

Commission of Inquiry into the Decline of  
Sockeye Salmon in the Fraser River



Commission d'enquête sur le déclin des  
populations de saumon rouge du fleuve Fraser

## Public Hearings

## Audience publique

**Commissioner**

L'Honorable juge /  
The Honourable Justice  
Bruce Cohen

**Commissaire**

**Held at:**

Room 801  
Federal Courthouse  
701 West Georgia Street  
Vancouver, B.C.

Thursday, May 5, 2011

**Tenue à :**

Salle 801  
Cour fédérale  
701, rue West Georgia  
Vancouver (C.-B.)

le jeudi 5 mai 2011

## **APPEARANCES / COMPARUTIONS**

Brian Wallace, Q.C. Lara Tessaro	Senior Commission Counsel Junior Commission Counsel
Tim Timberg Geneva Grande-McNeil	Government of Canada ("CAN")
Tara Callan	Province of British Columbia ("BCPROV")
No appearance	Pacific Salmon Commission ("PSC")
No appearance	B.C. Public Service Alliance of Canada Union of Environment Workers B.C. ("BCPSAC")
No appearance	Rio Tinto Alcan Inc. ("RTAI")
No appearance	B.C. Salmon Farmers Association ("BCSFA")
No appearance	Seafood Producers Association of B.C. ("SPABC")
No appearance	Aquaculture Coalition: Alexandra Morton; Raincoast Research Society; Pacific Coast Wild Salmon Society ("AQUA")
Tim Leadem, Q.C.	Conservation Coalition: Coastal Alliance for Aquaculture Reform Fraser Riverkeeper Society; Georgia Strait Alliance; Raincoast Conservation Foundation; Watershed Watch Salmon Society; Mr. Otto Langer; David Suzuki Foundation ("CONSERV")
No appearance	Area D Salmon Gillnet Association; Area B Harvest Committee (Seine) ("GILLFSC")

**APPEARANCES / COMPARUTIONS, cont'd.**

No appearance	Southern Area E Gillnetters Assn. B.C. Fisheries Survival Coalition ("SGAHC")
Christopher Harvey, Q.C.	West Coast Trollers Area G Association; United Fishermen and Allied Workers' Union ("TWCTUFA")
No appearance	B.C. Wildlife Federation; B.C. Federation of Drift Fishers ("WFFDF")
No appearance	Maa-nulth Treaty Society; Tsawwassen First Nation; Musqueam First Nation ("MTM")
No appearance	Western Central Coast Salish First Nations: Cowichan Tribes and Chemainus First Nation Hwlitsum First Nation and Penelakut Tribe Te'mexw Treaty Association ("WCCSFN")
Brenda Gaertner Crystal Reeves	First Nations Coalition: First Nations Fisheries Council; Aboriginal Caucus of the Fraser River; Aboriginal Fisheries Secretariat; Fraser Valley Aboriginal Fisheries Society; Northern Shuswap Tribal Council; Chehalis Indian Band; Secwepemc Fisheries Commission of the Shuswap Nation Tribal Council; Upper Fraser Fisheries Conservation Alliance; Other Douglas Treaty First Nations who applied together (the Snuneymuxw, Tsartlip and Tsawout); Adams Lake Indian Band; Carrier Sekani Tribal Council; Council of Haida Nation ("FNC")
No appearance	Métis Nation British Columbia ("MNBC")

**APPEARANCES / COMPARUTIONS, cont'd.**

No appearance	Sto:lo Tribal Council Cheam Indian Band ("STCCIB")
No appearance	Laich-kwil-tach Treaty Society Chief Harold Sewid, Aboriginal Aquaculture Association ("LJHAH")
No appearance	Musgamagw Tsawataineuk Tribal Council ("MTTC")
No appearance	Heiltsuk Tribal Council ("HTC")

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1 Vancouver, B.C. /Vancouver  
2 (C.-B.)  
3 May 5, 2011/le 5 mai 2011  
4

5 THE REGISTRAR: Order. The hearing is now resumed.  
6

7 ANDREW TRITES, recalled.  
8

9 JOHN FORD, recalled.  
10

11 PETER OLESIUK, recalled.  
12

13 MR. LEADEM: Good morning, Mr. Commissioner. For the  
14 record, Leadem, initial T., appearing as counsel  
15 for the Conservation Coalition.  
16

17 CROSS-EXAMINATION BY MR. LEADEM, continuing:  
18

19 Q Gentlemen, I want to begin by taking up again some  
20 of the themes I was developing with you yesterday  
21 afternoon. And invariably we are about halfway  
22 through these projects, these research projects,  
23 and invariably when one looks at the  
24 recommendations, one sees things such as we need  
25 to do research in these areas, we need a better  
26 dataset, we need this, we need that, and I suspect  
27 that's what the rest of the projects that are also  
28 going to say, we need more research. And is that  
29 just the nature of science, that science always  
30 needs more research or needs more data?

31 I just throw that open as a general  
32 discussion, and then I want to take up some  
33 questions from that. Dr. Ford, you seem to be  
34 nodding your head.

35 DR. FORD: Yes, I think that, you know, it's a very  
36 good question and certainly worthy of considerable  
37 discussion. It's an interesting one. I think in  
38 terms of the requirement for more research, when  
39 we're being faced with fairly specific questions  
40 such as these that have been raised about the  
41 effect of marine mammals on sockeye salmon, these  
42 are difficult animals to study compared to many  
43 terrestrial animals, and so some of the questions  
44 are fairly straightforward, but are very difficult  
45 in practice to collect the kind of information we  
46 need to address those questions. And so we are  
47 making progress, but at times it's slow.



1           New technologies have become available to  
2           provide greater insight into the diet of marine  
3           mammals through chemical tracers like fatty acids  
4           and stable isotopes or genetic analysis of prey  
5           remains, but these are recent innovations and  
6           they're just now being implemented in field  
7           studies. So indeed, you know, there is -- these  
8           animals are fairly data poor, especially with  
9           regard to some of the pressing questions that  
10          we've been deliberating on.

11         Q     All right. Dr. Trites?

12         DR. TRITES: Yeah, I agree with the point you're  
13           making. I mean, so often in science we ask  
14           sometimes simple questions, but those questions  
15           only give us sometimes, you know, a simple answer.  
16           They often raise two or three more new questions.  
17           I think the one thing I've learned to appreciate  
18           over time is that essentially the more we learn,  
19           the more realize how little we truly understood.

20           What we tried to do with our recommendations  
21           is not do the catchall phrase at the end which  
22           just says "Give us more money and we'll answer  
23           more questions".

24         Q     I'm sure you would take it if were someone were  
25           offering it.

26         DR. TRITES: Yeah, but we're trying to sort of focus  
27           things and where the biggest gaps were, by  
28           identifying six species we think should get some  
29           more focus if the primary question is sockeye  
30           salmon. And also that final recommendation which  
31           was the power of using a model to synthesize what  
32           we currently understand to help focus our research  
33           to get the best value out of the money that might  
34           be put forward to answer the key questions that  
35           may resolve some of those key uncertainties.

36         Q     And, Dr. Ford, when you were giving me your  
37           answer, you talked about some of these issues  
38           around research were difficult issues. I take it  
39           "difficult" can be equated to "costly"?

40         DR. FORD: Indeed. Marine mammals can, depending on  
41           the species of course, be extremely expensive to  
42           study. They're in often remote areas, at sea, and  
43           require large ships to get out there to undertake  
44           field studies. So that is often a limiting factor  
45           in progress of towards some of these questions.

46         Q     And I would suspect that, Mr. Olesiuk and Dr.  
47           Ford, as staff scientists for DFO, that you're in

1 a world where you're scrambling for dollars, is  
2 that right, or is that a fair statement?

3 DR. FORD: We're certainly operating as efficiently as  
4 we can with the resources we have available, and  
5 there's always more that could be done with  
6 greater resources. As I mentioned, you know, in  
7 my research groups, the priority activities it  
8 does involve considerable time at sea, and the  
9 reality is that those costs can be prohibitive to  
10 do everything we'd like to do.

11 Q Mr. Olesiuk, is your...

12 MR. OLESIUK: Yeah, I was just going to say that, yeah,  
13 we are scrambling for research funding, and it is,  
14 I think, the nature of science that there's always  
15 going to be new questions arising. But I think if  
16 you look at the Science program, pinnipeds, we've  
17 been at it a little longer than cetaceans, about  
18 three decades we've been doing serious science in  
19 DFO. And there really has been very measurable  
20 progress. We know a lot more about abundance,  
21 status, diet, you know, prey requirements of these  
22 animals than we did 30 years ago. And our  
23 questions now are becoming more focused on very  
24 specific issues and, you know, I think that's the  
25 nature of science.

26 Q But if I can get the focus back to the key  
27 question that this Commission is facing, is what  
28 was the cause of the 2009 decline. And if you can  
29 put it in that stark language, I suspect that at  
30 the end of the day we're not going to be able to  
31 say that "X" is the cause, but we're likely to say  
32 that the salmon have been declining, it's like a  
33 death by a thousand cuts, as I think you've said,  
34 Dr. Trites. It's like this is happening through a  
35 number of contributing factors.

36 And that is perplexing, because then if we  
37 were depending upon science to provide the  
38 answers, then there are two key questions that  
39 come out from that: (1) is where are we going to  
40 find the funding to allow science to show us the  
41 way through this predicament, and (2) who is going  
42 to control what kind of science gets done?

43 Because you are focusing upon predation and that  
44 may not -- that may be a contributing cause, but  
45 who is going to be pulling the strings and  
46 actually saying what science should go forward.

47 And I wonder if any panel members have any

1 reaction to what I've just suggested.

2 DR. TRITES: Maybe if I can just start on that. You  
3 know, there's a big focus on what research has DFO  
4 done. At the same time there's a lot of research  
5 being done on marine mammals by NGOs, by  
6 academics. So, for example, I lead a program that  
7 has both cetacean and pinniped research, and I  
8 have 14 researchers working on pinnipeds. A lot  
9 of that money is coming from -- it's not coming  
10 from the Canadian government, it's coming from  
11 external sources, private foundations, U.S.  
12 sources. So there are other people contributing  
13 to trying to answer some of these questions. A  
14 lot of it are focused on why marine mammals are  
15 abundant in some areas, declining elsewhere.

16 In terms of who sets those agendas, it's  
17 often by -- I guess there's a variety of ways that  
18 that gets done. But I just want to make the point  
19 that there are different groups doing research. I  
20 think all are contributing to answering some of  
21 these key questions.

22 Q And, Dr. Ford?

23 DR. FORD: If I can, I think if I understand your  
24 question, it's really where do we go with  
25 predation specifically as a factor in the 2009  
26 situation with Fraser River sockeye, as well as  
27 the decline over the 15-year period under  
28 consideration. I think what will come from this  
29 process here, as well as other related processes,  
30 such as the Pacific Salmon Commission Synthesis  
31 Workshop, last June it was, that addressed  
32 multiple hypotheses of factors that could have  
33 played significant roles in the overall picture, I  
34 think the result of these kinds of efforts will  
35 ultimately result in the most likely significant  
36 factors, you know, in this Fraser River sockeye  
37 situation, and that ultimately will steer the  
38 future direction for much of the science.

39 I think we're all in agreement that marine  
40 mammals seem to not -- there's no evidence that  
41 they played a role in the situation in 2009. They  
42 may have played a role in the overall decline over  
43 the past 15 years, as a result of increasing  
44 predation levels for various reasons, mostly to do  
45 with changes in abundance. And research in this  
46 area of the role in the overall ecosystem to  
47 include predation on all species, I think will

1 continue, and may help shed further light on the  
2 contributing factor of marine mammals than we now  
3 understand.

4 Q It strikes me that the scientific community is  
5 very much a collaborative community. You get  
6 together from time to time to discuss the results  
7 of your research. You share data where it can be  
8 shared without somebody scooping your paper. And  
9 you basically, it seems, it strikes me that it's a  
10 pretty transparent kind of process that leads to  
11 the development of science. Am I completely wrong  
12 in that approach?

13 DR. FORD: I think in the case of our work, much of the  
14 research that we undertake to provide science  
15 advice for DFO management is certainly reviewed by  
16 peers, both internally and externally, especially  
17 if it is ultimately published in the open  
18 scientific literature, and that process of review  
19 and revision is as hopefully transparent as it can  
20 be, so it is very much a collaborative effort.

21 Q And you would agree with me, Dr. Ford and Mr.  
22 Olesiuk, as DFO scientists that it would be  
23 important for you to share the results of your  
24 work and to basically get it out to the public so  
25 everyone is aware of it. Isn't that accurate?

26 MR. OLESIUK: Yes, I would agree, and it's not just  
27 getting out the final result, but working with our  
28 colleagues during the intermediate processes so  
29 they can identify problems and weaknesses before  
30 we get too far along.

31 But getting back to your question as to how  
32 do we proceed from here and set priorities, and  
33 identify, as John as said, with a relatively high  
34 degree of confidence, we can conclude that marine  
35 mammals were not responsible for the low returns  
36 in 2009.

37 As far as the general decline in  
38 productivity, I think we've narrowed it down to,  
39 you know, a couple of marine mammal species. And  
40 in the case of sea lions, we've identified when  
41 and where they are now feeding on sockeye. Then  
42 we've had a series of workshops in DFO where we  
43 get together with our colleagues that are studying  
44 salmon, and they're looking at the migration  
45 routes of salmon, where the mortality is  
46 occurring, and based on that, we are going to come  
47 up with presumably some sort of multidisciplinary

1 projects where we're combining the factors that  
2 could be causing mortality with information where  
3 that mortality is occurring.

4 Q My time is drawing to a close with you. I wanted  
5 to just get your reaction to one question I had  
6 about Exhibit 795. This was a DFO Synthesis  
7 Workshop on the Decline of Fraser River Sockeye.  
8 Am I right in assuming that this was a workshop  
9 that was conducted by and for DFO scientists alone  
10 and not the greater scientific community?

11 DR. FORD: Yes, that's correct. It was just a follow-  
12 up to the Salmon Commission-sponsored meeting last  
13 June.

14 Q Yes.

15 DR. FORD: And it was basically to continue that effort  
16 towards reviewing available evidence leading to  
17 again, as it says, synthesis to try and keep some  
18 momentum going, you know, internally to keep  
19 addressing these questions and steering direction  
20 for future research.

21 MR. LEADEM: Thank you. I'm afraid my time is up.  
22 Thank you for the discussion.

23 MS. REEVES: Good morning, Mr. Commissioner, Reeves,  
24 initial C., for the First Nations Coalition. And  
25 just for the benefits of our panel, the First  
26 Nations Coalition includes the First Nations  
27 Fisheries Commission, which is a provincial  
28 organization, the Council of the Haida Nation,  
29 three Saanich First Nations, as well as tribes  
30 from Chehalis up to the upper headwaters.

31  
32 CROSS-EXAMINATION BY MS. REEVES:  
33

34 Q I have two series of questions and my first  
35 questions will be directed towards Dr. Trites.  
36 Mr. Lunn, could you please pull up Exhibit 783,  
37 the Technical Report, and I'd like to go to page  
38 11. And at the second paragraph of the report on  
39 page 11, it says:

40  
41 Another aspect of environmental conditions  
42 relates to the impact of water temperature.  
43 While temperature will have a direct  
44 influence on metabolic rates of sockeye  
45 salmon it also impacts other parts of the  
46 ecosystem, including the risk of predation.  
47

1 And then it just talks about how this was  
2 illustrated, and Petersen and Kitchell:

3  
4 ...predicted that warmer climactic conditions  
5 can lead to an increase in predation rates in  
6 the range of 26-31%.

7  
8 And our question is this, if warmer climate  
9 conditions did lead to an increase in predation  
10 rates of, say, 26 to 31 percent in marine waters,  
11 which predators on your list would become an  
12 immediate or a significant concern to sockeye  
13 salmon, and in this case Fraser River sockeye  
14 salmon?

15 DR. TRITES: Yes, good question, but I'm not sure that  
16 I can give you a definitive answer to it. What's  
17 a bit surprising, I think, to a lot of people is  
18 realizing that one of the consequences of warming  
19 oceans is that it's going to affect the food  
20 requirements of fish. And it's because it's going  
21 to raise their metabolic rates, they're going to  
22 have to eat more food to compensate for that. To  
23 require more food, they're either going to take  
24 greater risks to be out and be exposed to be eaten  
25 by other predators that also have increased  
26 feeding requirements, as well. so it's hard to  
27 say at this point who is going to come out the  
28 victor in all that, except there's a realization  
29 that all the fish are going to require more food,  
30 and that food has to come within that fish  
31 community.

32 Q But what about migrating animals. How would that  
33 impact them?

34 DR. TRITES: Are you referring in this case to fish --

35 Q Yeah, I mean (indiscernible - overlapping  
36 speakers).

37 DR. TRITES: -- or to mammals?

38 Q Or mammals, I guess, if you speak to your --

39 DR. TRITES: The mammals are not going to be affected  
40 in the sense of -- their metabolic rates are not  
41 going to be increased. They're breathing air.  
42 They're not acquiring their oxygen out of the  
43 water. So if anything, for the mammals, what will  
44 be affecting them is whether or not the  
45 distribution of the fish shifts, are they moving.  
46 Although some of those fish may also now be  
47 exposed to more predation.

1           This is really theoretical and we're  
2           guessing, and time will be the -- what will show  
3           us in fact what is or will happen and occur.  
4           Right now the projections of these have been  
5           coming from models, are projecting increased food  
6           requirements, increased risk of being eaten, and  
7           for marine mammals, they may not suffer directly,  
8           but they, too, will be playing a role in changing  
9           the face of our ecosystems.

10        Q     Right. And I guess that leads into my next  
11           question, and one of your last recommendations on  
12           page 83 - I don't know if we need to go there -  
13           talked about the need to create an ecosystem model  
14           as one of your recommendations. And given the  
15           complexity of the system, including climate  
16           changes, would you agree, I guess, that we would  
17           need ongoing monitoring of all these factors,  
18           including climate, temperature, and that sort of  
19           thing if we're going to keep updating the models?

20        DR. TRITES: Yes, I would agree, but at the same time  
21           it may not be necessary to monitor everything in  
22           great detail. We have a lot of knowledge already,  
23           and the model helped bring what we do know  
24           together in a way that we can evaluate it with a  
25           common set of indices. So and then over time the  
26           model can be updated as better information comes  
27           in, or we may identify from the model what the key  
28           information gaps are, and therefore help to focus  
29           our research efforts, as well as our research  
30           dollars to get that information. So the models  
31           are very valuable tools for such like creating an  
32           encyclopaedia of knowledge, in this case here for  
33           the sockeye salmon, what we do know and what we  
34           need to learn.

35        Q     Okay. I'm just wondering about, given ecosystem  
36           modelling, and I'm not sure if you're able to  
37           answer this question, but are you aware of  
38           bringing in traditional ecological knowledge of  
39           First Nations indigenous people into ecosystem  
40           modelling and...

41        DR. TRITES: I, as a member of COSEWIC, we have a  
42           subcommittee that does bring traditional knowledge  
43           to our committees. It influences the status  
44           reports we do. And so that information is used.  
45           Sometimes it may not be quantitative, but it is  
46           qualitative in a way that we can put into the  
47           models to look at changes over time, for example.

1 So the models are built with a wide variety of  
2 information, and certainly do value any insights  
3 that people have about the systems, how they were  
4 and what's being seen today. Sometimes the models  
5 are also very good for, you know, even verifying  
6 observations that people have made using a  
7 different set of data, a different set of  
8 observations, and then collectively they help to  
9 build a fuller understanding of what has happened.

10 Q And perhaps I could just ask you, Dr. Ford, or  
11 you, Mr. Olesiuk, is DFO Science, if you're  
12 working on an ecosystem approach, which is  
13 suggested in the Strait of Georgia study, is  
14 traditional ecological knowledge being used in the  
15 creation of indicators for that model?

16 DR. FORD: I can't speak to the modelling exercises,  
17 because that's outside of my area. But I can  
18 confirm that traditional knowledge is incorporated  
19 wherever possible in development of recovery  
20 strategies for species that are listed under the  
21 **Species at Risk Act**, including all the whale  
22 species, and other marine mammals, sea otters that  
23 had been listed, so that is an important component  
24 of those efforts.

25 MR. OLESIUK: And in the case of my work, the modelling  
26 I'm doing, we're working with species that I don't  
27 think there is a history of any sort for hake in  
28 the Strait of Georgia that I'm aware of. But our  
29 general marine mammal, our pinniped assessments,  
30 we try to gather as much knowledge from all  
31 sources before we go out and survey a new area,  
32 for example, and we'll work with all groups,  
33 including First Nations, to sort of identify where  
34 haul-out sites are and to make sure that we  
35 include them in our surveys.

36 Q Okay. Thank you for that. I guess my next set of  
37 questions will be directed to you, Mr. Olesiuk,  
38 and anyone else can follow up. I am specifically  
39 talking about now pinnipeds and harbour seals.  
40 And, Mr. Lunn, if you could pull up Exhibit 796  
41 and go to slide 30. Thank you.

42 Mr. Olesiuk, yesterday in testimony you  
43 talked about that harbour seals had not been  
44 systemically studied on the Fraser River and no  
45 study had been done, and then you talked about  
46 that studies could be done. And I believe  
47 yesterday one of the study papers suggested that



1           you had an outline of how that could be done. And  
2           I'm wondering about this thing, this table here,  
3           and it gives an estimate of harbour seals. Now,  
4           did that include in the Fraser River, or this is  
5           estimate outside of that?

6       MR. OLESIUK: It does not include the Fraser River.  
7           And the information that we have, there were  
8           studies done in the '50s at both the upper reaches  
9           of the Skeena and Fraser River, and as far as we  
10          know there are seals a long ways up the river, but  
11          in relatively low abundance. And probably an  
12          insignificant number, compared to the B.C.  
13          population.

