointed out a problem that would warrant a radical step** that is being required or requested, I should say, by -- and suggested by some external observers.

Transcript November 4, 2010, p. 30, ll. 21 – p. 31, ll. 43; p. 33 ll. 39 – p. 40 ll. 1

114. When Dr. Stephen was specifically asked whether the precautionary approach would necessitate removing salmon farms from the migration route to protect wild fish, he replied that he would advise ensuring fish were robust and that bio-security measures were in place. He replied, explaining the issue of siting salmon farms based on controlling a pathogen would be challenging public policy:

> …Dr. Stephen, I'm going to come to you, because you approach it from a prevention aspect - **wouldn't that be good prevention science to actually remove the possibility of horizontal transmission by taking the pens away from migratory pathways?**
>
> DR. STEPHEN: I think that to answer that question of siting of salmon farms based -- or of other activities based solely on one pathogen would make, I think, **challenging public policy**. I think as a generality, one of our **goals of any disease prevention** is we heard about **bio-security at the hatcheries,** is to try to **avoid exposure to your pathogen, or to try to ensure that the fish are robust enough to deal with the exposure and challenge.**
>
> Q Yes. And I understand that you don't want to delve into public policy, but from a scientific aspect, I mean, if you, as an epidemiologist, are simply advising a fish farm how to prevent the IHN transmission from wild stock to fish farms,

wouldn't it -- it seems to make sense to me to remove that fish farm from migratory pathways of sockeye salmon.

DR. STEPHEN: Well, I think, for me, **if I was to give advice to any population, I'd be looking at the more comprehensive approach than simply removal.**

…

…again, as you pointed to, for a **precautionary perspective**, if you were going to have that activity in the area, **we've often focused on trying to build, as I say, those robust systems and bio-security in place.**

Transcript, August 23, 2011, p. 73 ll. 29 – p. 74, ll. 17 [emphasis added]

115. As Clare Backman explained, while the industry is interested in developing new technology such as closed containment, companies must remain profitable to use those technologies. According to a report prepared by Mr. David Jackson of WorleyParsons for the BCSFA's use in the Commission, closed containment is presently not commercially feasible. The report explains that despite some claims to the contrary, "[w]hile [Closed System Aquaculture] (specifically [Recirculating Aquaculture Systems]) has exciting potential, the state of readiness of the technology is such that considerable technical and economic challenges remain and the relative sustainability merits of the two technologies (considering [Greenhouse Gas] emissions, for example) are unclear at this point in time." It also explains that most floating closed containment systems only treat the sediment-rich portion of their effluent, meaning they are not completely biologically isolated.

Backman, Transcript Sept 7, 2011 p. 54 ll. 1 – p. 55 ll. 28, p. 56 ll. 26 – p. 57 ll. 33;
Transcript September 8, 2011, p. 18 ll. 31 – 42;
Exhibit 1805, D. Jackson, *Perspective on the Technical Challenges Associated with Closed System Aquaculture for Grow-out of Salmon in BC*, 2011 p. 1, 4;
see also Exhibit 1366, Watson, *Questions and Answers on Salmon Aquaculture in British Columbia*, v2, Aug 16 2011, p. 56-58

116. The BCSFA argues that the precautionary approach does not require extreme or draconian management decisions such as closed containment, particularly in the case of salmon farming where reliable evidence shows there is low risk of harm. Rather, it necessitates the collection and analysis of information and the continued mitigation of assumed risks. For example, Mr. Marmorek was asked by counsel for the Aquaculture Coalition whether Dr. Dill was right to look at literature from other places, such as Exhibit 1482, *Rimstad, Examples of emerging virus diseases in salmonid aquaculture, Aquaculture Research, 2011* which suggest salmon farms are an ideal breeding ground for disease, implying that Dr. Noakes had not. Mr. Marmorek answered that he did not say whether Dr. Noakes had not looked at that literature, and that while literature from other salmon farming areas might be useful in assessing the risk, they are not useful in quantifying that risk, and

recommended gathering data from existing salmon farms to help make best judgments on a number of factors including salmon farms:

> 9 A I think it's reasonable to look at that other
> 10 literature in terms of assessing the risk. **In**
> **11 terms of evaluating how large that risk is, as I**
> **12 said earlier, until you have data, the range of**
> **13 tangible hypotheses is really large. So I don't**
> **14 think it's that difficult to collect that data**
> **15 and, therefore, rather than making inferences**
> **16 entirely based on evidence from other places, I**
> **17 think it would actually make sense to get the**
> **18 data.**

Marmorek, Transcript September 19, 2011, p. 83 ll. 9 – 36

117. Counsel for the Aquaculture Coalition then likened salmon farms to explosives factories and asked Mr. Marmorek whether he would send his children to the school next door. Mr. Marmorek answered that there is little evidence that salmon farms have caused disease in sockeye, and that it would be best to collect the necessary information prior to making management decisions:

> 37 Q So, I mean, to be -- to use a metaphor, if you
> 38 have an explosives factory that hasn't blown up
> 39 for three or four years but creates a risk, does
> 40 it make sense to site it in downtown? **Or would**
> **41 you send your children to a school next to an**
> **42 explosives factory? Isn't risk a factor to be**
> **43 considered, even though you lack empirical**
> **44 evidence, and isn't that what Dr. Dill was doing?**
> 45 **A** Well, I think there's pretty strong empirical
> 46 evidence that explosives explode, and **I don't**
> **47 think there's quite as strong empirical evidence**
> 1 that --
> 2 Q That fish farms cause disease?
> 3 A -- **that fish farms have caused disease in sockeye**
> **4 salmon, and so I think it's reasonable to combine**
> **5 what evidence you have and make your best**
> **6 judgments**, just as Dr. Dill did, and just as
> 7 Dr. Noakes did, as well. …
> 10 …. I still
> 11 would argue that, you know, **if it took you 10**
> **12 years to get this information, okay, maybe you can**
> **13 make a judgment now, but if it takes you one year**
> **14 to get the information, why not just go out and do**
> **15 it?**

Marmorek, Transcript September 19, 2011, p. 83 ll. 37 – p. 84 ll. 15 [emphasis added]

118. The BCSFA also notes with respect to the Aquaculture Coalition's suggestion that salmon farms "can offer close to ideal environments for the spread of infectious diseases", this same exhibit, Exhibit 1482, *Rimstad, Examples of emerging virus diseases in salmonid aquaculture, Aquaculture Research*, 2011 was put to Dr. Kent who called this an "overstatement", "sensationalized", and "slightly incorrect" as written. Dr. Kent testified that the statement might apply in "poorly run aquaculture with no disease control" but not to aquaculture generally. Dr. Kent also clarified the common misconception that detected viruses often "don't spontaneously emerge" in salmon farms, but rather that pathogens occurring in wild fish are not detected until farmed fish under denser conditions and closer scrutiny allow it to be detected. He said, like Mr. Marmorek and Dr. Saksida separately suggested, that baseline data would be helpful in understanding this situation.

Kent, Transcript, August 23, 2011, p. 44 ll. 19 – p. 46 ll. 10;
Saksida, Transcript, September 6, 2011, p. 57 ll. 15 - 43

119. A precautionary framework, adaptive management, risk based management, and scientific research informing the regulation and management of salmon farms means salmon aquaculture can coexist with wild salmon in the marine environment. It provides social and economic benefits to coastal communities through employment opportunities for skilled workers. As noted above it also has the potential to alleviate pressures on wild stocks. The BCSFA argues that on a balance of these considerations and the evidence that salmon farms pose a minimal risk to wild salmon, the continued scheme of mitigating risks, monitoring harm, and adapting management based on new scientific research into aquaculture in the marine environment is an appropriate management action. As Ms. Parker said:

> 46 MS. PARKER: Yes, I think that fish farms can coexist
> 47 with wild stocks. And I think that's partly
> 1 because of the **precautionary framework** towards
> 2 management that we have in place. I think it's
> 3 because of the **adaptive management**. I think it is
> 4 because it -- we have the science to -- we have
> 5 the **science and the ability to make good**
> **6 decisions**. We have **risk-based management**. And
> 7 with all that in place, we can continue to have
> 8 **coastal employment**. And I think one of the values
> 9 of salmon farming is **it's not just minimum wage**
> **10 jobs in coastal communities. It is highly skilled**
> **11 technical positions.**

Parker, September 7, 2011, p. 103 ll. 46 – p. 104 ll. 11 [emphasis added]

120. A recommendation suggested by the peer reviewers of Dr. Connors' report was the experimental fallowing of farms on the migratory route. As one of those peer reviewers, Tom Carruthers said, "Clearly such a recommendation does not

account for economic considerations." The BCSFA says that such a management decision is neither supported by the data analysed by Drs. Noakes and Korman, the mitigation measures in place which numerous experts testified are effective, nor by the precautionary approach which necessitates a weighing of science and socio-economic considerations in making management decisions.

Exhibit 1545, *(formerly UU) - Connors, Cohen Commission Technical Report 5B, Examination of Relationships btw Salmon Aquaculture and Sockeye Salmon Population Dynamics*, Jun 2011 ("**Exhibit 1545, *Connors Report 5B*, 2011**") p. 89; Exhibit 51, *A Framework For The Application Of Precaution, supra*.

121. The BCSFA says that in addition to the economic costs to the industry, due to the complexity of such experimentation, the DFO would be required to invest an inordinate amount of time and money to design and conduct such an experiment to ensure any observed effects were not the result of confounding factors such as regime shifts or changes in the marine ecosystem including predators and food availability. Due to the variable returns of sockeye salmon over the past century and longer as noted by Exhibit 553, *Hinch & Martins Report 9, 2011*, the BCSFA argues that it would be too difficult to conclude that any change in salmon returns were the result of the fallowing of farms and not due to natural processes.

122. Furthermore, the BCSFA argues that the fallowing of farms has been done experimentally since at least 2003, and that there is evidence it has no effect on wild salmon populations. As Dr. Beamish explained in Exhibit 1790, *Beamish et al., Exceptional marine survival of pink salmon suggests that farmed Atlantic salmon and Pacific salmon can coexist successfully,* ("**Exhibit 1790, *Beamish et al., Exceptional marine survival,* 2006***")* several farms were fallowed in 2003 pursuant to the Provincial Sea Lice Action Plan because of the sea lice controversy created by publications by Ms. Morton and others claiming an effect on pink salmon, but that "the biomass of farmed salmon reared in the Broughton Archipelago has remained almost constant since 1999." In Exhibit 1984, "Assessing the impacts", Dr. Beamish observes that "Brooks and Jones (2008) [also] noted that despite some fallowing the actual production of farmed fish in 2003 varied little from the previous few years." Dr. Beamish's 2006 paper in fact concluded:

> Morton et al. (2005) found sea louse abundance and prevalence to be lowest on juvenile pink salmon during the fallowed period, and other studies in the area found a similar' trend (SJ, unpublished). However, production of farmed salmon in 2003 remained at levels similar to those in 2001 and 2002 when pink salmon survival was low. This is a significant finding because active and viable salmon farming continued even as wild salmon showed high marine survival.

Exhibit 1790, *Beamish et al., Exceptional marine survival*, 2006, p. 1-2, 10

123. According to Mr. Backman, Exhibit 1790, *Beamish et al., Exceptional marine survival,* 2006 is "consistently misrepresented" by some as authority on the necessity of fallowing migration corridors whereas the paper was actually focused on regime changes in the ecosystem of the Broughton Archipelago. The testimony of Ms. Morton and Mr. Backman in fact suggest Dr. Beamish may have been forced to note Ms. Morton's fallowed farms hypothesis in order to publish the paper, as Ms. Morton was one of the reviewers of the paper. Ms. Morton referred to Exhibit 1790, *Beamish et al., Exceptional marine survival,* 2006 as this authority in her testimony, as well as in Exhibit 1557, *Morton et al., Sea Lice Dispersion and Salmon Survival in Relation to Salmon Farm Activity in the Broughton Archipelago*.

Morton & Backman, Transcript September 8, 2011, p. 76 ll. 31 – p. 77 ll. 23;
Exhibit 1557, *Morton et al., Sea Lice Dispersion and Salmon Survival in Relation to Salmon Farm Activity in the Broughton Archipelago*

124. Ms. Morton herself recently published a paper, Exhibit 1557, *Morton et al., Sea Lice Dispersion and Salmon Survival in Relation to Salmon Farm Activity in the Broughton Archipelago* , that reports a population of salmon in decline despite the coordinated fallowing of farms along their migratory route. As explained by Dr. Saksida, the results in fact counter most of the other papers that says fallowing makes a difference. The BCSFA argues that this is further evidence that neither sea lice nor disease in salmon farms on the migratory route have an effect on salmon at the population level, as fallowing would have mitigated both potential impacts.

Saksida, Transcript September 6, 2011, p. 73 ll. 37 – p. 74 ll. 34;
Exhibit 1536, *Noakes Report 5C*, 2011 p. 101 (comment
by Dr. Farrell re Jackson et al. 2010)

III. Protection of Wild Salmon on Migration Route

125. All human activity has risk. The evidence given in this inquiry demonstrates a properly managed aquaculture industry is able to coexist in the marine environment with wild salmon. As demonstrated below, government and industry already protect the migration route of wild salmon through siting criteria and Environmental Assessment processes which take risks to fish populations into consideration, whether under the *Canadian Environmental Assessment Act* or under the new conditions of licence, and through Fish Health Management Plans, biosecurity and area-wide agreements between aquaculture companies to manage fish health. Some salmon stocks that migrate past salmon farms are increasing in abundance and several that do not are in decline. Salmon farms are an unlikely cause of the decline whether as a primary factor or cumulatively with other factors.

Exhibit 1623, *BC Pacific Salmon Forum Final Report and Recommendations*, Jan 2009 (**"Exhibit 1623, *PSF Final Report*, 2009"**), p. 43;
Farlinger, September 22, 2011, p. 83, ll. 14-17

126. Fish health experts testifying before the Commission explain that bio-security should be used along with avoiding factors known to contribute to disease to protect wild salmon from pathogens, not removing salmon farms from migration routes. Proper husbandry and fish health management reduce risks to wild salmon, and have significantly decreased the incidence of high risk disease events in salmon farms. As demonstrated above, the weight of expert scientific opinion given in this Commission is that it is not necessary to remove salmon farms from the marine environment which would make the aquaculture industry "non-viable".

See paras. 103 to 119, above

127. Drs. Noakes and Korman explained that had aquaculture played a significant role in the decline of the Fraser River sockeye, the dramatic contrast between the returns in 2009 and 2010 would have shown a "strong signal" that aquaculture was involved. No such signal existed in the BCSFA database or Province fish health records analysed by Drs. Korman, Connors, and Noakes. As Dr. Noakes observed in his report, Dr. Connors' found "no significant relationship between the 'high risk' diseases and Fraser River sockeye salmon production". Based on the information available, Dr. Noakes concluded that "the impact from salmon farms appears to be minimal at best."

Transcript August 26, 2011, p. 82 ll. 39 – p. 83 ll. 44;
Exhibit 1536, *Noakes Report 5C*, 2011, p. 7;
also see Connors, Transcript August 26, 2011, p. 34, ll. 6-13

128. The BCSFA notes that a central theory underlying the argument that salmon farms must be removed from the Fraser River sockeye salmon's migration route is

that Harrison River salmon are doing well. The Harrison River salmon have been reported to migrate along the West Coast of Vancouver Island, although as noted below there limited evidence for this. Critics of the aquaculture industry say the increase in Harrison River sockeye and the decline of Fraser River sockeye salmon means exposure to salmon farms on the Fraser River sockeye's migration route is the primary differential factor. However, this theory has been rebutted by a number of experts called to testify before the Commission, including the Commission's contracted researchers who prepared the Technical Reports. The BCSFA in fact notes that Harrison Sockeye from the 2005 and 2006 brood years which returned in 2009 "exhibited the lowest productivity on record for this stock". Furthermore, as Mr. Backman noted, there are salmon farms in Puget Sound which salmon migrating through Juan de Fuca would pass.

Exhibit 1326: Crawford & Irvine, *State of the Pacific Ocean 2009*, p. 5;
Transcript, September 7, 2011, p. 83 ll. 41 – p. 84 ll. 2

129. For example, counsel for the Aquaculture Coalition asked Mr. Marmorek about the "bottleneck" of the coastal marine stage and stressors on the coastal migration phase new to the environment since the long-term productivity decline in 1992. Mr. Marmorek answered that salmon farms are one candidate stressor included in the conceptual model used for Exhibit 1896, Marmorek et al. *Technical Report 6*, 2011, *supra* and directed the Commissioner to several figures which demonstrate other stocks with minimal exposure to salmon farms are also declining, noting different ocean conditions on the West coast of Vancouver Island:

> A Well, **clearly, fish farms are one candidate stressor and they were included in our conceptual model**. I wonder if I could quickly get, Mr. Lunn, if you could go to page 34 in our report. Just by way of answering this question, **I think it's really important, as I said at the beginning, to think about the overall pattern that it is we're trying to explain, and it's not only the pattern of decline in the Fraser stocks, these are non Fraser stocks.**
>
> Now, they've also, if you look at the Southeast Alaska stocks and you look at the Yakutat stocks and you look at the Central Coast stocks, which have **very minimal exposure to fish farms, they've also shown declines**. So this isn't to say that fish farms could not have effected Fraser River stocks, but I don't think there is sufficient **-- I don't think fish farms are a sufficient explanation for the pattern of decline in sockeye, generally, between Washington and Southeast Alaska**.
>
> Q So the fact that the Okanagan and Columbia stocks did well in 2009, when the stocks that migrated up the inside passage, that would be a relevant fact

> to you, too, wouldn't it?
> A Yes. **And the work that Kim Hyatt's done shows that there were very different temperature conditions on the outer side of the west coast of Vancouver Island** where those stocks were going than occurred in the Strait of Georgia, in 2007, which was the migration year for those smolts.
> **So what I'm pointing to is it's not just fish farms that differ between the inside and outside, there's also man other oceanographic variables that can differ.**
>
> Transcript, September 19, p. 84 ll. 42– p. 85 ll. 29;
> Exhibit 1896, Marmorek et al. *Technical Report 6*, 2011, *supra*, p. 34

130. Dr. Peterman and Dr. Dorner note in Exhibit 748, Peterman & Dorner, *Cohen Commission Technical Report 10 - Fraser River Sockeye Production Dynamics*, 2011 ("***Peterman & Dorner, Technical Report 10, 2011***") that that although Harrison River sockeye has a different life history, Lake Washington sockeye with similar migration route is also decreasing in productivity, suggesting the different migration route is not the sole reason for the Harrison River salmon's increasing productivity. They explain summarize the life history:

> … Harrison fish have notable differences in their life history strategy from the majority of other sockeye populations that we examined, including other Fraser River stocks. These life history differences may provide an important clue about causes of the decline in other sockeye stocks. Specifically, **(1) Harrison fish migrate to sea in their first year of life as fry instead of overwintering in fresh water and migrating to sea in their second year as smolts,** (2) they appear to rear for some time in the Fraser River estuary, (3) they remain in the Strait of Georgia later than other Fraser River sockeye, and (4) there is some evidence that the fry migrate out around the southern end of Vancouver Island through the Strait of Juan de Fuca instead of through Johnstone Strait to the north. That southern fry-migration route is shared with Lake Washington sockeye, yet the latter stock was one of those that showed a decrease in productivity similar to that of other B.C. sockeye stocks. **Thus, the reason for the Harrison's exceptional trend is probably not attributable simply to its different migration route.**
>
> Exhibit 748, Peterman & Dorner, Technical Report 10, 2011, p. 3

131. Dr. Peterman's testimony furthermore brought into question whether Harrison River sockeye in fact have a different migration route. He said that there was only one study, which is "very limited evidence", that suggested they may exit through the Strait of Juan de Fuca and up the West coast of Vancouver Island. This is also noted in Exhibit 73, *PSC - Synthesis of Evidence from a Workshop on the Decline of Fraser River Sockeye.* Dr. Peterman instead suggested that due to

their different life history, their body size "might make them less vulnerable to whatever stressor it is that's causing mortality for the other fish." The BCSFA says that if Harrison River salmon in fact follow the same migration route as the Fraser River sockeye salmon, it significantly weakens the theory that salmon farms on the migration route are the cause of the decline of sockeye salmon. Furthermore, either migration route takes them past salmon farms.

Peterman, Transcript, April 20, 2011 p. 67 ll. 13 – p. 68 ll. 1;
Exhibit 73, *PSC - Synthesis of Evidence from a Workshop on the Decline of Fraser River Sockeye* at 48;
Backman, Transcript, September 7, 2011, p. 83 ll. 41 – p. 84 ll. 2

132. Although it is presumed that there is a single migration route for Fraser River sockeye salmon, Exhibit 1620, *Comprehensive MAL Response to BC Audit, Apr 5 2006* notes the morphology of the B.C. coast can be distinguished from that of Norway or the UK where inlets and fjords "restrict the salmon migratory route to a single pathway", whereas in B.C. "the migratory routes vary as a result of the geography and changing environmental and weather conditions, available feed, and the fish species migrating." The BCSFA says this fact necessitates a different approach in B.C. for protecting salmon migration routes by avoiding salmon-bearing streams, and implementing a suite of management measures such as area based management and fish health plans as described by Ms. Parker. The DFO has also conducted research that "challenges the idea that that juvenile salmon follow distinct 'migration corridors'".

Exhibit 1620, *Comprehensive MAL Response to BC Audit, Apr 5 2006* at 4-5;
Parker Transcript, September 7, 2011, p. 34 ll. 7 – p. 36 ll. 11;
September 8, 2011, p. 104 ll. 31 – 105 ll. 35;
Exhibit 1803, *Protection, Restoration and Enhancement of Salmon Habitat, Focus Area Report*

A. Overview of Project 5 Reports

133. The authors of the two Project 5 reports, Dr. Noakes and Dr. Dill, adopted two fundamentally different approaches. Dr Noakes established a set of hypotheses and set out to examine the published literature, expert opinions, and general beliefs on the issues. Both evidence for and against were included in his analysis. Dr Dill established a single hypothesis linking salmon farming to declines in Fraser River sockeye salmon. He then set out to prove his hypothesis selecting and citing evidence to support his position. This second approach is not consistent with scientific method. As observed in Exhibit 1757 Marmorek et al. *Addendum to Technical Report 6*, 2011, Dr. Noakes' treatment was more inclusive and fulsome, and reached largely the same conclusions.

Marmorek, Transcript September 19, 2011, p. 74 ll. 2-16;
Morton & Parker, Transcript September 8, 2011, p. 73 ll. 41 – p. 74 ll. 5;
Exhibit 1757 Marmorek et al. *Addendum to Technical Report 6*, 2011, p. 10-11

134. The only significant difference between those two reports was on the issue of disease. As explained by a detailed farm-by-farm analysis by Dr. Noakes, the evidence shows that salmon farms are very unlikely to have contributed to the prevalence of endemic pathogens to which the Fraser River sockeye salmon is naturally exposed to.

135. As Dr. Noakes noted, the fish health data time series is relatively short but the Fraser River sockeye salmon data includes the historic high return of 2010 and the historic low return of 2009, which provides the contrast which Mr. Marmorek explained is necessary to determine the likelihood of relationships. Drs. Noakes, Connors, and Korman were all unable to attribute the differences in the 2009 and 2010 returns to salmon farms, suggesting they play a minimal role. Dr. Noakes explained at length why the short term analysis, which failed to detect any significant relationships, had more statistical power:

> 26 So we have a unique situation here. Even though
> 27 it's a short one, **you have a bit more power in**
> **28 terms of an ability to look at the relationship**
> **29 simply because we're looking at the extremes**, at
> 30 both the high and the low. So **if we're going to**
> **31 see some sort of a signal associated with**
> **32 aquaculture or something else, then you should be**
> **33 able to see it when you're looking at those**
> **34 extremes** because, as I say, most of the time when
> 35 you're limited with a short-term time series,
> 36 you're dealing with things right around the mean
> 37 and you don't have a lot of ability to try and see
> 38 those signals. **But if there was something that**
> **39 caused the huge decline in 2009, it should jump**

> **40 out at you.**
> **41 And the same thing would happen in 2010 in**
> **42 terms of a large return.** Even though we don't
> 43 know exactly what the number is, we know it was
> 44 very large. So again, what changed to give us
> 45 that kind of high contrast that we see in the two
> 46 returns from those two years? It's a unique
> 47 situation. As I say**, most of the time when you**
> **1 only have three or four years of data, the data**
> **2 points are typically closer to the mean** and you
> 3 don't have that kind of **high contrast** to actually
> 4 look and see what the signal might be. **So it's**
> **5 very powerful and it's very unique and it gives us**
> **6 a lot more information simply because we've got**
> **7 that huge range.**
>
> Noakes, Transcript August 26, 2011, p. 43, ll. 17 – p. 44 ll. 7;
> see e.g. Marmorek, Transcript September 19, 2011, p. 13, ll. 16-18

136. Similarly, Dr. Korman, noted "[n]egative effects of salmon farms on returns of Fraser River sockeye between 2002 and 2010 were not apparent", the Fraser River salmon demonstrated "exceptionally low and high returns in 2009 and 2010, respectively", and that the number of mortalities on farms potentially caused by disease remained constant while high risk diseases and sea lice levels declined. Given the reliability of the fish health data from the industry and the rigour of the audit program, it is significant that the Commission's Project 5 experts agreed that there was no "strong signal" in the data predictive of the low sockeye returns in 2009 and the high returns in 2010.

