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.

Monday, April 18, 2011

Tenue à :

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

le lundi 18 avril 2011

APPEARANCES / COMPARUTIONS

Patrick McGowan Jennifer Chan	Associate Commission Counsel Junior Commission Counsel
Mark East Charles Fugère	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")
Don Rosenbloom	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")
Keith Lowes	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")
Anya Brown 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.

Tim Dickson	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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THE REGISTRAR: The hearing is now resumed.
MR. McGOWAN: Good morning, Mr. Commissioner. It's Patrick McGowan along with Jennifer Chan, counsel for the Commission.

Today's witness is Dr. Mark Johannes. He is the author of Commission's technical report number 12, "Fraser River Sockeye Habitat Use in the Lower Fraser and Strait of Georgia." I'm prepared to proceed with his examination on his qualifications. Perhaps the witness could be affirmed.

MARK JOHANNES, affirmed.

THE REGISTRAR: Could you state your name, please?
A Mark Johannes.
THE REGISTRAR: Thank you. Counsel?
MR. McGOWAN: Yes, Mr. Commissioner. Dr. Johannes describes his area of expertise as being in the area of ecosystem biology with technical specialties in aquatic ecology and environmental assessment. I'll just say that again. Ecosystem biology with technical specialties in aquatic ecology and environmental assessment, and it's in that area that I'll seek to have him qualified.

EXAMINATION IN CHIEF ON QUALIFICATIONS BY MR. McGOWAN:

Q Dr. Johannes, you first obtained a Bachelor of Science in Fisheries and Wildlife from the University of Guelph in 1982?
A Yes.
Q You proceeded then to obtain a Master's of Science in Ecological Restoration and Fisheries from York University?
A Yes.
Q And that was in 1987?
A Yes.
Q Finally, you obtained your Ph.D. in Aquatic Ecology with a focus on fisheries from York University in 1990?
A Yes.

Q I wonder if you could just briefly explain to the Commissioner what your area of study was within your Ph.D.?
A Good morning. My Ph.D. was looking at a series of lake and watershed systems where we were manipulating the structure of the fish populations to look at the changes on how food webs worked, and where the nutrients flowed and where the dynamics of the ecosystem pieces fell out in terms of production characteristics along each of the trophic levels.
Q Okay. Since 1990 at least, you've been employed and in positions related to aquatic ecology, environmental assessment and fisheries biology?
A Yes.
Q Okay. Now, the Commissioner has heard about aquatic ecology before. I wonder if you could - and I'm sure he's heard about environmental assessments - but I wonder if you could just briefly explain what an environmental assessment is?
A From the context that we review environmental assessments and work with, in this case through my present employer, we worked through proponents or clients to work through two particular environmental assessment ***Acts***, the ***Canadian Environmental Assessment Act***, ***CEAA***, and the ***British Columbia Environmental Assessment Act***, ***BCEAA***, and through those characteristic ***Acts***, what we're trying to do and attempt to do is look for the project-related effects on the environment and potential residual effects that come from those project-related effects, residual effects being those that are not mitigated to avoid or limit potential project-related effects.

Then we follow through the same sort of process for identifying how best the project can be pre-designed, designed and constructed, operated, in order to limit -- or first avoid and then limit potential environmental-related effects.
Q Okay. And there is a particular methodological approach which is often adopted in environmental assessment; is that right?
A Yes.
Q And you have applied a similar methodological approach to the creation of this report; is that

correct?
A I have attempted to apply that approach, yes.
Q Now, coming back to your employment for a moment, you've worked for the Department of Fisheries and Oceans on two occasions, first in the mid-'90s, and subsequently in the years 2002 to 2006?
A Yes.
Q And most recently, in 2002 to 2006, you worked for the DFO as a fisheries biologist tasked with coordinating large environmental and fisheries projects including some which focused on B.C. salmon stocks and habitats?
A Yes, the primary focus was in fact related to climate change issues and coordination of a national aquatic resource sector office on climate change.
Q Okay. Have you also worked for some environmental organizations over the years?
A Absolutely.
Q I wonder if you could give a couple of examples, please.
A I helped form and found something called the Northwest Ecosystem Institute which was a not-for-profit research institute. Its function and role was looking at things that NGOs and governments -- non-government organizations and government organizations couldn't easily deal with. It had a research focus which is in fact some aspects of my own experience.
We had a Board of Directors and sought and found conservation-related research funding to do a number of initiatives.
Q Okay. And you've worked for other environmental organizations as well?
A I've worked for environmental organizations, yes.
Q Have you done some work for the Pacific Salmon Foundation?
A Under contract, yes.
Q Okay. You presently work with Golder & Associates?
A Yes.
Q And in that capacity you manage environmental fisheries and habitat projects and are involved extensively with environmental assessments?
A Yes.
Q Okay. Over the years, you've worked for proponents on a number of large development

projects; is that correct?
A Yes.
Q Your clients have included municipalities?
A Yes.
Q Mining corporations?
A Yes.
Q You've worked on projects dealing with port development?
A Yes.
Q And projects dealing with railway developments?
A To some extent, yes.
Q You see before you on the screen a résumé. That's your résumé?
A Yes.
Q And it's a somewhat abbreviated copy of your c.v.; is that right?
A Oh, yes.
Q The full one is quite a bit lengthier?
A Yes.
Q In addition to working in this area, have you published academic articles?
A Yes.
Q And have you held any teaching positions?
A Yes, I still do.
Q Okay. I wonder if you could describe those briefly, what your present involvement in teaching to the Commissioner?
A My present involvement is I have actually three graduate students through Royal Roads University in a Master's capacity, so some of them are getting closer to completing, and some are not. I regularly -- I'm associated with the biology faculty at University of Victoria and teach through Environmental Studies at the University of Victoria, and have had graduate students in the past at University of Victoria.
MR. McGOWAN: I wonder if Dr. Johannes' c.v. could be marked as the next exhibit.
THE REGISTRAR: Exhibit number 731.

EXHIBIT 731: Résumé of Dr. Mark Johannes

MR. McGOWAN: Mr. Commissioner, those are my questions on his qualifications. I'll seek to have him qualified as an ecosystem biologist with technical specialties in aquatic ecology and environmental assessment.

I believe at least one of my friends has some questions on qualifications. Mr. Leadem?
MR. LEADEM: Leadem, initial T., appearing for the Conservation Coalition, Mr. Commissioner.

CROSS-EXAMINATION ON QUALIFICATIONS BY MR. LEADEM:

Q Good morning, Dr. Johannes. I have a few questions about your résumé. I may also have some questions about some of the people that you work with and their qualifications as well.
A Yes.
Q I'm hoping that you can answer the questions about their qualifications.
To begin with, in terms of the writing of the report, I take it that because you were the senior author that you assumed responsibility for the entire contents of the report that we have before us; is that correct?
A Yes.
Q And to some extent, though, you also had a couple of other members of your team that assisted you in the production of that report; is that correct?
A Absolutely.
Q And one of those was a Mr. Lee Nikl; is that correct, N-i-k-l?
A Yes.
Q And another one was a Mr. Rob Hoogendoorn; is that correct?
A Yes, Mr. Rob Hoogendoorn.
Q And both of those individuals are employees of Golder; is that correct?
A Yes, that is correct.
Q Now, just dealing with your résumé for the time being, I want to focus upon your work experience with Fisheries and Oceans. The most recent time that you worked with them was for a period of time from 2002 to 2006; is that correct?
A Yes.
Q And did you work for Fisheries and Oceans in the context of examining habitat in the Fraser River during that period of time?
A Briefly.
Q Briefly. All right. So the focus was global climate change, was it?
A The main focus and emphasis was aquatic resource sector issues associated with climate adaptation,

climate change adaptation.
Q All right. Under your résumé, for example, I see these words:

> Under contract, managed, coordinated, and conducted large freshwater, marine, and terrestrial based environmental and fisheries projects, including focus on BC salmon stock and habitats.