14       Q       Right. And what would that be based on, like, how  
15          would you know that number of abundance?

16       MR. OLESIUK: It would be based on the surveys that  
17          were done up there in the '50s, where they made a  
18          concerted effort to -- and noted large  
19          concentrations of seals at the mouth of the  
20          Fraser, but very few seals upriver. We do include  
21          the animals in the lower part of the river in our  
22          surveys. And then just anecdotal reports we  
23          receive from, you know, fishery officers, whoever  
24          are in those areas, what we get are reports of  
25          scattered individuals, not -- I don't know of any  
26          major haul-out sites.

27       Q       But other than the 1950 study there's nothing more  
28          recent to say whether the abundances of harbour  
29          seals in the river may have changed since the  
30          1950s to today, there's no systematic quantitative  
31          data of that?

32       MR. OLESIUK: No systematic quantitative, just these  
33          anecdotal reports.

34       Q       Okay. And so then yesterday you were speaking of  
35          a follow-up workshop with DFO scientists where you  
36          worked on sort of the widely perceived predators.  
37          You discussed that yesterday. And one of the  
38          things I wanted to know is what do you think  
39          drives the wide perception, I guess, that harbour  
40          seals, because you mentioned harbour seals as one  
41          of the widely perceived predators. What do you  
42          think drives that perception, then, if there isn't  
43          actual quantitative data of the number of seals  
44          in, say, the Fraser River?

45       MR. OLESIUK: Well, what drives the perception that  
46          they're a salmon -- a key salmon predator is that  
47          their predation on salmon is concentrated in

1 rivers and estuaries where there tend to be a lot  
2 of people. A large prey like salmon are brought  
3 to the surface and so you can see seals feeding on  
4 salmon. Small prey like herring are consumed  
5 underwater. Hake are consumed at night when they  
6 migrate up in the water column. So if you watch  
7 seals feeding, basically what you see them feeding  
8 on is salmon. So that's why they're perceived to  
9 be the most important pinniped predator.

10 In reality, the Steller sea lions are the  
11 most important predator, but their predation is  
12 occurring offshore, ten to 30 to 40 kilometres  
13 offshore, as salmon are entering coastal waters.  
14 And that's out of sight, out of mind, people don't  
15 observe that and you don't appreciate the level of  
16 predation that's going on.

17 Q Right. Mr. Lunn, if you could take me to our Tab  
18 3, and this a letter to the Marine Mammal  
19 Coordinator for Fisheries and Oceans in the  
20 Pacific Region, and from Keith Forrest, who is a  
21 test fishing biologist, and here they're  
22 discussing a test fishing site and predation by  
23 harbour seals. And in the second paragraph they  
24 talk about:

25  
26 ...the Cottonwood and Whonnock test fisheries  
27 severely impacted by seal presence and  
28 predation. Seals now consume a significant  
29 proportion of salmon that are caught - up to  
30 100% of the catch.  
31

32 Now, yesterday you referred to marine mammals  
33 taking stock at certain specific sites like test  
34 fishing sites. Am I to understand that's known as  
35 depredation, is that the term that you used?

36 MR. OLESIUK: Yes.

37 Q Okay. And I guess I'm wondering is if the test  
38 fishing sites and these kinds of, I guess, letters  
39 and that sort of thing, sort of drives that idea  
40 that harbour seals are high predators within the  
41 Fraser River, when people see them at test sites  
42 and that, taking a lot of salmon. Would you agree  
43 with that?

44 MR. OLESIUK: Yeah, and that's just part of the  
45 perception issue. The seals are opportunistic  
46 predators. They'll take the fish wherever they  
47 are most vulnerable, and if that's in nets and at

- 1 weirs and things, that's where they'll take fish  
2 over rather than free-swimming salmon.
- 3 Q Right. And I guess my final question in this line  
4 of questioning is do you think that the Department  
5 maybe perhaps could better communicate the results  
6 of, say, your research to date, and perhaps the  
7 Technical Report, that harbour seals you don't  
8 believe are a major predator, somehow to offset  
9 that perception, even for our clients who have,  
10 you know, a concern or about these issues. Is  
11 there something that could be done in terms of  
12 communicating that low level, lower levels of  
13 predation.
- 14 MR. OLESIUK: There is, and we have in the past, and  
15 it's too far in the past, put out sort of  
16 brochure-type documents that translate our  
17 research into information for public consumption.  
18 And we should be doing more of that, it just...
- 19 Q And perhaps just a follow-up question then is, so  
20 those pamphlets are no longer being produced for  
21 the public by DFO?
- 22 MR. OLESIUK: They're not. The last one was really  
23 done in like the late '80s and is outdated.
- 24 Q Right. And is that just a funding issue, or...
- 25 MR. OLESIUK: It's a funding and priority issue. I  
26 think there's been a more recent cetacean pamphlet  
27 put out that -- I'll let John answer that.
- 28 DR. FORD: That's true. There are efforts also under  
29 -- more so in recent years with providing  
30 information on the DFO website, and so that is  
31 becoming, I think, more and more the sort of forum  
32 for interacting with the public in terms of  
33 providing science information.
- 34 Q Right.
- 35 MR. OLESIUK: And I should add that I forgot that when  
36 we write a technical report and it's peer  
37 reviewed, there is almost always an accompanying  
38 Science Advisory report, and those are written for  
39 managers, but the requirement is that we eliminate  
40 scientific jargon. And so that a naturalist or an  
41 interested person would find those useful, and  
42 they are posted on our website.
- 43 Q Right. And are these scientific data or science  
44 outcomes, if you will, communicated at broader  
45 meetings, do you know, I mean, do you report out  
46 to managers, and then if there's meetings between  
47 First Nations along the Fraser River and managers

1 from DFO, do you know if this information that  
2 you've found through your scientific studies is  
3 communicated to First Nations?

4 MR. OLESIUK: Yeah, and again insofar as sort of time  
5 allows, we do, you know, I routinely give talks to  
6 various, from naturalists to sport fishing  
7 organizations, to, you know, commercial fishery  
8 management groups, give talks on sort of an update  
9 of the work we're doing and what the priorities  
10 and issues are.

11 Q Okay. I think I'll just leave that line of  
12 questioning there. My last question for you, Mr.  
13 Olesiuk, is yesterday you talked about harbour  
14 seal impacts, and you mentioned that they may have  
15 -- or, you may have actually been speaking also  
16 for Steller sea lions, it wasn't clear, had small  
17 depressed -- could have an impact on small  
18 depressed salmon stocks.

19 Yes, sorry. Perhaps I could just mark our  
20 Tab 3 as an exhibit, sorry.

21 THE REGISTRAR: Exhibit number 799.

22  
23 EXHIBIT 799: Letter from K. Forrest to M.  
24 Joyce re Initial Trials of an Electric Pulse  
25 Deterrent System to Protect Salmon Catches in  
26 Gillnets from Predation by Harbour Seals in  
27 the Fraser, November 2, 2006  
28

29 MS. REEVES: Thank you.

30 MR. OLESIUK: Yes. And that is particularly an issue  
31 for harbour seals.

32 Q Harbour seals.

33 MR. OLESIUK: Impacts on salmon stocks.

34 Q And what depressed salmon stocks were you  
35 specifically referring to there?

36 MR. OLESIUK: The best-known cases are Puntledge River  
37 summer chinook, but I think those, there are  
38 similar issues with several chinook stocks in the  
39 Strait of Georgia, Cowichan chinook, Quinsam  
40 chinook.

41 Q Right. And did it relate at all to Cultus or  
42 Sakinaw sockeye?

43 MR. OLESIUK: Well, Sakinaw sockeye is another -- would  
44 be a prime example, that there was an anecdotal  
45 information that seals were feeding on salmon in  
46 the small river that connects Sakinaw Lake to the  
47 Strait of Georgia. And we did actually issue --

1           there are so few sockeye that it wouldn't be  
2           practical to go in there and do a Science  
3           assessment, but we did issue a nuisance seal  
4           licence to remove any seals feeding in that  
5           immediate area, just because that run was so  
6           seriously depressed.

7           Q     And what about any of the other Fraser River  
8           sockeye, would it impact any of them?

9           MR. OLESIUK: I don't think Fraser River sockeye, but  
10          if you look at some of the steelhead runs and some  
11          of the depressed coho stocks, I would have  
12          concerns with seal predation on those stocks.

13          MS. REEVES: Okay. Thank you for that. Those are my  
14          questions.

15          MS. TESSARO: I'm not sure if Mr. Timberg has any  
16          questions in re-examination.

17          MR. TIMBERG: No.

18          THE COMMISSIONER: Ms. Tessaro, I wonder if I could  
19          just ask one brief question of this panel.

20

21          QUESTIONS BY THE COMMISSIONER:

22

23          Q     I ask it because Mr. Leadem raised it, and I'm not  
24          sure in fairness to the three of you, whether  
25          you're the appropriate panel members to answer.  
26          But I was trying to -- perhaps, Mr. Lunn, if we  
27          could bring up Exhibit 795, and I think Dr. Ford  
28          mentioned that this April 2011 in-house DFO  
29          session or workshop was a follow-up to the June  
30          2010 Pacific Salmon Commission Forum; is that  
31          correct?

32          DR. FORD: That's correct.

33          Q     Right. What I was trying to understand, and again  
34          in fairness to you, you may not be the people to  
35          answer this, but within DFO, or within the larger  
36          community of science, and I'm talking about  
37          Science within DFO and the larger community, is  
38          there an ongoing overarching body that does the  
39          macro analysis, drawing together all the streams  
40          of research that are taking place, trying to  
41          understand it, and then share that in a way that  
42          allows you to draft an agenda for some suggestions  
43          to go forward, other than on a reaction basis  
44          where there's some event that you react to, but on  
45          an ongoing basis. Now, you may not know because  
46          you're working in specific areas, and you may not  
47          be aware of this, but I'm just trying to

1 understand, and your answers to Mr. Leadem about  
2 who's going to draw the agenda, who's going to  
3 drive the research. I think Dr. Trites mentioned  
4 there are private foundations and obviously  
5 universities and others who are involved in a  
6 variety of research projects. I'm just trying to  
7 get a sense of is this a scrambled situation in  
8 our world of research, or is there actually some  
9 game plan here now in 2011 and going forward that  
10 takes advantage of all this work that's been done  
11 and tries to get a sense of for the politicians  
12 and the bureaucrats and the managers, where should  
13 they be going forward, and where should they be  
14 assigning the resources to go forward?

15 DR. FORD: I think those are excellent questions, and  
16 if I could speak broadly, of course, DFO Science  
17 is involved with a wide diversity of different  
18 kinds of research activities on a wide variety of  
19 different taxon groups, from whales to seals to  
20 invertebrates and fish and so on, and those in, I  
21 think, historically, we're rather isolated in  
22 their direction. I think with the move broadly  
23 towards ecosystem-based management, and I think  
24 the Strait of Georgia Research Initiative is an  
25 example of how to catalyze those kinds of  
26 interactions and those kinds of syntheses that are  
27 needed to better understand the interconnections  
28 between predators and prey, for example.

29 If I could provide perhaps just a quick  
30 example in my own area. We about five years ago  
31 discovered that resident killer whales, which I  
32 was describing yesterday, appeared to be dependent  
33 on chinook salmon to the point that several years  
34 of depressed chinook salmon abundance availability  
35 in the late '90s caused a very significant  
36 increase in the mortality rate of killer whales.  
37 And so it appeared that there's a strong  
38 connection there. And when chinook stocks  
39 recovered in the early 2000s and went above the  
40 long-term average, the killer whale mortality  
41 rates went down below normal. And so as a result  
42 of that, we've been working with internally to  
43 work with chinook salmon managers to better  
44 understand the -- how for us in the marine mammal  
45 section, how salmon management functions and how  
46 predation is incorporated into the management  
47 plans.

1           And this has then led to an upcoming series  
2           -- or I should say a recent meeting that took  
3           place in March where we brought together experts  
4           from DFO Science, in terms of salmon and marine  
5           mammals, DFO salmon managers, and also our  
6           colleagues from the U.S. National Oceanic and  
7           Atmospheric Administration, and science personnel  
8           in both mammals and salmon, to start better  
9           understanding what can be done to accommodate the  
10          needs of these predators in the management of  
11          fisheries. And this now is going to lead to a  
12          series of workshops co-sponsored by DFO and NOAA  
13          in the U.S. over the next two years to better  
14          refine the kinds of management tools that we have  
15          at our disposal to ensure that these ecosystem  
16          connections are recognized in fisheries management  
17          to provide for, in this case, the recovery of  
18          killer whales.

19          So that's just an example of how these  
20          different disciplines are brought together.

21          Q     Thank you. Dr. Trites?

22          DR. TRITES: Maybe I can give you sort of my  
23          perceptions as an academic. I think the killer  
24          whale example that Dr. Ford just gave is a good  
25          one in a sense, but that's a cross-boundary issue  
26          and almost by definition then brings in the U.S.  
27          researchers from the other side.

28          I think in terms of fisheries management,  
29          let's say within British Columbia, as an academic,  
30          I don't feel that there is a game plan. I think  
31          we look towards DFO to take leadership in this.  
32          But often I think the academics would feel that  
33          their opinion is that we are training the graduate  
34          students to ultimately be fisheries managers or  
35          the major fisheries researchers. I think there's  
36          a tendency to feel quite cut off from that as a  
37          result. There are a number of independent  
38          initiatives. I think some of the foundations  
39          would probably share some of those same views. I  
40          think we could be doing a lot more together.

41          This ecosystem research initiative was a  
42          wonderful initiative, but the academics aren't  
43          involved. There was no money to include. And so  
44          I think that there are initiatives that could be  
45          taken to make sure we have all the brightest minds  
46          in British Columbia working together to solve  
47          these problems. But at this point I think there's

1 too many independent initiatives and we can do a  
2 lot more by working together.

3 THE COMMISSIONER: Mr. Olesiuk?

4 MR. OLESIUK: Yeah, and I was just going to follow up.  
5 And again I think the ecosystem research  
6 initiative stands out as an example of a project  
7 that was not reactionary to any issue, it was more  
8 visionary. We recognize the Strait of Georgia is  
9 an important ecosystem, and the theme of the whole  
10 project was to sort of plan for what the Strait  
11 will look like 30 years from now in the future.

12 And I think what's happened, though, is that  
13 we now have the **Oceans Act**. It used to be the  
14 Department of Fisheries operated solely under the  
15 **Fisheries Act**, which was basically resource  
16 management. I think we now, with the **Oceans Act**  
17 have a much broader mandate that will hopefully  
18 increasingly consider the broad ecosystem  
19 interactions.

20 THE COMMISSIONER: Dr. Ford, did you want to add...

21 DR. FORD: I just wanted to follow-up on a comment Dr.  
22 Trites made, and I neglected to mention that in  
23 these upcoming -- in this recent meeting to do  
24 with killer whales and chinook salmon, there were  
25 in fact representatives from academia, from non-  
26 governmental organizations involved in the  
27 workshop that was a three-day workshop, I believe.  
28 And in these upcoming joint meetings with our U.S.  
29 colleagues, it's actually going to be -- these  
30 meetings, these workshops are going to be modelled  
31 after the PSC meeting from last June, where  
32 there's an expert panel who will be overseeing all  
33 the science that's presented and discussed, and  
34 they will synthesize recommendations from those  
35 discussions. And that panel will not include, it  
36 will be dominated by non-governmental science  
37 representatives from universities and elsewhere.

38 THE COMMISSIONER: Thank you.

39 DR. TRITES: And just as a final point, I think that  
40 killer whale workshop is a great example and a  
41 great model of the way things could be, and it  
42 would be nice to see that extended to other  
43 species, such as sockeye salmon.

44 THE COMMISSIONER: Thank you very much.

45 MS. GAERTNER: Mr. Commissioner, I wonder if I might  
46 follow with one question based on your question,  
47 if that's possible, and I think it's an important



1 -- I mean, I very much appreciate the nature of  
2 the importance of your question, and it's one  
3 that's been one that my clients watch with much  
4 care. And so if I could just contribute to this  
5 dialogue, I would like to. And it's Brenda  
6 Gaertner for the First Nations Coalition.  
7

8 CROSS-EXAMINATION BY MS. GAERTNER:  
9

10 Q I heard in the question, a part of the  
11 Commissioner's question, this notion that science  
12 should take the lead. My clients, of course,  
13 might take issue with that, Commissioner Cohen,  
14 because in our view ecosystem management, of  
15 course, is something First Nations have been doing  
16 all their life, and so they believe they have  
17 something very important to contribute in that.  
18 And that ecosystem management requires a  
19 collaborative look, right from the get-go, on how  
20 we look at the environment, how we feel as part of  
21 the ecosystem, how we are a part of the ecosystem,  
22 what indicators we look at, what questions we ask  
23 of science, who reviews the results, all of those  
24 things.

25 And so I wonder if you, as learned people in  
26 this field with different perspectives, might also  
27 want to add a comment on how important it is to  
28 have the body that's asking the questions to  
29 reflect deeply, a multidisciplinary approach,  
30 including very respectfully the First Nations'  
31 approach to the ecosystem.

32 DR. TRITES: Perhaps I'll start on that. I wasn't  
33 saying that science should take the lead. My  
34 feeling was that DFO as the management agency  
35 should be playing a greater leadership role in  
36 this. In doing so, I believe they should be more  
37 inclusive. I feel particularly academics, NGOs,  
38 First Nations, people who are concerned about the  
39 health of our oceans, and long-term  
40 sustainability. So I think indeed it does take a  
41 more collaborative approach. I think the workshop  
42 that Dr. Ford made reference to is a good example  
43 of bringing people together. And I think even  
44 that initiative can be expanded. Hopefully we'll  
45 see more of that in the future.

46 Q Dr. Ford.

47 DR. FORD: I'm definitely not the best to address

1 broader policy issues for DFO. I can only really  
2 speak to my own area of experience in interaction  
3 with First Nations in the science that we  
4 undertake. And we do work very closely with  
5 various different First Nation groups on surveys  
6 for marine mammals, cetaceans, in various regions  
7 of the British Columbia coast that are funded by  
8 the **Species at Risk** program. We work very closely  
9 with them to -- in survey designs, in collection  
10 of data, and in basically providing guidance to  
11 help address the kinds of questions they have in  
12 regions, in the different regions of the coast.  
13 So we have and are working quite closely with  
14 different First Nations groups at that level.

15 MR. OLESIUK: And I'll just say I do think there has  
16 been an improvement in our sort of consultation  
17 and inclusion of all interests, including First  
18 Nations. If you look at, you know, recovery  
19 planning of something under **SARA**, or development  
20 of that sea lion management plan, those things we  
21 tend to have workshops that are, or meetings that  
22 are inclusive rather than exclusive and try to  
23 have all interests represented including First  
24 Nations, I believe.

25 MS. GAERTNER: I'm not going to take any more time,  
26 Commissioner Cohen. This is a topic that we're  
27 going to pursue hopefully more with the next  
28 panel, so it's great that we have the opportunity  
29 now.

30 THE COMMISSIONER: Thank you very much, Ms. Gaertner.

31 MR. TIMBERG: Mr. Commissioner, I have one brief  
32 question just to follow up on your question.  
33

34 CROSS-EXAMINATION BY MR. TIMBERG, continuing:  
35

36 Q The question is who at DFO is the person who could  
37 provide the Commissioner with an answer to this  
38 question about a macro analysis of science  
39 projects?

40 DR. FORD: I believe it would be Dr. Ian Perry, who has  
41 been overseeing the Strait of Georgia Ecosystem  
42 Research Initiative. I think he would be the best  
43 person to go to first.

44 Q Okay, thank you. Mr. Olesiuk, do you have  
45 anything further?

46 MR. OLESIUK: No, but and if you -- for who is included  
47 in these discussions, I would look at the Marine

1 Mammal Coordinator and the **SARA** Coordinator to see  
2 who are invited to participate in these processes.

3 MR. TIMBER: Thank you.

4 MS. TESSARO: Mr. Commissioner, I have just three quick  
5 issues in re-examination, which will take us no  
6 further than 11:00.

7

8 RE-EXAMINATION BY MS. TESSARO:

9

10 Q The first question is for Mr. Olesiuk and Dr.  
11 Trites. I'm going to see if we can achieve some  
12 agreement on slide 27 of Exhibit 796. Both of you  
13 commented on either this slide or another version  
14 of it. Mr. Timberg put this slide to you, Mr.  
15 Olesiuk, and a similar version was commented on by  
16 Dr. Trites, although the fish, the species were  
17 ordered differently in the other version. And my  
18 question is, looking at that red bar of sockeye or  
19 pink -- I'll ask you, Mr. Olesiuk, first. As a  
20 basic default scientific assumption, wouldn't one  
21 assume that that large -- that 15 percent bar  
22 there would mostly likely break down in similar  
23 proportions as the sockeye and pink in the other  
24 bars?

25 MR. OLESIUK: That --

26 Q Could I ask you to turn on your mike, please.

27 MR. OLESIUK: Yes. That concept is right. If you  
28 could go to maybe the next slide or the slide  
29 after, can we just advance one at a time here. I  
30 will -- yeah, that's actually the slide, that's  
31 the key slide right there. And that you have, you  
32 would partition the unknowns based on what is  
33 known.

34 Q Right.

35 MR. OLESIUK: And so most of the sockeye that sea lions  
36 are consuming are on the Scott Islands, that pie  
37 to the left. And there are -- I would draw your  
38 attention to the three sections on the right: the  
39 dark red is the known sockeye, the red is the  
40 unknowns, and the pink are pink salmon. And so  
41 you would partition them based on where the  
42 unknowns occurred, not just in the whole sample.  
43 And so based on that, I would kind of assume that  
44 about half of the unknowns would be pink and half  
45 sockeye. And then the rest of the sockeye are  
46 being consumed along the West Coast, a much lower  
47 fraction of the total. And in that case the

1 unknowns occur where relatively few sockeye were  
2 identified and lots of pink, and I would partition  
3 those based on -- the unknowns based on the  
4 relative percentage of the knowns. And then you  
5 need to weight these according to how many sockeye  
6 are being consumed in each of those areas. But  
7 it's kind of 50/50, because most of the sockeye  
8 are in the Scott Islands.