> Exhibit 1543, *(formerly SS) - Korman, Cohen Commission Technical Report 5A, Summary of Info for Evaluating Impacts of Salmon Farms on Survival of FRSS*, May 2011 ("**Exhibit 1543, *Korman Report 5A*, 2011**"), p. 10;
> Transcript August 26, 2011 p. 83 ll. 28-44

137. The BCSFA notes that Dr. Noakes actually conducted the same analysis that Dr. Dill explained in his report was necessary to determine the risk of transmission of pathogens from farmed salmon to wild salmon. Dr. Connors testified that he aggregated the data, and did not assume migration routes. Dr. Dill's report, Exhibit 1540, criticised the farm data for being aggregated by fish health zone, which precluded "a breakdown according to proximity of the farms to the presumed migration route of the majority of juvenile Fraser sockeye". However, Drs. Korman, Connors and Noakes all testified that the data was not aggregated and was available provided on a farm by farm basis. This shows that Dr. Dill not only relied on Dr. Connors' report in its entirety, but that he did not even look at the available data.

Transcript August 26, 2011, p. 93 ll. 23 – p. 94 ll. 39;
Exhibit 1540, *Dill Report 5D*, 2011, p. 16

138. Furthermore, Dr. Noakes in fact did the fine-scale farm-by-farm analysis of the data that Dr. Dill said should have been done in order to determine where high risk disease events occurred and whether there was a risk of pathogen transfer. Not only did this increase the power of Dr. Noakes analysis, it also led him to conclude "The evidence suggests that disease originating from salmon farms has not contributed to the decline of Fraser River sockeye salmon." Dr Noakes furthermore testified this analysis showed farms are "very unlikely to contribute any exposure to pathogens". The BCSFA says that Dr. Noakes' report should be accorded significantly more weight that that of Dr. Dill or Dr. Connors.

Noakes Transcript August 26, 2011, p. 94 ll. 21 – 39,
August 26, 2011, p. 96 ll. 25-26;
Exhibit 1536, *Noakes Report 5C*, 2011, p. ii ;105

139. The BCSFA argues that the other factors considered above that occurred in 2007, such as the food abundance in the marine environment in SOG and QCS, anomalous temperatures in QCS, and heterosigma blooms, are all "strong signals" that indicate the cause of the decline is not salmon farms but the other factors considered by the Commission.

1. Agreements between Drs. Noakes & Dill

140. Marmorek et al. in Exhibit 1575, *Addendum, Technical Report 6: Implications of Technical Reports on Salmon Farms and Hatchery Diseases for Technical Report 6 (Data Synthesis & Cumulative Impacts)* ("**Exhibit 1575, Marmorek et al. *Addendum, Technical Report 6***"), summarize the areas of agreement between the reports of Drs. Noakes and Dill. The Addendum expressly says that they merely summarized the reports. However, it notes that Dr. Noakes reviewed a larger body of literature for both the escapes and the sea lice issues.

Exhibit 1575, Marmorek et al. *Addendum, Technical Report 6*, 2011, p. 10-11

141. Both Dr. Noakes and Dr. Dill agree that waste, escapees, and sea lice are unlikely to have made a significant contribution to the observed declines in Fraser River sockeye. Dr. Noakes in fact concluded "[R]isk from escaped Atlantic salmon and waste discharge from farms are both miniscule approaching zero." Similarly, Dr. Dill focuses his speculation on disease as a possible mechanism to explain Dr. Connors' long term analysis, noting that "[n]one of the other possibilities considered (lice, benthic and pelagic impacts, escapes, etc.) are likely to be sufficient, **alone or in concert**, to cause either the long-term population declines or the especially low returns in 2009."

Exhibit 1575, Marmorek et al. *Addendum, Technical Report 6*, 2011, p. 18-19;
Exhibit 1536, *Noakes Report 5C*, 2011 p. 32;
Exhibit 1540, *Dill Report 5D*, 2011, p. 2

142. As Exhibit 1575, Marmorek et al. *Addendum, Technical Report 6*, says, both Drs. Noakes and Dill conclude that waste from salmon farms will likely be "small and localized (i.e., within metres) in part due to high flushing and mixing of waters within the Discovery Islands" meaning "the localized scale of potential exposure is inconsistent with the observed declines in total productivity."

Exhibit 1575, Marmorek et al. *Addendum, Technical Report 6*, 2011, p. 8

143. According to Dr. Noakes, "There is no evidence that escaped Atlantic salmon have contributed to the decline in Fraser River sockeye salmon stocks or that escaped Atlantic salmon pose any threat to sockeye or any other salmon stocks in the Fraser River." Both Marmorek *et al.* in Exhibit 1575, *Addendum to Technical Report 6* and Dr. Farrell who peer-reviewed Dr. Noakes' report complimented it on its thoroughness on this subject. Dr. Farrell wrote: "The scientific arguments presented for this conclusion are balanced and comprehensive. It is perhaps the best summary that I have read and provides information and analysis well beyond the [Exhibit 1543, *Korman Technical Report 5A*, 2011]".

Exhibit 1536, *Noakes Report 5C*, 2011 p. ii, 97-98

Sea Lice – Noakes, Dill, and Other Evidence

144. The BCSFA agrees with Drs. Dill and Noakes that the evidence shows sea lice from salmon farms have not played a role in sockeye salmon productivity. Both of the Commission's Project 5 lead researchers, Dr. Dill and Dr. Noakes, independently came to the conclusion that sea lice are not linked to the overall decline of sockeye salmon. Sea lice has been a controversial topic for several years, and the BCSFA argues that based on the further evidence summarized below, sea lice from salmon farms are not affecting Fraser River salmon or other Pacific salmon species.

Dill & Noakes, Transcript August 25, 2011, p. 76, ll. 27-37

145. Exhibit 1575, Marmorek *et al. Addendum to Technical Report 6* says the reports of Dr. Noakes and Dr. Dill agree that while sea lice is a plausible mechanism, "the available evidence does not suggest a correlation between sea lice and sockeye salmon productivity". Marmorek et al also note that Dr. Noakes "explicitly considers a larger body of evidence to evaluate the potential impacts of sea lice from salmon farms on Fraser River sockeye" and presents other forms of evidence further supporting his conclusion that suggest:

> (1) wild Pacific salmon are the likely source of infestation on salmon farms (not vice versa); (2) juvenile sockeye salmon are

> likely more tolerant to sea lice infestation than other salmon species because they are larger; and (3), Pacific salmon are likely more resistant to lice than Atlantic salmon

Exhibit 1575, Marmorek *et al. Addendum, Technical Report 6*, p. 14, 11-12

146. Sea lice from salmon farms are considered a low to moderate risk to sockeye salmon, and are unlikely to have contributed to the overall decline in Fraser River sockeye salmon productivity or the 2009 return, and are a particularly minimal risk when properly managed. As explained by a number of experts and exhibits, Pacific *Lepeophtheirus salmonis* ("***Lep. salmonis***") are genetically different than Atlantic *Lep. salmonis*, and appear to be less pathogenic and more sensitive to environmental conditions. Dr. Jones, a co-author of the study that discovered the genetic difference, noted published studies that show differences in pathology between sea lice in the Atlantic versus Pacific, and much lower frequency of treatment in B.C. than Norway or Scotland. Dr. Saksida explained in her testimony that based on her personal experience and observations in Atlantic Canada, Norway, and Chile, *Lep. salmonis* cause more damage to Atlantic salmon in those areas than in B.C.

Saksida & Jones, Transcript September 6, 2011, p. 38 ll. 3 – p. 40 ll. 23;
Exhibit 1481, Price *et al., Evidence of Farm-Induced Parasite Infestations on Wild Juvenile Salmon of Coastal BC*;
Exhibit 1555, Marty *et al., Relationship of Farm Salmon*, 2010, supra;
Johnson, Transcript, August 22, 2011, p. 103, ll. 21-26;
Jones, Transcript September 6, 2011, p. 3 ll. 35 – p. 5 ll. 12;
Exhibit 1763, Yazawa *et al., EST and Mitochondrial DNA Sequences Support a Distinct Pacific Form of Salmon Louse, Lepeophtheirus salmonis, June 24 2008*;
Exhibit 1536, *Noakes Report 5C*, 2011, p. 16;
Saksida Transcript, September 6, 2011, p. 6 ll. 45 – p. 7 ll. 15;
Exhibit 1788, Saksida, *Sea Lice Presence and Pathogenicity in the Campbell River and Sunshine Coast Salmon Farming Regions of British Columbia*, p. 7

147. Fraser River sockeye salmon are relatively resistant to *Lep. salmonis*. As observed by Dr. Johnson, *Lep. salmonis* is the "least abundant of the different species of sea lice found on sockeye". As Dr. Saksida explains, because studies find more *Caligus clemensi* on sockeye than *Lep. salmonis*, this means sockeye appear to be resistant to *Lep. salmonis*. Both Dr. Kent and Dr. Johnson also note that sockeye are much larger than pink salmon when they outmigrate, meaning they are larger than the 0.7 grams at which effects from sea lice on pinks have been found.

Johnson, Transcript August 22, 2011, p. 102 ll. 1-7;
Saksida, Transcript September 6, 2011, p. 13, ll. 9-16;
Jones, Transcript September 6, 2011, p. 31, ll. 10-34;
Kent, Transcript August 22, 2011, p. 101 ll. 20-47

148. The majority of sea lice on found on Fraser River sockeye, as much as 70 %, are *caligus clemensi*. *Caligus clemensi* are not the prevalent species of lice found on salmon farms. *Caligus clemensi* are also known as the herring louse, and have a number of wild hosts. As Dr. Jones also pointed out, sockeye are infected with *caligus clemensi* in the SOG prior to reaching salmon farms. The BCSFA argues that any effects of *caligus clemensi* on sockeye are not associated with salmon farms.

Exhibit 1788, *Sea Lice Presence and Pathogenicity in the Campbell River and Sunshine Coast Salmon Farming Regions of BC, Oct. 2010,* p. 34;
Jones, Transcript, September 6, 2011, p. 34 ll. 43 – p. 35 ll. 45;
Ibid. p. 11, ll. 40 – p. 12 ll. 12

149. The BCSFA furthermore argues that salmon farms may not be the primary source of *Lep. salmonis.* As Dr. Jones explained, sticklebacks have been found to be an alternate host for *Lep. salmonis*, and can carry five to ten times as many sea lice as found on juvenile salmon. Although Dr. Noakes agrees with the conclusion of Drs. Marty, Saksida, and Quinn in Exhibit 1555 *Marty et al., Relationship of Farm Salmon, 2010*, he suggested that their conclusion that salmon farms were a source of *Lep. salmonis* did not take into consideration alternate hosts. The BCSFA also notes that Exhibit 1555, written by an expert in fish health and disease, a veterinarian, and a statistician, despite assuming salmon farms are the primary source of *Lep. salmonis* infection nevertheless concludes that there are no population-level effects of sea lice on pink salmon, and that coordinated fallowing or closed containment are unnecessary to protect wild salmon.

Jones, Transcript, September 6, 2011, p. 28, ll. 32-40;
Noakes, Transcript, August 26, 2011, p. 69 ll. 13– 32;
Exhibit 1555, Marty *et al., Relationship of Farm Salmon*, 2010, supra, p. 1, 5

150. Although Dr. Orr noted potential sub-lethal effects of sea lice such as affecting their swimming performance or schooling behaviour which may expose them to predation, the BCSFA argues that these effects are unlikely to be relevant to sockeye at a population level. Recent research in Exhibit 1795 by Nendick *et al. Sea lice infection of juvenile pink salmon (Oncorhynchus gorbuscha): effects on swimming performance and postexercise ion balance* suggests that only the smallest pink salmon experience sub-lethal effects of an impact on their swimming performance. Furthermore, Exhibit 1785, Morbidity-Mortality Effects of Sea Lice on Juvenile Salmon Workshop, described by Dr. Orr as the proceedings of the workshop, is incomplete and omits some criticisms regarding research on sub-lethal effects of sea lice. A summary of the omitted comments made at the workshop which are audible in the audio recordings, notes a period of discussion in which "Dr. Dill recognizes that study does not investigate the schooling behaviour of individual fish, and therefore cannot compare parasitized and non-parasitized schooling behaviour." The BCSFA says that while there are studies demonstrating sub-lethal effects, Dr. Orr should have clearly

acknowledged the weaknesses of applying such studies to assess risks to wild sockeye salmon.

Exhibit 1795: Nendick *et al., Sea lice infection of juvenile pink salmon (Oncorhynchus gorbuscha): effects on swimming performance and postexercise ion balance*, 2011;
Exhibit 1955, *CAAR-MHC Mortality & Morbidity Workshop Nov 18, 2009 - Comments on Proceeding Transcript as Submitted by the Conservation Coalition to the Cohen Commission [BCSFA] (cf Exh 1785)* p. 2;

151. As explained by Dr. Saksida, the current management trigger of three motile lice per fish on salmon farms was not implemented for health reasons, but because of the precautionary principle. Dr. Saksida's research in Exhibit 1794, Saksida *et al., The efficacy of emamectin benzoate against infestations of sea lice* found no resistance to SLICE in B.C. unlike Europe where SLICE was overused, and hypothesized that a number of factors may explain the difference including larger populations of infected wild hosts which may reduce selection pressures, and the genetically different sea lice may be less pathogenic and require fewer treatments. Dr. Saksida also testified that there are some farms in B.C. that do not have to treat for lice because they never reach the trigger point. Exhibit 1794 does however note that SLICE is the only available treatment option in B.C. and recommends a number of measures for an integrated pest management programme, including access to alternative sea lice treatments, as a means to ensure efficacy is not diminished in the future.

Saksida Transcript, September 6, 2011 *p.* 71 ll. 44-47;
Ibid. p. 22 ll. 24 – p. 23 ll. 6;
Ibid. p. 75 ll. 20 – 45;
Exhibit 1794, Saksida *et al., The efficacy of emamectin benzoate against infestations of sea lice, p. 916*

152. Although the evidence shows that there is a low risk of sea lice in B.C. from developing resistance to SLICE, both because of the low rates of use relative to other salmon farming areas and new research by Messmer *et al.*, cited in Exhibit 1536, *Noakes Report 5C*, 2011, which shows a single well-mixed population of *Lep. salmonis* on the West Coast of North America, the BCSFA says that a precautionary approach would be to recommend that DFO assist the industry in gaining access to other treatments. As recommended in Exhibit 1623, *PSF Final Report*, 2009, supra, a transparent and timely process is needed to review and approve non-drug treatment options to manage disease and parasites.

Exhibit 1536, *Noakes Report 5C*, 2011, *supra*, p. 16;
Exhibit 1623, *PSF Final Report*, 2009, *supra*, p. 44-45

2. Problems with Reports by Dr. Dill & Dr. Connors

153. Marmorek *et al.* note that Dr. Noakes and Dr. Dill reached different conclusions as to the likelihood of pathogens from salmon farms being a potential cause of Fraser River sockeye salmon declines. The BCSFA notes that Dr. Dill admitted he approached his report with the preconception that evidence exists linking salmon farms to the decline of sockeye salmon. In addition to this subjective approach, Dr. Dill selectively quoted literature and omitted conflicting views to make speculative conclusions as to potential pathways of disease transmission, and relied entirely on Dr. Connors' report to speculate on a potential correlation despite the fact that Dr. Connors was not qualified to undertake the analysis he did. The BCSFA says Dr. Dill's report suggesting a link between salmon farms and Fraser River sockeye salmon should be given significantly less weight than that of Dr. Noakes which demonstrates an objective and in many cases more thorough approach to the issues.

Project 5 Reports: Approaches and Results

154. When Commission Counsel asked Drs. Dill and Noakes to imagine themselves as jurors considering the guilt or innocence of the salmon farming industry, Dr. Dill answered that he "started from the basis that there is some evidence of an impact of salmon farms, and was looking for what the causative mechanism might be underlying that." Dr. Noakes on the other hand answered that he started by looking at the evidence, including the trends, and then formed an opinion the data showed "more than just not proving guilt", but in fact declaring the person "innocent." Dr. Dill tried to correct himself the next day by saying that although he expected he would find an effect he kept an open mind, but that the Connors report provided some "weak support" for his hypothesis that there is an effect of farms on sockeye survival.

Dill and Noakes, Transcript August 25, 2011, p. 107 ll. 15 – p. 108 ll. 13;
Dill, Transcript August 26, 2011, p. 40, ll. 36 – p. 41, ll. 29

155. In fact, the BCSFA notes that one of the peer reviewers of the reports by Dr. Dill and Dr. Noakes, Professor Farrell, noted the possibility that salmon farms have positive impacts on wild salmon productivity and said a "balanced scientific approach should consider both positive and negative impacts", noting that while the reports "start with the tenet that only negative impacts are possible, this assumption "has yet to be scientifically defended." Dr. Noakes in fact considered this in his reply but concluded there might be a minimal increase in productivity from the addition of nitrogen, although it would be minimal relative to the nutrients from the Fraser River plume. It is clear from Dr. Dill's testimony that his was not a balanced approach.

Exhibit 1536, *Noakes Report 5C*, 2011, *supra*, p. 97-98

156. The BCSFA says that Dr. Dill's approach shows that he was unable to reject his theory that evidence shows salmon farms impact wild salmon when he was unable to find any convincing evidence, which is why he concluded an effect was "possible". Had he started with a null hypothesis, he would have concluded there was no significant relationship between salmon farms and sockeye salmon productivity. Furthermore, as explained below, the evidence that Dr. Dill presents to support his conclusion that disease from salmon farms is a "possible" contributor to the decline is suspect. Dr. Connors' report is also too unreliable to be the sole basis for concluding salmon farms have a potential effect on wild sockeye. The BCSFA argues that there is no evidence that salmon farms are the cause of the decline of Fraser River sockeye salmon.

Selective Quotations and Speculative Reasoning

157. As the BCSFA argues below, Dr. Dill's hypothesized pathways of pathogen transfer via waste, escapes, and sea lice are speculative and are not supported by the available evidence. These potential pathways are visually represented in Exhibit 1575, Marmorek *et al. Addendum to Technical Report 6* provide in Figure 3 possible pathways of effect "based on Dill (2011)" in which pathogens from salmon farms may affect Fraser River sockeye salmon, noting these are possible influences "with an uncertain magnitude of effect" which "cannot be definitively rejected or assigned a relative likelihood of 'unlikely' with the evidence currently available, as presented by Dill (2011)." What is not clear from this statement, but was explained in Mr. Marmorek testimony, is that these pathways were based entirely on Exhibit 1540, *Dill Report 5d,* 2011, and that Dr. Noakes considered all of these pathways to be unlikely based on the available evidence.

Exhibit 1575, Marmorek *et al.*, *Addendum to Technical Report 6* p. 19

158. As Dr. Farrell noted several times in his peer review, Dr. Dill is overly selective in his use of literature, deliberately omits relevant literature, and is insufficiently balanced. Given the potential bias that Dr. Dill himself admitted to in searching for evidence to support his belief that some existed to inculpate salmon farming, this is not surprising. Notably, Dr. Farrell observes Dr. Dill leaves out opposing details from his cited materials:

> The scientific rigour of the DR was greatly weakened by the absence of a comprehensive and an objective consideration all available literature and information. **Some of the relevant literature was omitted completely** and **some was rather shallowly dismissed**. Some complex issues were **paraphrased too simply and opposing details were left out**. Lacking proper scientific coverage, the DR could easily be viewed as **a highly selective and polarized opinion**. This would be an unfortunate

> situation because it reduces the validity of some credible concerns.

Exhibit 1540, *Dill Report 5D*, 2011, p. 67, 74, 65

159. The BCSFA says that failing to note the opposing qualifiers to such statements is a significant omission which is illustrative of the potential bias. The various potential pathways by which Dr. Dill hypothesizes pathogens from salmon farms could affect sockeye salmon are summarized below. As the BCSFA will show, the evidence suggests that these pathways are speculative and not well supported, and in some cases are based on Dr. Dill's selective quotation of the cited materials:

> The viral and/or bacterial pathogens considered the most risky to wild sockeye are *Renibacterium salmoninarum* (causing bacterial kidney disease, BKD), the IHN virus (causing infectious hematopoietic necrosis, IHN) and *Aeromonas salmonicida* (causing furunculosis). There are a variety of ways these may be transferred from farmed fish to wild sockeye, including horizontal transfer of shed pathogens, via farmed salmon escapees, via movement of infected sea lice (vectoring), and through discharge of untreated "blood water" from processing facilities. **Horizontal transfer and vectoring by sea lice are likely to be the most important routes of transmission**, but the role of processing facilities needs to be examined further.

Exhibit 1540, *Dill Report 5D*, 2011, p. 2

160. First, Dr. Dill's hypothesis that BKD may be transmitted to sockeye through the benthos and intermediate hosts is based on a selective quoting of the only literature supporting this thesis. In claiming that feces from farmed fish are a potential pathway for pathogen transmission, based on the fact that "*Renibacterium* (the causative agent of BKD) can survive in faecal matter for up to 21 days (Hammell *et al.* 2009)" Dr. Dill leaves out an opposing detail from the report he cites. Hammell *et al.* 2009, marked as Exhibit 1561, *Hammell et al., Salmon Aquaculture Dialogue - Working Group Report on Salmon Disease, Draft Mar 3 2009* **("Exhibit 1561, *Hammell et al. S.A.D. Working Group Draft*")**, in fact provides several important qualifiers to that statement that tend to reduce the risk suggested by Dr. Dill, specifically that there was a report of *renibacterium* surviving for that period of time in faecal matter but that it was not found in the overlying water, and that it was unable to compete with the normal aquatic micro flora. Furthermore, as Dr. Noakes' fine-scale analysis of the data demonstrates, BKD occurred in salmon farms that were not on the migration route, which leads him to the conclusion there is "no evidence of any significant link or relationship between BKD in farmed salmon and Fraser River sockeye salmon returns". Because neither Dr. Dill nor Dr. Connors' did a fine-scale analysis of the data, Dr. Dill's hypothesis is based on an assumption.

Exhibit 1561, *Hammell et al. S.A.D. Working Group Draft*, *supra,* p. 27

161. The BCSFA says that these opposing details reduce the possibility that faecal matter could act as a vector for *renibacterium.* The BCSFA also notes that Dr. Dill goes on to speculate about intermediate hosts for parasites, indirectly alluding to the possibility *renibacterium* could be transmitted like *Kudoa thyrsites*, but does not actually suggest or cite any literature that suggests *renibacterium* could be transmitted via an intermediate host to wild sockeye. Dr. Dill leaves the *renibacterium* to die in the benthos, out of the overlying water where the sockeye are located, to be outcompeted by normal micro flora. Without more, the suggestion that waste from farms can act as a vector for "high risk" diseases is entirely speculative.

Exhibit 1540, *Dill Report 5D*, 2011, p. 27-28

162. Dr. Dill also speculates that there is "a slight potential" for farmed salmon escapees to act as a vector, again citing Exhibit 1561, *Hammell et al. S.A.D. Working Group Draft*, *supra*. The BCSFA notes however that Dr. Dill's quotation from Exhibit 1561 omits the sentences subsequent to those quoted by Dr. Dill, which note several opposing facts. Dr. Dill's report in fact cuts off the quotation mid-sentence with no ellipsis or other punctuation to show something might have followed it:

> As Hammel (sic) *et al.* (2009) say: "A variety of salmon diseases can result in a carrier state in asymptomatic fish (such as furunculosis, bacterial kidney disease, infectious hematopoeitic necrosis, infectious salmon anemia, infectious pancreatic necrosis). We found no studies that examined what proportion of escaped salmon includes asymptomatic disease carriers and how many survive long enough to transmit their pathogen to another fish. Asymptomatic, persistently infected fish typically do not shed as much pathogen as a sick fish, but their shedding happens over an extended time period

Exhibit 1540, *Dill Report 5D*, 2011, supra, p. 28

163. The remainder of the paragraph from Exhibit 1561, *Hammell et al. S.A.D. Working Group Draft*, *supra* reads:

> and shedding rates could increase with stress. Opportunities for transmission through co-mongling (sic) will be **lower in jurisdictions where the species of salmon reared are different than the wild species** and **social and ecological barriers would reduce the interaction** of escaped and wild fish. Escape rates in salmon farms have **decreased dramatically in recent years in many jurisdictions**. **All of these factors reduce the risk of escaped fish transmitting diseases to wild stocks**, but the level of risk still cannot be quantified due to gaps in knowledge.