So to be specific, then, what portion of that time would have been focused upon the Fraser River?
A Portion of that time, probably less than two percent, let's say.
Q Okay. Were you involved in any major review of any major projects on the Fraser River, and the lower Fraser specifically, during that period of time?
A Review of those projects, no. In terms of facilitating the information associated with them, yes.
Q And which projects would they have been?
A These would have been discussions associated with climate change issues, Fraser River water temperatures and characteristics. If I can explain a little bit more on --
Q Certainly.
A -- that detail. I was the Chair for a conference in 2005 called Fisheries and Climate, and it was a large sponsored American Fisheries Society conference. As Chair of that conference, I facilitated organization for numbers of sessions, including one that was devoted to salmon and climate issues that was sponsored by Pacific Fisheries Resource Conservation Council. I participated in a number of talks on my own sets of work that were associated with different stocks in areas of the province.
Q Okay. I appreciate that that wasn't your total job that was -- chairing this particular climate, was it, the Climate Conference?
A No.
Q No, there was other things you did. Going back in time to 1993 to 1995, you were also an employee of the Fisheries and Oceans Canada, were you not?
A Yes.
Q And at that time, you conducted fisheries

assessments and management projects across B.C. on salmon, did you not?
A Yes.
Q And some of that work would have included the Fraser River, correct?
A Yes.
Q And that would have included the lower Fraser River, correct?
A To some extent. It was mostly including lake systems, juvenile sockeye migration patterns.
Q Yes. You also are a project biologist for developing the Wild Salmon Policy Habitat Strategy 2, are you not?
A I am just finishing a contract through Golder with Fisheries and Oceans Canada looking at habitat monitoring strategies, yes.
Q And specifically that's Strategy 2 of the Wild Salmon Policy, correct?
A Associated with habitats, yes.
Q And you would have come into contact with Heather Stahlberg in that context, is that not fair?
A No.
Q No?
A I have not been in contact with --
Q Okay. Who did you work with, then, in conjunction with your provision of advice to DFO Wild Salmon Policy, Habitat Strategy 2?
A The contract project manager through Fisheries and Oceans Canada is Mr. Brad Mason, who is the habitat inventory coordinator.
Q All right. And did your work also take you into affiliation or working with Dr. Kim Hyatt on occasion?
A I know Dr. Hyatt very well.
Q Yes?
A But in this case, this contract did not. There was only one single meeting where Dr. Hyatt attended to provide some input through Strategy 3 to this document, but that has not been developed any further on that, nor have we had conversations about this document or the --
Q One of the other projects that you worked on for Fisheries and Oceans Canada was as a participating author for preparation of reporting on an integrated salmon chapter for the Pacific north coast integrated management area of B.C.; is that not correct?

A That is correct.
Q How long ago did that occur?
A That was in the mid-2000s, 2005, 2006 period.
Q You also, in conjunction with Department of Fisheries and Oceans, were a biologist and a lead author for an aquaculture contract, were you not? That was based in Ottawa.
A Yes.
Q And what time frame are we talking about for that?
A About the same period, the mid-2000s.
Q So the mid-2000s?
A Yes.
Q 2005 or so?
A I believe so, but I can check on that if you wish.
Q Now, do you have the résumé of Mr. Nikl before you?
A If you just give me a second.
MR. LUNN: It's on the screen as well, Mr. Leadem.
MR. LEADEM: Thank you.
A I have it.
Q All right. Thank you. Mr. Nikl is an employee of Golder Associates, and you've worked with him on this project, correct?
A Yes.
Q He was a past head of water quality for Department of Fisheries and Oceans from 1992 to 2001; is that correct? If you look at the bottom of his résumé, the last item on page 1.
A Yes.
Q And over the years, he's done a number of things for Golder and Associates including some work that he's conducted for Department of Fisheries and Oceans; is that fair to say?
A As a client in that case, yes.
Q Right. And in that context, then, DFO was a client of Golder and Associates; is that fair to say?
A Yes.
Q If I can ask you to turn to page 7 of Mr. Nikl's *curriculum vitae*, the second item down itemizes that he was the principal investigator for a study of fish and water contamination levels from a large chemical spill on the Fraser River. Do you know where that spill occurred?
A I do not.
Q Okay. If I can ask you to turn to page 10 of his *curriculum vitae*, the last page of it. There are

a number of projects listed on that page where he was under contract or presumably DFO was a client of Golder's, including numerous macroinvertebrate stream surveys across B.C., and as a designer of an integrated pollution prevention program; is that fair to say?

A As a biologist, yes.

Q Yes. And finally, if I can ask you to turn to the résumé of Mr. Hoogendoorn, do you have that one in front of you?

A I do.

Q Now, he was one of the authors of your report with you; is that right?

A Yes.

Q And, at times, he has also worked for Golders (sic) and Associates in which the client was Department of Fisheries and Oceans; is that right?

A Just let me check here.

Q For example, if I look at page 2, I see Fisheries and Oceans Canada in Squamish, B.C.:

> ...provided technical input into the Squamish watershed salmon assessment framework.

A Yes, that's correct.

Q All right. He also, at one point, one of his clients was Marine Harvest Canada; is that right? If I look at page 4 of his résumé.

A Well, look at that, yes.

Q All right. And he was developing a study for an assessment of potential impacts from a proposed land-based hatchery development on water quality of an adjacent stream in B.C. in that context; is that right?

A Yes.

Q Now, in preparing your report, you had drafts of the report that you prepared. Did you have discussions at any time with Department of Fisheries and Oceans officials in the preparation of your report leading up to the preparation of your report?

A Only in the context of requests for information.

Q All right. And who did you make those requests for information to?

A Dave Mackas and Moira Galbraith in IOS.

Q At any time, did you share a copy of your draft report with anyone from Department of Fisheries

and Oceans?
A A draft? No.
Q And, to your knowledge, did any of your associates ever discuss your draft comments on the report with anyone from DFO?
A They knew it was confidential. Mr. Nikl did contact DFO for information which is provided in a table, and a vignette insert that was also provided, but he was making an information request directly to DFO, not making a comment on the report.
Q All right. Okay. Did you have any discussions with Dr. Hyatt about your report?
A Not about the content of the report. He was aware that I was participating in it, I believe.
Q Yes. Did you have casual conversations then with him about the report?
A Absolutely not.
MR. LEADEM: Those are my questions, Mr. Commissioner.
THE COMMISSIONER: Thank you.

CROSS-EXAMINATION ON QUALIFICATIONS BY MR. ROSENBLOOM:

Q Dr. Johannes, my name is Don Rosenbloom and I appear on behalf of Area D Gillnet, Area B Seiner. I have one very simple question for you.

In respect to the paper that is before us and the subject of your testimony, Project 12, you focus on, I believe, 70 major projects in the Lower Mainland area for your analysis that leads to certain conclusions.

My question to you is in respect to those 70 projects. To what extent were you involved personally in any of those projects, either in the context as an employee of a governmental agency reviewing the project, GVRD, Metro Vancouver or, alternatively, as a paid employee of the proponent that was pursuing the project?
A I don't have an answer to that.
Q Why is that?
A I did not actually -- I had one of my technical people assemble the database from independent methods and sources, as I articulate in the document, and those databases and approaches are project registries that are well-published and distributed. I did not look at the specific individual naming of particular projects, so I

can't give you an answer about how many I've been involved with or not. I can probably name two that may be on that list, but I cannot guarantee which ones those (sic) are listed in that same way.

Q I may not have completely grasped your response. My question firstly is limited exclusively to your personal interest in any of those 70 projects, and surely you have memory whether or not, either as a governmental regulator, you were involved in any of those 70 projects in terms of overview or, alternatively, were you personally retained as a biologist for the proponent in any of those 70 projects?

A Again, I don't know the answer to that because I don't know the exact listing of the individual projects within that list. I know where they are spatially distributed, where they are and their general context in terms of what they are in terms of the approach to the project and the characteristics of the project. But to name an individual project, I cannot do that right in front of you at this particular point. I can certainly look at the database to identify what the projects are and tell you which ones I've been involved with.

As a regulator, no, I will not have been involved in any of those projects that way at all. As an employee of Golder Associates, either peripherally or as a biologist, I will have been involved in probably a number of those projects.

Q Well, in fact, forgive me, but as we stand here today, are you saying that you are not aware of the identity of any of the 70 projects that are spoken about in this report?

A Of course I am aware of the general identity of those projects, and I can surmise, but I'm not having the list in front of me that will articulate every single individual project.

Q And since we're going to be living with each other for two days, are you able, overnight, to come back tomorrow and inform me to what extent you, personally, were involved in any of the 70 projects, either as a regulator, an employee of the regulator, or the GVRD or any other government agency or, alternatively, as a paid biologist for the proponent.

A I certainly should be able to do that, yes.
Q All right.
A But I can answer your question first if --
Q Thank you.
A -- you let me.
Q Sure.
A The very first one I've already responded to which is I have not acted as a regulator for any of these projects that are identified here. I can guarantee that right now.

In terms of the characteristics of the projects that I've operated on right now, I've operated on them within a number of characteristics and I'll give you that description in a general framework, which is, I operate as a biologist, a professional. I operate within the context of the ***Acts*** that are regulatory functions of this which include the ***Fisheries Act of Canada***, the federal ***Fisheries Act***, the provincial ***Water Act*** and the federal and provincial ***Environmental Assessment Act***. Within those characteristics, I have acted presumably on some of those projects as an environmental lead or just a biologist articulating a discipline-specific issue, and those follow rigorous, rigorous professional review both from a regulatory standpoint and First Nations and community perspectives, including fishers.

That perspective is well-rounded and very well documented in the project registries and the documentation for any of those projects.

That said, I can also articulate that I have worked on a number of projects that have been profiled projects and I can certainly outline to you right now what those projects were and what my role was.