9 And just that I realize that the timing is  
10 awkward, but I expect to have the results of those  
11 unknowns next week, so it's...

12 Q Oh, you shouldn't offer things like that. I'm  
13 just teasing you. I'm just teasing you.

14 I'm going to ask Dr. Trites if he could  
15 comment on that assessment of how one would, in  
16 Mr. Olesiuk's words, "partition the unknown".

17 DR. TRITES: No, I would do just as he's done, and  
18 expect the results will come out that way. And  
19 we'll see when those DNA results come back, if the  
20 expectation that there's probably more pinks in  
21 that unknowns than sockeye stands up or not. But  
22 that would be my guess.

23 And maybe one other point to make in this is  
24 you have to keep in mind that these were samples  
25 that didn't come from the mouth of the Fraser.  
26 They came in this case from the Scott Islands.  
27 And so we're making assumptions that all those are  
28 Fraser River sockeye. Some of those could have  
29 been Columbia River or other runs. And so you  
30 have to keep in mind that without doing more work,  
31 you have to figure out the origins of that DNA,  
32 which runs they were. We're making some  
33 assumptions here about how to break that up by  
34 rivers.

35 Q That's helpful, thank you. My second question is  
36 for Dr. Ford and Mr. Olesiuk, and this relates to  
37 Exhibit 797, if we could pull that up, Mr. Lunn.  
38 Mr. Olesiuk, you were asked by Mr. Timberg whether  
39 you agreed that the Steller sea lion management  
40 plan is similar to resident killer whale  
41 management that Dr. Ford had described earlier.  
42 Do you remember that question?

43 MR. OLESIUK: Vaguely.

44 Q Could I ask you to turn on your mike.

45 MR. OLESIUK: Yeah, I vaguely remember it.

46 Q And your answer to the question was yes, and I'm  
47 going to suggest to you and to Dr. Ford that the

1 way that DFO manages salmon and resident killer  
2 whales on one hand, and the way that DFO manages  
3 salmon and Steller sea lions on the other hand, is  
4 clearly different in one fairly obvious respect.  
5 And so my first question for you, Mr. Olesiuk, is  
6 that this Management Plan for the Steller Sea Lion  
7 obviously does not identify critical habitat,  
8 right?

9 MR. OLESIUK: Correct. And I think there was a  
10 question I was asked of what are the requirements  
11 for a species of special concern, and the  
12 requirement is a management plan, but not  
13 definition of critical habitat. If a species is  
14 threatened or endangered, that requires a recovery  
15 plan, which is different than a management plan,  
16 and designation of critical habitat.

17 Q Exactly. And so, Dr. Ford, in contrast, for the  
18 resident killer whales, DFO as a function of that  
19 recovery strategy is actually required to legally  
20 protect salmon availability as a part of the  
21 resident killer whales' critical habitat, right?

22 DR. FORD: That's correct.

23 Q And so my final question is one that arose out of  
24 the discussion we've been having with -- arising  
25 from the Commissioner's question about is there an  
26 overall game plan for all these science pieces to  
27 come together, and my question is, in your work as  
28 marine mammal scientists doing this research and  
29 looking at the relationship between marine mammals  
30 and their prey, and salmon, who at DFO gives you,  
31 if anybody, direct guidance on ensuring that your  
32 science is part of that overall management game  
33 plan. Who do you understand to be the captain of  
34 the team? Who's creating that game plan and  
35 saying, we need this science from you, Dr. Ford,  
36 or we need this science from you, Mr. Olesiuk, to  
37 ensure that the marine mammal piece of our big  
38 game plan is fit. Do you know of that person  
39 exists?

40 DR. FORD: In terms of marine mammal interactions with  
41 management, it's really facilitated by the Marine  
42 Mammal Management Coordinator, Paul Cottrell, who  
43 is in Fisheries and Aquaculture Management, and  
44 interacts with various fisheries managers as well  
45 as with habitat issues that would potentially  
46 impact marine mammals. So major construction  
47 projects, seismic exploration surveys for

1 geophysical research, you know, these kinds of  
2 things could have impacts on marine mammals. So  
3 the marine mammal management coordinator is the  
4 key sort of liaison with all these other sectors.  
5 Q So "liaison" is a very interesting word, and  
6 that's how I also understand Paul Cottrell's very  
7 important role, he's liaising between the managers  
8 and the scientists. But who is making -- who's  
9 designing the game plan that Mr. Cottrell is being  
10 responsive to? That's more the question. Who's  
11 deciding, for example, how marine mammals and  
12 their pretty will be co-managed in the Strait of  
13 Georgia. Do you know who on the other end of Paul  
14 Cottrell is making that decision, or giving that  
15 direction?

16 DR. FORD: That's a difficult question. It depends on,  
17 you know, the species involved, the kinds of  
18 interactions that are -- that reveal themselves to  
19 be significant. And I think I can just speak  
20 again to the resident killer whale/chinook  
21 interaction as an example of the kinds of -- the  
22 process that was involved. When it was -- as soon  
23 as it was recognized that chinook salmon were sort  
24 of counter-intuitively so important to these  
25 animals, that triggered a series of interactions  
26 with management to better understand again how  
27 predation is taken into account and then what the  
28 next steps might be.

29 So I just think it really is through an  
30 ongoing sort of dialogue interaction between  
31 Science and Management, and again facilitated by  
32 the Marine Mammal Manager to bring those groups  
33 together.

34 Q Dr. Olesiuk, is there anything you disagree with  
35 in that?

36 MR. OLESIUK: I don't disagree, but I was going to say  
37 that we are, like I mentioned before, it's a two-  
38 way street. We are constantly feeding up to  
39 managers what we think are issues that might be  
40 important. But ultimately, we don't decide what  
41 assessments to do, you know, whether to go out and  
42 do a sea lion study or a harbour seal study in a  
43 certain area. Those come through management  
44 questions, requests for science advice. And then  
45 that in turn translates to allocating and  
46 identifying priorities for funding, and that would  
47 be done, at my level, the priorities are set by

1           our Division Chief, who would, "Okay, well,  
2           management is asking for this particular advice.  
3           Can we afford to do it? How are we going to, you  
4           know, how much is it going to cost?"

5           Q    My last question is just who is your Division  
6           Chief, what's that person's name?

7           MR. OLESIUK: Laura Brown.

8           Q    Right, thank you.

9           MR. OLESIUK: So that she is Marine Ecosystems and  
10          Aquaculture Division.

11          MS. TESSARO: Thank you. Mr. Commissioner, we're at  
12          eleven o'clock. I'm going to suggest that we take  
13          an early break to facilitate the panellists  
14          changing.

15          THE COMMISSIONER: Thank you very much, Ms. Tessaro.

16          MS. TESSARO: Thank you.

17          THE REGISTRAR: The hearing will now recess for 15  
18          minutes.

19  
20                   (PROCEEDINGS ADJOURNED FOR MORNING RECESS)  
21                   (PROCEEDINGS RECONVENED)

22  
23          THE REGISTRAR: Order. The hearing is now resumed.

24          MR. WALLACE: Good morning, Mr. Commissioner, Brian  
25          Wallace, Commission counsel. I am here to  
26          introduce the second panel on the predation  
27          hearings. These gentlemen will address the issues  
28          principally of fish predation but also there will  
29          be some discussion of birds. Dr. Christensen has  
30          been here before, yesterday, and has been  
31          affirmed. And next to him is Mr. Jeremy Hume and  
32          Mr. Gordon McFarlane. And I wonder, Mr. Giles, if  
33          you could affirm the new witnesses.

34          THE REGISTRAR: Yes.

35  
36                   JEREMY HUME, affirmed.

37  
38                   GORDON McFARLANE, affirmed.

39  
40          THE REGISTRAR: Would you state your name, please?

41          MR. HUME: Jeremy Hume.

42          THE REGISTRAR: Thank you. Would you state your name,  
43          please?

44          MR. McFARLANE: Gordon McFarlane.

45          THE REGISTRAR: Thank you. Counsel?

46          MR. WALLACE: Thank you.

1 EXAMINATION IN CHIEF ON QUALIFICATIONS BY MR. WALLACE:

2

3 Q Mr. McFarlane, let me start with you.

4 MR. WALLACE: I would ask, Mr. Lunn, if you could put  
5 Tab 24 from the Commission's documents on the  
6 screen, which -- I'm sorry. That's the wrong one.  
7 Mr. McFarlane is Tab 25.

8 Q Just, if I may, briefly, Mr. McFarlane, the  
9 document on the screen, is that your *curriculum*  
10 *vitae*?

11 MR. McFARLANE: Yes, it is.

12 MR. WALLACE: Mr. Giles, could we mark that, please, as  
13 the next exhibit?

14 THE REGISTRAR: Exhibit 800.

15 MR. WALLACE: A milestone.

16

17 EXHIBIT 800: *Curriculum Vitae* of Gordon  
18 McFarlane

19

20 MR. WALLACE:

21 Q Mr. McFarlane, you are a DFO scientist *emeritus*?

22 MR. McFARLANE: Yes.

23 Q At the Pacific Biological Station. And you  
24 graduated from the University of Winnipeg in  
25 science in 1971 and have been involved, I think,  
26 in fisheries research ever since?

27 MR. McFARLANE: Yes, that's correct.

28 Q And for the last 30 years, you have studied marine  
29 life extensively in the Georgia Strait, correct?

30 MR. McFARLANE: As well as other parts of our coast,  
31 yes.

32 Q Thank you. And that research centres on  
33 biological parameters, that is, age, growth and  
34 mortality, et cetera, to be used in stock  
35 assessments and examining climatic and oceanic  
36 factors influencing the dynamics of marine fish  
37 and the physical, biological and fisheries  
38 oceanographic linkages of large marine ecosystems.  
39 Does that cover it?

40 MR. McFARLANE: Yes, that covers it.

41 Q Thank you. In the course of this research, am I  
42 correct that you have done a fair amount of field  
43 research collecting and analyzing stomach content  
44 data on predator-prey relationships in British  
45 Columbia waters?

46 MR. McFARLANE: Yes.

47 Q And you have studied the biology and distribution



1 of sharks and skates off the west coast of Canada?

2 MR. McFARLANE: Yes, I have.

3 Q You were, I think, the head of Marine Fish  
4 Population Dynamics at PBS from '92 to 2000?

5 MR. McFARLANE: Yes.

6 Q And the head of the Groundfish Research Section  
7 prior to that?

8 MR. McFARLANE: Correct.

9 Q You're a long-time member and advisor to the  
10 International Negotiating Teams for the INPFC, the  
11 Canada/U.S. Groundfish Committee PICES, the  
12 Pacific Hake Scientific Working Group, that's  
13 correct?

14 MR. McFARLANE: Yes.

15 Q And you've participated in the development and  
16 conduct of a number of international research  
17 projects?

18 MR. McFARLANE: Correct.

19 Q I understand you've authored some more than a  
20 hundred primary publications on biology and over a  
21 hundred technical publications relating to stock  
22 assessment of pacific marine fish?

23 MR. McFARLANE: Correct.

24 MR. WALLACE: Mr. Commissioner, I would submit that Mr.  
25 McFarlane is qualified, by his experience, as an  
26 expert to speak to marine fish predation on  
27 sockeye salmon.

28 THE COMMISSIONER: Thank you.

29 MR. WALLACE: Thank you.

30 Q Mr. Hume, I'll ask Mr. Lunn to put your c.v. on  
31 the screen.

32 THE COMMISSIONER: Did you wish to mark the earlier  
33 c.v.?

34 MR. WALLACE: Oh, thank you, Mr. Commissioner.

35 THE COMMISSIONER: Or has it been marked?

36 THE REGISTRAR: That was marked as 800.

37 THE COMMISSIONER: That's 800?

38 MR. WALLACE: Thank you.

39 Q Mr. Hume, can you identify this document on the  
40 screen as your *curriculum vitae*?

41 MR. HUME: Yes, it is.

42 MR. WALLACE: And Mr. Giles, could you mark that,  
43 please, as the next exhibit?

44 THE REGISTRAR: Exhibit 801.

45

46 EXHIBIT 801: *Curriculum Vitae* of Jeremy Hume

47

1 MR. WALLACE:

2 Q Mr. Hume, you have a Masters degree in aquatic  
3 ecology from UBC in 1979, correct?

4 MR. HUME: That's correct.

5 Q And your career has focused principally on  
6 research into the ecology of juvenile salmonids,  
7 particularly sockeye salmon?

8 MR. HUME: That's correct.

9 Q You first conducted research, I believe, for DFO  
10 on juvenile sockeye in Babine Lake. You were then  
11 with the B.C. Ministry of Environment where you  
12 conducted research into management-related  
13 freshwater fishery problems, correct?

14 MR. HUME: Yes.

15 Q And for the last 24 years, you have been the  
16 senior fisheries biologist for DFO's lake research  
17 program, the principal objectives of which are to  
18 determine the trophic status, productive  
19 capacities and limiting factors for sockeye salmon  
20 rearing in nursery lakes?

21 MR. HUME: That's correct.

22 Q Okay. Am I correct that during the course of this  
23 work, you have also dealt in field research  
24 collecting and analyzing data on the abundance,  
25 survival and growth of juvenile sockeye in lakes,  
26 and in recent years you have initiated and  
27 conducted and reported on the Predator Control  
28 Program for northern pikeminnow in Cultus Lake?

29 MR. HUME: That's correct, yes.

30 Q You have authored some ten primary and over 50  
31 technical publications concerning the biology and  
32 ecology of juvenile salmonids in freshwater  
33 ecosystems?

34 MR. HUME: Yes.

35 MR. WALLACE: Mr. Commissioner, I submit Mr. Hume is  
36 qualified by his education and experience to speak  
37 to freshwater predation on sockeye salmon.

38 THE COMMISSIONER: Thank you.

39 MR. WALLACE: Thank you.

40

41 EXAMINATION IN CHIEF BY MR. WALLACE:

42

43 Q Thank you. I wonder if I might start --

44 MR. TIMBERG: Mr. Commissioner, I'm just wondering if  
45 we could change the exhibit number. We provided  
46 the Commission with a redacted version of the  
47 résumés that took out personal information. We

1           have that in the list at the -- this is the  
2           Commission's list of documents at Tab 24. And  
3           then I have a CAN number, also. The Commission  
4           provided a redacted version at Tab 24.  
5   MR. LUNN: The Commission list?  
6   MR. TIMBERG: The Commission list, yeah.  
7   MR. WALLACE: The one I have is not redacted. May I  
8           suggest that we find the redacted version and  
9           replace --  
10   MR. TIMBERG: We have it right here and I have the CAN  
11           number, too, if Mr. Lunn wants that; it's 185597.  
12   MR. LUNN: That's the document that we filed. It is  
13           listed as Tab 24 with that CAN number so I imagine  
14           there's a redacted version elsewhere.  
15   MR. TIMBERG: Okay. Well, we have a redacted version.  
16           Okay. Well, sorry about that. We'll have to deal  
17           with this later.  
18   MR. WALLACE: I suggest that we will replace this with  
19           our redacted version, taking out Mr. Hume's  
20           personal information today, I hope. The same  
21           issue arises with respect to Mr. McFarlane's c.v.  
22   Q   Thank you. Mr. Hume, you've had an opportunity to  
23           review the Project 8 report that the Commission  
24           had from Dr. Christensen and Dr. Trites?  
25   MR. HUME: Yes, I have.  
26   Q   Do you have any comments on the assessment in that  
27           report of the potential impacts of freshwater fish  
28           predators?  
29   MR. HUME: Yes, I do. I agree in general with their  
30           assessment that freshwater predators probably did  
31           not contribute to the decline in sockeye  
32           production in the Fraser River. I base that on my  
33           own research looking at a fry abundance in  
34           Quesnel, Shuswap and Chilko Lakes and finding no  
35           change in survival rates with time in those lakes,  
36           which indicates the mortality problems are not  
37           occurring in freshwater. So in general, I agree  
38           with their conclusions.  
39           I note that they have missed a few important  
40           documents in their research. The first one was in  
41           1941 by Dr. Ricker on consumption of sockeye  
42           salmon by predacious fish in Cultus Lake. The  
43           second one would be a paper by Ward and Larkin on  
44           cyclic dominance in Shuswap Lake where they  
45           studied rainbow trout predation as well. And a  
46           third one that's also in Shuswap Lake in 1989 by  
47           Gilhousen and Williams where they studied a number

1 of predators of sockeye salmon, including rainbow  
2 and cutthroat and burbot as well.

3 Q Thank you. You have also written on the issue of  
4 rainbow trout predation on sockeye, correct?

5 MR. HUME: I have, yes.

6 MR. WALLACE: And I wonder, Mr. Lunn, if we could have  
7 Tab 30 from the Commission's documents?

8 Q And this is a document that you were a co-author  
9 on I see, Mr. Hume, in 1989, which deals with  
10 rainbow trout predation on sockeye. What was your  
11 overall conclusion in that report?

12 MR. HUME: For the larger rainbow size classes, kokanee  
13 and sockeye salmon are a major food source for  
14 these fish and, in fact, the larger, what they  
15 call trophy rainbow trout, require the presence of  
16 either kokanee or sockeye in the lake with them in  
17 order to reach their large size. We were looking  
18 at this study from a rainbow trout point of view  
19 rather than from a sockeye point of view so their  
20 actual impact on sockeye wasn't considered in the  
21 study but they did provide, particularly in  
22 dominant years, a major source of food for the  
23 rainbow trout in the lake.

24 Q Thank you. And does this paper reflect your  
25 current view on this relationship?

26 MR. HUME: Yes, it does.

27 MR. WALLACE: Thank you. I wonder, Mr. Giles, if we  
28 could mark the 1989 paper referred to of  
29 Parkinson, Hume and Dolighan as the next exhibit?

30 THE REGISTRAR: Exhibit 802.

31

32 EXHIBIT 802: Size Selective Predation by  
33 Rainbow Trout on Two Lacustrine Oncorhynchus  
34 nerka Populations by Parkinson, Hume and  
35 Dolighan, 1989

36

37 MR. WALLACE:

38 Q Next paper I would like to direct your attention  
39 to, Mr. Hume -- actually, let me just introduce  
40 this by referring to your work in Cultus Lake.  
41 You've been actively involved there with respect  
42 to the pikeminnow and the removal program over the  
43 years?

44 MR. HUME: Yes, I have.

45 Q I have a couple of papers here that I'd just like  
46 to refer you to and perhaps you can use those as a  
47 vehicle to tell us how information and knowledge

1           on the pikeminnow and the effectiveness of the  
2           program have developed over the years. And the  
3           first paper I would refer to is at Tab 34 of the  
4           Commission's book of documents. And this is a  
5           2005 paper by William Gazey. And you're familiar  
6           with that paper?

7       MR. HUME: Yes, I am. Sorry. It's not what's up on  
8           the -- oh, yeah, okay.

9       Q     I think the copy we have is missing the cover  
10           page.

11       MR. HUME: Right.

12       Q     So you really have to go to the third page to see  
13           the author's name. And that paper identifies  
14           depensatory predation as the causal mechanism for  
15           low freshwater productivity.

16       MR. HUME: I believe that's on the next page.

17       Q     Yes. That conclusion is on page 3 under  
18           "Conclusions". Thank you. Now, first of all, can  
19           you explain in lay language what that means and  
20           provide us your views as to whether that is an  
21           accurate assessment?

22       MR. HUME: Depensatory mortality is -- I always have a  
23           hard time explaining this one. Basically, say, if  
24           you have a fixed number of predators that are  
25           always hungry so that they try to eat as much as  
26           they can. If there's a small number of fish in  
27           the lake, the predation rate on those fish will be  
28           higher than if there's a larger abundance of fish.  
29           So in very low prey densities, the mortality rate  
30           will be higher on the fish than at the high prey  
31           densities.

32       Q     Thank you. And is that the issue in Cultus Lake?

33       MR. HUME: Yes, it is.

34       MR. WALLACE: Mr. Giles, could you mark that paper by  
35           Mr. Gazey, please, as the next exhibit?

36       THE REGISTRAR: Exhibit 803.

37  
38                   EXHIBIT 803: Report and Recommendations  
39                   prepared by William Gazey, April 27, 2005  
40

41       MR. WALLACE: Now, if I may ask you, Mr. Lunn, to put  
42           Tab 32 on the screen, please?

43       Q     Now, Mr. Hume, this is a paper that you co-  
44           authored, the CSAS paper, in 2010. And that's a  
45           more recent assessment of the status of Cultus  
46           Lake sockeye, correct?

47       MR. HUME: Yes, it is.

1 Q And it discusses, I think, the efficacy of the  
2 recovery measures up to 2010 as well?

3 MR. HUME: That's correct.

4 Q Now, that assessment looked at the predator  
5 control measures?

6 MR. HUME: Yes, it did.

7 Q Can you give us your views on the efficacy of the  
8 predator control? The predator at issue here is  
9 the northern pikeminnow, correct?

10 MR. HUME: Yes, we removed only northern pikeminnow  
11 from the lake.

12 Q Okay. Can you just describe that program and the  
13 limits or not on its effectiveness?

14 MR. HUME: In 2004, we did a mark-recapture population  
15 estimate of the pikeminnow in the lake and came up  
16 with approximately 60 to 70,000 adult northern  
17 pikeminnow in the lake. From starting in 2005  
18 through to, well, currently, right now, it's still  
19 ongoing. We removed approximately 45,000 adult  
20 pikeminnow from the lake. Of course, there's been  
21 replacement from the younger-year classes into the  
22 adult life history stage but we removed a  
23 significant proportion of the northern pikeminnow  
24 from the lake. This has resulted in increased  
25 survival at the current densities of sockeye in  
26 the lake, as we saw increased survival for those  
27 fish relative to years to when no pikeminnow  
28 removal occurred.