Exhibit 1561, *Hammell et al. S.A.D. Working Group Draft*, *supra* p. 32

164. The BCSFA says Dr. Noakes' demonstrates his objectivity in his more thorough analysis of the escapes issue which included consideration of escapees as potential vectors for disease:

> … with respect to disease, it is far more likely that farms would be a more viable source of pathogens than chance encounters between Pacific salmon and escaped Atlantic salmon. **All of these issues have been considered in detail before and the main concerns regarding escaped Atlantic salmon appear to be potential ecological interactions and sustained colonization** (Anon. 1997; Nash 2003; Waknitz *et al.* 2003). With respect to Fraser River sockeye, there is simply no evidence to suggest that escaped Atlantic salmon have contributed to the decline in recent years or that escaped Atlantic salmon pose any threat to these stocks. The same would also apply to other species of Pacific salmon in the Fraser River.

Exhibit 1540, *Dill Report 5D,* 2011, *supra* p. 22, 28;
Exhibit 1561, *Hammell et al. S.A.D. Working Group Draft*, *supra,* p. 32;
Exhibit 1536, *Noakes Report 5C*, 2011, *supra* p. 12

165. Regarding Dr. Dill's hypothesis that sea lice can act as vectors for high risk diseases, numerous experts called before the Commission testified that sea lice are not an effective vector for disease. Notably, Dr. Jones explained that the literature cited by Dr. Dill for this point did not establish the risk. The BCSFA therefore argues that this possible pathway of effect identified by Dr. Dill in ranking is itself unlikely, and that this further lessens the likelihood of Dr. Dill's conclusion pathogen transfer from salmon farms to wild salmon is a "possible" cause of sockeye declines.

166. According to Dr. Jones, the list that was referred to in Dr. Dill's report as evidence of sea lice acting as a disease vector was actually a list of references to the scientific literature where researchers had associated a particular fish pathogen with salmon lice. In other words, they had conducted diagnostic tests on the salmon louse to look for the presence of a virus or a bacteria. Dr. Jones explained "that's a very different piece of information than saying that the salmon louse, because of its biology and behaviour, is a competent vector of those pathogens" and contrasted it to a mosquito that transmits malaria by moving from animal to animal to feed, whereas the salmon louse for the most part stays attached to a fish.

Jones, Transcript, September 6, 2011, p. 26 ll. 47 – p. 27 ll. 27;
Exhibit 1540, *Dill Report 5D, 2011*, p. 30

167. Dr. Noakes also considered the possibility of sea lice as a disease vector in Exhibit 1536, *Noakes Report 5C*, 2011. This fact was not noted in Exhibit 1575,

Marmorek *et al. Addendum to Technical Report 6*, 2011 which only cited Dr. Dill on this point. Dr. Noakes reported:

> There is also the potential for sea lice to act as vectors for other pathogens (for instance, BKD or IHN) that may cause disease in sockeye salmon (Barker *et al.* 2009; Nese and Enger 1993). It is certainly possible to isolate a pathogen such as IHN from sea lice and to cause a disease through injection but disease agents have evolved more effective modes of transmission (K. Garver, pers. comm.). For instance, IHN can spread very effectively through water – much more effective and efficiently than using sea lice as a vector (K. Garver, pers. comm.). Thus, the transfer of disease through via a sea lice vector is unlikely to be of significance at a population (salmon) level.

Exhibit 1536, *Noakes Report 5C*, 2011, p. 20

168. The one expert that Dr. Dill appears to have consulted on this subject, D. Baker, noted that sea lice may transmit *Aeromonas salmonicida*. However, as explained by Dr. Lewis in Exhibit 1975, *Sea Lice – Could they Act as Disease Vectors*, 2011, notes that sea lice was shown to be capable of transmission "experimentally", and furthermore that "[s]ince farmed salmon in BC are all vaccinated before they leave freshwater sites, however, disease caused by this pathogen (furunculosis) has largely disappeared on salmon farms." The BCSFA argues that a disease that is generally not occurring in salmon farms cannot be transmitted from salmon farms to wild fish through sea lice.

Exhibit 1975, Dr. Lewis, *Sea Lice – Could they Act as Disease Vectors*?, 2011, p. 3

169. Dr. McKenzie summarized Exhibit 1975, Dr. Lewis's report *Sea Lice – Could they Act as Disease Vectors*?, to say that although sea lice "can act as a potential transmitter of disease", it is more than likely that the transmission is "mechanical". Dr. Saksida furthermore adopted the report as her own evidence. Dr. Lewis explains the significance of mechanical transmission by sea lice as follows:

> **A distinction must be made between an agent capable of mechanically transmitting a pathogen (acting as a fomite) versus a biological vector (agent that is necessary for its transfer)**; a rubber boot may act as a fomite and physically transmit pathogens short distances. A biological vector, however, not only transmits the pathogen but also supports its survival; for example, bats can act as biological vectors for the rabies virus. In some cases, a biological vector may actually be necessary for an agent to complete its life cycle; a mosquito is necessary for the replication of the parasite that allows malaria to develop to an infectious stage. **A mechanical vector, of course, is much less important in disease spread.**

> Sea lice have been shown experimentally to be capable of mechanically transferring ISA and IHN viruses and some fish bacterial pathogens. **There is, however, no indication or evidence that such mechanical capability is important or significant regarding potential disease transmission between farmed and wild salmon in British Columbia**.

McKenzie, Transcript August 31, 2011, p. 77 ll. 14 – 28;
Saksida, Transcript, September 6, 2011 *p.* 17, lines 40-44;
Ibid. *p.* 18, lines 19 – 43, *Ibid*. *p.* 61, lines 12-14;
Exhibit 1975, Dr. Lewis, *Sea Lice – Could they Act as Disease Vectors*, p. 2

170. Finally, Dr. Jones summarized the issue of sea lice as a disease vector as discussed during the sea lice panel: "My sense is that from what we've heard and what we've described today, that the spread of disease that's specifically due to sea lice is not a significant issue as it relates to the health of wild salmon populations."

Transcript Sept 6, 2011 p. 95, ll. 41-46

171. Based on the wide agreement by experts on fish health and disease such as Dr. Garver, Dr. McKenzie, Dr. Saksida, Dr. Jones, and the report by Dr. Lewis, the BCSFA submits that the evidence shows sea lice do not act as an effect disease vector. Dr. Dill's hypothesis that they do as support of his conclusion that diseases from salmon farms are a "possible" cause of the decline should therefore be accorded little weight.

Problems with the Connors Report 5B, 2011 and Dr. Dill's Reliance

172. Dr. Dill relied on Dr. Connors' long term analysis to conclude that farms are having some sort of negative impact on wild salmon productivity. The BCSFA notes that there are several areas of concern with Dr. Connors' report, notably the fact that he is not a qualified expert in fisheries-climate interactions yet relied on time series involving SST without accepting the constructive criticisms of Dr. Noakes who is an expert in that area. Furthermore, as explained by Dr. Noakes, Dr. Connors failed to ensure the farm production data was a reasonable proxy for disease, omitted important competitive information omissions such as competitive interactions between sockeye, pink, and chum salmon and other species in the North Pacific and the SOG, and ignored confounding interactions that would tend to increase the likelihood of finding a relationship between salmon farms and sockeye returns. All these factors suggest that Dr. Connors' analysis is "not useful" or reliable. The BCSFA argues that Dr. Connors' report should be afforded little weight in associating farmed salmon production to sockeye declines. By extension, Dr. Dill's conclusion that there is a possible effect of pathogens from salmon farms is "not really a supportable statement."

Noakes, Transcript, August 26, 2011, p. 17 ll. 5 – 18, p. 40 ll. 2-27

173. It is significant to note that Dr. Connors himself testified that all his model did was to make "associations between particularly farmed salmon abundance and the abundance of pink salmon North Pacific Ocean and declines in productivity", and that his model doesn't say whether the variables considered caused the reductions – it is therefore necessary to infer causation. The BCSFA argues that in light of Dr. Dill's testimony that he approached the project believing that evidence existed to link salmon farms to the decline, his inferences are not sufficiently objective to be reliable. Had Dr. Dill approached the project with an open mind as he later claims to have done, the data would not have let him reject the "null hypothesis" that there is no significant relationship between farm salmon production and Fraser River sockeye salmon productivity.

Dill & Noakes, Transcript, August 26, 2011, p. 39 ll. 13 – p. 40 ll. 28]

174. The BCSFA suggests that the qualifications of Dr. Noakes and Dr. Connors is an important factor to consider when reviewing the disagreement between them over Dr. Connors' interpretation of the data, specifically because Dr. Connors is not an expert in the area in which Dr. Noakes had significant criticisms. Dr. Noakes was qualified as an expert in salmon population dynamics, including wild salmon/farmed salmon interactions, fisheries climate interactions and in statistical analysis including time series analysis. Dr. Connors was not qualified in fisheries-climate interactions or time series analysis. His qualifications are limited to statistical analysis, and fish population dynamics with a particular research emphasis on wild salmon/farmed salmon interactions. However, Dr. Connors' long-term analysis is dependent on fisheries-climate interactions, specifically SST, and time series analysis. Significant weight should be accorded to Dr. Noakes' criticisms of Dr. Connors' correlation of SST as a proxy for climatic variables to farmed salmon production and pink salmon abundance, as Dr. Noakes is an expert in this area.

Transcript, August 25, 2011 p. 68 ll. 40 – p. 69 ll. 4, p. 74 ll. 14 - 23

175. For example, Dr. Noakes observes that Dr. Connors found "no significant relationship between farmed salmon production and Fraser River sockeye salmon productivity, no significant relationship between pink salmon abundance in the North Pacific and Fraser River sockeye production but he did identify a significant negative relationship between winter sea surface temperature (SST) and Fraser River sockeye salmon productivity." Dr. Noakes observes this relationship "isn't surprising as other studies have demonstrated links between SST and salmon production". However, Dr. Noakes says that by systematically combining time series that are already significantly correlated such as SST and salmon abundance to test for significant relationships, while failing to consider other salmon at the same trophic level as sockeye which may both compete with one another and also be affected by climate, Dr. Connors made spurious correlations and wrongly assigned relationships where none exist.

Exhibit 1536, *Noakes Report 5C*, 2011, p. 5-6

176. The BCSFA says that Dr. Connors's reliance on SST, despite his lack of expertise in fisheries-climate interactions, in order to find a correlation between SST, farmed salmon production, and pink salmon abundance, means that his analysis is fundamentally flawed. As Dr. Noakes explains at length, Dr. Connors' failed to consider the problems of simply correlating salmon abundance time series and climate variables such as SST. Because Dr. Connors is not an expert in this area, his long-terms analysis lacks reliability and should be given little weight. As Dr. Noakes explains:

> … [B]y combining SST with other time series, a **significant relationship may be wrongfully assigned** the other variable when none actually exists. The **relationship may be (and quite likely is) solely with SST with the other factor or variable being completely unrelated**. None of the combinations examined by Connors (2011, Table 6) were statistically significant (even before adjustments for multiple comparisons) so **the discussion about possible links is simply unwarranted speculation**.

Transcript, August 25, 2011, p. 74 ll. 20-23;
Exhibit 1536, *Noakes Report 5C*, 2011, p. 8

177. As Dr. Noakes testified, he raised these concerns with Dr. Connors at least three times prior to the final reports being submitted because he was concerned Dr. Connors' analysis would not be useful. The BCSFA says that Dr. Connors was not qualified to undertake the analysis he did, and should have deferred to Dr. Noakes' constructive criticism prior to completing his report. Dr. Connors failure to do so means his report makes a "spurious correlation" between SST, pink salmon, and salmon farm production in his long term analysis, meaning his conclusion, that the long term analysis shows some sort of a negative impact on wild salmon by salmon farms, is entirely speculative, without merit, and should be afforded little if any weight. Because Dr. Dill did not engage in his own analysis but adopted Dr. Connors' report to support his conclusion that pathogen transfer from salmon farms is a "possible" factor, Dr. Dill's report should also be accorded little weight. The BCSFA argues that Dr. Noakes' Report should be preferred over those of Dr. Connors and Dr. Dill as he is an expert in the areas of analysis which he undertook and performed a detailed and rigorous analysis of the data in reaching his conclusion.

Noakes, Transcript August 26, 2011, p. 15 ll. 36 – p. 16 ll. 5

178. Significantly, Dr. Connors did not consider conditions inside the Strait of Georgia in his analysis. When asked whether he had considered juvenile pinks and chums in the Strait of Georgia, he answered that he "considered the abundance of pink salmon in the North Pacific, as opposed to juvenile abundance or abundances in a suite of other regions." His justification was that an independent expert panel,

whose findings are presented in Exhibit 73, *PSC - Synthesis of Evidence from a Workshop on the Decline of Fraser River Sockeye, June 15-17, 2010*, considered there was evidence of competition between sockeye and pink salmon in the North Pacific. However, the hypothesis presented in "Session E" chaired by Dr. Ruggerone was entitled "Competitive interactions among wild and hatchery fish (**potentially all salmon species**) are important contributors to the Fraser sockeye situation" which is the identical language used in item #16 of the Workshop Participant Survey which asked participants to rate the likelihood of that hypothesis, not whether pink salmon are an important contributor. The BCSFA argues that the workshop does not say that competition with other salmon on the same trophic level such as chum should not be considered.

Connors, Transcript, August 26, 2011 *p.* 31 ll. 37 – p. 32 ll. 1;
Exhibit 73, *PSC - Synthesis of Evidence from a Workshop on the Decline of Fraser River Sockeye, June 15-17, 2010*, ("**Exhibit 73, *PSC - Synthesis of Evidence***") p. 37, 139

179. Dr. Noakes noted that a number of other possible variables that he discussed with Dr. Connors when generating hypotheses to test weren't considered in Exhibit 1545, Connors Report 5B, 2011. These included the abundance of herring and hake in the Strait of Georgia. Dr. Connors also failed to consider competition by chum salmon in the North Pacific. As Dr. Beamish testified, summarizing a recent book chapter he wrote with Dr. Noakes, Exhibit 1324, Beamish & Noakes, *Shifting the Balance,* 2011, *supra,* there is "a potential that – and particularly for chum salmon that are enhanced in Asia - there is that potential that our pink salmon, say, in Alaska, could have an impact on Fraser River sockeye, say in the Gulf of Alaska". Exhibit 1324 explains further:

> **Pink and chum salmon are the two most abundant species of salmon in the North Pacific** and both species (particularly chum salmon) are **supported by large salmon enhancement programs on each side of the Pacific**. For instance, in some areas of Alaska, 60-80% of the catch of pink and chum salmon are hatchery fish in some years, with hatchery origin salmon representing about 30% of the total salmon catch in Alaska in recent years (Heard 2003; Knapp *et al.* 2007). The scale of the enhancement programs is enormous with more than **4.5 billion juvenile salmon being produced or released (all species combined) annually** by Canada, Japan, the United States, and Russia (North Pacific Anadromous Fish Commission, www.npafc.org). **There is some evidence to suggest that hatchery salmon from the different countries interact with wild salmon resulting in negative consequences for all of the salmon involved (both hatchery and wild salmon).** … Mantua *et al.* (2007) have also suggested that wild and hatchery salmon may interact in the ocean, and their modeling suggests that reducing the number of hatchery fish may not result in an overall reduction in salmon production, only a shift towards more wild fish.

Noakes, Transcript August 26, 2011 p. 40 ll. 2-27;
Beamish, Transcript, July 7, 2011, p. 84 ll. 44-p. 85 ll. 9;
Exhibit 1324, Beamish & Noakes, *Shifting the Balance,*
2011, *supra* p. 29-30 [emphasis added]

180. As noted above, because Exhibit 73, *PSC - Synthesis of Evidence* does not rule out potential interactions between sockeye and other salmon species, Dr. Connors' failure to consider conditions in the SOG or competition by other species of salmon means the associations made between salmon farms, SST and pink salmon abundance and Fraser River sockeye salmon productivity are highly speculative. Dr. Noakes therefore felt that Dr. Dill's statement that farms are having some sort of negative impact, based on Dr. Connors' analysis, was "not really a supportable statement." Exhibit 1536, *Noakes Report 5C*, 2011 says it is "much more reasonable to consider the relationship between sockeye, pink, and chum abundance in the North Pacific and Fraser River sockeye productivity" because there is "strong evidence that sockeye, pink, and chum salmon have a very high overlap at the trophic level and there is likely to be negative interactions among these species through competition." It explains further:

> There is also evidence that **pink and chum production (as indexed by catch) in the North Pacific has responded to shifts in ocean conditions** in a synchronous fashion with the reverse pattern of changes (shifts) being observed for sockeye salmon (Noakes and Beamish 2009). … It does not make sense to consider pink salmon abundance only given the **significant trophic overlap for the three species (sockeye, pink, and chum salmon)** and particularly when **no significant relationship was found between the abundance of pink salmon in the North Pacific and Fraser River sockeye salmon production when they were considered independently**.

Transcript August 26 2011, p. 32 ll. 2 – 40, p. 40 ll. 2 – 27;
Exhibit 1536, *Noakes Report 5C*, 2011 *supra p.* 6 [emphasis added]

181. Dr. Connors failed to take a number of pre-analytical steps, in particular he did not perform the necessary diagnostics on the data to prove that farm production data is a good proxy for disease. In Exhibit 1538, *Noakes Response to B Connors*, Dr. Noakes went to great lengths to explain why salmon farm production data is inappropriate, specifically because farm production is increasing while "high risk" disease events are not. As Dr. Noakes explained, this means Dr. Connors' approach is unreasonable and without basis:

> … It is clear from his report, his comments on my criticism of his report, and the manner in which the data are included in his model that **Connors assumes 'pathogen exposure' is proportional to farm salmon production.** It is, however, **neither sufficient nor acceptable to use farm salmon production as a 'proxy for pathogen exposure' simply**

> **because as Connors notes 'it is the only source of information we have.** Connors spends considerable time qualifying and justifying the use of the various sockeye salmon time series and other variables in his model but **employs farm salmon production in his model (as a proxy) without any critical assessment or review**. The onus is on Connors to clearly demonstrate that this assumption (using farm salmon production as 'a proxy for pathogen exposure') is appropriate. **Connors has to clearly demonstrate that farm salmon production (as a proxy for pathogen exposure) is consistent with the fish health data (evidence) available from the farms (detailed data are available since 2003) and that his assumed relationship (proportionality) is consistent over the entire time series**. Based on the discussion below, I believe the evidence clearly shows that **Connors assumption with respect to farm salmon production as a proxy for pathogen exposure is not reasonable and consequently his analyses and conclusions are without basis.**

Exhibit 1538, *Noakes response to B. Connors,* p. 1 [emphasis added]

182. Mr. Marmorek also acknowledged that Dr. Connors long-term analysis is limited. He said Dr. Connors "did the best he could to use the farm production as a proxy indicator, if you will, for disease" and proceeded to suggest that Dr. Connors' approach would have been better if he did not have to aggregate the data "for proprietary reasons." This is inconsistent with Dr. Connors' explanation for aggregating the data to avoid assuming migratory routes, and furthermore does not explain why Dr. Connors was using aggregated data when Dr. Noakes was able to do a fine scale analysis using the farm by farm data which Dr. Dill said was preferable to analysing aggregated data.

Marmorek, Transcript September 19, 2011, p. 81 ll. 13-38

183. Finally, the BCSFA says that Dr. Connors analysis was undertaken in such a way as to increase the likelihood of finding a relationship between farmed salmon and Fraser River sockeye salmon productivity. For example, in addition to assuming farm production data is a reasonable proxy for disease despite Dr. Korman's analysis, Dr. Connors also acknowledged that he had used silvers in his analysis in such a way as to increase the likelihood of finding a relationship between salmon farms and sockeye declines. It is therefore more significant that he was unable to find a statistically significant relationship between farms and wild salmon.

Transcript, August 26, 2011 p. 33 ll. 29 – p. 34 ll. 13

184. The BCSFA therefore submits that where their reports diverge, the conclusions of Dr. Noakes should be accorded more weight than those of Dr. Dill. Specifically,

the BCSFA says that Dr. Noakes report establishes there is "no significant correlation between farmed salmon production within the main migration path of Fraser River sockeye salmon, the waters between Vancouver Island and the mainland of British Columbia, and the returns of Fraser River sockeye salmon", that "disease originating from salmon farms has not contributed to the decline of Fraser River sockeye salmon" and that "the incidence of diseases in farmed salmon that would be classified as high risk to sockeye salmon is very low and do not pose a significant risk."

Exhibit 1536, *Noakes Report 5C*, 2011, ii

B. Farm siting & Protection of Migratory Route

185. The siting of a salmon farms is a multi-step process. First, an aquaculture company performs a preliminary survey of possible sites using a list of siting criteria to determine whether or not to conduct further research to make a site application. Messrs. Last and Thomson agreed that because of the significant investment of time, money and expertise needed to apply for new aquaculture sites, aquaculture companies are very careful in applying for sites that are most likely to pass the siting protocols and environmental assessment, which were themselves developed by regulators using the best available science and the precautionary approach where gaps existed in science. This likely explains why neither Mr. Thomson nor Mr. Last could recall any site applications having been rejected because of wild salmon migratory routes.

Exhibit 1589, *Pacific Marine Finfish Aquaculture Application Form* p. 5;
Transcript, August 30, 2011, p. 56 ll. 32 – p. 57 ll. 13;
Ibid. p. 71 ll. 8 - 18

1. Farm Siting Process

186. The siting criteria used by salmon farmers under the Province were put in place in March 2000. This list has been adopted by Canada in its application for aquaculture sites. As both Mr. Thomson and Ms. Dansereau noted, the site application is a "very minor document compared to everything that a site operator was going to have to implement" in terms of meeting the regulatory requirements for information and monitoring. Mr. Thomson suggested the siting criteria may soon be reviewed by DFO.

Exhibit 1632 *Criteria for Siting New FinFish Aquaculture Facilities*;
Exhibit 1589, Pacific Marine Finfish Aquaculture Application Form
Dansereau, Transcript, September 22, 2011, p. 83 ll. 24-30;
Thomson, Transcript August 30, 2011, p. 18, ll. 28-37

187. Second, the company will collect the information necessary to satisfy a site application, including for the *CEAA* screening. A guide to the information required by the Province notes the applicant is responsible for completing and submitting the information required by both the Province and Canada. The provincial guide in fact defines "fish habitat" to mean migration areas according to the *Fisheries Act* (Canada):

> The spawning grounds and nursery, rearing, food supply **and migration areas** on which fish depend directly or indirectly in order to carry out their life processes. Source: Fisheries Act (Canada)

Exhibit 1622, *Guide to Information Requirements*, 2003, *supra, p. 1-3, 48*

188. Third, biologists at DFO review the information submitted. The final report of the Pacific Salmon Forum in fact notes "all site applications must undergo detailed biological and environmental reviews in accordance with both provincial and federal regulations." If a site is approved, habitat compensation may, and commonly is, required by DFO. Section 13.10(c) of the Exhibit 1594, *Finfish Aquaculture Licence 2010 Under the Pacific Aquaculture Regulations* gives DFO the continued authority to require compensation.

Exhibit 1623, *PSF Final Report*, 2009, supra p. 37;
Transcript September 8, 2011, p. 61 ll. 3 – 22

189. Canadian Environmental Assessment Act ("***CEAA***") screenings consider a wide range of valued ecosystem components ("**VECs**") when determining what risks and mitigation measures must be implemented when approving a farm site. *CEAA* screenings consider potential risks to wild fish populations in a number of places, propose mitigation measures, and assess the risk to each VEC. As Ms. Parker testified, "I can say with some confidence that salmon habitat, fish habitat and fish population level effects are considered in *CEAA* screenings." Evidence supporting this claim is reviewed below.