Q In which projects, I'm sorry?
A In a number of larger projects here in the Lower Mainland in the area.
Q Right. Well, rather than doing this in a disjointed way between today and tomorrow, if you would, overnight, review the full list, the wholesome (sic) list of the 70, and come back and inform us, at least during my cross-examination, to what extent you were involved in any way whatsoever in those 70 projects.

As an example, I read in your *curriculum*

vitae - or résumé, I should say - Southern Railway, you worked as environmental lead and project director for the Southern Railway. That is in the Lower Mainland; is that correct? Was that project in the Lower Mainland?

A Cloverdale, yes.

Q Yes. At this moment, are you aware whether that was one of the 70 projects?

A That is not one of the 70 projects.

Q I see. And, for example, Burnco Rock Products out of Abbotsford, do you have any idea whether that was one of the 70 projects?

A That is a listing of a project, it's not a project in terms of constructability or anything else. It's in partial review, and it is not one of the projects.

Q Now, if you would be kind enough then to get back to me by tomorrow with that information, or even through your counsel so we speed this process up. I would appreciate that information.

But I'm asking that information not only of you, Doctor, but of those that also participated in this report, your co-authors. Are you in a position, between today and tomorrow, to inform us to what extent any of the co-authors did have personal interest in the context I've asked of you?

A I won't be able to speak for my co-authors at this time. I certainly can speak for myself and I'll gladly represent that.

Q Oh, sorry, why can't you speak for co-authors? Can you not phone them this evening and -- sorry, even at noontime today and ask them to start reviewing the list of 70 so that we can be informed of their interest?

A I'm not sure that -- knowing their schedules to some extent, I'm not sure that they'll be able to respond to me --

Q Well, I --

A -- beyond lunch, so --

Q I would ask the best that you can do, and to report to me tomorrow at the hearing or through counsel as to what extent you've been able to give me this information and, if not, for what reasons you've been unable to. I'd appreciate that, okay?

A Yes.

MR. ROSENBLOOM: I thank you very much. No further

questions.
MR. McGOWAN: Mr. Commissioner, if perhaps the witness then could be excused from the usual rule about communicating about his evidence during cross-examination to the extent it's necessary to respond to that request.
THE COMMISSIONER: Yes.
MR. HARVEY: And, Dr. Johannes, I just have a few questions. Chris Harvey, I represent the Area G Trollers and the UFAWU.

CROSS-EXAMINATION ON QUALIFICATIONS BY MR. HARVEY:

Q I didn't get a clear note of what your Ph.D. topic was. Can you give it to us again?
A My Ph.D. topic was in a series of lakes and watershed areas where I was looking at the trophic interactions, if I can use those terms, between the large predator fish and the smaller fish and their prey, and the nutrients associated with them. That was through a series of lake systems that were being manipulated through -- both in Michigan and in Ontario, and involved a lot of different field sampling and components which allowed me to look at some of the behavioural characteristics of some of the fish, and the trophic dynamic responses of the ecosystems.
That resulted in a number of primary publications which are known in the literature on something called "top down/bottom up ecosystem trophic level modelling." That's where that topic represented itself.
Q And are those publications under your name?
A Some will be under my name, yes.
Q Yes. Did you do any similar studies in B.C.?
A Working on sockeye lakes, yes.
Q Which lakes in particular?
A I'm afraid I probably couldn't name them all, but certainly the focus initiated in Barclay Sound in terms of Great Central, Sproat Lake, Henderson Lake, up-Island, Nimpkish, to some extent some of the resident kokanee populations in Cowichan and other areas, across some of the Fraser, certainly up in the major Nass systems, on the Queen Charlottes, in the Skeena. So a good number of many of the sockeye nursery lakes and --
Q Were you involved in the experiment in Rivers

Inlet in any way?
A Initially, yes.
Q In what way?
A I looked at the original historic information associated with Owikeno and Rivers Inlet, Smith and Long too, in terms of the characteristics of the information, what it was telling us about the productivity and state, characteristics of the nursery system and the watershed.
Q Yes. Okay. Thank you. Those -- or one further question. Have you published anything on that?
A On that, it's going to be presumably a grey literature, a draft internal report. But, no, not primary published.
Q I'm sorry, "grey" literature? What did you say it was?
A I'm not sure its status. I'll answer it that way. But it's probably some internal document which was part of the group I was with at that time. It's not a primary literature piece, no.
Q Okay. What group were you with at the time?
A I'm forgetting what it was called because it changed names so many times, but it was basically a stock assessment associated group. That's where, in part, where I did my post-doc, and then it was looking mostly at sockeye populations across the coast.
Q Who was your employer at that time?
A My employer was Dr. Kim Hyatt.
Q Kim Hyatt. So you were with DFO at that time?
A I was.
MR. HARVEY: Yes. Thank you. Those are my questions. Thank you.
MR. LEADEM: I just have a very brief submission with respect to the qualifications of this witness, Mr. Commissioner. It comes down to what I would say weight over admissibility. If we were in a trial, I would probably be making a stronger submission to have this particular witness disqualified for bias and for past association.

But given that we're in an inquiry, I'm going to not pound the table and strike the hammer against the anvil so strongly. I think that it does go to weight, and I will ask that you consider the opinions and the recommendations coming from this witness in the couple of days to come in the context of his past associations with

Department of Fisheries and Oceans, particularly given that he has some work history with the Fraser River, and with habitat and that he is from a company that is very much -- considers DFO to be a client. Obviously there's somewhat of a financial interest.

In my respectful view - and I mean no discredit to Dr. Johannes in so saying - it comes down to a question of how much weight can you attribute to the opinions that you're likely to hear from him.

Those are my respectful submissions.

MR. ROSENBLOOM: Mr. Commissioner, I support Mr. Leadem and say nothing further, in particular, in light of the outstanding information that I'm requesting that the witness is unable to provide today. Once knowing that information, in final submission obviously we can speak to the weight that should be given to this witness's opinions in his expert report. So I totally support Mr. Leadem, that I don't challenge his expertise to testify, but it will be an issue of weight and that, I think, should be left to final argument. Thank you.

MR. HARVEY: Sorry, I have no submissions.

MR. McGOWAN: Mr. Commissioner, I don't hear any of my learned friends taking the position the witness ought not to be qualified. I'd ask that he be qualified as previously articulated, as an expert in ecosystem biology with technical specialties in aquatic ecology and environmental assessment.

THE COMMISSIONER: Yes. Very well, thank you.

MR. McGOWAN: I wonder if we could have -- and perhaps just before I start with the examination in chief on the report proper, Mr. Commissioner, it might be appropriate to mark some of the other c.v.'s that were referred to, reasonably extensively, by at least one counsel. Maybe I'll just do that by asking the witness a couple of questions about his team.

EXAMINATION IN CHIEF BY MR. McGOWAN:

Q Dr. Johannes, you are the primary author of the report, the lead author of the report?

A Yes, the primary contributor and facilitator of the information and its structure in the outline.

Q Is it fair to describe you as the lead author?

A Yes.
Q Okay. There were three others that contributed in a writing capacity to this report; is that correct?
A Yes.
Q They were Rob Hoogendoorn, Roxanne Scott, and Lee Nikl?
A Yes.
Q You also had approximately 20 others who contributed in other ways in assisting in the preparation of the report; is that correct?
A Yes.
Q Okay. You have provided to the Commission the c.v.'s for Rob Hoogendoorn, Roxanne Scott and Lee Nikl; is that correct?
A Yes.
Q Two of them have been referred to you before. I wonder if we could just bring up the Roxanne Scott c.v., please, and that's Ms. Scott's résumé; is that correct?
A Yes.
MR. McGOWAN: I wonder if those three c.v.'s should be marked as the next three exhibits, Mr. Commissioner.
THE COMMISSIONER: Very well.
THE REGISTRAR: The Scott document will be marked as 732; the Nikl document is 733; and the Hoogendoorn document is 734.

EXHIBIT 732: Résumé of Roxanne Scott

EXHIBIT 733: *Curriculum vitae* of Lee Nikl

EXHIBIT 734: Résumé of Rob Hoogendoorn

MR. McGOWAN: Thank you.
Q Now, while others contributed to the writing, as the lead author do you adopt all of the statements and opinions expressed in the body of the report?
A I adopt them, yes.
MR. McGOWAN: Okay. Now, perhaps at this time, Mr. Commissioner, we ought to mark the report, pull that up.
Q This is the first page of your report, sir, "Fraser River Sockeye Habitat Use in the Lower Fraser and Strait of Georgia"?
A Yes.

MR. McGOWAN: If that could be the next exhibit, please.
THE REGISTRAR: Marked as Exhibit number 735.