29 Q Is there a lesson to be learned about the  
30 effectiveness of predator removal programs from  
31 the Cultus Lake circumstance?

32 MR. HUME: It's hard to expand this study to other  
33 lakes in the system. Every system will be  
34 different. Cultus Lake is a fairly small sockeye-  
35 rearing lake with a relatively easy population of  
36 predators that we could capture and remove.  
37 Certainly, in Cultus, it's shown to be an  
38 effective method to work at low sockeye densities.  
39 Actually, if we go to Figure 11, I believe it is,  
40 in this paper. I'm not sure what page number that  
41 is, I'm sorry. Towards the end. Figures are all  
42 at the end.

43 Q Page 41.

44 MR. HUME: So this figure shows survival on the  
45 vertical axis plotted against the total number of  
46 spawners in the lake. The diamonds are there's no  
47 pikeminnow removal and the circles are years when

1 we did have pikeminnow removal. You can see at  
2 higher densities that there's no apparent effect  
3 on survival at the high densities, whereas at the  
4 low densities, we seem to have a -- we appear to  
5 have a much higher survival rate for fish, say,  
6 less than 6,000 spawners in the lake. So I guess  
7 what we can learn from this is that for  
8 populations that are in trouble, low densities and  
9 spawners, this may be a way to help rebuild the  
10 population by increasing their survival. The lake  
11 is very small. It's unknown whether this  
12 technique could be transferred to other larger  
13 systems.

14 Q The turning point in this model seems to be around  
15 6,000 spawners and this is in a lake that would  
16 support how large a spawning population?

17 MR. HUME: We estimate that it could support anywhere  
18 in the 70 to 80,000, 60 to 80,000 range.

19 Q Has there been any study on the impact on other  
20 ecosystem impacts from the predator removal  
21 program in Cultus Lake?

22 MR. HUME: There is some work being done, yes. Our  
23 regular mid-water trawl work that we do on the  
24 lake monitors all pelagic fish in the region. As  
25 well, we do an annual spawning or beach seine  
26 survey around the lake, usually in September,  
27 looking to detect gross changes in population  
28 estimates and populations of other fish.

29 Q Are you able to draw any conclusions about the  
30 impact of the program on other parts of the  
31 (indiscernible - overlapping speakers)?

32 MR. HUME: The data hasn't been completely analyzed but  
33 certainly there's been nothing that's looked  
34 surprising in a quick examination of the datasets.

35 Q You say nothing that looks surprising?

36 MR. HUME: Sorry. There's no obvious increase in  
37 abundance of any species that we -- seeing the  
38 same sorts of abundance of species that we've  
39 always seen previous years.

40 Q Thank you, Mr. Hume. Mr. McFarlane, let me ask  
41 you the same question. Do you have any comment on  
42 the assessment of the Project 8 report on  
43 potential impacts on Fraser River sockeye of  
44 marine fish predators?

45 MR. McFARLANE: I've read the report. And I don't have  
46 any differences of opinion on their final  
47 conclusions, which is that marine fish probably

1 was not a major factor in the 2009 reduced  
2 returns. I also agree that much of this is based  
3 on limited data on many of these species and that,  
4 in general, it would be nice to be able to look a  
5 little more closely at some of the species, as  
6 they suggest.

7 Q Okay. So you would agree with the recommendations  
8 as well?

9 MR. McFARLANE: I agree with the recommendations in  
10 general, although I would change one or two of  
11 them up a little bit in terms of species group,  
12 which we looked at in terms of the development of  
13 a predator or a prey diet database.

14 Q Can you be more specific?

15 MR. McFARLANE: Yes, on which one?

16 Q What changes would you make on the species?

17 MR. McFARLANE: There's a number of things. If you  
18 want to stick to the Strait of Georgia versus the  
19 open ocean, there's different species groups you  
20 would want to concentrate some of your efforts on.  
21 If you were looking at the Strait of Georgia only,  
22 I would concentrate on a number of species and I  
23 haven't got in front of me, sorry, which ones I'm  
24 thinking of.

25 Q Perhaps have a look at page 82 of the Project 8  
26 report. I'm sorry. I've forgotten the exhibit  
27 number.

28 MR. LUNN: Could you say the name of the document  
29 again?

30 MR. WALLACE: It's the Project 8 report.

31 MR. LUNN: 780.

32 MR. WALLACE: 780, thank you.

33 MR. McFARLANE: Okay. They've basically come up with  
34 six species that they would recommend are  
35 potential predators of interest that more  
36 information is probably needed on. Most of those  
37 species are outside of the Strait of Georgia. I  
38 don't disagree that it would be nice to have more  
39 information on those species but there are a  
40 number of other species outside of the Strait of  
41 Georgia that they also have talked about in their  
42 report where more diet data would be needed.

43 I'm thinking specifically of things like  
44 northern stocks of arrowtooth flounder and some of  
45 the other groundfish species. In the Strait of  
46 Georgia, I think it's important to concentrate  
47 studies not only on the two species mentioned



1 here, which are river lamprey and the common  
2 murre.

3 I would suggest that there should be a lot  
4 more work on some of the other species, such as  
5 dogfish sharks. Now, that's as a potential  
6 predator but there are other species in the  
7 ecosystem context that should be looked at as  
8 well, which are not predators but may be  
9 competitors.

10 MR. WALLACE: Thank you. Mr. Giles, did I mark the  
11 2010 CSAS report on the status of Cultus sockeye  
12 as an exhibit?

13 THE REGISTRAR: You did not. That will be Exhibit 804.

14 MR. WALLACE: Thank you.

15

16 EXHIBIT 804: Status of Cultus Lake Sockeye  
17 Salmon, CSAS 2010

18

19 MR. WALLACE:

20 Q Thank you. Mr. McFarlane, you have some expertise  
21 in salmon shark, I think, among other sharks.

22 MR. WALLACE: I wonder if I could have Tab 26 put on  
23 the screen, please?

24 Q This is a 2010 report done by Williams and others.  
25 You're familiar with this report, Mr. McFarlane?

26 MR. McFARLANE: Yes.

27 Q And do you agree with the conclusions of the  
28 authors on the salmon shark?

29 MR. McFARLANE: Well, there's a number of conclusions.  
30 One is that they wanted to attempt to come up with  
31 some sort of reasonable biomass estimate. Another  
32 is that they don't actually conclude much in the  
33 way of importance of salmon shark. They present a  
34 lot of their interpretations of what might be  
35 important, for example, predation on Fraser River  
36 sockeye, predation on other species, which  
37 apparently are in the hot zone that they speak of,  
38 those types of things. So do I agree that what  
39 they've done is reasonable and are the conclusions  
40 reached reasonable based on their analysis? In  
41 general, I think. I was confused as to why they  
42 limited their data in certain ways. I'm not sure  
43 I agree with the idea of using these types of  
44 techniques for sharks.

45 The line transect theory and whatnot and  
46 models are difficult at the best of times, let  
47 alone for sharks. However, given that these

1 people are good at this type of work for marine  
2 mammals, I think if we accept that their  
3 conclusion is that in the hotspot that they speak  
4 of, which is the southern tip of Queen Charlotte  
5 Sound or Queen Charlotte Island in Queen Charlotte  
6 Sound, that there may be in the neighbourhood of  
7 10,000 sharks, of which possibly 4,500 sharks are  
8 salmon sharks, okay, I accept that that's an  
9 estimate that comes out of their analysis. You  
10 then have to say to yourself, okay, does 4,500  
11 sharks over the course of July and August in  
12 certain years because in some years they found no  
13 sharks, does it mean anything in terms of impacts  
14 on the actual dynamics of the stock? Obviously,  
15 it means something to the individual fish that got  
16 eaten but does it mean anything to the dynamics?  
17 And there's not a lot of information.

18 In Project 8, it recognizes a lack of diet  
19 information on salmon sharks but they're episodic  
20 feeders. They're also opportunistic feeders.  
21 They feed on a lot of things other than salmon.  
22 That particular area is fairly rich in other  
23 species of forage fish, particularly in the last  
24 number of years, sardine. One of the reasons the  
25 whales seem to congregate off that area is the  
26 presence of sardine. So all those things together  
27 indicate to me that, yes, there's salmon shark  
28 there. In my own studies of look at bycatch in  
29 other fisheries, that also shows up as an area of  
30 salmon shark abundance, as does other areas on our  
31 coast. It's not the only one.

32 And so the question really comes down to, is  
33 there evidence that they are feeding on salmon in  
34 that area? There is no evidence and that doesn't  
35 mean they aren't. It means there's actually no  
36 data from that area. However, in areas where  
37 there is data, salmon shark definitely feed on  
38 salmon, hence their name. But there has been no  
39 linkage between salmon shark predation and  
40 declines or increases, for that matter, in salmon  
41 population. And I'm speaking specifically of  
42 Prince William Sound where most of the work on  
43 salmon shark has been done.

44 MR. WALLACE: Thank you. Mr. Giles, could that  
45 document, Shark aggregation in coastal waters of  
46 British Columbia of Williams *et al*, 2010, be  
47 marked as the next exhibit, please?

1 THE REGISTRAR: Exhibit 805.

2  
3 EXHIBIT 805: Shark aggregation in Coastal  
4 Waters of British Columbia, 2010  
5

6 MR. WALLACE:

7 Q Dr. Christensen, I'll take you to Canada's Tab 13  
8 and 14. These are two papers that relate to the  
9 rhinoceros auklet, a bird found on Triangle Island  
10 off the northwest coast of Vancouver Island, I  
11 think. And these two papers, you're familiar with  
12 those?

13 DR. CHRISTENSEN: Yes, I am.

14 Q And I take it, they both come to the conclusion  
15 that the rhinoceros auklet is a bird that we ought  
16 to be paying attention to in the context of  
17 predation on early sockeye migrants into the  
18 ocean, correct? That's their conclusion?

19 DR. CHRISTENSEN: Yes.

20 Q And yet the rhinoceros auklet didn't make the cut  
21 in your analysis. I'm wondering if you've  
22 considered these remarks and what your views are?

23 DR. CHRISTENSEN: We did look at information about the  
24 species when we wrote the report. We had a lot of  
25 species to cover. We did not find it likely that  
26 this would be an important species based on that  
27 information. And in examining what we could find  
28 of information about abundance and trends in the  
29 species, the conclusion was it was a fairly rare  
30 species and that there was no indication that its  
31 abundance had been increasing in recent decades.  
32 So they were the reasons why we did not include  
33 it.

34 In examining it again now, I find it very  
35 unlikely that it would have any significant impact  
36 on the Fraser River sockeye salmon given the very  
37 limited time that there's an overlap in spatial  
38 distribution, given the numbers. Compared, for  
39 instance, to salmon shark we just heard about,  
40 rough indications would be that salmon sharks  
41 could probably eat to order of magnitude more than  
42 the rhinoceros auklets. So overall, I do not  
43 think that this is a species that may have  
44 contributed significantly to the predation  
45 mortality of Fraser River sockeye salmon.

46 MR. WALLACE: Thank you. Mr. Giles, may I ask you  
47 please to mark first the Environmental Control of

37  
PANEL NO. 33  
In chief by Mr. Wallace

1           the Breeding Success of Rhinoceros Auklets at  
2           Triangle Island as the next exhibit?  
3 THE REGISTRAR: Exhibit 806.

4  
5           EXHIBIT 806: Environmental control of the  
6           breeding success of rhinoceros auklets at  
7           Triangle Island, British Columbia

8  
9 MR. WALLACE: And the document that's at Tab 14 of  
10           Canada's book, Forage Fish of the Pacific Rim as  
11           Revealed by Diet of a Piscivorous Seabird  
12           Synchrony and Relationships with Sea-Surface  
13           Temperatures as the next exhibit?

14 THE REGISTRAR: 807.

15  
16           EXHIBIT 807: Forage fish of the Pacific Rim  
17           as revealed by diet of a piscivorous seabird:  
18           synchrony and relationships with sea surface  
19           temperature

20  
21 MR. WALLACE:

22 Q   And Dr. Christensen, I believe you have summarized  
23    what you've just told us in a short document that  
24    you provided to us and we've circulated.

25 MR. WALLACE: Could that be put on the screen, please,  
26    Mr. Lunn, Dr. Christensen's response?

27 Q   Do you recognize that as the response, which is in  
28    written form, pretty much what you just gave in  
29    evidence?

30 DR. CHRISTENSEN: That's correct, yes, though this one  
31    does not talk about the -- how much they would  
32    have consumed.

33 MR. WALLACE: Thank you. I'd ask, Mr. Giles, if this  
34    could be marked as the next exhibit?

35 THE REGISTRAR: Be 808.

36  
37           EXHIBIT 808: Rhinoceros Auklet (*Cerorhinca*  
38           *monocerata*) and Fraser River sockeye salmon

39  
40 MR. WALLACE:

41 Q   Finally, Dr. Christensen, this morning, there was  
42    a discussion about DFO's ecosystem research  
43    initiative arose and this is a topic that you and  
44    Dr. Trites address at page 78 of the Project 8  
45    report.

46 MR. WALLACE: If that could be put on the screen,  
47    please, Mr. Lunn?

May 5, 2011

1 Q I think the tenor of your comments in the report  
2 itself are that the level of support for this  
3 initiative is insufficient to ever meet the goals  
4 of integrated management. Could you care to  
5 expand on that and any other comments from what  
6 you heard on the discussion of the ecosystem  
7 research initiatives at DFO?

8 DR. CHRISTENSEN: It is clear that the scientists at  
9 DFO are doing an incredibly good job from moving  
10 the research ahead and that they are doing this  
11 with very limited resources. If I look at the  
12 ecosystem research initiative and the documents  
13 that describes this, I find a lot of good  
14 intention in it. I do, however, not see a clear  
15 strategy in the way it has been implemented. The  
16 funding envelope of, I think, around 500,000 --  
17 well, it's 2.3 million for five areas, which on  
18 average, would be four to 500,000 is a very  
19 limited amount of funding for a research  
20 initiative that is fundamental for where DFO is  
21 moving with its integrated management. The way  
22 that this funding has been broken up into  
23 piecemeal practice to me indicates a lack of  
24 strategy.

25 It's small projects and I have problem seeing  
26 how this initiative is going to prepare DFO and  
27 the overall community here on the west coast when  
28 it comes to predicting how the Strait of Georgia  
29 will look in 2030, which is a key objective of  
30 this research. So I really feel that this funding  
31 has been used to do more of the good work we are  
32 already doing. That was in quotation mark, as  
33 "we" not "me". But the good work that the DFO  
34 scientists is always doing, it's been allocated  
35 for that use, as far as I can see from the  
36 documents. And it has not been used strategically  
37 to promote the chief objective.

38 MR. WALLACE: Thank you. Mr. Commissioner, I have no  
39 further questions for this panel. And Mr. Timberg  
40 is next in line.

41 MR. TIMBERG: Yes, for the record, Tim Timberg for the  
42 Government of Canada. And with me, my colleague,  
43 Geneva Grande-McNeill.

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47 CROSS-EXAMINATION BY MR. TIMBERG:

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Q We've heard this morning about conversation about the importance of data and the importance of ecosystem modelling. And I'd like to start with you, Mr. Hume. Can you explain for the Commissioner, whether your work includes collection of freshwater data?

MR. HUME: Yes, it does.

Q And can you describe what that means? What do you do to collect that?

MR. HUME: Our lakes research program studies juvenile sockeye fry in lakes, well, obviously in lakes. We collect physical, chemical and biological and limnological data from the various trophic levels that supply food to the sockeye salmon, as well as occasionally look at the predators of salmon as well but also their competitors, too. The fish part of the data is collected through hydroacoustic population estimates and was with actual physical sampling through mid-water trawling.

Q Okay. And can you describe generally the areas where that data is collected?

MR. HUME: We've sampled just about every sockeye-rearing lake in the Fraser River system except for a few of the very small ones or lakes with very low populations of sockeye. And we have detailed data over a long time series going back to 1975 for Quesnel, Shuswap Lake, Cultus Lake and off-and-on for Chilko Lake as well. And a few other lakes as well we have time series but not as long as those.

Q Thank you. And Mr. McFarlane, can you explain whether you in your work collect marine data and, if so, what kind of data do you collect?

MR. McFARLANE: Yes, I do. Generally crews go out to answer a question or a specific set of questions and it could be things like examining the abundance and distribution of specific species or a specific group of species. As part of that, we would also collect other types of information: age, sex, length, all of the biological parameters that would allow us to say something about the stock structure. In many cases, in my own surveys, I generally try to take diet information from the key species as well as the incidental species I'm taking. Some other groups do the

1 same. Some do all the first parts but not the  
2 diet part. It is time consuming.

3 We also take physical oceanographic and  
4 biological oceanographic, so lower trophic level  
5 abundance of copepods, euphausiids, that type of  
6 thing, along with all the other information. So  
7 at sea, those are basically the types of  
8 information that we would use. And we use  
9 equipment, such as trawl nets, traps and long  
10 lines, as well as, in some cases, we might put out  
11 specialized gear for specific purpose such as  
12 modified gillnets in some cases, very seldom. All  
13 of our diet work comes from trawl nets because, of  
14 course, they're passive in terms of they're not  
15 drawing the fish to a bait of any kind.

16 Q Right. And Dr. Christensen, do you collect any  
17 data in your work in the freshwater or marine  
18 waters?

19 DR. CHRISTENSEN: Not in my current work, no.

20 Q Okay. And I was just wondering if, Mr. McFarlane,  
21 you could comment on the relationship between data  
22 and ecosystem modelling? And we've heard that  
23 ecosystem modelling earlier is not very expansive  
24 but I'm wondering about the cost to collect this  
25 data and the relationship between data and  
26 ecosystem modelling?

27 MR. McFARLANE: Yes, depends on the ecosystem model, I  
28 suppose, but if we're talking about the type of  
29 modelling that's suggested in the report, which is  
30 ecopath with ecosim, it is very data-hungry in  
31 terms of diets, consumptions, abundance estimates  
32 for numerous species and that type of information  
33 so collected at sea and transferred into databases  
34 which can then be used. Building the model, I  
35 mean, Villy's the guru of building these types of  
36 models and I'm sure he's correct in saying that he  
37 can build them pretty quickly. The ones I've  
38 worked on are very nice to work with but the  
39 collection of the data is incredibly expensive in  
40 terms of dollars and in terms of ship time.

41 Q Okay. So would it be fair to say that you need  
42 both then? You need the data to feed the model?

43 MR. McFARLANE: Well, it would be fair to say to me,  
44 absolutely.

45 Q Okay.

46 MR. McFARLANE: Otherwise, you have to make the data  
47 up.

1 Q All right. And does anybody else on the panel  
2 have a comment with respect to that relationship?  
3 DR. CHRISTENSEN: What Sandy McFarlane said is totally  
4 correct. One question, though, is what data do we  
5 need? As it was pointed out this morning,  
6 scientists always want more data. We cannot  
7 collect all the data and it's very important that  
8 we use models to guide us with regards to what  
9 kind of data do we need to collect? So a starting  
10 point is what policy questions are important? We  
11 use the models to guide us and to guide not the  
12 least a very expensive data collection. That can  
13 be much more efficient if it is driven by model  
14 studies.  
15 Q Thank you. Mr. Hume, if we could --  
16 MR. TIMBERG: Mr. Registrar, actually, if we could turn  
17 to Canada's list of documents, Tab 1. And if we  
18 could turn to page, it's 1330 in the top right-  
19 hand corner. And we'll be looking at the text on  
20 the right-hand side of the page.  
21 Q Mr. Hume, before I get to a specific question with  
22 this document, would you agree that over the  
23 entire lifetime of a sockeye population, most  
24 mortality occurs in freshwater?  
25 MR. HUME: Yes, I would.  
26 Q And using this document, could you explain to us  
27 the freshwater mortality and in stages? I'm going  
28 to sort of break down the stages from egg to fry.  
29 What is the freshwater mortality between going  
30 from egg to fry?  
31 MR. HUME: Around 8 percent overall for all salmonids.  
32 Sockeye, probably a little bit higher than that,  
33 around maybe 10 percent, 10 to 15 percent. Sorry.  
34 Survival, that is, not mortality.  
35 Q Okay. And we're looking here and so, first of  
36 all, can you identify this document that we have  
37 in front of us?  
38 MR. HUME: Yes, I can.  
39 Q Okay. What is it?  
40 MR. HUME: It's a comparative review of Pacific salmon  
41 survival rates by Dr. Bradford.  
42 Q And he's a colleague of yours?  
43 MR. HUME: Yes, he is.  
44 MR. TIMBERG: If we could have this marked as the next  
45 exhibit?  
46 THE REGISTRAR: Exhibit 809.  
47



1 EXHIBIT 809: Comparative review of Pacific  
2 salmon survival rates  
3

4 MR. TIMBERG: And going back to page 1330.

5 Q Then what you've just said about the rate of  
6 mortality, the 8 percent, then you're getting that  
7 in the end of the first column on the right-hand  
8 side there?

9 MR. HUME: Yeah, it's 8 percent survival; it's 92  
10 percent mortality.

11 Q Okay. That's helpful. And then can you explain  
12 the freshwater mortality from the smolt stage to  
13 entering marine waters? What have I missed? Oh,  
14 we've done egg-to-fry. Sorry.

15 MR. HUME: We don't actually know what --

16 Q Sorry. I'm going to backtrack. I've missed a  
17 step here. We've done egg-to-fry and I'd like to  
18 now ask you from fry-to-smolt. And I understand  
19 that's at the bottom of the next paragraph.