Transcript, September 8, 2011 p. 6 ll. 47 – p. 7 ll. 2

190. In a *CEAA* screening done by DFO, Exhibit 1625, *CEAA Screening Report, Grieg Seafood, Proposed Finfish Aquaculture Facility at Concepcion Point*, a report was provided to DFO by the Nuu-chah-nulth Tribal Council Fisheries Program entitled "Preliminary Review of Pacific Salmon (Onchorynchus spp.) Populations at Risk of Extinction with a Single Migration Route in Muchalat Inlet, Nootka Sound" (R. Dunlop, 2003) which the screening report says was considered. The report says for example, that "[a]ccording to DFO-Stock Assessment, Muchalat Inlet supports all six species of Pacific salmon", and in addition to the required FHMP to reduce the risk of pathogen transmission, proposes other measures to mitigate risks to migrating salmon populations, such as

> The proposed finfish farm at Concepcion Point is located a minimum of approximately 190 m from the shoreline **to minimize effects of out-migrating smolts which tend to follow the shoreline.**
>
> **Night lighting** will not be used during timing of expected herring spawn times, egg hatching and juvenile herring presence in Muchalat Inlet **or from Feb 22nd to Oct 31st of any year to avoid the times for salmonid migration.**

Exhibit 1625, *CEAA Screening Report, Grieg Seafood, Proposed Finfish Aquaculture Facility at Concepcion Point*, p. 11, 10, 23

191. It is informative to note that Dr. Dill noted in several places in his report, Exhibit 1540, *Dill Report 5D, 2011*, and testified as well, that "lights are kept on at night, even during the sockeye migration period" which could attract wild salmon and increase their risk of being exposed to pathogens from salmon farms. The *CEAA* screening noted above contradicts Dr. Dill's testimony, showing that one of the mitigation measures required of aquaculture sites is to turn off night lighting during salmon migration times. The BCSFA suggests that Dr. Dill should have better informed himself as to *CEAA* screening mitigation measures prior to making these assertions.

Exhibit 1540, *Dill Report 5D, 2011 p. 20, 27;*
Dill Transcript, August 25, 2011, p. 99, ll. 3-11

192. Fourth, once a site has been approved and licensed according to the regulator's application of the precautionary approach to its decision-making, there are multiple levels of monitoring and oversight of the environmental effects of the operations. Messrs. Thomson and Last agreed that the aquaculture industry itself monitors and reports to the regulators to "ensure that the performance standards are being met and … to establish and to determine whether the established measures of mitigation are being effective." Ms. Parker observed that because industry conducts its own monitoring as a type of user pay arrangement, the government auditing and investigation program is in fact a second tier of monitoring.

Thomson & Last, Transcript August 30, 2011, p. 58 ll. 1-9;
Parker, Transcript September 8, 2011 p. 62, ll. 15-29;
also see PPR #8, DFO's Habitat Management Policies and Practices, para. 135

2. Adapting Management & Regulatory Transition

193. On the issue of monitoring and oversight, Mr. Backman added there is in fact a third tier of monitoring of the industry in addition to self-monitoring and government inspections and auditing. He explained that ISO-14000 certification is a further annual third-arty audit that ensures certified companies are complying with all regulations. As Drs. Noakes and Beamish observed in Exhibit 1324, Shifting the Balance, most aquaculture companies in B.C. are ISO certified:

> Consolidation within the industry has also resulted in greater economies of scale and improvements in environmental performance (BCPSF 2007). The increased control has also allowed salmon farmers to more easily certify their fish as organic if they so choose. At present, three-quarters of the salmon farming companies in British Columbia have attained ISO 9001/14001 certification for environmental and quality management.

Backman, Transcript September 8, 2011 p. 62, ll. 31-36;
Exhibit 1324, Noakes & Beamish, *Shifting the Balance*, 2011, *supra p.* 40

194. It must also be noted that the lifting of the moratorium in 2002 permitted the aquaculture industry to improve the environmental performance of several older sites. Following the Salmon Aquaculture Review in 1997 which recommended assessing existing salmon farms to see whether any significant negative effects needed to be corrected, 37 sites were identified for potential relocation. When the moratorium was lifted, the aquaculture companies were able to apply for several new sites. Although not expressly stated, it is reasonable to assume that these sites would have been assessed and approved based on current scientific knowledge and regulations. The operations of the remaining sites were adjusted to meet their existing location.

Last, Transcript, August 30, 2011 p. 51 ll. 3 – 33

195. A review of Exhibit 1615, *Province of British Columbia actions to meet the intent of the Salmon Aquaculture Review's Recommendations* shows that the Province had made significant progress in implementing the Salmon Aquaculture Review's numerous recommendations at the time of the regulatory transition. For example, following the Salmon Aquaculture Review's recommendation, FHMPs became an enforceable condition of licence under section 13(5) of the *Fisheries Act* (B.C.), and non-compliance with the FHMP could have been remedied voluntarily, or pursued as a breach that could have resulted in revocation, suspension or refusal to renew a licence and monetary penalties on conviction.

EX1615, *Province of British Columbia actions to meet the intent of the Salmon Aquaculture Review's Recommendations*;
Exhibit 1620, *Comprehensive MAL Response to BC Audit, Apr 5 2006 p.* 20 - 21;
see also Last, Transcript August 30, 2011 p. 49 ll. 37 – p. 53 ll. 35

196. The aquaculture industry under Canada's jurisdiction will continue to be as stringently regulated as under the Province. For example, FHMPs continue to be an enforceable condition of the Exhibit 1594 *Finfish Aquaculture Licence 2010 Under the Pacific Aquaculture Regulations* under the *Pacific Aquaculture Regulations* (Canada). Furthermore, as Mr. Thomson testified, in addition to new sites triggering a *CEAA* screening under the *Navigable Waters Protection Act* (Canada), Canada also incorporated the environmental impacts assessed through *CEAA* screenings into the conditions of licence.

Transcript, August 30, 2011, p. 108 ll. 7-20

197. The regulatory transition of aquaculture from the Province to Canada will result in a number of changes to the management of the industry. One particularly notable change is the new Integrated Management of Aquaculture ("**IMAP**") plan, which as Mr. Thomson testified, is intended to take an area management approach to aquaculture. Although the IMAP process has not been settled, Mr. Thomson did

say that their development would be "informed by the Wild Salmon Policy." IMAPs are expected to "contribute to a sustainable aquaculture framework", and act as "a key mechanism for setting, consulting on and generally communicating licence conditions in advancing sustainable aquaculture commitments and ecosystem based planning." Generally, IMAPs will support:

> • The incorporation of the federal policy approach for aquaculture, in particular the precautionary approach and ecosystem approach to management in aquaculture decision-making;
>
> • The desire by Canadians for increased stability and transparency related to aquaculture management; and
>
> • A rules-based approach to decision-making which is transparent, rigorous and systematic.

Transcript Augusts 30, 2011, p. 74 ll. 40-46, p. 105 ll. 42-45;
Exhibit 1604, *Pacific Aquaculture Regulations Integrated Management of Aquaculture Plans Guidance*, *p.* 1- 2

198. In Exhibit 1536, *Noakes Report 5C*, 2011, Dr. Noakes provides information on how Canada and the Province may jointly regulate the discharge and monitoring of waste from salmon farms using the performance based regulations developed by the Province under its regulatory regime:

> Over a period of time, the Finfish Aquaculture Waste Control Regulation (FAWCR) Committee developed standards and guidelines (amended January 14, 2010) governing the discharge and monitoring of waste (as defined in the regulation) at finfish aquaculture sites (Anon. 2010). The standards are performance driven with mandatory reporting and audits by government personnel. The expectation is that these regulations in conjunction with independent government audits will be used within the Federal Government's Pacific Aquaculture Regulations to manage waste and waste discharge at finfish aquaculture operations (A. Thomson, pers. comm.).

Exhibit 1536, *Noakes Report 5C*, 2011 *p.* 14

199. Ecosystem-based management is expected to improve the sustainability and reduce the impacts of aquaculture even further. For example, cumulative effects are considered and managed through siting criteria and environmental assessment screening, the development of FHMPs and ecosystem management under the Province which are conditions of licence under DFO, and area-based management by aquaculture companies so they are not acting independent of one another. Mr. Bevan explains that the "whole design of the regulatory regime" does not just measure the impact of each licence holder but looks at the entire area. The conditions of licence will reflect existence of other farms in the area. He also

noted that observes that Province will still be involved in licensing, whereas DFO will evaluate impacts before determining whether site can be used.

Farlinger, September 22, 2011 p. 79 ll. 17 – p. 80 ll. 40;
Farlinger, Dansereau, Bevan, Transcript September 22, 2011, p. 82 ll. 38 – p. 84 ll. 35

200. As reported by Exhibit 1575, Marmorek *et al., Addendum to Technical Report 6*, 2011, Drs. Noakes and Dill conclude "it is unlikely that waste from salmon farms are a primary factor in explaining the observed declines in the productivity of Fraser River sockeye salmon." Although Marmorek *et al.* note that both Dr. Noakes and Dr. Dill recognize the need to monitor water quality, and that Dr. Dill recommends research into "the cumulative impact of repeated exposure to poor water quality and pathogens when passing multiple farms in succession", they fail to note the fact that Dr. Dill assumes there is poor water quality around salmon farms without citing any literature to support his claim. Furthermore, Dr. Noakes observes in his report: "Although industry regularly monitors water quality at their farms for their own purposes, there is no ongoing monitoring by government." The BCSFA says it is reasonable to assume that any poor water quality would affect farmed salmon before affecting wild salmon, and that salmon farmers would ensure good water quality in and around their sites by identifying well-flushed sites through their siting process for the purpose of maintaining healthy fish.

Exhibit 1575, Marmorek *et al., Addendum, Technical Report 6: Implications of Technical Reports on Salmon Farms and Hatchery Diseases for Technical Report 6 (Data Synthesis & Cumulative Impacts), Jul 29 2011 p.* 8;
Exhibit 1536, *Noakes Report 5C*, 2011, *p.* 15

201. On the issue of water quality, on September 6, 2011 the Sea Lice panel was asked to comment on statements contained in Exhibit 1797, *Expert Judgments Regarding Risks Associated with Salmon Aquaculture Practices in British Columbia,* put to them expressing concern that "Changes in local water quality were … important risks to both wild salmon and other ecosystem species...". These concerns were contained in an anonymous survey of individuals from DFO, scientists from the Province, consultants, industry, academics, and students, compiled and published by someone named Dr. McDaniels in 2006. Dr. Jones himself said that he was "a little concerned that these conclusions are based on the opinion of 49 or 50 anonymous individuals who may or may not have expertise in disease or pathology or sea lice", and disagreed with the statements. Dr. Saksida disagreed with the statements as well. Although Dr. Orr and Mr. Price agreed with the statements, neither of them are qualified experts in disease or fish health.

Jones & Saksida, Transcript, September 6, 2011, p. 95 ll. 12 – p. 96 ll. 10

202. The BCSFA says that while Dr. Noakes and Dr. Dill both recognize water quality should be monitored, it should not be assumed that water quality is low.

3. Basis for North Coast Siting Moratorium – New Information

203. The independent review of the Wild Salmon Policy, Exhibit 944, *Report of the Skeena Independent Science Review Panel*, May 15 2008 concluded on the basis of two papers, Krkosek *et al.* 2007 and Ford & Myers, 2008, that the provincial moratorium on salmon farming in the North Coast was consistent with the DFO's and provincial Ministry of Environment's commitment to protect wild salmon and steelhead stocks. In light of the evidence reviewed here, the BCSFA argues that the sources considered to reach this conclusion are wrong, and that the moratorium on salmon farms should be reconsidered.

Exhibit 944, Report of the Skeena Independent Science Review Panel, May 15 2008 p. 68-69

204. In Exhibit 1984, *[Formerly for ID WW] – Beamish, Assessing the Impact of Salmon Farming on Pacific Salmon at Population Level in British Columbia* (**Exhibit 1984, Beamish, *Assessing the Impact*, 2011**) Dr. Beamish reviews several papers considering the impacts of sea lice from salmon farms on salmon populations, including the paper by Ford and Myers, marked as Exhibit 1487, Ford & Myers, *"A Global Assessment of Salmon Aquaculture Impacts on Wild Salmonids"*, and Exhibit 1555, Marty *et al., Relationship of Farm Salmon*, 2010, supra. On the Marty *et al.* paper, Dr. Beamish writes:

> The Marty *et al.* (2010) study is the most complete and comprehensive study of the relationship between farmed salmon and pink salmon in the Broughton Archipelago and in British Columbia. … Importantly, they stated very clearly that the populations of pink salmon were not negatively affected by the numbers of lice on the farmed fish or the numbers of fish in all of the farms.

Exhibit 1984, Beamish, *Assessing the Impact*, 2011 *supra,* p. 8

205. Regarding Exhibit 1487, Ford & Myers, *A Global Assessment of Salmon Aquaculture Impacts on Wild Salmonids,* Dr. Beamish notes several problems with their study. Most significantly, there is an inconsistency between their conclusion and abstract, as they conclude that in B.C. only pink salmon showed significant declines which they correlated to aquaculture, whereas their abstract reported a reduction in survival for pink, chum, and coho salmon in association with aquaculture. Their conclusion that salmon farming in B.C. has negatively affect pink salmon is itself problematic, as they excluded pink salmon from the Fraser River from their analysis, which has been increasing in abundance for 25 years despite the fact that "these pink salmon pass by the same fish farms on their migration route to the open ocean that are passed by the juvenile sockeye salmon from the Fraser River." Dr. Noakes agreed with Dr. Beamish's conclusions, and Dr. Saksida herself adopted Dr. Beamish's the paper as her evidence subject to a changing a reference to her paper from the word "pink salmon" to "farmed salmon" which did not change the paper's substance.

Exhibit 1984, Beamish, *Assessing the Impact*, 2011 *supra*, p. 4 – 6;
Noakes, Transcript, August 26, 2011 *p.* 87 ll. 2 – p. 88 ll. 31;
Saksida, Transcript, September 6, 2011 *p.* 64 ll. 44 – p. 66 ll. 28

206. The BCSFA says that Dr. Beamish's assessment shows that Exhibit 1487, Ford & Myers, *"A Global Assessment of Salmon Aquaculture Impacts on Wild Salmonids* is unreliable and speculative. For example, the paper uses estimates of salmon "survival", but Dr. Beamish explains that "[r]eliable estimates of survival are extremely hard to find". Dr. Beamish also notes that the paper only looks at two variables and assumes a relationship between them, which "greatly oversimplifies 'the innumerable factors'" that affect the dynamics of sockeye populations, particularly in light of the fact that the control populations were also in decline. The discussion between Dr. Noakes and Dr. Connors on data analysis by itself establishes that such a correlation is oversimplified and undoubtedly wrong.

Exhibit 1984, Beamish, *Assessing the Impact*, 2011 *supra*, p. 4

207. Dr. Beamish questions the results of Krkosek *et al.* 2007, and Krkosek & Hillborn, 2011, a recent paper which reached a contrary conclusion to that of Exhibit 1555, Marty *et al.*, *Relationship of Farm Salmon*, 2010. He explains that both of those papers, like Ford & Myers 2008, disregarded some stocks from their analysis and did not use sea lice data from salmon farms to reach their conclusions. Dr. Noakes in Exhibit 1536, *Noakes Report 5C*, 2011, similarly criticized the Krkosek *et al.* 2007 paper extensively for assuming farms were the predominant source of lice without using salmon farm data, for excluding pink salmon production data from a key river in the area, and selecting the highest pink salmon return on record as their reference point. Both Dr. Noakes and Dr. Beamish note that the analysis by Dr. Marty, Dr. Saksida, and Dr. Quinn, Exhibit 1555, is more credible:

> Krkosek *et al.* (2007a) were correctly criticized for these serious errors and omissions and an extensive exchange of views took place through a series of papers (Brooks and Jones 2008; Krkosek *et al.* 2008; Krkosek and Hilborn 2011; Riddell *et al.* 2008). The original predictions of a total collapse of pink salmon populations was subsequently tempered (Krkosek *et al.* 2009; Morton *et al.* 2011) and eventually (not surprisingly) Krkosek *et al.* (2007a) were proven to be wrong. There have been strong returns of pink salmon to the Broughton in recent years and a credible assessment using sea lice data from fish farms and other information showed no significant relationship between sea lice on fish farms and pink salmon survival (Marty *et al.* 2011).

Exhibit 1984, Beamish, *Assessing the Impact*, 2011 *supra*, p. ;
Exhibit 1536, *Noakes Report 5C*, 2011, supra, p. 18

208. The authors of Krkosek & Hillborn, 2011, recently published a paper, Exhibit 1556, *Krkosek et al, Effects of Parasites from Salmon Farms on Productivity of*

Wild Salmon, 2010, purporting to rebut the findings of Exhibit 1555, Marty et al, *Relationship of Farm Salmon, supra*. As Dr. Noakes explained in his answer to the Commissioner, unlike Exhibit 1555, Marty et al., none of the authors of Exhibit 1556 are fish health professionals. Drs. Saksida and Jones also criticized Exhibit 1556 for several assumptions and inconsistencies, in particular noting that while "statistically it looks great, but it really makes no biological sense" to assume there were no lice prior to 2000, or failing to refer to experimental data supporting resistance of pink and coho salmon to *Lep. salmonis*.

Noakes, Transcript, August 29, 2011, p. 82 ll. 14 – p. 83 ll. 6;
Saksida Transcript September 6, 2011, p. 69 ll. 11 – p. 70 ll. 17,
p. 70 ll. 38 – p. 71 ll. 22;
Jones and Saksida, Transcript September 6, 2011, p. 72 ll. 21 – p. 73 ll. 36

C. Fish Health Management Plans & Disease Events

209. Aquaculture companies employ a suite of preventative measures to keep farmed fish healthy which reduces risks to wild salmon, including improved siting, brood stock programs, stocking densities, improved husbandry, and vaccinations. FHMPs are the keystone to these practices, and have been required by aquaculture conditions of licence since 2003. They prescribe actions to reduce stressors and enhance the overall health of farmed fish by improving nutrition, welfare standards, and by avoiding predators. The BCSFA argues that the effectiveness of these practices is evident in Dr. Korman's observation of a "statistically significant" decline in high risk diseases in salmon farms since 2003.

1. FHMPs – The Purpose

210. Wild salmon migration routes are expressly considered and protected by the various tools used by the Province and DFO to ensure environmental standards are followed at the time of siting a farm and throughout its operation. Specifically, FHMPs are the primary ways in which government and industry ensures wild salmon migration routes are protected from the risk of pathogen transmission between farmed and wild salmon populations.

211. When it was suggested to the Regulatory Panel on Aquaculture Siting and Licensing that DFO disregards risks from pathogen transfer from salmon farms to wild salmon populations when siting farms on the migration route, Mr. Swerdfager noted that DFO did give consideration to disease issues, and that fish health management plans, although they could not eliminate risk to wild salmon, "substantially reduces or minimizes risk." When asked whether the risk of pathogen transmission was considered when siting farms in Discovery Passage, Mr. Thomson explained that one of the valued ecosystems considered in *CEAA* screenings is the impact of fish health, and the consideration that proper fish health management on salmon farms reduces the likelihood of the transfer of pathogens to wild salmon populations.

Swerdfager, Transcript August 30, 2011, p. 71 ll. 19 – p. 72 ll. 20;
Thomson, *Ibid*., p. 73 ll. 3-7

212. The aquaculture industry begun to actively vaccinate fish and improve husbandry at the same time that it began to increase volumes of fish per farm. This led to better health and survival of farmed fish. Improved feed and feed conversion rates were also researched and developed to reduce waste components being released from the farms. Based on personal communications with Drs. McKenzie and Saksida, Dr. Noakes explained in his report:

> The percentage of 'High Risk' FHE has remained relatively stable since 2005 (approximately 22 FHE or ~17% on average

> since 2005) with no outbreaks of IHN (Infectious Hematopoietic Necrosis virus) since 2003 and 8 cases of vibrio in total since 2002 (Table 4).The downward trend in the number of 'high risk' FHE reported (Korman 2011) is **likely due in part to the routine vaccination of farmed fish for furunculosis, vibrio, and IHN** as well as **changes and improvements in fish husbandry practices** (P. McKenzie, S. Saksida, pers. comm.).

Exhibit 1543, *Korman Report 5A, p. 15*;
Noakes, Transcript August 26, 2011, p. 23, ll. 11 – 31;
Exhibit 1536, *Noakes Report 5C, 2011, supra* p. 24 [emphasis added]

213. Mr. Thomson testified that conditions of licence require salmon farms to have and follow FHMPs which are designed "to limit pathogens being on the farm site" not to make it illegal for a farm to be infected with a pathogen. As explained by Exhibit 1663, *Required Elements of a Fish Health Management Plan for Public and Commercial Fish Culture Facilities in British Columbia, June 2003,* generally, FHMPs are intended to:

> 1. prevent the introduction of exotic diseases or disease causing agents;
> 2. reduce the occurrence of disease in fish held in the culture facility;
> 3. minimize the spread of disease to stocks within and outside the facility;
> 4. maintain an environment that promotes the health and productivity of cultured fish and reduces the susceptibility of fish to disease;
> 5. protect public health and minimize disease risks to cultured and wild fish through judicious use of drugs and chemicals; and
> 6. provide culturists and regulators with appropriate information from which rational, evidence-based fish health management decisions can be made.

Thomson, September 1, 2011 p. 52 ll. 29 – 37;
Exhibit 1663, *Required Elements of a Fish Health Management Plan for Public and Commercial Fish Culture Facilities in British Columbia*, June 2003
("**Exhibit 1663, *Required Elements of a FHMP***")

214. The primary tool for minimizing the risk of pathogen transfer to wild fish is the Fish Health Management Plan. For example, a screening report done under Transport Canada as the lead agency, Exhibit 1629, *Transport Canada-Canadian Environmental Assessment Act, (Dunsterville)* was put to Mr. Thomson to identify whether the report considered the risk of transmission of pathogens from farmed salmon to wild salmon. That report provides numerous mitigation measures which the proponent Marine Harvest must comply with, including the "Fish Health Management Plan which forms part of the provincial aquaculture licence", and provides in the VEC tables:

> …**a Fish Health Management Plan is required to address issues of fish health for farmed fish and takes into account interactions with wild fish**. This Fish Health Management Plan also requires a mandatory sea lice monitoring program to further minimize risks to wild fish populations. **The Fish Health Management Plan will be reviewed on an annual basis and will be updated as necessary in conjunction with an adaptive management approach.** BCMAFF will conduct audits of sites on a random basis and take compliance enforcement actions where necessary.
>
> …
>
> **Pathogens that originate in salmon farms at renewal sites in Hoskyn and Okisollo Channels are not likely to have significant cumulative adverse effects on migratory salmonids**. Uncertainty exists with respect to the migratory patterns of salmonids along the channels/inlets in the area, and on effects associated with groups of salmonids migrating past multiple farm sites a short distance apart (potential IHN reservoir locations). **Measures outlined in the companies Fish Health Management Plans reduce likelihood of transmission and effects on wild fish populations**.
>
> Exhibit 1629, *Transport Canada-Canadian Environmental Assessment Act, (Dunsterville)*, p. 4, 8, 13 [emphasis added]

215. As explained by Dr. McKenzie, who was himself involved in the development of FHMPs, a FHMPs is "a process, it's a way of managing to mitigate disease". It cannot prohibit disease on a farm, but instead requires aquaculture companies to perform due diligence by taking "all the effort possible to mitigate risk." In response to the question of whether special rules existed for farms on migratory paths of wild salmon, Dr. Sheppard replied that the outbreak management protocols in FHMPs, including increased reporting to increased biosecurity or a quarantine, are all in place to minimize the risks to fish within salmon farms as well as to the ecosystem outside:

> 47 DR. SHEPPARD: Not in so many words.
> 1 Q No. So no particular extra reason to take action.
> 2 DR. SHEPPARD: As I said, **there's an outbreak**
> **3 management protocol within the Health Management**
> **4 Plans, and so the -- which would include**
> **5 everything from increasing reporting to increasing**
> **6 the biosecurity measures to ultimately a**
> **7 functional quarantine.**
> 8 Q And none of that will help the wild salmon, will
> 9 it, not one of those things.
> 10 DR. SHEPPARD: I think **those measures, Mr. McDade, are**
> **11 in place to minimize the risks of that situation**
> **12 and minimize the risks not only to the fish within**

13 the cages, but also to the ecosystem outside of
14 those cages.

Sheppard, Transcript, August 31, 2011, p. 93 ll. 47 – p. 94 ll. 14 [emphasis added]

216. There are a number of management and regulatory processes by which a decision can be made to remove salmon from a farm to mitigate any potential release of pathogens. Dr. McKenzie noted that in addition to outbreak management plans in the FHMPs, the aquaculture industry has itself developed "viral outbreak management agreements" that may require the removal of fish. He noted that the government may also require that fish be removed when outbreaks are reported. According to Exhibit 1611, *Pacific Aquaculture Regulations, Approach to Fish Health (Draft),* endemic diseases of serious concern for a potential outbreak must be immediately reported as a Fish Health Emergency, and any non-endemic diseases must immediately be reported to the Canadian Food Inspection Agency ("CFIA").