EXHIBIT 735: Technical Report 12, Fraser River Sockeye Habitat Use in the Lower Fraser and Strait of Georgia, February 2011

MR. McGOWAN:
Q Sir, subsequent to preparing this report and after a meeting with Commission counsel, you provided to us an errata sheet; is that correct?
A Yes.
MR. McGOWAN: Mr. Commissioner, that's been distributed to all counsel.
Q And that errata sheet corrected things such as an error in citation and some missing units of measurement on a graph; is that correct?
A Yes.
Q I see it on the screen. Is that the errata sheet there?
A Yes.
Q And you actually have one correction to make to the errata sheet, I understand; is that right?
A I do.
Q If you could please just explain to the Commissioner what the correction to the errata sheet is?
A Mr. Commissioner, I'd like to actually remove item number 4. Fish is actually represented in that discussion on page 31.
Q And this is a document you prepared, correct?
A Yes.
Q Okay. So if we strike out number 4, aside from that, these are the corrections you wish to make to your report?
A Yes.
MR. McGOWAN: Okay. I wonder if that -- what was the report exhibit number, Mr. Giles?
THE REGISTRAR: Exhibit 735.
MR. McGOWAN: I wonder if this should be 735A, Mr. Commissioner?
THE COMMISSIONER: Thank you.
THE REGISTRAR: So marked.

EXHIBIT 735A: Errata sheet for Technical Report 12

MR. McGOWAN:
Q Now, the scope of this report was defined by the Commission who engaged you to prepare it; is that correct?
A Yes.
Q Speaking generally, you were requested by the Commission to prepare a report analyzing sockeye habitat in the lower Fraser and Strait of Georgia, and the interaction of human development activity with this habitat; is that correct?
A Yes.
Q In terms of the objectives of the report, you were asked to describe historical trends in development activities in the lower Fraser and Strait of Georgia that impact sockeye habitats?
A Yes.
Q And you were asked to quantify sockeye habitats that are exposed to human development activities and determine the severity of those impacts?
A Yes.
Q And finally you were asked to describe the linkages between sockeye declines and human development in the lower Fraser and Strait of Georgia?
A Yes.
MR. McGOWAN: If we could bring up, please, pages 94 going onto 95, the portion there titled "Scope of Work".
Q While that's being brought up, sir, you were asked specifically to look at the time period of 1990 to 2010?
A I was, yes.
MR. McGOWAN: And you see here on this, if we could just scroll down a bit, please, Mr. Lunn, onto the next page so we see the whole "Scope of Work". Thank you.
Q There are five points there under "Scope of Work", 3.1 to 3.5.
A Yes.
Q See those? And were you able to address each of those aspects of the scope of work that you were asked to address?
A As best possible, yes.
Q Preparing the report, did you encounter some over-arching challenges that impacted on the degree to which you could address any of these or more than one of them?

A Yes, there are a number of qualifiers on the report and its development associated with those scopes.
Q I wonder if you could just explain to the Commissioner in a general way some of the most significant over-arching challenges that presented themselves to you in the preparation of this report?
A Well, as a way of explanation, the very first challenge was time. We started as probably one of the latter reports in the series. Second is availability of information and process for obtaining information. That was always a challenge. That's particularly highlighted in a number of passages and comments within the report which talk about quantifying habitat size and characteristics of those habitats for sockeye particularly.

General information, as you can see by this list, scope and the statement of work, it's very encompassing, and the focus and the filter of bringing this down to a reasonable review was a challenge, a major challenge. So between time and extent, there was always an attempt to try to focus this down to some level that was workable in what we had in terms of conditions. That's why my team was well-represented by well over 20 people with expertise in a number of areas, both biology and socioeconomics and all the rest of the characteristics that we spoke about.

So, yes, there were constraints.
Q Okay. You made reference to the gathering of information. In addition to relying on your own experience, did your team gather or consider data with respect to habitat and development activities?
A Did we consider it?
Q Yes.
A Yes, we wrote about it.
Q Okay. And from which sources did you obtain that data?
A The direct association between habitat and development, we used three sources in fact. One was the evaluation review that Fisheries and Oceans Canada published on through Harper and Quigley, Quigley and Harper, et cetera. The second was our professional judgment and

experience associated with projects, and the third was, I'll say this, informal requests to DFO for information.

Q Speaking generally, what type of information did you get from the Department of Fisheries and Oceans in response to your informal requests?

A They're exactly and explicitly represented in insert -- I believe it's insert 3, and a single table within the paper.

Q When you say "insert 3" are you referring to Figure 3 or...?

A I've called them inserts within the -- that's the blue highlighted area. I will find it if you just give me two shakes of a donkey's tail here.

Insert 1 is represented on page 52, insert 2 is represented on page 55, and it's going to be insert 3, which is on page 56, which, in part, came from a discussion with Matt Foy.

Q Okay. Thank you. Now, when I was asking you questions on your qualifications, your evidence was that the overall methodological approach you took to this was similar to the methodological approach taken in environmental assessments; is that correct?

A The overall methodological approach, yes.

Q Okay. I wonder if you could just explain to the Commissioner briefly the methodological approach that's adopted or employed when conducting environmental assessments.

A The general approach for an environmental assessment is the definition of the conditions or baseline condition in the environment for a series of environmental associated issues. The definition within those baseline conditions of a potential effect or association -- they're often called "valued ecosystem components" or "valued social components". They are considered the indicators that will be reviewed in terms of an effects assessment.

The next stage of that effects assessment is to understand if any of those, as I've said before, project-related types of effects, the implications of the project on those environmental effects can be managed in a way where those effects are limited or avoided.

And then following that discussion about the potential interaction and the likely interaction

of those project-related effects, how they're disseminated in terms of if they are going to be residual effects that's carried on within a project associated with its development, and if those effects cannot be mitigated, how they might accumulate it and are they unresolvable in terms of their potential effects. That unresolvable characteristic of a project-related effect is the process of review. The process of review is not conducted by either the proponent or the proponent's representative, which I might represent in some cases.

In doing that project review, it's headed through all the regulatory agencies that participate in a technical working group which comments and reviews, very detailed, each of the project-related issues and the project file itself, to actually provide, at the very end, whether the project will be certified to actually be constructed and operated. That's independent of the regulatory issues associated with its operation and conducted -- and just the conducting of the project.

So that's the general nature of that kind of review process, yes.

Q Okay. Thank you for that. I'm going to ask you a few questions about the methods you applied to this particular project, and see if I have a clear understanding of it.

The first thing you did - and correct me if I'm wrong - was identify sockeye habitat in the lower Fraser and Strait of Georgia and assess the use of that habitat by sockeye; is that correct?

A Yes.

Q And that's contained in section 2 of your report.

A Yes.

Q And ultimately, when we're dealing with the Lower Fraser and the Strait of Georgia, you took those two larger areas and broke each of them down into three sub-areas for your analysis.

A Generally, yes.

Q Okay. You then assessed the use of each of those sub-areas by sockeye?

A Yes.

Q Following that, you identified human development activity in the lower Fraser and Strait of Georgia; is that right?

A Yes.
Q And you focused on ten particular human development activities that are described in your report.
A Yes.
Q We'll come to those in a moment. The next thing you did was reviewed potential interactions between the human activity and the sockeye habitats?
A Yes.
Q And that's in section 4 of your report?
A Yes.
Q And finally, you assess the potential link between each of the identified human activities and sockeye decline?
A I go through a review process to assign that, yes.
Q Okay. And the purpose of the review process was to assess potential links between the activity and decline of the sockeye.
A Yes. More over the association of the risk and loss of degradation of sockeye habitats.
Q Okay. And were you considering the decline - or more specifically - the decline of productivity in the comparison?
A The state and characteristics of the habitat and their habitat use.
Q Okay. Let's start first, then, with identifying the sockeye habitat. What method did you employ to identify sockeye habitat in the lower Fraser and Strait of Georgia?
A That was a very comprehensive - in my opinion - a comprehensive approach and it hadn't been done previously. It was actually a very large task of reviewing all the literature and the databases that we could find. It certainly is not a comprehensive review, but it's exhaustive. The references and the publication material are certainly articulated throughout maps 3 to 4.
Q Okay. And those maps set out both the sockeye habitat you'd identified, and also the use of the habitat; is that correct?
A Given the limitations in the information, yes.
Q Okay. And was your information about the use similarly obtained through a literature review?
A Yes.
Q Is there extensive literature which precisely identifies sockeye habitat and the use of the

habitat?
A In specific locations, yes. Over a larger population level, no.
Q I ask because when I look at some of the maps which you just referred to, I see fairly bright stark lines sort of setting out sockeye habitat is here, sockeye habitat is not here, and the same with the uses. Is the literature sufficient to support such sharp delineations of sockeye habitat and sockeye use, or should there be some fuzzy lines or grey areas if one were to accurately describe our state of knowledge?
A I have an explanation to discuss within that context. It might be a longer discussion in terms of the characteristics of habitats. But to answer your question, it can be fuzzy, absolutely.
Q Okay. If there's a further explanation that you think would assist the Commissioner in understanding your description of habitat and habitat use, I'm happy for you to share it with him.
A It really goes down to the foundations and fundamentals of what fish do and use. I mean, they're behavioural animals and this is as a biologist with lots of experience in this area, and all my colleagues and authors helped support this discussion. Animals change their behaviour associated with their environmental conditions and parameters all the time, and so to say that they use one habitat one day and not a habitat the other is actually fair. They will change because of the characteristics and dynamics of each of those habitats.