20 MR. HUME: Actually, the next numbers that he provides  
21 there are total mortality from eggs to smolt?

22 Q Yeah.

23 MR. HUME: So that includes the egg-to-fry mortality as  
24 well. But it's 2 percent survival or 98 percent  
25 mortality on average occurs.

26 Q And that's for the sockeye salmon?

27 MR. HUME: That's for sockeye salmon, yes.

28 Q All right. And then my third question then is,  
29 what can you tell us about freshwater mortality  
30 from smolt to the marine waters?

31 MR. HUME: Well, we can't say a lot about that at the  
32 moment actually because until very recently  
33 there's been virtually no work done on mortality  
34 within the smolt migratory corridor. There's been  
35 one study done by Dr. Welch using acoustic tags  
36 and the POST system, which I believe mortality  
37 from -- that was large atypical smolts released  
38 from Cultus Lake. They were very large, about  
39 double the size, well, more than double the size  
40 of normal smolts. And they had a high mortality,  
41 I believe around 40 percent mortality by the time  
42 they left Cultus Lake until they passed receivers  
43 at the mouth of the Fraser River.

44 Q All right. And so what would you say then is the  
45 overall freshwater survival?

46 MR. HUME: Very low. Again, it's somewhere in the  
47 range of 2 percent.

1 Q All right. And what would be the percentage of  
2 survival in a year for a good return?

3 MR. HUME: Freshwater?

4 Q Yeah. I'm trying to ask for a range so if the  
5 average is 2 percent, I'm wondering if you could  
6 give us a range like a bad year and a good year.

7 MR. HUME: Well, a bad year would have certainly been  
8 observed in some years to be less than 1 percent.  
9 And up to maybe 7 percent survival.

10 Q And 7 percent for a good year?

11 MR. HUME: For a good year, yeah.

12 Q All right. And can you explain the role that  
13 predation plays in this low freshwater survival  
14 rate?

15 MR. HUME: Well, the causes of mortality in the  
16 freshwater is quite varied and not very well  
17 understood, to be quite honest, presumably. From  
18 the egg deposition to emerging fry, mortality  
19 certainly plays a role. Sculpins and other small  
20 fish and invertebrates such as dragonfly nymphs  
21 and things like that will be large causes of  
22 mortality. But also in that stage, just simple  
23 physical forces, excessive stream flows caused  
24 physical disruption of the eggs, just being  
25 dislodged from the gravel and floating downstream  
26 causes problems.

27 Other factors would be disease and parasites  
28 at various stages. The fry are very vulnerable to  
29 predation presumably when they first leave the  
30 gravel and are migrating down the stream and then  
31 they typically spend quite a bit of time along the  
32 shorelines before they get out into deeper water.

33 Q Okay.

34 MR. HUME: And they'd be quite vulnerable there as  
35 well.

36 Q So what information would be helpful to better  
37 understand then Fraser River sockeye in a  
38 freshwater environment?

39 MR. HUME: Well, a continuation of what we're doing,  
40 looking at longer-term datasets and other lake  
41 systems would be very useful. But I think our  
42 biggest area of lack of knowledge is what's  
43 happening the smolt migratory corridor. We don't  
44 even know what the mortality rate is or what  
45 causes mortality or whether there are points where  
46 mortality is higher than in other points along the  
47 system. So that would probably be my major

1 recommendation would be look at both the smolts  
2 and also look at the condition of the smolts as  
3 they leave the lakes for energy content, see their  
4 ability to withstand the rigours coming up.  
5 Q Okay. Thank you. And can you describe whether  
6 your work takes into account ecosystems?  
7 MR. HUME: Yes, it does. We certainly study both the  
8 physical and chemical environment that the fish  
9 live in. We do primary and secondary trophic-  
10 level studies as well. We've developed models  
11 looking at primary production as a predictor of  
12 care and capacity for sockeye-rearing lakes. Not  
13 to the same extent, but we've also done studies on  
14 top down control of sockeye salmon through  
15 predator work that we've done on both Cultus and  
16 Quesnel Lake.  
17 Q Okay. And is your work incorporated into  
18 forecasting models at DFO?  
19 MR. HUME: Yes, it is.  
20 Q Okay. I think you answered this question this  
21 morning but just for clarification. I think you  
22 said that there's no evidence that mortality of  
23 Fraser River sockeye in freshwater is increasing.  
24 Is that --  
25 MR. HUME: That's correct. Well, the lakes that we've  
26 studied. So we have fry data collected in the  
27 fall of the year for a number of years for Quesnel  
28 and Shuswap Lakes and as well as the long terms.  
29 That goes back to 1975. And we also have long-  
30 term smolt data from Chilko Lake, which goes back  
31 to 1948. And in all three of those cases, there's  
32 no indication that there's been any downward trend  
33 or upward trend, for that matter, in survival over  
34 that time period.  
35 Q And what's the importance of the long-term data  
36 series? Why is it important to have long-term  
37 data?  
38 MR. HUME: So we can answer the questions just like  
39 what you asked me.  
40 Q All right. Thank you. Mr. McFarlane --  
41 THE COMMISSIONER: Mr. Timberg, I wonder if I could  
42 just --  
43 MR. TIMBERG: Certainly.  
44 THE COMMISSIONER: -- for my understanding, if I could  
45 just go back a step through Mr. Hume. You've  
46 asked him about survival rates and he's talking  
47 about some of the elements that bear upon this and

1 he mentioned Cultus, for example. But just so I  
2 understand, are we talking about where the  
3 spawning is in the river or are we talking about  
4 where the spawning is in the lake? Are there  
5 differences between those two aspects of spawning  
6 history?

7 But more importantly, I'm not quite sure I  
8 fully understand what are the elements, how he's  
9 tying this together with, for example, he talked  
10 about the data that he's collected with regard to  
11 the rearing capacity of these lakes? How is this  
12 all tied together in terms of answering your  
13 question about survival rates? For example, he  
14 mentioned disease but he's mentioned parasites.  
15 He's mentioned some of the elements that make the  
16 fry vulnerable to predation.

17 I'm just trying to understand where food  
18 comes into this in terms of what's available for  
19 these fry in the lake system and how that bears  
20 upon their survival. So I'm just not sure I'm  
21 getting the picture here of all of the elements  
22 that bear upon the survival of the fry. I  
23 certainly understand some of the elements he's  
24 talked about but how do I tie together all of  
25 these elements?

26 So where the fish spawn, to me, is something  
27 that would be helpful to understand where he's  
28 making these and the relationship of the lake to  
29 survival and the relationship of these other  
30 elements to survival, be it parasites, disease,  
31 whatever. Are there different studies going on  
32 here or are you talking about one study, or is  
33 this different data that he's collected or is it a  
34 single set of data? I'm just not clear on this.

35 MR. TIMBERG: I'll do my best, Mr. Commissioner, to  
36 walk you through that. I've been given 60 minutes  
37 to do so much. It's difficult so we're rushing.

38 THE COMMISSIONER: I realize that. I'm just getting a  
39 bit lost here.

40 MR. TIMBERG: No, fair enough. I'm just noting the  
41 pressures we're all under to try to explain a lot  
42 in a short period of time.

43 Q Mr. Hume, what I'll ask you to do is walk us  
44 through. And you tell me if this is the  
45 appropriate approach to help unpack this. My  
46 thought is that you should first talk about the  
47 egg-to-fry stage in the river and the different

- 1 impacts that happen with respect to freshwater  
2 survival in the river, in the egg-to-fry stage.  
3 Then perhaps you could talk about the fry-to-smolt  
4 stage with the lakes and survival in freshwater  
5 lakes. And I think then the third stage is the  
6 smolt-to-ocean part, which you've said we don't  
7 really know very much about yet. So my thought is  
8 if you could unpack the first two stages, perhaps  
9 sort of the first year in the river, the egg-to-  
10 fry and then move on to the year in the lake?
- 11 MR. HUME: Perhaps I should first just say a little bit  
12 about what we do do and what we don't do.
- 13 Q Sure.
- 14 MR. HUME: Our work doesn't look that much at the  
15 causes of mortality for sockeye. We're looking  
16 mostly at the results of the various mortality  
17 factors that have been happening to the fry  
18 sockeye populations.
- 19 Q And when you say the results, why is that?
- 20 MR. HUME: So we do that by determining abundance. We  
21 know the number of spawners and we determine  
22 abundance at various life history stages.  
23 Sometimes we do summer surveys and as well as fall  
24 surveys so we can break that mortality down to  
25 various life history stages. We do very little  
26 work on actual factors that are causing the  
27 mortality to these fish at the time. Certainly,  
28 there's a difference in survival rates between --  
29 well, I'll just stop there.
- 30 Q So perhaps I'll just ask you if you could focus  
31 then on the work that's being done and the  
32 information you have on the first stage between  
33 the egg and the fry stage in the rivers.
- 34 MR. HUME: Our larger freshwater research group has  
35 done some work on egg-to-emergent-fry, which we  
36 call the fish as they leave the gravel and migrate  
37 down to the lake. But I haven't personally been  
38 involved with that.
- 39 Q Okay. And are you able to comment on any of the  
40 factors that are at play that result in such a low  
41 survival rate at that stage?
- 42 MR. HUME: Well, from my Cultus Lake project, we've  
43 certainly seen the fry-to-smolt survive work  
44 that's not published yet but we're just developing  
45 the data now, is that by removing the pikeminnow  
46 from the lake or reducing the numbers of  
47 pikeminnow in the lake, we're increased the over-

1 winter survival of these fish by almost double.  
2 So on average, we were getting about 22 percent  
3 survival from fall fry to smolts going out of the  
4 lake in the following spring and now it's more  
5 than double; it's around 50 percent, 55 percent  
6 survival on average.

7 Q All right.

8 MR. HUME: So indicating that predation is certainly a  
9 major factor in mortality during at least that  
10 time period of their life history.

11 Q And are there other factors that you're aware of  
12 with respect to that life stage between egg and  
13 fry? And if not, is there someone that could  
14 inform us on that stage?

15 MR. HUME: It's an area of research that we haven't  
16 really looked into all that much, to be quite  
17 honest.

18 Q Okay. Moving then from the fry-to-smolt stage,  
19 can you describe for the assistance of the  
20 Commissioner, the work that you're doing with  
21 respect to the lake survival and your  
22 understanding of how the lake operates with  
23 respect to salmon productivity?

24 MR. HUME: Certainly. Survival in lakes tends to be  
25 density-dependent. What we do know is that  
26 survival is density-dependent in the lakes in most  
27 cases. The causes of the mortality, we haven't  
28 put a handle on. We know that predation must play  
29 a fairly large role given the fact, well, our  
30 Cultus experiment, but also sockeye fry are found  
31 in large amounts in certain fish species such as  
32 the trout, cutthroat and rainbow trout. Burbot  
33 are also found to contain large numbers of sockeye  
34 fry. Fry predation rates are lower but pikeminnow  
35 tend to be very abundant so they make up for low  
36 predation rates by large abundance.

37 MR. TIMBERG: Okay. And I'm just wondering if we could  
38 turn to Tab 45 of Canada's list of documents?

39 Q And I understand this document is some of the  
40 results of DFO's lake research program. Perhaps  
41 you could use this to explain these results for  
42 us?

43 MR. HUME: Well, this is the results of our fall fry  
44 acoustic estimates of the abundance of sockeye fry  
45 in Quesnel Lake. It's plotted against effective  
46 female spawners on the bottom axis.

47 Q That's the amount of female spawners. And on the

1 left is the fall fry. What does this tell us?  
2 MR. HUME: Well, what it tells us is that at a certain  
3 density of abundance female spawners, the  
4 mortality rate increases to keep the fall fry  
5 abundance basically at a constant level. We've  
6 fitted a Ricker curve to this dataset and you can  
7 see at the far end that it's decreasing. The  
8 solid line is dropping down but in actual fact the  
9 measured abundance estimates that we received, the  
10 abundance of fall fry, we've measured and those  
11 really high densities has not decreased, as the  
12 model would predict, indicating that perhaps  
13 another model that doesn't decline at high  
14 densities would be more appropriate.

15 MR. TIMBERG: All right. And Mr. Commissioner, perhaps  
16 this is time for the lunchtime break. And I'll  
17 work with the witness to help fully explain this  
18 issue for you.

19 THE COMMISSIONER: Could you scroll down just a little  
20 bit? All right. Thanks very much.

21 MR. TIMBERG: Thank you.

22 THE REGISTRAR: The hearing is now adjourned till 2:00  
23 p.m.

24  
25 (PROCEEDINGS ADJOURNED FOR NOON RECESS)

26 (PROCEEDINGS RECONVENED)

27  
28 THE REGISTRAR: The hearing is now resumed.

29 MR. TIMBERG: And it's Tim Timberg for Canada, with my  
30 colleague, Geneva Grande-McNeill.

31  
32 CROSS-EXAMINATION BY MR. TIMBERG, continuing:  
33

34 Q Mr. Hume, I'd like to review the various factors  
35 affecting freshwater survival with you and then  
36 I'll turn to Mr. McFarlane to discuss marine  
37 freshwater survival.

38 Going back to a conversation before the lunch  
39 break, can you summarize the factors that affect  
40 freshwater -- perhaps first, before we talk about  
41 freshwater egg to emerging fry freshwater  
42 survival, where do fish spawn? Where do sockeye  
43 salmon spawn in the Fraser River system?

44 MR. HUME: In the Fraser River, most of them spawn  
45 upstream, tributaries upstream to their rearing  
46 lakes. A few of them spawn downstream from the  
47 rearing lakes, such as Chilko Lake. A few spawn

1 in the lake itself, in the gravel beds along the  
2 shoreline. In most cases, that's just a few.  
3 They'll be a combination of upstream spawners and  
4 lake spawners. But in Cultus Lake, they're  
5 entirely lake spawners.

6 Q So Cultus Lake is unique in that it's entirely  
7 lake spawners?

8 MR. HUME: Unique in the Fraser River system, yes.

9 Q Okay. All right. And so, then, with that  
10 knowledge about the locations, what are the  
11 factors that affect freshwater survival on eggs to  
12 emerging fry?

13 MR. HUME: Well, they're all affected by disease,  
14 parasites, predation, possibly lack of oxygen. In  
15 the rivers they have another extra factor that  
16 would include high flood events, which actually  
17 just move the gravels, dislodge the eggs and  
18 actually physically damage the eggs as well.

19 Both lakes and river spawners would be also  
20 affected by sedimentation.

21 Q All right. And then if we move on to -- if you  
22 could explain what are the factors that affect  
23 freshwater survival from emerging fry to smolts,  
24 and perhaps again, first you should talk about the  
25 location where emerging fry to smolts live.

26 MR. HUME: Well, depending on where the eggs were  
27 deposited, the fry that spawned in rivers will  
28 come out of the gravel and migrate either down to  
29 the lake or swim upstream to the lake depending on  
30 where they were born. Then, typically, they  
31 migrate along the shoreline as they disperse  
32 throughout the lake. As the season progresses,  
33 they'll migrate offshore and into deeper water --

34 Q Okay.

35 MR. HUME: -- and start undergoing vertical migration  
36 so they'll actually migrate down, deep water  
37 during the day, to avoid predation.

38 Q And you're talking about in the lakes?

39 MR. HUME: In the lake itself, once they've moved  
40 offshore. So this would be, say, a typical lake  
41 such as Shuswap, they'd come out of the gravel in  
42 around late April, May, migrate along the  
43 shoreline, start moving offshore in early June and  
44 through to the end of July. Then from end of July  
45 onwards, they would be out in deep water mostly.

46 Q All right. Do some emerging fry to smolts not  
47 move to the lakes but stay in the river?



1 MR. HUME: There is a river type of sockeye, yes, such  
2 as at the Harrison. It's the main example in the  
3 Fraser River.

4 Q And so that's a unique characteristic of the  
5 Harrison?

6 MR. HUME: It's not unique to sockeye in general, but  
7 it is -- I believe actually Widgeon Slough is also  
8 a river-type sockeye. They basically come out of  
9 the gravel and migrate downstream immediately to  
10 the ocean. Then they go a very short time period  
11 where they're -- well, the smolt, they spend a  
12 very short time in fresh water.

13 Q Right. And so can you then, for the assistance of  
14 the Commissioner, what are the factors that affect  
15 the freshwater survival in lakes and/or rivers of  
16 the emerging fry to smolt stage?

17 MR. HUME: Predation is obviously one factor. Food  
18 supply may be problem if the high densities or the  
19 lake is nutrient poor which may not actually  
20 directly kill them, it may make them more --  
21 because they're slow-growing makes them more  
22 vulnerable to predation for a longer time period,  
23 and therefore may actually increase the mortality  
24 rate.

25 At the same time, they may also be more  
26 susceptible to disease. It's very hard to  
27 distinguish, to tell -- we do have very little  
28 information on diseases actually killing off fry  
29 because basically we can't observe that in the  
30 wild.

31 Q Okay. Just so I can get a list in my head, what  
32 you've said is that the factors that affect  
33 freshwater survival from merging fry to smolts are  
34 predation, nutrients in the lakes and disease.  
35 Are there any others or are those the three  
36 factors?

37 MR. HUME: Those would be -- well, parasites also.  
38 There's a parasitic copepod which can affect some  
39 stocks particularly.

40 Q Okay. And I'd like to sort of talk about lake  
41 productivity, then, with this nutrient point that  
42 you've raised. How do we understand lake  
43 productivity? How do we look at that?

44 MR. HUME: Well, lake productivity is driven mainly by  
45 the nutrients in the lake itself. So most Fraser  
46 River lakes are, relative to lakes in general,  
47 say, throughout North America, are quite

1 oligotrophic. It means that they have very low  
2 nutrient levels. This is fairly typical of  
3 sockeye-rearing lakes, though. But it's atypical  
4 of lakes in general.

5 Q Okay.

6 MR. HUME: But the level of nutrients that are  
7 available determines how much phytoplankton can  
8 grow, and that in turn controls the zooplankton  
9 which the sockeye feed upon.

10 Q That's their food at that stage?

11 MR. HUME: Yeah.

12 Q And is that what we call a "bottom-up process"?

13 MR. HUME: Yes, it is.

14 Q All right. And with that description of lake  
15 productivity, how does predation fit into this?

16 MR. HUME: Predation is a top-down process.

17 Q And what does that mean?

18 MR. HUME: It means the bottom-up process means the  
19 production of the fish are controlled by things  
20 coming from the lower trophic levels and  
21 nutrients. Top down means a higher trophic level  
22 such as predatory fish, piscivorous fish feeding  
23 on them, control the abundance of the sockeye, the  
24 fry in the lake.

25 MR. TIMBERG: Okay. And then if we could then return  
26 to Exhibit -- oh, we have Exhibit 45. Perhaps we  
27 could have this marked as the next exhibit. That  
28 was Tab 45, for the record.

29 THE REGISTRAR: Exhibit 810.

30

31 EXHIBIT 810: Examples of results produced by  
32 DFO's Lake Research Program  
33

34 MR. TIMBERG:

35 Q So looking at Exhibit 810, can you just help us  
36 understand what the "x" and the "y" axes shows  
37 here?

38 MR. HUME: The "x" axis is effective female spawners.  
39 This is a graph of Quesnel Lake, Quesnel Lakes.  
40 The bottom axis is effective female spawners in  
41 millions of fish starting -- it goes up to two  
42 million fish on the right-hand side. The "y"  
43 axis, or left-hand axis is the number of fall fry  
44 estimated, abundance of fall fry done through our  
45 acoustic and bottom trawl surveys.

46 Q All right. And what does the red square show us?

47 MR. HUME: The red dot is the results of a model that

1 we built based on the primary productivity of the  
2 lake, and what the model does is estimates the  
3 carrying capacity, optimum escapement to the lake,  
4 and also the -- actually, what it really estimates  
5 is the maximum biomass of the lake in support, and  
6 then it uses some rough numbers to estimate the  
7 optimum escapement to the lake that would produce  
8 that biomass.

9 Then it's further using an average fry size.  
10 We can actually then use and turn that into  
11 estimating the total number of fall fry or smolts  
12 that would be produced by that optimum escapement.

13 Q And so in this instance, what does it tell us  
14 about Quesnel Lake?

15 MR. HUME: So from Quesnel Lake, what we're suggesting  
16 is we can produce -- the lake can support about 60  
17 million smolts. It would take approximately  
18 750,000 effective female spawners, 1.5 million  
19 spawners in total.

20 Q And where are you getting that from? Is that the  
21 start, or is that the --

22 MR. HUME: No, the 1.5 -- sorry, I just multiplied  
23 effective females by two. So total returns to the  
24 lake would be 1.5 million.

25 Q Okay.

26 MR. HUME: The graph shows 750 (sic) female spawners.

27 Q All right. And then if we could turn to the next  
28 page of this exhibit. If you could assist us to  
29 let us know what this graph shows us.

30 MR. HUME: We've applied our PR - we call it a PR model  
31 or photosynthetic rate model - we've applied this  
32 model to many of the Fraser River's sockeye  
33 rearing lakes. So the blue bars in this graph, so  
34 they're showing - when we're presenting the data  
35 in this case - is the number of spawners per  
36 hectare lake surface area so that we can compare  
37 all the graphs, the relative productivity of each  
38 lake to each other.

39 Q So you've done this for 18 sockeye lakes?

40 MR. HUME: Yes.

41 Q And should we be careful about the green bar? The  
42 green bar says "Maximum observed spawners".

43 That's not an average. Could you explain --

44 MR. HUME: It's not an average, no. It's in the last  
45 20 years. This is maximum observed spawner ever  
46 that we've seen for each one of these lakes.

47 Q All right. And so if the blue bar is tall, like

1 take for example Anderson Lake, and the green bar  
2 is low, what does that tell us?

3 MR. HUME: Anderson Lake is capable of spawner density  
4 of about approximately 100, 110 spawners per  
5 hectare, and so far we've only, in the last 20  
6 years, observed about 40 spawners per hectare in  
7 that lake.