McKenzie, Sheppard, August 31, 2011, p. 91 ll. 10 – p. 93 ll. 1;
Exhibit 1611, *Pacific Aquaculture Regulations Approach to Fish Health (Draft)* p. 4

217. FHMPs are central to the *CEAA* screening mitigation measures. In its response to the audit by Mr. Porter for the Pacific Salmon Forum, Exhibit 1620, *Comprehensive MAL Response to BC Audit, Apr 5 2006,* the Province provided a lengthy overview of the regulation and management of salmon aquaculture in B.C. In that response, it included a number of DFO documents and excerpts from DFO's guidelines, one of which is a Cumulative Effects Assessment Work Sheet, used to assess the risks to various VECs. The "IHN" worksheet for "wild fish" as a VEC illustrates that DFO considers the potential risks to wild fish, recommends at 2(a) mitigation measures of avoidance of salmonid bearing streams according to the siting criteria and FHMPs as site specific mitigation measures, and area health management in the event of an outbreak. Furthermore, in considering at 2(c) the cumulative effect, DFO expressly considers both the worst case and best case scenarios of disease management at aquaculture sites to rate the risk to migrating fish populations:

Significance of Potential Adverse Effects on VEC

Criteria	Failure of disease management at multiple sites (Probability of Occurrence: Moderate)		Disease Management as Planned	
		Rating		*Rating*
Magnitude:	Potential to cause measurable reduction in population of susceptible species. Pacific salmonids appear to have relatively low susceptibility. IHN occurs naturally in wild populations.	*Moderate*	Measurable reduction in population of susceptible species (e.g., Pacific salmonids appear to have relatively low susceptibility. IHN occurs naturally in wild populations) is not expected.	*Low*
Geographic Extent:	Information on migratory patterns of salmonids in the Principe Channel – Ogden Channel area is weak. Assume that wild fish that receive IHN pathogens from farmed fish are from populations located along the inlet and these migrate close to shore and pass close to multiple pen systems.	*Regional*	Information on migratory patterns of salmonids in Principe Channel – Ogden Channel is weak. Assume that wild fish that receive IHN pathogens from farmed fish are from populations located along the inlet and these migrate close to shore and pass close to multiple pen systems..	*No detectable extent*
Duration/Frequency:	Worst case conditions may occur on at least one occasion for the life of the project (farmed Atlantic salmon will be susceptible to infection from wild fish). Biological effect on wild fish if a farm-outbreak occurs is expected to be relatively low (magnitude) based on natural occurrence of IHN; if outbreak occurs, detection of reduced population	*Duration: Long-term.* *Frequency: Rare*	IHN outbreak on farms would have to occur at same time that vulnerable wild fish are in proximity of cages. Magnitude of effect is expected to be low, without a measurable reduction in size of affected population.	*Duration: Short-term.* *Frequency: Rare*

	size could persist for one or more generations.			
Reversibility:	It is not likely that all members of a wild population would be affected and that mimbers of fish succumbing to IHN infections would cause extinction of a population. Recovery could take several generations (Duration)	*Full recovery*	Effects on population sizes are not expected to be measurable (magnitude) and if small-scale effects occur full recovery of a population is expected, likely in one generation (Duration)	*Full recovery*
Fragility:	Some populations of salmonids in Principe Channel – ogden Channel area might have been reduced by other factors	*Moderate*	Some populations of salmonids in the Principe Channel – ogden Channel area might have been reduced by other factors.	*Moderate*

> IHN pathogens that originate in salmon farms proposed for Petrel Point are not likely to have significant cumulative adverse effects on migratory salmonids in the Inlet. **Uncertainty exists with respect to the migratory patterns of salmonids along the channels. Precautionary assessments have been made for farm sites that have been proposed.**

Exhibit 1620, *Comprehensive MAL Response to BC Audit, Apr 5 2006,* at Appendix 2, *Appendix: CEAA Worksheets*, PDF 59-62 [emphasis added]

218. The BCSFA notes that pursuant to the FHMPs, salmon aquaculture companies use a broad suite of measures to prevent disease by improving the health of farmed fish. Dr. McKenzie provided an overview of these steps in his testimony on August 31, 2011. He explained the broodstock programs which use genetics and evolution to improve the growth and health of the fish, as well as the disinfection and biosecurity standards used to ensure eggs are not exposed to pathogens. Vaccines and incoming water disinfection are used in hatcheries to provide low pathogen exposure during the rearing stage, and the fish are monitored daily. Vaccines are then injected into the fish prior to them being introduced into salt water, and once the fish are in the marine net pens they are monitored daily for trends and any changes are brought to the attention of the veterinarian for investigation. Proper nutrition, welfare standards, and predator avoidance are also captured by the FHMPs to reduce stressors to farmed fish.

McKenzie, Transcript, August 31, 2011, p. 35 ll. 32 – p. 38 ll. 4;
Exhibit 1611, *Pacific Aquaculture Regulations Approach to Fish Health (Draft)* p. 2

219. As noted above, FHMPs are an example of the use of reference points and "pre-agreed risk-based actions to be taken at those reference points" required by the precautionary approach. FHMPs not only provide for reporting of significant disease events to the authorities, but also for reporting to the BCSFA to alert other unaffected sites in the area, as well as "to their industry associations, e.g., the BC Salmon Farmers Association (BCSFA) so that clinically unaffected sites in the geographic vicinity can be alerted to the concern." This requirement in the FHMP, enforced as a condition of licence, is supplemented by close relationships between aquaculture companies to communicate and engage in area based management, as explained by Dr. McKenzie. Management of salmon farms includes consideration of interactions with the environment including algae blooms and migratory pathways:

> 22 …Now, into the
> 23 bigger picture of how we manage disease is we

24 always **have to manage disease in a very holistic**
25 perspective. We have to be monitoring the -- we
26 monitor the environment very closely as it has
27 great influence on our fish health.
28 We monitor fish -- a lot of aspects of our
29 fish, but **in a big picture we manage on an area**
30 basis, so we are conscious of diseases that are
31 found in the wild stocks, very important to us.
32 We don't have a lot of knowledge about what
33 exactly is in the wild stocks, many times, but
34 it's very important that we understand what is
35 present, what could be exposed to our fish.
36 We also manage our farms on an area basis, so
37 that we are looking not just within a pen. We're
38 not blind, we're not operating in a fish health
39 perspective in a vacuum. So we don't see our farm
40 as that. **We look at interactions in the**
41 environment. We often consider migratory pathways
42 and how we manage fish. We consider different
43 aspects of whether it be algae blooms, or changes
44 in the environment that may impact how we do our
45 -- use our production strategies.
…
4 In some of the specific aspects of our farm
5 management, we have **a very close relationship with**
6 other companies in the area so that we can have a
7 very open communication about issues and **how we**
8 manage our farms together so that we are -- we are
9 monitoring areas and understanding if there's any
10 changes in those areas.

Exhibit 1664*, Template for Development of Facility - Specific Fish Health Management Plans British Columbia Revised May 2006*, ("**Exhibit 1664, *FHMP Template 2006***") *p.* 5-6;
Exhibit 1594, *Finfish Aquaculture Licence 2010 Under the Pacific Aquaculture Regulations* at section 5, p. 8;
McKenzie, Transcript August 31, 2011 p. 70 ll. 22 – p. 71 ll. 10 [emphasis added]

2. FHMPs – Results

220. There is evidence that FHMPs are working to reduce risks to wild salmon. As noted by PPR #20, FHMPs became a condition of licence under the Province in 2003, and these require on-site monitoring and reporting of site-specific information to the BCSFA industry database on a monthly basis. The aquaculture industry's fish health management has in fact resulted in a "statistically significant" decline in high risk diseases on farms since 2003, as explained by Dr. Korman in his analysis of the BCSFA's database. Furthermore, modern husbandry practices and preventative measures such as water quality monitoring

and strict biosecurity have resulted in improved fish health. There has been a corresponding decrease in antibiotics use to treat farmed salmon.

PPR #20, at para. 55, 67;
Exhibit 1543, *Korman Report 5A*, *p.* 5;
Exhibit 1536, *Noakes Report 5C*, 2011 p. 7;
Exhibit 1366, Watson, *Questions and Answers*, 2011, *supra*, p. 23-25

221. This observation was furthermore reinforced by Dr. Sheppard who credited the decline in prevalence of diseases on salmon farms to the use of FHMPs. Counsel for the Aquaculture Coalition suggested that diseases occur on salmon farms "despite the best efforts by fish farms to avoid that happening". Dr. Sheppard said that although risk can never be zero because Atlantic salmon are exposed to the ecosystem, there has been a precipitous decline in the prevalence of diseases on salmon farms.

Sheppard, Transcript, August 31 2011, p. 88 ll. 44 – p. 89 ll. 23

222. Dr. Korman noted that despite the moratorium on new sites, salmon farm production levels went up, suggesting more fish per site. Nevertheless, Dr. Korman's report, Exhibit 1543, *Korman, Project 5A, supra* concludes that negative effects of salmon farms on wild salmon were "not apparent" based on his analysis, and that the number of mortalities potentially caused by disease has remained "relatively constant" whereas high risk disease events "showed a declining trend". This alone suggests that disease on salmon farms is not proportional to salmon farm production, which is one of the reasons why Dr. Noakes cautions against reliance on Dr. Connors' analysis. Dr. Noakes explained:

> While combining two time series in a model was done to capture any potential synergistic relationships, Connors (2011) does not present a compelling case for the comparisons he considered. For example, **the implicit assumption in Connors' (2011) analyses is that the magnitude or level of disease in farmed fish (specifically the 'high risk` diseases and/or the number of sea lice on farm fish) is proportional to farmed salmon production**. This assumption is **clearly not supported by the data** as Korman (2011) identified **a declining trend in the number of 'high risk' diseases as well as the number of sea lice** on farmed salmon between 2003 and 2010 – **a period when farmed salmon production was actually increasing** (Figure 1).

Korman, Transcript, August 26, 2011, p. 22, ll. 32 – 46;
Exhibit 1543, *Korman Report 5A, p. 15*;
Exhibit 1536, *Noakes Report 5C*, supra p. 7;
Exhibit 1538, *Noakes, Response to B Connors*, Aug 10 2011

223. As explained by C. Backman, the draft report prepared by a team of international experts for the Salmon Aquaculture Dialogue, Exhibit 1561, *Hammell et al. S.A.D. Working Group Draft*, *supra*, "speaks to the adequacy of the actions and precautionary approaches taken in the management and operation of salmon farms related to their potential impacts on the wild fisheries in the areas in which they're located." The report cites B.C. a number of times as a good example of aquaculture regulation and management. For example, it notes that because some pathogens can move "considerable distances" on tidal currents, siting farms away from critical wild fish habitat is an "imperfect system." It suggests:

> Success can be enhanced when neighbouring farms agree to standard protocols for fish and equipment movement as well as to a certain standard of hygienic practice. **In some jurisdictions, such as British Columbia, such a standardized approach is a required part of farm licensing.**

Backman, Transcript September 7, 2011, p. 29, ll. 40-44
Parker, Transcript September 8, 2011, p. 105 ll. 27-35;
Exhibit 1561, *Hammell et al. S.A.D. Working Group Draft*, *supra,* p. 42

224. Exhibit 1561, *Hammell et al. S.A.D. Working Group Draft*, *supra* holds B.C. up as an international model for disease prevention and avoidance measures. For example, it notes "fish licensing requirements in British Columbia require a group's disease history to be considered when transporting fish" and cites the Provincial FHASP and BCSFA fish health database as a good example of information sharing to avoid diseases:

> … **These two efforts significantly improve government and industry understanding of disease trends and emerging risks.** … These mandatory and voluntary report systems are a significant improvement over the state of communications that existed in the early 1990's where companies were reluctant to share information between each other so as to gain competitive advantages. Lessons from diseases such as infectious hematopoietic necrosis taught farmers in that province that failure to share information on diseases with their neighbors often doomed them to uncontrollable disease outbreaks.

Exhibit 1561, *Hammell et al. S.A.D. Working Group Draft*, *supra,* p. 59-60

225. That report also notes the extreme difficulty in making an aquaculture facility completely pathogen free, but explains that a substantial degree of risk reduction is achievable:

> …What is achievable is **a substantial degree of risk reduction by the judicious use of biosecurity measures and effective risk reduction strategies.** Although it may not be possible to avoid all disease interactions on an aquaculture site, **it is possible to reduce the risk from some diseases that can have**

> **a devastating effect on wild and farmed population.** In some cases, by the judicious use of risk management strategies **it is quite possible to have a biosecure site where it is possible to achieve specific pathogens free status.**
>
> Exhibit 1561, *Hammell et al. S.A.D. Working Group Draft*, *supra,* p. 46-47

226. Notwithstanding the knowledge gaps and uncertainties identified in their report, Exhibit 1561, *Hammell et al. S.A.D. Working Group Draft*, *supra*, the fish health professionals who authored the report disagree with advocacy for "zero transmission" and in fact advocate for "comprehensive infection control" as a "reasonable" and "possible" means that is "likely to result in risk reduction", noting the importance of an ecosystem approach to health management. They write:

> It is reasonable to conclude that **advocacy for a zero transmission probability is also advocacy for an end to open netpen farming or to any other forms of farming that take in and extract water from fish bearing waters**. It is also reasonable to conclude that **a non-zero probability of transmission cannot be taken to imply a risk to wild fish exists**. We believe that advocating for **required comprehensive infection control on farms is reasonable, is possible and is likely to result in risk reduction**. Furthermore, we believe that selecting, managing and enforcing infection control practices will **require research to identify meaningful and reliable indices of effectiveness as well as validating the effectiveness of health management from an ecosystem and not just a farm perspective**. Most challenging will be developing political and social consensus on the targets for disease risk reduction given the prevailing uncertainties.
>
> Exhibit 1561, *Hammell et al. S.A.D. Working Group Draft*, *supra,* p. 14 [emphasis added]

227. Furthermore, Dr. Noakes took a more refined approach to his analysis of the data than either Dr. Korman or Dr. Connors, and determined that none of the high risk diseases occurred on the migration route. Dr. Noakes concluded that it was unlikely that salmon farms were a primary cause of the 2009 sockeye return. It is noteworthy that neither Dr. Korman nor Dr. Connors took this step in their analyses, and that Dr. Dill relied entirely on Dr. Connors' analysis to reach the conclusion that disease from salmon farms was a "possible" factor. Following this analysis, Dr. Noakes concluded:

> …
> 18 So that was sort of a long explanation. But
> 19 by and large I think I'm quite confident, having
> 20 looked at that level of detail in terms of the
> 21 fish health events that are reported, and also the

22 fish health audits, which I also looked at, that
23 it's -- that I was not as surprised as Josh to see
24 the limited number of fish health events, but
25 certainly **it gave me good confidence that the**
26 disease is not having a major impact, or is not
27 likely to have a major impact on the survival of
28 Fraser sockeye.

Noakes, Transcript, August 25, 2011, p. 103 ll. 7 – p. 105 ll. 28 [emphasis added]

228. Not only did Dr. Connors fail to consider where the fish health events occurred, he also based his analysis on assumptions that farm production was a good proxy for disease. Although David Marmorek explained that Dr. Connors used the best data he had available, Dr. Noakes explained at length in Exhibit 1538 *Response to B. Connors* why it is not acceptable to use the best data available if it does not pass diagnostic tests. Specifically, Dr. Noakes pointed out that the data analysed by Dr. Korman indicated farm production could not be used as a proxy for pathogen exposure because fish health events were in fact declining on farms while production increased.

Exhibit 1538, *Noakes, Response to B Connors, Aug 10 2011,* p. 1-4

229. Although Exhibit 73, *PSC - Synthesis of Evidence*, 2010, *supra* concluded that it was either "very likely or likely" that the hypothesis "marine and freshwater pathogens, including parasites, bacteria and/or viruses, are important contributors to the Fraser sockeye situation", David Marmorek noted that Dr. Winton "basically went to a workshop, listened to some presentations, and then had a couple of days to work on this". Dr. Kent on the other hand "had a lot more time to go through this a lot more systematically and write a more detailed report had significantly more time to prepare his report", concluding that there was insufficient data to reach a conclusion. The BCSFA suggests that Dr. Kent's report, Exhibit 1449, *Cohen Commission Technical Report 1 Infectious Diseases and Potential Impacts on Survival of Fraser River Sockeye Salmon*, ("**Exhibit 1449, *Kent Report 1,* 2011**") should be given more weight for this reason.

Exhibit 73, *PSC - Synthesis of Evidence*, 2010, *supra*, p. 64;
Marmorek, Transcript, September 19, 2011, p. 50 ll. 33 – p. 51 ll. 20

3. Specific Pathogens Identified in BC

230. Exhibit 1449, *Kent Report 1*, 2011, *supra* identified the following pathogens as "high risk": "IHN virus, three bacteria (*Vibrio anguillarum*, *Aeromonas salmonicida*, *Renibacterium salmoninarum*), and two parasites (*Ich* - *Ichthyophtheirus multifillis* and the myxozoan *Parvicapsula minibicornis*)." Those pathogens relating to salmon farms are addressed below, as are plasmacytoid leukemia and the Mortality Related Signature discovered by Dr. Miller.

Exhibit 1449, *Kent Report 1*, 2011, *supra* , p. i

231. The BCSFA says that the evidence shows it is unlikely that salmon farms have changed the abundance of the endemic "high risk" pathogens identified by Dr. Kent. Dr. Korman found four of these high-risk diseases identified by Exhibit 1449, *Kent Report, 2011* were identified in the BCSFA database, and concluded that there was a "statistically significant declining trend" in their occurrence on farms between 2003 and 2010.

Exhibit 1543, Korman, Cohen Commission Technical Report 5A, Summary of Info for Evaluating Impacts of Salmon Farms on Survival of FRSS, May 2011, at 7 ("**Exhibit 1543, *Korman Report 5A, 2011***")

232. In fact, as explained by Dr. McKenzie, salmon farms can only reasonably be considered possible sources for IHN and BKD. Dr. McKenzie adopted as his evidence a report by Dr. Lewis prepared for the BCSFA Exhibit 1986, *R. Lewis, Re. Kent's Infectious Diseases and Potential Impacts on Survival of Fraser River Sockeye salmon – Aquaculture Issues*, 2011, ("**Exhibit 1986, *R. Lewis, Re. Kent's Infectious Diseases and Potential Impacts***"), which reviewed Exhibit 1449, Kent Report 1, 2011 prepared by Dr. Kent for the Commission, and the occurrence of those diseases in the BCSFA fish health database. Dr. Lewis summarized the risks and mitigative actions taken by the farms to control those diseases. Dr. Lewis notes the measures taken by salmon farms to address these pathogens such as biosecurity, broodstock screening, and vaccination, and concludes:

> **Of the high-risk agents identified by Dr. Kent, salmon farms could only be reasonably considered as possible sources for two of them (IHN and BKD).** As noted above, IHN would only be a factor on salmon farms if the agent were present in the wild. Sockeye adults are relatively resistant to the virus and its presence in Atlantic salmon would provide an early warning of its presence in the marine environment. **Enhanced biosecurity on salmon farms and a high level of vaccinated fish mitigate against another significant outbreak of IHN.**
>
> BKD is most likely to occur in farmed Chinook and Coho salmon and its presence in these animals has been diminishing. It is **unlikely that the low level of BKD in these farmed salmon poses any significant additional risk to that already present or encountered by sockeye in their marine environment**.

McKenzie, Transcript August 31, 2011, p. 71 ll. 24-33 (on qualifications of Dr. Lewis); *Ibid*. p. 72 ll. 10 – p. 73 ll. 12;
Exhibit 1986, *R. Lewis, Re. Kent's Infectious Diseases and Potential Impacts,* p. 3

233. It should be noted that Dr. Dill's report, Exhibit 1540, *Dill Report 5D,* 2011, suggests three of the four high risk diseases identified by Dr. Korman are "not infrequently diagnosed on Discovery Island farms", but that "reports of their occurrence, either in the BCSFA Fish Health Events or the BCMAL Audits, are not associated with sockeye survival." One peer reviewer, Professor Farrell, Canadian Research Chair (Tier I) in Fish Physiology, Culture and Conservation, criticises the vagueness of the comment "when quantitative information is available" that shows "a decrease of ~6 high risk-disease events per year over the period of analysis running counter to an overall contribution to the decrease in FR SS productivity during the same period."

Exhibit 1540, *Dill Report 5D, 2011*, *supra*, p. 24, 66

234. Unlike Dr. Dill's report, Dr. Noakes' Report, Exhibit 1536, does provide a quantitative summary of the occurrence of the "high risk" diseases on salmon farms in his "Key Findings" section, noting the number of events, the year, and importantly the location relative to the "main migration path" for Fraser River sockeye salmon. As Dr. Noakes explained in response to a peer reviewer comment, he performed "a more thorough analysis of each disease at the farm level rather than performing correlation tests" meaning his analysis of the disease information was not limited by the low power of the sea lice data analysis identified by Dr. Korman. Significantly, Dr. Noakes' analysis found:

> 5. The evidence suggests that disease originating from salmon farms has not contributed to the decline of Fraser River sockeye salmon. **Since 2003, no outbreaks of IHN have been reported on any salmon farm**. Only **1 or 2 cases (per year) of vibrio were reported** on salmon farms **for 5 of the 9 years** between 2002 and 2010. **Since 2003, the majority (29 of 38) reported cases of furunculosis were from farms on the West Coast of Vancouver Island** with an average of **only 1.3 cases/year on farms located in the main migration path for Fraser River sockeye salmon**. Since 2003, there has been **a significant decline in the number of farms reporting BKD in BC Fish Health Area 3 (the main migration route for Fraser River sockeye salmon)** … Of the 20 cases of BKD reported between 2007 and 2009, … only 1 farm in each of the 3 years being located within the main migration route for Fraser River sockeye salmon. **Overall, the incidence of diseases in farmed salmon that would be classified as high risk to sockeye salmon is very low and do not pose a significant risk**.

Exhibit 1536, *Noakes Report 5C, 2011 supra*, p. 105, ii

Infectious Hematopoietic Necrosis ("IHN")

235. In Exhibit 1449, *Cohen Commission Technical Report 1 Infectious Diseases and Potential Impacts on Survival of Fraser River Sockeye Salmon*, ("**Exhibit 1449,**

Kent Report, 2011") Dr. Kent classified IHN as a potential "high risk" virus, noting it is will recognized as a lethal pathogen in freshwater and that it also occurs in marine waters, and has caused several outbreaks in Atlantic salmon farms. However, he noted in testimony that post-smolt sockeye are less susceptible to IHN in the marine environment and that he assumes there would be lower concentrations of IHN than in freshwater.

Exhibit 1449, *Kent Report, 2011 supra* p. i;
Kent, Transcript, August 22, 2011, p. 107 ll. 10-24

236. The risk of IHN outbreaks is carefully managed by salmon farmers. FHMPs contain specific management actions to address IHN outbreaks. Exhibit 1986, *R. Lewis, Re. Kent's Infectious Diseases and Potential Impacts on Survival of Fraser River Sockeye salmon – Aquaculture Issues*, 2011, ("**Exhibit 1986, *R. Lewis, Re. Kent's Infectious Diseases and Potential Impacts***"), as adopted by Dr. McKenzie, summarizes the IHN issue as it relates to aquaculture as follows:

> 1. Infectious Hematopoietic Necrosis (IHN) This disease has not been recognized in farmed salmon since 2003 and Kent re-iterates that the source of this virus for farmed salmon is in marine reservoirs (page 6).
>
> The main emphases as they relate to aquaculture are that:
>
> - The disease has not occurred for several years i.e. an outbreak of IHN is an unusual event and the virus does not reside on salmon farms;
> - IHN is now a federally-reportable disease under the *Health of Animals Act* and any suspicion of the disease must be immediately reported to the Canadian Food Inspection Agency. This increases the likelihood of early detection of any infection
> - Farms have enhanced their biosecurity and emergency management plans since 2003 and are better prepared to identify and respond early to a suspected event
> - Approximately 75% of salmon farms, including all farms in the Campbell River area (Zone 3.2), vaccinate with a DNA subunit vaccine to protect their fish. The prevention of disease on salmon aquaculture sites serves to also protect sockeye from any concentrated source of the virus.

Exhibit 1664, *Template for FHMP, 2006*, *supra*, section 2.9.3, p. 25 – 29;
Exhibit 1986, *R. Lewis, Re. Kent's Infectious Diseases and Potential Impacts*, 2011 p. 1;
McKenzie, Transcript August 31, 2011, p. 71 ll. 11 – p. 73 ll. 22

237. The preventative measures taken by salmon farms have been effective in protecting farmed salmon from high risk diseases. For example, IHN has not been diagnosed on salmon farms since 2003, which is the same year that FHMPs

were first completed and required by the provincial conditions of licence. The BCSFA submits that the precautionary approach adopted in the FHMPs has in fact reduced the risk of IHN outbreaks at salmon farms, and consequently has reduced the risk to wild sockeye.