That said, when an animal like a sockeye is small in a lake system, they have a set of optimal and preferred habitat types that they will use, and you can go through the literature. Brett is a good example of the physiological state of juvenile sockeye salmon habitats and their use of certain depth areas and the vertical migration that they use in lakes to behaviourally sample the environment for feeding and to avoid predators and so on.

So they absolutely change their behaviours and use. So what we were able to do is to look at what available information there was. Again, there hasn't been an extensive project or program

that looked at sockeye distribution habitat use in a continuous basis. So there's yearly annual surveys methodologies, even some that were Carl Haegele and Doug Hay's work on herring which captured sockeye throughout the Strait. Those found sockeye in some places and not in others. So all we could do, together with some of the modelling results by Cees Groot and Randall Peterman and others, was compile a slow, careful evidence of what existed in terms of information, and what we believed was the assembled information that allowed us to say what we said.

So a red area that's articulated as a key habitat is in fact a habitat that was found to have much more frequent use, and associated with the behaviour of the animal.

Q Thank you for that explanation. I want to move on, for a second, to the identification of criteria for human -- or the identification of human development activity.

MR. McGOWAN: Mr. Lunn, I wonder if we could please bring up page 17, and flowing onto page 18. There's a 10-item list there of the report. Fit all ten -- okay, that's perfect, thank you.

Q There's a list that's displayed on the screen and we see it a couple of places in the report, but page 17 and 18 is one convenient location listing ten human activities. Are these the human development activities that you identified for consideration in the report?

A These are the ten that we used in the report.

Q Okay. What was the process you went through to identify which human activities you would consider specifically when addressing questions about impact of human activity on habitat?

A That process followed, in part, an environmental assessment-like methodological approach, and then it also followed some of the standards that were developed in the literature and by people publishing in the area of environment and ecosystems. For example, the 2006 Ministry of Environment's state of the environment reporting indicated a series of indicators that were thoughtful and useable and provided data.

Similarly, work by Johannessen and McCarter and others that developed a much more broad review of the Strait of Georgia and the area also

considered a number of indicators as views and thoughts of characteristics, within just a construct of environmental assessment, you know, what data was available over that period of time to provide at least some rigour in terms of the information.

We tried to compile and develop a number of pieces of information but were unsuccessful because, one, of the extent of the information or the quality of the information, and secondarily, in terms of, as explanation, our time constraints.

Q Right. I don't see, for example, consideration of, for example, water extraction, which is one human activity that some may consider relevant. Is that something you considered in your report?

A Yes.

Q Okay.

A It's not explicit as one of the indicators that we used, and I was fairly careful to call them indicators, not anything else.

Q Yes.

A And water extraction is one of the -- if I can go back to some of the related experience that I was asked about, about Stahlberg's reporting on Wild Salmon Policy, as one of the habitat-specific indicators, discharge, permitting and water extraction are very fundamental components of that.

One of my team members, his name is Pat Brisbin. Pat is an agricultural specialist, long history of working with agricultural and water extraction issues and knows the databases associated with this information well. He was very reticent in us just using the water licence information and believed that it would have taken us a good month-and-a-half to actually pull out the detail, the information that said how much water was getting extracted from the lower Serpentine River for the purposes of defining in this report. It just became untenable and we just proceeded without it, knowing that there was a limitation there. That's why they built out two ten indicators (sic).

Q Right. Are there other potentially significant human activities which might impact on sockeye habitat that were not identified or considered in the report?

A Yes.
Q When I look at this list of ten, I'm sort of zeroing in on numbers 7 and 8, the two Strait of Georgia references there. Maybe you can explain to the Commissioner how those fit onto a list of human activities.
A They don't necessarily. They're the integrators of things. The human activity in the Strait of Georgia might be associated with traffic movement or vessel traffic movement or some consideration like that. What there was in our scope was some discussion about -- and that's why I said the diversity of deliverables. Our scope was fairly broad. One of the issues and discussion items was the Strait of Georgia and its water quality, and that should be somewhere on page 95, I believe.
So we didn't know how else to fit that together other than to be a broad level discussion of water quality issues. It might have been a way of integrating what was flowing into it from a freshwater source.
Q Okay. Thank you. I want to now move to the section of your report associated with assessing the degree of interaction.
MR. McGOWAN: If we could please have page 39 displayed?
Q And you proceeded to the portion of your analysis where you were assessing the degree of interaction. You applied certain criteria that are expressed in the chart on page 39; is that correct?
A Yes.
Q Specifically, you considered three interaction criteria, you assess three interaction criteria, the first being geographic overlap.
A Yes.
Q The second being the magnitude of the interaction?
A Yes.
Q And the third being the duration of the overlap?
A Yes.
Q And the details of the criteria you apply to arrive at your assessment of "Nil", "Low", "Moderate", or "High" are expressed in this chart; is that correct?
A Yes.
Q And after considering these three areas, geographic, overlap and magnitude and duration,

you assigned a ranking to each of the six geographic areas for each human activity; is that correct?

A Yes.

Q So every human activity for each of the six sub-areas was assigned a ranking of either "Nil", "Low", "Moderate" or "High".

A With explanation, yes.

Q And there was accompanying explanation which I'll come to in a moment. Based in part on these rankings, you ultimately expressed an opinion as to the likelihood that each of the human activities was linked to sockeye decline; is that correct?

A It is an opinion, yes.

Q Okay. I'm going to come back to the overall expression of your opinion with respect to each of these, but before I do that, I want to take a step back to the assignment of rankings and how that was accomplished. If we could just scroll back to the bottom of 37 and carrying on to page 38, please.

I'm looking at the last sentence on page 37 that starts on the last line with "Rankings for each of the six...", and carries onto the next page, just that sentence in isolation which describes how the rankings were arrived at. It says:

> Rankings for each of the six general habitat areas were assigned through a combination of expert opinion, the results for the factor being evaluated and an overall ranking based on the interaction criteria.

And that's a description of the application of criteria in Table 1; is that right?

A Yes.

Q Okay. So I want to sort of see if I can understand or help the Commissioner understand what went into the analysis. You reference three things there, the first is expert opinion. Is that another way of saying professional judgment?

A Yes.

Q And the next assessment tool you reference is the results for the factor being evaluated. Is that perhaps another way of describing professional

judgment?
A More associated with the actual expression of the results of each of the individual factors and its discussion in the literature.
Q Okay. And finally, you state the last sort of phrase you put in there is an overall ranking based on the interaction criteria. Is that ranking based on professional judgment or is it based on something else?
A That overall ranking is more or less a sum average-like approach. It's an average actually.
Q In assigning the criteria that we see in each of the areas of Table 2, is there anything aside from sort of professional judgment or expert opinion that went into the analysis and assignment of those rankings?
A Lots of review of the literature.
Q And was there any statistical analysis?
A A statistical analysis through normal parametric statistics was not possible.
Q Okay. So if we look, for example, at the very first chart on page 40, which is Table 2, geographic overlap, in the lower Fraser Watershed, you've applied a criteria of low.
A I'm sorry, can you say that again?
Q Sorry, I'm looking at the population table which is the first of the tables under Table 2. It's on page 40.
A Yes.
Q And you assess the geographic overlap in the lower Fraser watershed as low.
A Yes, with an explanation.
Q Yes, and I'll come to the explanations in a moment. The application of that, I understand from what you've said, arose not from a statistical analysis but from the application of your professional judgment after considering the information you had in the literature; is that a fair description?
A Yes.
Q Okay. While we've got this page up, maybe we can just explore Table 2 in the manner in which it's set up. Table 2 is the section of the report where, in table format, you summarize your results and opinions with respect to each of the ten human activities; is that correct?
A Yes.

Q Maybe we can just walk through the structure of this chart to assist the Commissioner in understanding. At the top line, you've listed the human -- sorry, in the top line across the right-hand side, you've listed the six sub-areas, sub-geographic areas that you considered, right?
A Yes.
Q And then, sort of moving down in the left-hand column, you've listed population which is the criteria being considered. Under that, you say "Likely Interaction." There's open circles, closed circles and nil. Can you explain what each of those mean, please?
A It references back to page 37. What it is, is within an effects assessment, the normal consideration is as a team you express whether there's a likely interaction or not. That interaction, it almost follows like a filtering process and it's intended to be as transparent as possible. Although professional judgments apply to this, this was displayed and developed in a way that people can go, hmm, that makes sense or, you know, I totally reject that approach, and that's fair. Within the context of an environmental assessment, that is reviewed and that's fair and appropriate.