8 Q And that was the maximum observed?

9 MR. HUME: That's the maximum observed, yes.

10 Q Do we need to consider the fact that these salmon  
11 co-migrate when we look at this chart?

12 MR. HUME: It's one way of looking at relative  
13 productivity of various lakes, various sockeye  
14 conservation units. So, in this case, the Shuswap  
15 and Cultus Lake are an example of two stocks that  
16 migrate at the same time. Cultus Lake is  
17 obviously, in recent years, has not produced  
18 anything near its capability, whereas Shuswap has  
19 been over -- has at least one year which is well  
20 over its estimated carrying capacity.

21 Q So fisheries management, they have to balance  
22 those lakes out to ensure that they're -- that you  
23 ensure sufficient returns of each lake.

24 MR. HUME: This is one measure of that. Stock  
25 productivity is partly due to freshwater factors,  
26 but also marine survival and marine productivity  
27 would affect it as well. This is just one factor  
28 that goes into the whole mix.

29 Q Okay. Thank you. I'd like to then move onto the  
30 question of -- now moving from smolt to the marine  
31 water.

32 THE COMMISSIONER: Mr. Timberg, is this graph on the  
33 screen part of Exhibit 45 -- I'm sorry, Exhibit  
34 810?

35 MR. TIMBERG: Yes, it's the second page.

36 THE COMMISSIONER: Thank you.

37 MR. TIMBERG:

38 Q Mr. Hume, then, earlier, before the lunch break,  
39 we were talking about smolts to marine and you  
40 talked about the need for further data on that  
41 information.

42 MR. TIMBERG: I'm wondering if we could turn, Mr.  
43 Registrar, to Exhibit 804. This is a document  
44 that Commission counsel entered this morning.

45 Q If we could turn to page 37. I understand that  
46 this graph shows on the left side, smolt-to-  
47 recruitment survival, so that's outgoing smolt.

1 And then their returns as adult fish --

2 MR. HUME: Yes.

3 Q -- on the left-hand side. Then on the bottom,  
4 it's the brood year, so that's the year that the  
5 eggs were laid.

6 MR. HUME: That's correct.

7 Q So what does this graph tell us about freshwater  
8 to marine survival from smolts to recruitment  
9 returns?

10 MR. HUME: It shows a number of things. One is it  
11 shows that the Cultus -- if you look at the  
12 "Cultus Wild" line, which is the solid black line,  
13 and compare that to the Chilko line, you can see  
14 that they're fairly well together, so it appears  
15 that maybe mortality factors that affect one are  
16 affecting both stocks at the same time.

17 Secondly it can show us that for Chilko,  
18 survival is being slowly decreasing over time, so  
19 it started off in 1999 at approximately eight  
20 percent survival, and it's decreased now down to  
21 2005, which is the brood year in question for the  
22 inquiry, to well less than one percent survival.

23 Q Okay. Thank you, Mr. Hume.

24 I'd like to now turn to discussing marine  
25 survival rates, and Mr. McFarlane, can you  
26 describe the most vulnerable stage for salmon in  
27 the marine waters?

28 MR. McFARLANE: I believe the most vulnerable stage is  
29 immediately upon ocean entry, probably within the  
30 first four, maybe five weeks.

31 Q And so where would that be? That would be in  
32 Georgia Strait?

33 MR. McFARLANE: For these stocks, yes.

34 Q Okay. And why is that your opinion?

35 MR. McFARLANE: Well, I'm not a salmon biologist, but I  
36 think it's becoming generally accepted that this  
37 is the case. There's been a fair amount of recent  
38 work on what's called the critical time-critical  
39 period hypothesis which indicates you sort of have  
40 to make it or break it very early in your ocean  
41 career, not unlike us.

42 Q Okay. All right. And so what's your opinion on  
43 the causes of decline, then, of the Fraser River  
44 sockeye salmon in 2009?

45 MR. McFARLANE: From the evidence I've seen, I believe  
46 that the problems were with the Strait of Georgia  
47 system in early 2007, and it was related to a very

1 low productivity of the Strait, and by  
2 "productivity", I mean the same as Jeremy just  
3 explained for fresh water. It's the lower trophic  
4 level success of the feed.

5 Q Okay. So it's sort of a nutrient issue. What are  
6 the species in the Georgia Strait that are  
7 competing with sockeye salmon when they enter the  
8 marine waters?

9 MR. McFARLANE: Well, the dominant species that would  
10 be considered competitors would be herring, chum,  
11 pinks. Although in 2007, I believe that wasn't a  
12 major pink year. You would also have other  
13 species such as chinook and coho.

14 Q All right. Is that the only other species  
15 competing with sockeye salmon in the Georgia  
16 Strait?

17 MR. McFARLANE: Probably not. There are other species  
18 which -- their early life history stages would  
19 also eat much of the same types of food. That  
20 would include things like Pacific hake. There's  
21 two other small what you could consider forage  
22 fishes which have a fairly significant abundance  
23 we think, although there's been virtually no work  
24 done recently on them, are one called a  
25 Leurroglossus, one called a Myctophid or  
26 midshipmen, and they are in fair quantities in the  
27 mid-water. They're not right at the surface like  
28 these other species.

29 Q I think for the record, somebody's going to have  
30 to spell those words, or provide them in writing  
31 after your oral testimony, so we'll do it after  
32 your oral testimony. We'll get that in writing to  
33 help the record here.

34 MR. McFARLANE: Okay. I know how to spell them.

35 Q Well, we'll keep moving.

36 MR. McFARLANE: Okay.

37 Q And so going back, then, in the spring of 2007,  
38 what was your understanding of the ocean entry of  
39 the sockeye salmon in the Georgia Strait?

40 MR. McFARLANE: Well, again, this is from other  
41 people's work, but the data I've seen indicates  
42 that the overall abundance -- and this is based on  
43 trawl surveys in the Strait in around June and  
44 July. The overall abundance of these species was  
45 reduced. We're talking all of the species, not  
46 just sockeye. And the condition factor of these  
47 smolts, so that -- you could think of it as their

1 robustness, their fatness. It's a relationship  
2 between the length of the smolt and the weight of  
3 the smolt. It was the lowest on record for many  
4 of these species.

5 The same applies to herring. The juvenile  
6 herring were in extremely poor condition. This  
7 generally relates to ability to survive through  
8 the critical period of time. The predation might  
9 have an impact.

10 So the important thing is, I think, that you  
11 might want to take from this is that when you have  
12 fish in the poorest condition at this time, you'll  
13 see some immediate types of mortalities. But it's  
14 also indicative that there'll be mortalities  
15 following this time. It basically says they're  
16 going to be in a bad state. So they all don't die  
17 on the same day, they may continue to die over the  
18 next number of weeks, possibly even number of  
19 months because, like other animals, as they get  
20 sicker or don't respond to any other food sources,  
21 they can't make it.

22 Q Okay. And do you have a recommendation on how to  
23 better understand this early entry of sockeye  
24 salmon into the Georgia Strait?

25 MR. McFARLANE: Well, if you mean --

26 Q What more information would be of assistance to  
27 understand this?

28 MR. McFARLANE: If you wanted to design a program that  
29 looked directly at the relationship between  
30 sockeye smolts and some of these factors we've  
31 been talking about in terms of predation and  
32 competition and whether it's a bottom-up or top-  
33 down system, I would design the survey to go out  
34 there at the specific time, so this would be -- I  
35 would look at it in early spring to early summer,  
36 so let's say April to June or early July, and I  
37 would study all aspects of the system at that  
38 particular time.

39 That would include the physics of the system,  
40 wind patterns and nutrient patterns which would  
41 give you initial indication of productivity  
42 levels, study the lower trophic levels which is  
43 again the feed for these species, and then study  
44 the species themselves, the upper pelagic species  
45 which are the salmon species we mentioned,  
46 herring.

47 I'd also look at the other potential predator

1 species --

2 Q Mm-hmm.

3 MR. McFARLANE: -- which Villy and Andrew Trites had in  
4 their report, which would include things like  
5 hake, dogfish, pollock. But I'd also look at some  
6 of the other potential competitors which would  
7 include the other species I mentioned such as  
8 Leurroglossus and Myctophids.

9 Myctophids, now -- so you're directing or  
10 making a very directed ecosystem-type study to  
11 answer a very specific question. So you're not  
12 going out there -- it's not like what the ERI  
13 program is designed to look at, which is a much  
14 broader, broader approach.

15 Q Okay. Perhaps we could turn to Project number 8  
16 and turn to the recommendations at page 83. I  
17 note that the report recommends further data on  
18 six species, of which four of them are not located  
19 in the Georgia Strait. The report only recommends  
20 further study on river lampreys and common murre.  
21 Would you care to comment on that, or would you  
22 add to that list just to --

23 MR. McFARLANE: I would add to it. This list is -- I  
24 mean, some of these potential predators occur in  
25 waters just north of Georgia Strait and on up  
26 towards Alaska. So if you're looking at it  
27 through its whole life history, I think you would  
28 want to examine those species, and others, in  
29 those other areas as well. So these would be in  
30 addition to what I said for the Strait of Georgia.

31 Q Okay, thank you. And you mentioned dogfish and  
32 pollock.

33 MR. McFARLANE: Yes.

34 Q Can you perhaps describe why we would look at  
35 pollock in the Georgia Strait?

36 MR. McFARLANE: It's a species that's present in the  
37 Strait. It tends to be in the southern part of  
38 the Strait and it is a fish eater, so that it is a  
39 potential predator, has been identified. I'm not  
40 suggesting it is a predator of any consequence as  
41 far as sockeye are concerned, but I think when  
42 you're looking at trying to answer the question  
43 you are, which is what happened to these sockeye  
44 once they entered ocean waters, you want to  
45 examine all the potential predators. So this is  
46 why I would conclude that, remembering that when  
47 they enter the water, there's a lot of mortalities



1 going on for a fair amount of time, so we're  
2 looking at -- I don't think anyone would disagree  
3 that salmon are being eaten by a number of  
4 species. That's just the way it is in this world.

5 The question is are these species having an  
6 impact on the dynamics of those salmon? My belief  
7 is that it is a bottom-up situation which is a  
8 productivity controlled area, but in order to  
9 actually ascertain that and in order to study that  
10 into the future, you want to look at both top-down  
11 and bottom-up. A program such as I just said  
12 would give you that ability.

13 Q Okay. Thank you. Before we move off of the  
14 recommendations, recommendation number 3 on page  
15 83, it's the third paragraph, calls for a central  
16 database. Do you have any comments with respect  
17 to that recommendation?

18 MR. McFARLANE: My comment would be that, to begin  
19 with, and to get it off the ground, number one I  
20 agree on central databases. I think it would be a  
21 good thing. But I think the best way to go about  
22 this would be to have it as an actual metadatabase  
23 where you identify what data there is, the area of  
24 whatever data you have is taken, and the custodian  
25 of the -- the timeframes that are available, and  
26 the custodian of that data and the contact  
27 information for that custodian. I think that  
28 would give everyone access to what they need. It  
29 would let them know what's available, but it would  
30 also ensure that the proper explanations came  
31 along with the data, how it was taken, all those  
32 sorts of things, and probably, I would think, lead  
33 to collaborations. I've certainly done this type  
34 of thing with other datasets and I find it very  
35 useful.

36 Q All right. Thank you. Before we move off of the  
37 recommendations, did you have any other comments  
38 on the other four recommendations?

39 MR. McFARLANE: Well, I certainly agree with the next  
40 one as we just talked about, which is focus some  
41 of this salmon research work once the fish enter  
42 the sea, so no argument there.

43 Conceptual ecosystem model, sure. I mean, I  
44 do that myself. I actually worked with some of  
45 Villy's students on these types of things, and  
46 it's always beneficial.

47 Q So perhaps, just while we're on that point, could

1           you describe some of your work using ecosystem  
2           models? Is that something that's being utilized  
3           by DFO?

4       MR. McFARLANE: Ecosystem models are being utilized by  
5           DFO, yes. I've looked at -- I've participated in  
6           studies using ecopath with ecosim which is the  
7           model that is recommended here.

8       MR. TIMBERG: And perhaps we could turn then, Mr.  
9           Registrar, to Tab 20 of Canada's list of  
10          documents.

11       MR. McFARLANE: What's Tab 20?

12       MR. TIMBERG:

13       Q     Who is Ian Perry and Diane Masson?

14       MR. McFARLANE: Dr. Perry and Dr. Masson are both co-  
15           chairs of the Strait of Georgia ecosystem studies  
16           initiative.

17       Q     And could we turn to the abstract at page 3? And  
18           this abstract, perhaps you could just tell us what  
19           this document is first, just in general. I note  
20           it's a draft document. What's your understanding  
21           of what this CSAS document is intended to do?

22       MR. McFARLANE: Could you show me the title again,  
23           sorry, so I can tell you what it is? Framework  
24           for the -- oh, okay. This is the actual working  
25           paper for the Strait of Georgia ERI, building the  
26           framework for the ecosystem approach. This --

27       Q     So perhaps we could turn to page 3 of the  
28           abstract. It might help. So this, as I  
29           understand it, this document is summarizing the  
30           ERI project that recently concluded; is that...?

31       MR. McFARLANE: This document would be -- yes, this  
32           would be basically -- because the ERI project  
33           isn't actually concluding for another -- or I  
34           guess it just concluded in the past month -- that  
35           this would have included all the information up to  
36           that point on the various programs that were going  
37           on at the time. I believe it also will provide a  
38           series of recommendations and that sort of thing  
39           in establishing and providing an actual framework  
40           for future work.

41       MR. TIMBERG: Okay. If this could be marked as the  
42           next exhibit, please.

43       THE REGISTRAR: Exhibit 811.

44  
45  
46  
47

1 EXHIBIT 811: DFO document entitled, "A  
2 framework for an ecosystem-based approach to  
3 managing the Strait of Georgia" by Ian Perry  
4 and Diane Masson  
5

6 MR. TIMBERG: And if we could then turn to Tab 19 of  
7 Canada's list of documents.

8 Q I understand this is like an Executive Summary of  
9 that document; is that correct?

10 MR. McFARLANE: Yeah, this is a Science Advisory Report  
11 which basically pulls what the subcommittee that  
12 reviewed the previous document would consider the  
13 major points that should go into a document for  
14 easy access for everyone, not just Science people.

15 Q Okay.

16 MR. McFARLANE: So it gets rid of a lot of the science  
17 and concentrates on the actual conclusions and  
18 recommendations.

19 MR. TIMBERG: And if we could then have this marked as  
20 the next exhibit.

21 THE REGISTRAR: Exhibit 812.  
22

23 EXHIBIT 812: Executive Summary of Exhibit  
24 811, Science Advisory Report  
25

26 MR. TIMBERG:

27 Q If we could turn to page 8 of this document and  
28 I'd like you to comment on the knowledge gaps  
29 identified by DFO in the Executive Summary.

30 MR. McFARLANE: Okay. Yup, those are knowledge gaps.

31 Q All right. And if we could then turn to the next  
32 page to "Conclusions and Advice". So these are  
33 the -- maybe we'll just let the document speak for  
34 itself in the interest of time. I just note at  
35 the next page, at the bottom of the page, has  
36 recommendations. I'm not sure if you've had an  
37 opportunity to review the recommendations?

38 MR. McFARLANE: Yes, I have. I would say that in the  
39 previous part that you just skipped over, there's  
40 a timeline there that I think is very important.

41 Q Okay. If we could perhaps go to that, then.

42 MR. McFARLANE: It goes from short-term to mid-term to  
43 longer term research type approaches. I think it  
44 highlights a pretty reasonable approach to trying  
45 to determine what we can expect might happen in  
46 the Strait of Georgia over the next number of  
47 years. I do agree with some people who suggest

1           that this is -- that possibly DFO has not been  
2           putting enough effort -- and by "effort", I don't  
3           mean of individuals; I mean of money.

4           Q     So this, then, is part of the Science's --

5           MR. McFARLANE: This is the Science operational plan,  
6           basically.

7           Q     Plan to move forward in the next five years.

8           MR. McFARLANE: Yes, that's right. Yes.

9           Q     Okay. Thank you.

10          MR. McFARLANE: Now the recommendations?

11          Q     Yes, do you have any comments with respect to the  
12          recommendations?

13          MR. McFARLANE: Well, I do in terms of I think they're  
14          excellent recommendations. They seem to be in the  
15          order that follows the previous plan, the  
16          immediate, mid-term and longer term things that  
17          should be worked on, and I particularly agree with  
18          the recommendations 1 to 5, which is the  
19          synthesizing of the results right now. But  
20          basically to get into the selection and evaluation  
21          of indicators and monitoring programs, the  
22          operationalize (sic) of collection of data, which  
23          is always difficult to keep that sort of thing  
24          going, and the development and evaluation of the  
25          models developed under this initiative. That  
26          includes linking these models together from the  
27          physics right through to the higher trophic  
28          levels.

29                 I think that will generally lead to the final  
30          approach which would be to bring together the  
31          appropriate people from all the different  
32          stakeholders, and people who are interested in the  
33          Strait, and you can then, from there, get their  
34          ideas for setting out the objectives for how you  
35          would actually build an ecosystem management  
36          approach.

37                 This is basically an ecosystem assessment  
38          approach, not a management approach. So this is  
39          the science that goes into the management, but it  
40          does not incorporate the actual management  
41          objectives or how it would be implemented.

42          MR. TIMBERG: Okay. Thank you. If we could then turn  
43          to Tab 37 of Canada's list of documents.

44          Q     This is a document, a PICES scientific report  
45          number 25.

46          MR. McFARLANE: Yes.

47          Q     And it's an international program on climate

1 change and carrying capacity. Were you a co-  
2 author of this work?

3 MR. McFARLANE: Yes, I was.

4 MR. TIMBERG: And if this could be marked as the next  
5 exhibit.

6 THE REGISTRAR: Exhibit 813.

7

8 EXHIBIT 813: PICES Scientific Report No. 25

9

10 MR. TIMBERG:

11 Q If we could turn to page 1, there's an  
12 introduction here. For the assistance of the  
13 Commissioner, can you -- first of all, can you  
14 perhaps describe the larger work of which this  
15 paper, I understand, was part of. The larger  
16 work?

17 MR. McFARLANE: This is, basically, it was conducted by  
18 a task team under the auspices of PICES. The task  
19 team was called the Basin Studies, "Basin Scale  
20 Studies" task team or BASS. It looks at the two  
21 North Pacific gyres, the eastern gyre and the  
22 western gyre. Now, those fall within, you can  
23 see, ESA and WSA on the map.

24 Q And this is work that's international; is that  
25 correct?

26 MR. McFARLANE: Yes, it is. It's joint work between  
27 the six PICES nations.

28 Q Okay. We can look those up. So just before we  
29 get into the details of this, just --

30 MR. McFARLANE: Yes.

31 Q So how do those six nations work together on doing  
32 research?

33 MR. McFARLANE: The six nations get together and  
34 discuss research, formulate plans on where the  
35 most benefit might derive from, from doing certain  
36 types of projects together. It doesn't really  
37 support research itself. The individual countries  
38 still continue to do their own research. This is  
39 more of a guiding group that allows people to get  
40 together to develop their thoughts and to actually  
41 develop some joint programs for information  
42 exchange and that type of thing.

43 Q All right. And so I'm just cognizant of time, but  
44 if you just give a quick overview of the intent of  
45 the project and then we're going to jump to the  
46 conclusions.

47 MR. McFARLANE: Okay. The project was set up because

1           it was recognized by the six nations of PICES that  
2           a lot of things were going on in the two gyres,  
3           the eastern gyre and the western gyre. So why  
4           don't I just skip to the eastern gyre right now  
5           because you can use all the same stuff for the  
6           western.

7           It's very productive areas in the open ocean.  
8           It's a tremendously important rearing ground, or  
9           whatever type of ground you want to call it, for  
10          salmon. And it seems to respond to the same  
11          decadal scale type shifts or regime shifts that  
12          the coastal areas respond to. The people sitting  
13          on the BASS task team felt that it would be very  
14          useful to bring together as much information as we  
15          could on those gyres to build some conceptual  
16          models and then to take it one step further and  
17          try and build an ecopath with ecosim, ecotrophic  
18          model of the gyres with the hope that we would  
19          begin to understand how these gyres might  
20          influence coast systems because they're almost  
21          certainly linked.

22          Q     All right.

23          MR. McFARLANE: That was the intent.

24          Q     Okay. If we could then turn to page 37 of the  
25          document, and if we could look at that. What was  
26          the conclusion as it relates to predation, and  
27          specifically with salmon, in this report.

28          MR. McFARLANE: Well, the conclusions were fairly  
29          similar to the conclusions in Technical Report  
30          number 8 here, in that the -- there's a lot of  
31          information that is required still to ensure we  
32          have an understanding of the system, that there  
33          should be some directed studies on specific  
34          aspects of species that were out of the modelling  
35          exercise that appeared to be possibly of quite a  
36          bit of importance, and that the improvements to  
37          the models require that type of information, both  
38          diet information and abundance information.

39          Q     All right. And I note there in the first  
40          paragraph, it says we need better data on biomass  
41          trends for as many species as possible, especially  
42          competitors and predators of salmon such as flying  
43          squid, pomfret and sharks.

44          MR. McFARLANE: Right.

45          Q     Okay. And then over the page, it references a  
46          table at Table B-4 which is at page 56. This is  
47          where they recommend additional species that need

1 more data. Perhaps you can just briefly tell us  
2 what this table tells us.

3 MR. McFARLANE: This is simply the groups of species or  
4 the species or groups of species that were used in  
5 the model. It is the table indicating the data  
6 quality as we determined it to be using the data  
7 pedigree model which is basically assigning a  
8 number to it that says we either think the data is  
9 very good or very poor.

10 In this case, the colours represent how we  
11 felt about that data ranging from very poor, which  
12 is red, and excellent, which is green.