McKenzie, Transcript August 31, 2011, p. 72 ll. 46-47;
Exhibit 1457, *Garver, IHNV in FRSS and VHSV in Atlantic Salmon, undated*, p. 1

238. Dr. Garver's research in fact shows that salmon aquaculture has not increased the prevalence of IHN in wild sockeye salmon stocks. There is no discernible pattern of IHN over time. Furthermore, IHN is "enzootic (constantly present) in sockeye salmon in the Pacific Northwest of North America." Significantly, Dr. Garver notes:

> Additionally, the data set illustrates that the occurrence of IHN disease outbreaks in fry have not increased over the 24 year monitoring period for either Weaver Creek or Nadina River stocks (Figure 1). Our inability to detect IHNV in sockeye salmon fry from Weaver Creek and Nadina River over the past 10 (1998-2007) and 16 (1992-2007) years; respectively, suggests that IHNV is not a major contributor to the long-term decline of these two stocks.

Johnson, Transcript August 22, 2011, p. 29 ll. 26 – 33;
Exhibit 1456 *Garver, Hypothesis: Diseases in freshwater and marine systems are an important contributor to the Fraser sockeye situation*, June 2010, p. 3

239. In Exhibit 1518, *Garver, Hypothesis - Diseases in Freshwater and Marine Systems*, Dr. Garver presents his research on IHN dispersal from salmon farms and research showing IHN virus is quickly killed by UV light. He also notes that contrary to Ms. Morton's presentation to the Pacific Salmon Commission Workshop in 2010, the "[o]ccurrence of IHNV in Atlantic salmon aquaculture has not altered the prevalence of IHNV in wild sockeye salmon stocks".

Exhibit 1518, *Garver, Hypothesis - Diseases in Freshwater and Marine Systems*, p. 9

240. Although Dr. Kent notes there may be "variability in the virulence of this virus between isolates" meaning some strains may be more pathogenic to sockeye salmon in the ocean, Dr. Johnson and Dr. MacWilliams noted there is only a single genotype of endemic IHN in sockeye in B.C., and that the strain with increased virulence has been found in cultured steelhead populations in Washington State and not in B.C.. Dr. Johnson also noted that one of the reasons more laboratory studies have not been done on sockeye is because "they often have IHN", suggesting the disease is common in wild stocks.

Exhibit 1449, *Kent Report, 2011 p. i;*
Johnson & MacWilliams, Transcript August 22, 2011, p. 109 ll. 11 - 22
Johnson, Transcript August 22, 2011, p. 32 ll. 36 – p. 33 ll. 6

*Renibacterium salmoninarum (Bacterial Kidney Disease) ("**BKD**")*

241. Salmon farms pose little if any risk of transmitting BKD to wild salmon; the BCSFA argues it is more likely that wild salmon are already infected with BKD prior to reaching salmon farms, given its high incidence of occurrence in all Pacific salmon. As explained in Exhibit 1986, *R. Lewis, Re. Kent's Infectious Diseases and Potential Impacts*, 2011, farmed salmon broodstock are intensively screened for BKD and eggs from positive fish are culled. When shown Dr. Korman's analysis of fish health events on salmon farms, Dr. Kent noted a declining trend in BKD. In reply to being asked whether this meant BKD was unlikely to explain the difference between the poor 2009 run and the extremely large 2010 run, Dr. Kent replied BKD appeared to be a low priority as it is not easily transmitted and it is an incidental disease in Atlantic salmon. Dr Kent explained:

> 7 DR. KENT: Yes, that's right, yeah. **So as far as**
> **8 relating to bacterial kidney disease and**
> **9 Renibacterium on fish farms, I would objectively**
> **10 put that at a pretty low priority.** One is it's
> 11 **not that easily transmitted**; and secondly, the
> 12 **fish farms are mainly Atlantic salmon**; and third,
> 13 as we see, even if there's not a statistically
> 14 significant reduction in BKD, **it's really an**
> **15 incidental disease in the Atlantic salmon**.

Exhibit 1986, *R. Lewis, Re. Kent's Infectious Diseases and Potential Impacts*, 2011 p. 2;
Kent, Transcript, August 23, 2011 p. 2 ll. 31 – p. 3 ll. 15 [emphasis added];
Exhibit 1536, *Noakes Report 5C*, 2011, p. 7

242. As Dr. McKenzie testified when he adopted Dr. Lewis's report prepared for the BCSFA, Exhibit 1986, R. Lewis, *Re. Kent's Infectious Diseases and Potential Impacts*, 2011, BKD occurs mostly in chinook and coho salmon, and its prevalence is diminishing. Dr. McKenzie and Dr. Lewis attribute this to salmon farms' strategies around breeding programs and screening programs for brood stock to minimize any vertical transmission of the disease.

McKenzie, Transcript August 31, 2011, p. 73, ll. 4-12;
Exhibit 1986, *R. Lewis, Re. Kent's Infectious Diseases and Potential Impacts, p. 2*

243. Dr. Noakes reported that between 2003 and 2007 that 74% of Dr. Kent's identified 'high risk' diseases reported by industry were for BKD so in essence any potential

link to 'high risk' diseases is based almost entirely on this one disease agent." He noted that most occurrences were in chinook or coho farms located away from the migration route. With respect to the 2007 and 2008 information, which are the years relevant to the 2009 and 2010 returns, Dr. Noakes observed:

> With only one farm (Bennett Point) along the main migration path of Fraser River sockeye reporting a BKD FHE, it would be unreasonable (in the extreme) to suggest that BKD from salmon farms contributed to the significant decline in sockeye returns in observed 2009. … There is **no evidence of any significant link or relationship between BKD in farmed salmon and Fraser River sockeye salmon returns** when the data are examined in finer detail.

Exhibit 1536, *Noakes Report 5C*, 2011, *supra* p. 24, 31

Vibrio anguillarum ("Vibrio") & Aeromonas salmonicida ("Furunculosis")

244. As Dr. Kent explains, *vibrio anguillarum* is "ubiquitous in the marine environment" and *Furunculosis* is transmissible in seawater. He notes that both can cause severe disease in seawater pen-reared fish. However, Dr. Kent also observes that both *Vibrio* and *Furunculosis* can be controlled by vaccines. As noted above at para. 212, Exhibit 1536, *Noakes Report 5C, 2011* identifies IHN, vibrio, and furunculosis as pathogens against which salmon farmers vaccinate their fish, and that there have been few occurrences of these on salmon farms.

Exhibit 1449, *Kent Report, 2011*, *supra*, p. i, 9;
Exhibit 1536, *Noakes Report 5C, 2011 supra p.* 24 [emphasis added];
see also Noakes, Transcript August 26, 2011, p. 98, ll. 31-35

245. In Exhibit 1986, *R. Lewis, Re. Kent's Infectious Diseases and Potential Impacts,* 2011, Dr. Lewis notes that only 2 cases of *vibrio* were reported in 2008, and none in 2007 or 2009. He concludes: "Considering the ubiquity of the pathogen in the marine environment and the low level experienced on salmon farms, it would appear that sockeye are at little risk of developing vibriosis from exposure to saltwater sea pens." Regarding furunculosis, he writes:

> Note that all farmed salmon are vaccinated against this pathogen and disease caused by Aeromonas salmonicida was not identified in the BCSFA database between 2007 - 2009. Sockeye are at low or no risk from the possibility of Aeromonas salmonicida originating from salmon farms.

Exhibit 1986, *R. Lewis, Re. Kent's Infectious Diseases and Potential Impacts*, supra p. 2

*Salmon Leukemia Virus and Plasmacytoid Leukemia (PL) (aka. Marine Anemia) ("**Plasmacytoid Leukemia** ")*

246. In his 2011 report, Dr. Kent identified plasmacytoid leukemia as a low risk to sockeye. According to his report it is "not known to naturally occur in sockeye salmon". He testified that while they were able to experimentally infect sockeye, chinook and coho are the salmon primarily affected by plasmacytoid leukemia, and that Atlantic salmon are not known to display pathology consistent with plasmacytoid leukemia or salmon leukemia virus."

Exhibit 1449, *Kent Report, 2011* supra, p. 8;
Kent, Transcript, August 23, 2011 p. 5 ll. 17 – 30

247. As discussed above, FHMPs and proper siting of farms have addressed many of the potential factors noted in this paper, and plasmacytoid leukemia is now infrequently diagnosed. A 1996 paper by Drs. Stephen and Kent, and Dr. Ribble, Exhibit 1491, Stephen *et al., Descriptive Epidemiology of Marine Anemia in Seapen-Reared Salmon*, explains that plasmacytoid leukemia is endemic, and that it is more "an indicator of the general pattern of disease on a farm" than a predictor of "an impending epidemic of mortality." The BCSFA notes that the authors speculate that environmental conditions and various stressors created by "intensive aquaculture" may have contributed to the emergence and detection of the disease.

Exhibit 1491, Stephen *et al., Descriptive Epidemiology of Marine Anemia in Seapen-Reared Salmon*, p. 420, 424

248. Fish health experts do not consider plasmacytoid leukemia to be a high risk disease. When counsel for the Aquaculture Coalition suggested to Dr. Sheppard there had been a "major epidemic of plasmacytoid leukemia in the early '90s," Dr. Sheppard disagreed with the characterization as a major outbreak and explained it was a "finding of a clinical syndrome that is quite natural in Pacific salmon in British Columbia" and that it became a "point of interest for some researchers and it was monitored very closely". Dr. Sheppard testified that since the 1990s there have been next to no signs of plasmacytoid leukemia found in chinook or coho salmon. He also explained that because plasmacytoid leukemia was often concomitant with plasmacytoid leukemia, plasmacytoid leukemia was usually not the sole cause of mortality:

> 47 DR. SHEPPARD: I don't recall the cumulative loss
> 1 specifically to marine anaemia. As I said this --
> 2 or, I'm sorry, that the plasmacytoid leukemia,
> 3 because in my recollection back in the day when I
> 4 was examining those very same animals, the
> 5 **presence of plasmacytoid leukemia was often**
> **6 concomitant with bacterial kidney disease, and**
> **7 bacterial infections that which -- which are very**
> **8 overlapping symptoms**. So, no, marine anaemia, as

9 you say, was not -- or **plasmacytoid leukemia was**
10 not the cause, the sole cause of mortality.
11 Q Well, **have you read Dr. Kent's papers**?
12 DR. SHEPPARD: **Yes**.
13 Q Do you **disagree** with them?
14 DR. SHEPPARD: **Yes**.
15 Q Oh, I see. Have you published -- have you seen
16 **any peer-reviewed literature that contradicts**
17 them?
18 DR. SHEPPARD: **Yes, Dr. Stephen's thesis**.

Sheppard, Transcript August 31, 2011, p. 89 ll. 27-41, ll. 47 – p. 90 ll. 18

249. When asked whether the findings of interstitial hyperplasia in spreadsheet number BCP002864, later marked as Exhibit 1678, *Histopathology FHAS 2006-2010, showing data sorted for Province, Dr. Marty*, Dr. Kent agreed that interstitial hyperplasia of the kidney is a lesion associated with marine anemia, but disagreed that the signs could be used to diagnose plasmacytoid leukemia. Dr. Kent explained "Interstitial hyperplasia of the kidney can be caused by a vast number of organisms, including plasmacytoid leukemia, or referred to as marine anaemia" meaning those signs are "not inconsistent with", but are "not pathognomonic for marine anaemia." Dr. Kent explained that a clinical veterinarian would use Dr. Marty's observations in addition to other evidence and molecular tests and cultures to make a diagnosis, in this case, probably BKD rather than marine anemia:

39 …if this was prepared by
40 Dr. Marty, or his group, as a histopathologist he
41 described the lesions and eventually the typical
42 pattern would be then **a veterinarian, a clinical**
43 veterinarian, taking information on knowing the
44 species, the history, other information about the
45 fish, in conjunction with the pathological changes
46 would make the diagnosis. And sometimes the
47 diagnosis is made very strongly based on
1 histopathology, **sometimes in this case, this --**
2 like, for example, interstitial hyperplasia, if
3 they had run a test and found bacterial kidney
4 disease in the same fish, you know, by another
5 test, a molecular test or a culture, you would say
6 -- the veterinarian would probably say the
7 diagnosis would be bacterial kidney disease, not
8 marine anaemia.
9 So it's part of what a veterinarian uses for
10 making their diagnosis, and sometimes it's very
11 strong. Sometimes it's the major part of making
12 the diagnosis.

Kent, Transcript, August 23, 2011 p. 33 ll. 43 – p. 34 ll. 33,
p. 34 ll. 39 – p. 35 ll. 12 [emphasis added];

Exhibit 1678, *Histopathology FHAS 2006-2010, showing data sorted for Province, Dr. Marty*

250. The BCSFA says that Dr. Marty is "not something [he] would diagnose", not because he does not believe in it as suggested to him, but because marine anemia requires a clinical diagnosis and Dr. Marty is a pathologist, not a clinical diagnostician. As numerous fish health professionals explained, some signs are not pathognomonic for specific diseases but require other evidence to make a diagnosis. Dr. Sheppard, who was a veterinarian in the 1990s when Drs. Kent and Stephen were writing on plasmacytoid leukemia, noted that although some signs "overlap with other indigenous infection, such as bacterial kidney disease or… the Piscirickettsia infection", diagnosing plasmacytoid leukemia is in fact "really quite easy" due to the evident gross pathology from clinical examination. Dr. Marty and Dr. Sheppard also added that diagnosing BKD or Piscirickettsia would mean no diagnosis of plasmacytoid leukemia:

> 37 So I could speak to this topic somewhat,
> 38 because I was one of the early veterinarians. The
> 39 last 20 years has gone by quickly, but I was at
> 40 the farms with Dr. Kent and Dr. Stephen at the
> 41 time that these papers were written back in 1990
> 42 and '93, for example, and the clinical signs that
> 43 we would see in affected Chinook salmon are very
> 44 obvious. **So these fish are grossly -- the gross**
> **45 pathology is very evident.** Some of the signs
> 46 **overlap with other indigenous infection, such as**
> **47 bacterial kidney disease, or the Rickettsia, the**
> **1 Piscirickettsia infection.** And so there are some
> 2 field tests between the gross pathology, the
> 3 experience and the histology or the history of the
> 4 farm.
> …
> 11 So in short, the **diagnosis of plasmacytoid**
> **12 leukemia is really quite easy to determine at the**
> **13 farm and the gross clinical examination.**
> 14 Q Okay.
> 15 DR. MARTY: And the other point is that **if you have a**
> **16 diagnosis of bacterial kidney disease, or**
> **17 Piscirickettsia, then you do not give a diagnosis**
> **18 of marine anaemia. Those are not the same thing**.
> 19 DR. SHEPPARD: That's correct.

Marty, Transcript August 31, 2011, p. 62 ll. 16-20;
Sheppard & Marty, Transcript August 31, 2011, p. 62 ll. 37 – p. 63 ll. 19
[emphasis added]

251. Interpreting fish health data requires expertise, and is not merely an exercise in counting lesions. Counsel for the Aquaculture Coalition asked Dr. Korman to interpret correlations observed by Ms. Morton who counted the number of time

particular lesions occurred in Dr. Marty's fish health spreadsheets, and prepared a graph representing "ISA-like lesions" and "marine anemia symptoms". Dr. Korman said that it would be reasonable to add the numbers but not to make inferences about a diagnosis without consulting a vet. When asked again to interpret the graph, Dr. Korman replied "I hate to keep repeating myself but I've got to defer to the vet's diagnosis" and explained why it was necessary to have a veterinarian rather than a statistician interpret the data:

> 21 DR. KORMAN: No, no, **it's not a statistical issue; it's**
> **22 an interpretation** of what the variables going into
> 23 the statistics. That's where **you need the real**
> **24 skill of the vet**. All we can do is say, yeah,
> 25 it's correlated. I mean **we do other things with**
> **26 fish but as far as statistics go, we can only tell**
> **27 you about the correlation between two variables,**
> **28 not what those variables are supposed to**
> **29 represent.** And I don't know what the fact that
> 30 marine anemia symptoms, ISA symptoms, why they
> 31 correlate. I can't help you interpret at that at
> 32 all.

Korman, Transcript August 29, 2011, p. 45 ll. 32 – p. 46 ll. 33, p. 47 ll. 21— 32

252. Counsel for the Aquaculture Coalition then proposed to Dr. Korman that based on the data there was an "outbreak" of marine anemia in Conville Bay in 2007, and that "in 2008 there were no chinooks in the Discovery Islands". This theory was criticized by Dr. Korman, Mr. Marmorek, and is contradicted by the evidence given by several witnesses including Clare Backman who testified that there are two Chinook farms in the Discovery Islands that are currently in operation. Dr. Korman explained why there is not a lot of evidentiary support for the theory:

> 39 DR. KORMAN: Just a comment on that. Yeah, that does
> 40 line up with your class survival or that pattern
> 41 that you described that there's so many steps that
> 42 one would have to then do to determine that that
> 43 was actually a big factor. Does that disease
> 44 cause death in wild fish? Is it transmitted?
> 45 Does it cause death? Does it cause a significant
> 46 fraction? **All those steps we've been talking**
> **47 about over the last four days weren't established**
> 1 but certainly it's a hypothesis that's not
> 2 unreasonable. **There's just not a lot of support**
> **3 for it at this time.**

Backman, Transcript, September 7 2011, p. 84 ll. 6 – 10;
Korman, Transcript August 29, 2011, p. 51 ll. 39 – p. 52 ll. 3
[emphasis added]

253. During the Cumulative Effects panel, Mr. Marmorek was asked by counsel for the Aquaculture Coalition whether the lack of empirical evidence of pathogens in wild fish means it cannot be said that "diseases coming from fish farms are not the cause of the 2009 sockeye decline". Although he noted that salmon farms could potentially have cumulative effects, Mr. Marmorek rejected the theory that disease from salmon farms had played a role in the 2009 return as "pretty unlikely" on the basis that there was no 14 of 15-fold change in the amount of disease on salmon farms between 2009 and 2010, and that disease events are reported:

> Okay, so now you've asked a question with respect to one year's poor returns, namely 2009, and asking a question, if you don't have any empirical evidence, are you able to reject salmon farms as a cause of that decline? So I would argue that **based on the fact that the difference between 2009 returns and 2010 returns was something like a 14 of 15-fold change in recruits per spawner,** that it's **pretty unlikely that there was a 14 or 15-fold change in the amounts of disease occurring between the 2009 returns and the 2010 returns.** In other words, I would say **it's pretty unlikely that the main cause of the variation between those two years was due to salmon farms is much more likely, as we've said in our report, that it was due to marine conditions, specifically temperatures and lack of circulation and the like.**
>
> This is not to say that salmon farms have had no effect. As we've said several times today, things which are not the primary factors responsible could still be contributing factors. …
>
> …
>
> A **So your argument, as I take it, is that in the absence of any disease information**, but based on the fact that some diseases go up and down, **that diseases could be responsible for the 15-fold fluctuation in recruits per spawner** between 2009 returns and 2010 returns? I guess, in the absence of any information which would show one way or the other that there were massive outbreaks of diseases, you couldn't reject that. **It seems unlikely, though,** in that you would think that **if there were massive outbreaks of diseases you would have heard something about it from the fish farmers and you would have read -- seen something about it in the database that has been collected,** admittedly only for a very short period of time.
>
> So I think **looking at that data, which showed basically no trends in diseases, the work that -- the database that Korman -- Josh Korman put**

> **34 together --**
> …
> 36 A -- [it] **becomes a bit of a stretch to say that the --**
> **37 how likely it was that there was a sudden big**
> **38 disease that nobody detected.**
>
> Marmorek, Transcript Sept 19, p. 79 ll. 14 – p. 80. ll. 38 [emphasis added]

254. A negative inference might be drawn against the Aquaculture Coalition based on the fact that on August 31, 2011, although Dr. McKenzie had indicated his familiarity with the farm data for Conville Bay, counsel for the Aquaculture Coalition did not ask him a single question about marine anemia at that site. Dr. McKenzie testified that he had reviewed the data, and had spoken to the Marine Harvest veterinarian and was informed that plasmacytoid leukemia was not diagnosed at the Conville Bay site and furthermore that the fish at that site had been entirely harvested by early May of 2007. As Dr. Welsh explained in Exhibit 2, Fraser River smolts leave their natal lakes in late April to early May. This means Conville Bay was likely empty when the Fraser River sockeye were migrating past it:

> 46 DR. McKENZIE: Okay. In the issue of Conville Bay,
> 47 Conville Bay is a [M]arine [H]arvest site. Having
> 1 read the transcripts, I have spoken with the
> 2 veterinarian in charge of that facility, and we
> 3 discussed the issue of marine anaemia. **She was**
> **4 kind of surprised that there was an issue because**
> **5 marine anaemia had not been seen on the site and**
> **6 at any significant level.** And what she wanted to
> 7 -- the question we posed to her was, was that
> 8 accurate as far as the harvest data. I've looked
> 9 at the Salmon Farmers data itself, and **the harvest**
> **10 of Conville Bay actually started in late -- it**
> **11 started in December of 2006**, and they were almost
> 12 75 percent empty by March of 2007. And the last,
> 13 I believe the **last harvest was in early May**.
>
> Exhibit 2, Dr. Welch, *Marine Phase of the Fraser River sockeye Life Cycle: Smolt Entry to Adult Return* p. 9;
> McKenzie, August 31 2011, p. 79 ll. 46 – p. 80 ll. 13 [emphasis added]

255. Mr. Backman of Marine Harvest also investigated the Conville Bay issue raised by the Aquaculture Coalition as that site is owned by Marine Harvest. He testified that he had spoken to the company veterinarian who informed him that no marine anemia had been diagnosed on the site, either by the farm itself or the Province. He explained that fish health monitoring is a two-tier system; either the salmon farm would report to the Province if marine anemia was detected, or the Province would detect it in the audit and inform the farm, although he said that usually the farm is already aware of such situations because they see a rise in mortality in their fish.

Backman, Transcript, September 7, 2011, p. 38 ll. 9 – 38

256. Finding a lesion consistent with plasmacytoid leukemia does not automatically lead to a diagnosis of plasmacytoid leukemia; the process of making a diagnosis involves many pieces of evidence and expert interpretation. Dr. Marty explained his laboratory or observational diagnosis is different than a clinical diagnosis, meaning his diagnosis of "interstitial cell hyperplasia" which he notes in Chinook salmon is a "common finding with marine anaemia", would have to be looked at by a veterinarian to consider whether it was consistent with their findings. When asked how many fish it would take to make a diagnosis, Dr. Sheppard explained that to make a diagnosis at the population level he would look at a number of factors:

> DR. SHEPPARD: Well, again, Mr. Commissioner, it varies from case to case because the evidence collected from case to case varies. So again, the factors I would look at are **how many silver fish were available**. Sometimes if there are large numbers of silver fresh carcasses available, it's a clear indication that there's an active ongoing disease occurring at the time. Then **I would look at the laboratory results and the information from Dr. Marty to look at what percentage of those animals actually are showing indications**. And then I would **look at the rest of the information to see if their veterinarian had been involved with the mortality rate, if the mortality rate in the farm had been high, whether there'd been treatments occurring**. All of that would be pieced together to make me feel at the highest level of confidence how to assign that diagnosis at the population level.

Marty, Transcript August 31, 2011, p. 86 ll. 46 – p. 87 ll. 5;
Sheppard, *Ibid*. p. 87 ll. 28 – 46 [emphasis added]

257. As explained by Dr. Sheppard, plasmacytoid leukemia is relatively easy to diagnose. Based on the expert opinions of the fish health professionals called to testify before the Commission, there was no unreported "outbreak" of plasmacytoid leukemia in 2007 that could explain the 2009 sockeye salmon returns, and it is now rarely found in Chinook or coho salmon. As explained by the fish health experts and veterinarians, counting the number of occurrences of a pathological finding in Dr. Marty's data cannot be interpreted as a disease event by someone lacking either the necessary qualifications or the context of that information.

Mortality Related Signature ("MRS") & Parvovirus

258. The MRS and parvovirus are still highly speculative issues, particularly because it has not been established whether there is in fact a virus related to the signature, or whether it is transmissible. However, the empirical evidence that is available on the MRS and parvovirus shows that salmon farms are not involved in their transmission. The BCSFA suggests that although Dr. Miller's research is important, because it is still nascent and rapidly evolving, it should be carefully scrutinized when making findings of fact.

259. Dr. Miller's evidence tends to disprove the theory that the MRS is coming from salmon farms. In her testimony, Dr. Miller attempted to clarify several misconceptions about her research on MRS. She explained that she could not assume salmon farms were involved with the MRS and that she had evidence which shows the signature "exists in salmon passing either way around Vancouver Island." Because it is often suggested by critics of salmon farms that Harrison sockeye are doing well because they migrate through Juan de Fuca Strait where they are not exposed to salmon farms, the BCSFA argues this finding shows that salmon farms are not responsible for the MRS.