So we start at the very top with "Likely Interaction" from just a standpoint of pulling back. You apply the characteristic of your indicator across a spatial and temporal overlap with what we're looking at - in fact in this case is sockeye habitat and habitat use - and you basically apply the two of them over top of each other in an attempt to just say whether you perceive, understand, can characterize a likely interaction or not.
Q Thank you. Moving down the chart, the next section of the chart, "Interactions with Sockeye Habitat" is where you describe interactions with text; is that correct?
A We describe the likely interaction with that text component, yes.
Q Okay. And next we have geographic overlap, magnitude of interaction, duration of interaction. That's where you set out the criteria you've arrived at after applying the tests set out in Table 1; is that right?

A Yes.
Q Okay. "Significance of Potential Interaction" is where you describe your assessment of the significance of the potential interactions.
A For those criteria, yes.
Q And "Summary of Risk of Loss or Degradation of Sockeye Habitat", am I correct that for each of the geographic areas, you've expressed an average of your assessments from the three above?
A Yes, it's an expression, first, of an average with -- in only one example, some consideration, but yes.
Q Okay. And finally, "Potential Links to Fraser Sockeye Decline" is where you set out your opinion on the likelihood that this human activity is linked to sockeye decline; is that a fair description of that last box?
A I struggle with the word "opinion" because what we really tried to do is conservatively articulate what we think is going on. If that ultimately is expressed as an opinion, I guess that's fair. So that's where we express our accumulated understanding, both from the literature and expert and professional judgment of what we think might be going on. Again, it's referenced between the indicator and sockeye habitat use as we've understood it and developed it within section 2 of the report.
Q Okay. And for each of the human activities, there is a page dedicated to that activity with a chart similar to the one we're looking at now, setting out the very same type of analysis; is that correct?
A Yes.
Q Okay. And I won't take you through and have you explain all of your conclusions. They're contained within the chart. I will have some specific questions about some of them. Ultimately after considering your findings on each of the human activities, you made some overall expressions of opinion in the "Summary and Conclusion" of your report; is that correct?
A Yes. And that's represented in the report and on map 17, I believe.
Q Yes, I was going to come to that.
MR. McGOWAN: If we could perhaps bring up map 17 right now. Map 17 is on map page 35. It should be the

very last page of the report if that assists.
MR. LUNN: Thank you.
MR. McGOWAN: So if we could just zoom in, please, on map 17.
Q This is the map on which you set out broadly in both table and depicted on the map the conclusions that you reached along with some text on the right-hand side with a summary; is that correct?
A Yes.
Q So the summary for each of the ten population -- or human activities is depicted in the chart on the upper right-hand side?
A Yes.
Q And the sockeye habitat areas are expressed in three different shades of blue?
A Yes.
Q The dotted lines on this map set out the boundaries between the three sub-areas within the Strait of Georgia? Is that right?
A One, two, three, four, yes.
Q Okay. And then there are various coloured dots and squares which set out the location of certain infrastructure that may relate to human activity such as waste treatment facilities or pulp mills.
A That we found through our analysis to be potential -- with likely interaction with sockeye habitats, yes.
Q If we could go, please, to page 63. Starting on page 61 and carrying through to 64, that's the section of the report where you set out your "Summary and Conclusions"; is that correct?
A 61, 62, 63, yes, 64.
Q I'm looking at the first full paragraph on page 63, if we can have that enlarged a little bit, please. Thank you.
This paragraph reflects one of the conclusions that you drew; is that correct?
A Yes.
Q Okay. I'll just read it into the record.

> The habitat protection strategies used in the lower Fraser River and Strait of Georgia, appear to be effective at supporting sockeye habitat conservation during project review and project-related activities (e.g., construction impacts of a specific project). More broadly, a hypothesis that the declines

in Fraser River sockeye production are the result of major (or even moderate and minor) project development is not supported by the likely net gains in habitat that have occurred over the period of review.

That's one of the major conclusions of this report. Is it not directly addressing the question that was put to you about the possible impact of human activity on sockeye decline?

A Project development related to human activity, yes.

Q Yes. And the conclusion that you've reached is that project development is not -- the hypothesis that project development is impacting is not supportable; is that correct?

A Could you rephrase that, please?

Q Certainly. Your conclusion is that declines of Fraser River sockeye production are not the result of major project development; is that fair?

A At a population level, yes.

Q And one of the reasons you've come to this conclusion as expressed in this paragraph is your conclusion that there have been net habitat gains over the project period -- over the review period.

A Given our experience on projects and understanding that the rigours that it's intended to go through, and even individual project experiences, knowing the rigour that each project has to meet in the end, our assumption is that they are meeting those requirements and not necessarily losing habitat that are sockeye-related habitats.

Q Now, you used the word "assumption". Is that an assumption or is it an assessment you've made?

A It is -- honestly, it's an assumption and it relates back to a comment that we had earlier.

Q Okay. I'm going to have a few questions about that assumption as you've described it.

MR. McGOWAN: Mr. Commissioner, I wonder if this might be an appropriate time?

THE COMMISSIONER: Thank you.

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

(PROCEEDINGS ADJOURNED FOR MORNING RECESS)
(PROCEEDINGS RECONVENED)

THE REGISTRAR: The hearing is now resumed.
MR. McGOWAN: Mr. Commissioner, for the record, Patrick McGowan for the Commission. Continuing my examination of Dr. Johannes.

EXAMINATION IN CHIEF BY MR. McGOWAN, continuing:

Q Dr. Johannes, when we broke for the morning adjournment, I was asking you about the conclusion in your report regarding net habitat gains and I think I understood you to say that was an assumption you'd made that, over the review period, there had been net habitat gains in the Lower Fraser. Is that a fair summary of the evidence you gave?
A It is an assumption with conditions.
Q Okay. Well, why don't you tell the Commissioner what the conditions are?
A There are only a series -- as I explained a little bit earlier, there are only a couple of lines of evidence that are associated with development and understanding of that net loss approach. One of them is the literature that was developed again by some of the authors that we've spoken about. And the other is our own experience as a team in terms of environmental assessment and review and the conditions that are imposed on the projects that we have been involved in. And then there's my own professional experience throughout my career independent of who I'm working for now. So those three kinds of components led to the larger statement associated with that assumption.
Q Okay. So the conclusion or assumption that there have been net habitat gains in the Lower Fraser from 1990 to 2010 is based on, one, the limited literature, and is that the Harper and Quigley work you're referring to?
A Yes.
Q Okay. And in addition to that, the professional judgment and experience of you and your team?
A Yes. And so let me also preface that. Again, I'm sorry to do this. The explanation is associated with sockeye habitats. I'm not speaking about other salmonids, other fish species.
Q No, I understand. And that was because of the direction given to you by the Commission as to what you should investigate, correct?

A Yes.
Q Okay. I wonder -- I've got page 40 on the screen and that is the first page of Table 2 dealing with the potential link of population size to decline. And I wonder if we could, please, enlarge the very bottom box titled "Potential Links to Fraser Sockeye Declines". And I'm just looking at the first bullet there. And you articulate your conclusion with respect to the potential link of population growth and decline. The first bullet:

> Overall, the risk of development on sockeye habitat is ranked as low because there is evidence of a net habitat gain rather than loss.

Now, here you're expressing it as evidence, as opposed to an assumption.
A Yes.
Q Is the evidence you're referring to there, that which you articulated a moment ago, the Harper and Quigley work?
A In part. And I believe we represent a table in the document on page 57.
Q Okay. Thank you. Those are the two pieces of evidence?
A Evidence, yes.
Q Yes, okay. I'll come back to the table at page 57 in a moment. I want to deal first with the Harper and Quigley work. I wonder if we could have page 53 brought up, please? I'm looking at the first full paragraph.
MR. McGOWAN: If we could have that first full paragraph enlarged, please?
Q I'm just going to read the first half of this paragraph to you, sir.

> Harper and Quigley (2005) reviewed project-related habitat losses and gains from 105 projects located in British Columbia (83 in the Fraser River) and found that there was a net gain of 24,064 m2 of estuarine habitat and 10,900 m2 of marine habitat. The data provided by Harper and Quigley (2005) did not provide details on where the projects and habitats reviewed were located or whether or not they included sockeye habitats. However,

these results suggest that at least for individual projects, the habitat protection strategies are, on balance attaining the objective of conserving and in part supporting habitat gains as part of a project's environmental review.

And that's one of the articles that you refer to when you're talking about the Harper and Quigley work, correct?

A Yes, but I do follow sequence of time --

Q Yes.

A -- related to evolution of that discussion.

Q Okay. And just to be clear, this is one of the area where your errata sheet comes into play. You actually cited Harper and Quigley 2005 in your list of work cited. But you made a correction to that on your errata sheet, correct?

A Yes.

MR. McGOWAN: Okay. So I wonder if we could, please, bring up Exhibit 667?