13 MR. TIMBERG: Thank you. In the interest of time,  
14 those are all my questions.

15 MR. WALLACE: B.C. was on the list but has no  
16 questions. Mr. Leadem, thank you.

17 MR. LEADEM: For the record, Leadem, initial T.,  
18 appearing for the Conservation Coalition.

19  
20 CROSS-EXAMINATION BY MR. LEADEM:

21  
22 Q In the limited time that I have available to me, I  
23 wanted to focus upon ecosystem-based management  
24 and talk about how that can be achieved. I  
25 realize that we're supposed to be talking about  
26 predation, but we seem to be talking more at  
27 generalities when we're talking about ecosystem-  
28 based management. So I want to focus on that  
29 because I found the discussion in Project 8,  
30 particularly at pages 77, 78 and 79 to be very  
31 informative.

32 And so, Dr. Christensen, I'm probably going  
33 to start with you and then get some other comments  
34 from the other scientists on the panel. I think  
35 it's important for us to understand the "why".  
36 Why should management be focused upon the  
37 ecosystem and not just simply managing the sockeye  
38 from a sustainable aspect?

39 DR. CHRISTENSEN: Well, first of all, thank you for the  
40 question. I was wondering whether I would get  
41 any.

42 Management should also focus on  
43 sustainability aspect of it, that's clear. That  
44 is where we have our traditions for -- that's  
45 where we have tradition for emphasizing. But it's  
46 also quite clear that that cannot answer what has  
47 happened to Fraser River sockeye over the last

1 decade or two decades. All indications are that  
2 marine survival has been declining. That's what  
3 we've heard here. We are in want of good  
4 explanations for that.

5 That, by itself, is a good reason for looking  
6 at what happens at the ecosystem level. So it's  
7 really to try to understand that and also to see  
8 what management actions might be taken. To me,  
9 that's important reasons.

10 Q And I suppose the question comes down to this: Do  
11 we know enough about the ecosystem to allow  
12 management decisions to be based upon our  
13 knowledge of ecosystems? Are we still in the  
14 learning phase about the ecosystems or do we know  
15 sufficient amount so as to enable managers to  
16 start to incorporate ecosystem knowledge and  
17 values into the decision-making processes.

18 DR. CHRISTENSEN: Well, if you look at how this has  
19 progressed in Canada, it certainly looks like we  
20 don't know enough. I compare to other countries  
21 and I see Canada not being a leader, to be very  
22 diplomatic. Rather, Canada has provided intention  
23 that is going to take that direction, but not  
24 follow suit as far as I can see.

25 We need to try. We need to start. We need  
26 to start doing it. We need to start making the  
27 analysis at the ecosystem level. Certainly a lot  
28 of work has been done on this. By doing this, we  
29 become better at it. We ask the right questions,  
30 we find out what kind of research is needed, what  
31 kind of data is needed. We can't just wait until  
32 it's perfect. That means it will never happen.

33 Q Right. I'm looking at your report at page 79, Dr.  
34 Christensen, and the next to the last paragraph  
35 that begins [as read]:

36  
37 Overall Canada has not moved very far towards  
38 ecosystem-based management.  
39

40 And then you go and draw some comparisons between  
41 U.S. and Canada, and then you further then go on  
42 to say, at the very end of that paragraph:

43  
44 Australia is possibly leading on  
45 implementation of ecosystem-based management  
46 and has done so by initially "letting the  
47 policies move ahead of the science".



1 I really find that interesting and I'm going to  
2 see if I can get some understanding of what you  
3 mean, or what Mr. Smith meant when he communicated  
4 those words to you of letting the policies move  
5 ahead of the science.

6 And let me tell you why. Because in my mind  
7 - and maybe I have this all wrong - we have the  
8 Wild Salmon Policy which says that there will be  
9 ecosystem indicators, Strategy 3 of the Wild  
10 Salmon Policy deals specifically with ecosystem  
11 values and indicators, and so it seems like we  
12 have the words and the policy but we don't seem to  
13 be moving ahead.

14 Okay. So with that background, maybe you can  
15 explain how you let the policies move ahead of the  
16 science.

17 DR. CHRISTENSEN: What happened in Australia was that a  
18 senior colleague, a scientist called Keith  
19 Sainsbury, was quite influential in impacting the  
20 policy there. He talked to people, he explained  
21 what is involved in what he'll call integrate  
22 management (sic), so multi-sectoral management of  
23 the oceans. The politicians listened to him and  
24 they basically made policies that implemented  
25 this.

26 Then the scientists were really forced to  
27 move very, very quickly. They had to adopt quick  
28 approaches for guiding the actual implementation.  
29 They asked much better questions after this  
30 happened. They had to take a number of shortcuts  
31 and they burnt their fingers a few times, but the  
32 outcome was quite clear that they are now a leader  
33 in this field. I'm sorry...?

34 Q But if I can draw back, now, to a discussion about  
35 Canada and the Wild Salmon Policy because --  
36 you're familiar with the Wild Salmon Policy, are  
37 you not, Dr. Christensen?

38 DR. CHRISTENSEN: Not in details, but I have looked  
39 through it and I have an idea about what it  
40 covers, but I --

41 Q Right. And you're aware that it sets out  
42 mechanisms for determining benchmarks and  
43 conservation units in order to preserve  
44 biodiversity of the salmonid species, and then  
45 goes further and talks about habitat and how you  
46 need to have habitat factored into the Wild Salmon  
47 Policy.

1           It goes a step further to Strategy 3 which  
2           talks about the need to incorporate ecosystem  
3           values, so you're not just looking at the salmonid  
4           species, but you're looking at them in the context  
5           of the entire ecosystem.

6           All right. So if you can accept that that's  
7           a very brief synopsis of the Wild Salmon Policy,  
8           and we have that in place in Canada, how do you  
9           see us falling flat because, you know, we seem to  
10          have a policy in place, and yet at the same time  
11          we don't seem to be making much progress on it.

12         DR. CHRISTENSEN: Ecosystem-based management is not a  
13          question of measuring the temperature and adding  
14          an indicator and saying we are considering the  
15          ecosystem. It's much more a question of how do  
16          you deal with trade-offs? These trade-offs  
17          involved interest groups with some going beyond  
18          what we normally look at. It's not just a  
19          question of the traditional way of making  
20          management.

21          Trade-offs involve that you have to make  
22          choices. You need to make clear objectives for  
23          the management. You need to consider how you  
24          evaluate different stakeholder groups, different  
25          interest groups, that there would be conflicting  
26          outcome of this. It has to be much wider, and  
27          these things have to be explicitly considered.  
28          The interest groups have to be clearly involved in  
29          the definition of how you do this -- how you set  
30          the objectives, how you deal with trade-offs.  
31          That needs to go in, and that's hardly scratched.  
32          As I read the Wild Salmon Policy, the surface is  
33          hardly scratched.

34         Q         Okay. I'm going to allow the other panel members  
35          to comment on any of the discussion so far. Mr.  
36          McFarlane, do you want to add anything about how  
37          do we move forward in terms of developing  
38          ecosystem-based management for the salmonid  
39          species, particularly Fraser River sockeye in  
40          Canada.

41         MR. McFARLANE: Well, in terms of ecosystem-based  
42          management, I would have comments. In terms of  
43          how we do it in relation to Fraser River salmon, I  
44          probably would bow to people who actually study  
45          those types of things, although I did outline how  
46          I would look at it from a science perspective.

47         Q         Yes.

1 MR. McFARLANE: I agree with what Dr. Christensen just  
2 said in terms of ecosystem assessment versus  
3 ecosystem management. They are basically two  
4 different disciplines. Ecosystem assessment is  
5 the science part of trying to understand how the  
6 ecosystem works, the functional aspects of it,  
7 whereas ecosystem management is the -- how you  
8 protect the resilience of that ecosystem given the  
9 various demands made on that ecosystem by various  
10 groups.

11 So, as he said, the trade-offs are really the  
12 bread and butter of how you manage the ecosystem,  
13 and it requires the -- you know, people really  
14 wanting to work together to do that. So you have  
15 to have the right people in the room. They have  
16 to really be serious about trying to come to a  
17 consensus on what trade-offs are reasonable in  
18 order for everyone to benefit, as well as for the  
19 Strait of Georgia to maintain its resilience.

20 So we're not there yet. We're not even close  
21 to ecosystem management. Fisheries -- you know,  
22 ecosystem fisheries management, we're progressing  
23 on a little bit, but ecosystem management, we're  
24 very far away from that.

25 Q Are we somewhere along the track towards  
26 developing knowledge of ecosystem assessment?

27 MR. McFARLANE: Yes.

28 Q You make the point of bifurcating ecosystem  
29 assessment and ecosystem management.

30 MR. McFARLANE: Yes, I do.

31 Q Surely we're somewhere along the line or the track  
32 of determining what the ecosystem is like, even  
33 though it may be very complex. We can do energy  
34 analyses, we can do water fluxes, we can do all  
35 kinds of things that are crucial to our  
36 understanding of the trophic levels in ecosystems,  
37 so somewhere we're along that pathway.

38 MR. McFARLANE: Yes.

39 Q So have we advanced sufficiently to enable  
40 managers to then take the next step and to start  
41 to incorporate that knowledge into developing  
42 these trade-offs as you call it?

43 MR. McFARLANE: In my opinion, yes, we're progressing  
44 nicely along that line. Again, if you're thinking  
45 managers as fisheries managers, that's only one  
46 component. There's many other components to land  
47 use and --

1 Q Right.

2 MR. McFARLANE: -- those types of things that have to  
3 be incorporated into those decisions.

4 Setting up a marine protected area, or a  
5 marine park or terrestrial park on the shores of  
6 any of these systems requires a whole different  
7 group of people to come in and start being part of  
8 the whole dynamic.

9 Q So doesn't it come down to this, is that the  
10 problem is that we're really isolating Fraser  
11 River sockeye and we're saying, well, if we're  
12 just simply going to focus on Fraser River  
13 sockeye, we'll manage it in this way, but you're  
14 telling me that you can't just take the fish out  
15 of the water, because if you do that, you know,  
16 you take the fish out of the water, it's going to  
17 wriggle around for a while but then you're going  
18 to lose whatever value the fish might have. So  
19 you really need to put it all together. Is that  
20 what you're saying?

21 MR. McFARLANE: I don't remember that, actually.  
22 Sorry, I'm maybe -- the fish out of the water part  
23 is where you started to lose me.

24 Q Okay. Well, forget my analogy then.

25 MR. McFARLANE: Okay.

26 Q Just drop my analogy.

27 MR. McFARLANE: All right.

28 Q It was probably a weak analogy to begin with. I  
29 was just trying to strive for just some way to  
30 describe the fact that if we simply focus upon the  
31 Fraser River sockeye as a single aspect, we're  
32 going to be missing a great component and that's  
33 all the ecosystem-based values that you know  
34 about.

35 MR. McFARLANE: Yes, in terms of if you're going to use  
36 just the Fraser River sockeye as your basis for  
37 managing all of the Strait of Georgia. That, I  
38 don't think, would be anyone's intent.

39 But if you're looking at answering very  
40 specific questions, you can design programs  
41 incorporating the ecosystem assessment and  
42 eventually the ecosystem management approach to  
43 answer very specific questions, but there would  
44 also be a total approach for the Strait of  
45 Georgia.

46 People have talked about the spatial  
47 components of these things, setting up marine

1 reserves and things. Where do you place log  
2 booms? Where do you place aquaculture sites?  
3 Those are all components of ecosystem management,  
4 but they have to be based on some knowledge of  
5 those areas. In this particular case, we've been  
6 talking about the Strait of Georgia and the Fraser  
7 River sockeye, so you would try and use that  
8 information -- develop information bases for those  
9 things.

10 For other questions, which are also part of  
11 the ecosystem approach to managing the Strait of  
12 Georgia, you would require information on those  
13 types of things also, absolutely.

14 Q Mm-hmm. Dr. Christensen, do you have any other  
15 comments? I know I'm running late on time. Dr.  
16 Christensen, just one last comment from you.

17 You've heard the discussion around ecosystem  
18 assessment, ecosystem-based management. Where are  
19 we along that paradigm in your view? Are we very  
20 far advanced?

21 DR. CHRISTENSEN: In Canada in general, or with regard  
22 to Fraser River sockeye or both?

23 Q With regards to Fraser River sockeye, because  
24 that's the question in the room.

25 DR. CHRISTENSEN: May I step back and just make an  
26 observation? Based on the experience I've got  
27 from this work that I'm engaged in here, I started  
28 out here -- I was definitely not a salmon expert.  
29 I know how to work with food webs, that's where my  
30 experience is, how to evaluate numbers. So I  
31 basically had to review what's known about Fraser  
32 River sockeye all the way from spawning till they  
33 come back again, the whole process. In doing so,  
34 I came across a quote from David Starr Jordan who  
35 was the first president of Stanford University  
36 more than 100 years ago. He was also an eminent  
37 scientist and he was quoted for saying that to  
38 evaluate the knowledge about sockeye Fraser (sic),  
39 the sockeye leaves the fresh water and they go ten  
40 miles offshore and they stay there for two years  
41 until they come back again.

42 This was pointed out during this process here  
43 as illustrating how far we have moved in 100 years  
44 with regards to knowledge about sockeye salmon in  
45 general. However, when going through the material  
46 that's available, looking for data about numbers,  
47 predation, what we know about that whole life

1 cycle, I really got to question whether we have  
2 moved very far beyond what David Starr Jordan  
3 described more than 100 years ago.

4 The questions we heard from the counsel for  
5 Canada all dealt with fresh water and coastal  
6 zone, but the two years they spend offshore were  
7 not even touched upon apart from the study, the  
8 BASS study which, however, didn't produce numbers  
9 that were useful in this context here; that was  
10 not the focus.

11 So if we are going towards ecosystem-based  
12 management with regards to understanding the  
13 ecosystem of which the Fraser River sockeye salmon  
14 are an important part, we need to look at the  
15 whole life cycle, including the ocean phase. We  
16 need to know much more about what's happening  
17 there, and we need to also make it very clear what  
18 it is we know about that. I would say we have not  
19 moved very far.

20 Normally, I make models which are quantified  
21 with data. I tried to do that here as well, but  
22 there were just too many unknowns, too many  
23 unknowns for me to want to stand here today and  
24 defend those numbers. That's why I didn't do it.  
25 I tried. So I don't think we have moved that far  
26 in this 100 years.

27 MR. LEADEM: Thank you. I could carry on all afternoon  
28 in this kind of discussion, Mr. Commissioner, but  
29 unfortunately my time is limited so I will have to  
30 leave the podium.

31 THE COMMISSIONER: Thank you very much, Mr. Leadem.

32 MR. WALLACE: Thank you, Mr. Leadem. Would this be a  
33 convenient time to take the afternoon break?

34 THE COMMISSIONER: Yes, please.

35 THE REGISTRAR: The hearing will now recess for 15  
36 minutes.

37  
38 (PROCEEDINGS ADJOURNED FOR AFTERNOON RECESS)  
39 (PROCEEDINGS RECONVENED)  
40

41 THE REGISTRAR: Order. The hearing is now resumed.

42 MR. HARVEY: Yes, Mr. Commissioner, I think I'm up  
43 next. It's Chris Harvey, for the Area G Trollers  
44 and the United Fishermen Allied Workers Union.  
45  
46  
47

1 CROSS-EXAMINATION BY MR. HARVEY:  
2

3 Q Gentlemen, I'd like to start at page 79 of the  
4 report, technical report number 8, because the  
5 authors there, and Dr. Christensen, you're one of  
6 the joint authors, say, firstly, about halfway  
7 down, at the end of a paragraph:  
8

9 Concepts such as predation, prey, or food  
10 webs are not even mentioned.  
11

12 These are comments made about the Wild Salmon  
13 Policy. Then the next paragraph, it's stated  
14 there:  
15

16 There are no indications from the PSC website  
17 and publications...that ecosystem-based  
18 management or food web considerations are  
19 factored into the advice they give.  
20

21 Then on the bottom of the page, you say:  
22

23 The focus of fisheries management on short-  
24 term tactical advice and setting annual  
25 quotas, while ignoring the longer-term  
26 strategic decisions that are fundamental for  
27 implementation of ecosystem based management,  
28 appears to be a global problem that has not  
29 capitalized on the progress made in  
30 developing the science needed to support  
31 ecosystem based management... Notably,  
32 ecosystem-based management calls for  
33 evaluating trade-offs, which may be severe,  
34 and which in turn have socio-economic  
35 consequences. Such trade-offs are seemingly  
36 ignored in the Wild Salmon Policy.  
37

38 Dr. Christensen, you and Dr. Trites make some very  
39 significant points here, and I don't want to deal  
40 with the absence of a socioeconomic analysis  
41 discussion, because we've canvassed that with  
42 other panels, but what I did find most interesting  
43 and what confirmed an impression I had from other  
44 panels, was your conclusion that ecosystem-based  
45 management or food web considerations are not  
46 being factored into fisheries decision-making, and  
47 I take it that you've come to the conclusion that

- 1 DFO in its fishery management decisions is failing  
2 to properly take into account the broader  
3 ecosystem effects of their decisions on -- such as  
4 effects on predation, prey and food webs. Does  
5 that basically capture the gist of your comment?
- 6 DR. CHRISTENSEN: Well, as an academic, sometimes you  
7 can get carried away with what you're writing and  
8 not be 100 percent fair. But I think overall, as  
9 you expressed, it captures what it was we  
10 intended, yes.
- 11 Q Yes. And you've mentioned a lack of data, but I  
12 wonder if it's not just a lack of data, but in  
13 some areas there, there may be good data, but the  
14 ecosystem data tends not to be factored into the  
15 decision-making process.
- 16 DR. CHRISTENSEN: Typically, the decision-making  
17 process calls for information about the species  
18 that is being managed locally in that area, with  
19 that management, based on not factoring in other  
20 parts of the ecosystem, and the consequences that  
21 the actions may have on other parts of the  
22 ecosystem. In general, yes, that is the status in  
23 Canada.
- 24 Q Yes. And I'm wondering if that's a structural  
25 problem within DFO in the sense that there's no  
26 scientist in chief, as it were, drawing together  
27 all the different scientific data as it exists and  
28 collating it?
- 29 DR. CHRISTENSEN: There are activities within DFO that  
30 assembles that information, but it is minor  
31 activities and it's not within, you know, the core  
32 of what's happening there. In principle, DFO has  
33 embraced ecosystem-based management through its  
34 implemented management, but from what I can read  
35 and hear about this, it's only in principle. The  
36 actual implementation seems to be wanting or  
37 lacking far behind. It's not moving very fast.
- 38 Q Yes.
- 39 DR. CHRISTENSEN: We heard that also, even on the --  
40 from a previous question here on this panel, from  
41 what's up there, now, on the screen with how the  
42 PICES 2010 report on components of integrated  
43 multi-sector ecosystem-based management where  
44 Canada only scores on its policy for the SARA  
45 acts, and I may note, by the way, that this  
46 conclusion is written, actually, by DFO  
47 scientists, the contribution to the PICES report,



1 it's not just an academic exercise.

2 Q The gentleman in Australia who you mentioned who  
3 got the system going there to a pretty high level,  
4 was he a scientist?

5 DR. CHRISTENSEN: The person who suggested this was a  
6 very senior scientist. He had actually just been  
7 awarded the Japan prize, a very prestigious prize,  
8 but he was talking about policies and impacting  
9 policies. So he was suggesting it, but it was the  
10 politicians who moved on it and who actually made  
11 it law, even though science was not ready.

12 Q Yes. All right. Now, the general comment of  
13 yours is that -- as set out on page 79 that we've  
14 been discussing, is meant to apply as much to  
15 freshwater ecosystems, I think, as marine  
16 ecosystems; is that right?

17 DR. CHRISTENSEN: Yes, though I must admit I know less  
18 about freshwater ecosystems than I do about  
19 marine.

20 Q I see.

21 DR. CHRISTENSEN: But I have seen nothing that  
22 indicates that freshwater ecosystem management in  
23 Canada has moved any further than the marine has.

24 Q Yes.

25 DR. CHRISTENSEN: And actually, it probably have moved  
26 less --

27 Q Yes.

28 DR. CHRISTENSEN: -- with regards to ecosystem-based  
29 management.

30 Q Do you think it's possible that this problem that  
31 you've identified may have something to do with  
32 DFO's inability to reverse the long-term decline  
33 of Fraser River sockeye?

34 DR. CHRISTENSEN: I certainly don't think that that is  
35 what's driving DFO, but I do not consider DFO to  
36 be very proactive, I should say, on moving on  
37 these aspects. It is a big bureaucracy and  
38 there's a lot of inertia in such a big system.

39 Q Yes. All right.

40 DR. CHRISTENSEN: And I do not -- I cannot blame them  
41 for what happens to Fraser River sockeye, but I  
42 can say that we know surprisingly little about why  
43 there has been 10, 15, 20 years declining in  
44 Fraser River sockeye.