Miller, Transcript, August 25, 2011 p. 25 ll. 23 – p. 26 ll. 18

260. In Dr. Miller's presentation prepared for the Pacific Salmon Forum in 2010, Exhibit 1521, *Miller, Hypothesis - Genomic Studies Suggest That Some Disease has Infected Sockeye*, Dr. Miller wrote: "Given the high prevalence before fish leave the river, salmon aquaculture is not likely a main route of transmission to wild salmon." She testified that her opinion had not changed. Dr. Miller stated: "I would say that the main time point of transmission appears to be occurring in freshwater", and that she is working with the industry to determine whether farmed salmon even have the MRS or the virus.

Transcript, August 24, 2011, p. 84 ll. 34 – p. 85 ll. 6

261. The BCSFA notes the difference in fresh water residence time between Harrison River and Fraser River sockeye may be highly relevant to the MRS and parvovirus discovered by Dr. Miller. She noted a greater prevalence of both the MRS and the parvovirus in freshwater environment means the transmission of the virus "seems to emanate out of the freshwater environment". Dr. Miller also explained that there appears to be higher prevalence in salmon stocks higher up the river, and that the MRS is absent from all sampled Harrison River sockeye. Dr. Miller concluded: "So the fish that spend less time in freshwater tend to be doing better than those that spend more."

Transcript, August 24, 2011 p. 81 ll. 25 – 35, p. 82 ll. 3 – p. 83 ll. 13

262. The BCSFA says this research is at too early a stage to be useful to the Commission. For example, when it was suggested to Dr. Miller by counsel for

the Aquaculture Coalition that the MRS or parvovirus might be transmitted vertically, meaning salmon farms could be involved, Dr. Miller noted that while it was a possibility, a report prepared by Dr. Lewis for the BCSFA, but not tendered into evidence, suggests that "where vertical transmission with parvoviruses was a common route of transmission, you saw loss of the fetus, and he concluded that you would have losses of eggs" meaning vertical transmission is unlikely. Dr. Garver expressed concern at the speculation about vertical transmission, adding "it could potentially be in other species in a lake and could, therefore, be transmitted horizontally." He noted the discussion was pure speculation because they do not yet even know if it is a true virus, if it is transmitted, or if it is infectious.

Miller & Garver, Transcript August 24, 2011, p. 98 ll. 1 – p. 99 ll. 33;
also see Exhibit 1513, *Miller, Genomic Studies Suggest a Novel Disease Affecting Sockeye*, Apr 15 2011 p. 12

263. The timeline of Dr. Miller's research shows significant developments and revisions of the MRS theory. The BCSFA says that Dr. Miller's research should be pursued, but notes that because it is novel science it should be given particular scrutiny by the Commissioner when making findings of fact. This is particularly true where other experts, as well as Dr. Miller herself, express uncertainty as to her theories, for example the speculative links to plasmacytoid leukemia or aquaculture.

Exhibit 1522, Miller, *Timeline of Genomic Research relating to the Mortality-related Genomic Signature With Projections Through July 2011*,

264. For example, when cross-examined on some of her earlier research in Exhibit 1524, in which she suggests plasmacytoid leukemia may be involved and that hatcheries and salmon aquaculture might play a role in the decline, Dr. Miller answered, "I'm not an expert on plasmacytoid leukemia". She furthermore explained that all references to ocular tumours should be removed as those were not actually found. Dr. Kent, for example, found no significant pathological changes in any of the samples. It is also useful to note that notwithstanding Dr. Miller's suggestion in Exhibit 1522, Miller, *Timeline of Genomic Research relating to the Mortality-related Genomic Signature With Projections Through July 2011* that there was no trauma to the fish that could have explained observed pathological changes, Dr. Hinch testified that the sampled fish were killed by concussion, or blunt force trauma, which is consistent with Dr. Marty's findings.

Miller, Transcript August 24, 2011, p. 96 ll. 10-11;
Kent, Transcript August 23 2011, p. 5 ll. 45 – p. 6 ll. 21;
Exhibit 1522, Miller, *Timeline of Genomic Research relating to the Mortality-related Genomic Signature With Projections Through July 2011,* p. 6*;*
Hinch, Transcript, March 9, 2011, p. 10, ll. 3 – 39;
Miller, Transcript August 24, 2011, p. 74, ll. 15-22

265. Although Dr. Miller speculated on a potential parallel between plasmacytoid leukemia and the MRS in prior research, the BCSFA notes that Dr. Miller is not qualified to give opinions on whether the MRS is related to plasmacytoid leukemia. As noted by Dr. Noakes when replying to a question from the Commissioner on the qualifications of fish health professionals, Dr. Miller is "a genetic scientist who looks at fish diseases, but she's not a fish health scientist." When asked about plasmacytoid leukemia, Dr. Miller suggested asking Dr. Saksida about it, and noted she herself was less convinced it was a retrovirus based on Dr. Kent's testimony.

Miller, Transcript August 24, 2011, p. 87 ll. 44 – p. 88 ll. 21;
Noakes, Transcript August 29, 2011, p. 83 ll. 7-11;
Miller, Transcript August 24, 2011, p. 89 ll. 16-40

266. Dr. Saksida did in fact comment on Dr. Miller's research, and the potential link between MRS and plasmacytoid leukemia. She noted that Dr. Miller's original paper suggested the MRS might be a signature for a retrovirus, but that "[n]o retrovirus was actually isolated." Dr. Saksida also explained that the finding of a parvovirus made the speculative link to plasmacytoid leukemia less likely, noting that in fact nobody has yet determined whether Dr. Miller has even found an infectious virus:

> 13 Now it looks like the signature is most
> 14 potentially resembling a parvovirus. **Again there**
> **15 hasn't been the work done to show that it actually**
> **16 is a parvovirus, or that it actually is causing**
> **17 any disease**. This work has to occur. **But really**
> **18 a parvovirus and a retrovirus, one's a single**
> **19 strand DNA virus, which may mean nothing, one is a**
> **20 single strand RNA virus. It's like apples and**
> **21 oranges. They're very different viruses.** So
> 22 it's, you know, there's still a lot of work. **It's**
> **23 definitely moving away from the whole plasmacytoid**
> **24 leukemia.** It **may or may not be** a **disease**. It **may**
> **25 or may not** be a infectious virus.

Saksida, Transcript September 6, 2011, p. 63, ll. 13 – 25

267. The BCSFA notes that after Dr. Miller's publication of her MRS research in the journal *Science* in 2011, the executive director of the BCSFA, Ms. Walling, contacted Dr. Miller to ask about having farmed salmon tested for MRS. However, Dr. Miller had not at that point identified an actual pathogen to test for, and someone in DFO advised the aquaculture industry not to submit samples for testing at that time. Dr. Miller testified that the aquaculture companies will now be submitting samples for testing. This shows that the aquaculture industry is responsible and interested in developing new tests to help improve the health of both farmed and wild salmon.

Miller, Transcript August 25, 2011 p. 12 ll. 22 – 36, p. 13 ll. 11-20

Morton Report

268. The BCSFA says that Ms. Morton is not qualified to interpret or give opinions on fish health as she purports to do in her report, Exhibit 1976, Morton, *What is happening to the Fraser sockeye,* 2011. Ms. Morton refers to the work of Dr. Miller as being "cutting edge" and "a new field", but ignores the developments in Dr. Miller's research. Notwithstanding Dr. Miller's testimony and evidence saying they had found no tumours, Ms. Morton refers to a retrovirus causing tumours, suggests it is responsible for the MRS genomic profile and links this to early entry behaivour, and furthermore that Miller "believes it is the virus Salmon Leukemia.' All of these are either contradicted by the evidence. Ms. Morton then concludes that based on her interpretation of this circumstantial and unreliable evidence that "There is strong evidence that the loss of spawners carrying billions of eggs is due to a virus that appeared in salmon farms on the Fraser sockeye migration route one generation prior to the Fraser sockeye decline."

Exhibit 1976, Morton, *What is happening to the Fraser sockeye,* 2011 p. 10, 14

269. The BCSFA notes the evidence shows the link between MRS and plasmacytoid leukemia is tenuous, and that the current state of knowledge in fact leads away from linking the MRS and newly discovered parvovirus to salmon farms. The evidence and Dr. Miller's testimony shows higher prevalence of the MRS in salmon with longer freshwater residence times, which migrate on both sides of Vancouver Island, and that it is speculated that parvovirus may be less likely to transmit vertically, all of which the BCSFA says suggests a freshwater source for the MRS. Ms. Morton's subjective and inexpert interpretation of fish health data was criticized by a number of witnesses such as Dr. Kent and Dr. Korman who noted she was not a veterinarian, and was contradicted by the testimony of Dr. Marty, Dr. McKenzie, and Dr. Sheppard.

270. The BCSFA furthermore argues that Ms. Morton's report lacks credibility and reliability due to the fact that she only presents information for the purpose of supporting her theory, to the point of misrepresenting the very sources she quotes. For example, she summarizes Exhibit 1491, Stephen *et al. Descriptive epidemiology of marine anemia in seapen-reared salmon in southern British Columbia* as follows:

> Stephen, Ribble and Kent (1996) report "The environmental conditions created by intensive aquaculture may have facilitated the emergence of marine anemia. Rearing systems used in seapen aquaculture represent a substantial change in the ecology of Chinook salmon. … They suggest marine anemia is a "disease of confinement."

Exhibit 1976, Morton, *What is happening to the Fraser sockeye,* 2011 p. 15

271. Ms. Morton excludes the fact that the same page of that paper contradicts her characterization in several ways. First, Stephen *et al.* are careful to note that Chinook are not necessarily predisposed to marine anemia, but that because the aquaculture industry was raising Chinooks and was performing veterinary investigation that Chinooks are "over represented in clinical and laboratory records". Second, the sentence that immediately precedes Ms. Morton's first quote from the paper reads: "Regardless of the speculation regarding the relationship of other infectious diseases and marine· anemia, **our results suggest that the importance of diagnosing marine anemia on a salmon farm is not that it predicts impending epidemics of mortality**, but that it may be an important indicator of the pattern of disease on affected farms." Third, Ms. Morton misrepresents the paper to suggest that marine anemia "**is** a 'disease of confinement'", omitting the word "**If**" that precedes it:

> **If** marine anemia is a "disease of confinement," then its discovery may simply be a reflection of the recent rapid growth of the British Columbia salmon farming industry.

Exhibit 1491, Stephen *et al. Descriptive epidemiology of marine anemia in seapen-reared salmon in southern British Columbia* p. 424 ("**Exhibit 1491, Stephen et al *Descriptive epidemiology***") [emphasis added];
Exhibit 1976, Morton, *What is happening to the Fraser sockeye*, 2011 p. 15

272. Ms. Morton later states plasmacytoid leukemia "is considered a salmon farm disease," apparently suggesting that it is not common in the wild, despite the fact Exhibit 1491, Stephen *et al. Descriptive epidemiology*, supra, says it is an endemic disease in B.C. only discovered because of salmon farms. Furthermore, based on Dr. Noakes explanation of disease in wild fish, the BCSFA says Ms. Morton's assumption is not reasonable:

> **There is also not compelling or strong evidence of significant disease transfer from salmon farms to wild or hatchery fish (BKD being a case in point) given the high incidence of these diseases found in all species of Pacific salmon** (Kent *et al.* 1998; Noakes *et al.* 2000; Rhodes *et al.* 2006). For instance, **BKD infection rates for wild and hatchery Pacific salmon** ranged up to **60%** for chinook and **40%** for coho salmon, about 6 or 7% for sockeye and chum salmon, respectively, and up to 25% for pink salmon (Kent *et al.* 1998; Rhodes *et al.* 2006). Given these high levels of natural infection, **there is no easy way to establish the source of infection** unless there is evidence of disease in a hatchery or particular stream.

Exhibit 1976, Morton, *What is happening to the Fraser sockeye*, 2011 p. 18;
Exhibit 1491, Stephen *et al. Descriptive epidemiology*, supra p. 420;
Exhibit 1536, *Noakes Report 5C*, p. 7

273. The BCSFA notes that Exhibit 1976, Morton, *What is happening to the Fraser sockeye*, 2011 is highly biased in its interpretation of the material it cites. For example, Ms. Morton links Dr. Miller's MRS research to plasmacytoid leukemia and concludes plasmacytoid leukemia "is a retrovirus", and that it "is vertically transmitted". One of the documents which Ms. Morton appears to be basing this statement on uses language such as "suspected retrovirus" because it was an unproven hypothesis. Dr. Saksida, whom Dr. Miller called an expert on plasmacytoid leukemia, noted that Dr. Miller's paper suggested the MRS could be a retrovirus, but that no retrovirus was isolated and that the parvovirus discovery leads away from the plasmacytoid leukemia theory. The BCSFA notes the possibility that other papers and documents not entered into evidence may be similarly misquoted. It is apparent that the selection of documents and quotations is heavily biased, and lacks reliability.

Exhibit 1976, Morton, *What is happening to the Fraser sockeye*, 2011 p. 19;
Sakdisa, Transcript September 6, 2011, p. 63, ll. 3-25

D. Egg Importations and Absence of Exotic diseases

274. The BCSFA says that all diseases affecting aquaculture facilities are naturally occurring and endemic in B.C. The expert fish health professionals called before the Commission unanimously testified that no exotic diseases have been introduced into B.C. through salmon aquaculture, and several agreed that the risk of future introductions by the importation of eggs is "very low to remote" due to the stringent controls in place. There is a greater risk of infectious salmon anemia being introduced to B.C. from migrating wild stocks than through aquaculture egg importations. The rigorous monitoring, testing, reporting and auditing requirements, and oversight by qualified fish health professionals and veterinarians, gives high confidence that the introduction of high risk exotic diseases has not occurred.

Sheppard, Transcript August 31, 2011, p. 68 ll. 10—15;
Exhibit 1679, *Ministry of Agriculture and Lands, Briefing Note for Minister, Infectious Salmon Anemia viral outbreak in Chile*, Aug 1 2007

275. The BCSFA notes that the Commission's Technical Reports establish that all pathogens found in B.C. are endemic and that there have been no importations of exotic diseases. This was confirmed by Dr. Kent's testimony, as well as the Commission's Project 5 reports.

Kent, Transcript August 22, 2011, p. 61 ll. 1-6, August 23, 2011, p. 16 ll. 1 -15;
Marty, Transcript August 31, 2011, p. 57 ll. 17-24;
Exhibit 1536, *Noakes Report 5C*, 2011, *supra* p. 24;
Exhibit 1543, *Korman Report 5A*, 2011, *supra* p. ii

276. Dr. Kent explained from his personal knowledge during his time at DFO that Scientists at the Pacific Biological Station developed a rigorous program and policy for quarantine and avoiding the introduction of exotic pathogens when importing salmonid eggs. He described it as a "very rigorous program" that has "served as a model for other agencies for introduction of fishes into a given geographic area". The reason why the policy is effective, he notes, is because salmonid eggs take a long time to hatch, allowing for screening of eggs, ovarian fluid, the brood stock, and for pathogens both before they are imported and during quarantine after import. Furthermore the smolts continue to be held in quarantine and examined for specific pathogens after hatching. Dr. Kent concluded that based on this policy and testing, "we have not seen any introduction of any exotic pathogens", including both pathogens of "significant" and exotic pathogens of "less concern".

Kent, Transcript August 23, 2011, p. 15, ll. 1-28;
Exhibit 1449, *Kent Report, 2011*, supra p. 1;
Kent, Transcript August 23, 2011, p. 16 ll. 1-16

277. The BCSFA had Dr. Larry Hammell, Co-director of the OIE Collaborating Centre Epidemiology and Risk Assessment of Aquatic Animal Diseases, an expert in ISA and author of Exhibit 1561, *Hammell et al. S.A.D. Working Group Draft*, *supra,* prepare a report to submit to the Commission, qualitatively assessing the risks of Atlantic salmon egg importation to B.C.. In that report, Exhibit 1982, Hammell, *Qualitative Assessment of Risk, and Mitigation of Importing Exotic Disease through Eggs, rev Aug 18 2011* ("**Exhibit 1982, Hammell, *Qualitative Assessment of Risk 2011*"**), Dr. Hammell provides a literature review and concludes that based on newly published research on ISA, the weight of evidence suggests that vertical transmission of the disease does not occur. This research is more recent than that provided in Exhibits 1502 and 1687, and is by a recognized expert in the field whereas Dr. McKenzie noted Exhibits 1502 and 1687 were published by a graduate student. Dr. McKenzie, a veterinarian and former National Manager of Import and Export of the CFIA who was involved in developing regulations and programs to control imports and exports through the new regulation that was being set up under the *Health of Animals Act*, summarized the document as a risk assessment of egg importation into B.C. from 1985 to 2009.

McKenzie, Transcript, August 31 2011, p. 78 ll. 3-26; p. 94 ll. 26-39, p. 30 ll. 2-17, p. 34 ll. 18-31

Exhibit 1982, Formerly for ID OO - Hammell, *Qualitative Assessment of Risk, and Mitigation of Importing Exotic Disease through Eggs, rev Aug 18 2011* ("**Exhibit 1982, Hammell, *Qualitative Assessment of Risk 2011***")

278. Dr. Kent was asked to read two paragraphs from Dr. Hammell's report Exhibit 1982, Hammell, *Qualitative Assessment of Risk 2011, supra*, in which Dr. Hammell describes the risk from egg importation being reduced to "low to extremely low", and concludes that the importation and quarantine programs used in B.C. reduced the risk of importing exotic diseases through egg transfers. Dr. Kent read and agreed with both conclusions. Those paragraphs read:

> ***Comments regarding risk mitigation***: Three important aspects of the egg importation reduce the probability of pathogen introduction from **low to extremely low**. These are 1) taking eggs from FHPR approved sources, 2) restricting movement of live animals to the eyed egg stage, and 3) post-transfer quarantine with extensive diagnostic testing requirements. These actions are directed toward identifying stock that could be infected with an exotic pathogen and containing that infection if it occurred. It appears to be successful at least to the point of not identifying any exotic pathogens through the process to that stage of release from quarantine.
>
> ***Summary***: The probability that eyed eggs imported from 1995 to 2009 introduced any new pathogens to British Columbia is '**extremely low' to 'remote'**. Although the probability of

> introducing any new pathogens to BC may have been higher in the 1985-1995 period due to lack of advanced diagnostic methods used today, **the time period since has provided more opportunity to detect any introduced pathogens**. The measures employed since 1985, namely FHPR testing of broodstock to reduce the probability of vertical transmission of pathogens to eggs, lack of clinical disease in brood stock populations (part of FHPR), egg surface disinfection practices, and quarantine of newly introduced eggs, all **contributed to reducing the probability of inadvertent pathogen introduction. Pathogens not known in the early years of egg importation (e.g. ISAV, SAV) did not have testing to confirm their absence in the imported egg or their brood stock.** However, the fact that **these pathogens have little or no conclusive evidence of vertical transmission**, absence of clinical disease in broodstock and tests that often detected other pathogens (such as virus isolation on cell lines that are quite permissive to these viruses), mean that **other measures coincidentally reduced the probability of the introducing exotic pathogens, even if not yet discovered.**
>
> Kent, Transcript, August 23, 2011, p. 23 ll. 1-31; Exhibit 1982, Hammell, *Qualitative Assessment of Risk 2011, supra* PDF 5 [emphasis added]

279. The BCSFA notes that under the DFO, egg importation numbers will be made available to the public, which will show that few eggs are in fact imported by the aquaculture industry. As Mr. Swerdfager testified, providing the importation numbers to the public is intended to avoid the past problems of people making up or exaggerating numbers. Although he indicated DFO will post these numbers, Mr. Swerdfager could not say how often they would be updated largely because the industry does not engage in a lot of egg importations – it is "not an area where there's a lot of activity".

Swerdfager, Transcript August 31, 2011 *p.* 33 ll. 27 – p. 34 ll. 10

Infectious Salmon Anemia ("ISA")

280. Numerous expert witnesses testified that no exotic pathogens have been introduced to B.C. For example, Dr. Kent, the Commission Technical Report 1 researcher, says:

> **All of these pathogens are endemic to British Columbia and most likely have been present in this area for centuries**. Moreover, there is **no evidence of an exotic salmonid pathogen being recently introduced to the Province**. If there has been a dramatic increase in mortality caused by one or more of them in recent years, it is likely due to changes in the susceptibility of sockeye salmon to them or a change in the abundance in these

> pathogens. Environmental changes could be an underlying cause of either.

Exhibit 1449, *Kent Report, 2011 p. ii*

281. The BCSFA notes that only qualified experts are able to interpret fish health data. It was suggested to Dr. Kent using a document prepared by Ms. Morton that Dr. Marty's notes of "interstitial (hematopoietic) cell hyperplasia" and "interstitial hemorrhage/congestion" in Exhibit 1678, *Histopathology FHAS 2006-2010, showing data sorted for Province_Dr. Marty*, established ISA had been found in salmon farms in B.C. Dr. Kent questioned whether the diagnosis had been made by Dr. Marty, or whether Ms. Morton, who was not a veterinarian, interpreted the clinical signs and assigned a diagnosis herself. Dr. Kent observed that neither of these signs established the presence of ISA but could also have been caused by other diseases endemic to B.C. such as vibriosis, and that based on negative results from ISA screening in B.C., a document later marked as Exhibit 1471, *Publicly Available PCR Test Results for ISAV in BC Farmed Salmon, 2003-2010*, that he would not suspect those lesions to have been caused by ISA.

Kent, Transcript August 23, 2011, p. 37 ll. 22 – p. 40 ll. 31;
Exhibit 1471, *Publicly Available PCR Test Results for ISAV in BC Farmed Salmon, 2003-2010* ;
Kent, Transcript August 23, 2011, p. 38 ll. 23-35, p. 39 ll. 2-10

282. The BCSFA argues that the risks of ISA being introduced into B.C. have been exaggerated by people who lack the qualifications to interpret fish health data. For example, Dr. Dill's report said Dr. Marty had found "classic symptoms" of ISA in samples from salmon farms. Dr. Marty noted that he did not use the term "classic symptoms" of ISA in his reports, and explained the process involved in testing for and diagnosing ISA described in Exhibit 1676: Chapter 2.3.5 infectious Salmon Anaemia, from the World Organization of Animal Health ("**OIE**") manual. Like Dr. Kent, he explained that the lesions noted in Exhibit 1678 *Histopathology FHAS 2006-2010* are not pathognomonic for ISA, meaning a suite of changes are needed for the diagnostic team of expert fish health professionals to make a clinical diagnosis of ISA. He noted that as professionals, they have a responsibility to only report to CFIA things that are actually of concern.

Marty, Transcript August 31, 2011, p. 60 ll. 25 – p. 61 ll. 20;
Exhibit 1676: *Chapter 2.3.5 infectious Salmon Anaemia*

283. Dr. McKenzie summarized the numerous levels of ongoing testing and examination by qualified veterinarians and experts that shows ISA has not been introduced into B.C. by the aquaculture industry. He expressed concern that people lacking these qualifications such as Ms. Morton could interpret the same information differently while ignoring these guarantees of confidence. Dr. McKenzie noted the report by the CFIA, responding to Ms. Morton's report of her

suspicions of ISA based on Dr. Marty's histopathology reports, found that B.C. is at no risk of ISA.

McKenzie, Transcript August 31 2011, p.78 ll. 41 – p. 79 ll. 29;
Exhibit 1666, Aquatic Animal Health Division, Canadian Food Inspection Agency, Record of Decisions, May 16, 2011;
Marty & McKenzie, Transcript August 31, 2011, p. 42 ll. 19 – p. 44 ll. 1

284. The BCSFA notes that the documented absence of ISA from Atlantic salmon farms gives high confidence that the disease is not present in B.C. Dr. Marty in fact noted that in addition to the FHASP, salmon farmers themselves request PCR tests to build the confidence level that ISA is not present. Furthermore, researchers have established that Pacific salmon are relatively resistant to ISA, whereas Atlantic salmon are susceptible to the disease. Dr. MacWilliams in fact noted that Atlantic salmon would be reasonable sentinels of the disease, meaning the disease would likely be detected there first. Ongoing surveillance and auditing of farmed salmon including PCR testing have shown no indication of ISAV in B.C.

Marty, Transcript August 31, 2011, p. 44 ll. 1 – p. 45 ll. 9;
Exhibit 1464 *Rolland and Winton, Relative resistance of Pacific salmon in infectious salmon anemia virus*;
Johnson & MacWilliams, Transcript, August 22, 2011 p. 83 ll. 15 – p. 85 ll. 24

285. The BCSFA notes that Dr. Kent testified there are other ways exotic pathogen may be introduced to B.C. than by the aquaculture industry. He said that if ISA were to occur in salmon farms, that it could have come from wild fish, and that it would have to be followed up with extensive examinations of wild fish and whether there was a potential breach of biosecurity. Similarly, in Exhibit 1679: *Sheppard, Ministry of Agriculture and Briefing Note for Minister, For Information, August 1, 2007*, Dr. Sheppard wrote that "the most likely source for ISA in BC is from migrating wild fishes from other regions of the Pacific Ocean as there is no importation of live Atlantic salmon or eggs to BC". The BCSFA notes the ambiguity in this sentence is clarified by the first page which explains that importing live fish eggs is not permitted in B.C. – the BCSFA suggests that because it was a well-known fact that B.C. permitted the importation of fertilized eggs, the sentence should be read as "…live Atlantic salmon or [live] eggs to BC".