Q This is the document or the article which you have now referenced on your errata sheet as being the correct citation to support this paragraph in your report; is that correct?

A Yes.

Q Okay. And you've cited Harper and Quigley 2005, a project-related habitat which reviewed losses and gains from 105 projects located in British Columbia. And you then set out some numbers; is that correct?

A Yes.

Q I wonder if you could turn, please, to page 348 of that document?

MR. McGOWAN: The page numbers are in the top left, Mr. Lunn.

A Yes.

MR. McGOWAN: If we could enlarge that chart at that top of that page?

Q And I've done some math and when we've discussed this, sir, the estuarine number and the marine number were taken by adding the positive and negative numbers for each of those areas, as depicted on this chart; is that correct?

A Yes.

Q Okay. Now, they're reflected in your report to the Commission as relating to 105 projects from

British Columbia. This chart actually relates to 124 authorizations; is that correct?

A Yes.

Q And they span across Canada, not just British Columbia or the Fraser River; is that right?

A Yes.

Q Okay. So the numbers which you have reproduced in your report are not either British Columbia or Fraser River specific; is that right?

A With the exception of the comment on that same page, 348, under "Results of File Review", 83 occurred on the Fraser River basin.

Q Yes, thank you. But the number of square metres of habitat gain are not reflective of only British Columbia or the Fraser, they're across Canada; is that correct?

A I believe so, yes.

Q Okay. And you have used those numbers to support the proposition that the results suggest that at least for individual projects, the habitat protection strategies are, on balance, attaining the objective of conserving and in part supporting habitat gains as part of the project's environmental review; is that correct?

A As part of the project's environmental review?

Q Yes.

A Yes.

Q Okay. I wonder if we could just turn forward in the article to page 352, please? This is under the discussion section of the Harper and Quigley article, under the subheading "Habitat Impacts" I'm reading from. I'm going to read the first portion of that first paragraph.

> On first inspection, it would appear that NNL of fish habitat has been achieved based on the total HADD and compensation areas reported within the authorizations. An estimated 600,776 m2 of fish habitat has been potentially gained and only two habitat types, lacustrine rearing habitat and marine subtidal habitat, sustained negative habitat balances. The total amount of fish habitat gained is somewhat misleading, however, because 501,120 square metres of fish habitat was gained through four authorizations with exceedingly large compensation ratios. A

> quarter of the authorizations reviewed had compensation ratios that were less than 1:1. Thus, NNL is not occurring on an aerial basis for a significant number of authorizations, and given the high degree of uncertainty in fish habitat linkages, it is also likely that the relatively small compensation ratios (median: 1.3:1) being applied may not have been sufficient to achieve the desired goal of NNL.

Let me ask you, first of all, there's reference there to four large authorizations with large compensation ratios that may have skewed the data. Do you know if any of those four are located in British Columbia?

A I would presume that at least some of them are located in British Columbia, yes.

Q I wasn't able to find that in the report. Do you know if it's reflected in the report?

A It's not reflected in -- in my report?

Q No, in the Harper and Quigley article.

A It's not reflected here, no.

Q Okay. Do you have information that's not contained in the article that identifies what those four projects are and where they're located?

A Other than anecdotal information, no.

Q Can you tell us what those four projects were?

A I believe associated with the work by Kistritz and Levings and others. Those are associated with some of the intertidal marsh areas on the Lower Fraser area.

Q Okay. Are some of those reflected in page 57? The chart you referred to earlier?

A I believe that might be possible, yes.

Q Okay.

A But again, I don't have the details on Harper and Quigley or the information that they used.

Q Okay. So are you able to tell us with certainty whether any of these four are in B.C. and, if so, how many?

A With certainty? No.

Q Okay. When I read this last part of the paragraph to you:

> Thus, NNL is not occurring on an aerial basis for a significant number of authorizations,

> and given the high degree of uncertainty in fish habitat linkages, it is also likely that the relatively small compensation ratios (median: 1.3:1) being applied may not have been sufficient to achieve the desired goal of NNL.

Did you take that statement into account when coming to your conclusion that, on balance, attaining the objective of conserving and, in part, supporting habitat gains as part of the project's environmental review? That last sentence, did you take that piece of the discussion into account when drawing your conclusion about the Harper and Quigley literature?

A Yes.

Q Okay. And do you see those two statements as consistent with each other?

A Through the details, yes.

Q Okay. Maybe you could explain who the two co-exist, please.

A The premise with all the characteristics are the following. One, project review does a certain thing. When it looks at the potential habitat losses associated with the ***Fisheries Act*** through what's called a HADD and the requirements of a project to respond to that habitat loss is often -- I've very rarely seen it ever below 1.5:1. That means the gain is 1.5 times the loss. And most often, it's 2:1. And the rigours with which that is followed is usually associated with the proponent and DFO's audit and review on that sort of issue. But from the project review's perspective when the project is reviewed, that's the characteristics that's always applied and it has been since the ***Environmental Assessment Acts*** have been enforced. It's an approach. The second characteristic is -- this is where the devil is in the details -- sockeye habitat use is associated with projects in a variety of different ways. And so in developing section 2, what we were careful to try to do was to come out with an approach, an understanding where that spatial and time-related overlap might be between the sockeye's use of habitats and what we might call their sockeye habitats and those projects and pieces of human

development that we might associate back to it. So given those things, it's the devil is in the details here.

Q All right. There are additional articles by Harper and Quigley dealing with their assessment of the no net loss matter; is that correct?

A Yes.

Q Okay. You originally had cited an article for this proposition, which was also by Harper and Quigley, and you substituted another one. But I want to go back to the one that you had cited, first of all, in your paper.

MR. McGOWAN: I believe that is number 5 on our document list, Mr. Lunn. It's titled "A Comparison of the Aerial Extent of Fish Habitat Gains and Losses Associated with Selected Compensation Projects in Canada".

Q You're familiar with this article?

A Yes.

Q And it was again an assessment of compensation projects assessed across Canada; is that right?

A Over a restricted period of time, which somewhat overlaps our review time, yes.

Q Okay. And there were 103 projects assessed in this article?

A Yes.

Q And I'm just reading from about two-thirds of the way down the "Abstract", where the authors concluded that:

> Fifty percent of the projects had a compensation ratio of less than 1:1.

You're familiar with those results?

A I understand what they'd said there but I'm not familiar with their explicit results, yes.

Q Okay. And I want to bring up one final article by Quigley and Harper, which is also cited elsewhere in your project. It's number 3 on our document list. Just while we're going to that, I wonder if this last article could be marked as the next exhibit, please?

THE REGISTRAR: Exhibit Number 736.

MR. McGOWAN: So 736 is "A Comparison of the Aerial Extent of Fish Habitat Gains and Losses Associated with Selected Compensation Projects in Canada" by Harper and Quigley.

EXHIBIT 736: A Comparison of the Aerial Extent of Fish Habitat Gains and Losses Associated with Selected Compensation Projects in Canada by Harper and Quigley

MR. McGOWAN:

Q The article that's now on the screen, or is about to be on the screen, now is, "Compliance with Canada's ***Fishery Act***, A Field Audit of Habitat Compensation Projects". This is an article which is also cited in your paper; is that correct?

A I believe so, yes.

Q Okay. And this was an investigation of 52 habitat compensation projects across Canada, again, as opposed to just British Columbia?

A Yes.

Q And I'm reading from the Abstract on the right-hand side about a third of the way down where the authors concluded that:

> Approximately 86 percent of authorizations had larger HADD and are small in compensation areas than authorized.

So let me ask you first. You're familiar with that conclusion?

A Yes.

Q Okay. And moving now to the bottom of the Abstract, second-to-last or third-to-last sentence:

> Habitat compensation to achieve NNL as currently implemented in Canada is, at best, only slowing the rate of habitat loss in all likelihood increasing the amount of authorized compensation habitat in the absence of institutional changes will not reverse this trend.

And you're familiar with that conclusion of the authors?

A Yes.

Q Okay. Do you agree with it?

A On fish habitat across Canada, yes.

Q Okay. Do you agree with it with respect to sockeye habitat in the Fraser River?

A No.

Q Okay. Why is that?
A Because sockeye don't use the same sorts of habitats that all fish do. And again, the devil is in the details here and I don't want to spend too long explaining all those characteristics. But we were very careful in the end of the report to talk about experience associated with compensation works and where that experience was and evolving to. And knowing that the types of projects that had the experience over time and I'll apply that to the marine salt marshes of the Lower Fraser Estuary. Those ones that started off and are well-defined in Kistritz were good and bad and ugly.

And the record that Quigley and Harper and Harper and Quigley deal with in terms of their evaluation and review of the literature and of DFO's records was certainly from a period of '86 to somewhere in the early '90s. And so we're dealing with a period of time from 1990 to 2010. And so the experience on salt marshes on the Lower Fraser has evolved greatly. Now, is that experience the same and consistent for, let's say, creating a sockeye spawning habitat in a lake? No, not at all. That experience has not been developed the same way.