45 Q Yes. And you would expect, with all of the  
46 scientific knowledge available, that there would  
47 be a better understanding of the reasons for the

1           decline; is that consistent with your views?  
2   DR. CHRISTENSEN:  When I accepted to write the report  
3           and was looking forward to this big task of  
4           summarizing what is known about salmon, I  
5           certainly realized that -- I certainly knew that a  
6           very large part of the DFO body is spent on salmon  
7           research, and so I had certainly expected that  
8           there would be more information about the  
9           environment in which they live, and by  
10          "environment" I'm not just talking about  
11          freshwater habitat.  
12   Q       Yes.  Freshwater and ocean environment?  
13   DR. CHRISTENSEN:  And not just habitat, but also the  
14          ecosystems --  
15   Q       Yes, yes, right.  
16   DR. CHRISTENSEN:  -- in general, but the important  
17          parts I found very little information about who  
18          are they together and what is the importance of  
19          this.  
20   Q       Yes.  At page 76 of your report you discuss the  
21          role of predation in dominance cycles - that's the  
22          four-year cycle that we're familiar with - and you  
23          say that in spite of considerable work - this is  
24          the second paragraph - in spite of considerable  
25          work that has been done by the previous fisheries  
26          commission, there's -- no clear answer is evident  
27          as to the causes of the dominant cycle.  I wonder  
28          if, by clear answer, you mean proven beyond any  
29          doubt, or proven beyond reasonable doubt?  I'm  
30          using terms that lawyers are familiar with perhaps  
31          more than scientists.  
32                Because if you looked at the question on a  
33          balance of probabilities, you could say what  
34          probably caused -- or science could say what  
35          probably causes the dominant cycle, could it not?  
36   DR. CHRISTENSEN:  No, I cannot -- I'm not an expert in  
37          this area and I should not answer it.  
38   Q       Yes, all right.  But you would expect the answer  
39          to be found in the ecosystem interactions  
40          involving the food web, predators, diseases,  
41          parasites, and that sort of thing, would you not?  
42   DR. CHRISTENSEN:  As an ecologist, I'm fascinated with  
43          the lifecycle of sockeye, how they seem to move,  
44          how they do move through many different habitats  
45          and how they minimize the risks faced throughout  
46          the whole lifecycle.  It's something that seems to  
47          be -- it's an incredibly fascinating aspect we

1           have here. They spawn in nutrient-poor areas,  
2           they grow up in lakes where there are probably  
3           about as little nutrients, few predators, they  
4           move through the whole ocean, following  
5           production, only showing up in big numbers every  
6           four years, so they can really confuse predators.  
7           It's an amazing strategy.

8           Q     Yes.

9           DR. CHRISTENSEN: So I'm fascinated by this. But now  
10          I've talked myself completely out of answering  
11          your question, sorry.

12          Q     Well, no, that's helpful. The dominance cycle is  
13          one of the fascinating things about sockeye, isn't  
14          it; one very large year, then a subdominant year?

15          DR. CHRISTENSEN: Sure.

16          Q     And obviously that results from something in the  
17          freshwater system, because it's a different cycle  
18          for different stocks, correct? If it were caused  
19          by something in the ocean environment, it would be  
20          the same throughout for all different stocks;  
21          you'd accept that, I expect; is that correct?

22          DR. CHRISTENSEN: Yes, I will, and I also -- the  
23          samples I've seen of where attempts have been made  
24          to break those cycles have not been very  
25          promising.

26          Q     Yes.

27          DR. CHRISTENSEN: More disastrous than promising.

28          Q     Yes.

29          DR. CHRISTENSEN: But, really, this is an area where  
30          I'm not an expert.

31          Q     All right. But you would expect that an  
32          understanding of the ecosystem interactions that  
33          cause cyclic dominance to be quite essential to  
34          sound fishery management decisions?

35          DR. CHRISTENSEN: Yeah, in the terminology we're using  
36          here, I would consider this a prime suspect, that  
37          it has to do with predation as well, yes.

38          Q     All right. This Commission is mandated to make  
39          findings of fact regarding the causes of the  
40          decline of the Fraser River sockeye, and I wonder  
41          if you consider it to be possible that the cause,  
42          or at least one of the causes or factors for the  
43          decline may be found in the ecosystem interactions  
44          taking place in the freshwater stage of the  
45          sockeye?

46          DR. CHRISTENSEN: I have seen no clear indications that  
47          it should be in the freshwater stage. What I have

1 heard is it's likely to be a question of reduced  
2 marine survival.

3 Q All right.

4 DR. CHRISTENSEN: Though it should always be clear, as  
5 pointed out in the panel this morning, that we  
6 know very little of what happens from the period  
7 they leave the rearing lakes until they come back  
8 again.

9 Q Yes.

10 DR. CHRISTENSEN: So it could also be the outward  
11 migration, the early life stage in the ocean, that  
12 is the critical aspect.

13 Q But Dr. Christensen, we know a great deal more  
14 about what happens in the freshwater system than  
15 in the ocean, and yet we can't explain the causes  
16 of cyclic dominance.

17 DR. CHRISTENSEN: To me it looks like research has been  
18 focused under the street light, really, where it's  
19 easy to do the research. By that I mean in  
20 freshwater and focused on habitats --

21 Q Yes.

22 DR. CHRISTENSEN: -- and not in the ocean. So yes,  
23 you're right.

24 Q But your inference that the cause is in the ocean  
25 seems to be somewhat at odds with your -- with  
26 what we have -- somewhat at odds with our  
27 inability to understand what causes cyclic  
28 dominance, and that obviously takes place in the  
29 freshwater.

30 DR. CHRISTENSEN: That is a good point, yes.

31 Q At page 73 of your report - there's a graph, Mr.  
32 Lunn - of the increased spawner abundance in the  
33 last two decades, quite a dramatic increase. This  
34 is, of course, in the freshwater system. And at  
35 the bottom of that graph, figure 36, you pose a  
36 question - "you" I'm talking about you and your  
37 joint author:

38  
39 Number of effective spawners of Fraser River  
40 sockeye salmon. The number of spawners has  
41 increased in recent decades. Has this lead to  
42 more, but smaller smolts in poor feeding  
43 condition that will be more susceptible to  
44 predation.

45

46 And I don't think you answer that question; is  
47 that right?

1 DR. CHRISTENSEN: No, we do not answer that. It is  
2 well-known that smaller smolt will have a higher  
3 mortality rate, so we can expect -- and we've seen  
4 that from in Richmond experiments in freshwater,  
5 that there is a correlation between the size and  
6 the survival rates.

7 Q Yes.

8 DR. CHRISTENSEN: We've also heard, including this  
9 morning from Dr. McFarlane, that indications are  
10 that productivity has been decreasing in Strait of  
11 Georgia -- actually, also in the Queen Charlotte  
12 Sound, I know. So the '90s have been a poor  
13 period out there as well.

14 So I can certainly easily imagine that we  
15 have a combination of effects here which could  
16 include smaller smolt, because there are more, and  
17 also poor ocean conditions.

18 Q And the smaller smolts, because there are more, as  
19 you say, would necessarily involve smolts that are  
20 less capable of withstanding poorer ocean  
21 conditions?

22 DR. CHRISTENSEN: The mortality rate for smaller smolts  
23 can be expected to be higher.

24 Q Yes.

25 DR. CHRISTENSEN: We do have to see that in the context  
26 that there are always more of them.

27 Q Yes.

28 DR. CHRISTENSEN: So that is a balance there.

29 Q All right. You say that --

30 DR. CHRISTENSEN: For which we need calculations.

31 Q Yes. On the next page, 74, there's an interesting  
32 paragraph under that graph. You say:

33

34 Related to this is that the Fraser River  
35 sockeye may have become the unwitting victims  
36 of their own success. As shown in Figure 36,  
37 the numbers of effective spawners of Fraser  
38 River sockeye salmon have increased in recent  
39 decades, which in turn may have increased  
40 intraspecific competition and exposed smolts  
41 to higher rates of mortality. Previous  
42 studies have shown that increased sockeye fry  
43 abundance leads to lower average weight of  
44 smolts, and that the total biomass of a smolt  
45 year class may decrease with increasing  
46 number of spawners... The implication of this  
47 is that increased escapement may lead to

1 higher predation mortality in the ocean where  
2 there is a strong positive correlation  
3 between size and survival...  
4

5 So this phenomenon of increased escapement may  
6 lead to smaller smolts with less energy reserves,  
7 and also smolts of a size that are more  
8 susceptible to marine predation; is that right?

9 DR. CHRISTENSEN: Yes, see how you see the academic  
10 getting carried away in writing. I did write  
11 this. This is suddenly an interesting hypothesis  
12 that's formulated here. It's one for which I can  
13 put the forwards but I do not have clearer  
14 evidence that says that this is the smoking gun or  
15 something that looks like this.

16 Q Yes. All right.

17 DR. CHRISTENSEN: But I certainly would not rule out  
18 what's here. I think it's an interesting thing  
19 for consideration.

20 Q Yes. Now, I asked some written questions. I  
21 think probably it's Mr. Hume who will have the  
22 answer to this. I asked some written -- questions  
23 in writing to Mr. Ryall. I don't think we've put  
24 them in as an exhibit yet, but one of those  
25 questions I asked [as read]:  
26

27 Do you, or does DFO generally accept that in  
28 Quesnel Lake fall fry collected in the fall  
29 of 2002 and 2003 were among the smallest ever  
30 recorded, 2.7 grams and 1.9 grams,  
31 respectively, from Quesnel Lake, as noted in  
32 Exhibit 417, page 28.  
33

34 And the answer I got from Dr. Ryall was that [as  
35 read]:  
36

37 This question is best addressed by DFO stock  
38 assessment staff and PSC biological staff.  
39

40 I think I would like to take the opportunity of  
41 having Mr. Hume on this panel, to ask whether he  
42 can confirm that data.

43 MR. HUME: The 2002 brood year of smolts were the  
44 smallest -- or fall fry were the smallest we've  
45 ever observed. 2001 brood year, fry were small,  
46 but were not outside the expected range for that  
47 density.

1 Q All right. Well, we'll take the 2002 brood year,  
2 then, fry. Is the size that you determined an  
3 indication of ecosystem interactions?

4 MR. HUME: Sorry, I don't understand the question.

5 Q Well, is the fact that the fry are smaller, it  
6 seems obvious to me, but you can correct me if I'm  
7 wrong, the fry were smaller because the food web  
8 was depleted by the extremely large number of  
9 sockeye fry; would that be a fair inference to  
10 draw?

11 MR. HUME: In 2001 and 2002 we had the highest  
12 escapement to Quesnel Lake that had ever been  
13 observed, and we did not do any limnological  
14 sampling in 2001, but we did in 2002. Nutrient  
15 levels that increased in the lake in 2002, as  
16 fully expected from fertilization from the  
17 carcasses, but we -- but the phytoplankton that  
18 was produced by that nutrient was unusual in that  
19 it produced a large bloom of phytoplankton, called  
20 tabellaria, it's a diatom called tabellaria, which  
21 was a colonial diatom, and the evidence is a  
22 little unclear, but it's unlikely to be a  
23 preferred prey item for daphnia so that much of  
24 the nutrients produced by the carcasses were  
25 diverted into a trophic trap, I guess you could  
26 call it, where the food -- the nutrients didn't  
27 work their way up the food chain to the sockeye  
28 fry. So we're speculating that the fry grew  
29 poorly that year because of the high -- because of  
30 this tabellaria that -- there was an extremely  
31 large amount of tabellaria that was in the lake  
32 and, I think, unprecedented from anything we've  
33 ever seen before.

34 Q All right. There's a graph in the material I  
35 produced, at Tab 11, that I think comes from your  
36 data collection work. This was sent to me by Dr.  
37 Walters, Carl Walters, and I think he said that it  
38 came from your analysis. Can you confirm that?

39 MR. WALLACE: Have the witnesses seen this document?

40 MR. HARVEY: Yes. Yes, he has.

41 MR. HUME: I have seen this.

42 MR. HARVEY: It's Tab 11 in my production.

43 MR. HUME: Dr. Walters presented this at a small  
44 meeting we had about four years ago. I really  
45 haven't had a chance to discuss it with him, at  
46 that time, even, or since. I do recognize the  
47 data.

1 Q Yes. You recognize the data, and I think you were  
2 involved in the collection of that data, were you  
3 not?  
4 MR. HUME: Yes.  
5 Q Okay.  
6 MR. HUME: My program was -- collected most of the  
7 daphnia and that.  
8 Q Yes. What this seems to show, it's got, if we  
9 look right to the bottom of the page, the day of  
10 the year, starting at zero through to 360. So  
11 this is a time sequence. And if we look at the  
12 top graph, of course, the fall fry time would be  
13 towards the right-hand side of the graph; is that  
14 right? When we talk about fall fry, do we mean --  
15 MR. HUME: No. This is the graph of daphnia biomass.  
16 Q Oh, daphnia biomass. So this is the food web, one  
17 of the --  
18 MR. HUME: This is the primary food item that sockeye  
19 fry feed upon.  
20 Q Daphnia, is that a kind of a fly?  
21 MR. HUME: Sorry?  
22 Q Is a daphnia --  
23 MR. HUME: Daphnia is -- it's commonly called a water  
24 flea, but it's a cladoceran zooplankter, which  
25 doesn't look at all like a flea.  
26 Q All right. So I won't try to tie it on my gear.  
27 MR. HUME: I could draw you a picture, but...  
28 Q I'm always looking for fishing advice. And then  
29 you write, this is one of the principle food  
30 sources of sockeye fry?  
31 MR. HUME: It's their favourite food, and if it's  
32 present they'll feed on it --  
33 Q Yes.  
34 MR. HUME: -- in exclusion of others.  
35 Q If these lines in the graph are right, they seem  
36 to show the daphnia are in the top graph, at any  
37 rate, which is the dominant year run, shows the  
38 daphnia dropping off quite dramatically in the  
39 fall?  
40 MR. HUME: Yeah, well, I mean, without really  
41 understanding the origin of everything in this  
42 graph, the big, brown points that extend from one  
43 edge of the graph to the other, I believe are  
44 probably a model that Dr. Walters put together to  
45 mimic what's going on in the graph. I don't know  
46 of -- I'm not even sure that they're the same line  
47 in each graph.



- 1 Q Well, let me just ask you the question. Did your  
2 research determine that the daphnia biomass  
3 dropped off in the fall in the dominant run years  
4 when there was a lot of fry on the --  
5 MR. HUME: Yes, that's true. It drops off quicker in  
6 the fall.  
7 Q Yeah. That's sometimes called "overgrazing", I  
8 think, the overgrazing effect; is that right?  
9 MR. HUME: It's certainly a grazing effect.  
10 Q Yeah. And does it mean that the fry going into  
11 the winter have depleted energy reserves?  
12 MR. HUME: Not necessarily. There is still -- I mean,  
13 there's still -- it looks like there was a  
14 considerable amount of daphnia present in the lake  
15 at that time, so you have -- that's one of the  
16 reasons we measure fry size, weight and length.  
17 We should also be looking at energy content,  
18 itself, which is something we haven't done to  
19 date.  
20 Q All right.  
21 MR. HUME: And in fact, I would say that fall fry in  
22 the dominant years, in general, tend not to be  
23 smaller than in the other years; in fact, they're  
24 probably a little bit larger than in other years.  
25 Q Well, let me ask you to explain the document that  
26 Mr. Timberg put in. It's Exhibit 810. Because  
27 you may be the only -- I'm sure you're the --  
28 MR. HUME: One of the responses so you can get high  
29 densities instead of low growth is higher  
30 mortality, and so this graph, here, shows that,  
31 that we're done...  
32 Q But what is causing the mortality? Because if I  
33 interpret this graph correctly, we have the effect  
34 of female spawners across the bottom --  
35 MR. HUME: Mm-hmm.  
36 Q -- and up the -- in the Y axis, the fall fry in  
37 the millions, and the top most amount of fall fry,  
38 there's one towards the left right up near the  
39 top, and one way off on the right up near the top  
40 at the same level. And I think you mentioned a  
41 levelling off effect. So with the effect of  
42 female spawner abundance increasing, you get an  
43 increasing number of eggs and an increasing number  
44 of hatching fry --  
45 MR. HUME: That's fine.  
46 Q -- why don't you get an increasing number of fall  
47 fry?

1 MR. HUME: Because mortality also increases with  
2 density. Actually, in the predation report,  
3 Figure 1 in the predation report shows the  
4 relationship here quite well and that mortality  
5 increases with density.  
6 Q Before we leave this one --  
7 MR. HUME: And but growth doesn't.  
8 Q What causes the mortality? That's what I'm  
9 getting after.  
10 MR. HUME: Well, as I think I explained earlier, we  
11 don't have a definite smoking gun. We assume that  
12 they probably are growing slower, and so the  
13 smaller fry are probably preyed upon at a higher  
14 rate than --  
15 Q But food web interactions may have a role to play  
16 as well, correct?  
17 MR. HUME: Yes, it's all food web interactions, yes.  
18 Q In other words, there's a limit to the amount of  
19 food that a lake system can carry; is that  
20 correct?  
21 MR. HUME: That's right.  
22 Q And this limit is reached and shown by the  
23 levelling off of the --  
24 MR. HUME: Well, what we're seeing is that the sockeye  
25 fry respond -- or the sockeye fry population  
26 responds by increasing mortality but maintaining a  
27 more or less constant size at high densities.  
28 Q But the ones that manage not to die, I would  
29 expect they would be weaker than --  
30 MR. HUME: On average they're about -- and so, say,  
31 fish from -- on this graph here, fish from, say, a  
32 million to 1.8 million effective female spawners,  
33 so the right-hand side of the graph they're all  
34 approximately the same size.  
35 Q Same size, but --  
36 MR. HUME: On average.  
37 Q -- if there's --  
38 MR. HUME: At the time of sampling.  
39 Q If there's a higher mortality occurring as you  
40 expand along the X axis, surely the ones --  
41 MR. HUME: The smaller --  
42 Q -- that survive are not as strong as they would  
43 otherwise be, if they were near the left-hand end  
44 of the axis?  
45 MR. HUME: Well, I mean, all we -- the only information  
46 we have on their strength, as such, is their  
47 weight.

1 Q Dr. McFarlane mentioned the smolts reaching the  
2 gulf being - he used the terminology - robustness  
3 and fatness, no doubt trying to give us something  
4 we could understand, but is there a difference in  
5 the -- how do you assess robustness in a fry? Is  
6 that energy levels?

7 MR. HUME: Well, it is energy levels, which we don't  
8 measure, but we measure, instead of energy levels,  
9 we measure their weight and their length, and from  
10 that you get a ratio of those two and you can do  
11 something called "condition factor", which is a  
12 crude measure of energy content.

13 THE COMMISSIONER: Mr. Harvey, I think Dr. Christensen  
14 wanted to say something.

15 MR. HARVEY: Oh, yes.

16 Q Dr. Christensen, did you want to say something?

17 DR. CHRISTENSEN: If I can just answer your previous  
18 question, looking at the daphnia graph we had  
19 before, to me it certainly indicates that in the  
20 higher cycle -- in the dominant years the  
21 abundance of daphnia in the autumn would be one to  
22 two orders of magnitude lower than in the off  
23 cycle years. That seems to be the clear  
24 conclusion from that. You asked that specific  
25 question. This is all I can see from -- this is  
26 what this graph indicates. And that means  
27 depletion of the food resource in the dominant  
28 year, as indicated from these results.

29 Q Yes. And that would be a normal ecosystem  
30 consequence of greater abundance of the predators  
31 on that food web?

32 DR. CHRISTENSEN: This is what we would expect would  
33 happen, yes.

34 Q Yes.

35 MR. HUME: In Quesnel Lake we have the dominant and the  
36 subdominant years overlapping in escapement  
37 numbers, so that for the same density of -- or  
38 same escapement level or approximate same  
39 escapement level you can -- we can have -- we have  
40 fry from the same -- we have measures of fry from  
41 the same escapement size, but in two -- in a  
42 dominant and subdominant year, and in general we  
43 find that the fry in the dominant years are as  
44 large as, if not larger, than the fry in the  
45 subdominant years. And again, or as well, they're  
46 also -- it's not such a good overlap, but in the  
47 two following non-dominant years the fry are

1 smaller again.

2 Q So there must be some ecosystem carryover that --

3 MR. HUME: We're speculating. This is possibly shown  
4 by what you're seeing in these graphs here. I'm  
5 quite hesitant to put a lot of faith into these  
6 graphs, seeing as this data has not been reviewed  
7 by yourselves. It is my data, but it was an  
8 exercise that we were doing with Dr. Walters.

9 Q Have you never plotted your data onto a graph such  
10 as this?

11 MR. HUME: Well, no. Well, no, I, personally, haven't.  
12 This --

13 Q All right.

14 MR. HUME: My program looks at two separate -- well, my  
15 program has two biologists; one is a limnologist  
16 who basically works with this dataset; and I work  
17 with the fish, mainly. There's a bit of an  
18 overlap in the status side here and we -- I mean,  
19 I just -- I'm not confident, I'm not comfortable  
20 in discussing this data in great detail without  
21 having actually reviewed it more thoroughly.

22 Q But you don't have a better graph than this?

23 MR. HUME: Not at the moment, no.

24 MR. HARVEY: I wonder, with those qualifications, if  
25 this could be marked as the next exhibit?

26 THE REGISTRAR: Exhibit Number 814.

27  
28 EXHIBIT 814: Daphnia biomass charts of  
29 Quesnel Lake  
30

31 MR. WALLACE: Mr. Commissioner, I see it's a little  
32 after 4:00. Is this convenient, Mr. Harvey?

33 MR. HARVEY: Yes.

34 THE COMMISSIONER: What's the program for tomorrow, Mr.  
35 Wallace?

36 MR. WALLACE: Mr. Commissioner, we have, following Mr.  
37 Harvey, Ms. Gaertner, and Mr. Harvey estimated one  
38 hour, and has now been at it for about half of  
39 that, so he should be through by 10:30, and Ms.  
40 Gaertner for an hour or so, so something around  
41 11:30, quarter to 12:00 for the break.

42 THE COMMISSIONER: Thank you.

43 THE REGISTRAR: The hearing is now adjourned for the  
44 day and will resume at ten o'clock tomorrow  
45 morning.

46 (PROCEEDINGS ADJOURNED TO FRIDAY, MAY 6, 2011  
47 AT 10:00 A.M.)

1 I HEREBY CERTIFY the foregoing to be a  
2 true and accurate transcript of the  
3 evidence recorded on a sound recording  
4 apparatus, transcribed to the best of my  
5 skill and ability, and in accordance  
6 with applicable standards.  
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11 Pat Neumann  
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23 Karen Acaster  
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35 Diane Rochfort  
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42 with applicable standards.  
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47 Karen Hefferland