Kent, Transcript August 23, 2011, p. 48 ll. 8 – p. 48 ll. 31;
Sheppard, Transcript August 31, 2011, p. 68 ll. 10 – 15;
Exhibit 1679: *Sheppard, Ministry of Agriculture and Briefing Note for Minister, For Information, August 1, 2007*, p. 1-2

286. The BCSFA says that other exotic diseases such as IPN would have also been prevented from being introduced to B.C. IPN, for example, would also have been

detected in the testing and quarantine procedures. The Disease panel on August 22, 2011 testified that IPN has not been detected in B.C. and that it is rare in salmonids.

Exhibit 1982, Hammell, *Qualitative Assessment of Risk 2011, supra*, PDF 4
Transcript, August 22 2011, p. 72 ll. 34 – p. 73 ll. 34

E More research needed:

287. The BCSFA says that more research is needed on a number of areas to better understand the potential causes of the decline of sockeye salmon. Numerous gaps in data and knowledge have been identified. These include the causes of early marine mortality, climate change impacts, changing conditions in the marine environment and their effects on the abundance and quality of food for sockeye salmon, competitive interactions between sockeye and hatchery fish, and the prevalence of pathogens in enhanced and hatchery-reared salmon and in wild sockeye salmon in both freshwater and saltwater.

288. In Dr. Bradford's testimony, he recommended "a linked research program that would look at the lifecycle of the salmon and be able to provide information on how conditions in one life stage would affect a subsequent, to follow the cohort in a coordinated manner so abundance, health, the environment they are exposed to". This would include specialists in a number of fields in order to get a "complete picture of the fish health at different life stages", regarding factors such as energetics, growth, feeding, and pathogens and disease. **The BCSFA agrees with this holistic approach to the research areas outlined below.**

Bradford, Transcript, September 15, 2011, p. 72 ll. 20-43

289. Exhibit 1896, Marmorek *et al. Technical Report 6*, 2011, *supra*, provides a detailed list of research topics based upon the Commissions' various Technical Reports. Although not exhaustive, this list is comprehensive. The BCSFA highlights some of the research which it says should be considered high priority based on the evidence before the Commissioner. The BCSFA agrees that the proposed research for the coastal migration life stage is high priority and should be pursued. These are:

> 9 A fully integrated oceanographic and ecological investigation of the Strait of Georgia (SoG), the Strait of Juan de Fuca (SJF), Johnstone Strait (JS) and Queen Charlotte Sound (QCS) (including oceanographic conditions, zooplankton, algae, marine mammal predators, alternate prey) to quantify/evaluate factors affecting Fraser sockeye survival, and improve linked physical - ecosystem models;
>
> 10. Studies of residency and migration paths of Fraser sockeye post-smolts through the SoG, SJF, JS and QCS;
>
> 11. Sockeye pathogen and contaminant levels in SoG, SJF, JS and QCS under different marine conditions and exposures to aquaculture activities;
>
> 12. Estimates of the annual relative survival of Fraser sockeye over the period of residency in the SoG, SJF, JS and QCS; and

13. Studies of the migratory paths of Harrison Lake sockeye.

Exhibit 1896, Marmorek *et al. Technical Report 6*, 2011, *supra,* p. 109

Early marine mortality and Freshwater

290. The BCSFA says that research should be conducted on early marine mortality in SOG, QCS, and Hecate Strait. Dr. Noakes' report, Exhibit 1536, *Noakes Report 5C,* 2011 explains that because early marine mortality is thought to be on the order of 3% or more per day, approximately 5 million juvenile sockeye salmon die on average every day after they enter the SOG, and "roughly half of the juvenile salmon entering the Strait of Georgia each spring (~500 million fish) die within the first 25 days after ocean entry." It is not known what the causes are for this mass mortality. This is an area in which Dr. Noakes was qualified as an expert, and is currently conducting research.

Exhibit 1399, Proposed Research Framework Request for Projects, p. 10-14;
Exhibit 1536, *Noakes Report 5C,* 2011 p. 1;
Noakes, Transcript August 25, 2011, p. 68, ll. 33-38;
Saksida Transcript September 6, 2011, p.57, ll. 15 – 43

291. Collecting this information is necessary to give a better understanding of other potential impacts on Fraser River sockeye salmon, including those that may be affecting them in their freshwater environment. Exhibit 562, Nelitz *et al. Technical Report 3, Evaluating the Status of Fraser River sockeye salmon and Role of Freshwater Ecology in their Decline*, for example, says scientists need "better estimates of juvenile abundance, overwinter mortality, and mortality during smolt outmigration" to improve understanding about sockeye salmon survival in freshwater. The BCSFA says that this is an important area of research for DFO to engage in to be able to manage Pacific salmon in B.C.

Exhibit 562, Nelitz *et al. Technical Report 3, Evaluating the Status of Fraser River sockeye salmon and Role of Freshwater Ecology in their Decline*, p. 59

292. The BCSFA says that baseline research must be undertaken to determine not only pathogen prevalence in wild salmon, but also the environment. Dr. Saksida described the early marine phase as "a big black hole… [w]e don't know what happens to the fish once they leave fresh water", and suggested a holistic approach to researching variations in the environment. She recommended collecting baseline data on the environment, specifically temperatures, changes in salinity, and food availability and quality, as well as abundance of pink and chum salmon.

Saksida, Transcript September 6, 2011, p. 57 ll. 15 – ll. 43

Climate change impacts

293. As noted by Dr. Hinch and Dr. Martins, many potential effects of climate change are not well understood. One potentially significant area of uncertainty is the effects of ocean acidification on the Fraser River sockeye salmon. One of the peer reviewers noted in the report and Dr. Martins testified that there have been studies on other fish suggesting potential impacts on olfactory systems which could affect migration and other behaviours, and on the food web. Dr. Hinch and Martins note in Exhibit 553, *Hinch & Martins Report 9, 2011* that oceans are expected to become more acidic, and that "there is no information on how the acidification of marine waters could affect sockeye salmon and hence this topic also requires immediate consideration for future research."

Exhibit 553, *Hinch & Martins Report 9, 2011*, p. 54;
Hinch & Martins, Transcript March 9, 2011, p. 12 ll. 6 – 44

Changing conditions in the marine environment and their effects on the abundance and quality of food for sockeye salmon

294. Routine monitoring on plankton, including harmful algal blooms and heterosigma, is necessary to determine food abundance in the marine environment and to increase understanding of toxic algae blooms. Contaminants in the marine environment and their effects on sockeye salmon at all life stages are also a significant unknown requiring research.

295. As noted above at paragraph 33, the exact pathway of effect of heterosigma is not known. It could cause mortality, acute mortality, chronic mortality, or there may be a food web effect, or all of the above in some combination. Dr. Rensel also testified that heterosigma blooms worldwide are increasing in both intensity and extent of the blooms. Research into controlling, removing and mitigating heterosigma blooms in B.C. should be pursued.

Exhibit 1399, Proposed Research Framework Request for Projects, p. 10-14;
Rensel, Transcript August 17, 2011, p. 6 ll. 26-30, p. 7 ll. 42 – p. 8 ll. 9;
Exhibit 1359, Rensel *et al., FRSS marine survival decline and Heterosigma, 2010*, 2010, p. 112

296. Regarding contaminants in the marine environment, Dr. Ross testified sockeye can accumulate "notable concentrations of persistent contaminants such as PCBs, DDT, endosulfan, PBDE" deposited into the Gulf of Alaska from North America and Asia and bring them back to their natal streams during their return migration and spawning. These contaminants include persistent chemicals and endocrine disruptors such as PBDEs. Dr Ross disagreed with Exhibit 1371, *Briefing Memo for the Minister re Update on Factors Affecting the 2009 FRS Return (For Info), Jun 16 2011* which said that contaminants were "unlikely" to have contributed to the poor return in 2009. He explained that contaminants may "acutely" harm salmon, or indirectly harm them "in a developmental sense" such as weakening

their immune system, altering their behaviour, or olfaction or energetics, and that pollutants are considered in global assessments as "a major threat to the biota" but notes there is no funding for this work to continue.

Ross, Transcript August 17, 2011, p. 92 ll. 3 – p. 95 ll. 28;
Exhibit 1371, *Briefing Memo for the Minister re Update on Factors Affecting the 2009 FRS Return (For Info)*, Jun 16 2011

Competitive interactions between sockeye and hatchery fish

297. Exhibit 1896, Marmorek *et al. Technical Report 6*, 2011, *supra,* suggests several activities to conduct open ocean research on "competition (e.g. pink-sockeye), growth, maturity, and over-wintering survival." The BCSFA suggests that Marmorek *et al.*'s activity number 15, estimating the abundance and condition of sockeye in the Gulf of Alaska as well as oceanographic conditions, should be given high priority, and should research competitive interactions between salmon on the same trophic level such as pink, sockeye, and chum. Research should also be directed toward competition between wild salmon and hatchery and enhanced salmon from all countries releasing salmon into the North Pacific. As noted in Marmorek *et al.* at table 4.8-1, this was not an area considered by the Commission's technical reports.

Exhibit 1896, Marmorek *et al. Technical Report 6*, 2011, *supra*, table 4.8-1 p. 100;

298. As Dr. Peterman testified, adopting a statement read to him, "[t]here is a pressing need for research into the early marine survival of Pacific salmonids and the role of hatchery production in these processes." A press release he authored, Exhibit 773, *Peterman, General Press Release re Ruggerone et al paper, Oct 1 2010* summarizes his research that found that due to about 5 billion fish per year being released from hatcheries and salmon ranching in the North Pacific Ocean, "the ocean is getting over-crowded with salmon, raising the question of how many more fish the ocean can sustain." It notes historic highs of sockeye, pink, and chum in the North Pacific, and hypothesizes that this overcrowding may lead to higher competition, overfishing of less productive stocks, and lower diversity.

Peterman, May 2, 2011, p. 82, ll. 1-20;
Exhibit 773, Peterman, General Press Release re Ruggerone et al paper, Oct 1 2010

Prevalence of pathogens in enhanced and hatchery-reared salmon and in wild sockeye salmon in both freshwater and saltwater

299. Research into the prevalence of pathogens in wild fish and hatchery fish in the marine environment is needed. These are both areas in which the Commission Researchers were unable to reach any conclusion due to limited data. Dr. Kent recommends collecting disease data from wild fish over multiple years and performing data analysis using environmental factors and diagnostic methods.

Based on his research into the aquaculture industry, Dr. Noakes suggested this research should include "the abundance and prevalence of sea lice and pathogens of concern for salmon" and a "[m]andatory fish health monitoring and reporting programs for all federal, provincial and CEDP hatcheries consistent with the standards applied to the salmon farming industry" as a means of collecting data on an ongoing basis.

Exhibit 1449, *Kent Report 1*, 2011, p. 24-25;
Exhibit 1536, *Noakes Report 5C,* 2011 p.34

300. Exhibit 1896, Marmorek *et al. Technical Report 6*, *supra*, reports a knowledge gap in the survival rate of smolts during their downstream migration, or when they arrive in the Fraser estuary" which they identify as being "vital to understanding potential mismatches between arrival times and marine plankton blooms". One research activity they recommend, although they do not make it a high priority, is to make "estimates of the size and health of smolts arriving in the Fraser estuary (e.g., pathogens, contaminant body burdens, lipid reserves)". The BCSFA notes that the evidence of Drs. Miller and Garver suggest a possible freshwater source for the MRS or parvovirus. The BCSFA submits that this should be a high priority research area, coordinated between both DFO and the Province.

Exhibit 1896, Marmorek *et al. Technical Report 6*, *supra*, p. 108-109

Aquaculture

301. The BCSFA notes that Dr. Noakes' report Exhibit 1536, *Noakes Report 5C*, 2011, recommended maintaining the scope and level of fish health and sea lice monitoring and reporting currently in place for the salmon aquaculture industry. Dr. Dill recommended in his report, Exhibit 1540, *Dill Report 5D*, 2011, maintaining "a single consolidated database be maintained of farm production, lice, disease and mortality on a farm-by-farm basis" so that "the sort of analysis conducted by Dr. Connors be repeated annually, perhaps by Fisheries and Oceans Canada scientists, to see if a pattern begins to emerge when more wild sockeye year classes can be included." The BCSFA says that this ongoing monitoring and research is consistent with DFO's precautionary approach to aquaculture and should be pursued, with the caveat that the analysis should be undertaken by people with the necessary qualifications and the model should better integrate the feedback provided to Dr. Connors by Dr. Noakes and the peer reviewers of Exhibit 1545, *Connors Report 5B*, 2011.

Exhibit 1540, *Dill Report 5D*, 2011, p. 34

302. The BCSFA notes that when Counsel for the Aquaculture Coalition asked Mr. Marmorek about research on diseases, he read "fish health in farm salmon" in to the record, but excluded "wild and hatchery salmon" from the sentence that appears in the report. The BCSFA submits that the prevalence of pathogens in

hatchery fish and wild fish are high priority research areas that should not be disregarded. Farmed salmon is already very carefully monitored and audited by the industry's regulators, and unlike disease from wild salmon and hatchery salmon for which no conclusion was possible, disease from salmon farms was found to have no significant correlation with sockeye salmon productivity. Exhibit 1575, Marmorek *et al.* Addendum to *Technical Report 6*, 2011 reads:

> … This memo indicates that there are three categories of high-priority data which need to be incorporated into the integrated database and cumulative assessments described above: 1) fish health (disease, sea lice, viruses, bacteria, other pathogens) in **farm salmon, hatchery salmon and wild sockeye**; 2) water quality in the vicinity of salmon farms; and 3) wild sockeye post-smolt survival estimates before and after passing salmon farms. As stressed by all Project 5 authors, the data on farm salmon health are currently of too short duration to reliably assess associations with sockeye productivity, and collection of these data needs to continue. **Noakes (2011) recommends that disease monitoring programs for both wild salmon and hatcheries be maintained at a level equivalent to that required for salmon farms.**

Transcript September 19 2011 p. 85 ll. 31 to p. 85 ll. 44;
Exhibit 1575, Marmorek *et al. Addendum to Technical Report 6*, 2011 p. 23
[emphasis added]

IV. BCSFA Recommendations

303. The BCSFA recommends continued legislative review and modernization of the *Fisheries Act* (Canada) to expressly address aquaculture, and consolidation of regulations and oversight between the Province and Canada. See paras. 66, 67, 102.

304. Standardized data collection required for all freshwater hatcheries releasing fish.

305. The BCSFA recommends a single standard of fish health management plans for all fish producers in B.C., including all aquaculture sites, salmon enhancement programs and hatcheries including Public Involvement Programs and Community Economic Development Programs. See para. 299

306. Research funding to encourage enhancement facilities and aquaculture to work on collaborative projects (one example is the Canadian Agri-Science Clusters initiative of Agriculture and Agri-Food Canada (AAFC) to mobilize the scientific and technical resources needed to support innovation and competitiveness in its sector). See para. 299

307. Ensure DFO Science is equipped to provide prompt communications on research findings, issues and education materials about aquaculture.

308. DFO and the Province should collaborate to set up long term program for wild fish monitoring and research in both freshwater and the marine environment with a focus on health of wild stocks, and epidemiology of disease in wild sockeye. As the evidence of Dr. Garver and Dr. Miller suggests, research should be immediately conducted into whether the MRS is from a freshwater source. The BCSFA also notes that due to its speculative nature, this research needs to progress significantly before management decisions can be made. See paras. 109, 299, and 300

309. DFO to publish their research and fish management findings in peer reviewed journals on all species as a condition of continued program funding.

310. Consistent and seamless jurisdictional interface between the Province and the Federal Government in the management and regulation of the aquaculture industry in B.C. See para. 198

311. Increased data collection and public reporting on bycatch by commercial fishing on a vessel by vessel basis.

312. The BCSFA says that the DFO should support industry access to more modern therapeutants to increase its level of fish health and further decrease risk to wild stocks. See above at paras. 151 to 322

313. The BCSFA seeks a recommendation from the Commission that DFO provide support for quick access to ocean tenures from Cape Caution to Prince Rupert to

allow site relocation for environmental sustainability to continue. As suggested in Exhibit 1942, the industry is interested in moving those sites identified by Mr. Last that were not relocated when the moratorium was lifted, whose operations have been limited in order to remain compliant with environmental performance requirements, closer to the open sea to reduce the potential for environmental impacts and controversy. See above at paras. 194, and 203 to 207.

314. The BCSFA recommends research on heterosigma not only to determine the extent of its impact on the decline of Fraser River sockeye salmon, but also to help learn to predict and mitigate against blooms in the future. See para. 294

315. DFO to commit to long term funding for the implementation of the Wild Salmon Policy.

316. DFO to continue collecting fish health data from salmon farms for the purposes of auditing and doing data analysis such as that conducted by the Project 5 researchers. See para. 301.

317. DFO and stakeholders to create an independent working group of objective people knowledgeable in multivariate statistical analysis, and fish stocks to assemble existing information in a manner useful for ongoing analyses of salmon farm data.

Exhibit 1575, Marmorek *et al. Addendum to Technical Report 6*, p. 24

Conclusion

318. The BCSFA says that salmon farming in B.C. has not caused or contributed to the decline of Fraser River sockeye salmon. As explained by Dr. Korman and Dr. Noakes, there is no strong signal in the BCSFA data that could predict the high contrast in the 2009 versus the 2010 Fraser River sockeye returns. On the other hand, climate change affecting salmon outmigration timing zooplankton blooms, low food abundance and temperature anomalies in the marine environment, and severe heterosigma blooms in the SOG in 2007 are all likely factors in the long term decline and in 2007 combined to create the "perfect storm", leading to the observed 2009 return. However, marine conditions in 2008 were generally cooler, creating better conditions for food abundance and quality. The BCSFA says that these likely factors are the "smoking gun" in terms of Fraser River sockeye returns.

319. The salmon aquaculture industry in B.C. has long been subject to regulations applying the precautionary approach and adaptive management or performance-based management. The precautionary approach or the precautionary principle is not a zero risk tolerance approach, but rather requires governments and industries themselves to take actions notwithstanding scientific uncertainty to avoid serious or irreparable harm. As demonstrated above, both the Province, Canada, and the industry regularly act according to the precautionary approach in all aspects of aquaculture regulation and management. Careful monitoring and auditing of salmon aquaculture gives a high confidence in the quality and trustworthiness of the data reported to the industry's regulators. Furthermore, credible and reliable scientific knowledge and social and economic considerations must be considered when making decisions about industries such as the commercial fishery and the aquaculture fishery.

320. The Commission's Technical and Scientific Report Project 5, led by Drs. Dill, Connors, Korman, and Noakes did an extensive analysis of the BCSFA's fish health database and fish health data from the Province, reviewed literature, and conducted interviews. Those experts concluded generally that there was no statistically significant correlation or relationship between salmon farms and Fraser River sockeye salmon, that escaped Atlantic salmon and wastes from farms posed insignificant risks to wild salmon populations, and that there was no evidence of a harmful effect by sea lice. As Dr. Dill concluded the cumulative effect of these factors were also insufficient to cause either long term population declines or the low returns of 2009. Experts on sea lice and fish health also ruled out the concern of sea lice acting as a disease vector.

321. Dr. Noakes did a thorough farm-by-farm analysis of the BCSFA fish health data to see where diseases occurred relative to the migration route, and determined it is "very unlikely" salmon farms contribute pathogens to migrating sockeye salmon. On the other hand, Dr. Dill inferred an effect by salmon farms based solely on associations generated by Dr. Connors's long-term analysis and speculative statements selected to support his theory that salmon farms are having an effect to

conclude that he could not rule out an effect. Dr. Noakes, an expert in several areas including climate-fisheries interactions and time series, noted that Dr. Connors used climate and fisheries data in such a way he was making spurious associations, and that Dr. Connors' analysis used the farm production data as a proxy for disease in a way that was not supported by the data itself, meaning the analysis was useless. Furthermore, Dr. Dill actually said in his report that he would have preferred an analysis such as that performed by Dr. Noakes, but that it was not possible because the data was aggregated. Dr. Dill did not know that the data had only been aggregated by Dr. Connors because he did not himself look at the data, and that such an analysis was in fact possible. The BCSFA argues that Dr. Noakes' conclusions should be given more weight.

322. In B.C. the species of sea lice generally associated with salmon farms, the salmon louse or *Lep. salmonis*, is genetically different than, and appears to be less pathogonomic than, the Atlantic *Lep. salmonis*. Treatment of sea lice in B.C. is generally done for the precautionary purpose of protecting wild fish from potential harm rather than protecting farmed salmon. Furthermore, recent research suggests sockeye salmon are more resistant to *Lep. salmonis* than other species of salmon.

323. Aquaculture site applications are carefully considered and researched by the industry prior to making a formal application for a new site. Siting criteria were developed using the best available science, and a precautionary approach where uncertainty existed, and are supplemented by detailed environmental assessments which expressly consider uncertainties and potential effects on wild salmon and salmon migration routes, and implement mitigation measures to reduce the identified risks. The environmental assessment process, as well as ongoing monitoring of benthic impacts and fish health records, are all conditions of licence subject to inspection and audit by DFO. The BCSFA says that based on the available evidence, the provincial moratorium on aquaculture sites in the North Coast should be lifted and new sites should be made available to the aquaculture industry.

324. The primary tool used by the aquaculture industry to protect wild fish populations is the FHMP, a written standard of care enforced by Provincial, and now federal regulations as a condition of licence. FHMPs have been required since 2003, the same year as began a statistically significant declining trend in high risk diseases on salmon farms. All salmon pathogens found in BC, regardless of whether the fish are of wild, hatchery, or farmed origin, are endemic, meaning that they are already present in wild fish and do not present an unwarranted risk to Fraser River sockeye salmon. The BCSFA notes that most fish health experts asked whether salmon farms should be removed from migration routes replied that strict biosecurity was an effective measure to protect wild salmon. Salmon farming has not altered the prevalence of pathogens, and good husbandry and vaccinations mean most high risk diseases are rarely found on salmon farms. Furthermore, the protections and procedures in place have ensured no exotic pathogens have been introduced to B.C. and several fish health experts agree the risk of future

introductions is "low to remote." The BCSFA argues that removing salmon farms from the marine environment would not reduce the risk of pathogens infecting wild salmon because these diseases are actually higher in prevalence in wild than in farmed fish, and the risk posed by salmon farms is itself minimal.

325. There are numerous areas of potential research which have been listed for the Commissioner's consideration, and yet there is a finite amount of resources available, both in terms of money and staffing, to implement such research. The BCSFA suggests that understanding early marine mortality and gathering baseline data, researching the effects of climate change, changing conditions in the marine environment, competitive interactions with hatchery fish, and the prevalence of pathogens in wild, enhanced, and hatchery fish, including pathogens in the freshwater environment, should be priority areas. The ongoing collection and analysis of data from salmon farms by DFO should continue.

326. Finally, the evidence and analysis by numerous experts including the Commission's Project 5 researchers shows that salmon farms are not a risk to Fraser River sockeye salmon. Credible research into potential effects of salmon farms in B.C. shows that risks are being effectively managed through stringent regulations and diligent siting practices and fish health management by the industry. Proposals to remove salmon farms from migration routes are advocating for a zero-risk policy that is neither supported by the weight of evidence, the opinion of experts, or the precautionary approach itself. The BCSFA asks that the Commissioner consider the recommendations provided above, the precautionary approach as articulated in Exhibit 51 and the Rio Declaration, and the importance of credible science and socio-economic considerations when advising the DFO on how best to proceed with its management of the aquaculture industry and the conservation of the Fraser River sockeye salmon.

All of which is respectfully submitted

This 17th of October, 2011,

K. Alan Blair
B.C. Salmon Farmers' Association

B.C. SALMON FARMERS ASSOCIATION

FINAL SUBMISSIONS
OCTOBER 17, 2011

LIST OF AUTHORITIES

1. *Morton v. British Columbia (Minister of Agriculture & Lands)*, 2009 BCSC 136 (WLeC)

2. *Canadian Parks & Wilderness Society v. Canada (Minister of Canadian Heritage)*, 2003 FCA 197 (Fed. C.A.) (WLeC)

3. *Pembina Institute for Appropriate Development v. Canada (Attorney General)* 2008 FC 302 (WLeC)

4. *Homalco Indian Band v. British Columbia (Minister of Agriculture, Food & Fisheries)* 2005 BCSC 283 (WLeC)