So what we're seeing is apples and oranges in some of the comparisons here. And the experiences on tidal marshes has been long-fought. It's a hard, hard thing to do well and understand the characteristics. And many people will represent and understand that the effectiveness of those habitats has changed over time because of people's experience in doing that sort of work.

Q So is the Harper and Quigley work instructive insofar as Fraser sockeye are concerned?
A No. But it only provides -- sorry. I'll provide just a little explanation on that. It provides one of the only pieces of evidence available to discuss some of those characteristics. That's why we made the requests back to DFO on some issues. And that then relates back directly to the indicators that we've tried to evolve and develop in terms of the discussion. And as we go through the questions with you and the participants, I'm hoping that the discussion associated with diking and the history of diking and the evolution of

that issue, comes out a little bit more.
Q Does your reading of the Harper and Quigley work support the proposition that in the Lower Fraser River there have been net habitat gains between 1990 and 2010?
A We cite explicit components of that associated with marine and estuary work that say that there has been some gains.
Q And that was the chart that I took you to dealing with across Canada?
A On page 348, yes.
Q Okay. I just want to ask you a general question about the concept of no net loss. We've been talking about square metres and referring to charts about square metres. Do you understand the policy dealing with no net loss as relating to surface area or as relating to productive capacity?
A The paper by Quigley certainly talks about the aerial extent and aerial extent is square metres of habitat. So yes, I understand that characteristic.
Q Now, your understanding of the policy in its application in Canada and, specifically, British Columbia, is it designed to achieve replacement of solely square footage or to replace productive capacity?
A I have two pieces of experience with that. One is this literature that we're talking about right now and one is my own personal experience with those sorts of projects and, yes, aerial extent is the one that's been applied.
Q Sorry. Can you repeat that last bit?
A To this point, square metres of habitat area has been the metric that they've used to look at loss and gains.
Q Okay. If we're considering whether or not human activity may be connected to declines, would it not be important to consider the protective capacity of the replacement habitat?
A Across fish species or aquatic habitats, yes.
Q The other piece of evidence that you pointed us to, to support the proposition that there have been net habitat gains was contained, you told us, at page 57 of your report?
A Yes.
Q And you're referring to Table 3, "A Summary of

Restoration Projects and Estimated Areas Salmon Habitat has Created"?
A Yes.
Q Okay. And this is a table listing large restoration projects between 1988 and 2008?
A As examples --
Q Yes.
A -- as restoration projects?
Q Yes.
A Yes.
Q And totalling what appears to be quite an impressive number, 2,700,640 square metres of habitat created?
A Mostly associated with one single project but, yes.
Q Yes. And if I go back to the text above where you're describing this, you set out the habitats at Table 3 but you qualify it by saying:

> Within these habitat restoration projects, spawning sockeye salmon have been confirmed by DFO in the Upper Pitt River, Alvin Patterson Channel and in Big Silver side channel projects. Rearing sockeye salmon juveniles have also been confirmed in the Big Bend Channel project (Inset 3).

So are those the three restoration projects, which have been confirmed to be used by sockeye?
A Of these listed --
Q Yes.
A -- as restoration projects, yes.
Q Yes. So if I add up the square area from those three, it comes out to something in the neighbourhood of 70,000 metres squared, substantially less than the 2,700-and-some-odd metres squared accounted for by all the restoration projects listed?
A Yes.
Q Do you have any information regarding the effectiveness of the restoration projects aside from those three which have been observed to be used by sockeye?
A I do not. I tried to expand on Inset 2, 3, as specific examples but I don't have explicit information.
Q And to be fair, sir, you have acknowledged some of

the limits regarding -- in your report, some of the limits you have regarding information available about the effectiveness of habitat restoration and habitat replacement?

A Yes.

MR. McGOWAN: Okay. If we could turn to page 59, please, last sentence of the first paragraph?

> The foregoing provides an example of why the square unit area habitat inventories referenced in preceding sections are, perhaps necessarily, a simplification of habitat status because they do not take into account habitat quality or functional contributions.

That's one of the qualifications you've set out, or reservations?

A Yes.

Q Okay. And over onto the next page, last sentence under the heading, "Biological Monitoring of Constructed Habitats":

> However, simple metrics such as the area lost and the area gained do not adequately provide data on the ecological services that have been lost or gained. Such data will have present and future benefits in managing habitat as it will also contribute to habitat science.

That's another qualification. Is that fair to say?

A Yes. And the distinctions being that we've spoken about compensation projects and restoration projects, as distinctions in terms of the types of habitats that have been created and functioned.

Q And with each of those, you have been talking largely about area replaced, as opposed to productive capacity replacement; is that correct?

A Absolutely, yes.

Q Okay. Are you in a position to assess the productive capacity of the replacement area in either compensation projects or restoration projects in the Lower Fraser?

A There is a capacity to do that. I don't have the information on the audits to do that. If I did, I might have the capacity to understand its capacity

but at the present time, the answer is no.

MR. McGOWAN: So if we could just turn back to 58, the last sentence on page 58, please?

Q And you're speaking here about human activities, habitat interactions and sockeye production. Given the qualifications we just went through, or limitations, about the extent of knowledge about productive capacity at page 59 and 60, and given that you've just told the Commissioner you don't have information presently about the effectiveness of this replacement habitat, I'm wondering about this last sentence and whether it's supportable:

> More broadly, a hypothesis that the declines in the Fraser River sockeye adult returns (Figure 8) are the result of the development of major projects is not supported by the likely net gains in habitat that have occurred during the review of major projects following implementation of the "no net loss" policy.

I think there's enough qualifiers in there to actually support that statement, honestly. And it has to do with, again, major projects, the ones that are under environmental review that characterize how projects are intended to be done. In terms of the compliance of those habitat compensation issues, I don't necessarily have that information. But that statement is predicated on most of the results that we've dealt with in Table 2 because it says the edge effects of major projects and their development are not normally associated with the areas that sockeye use.

So at the population level, not at the specific race or area or this part of Lever Creek, at the population level across the characteristics of the Fraser sockeye population, more broadly, the hypothesis of the declines of those populations is not supported by the imposed environmental regulatory review of projects and their needs to replace almost two-to-one losses with gains. And so that's an assumption. And then the place and location of those specific projects. And so, you know, that's a largely but it's sockeye-related. And it's for the period of 1990 to 2010.

Q Okay. You've talked about the requirement to have two-for-one replacement. Do you know to the extent to which the requirements for habitat replacement, which are imposed, are complied with, are completed?
A I don't know the answer to that.
Q Okay. Taking us back to your final conclusion at page 63 then, second paragraph, last sentence of that paragraph:

> More broadly, a hypothesis that the declines in Fraser River sockeye production are the result of major (or even moderate and minor) project development is not supported by the likely net gains in habitat that have occurred over the period of review.

How significant are these likely net gains if we don't have any information about the productive capacity of the gained square footage and if we don't know the degree to which the requirement to implement the additional square footage has been complied with?
A I used the declines in the Fraser sockeye production as the qualifier on that statement, production being the association between growth and development and numbers. That's what production defines as. It's a broad discussion about are the Fraser populations of sockeye and their production characterized by the development of these individual projects that are under fairly strict rigorous review?
All I know is that the assumption for how the projects are reviewed and those experiences that I have had personally suggest that there is not the spatial and time-related overlap between the project's development and operation and what sockeye uses key habitats for their growth and development. And so therefore, I still maintain that more broadly a hypothesis that the declines in Fraser sockeye are singularly related to major projects. It's not necessarily supported that easily.
Q You're talking now about the duration that sockeye spend in the areas of some of these projects and the specific location of projects; is that right?
A Yes.

Q That's separate and apart from the issue of no net loss, is it not?
A Yes.
Q Okay. What I was asking you about is your linking of the supportability of the hypothesis to what you've described as likely net gains in habitat that have occurred.
A And the assumption that habitat gains have occurred.
Q If no net loss is not being satisfied and if the gains are not -- if your assumption that the gains are not being implemented or if the productive capacity of the area, the replacement area, is not that of the area that was lost, what does that do to your conclusion regarding the supportability of the hypothesis?
A That's not an easy answer to that question at all. And it goes to the heart of how you review and understand the characteristics of these types of work. And that's why the devil is absolutely in the details. Where do these animals use? What don't they use? Why do they use it? What's the productive capacity of the use of those habitats? And so at a broad level, which was the level of this report, at a very high level population level, we don't have enough information to qualify that, honestly.

Only thing that we can do in developing that understanding is a -- it's exactly like this effects assessment. It has to be transparent in terms of its approach for development of the idea that, as we go incrementally through this larger filter to make an assumption of the issues, and each of the assumptions can be qualified and challenged, and as we work through this focus of saying here are a series of indicators, here's an approach that associates back to it, this is what the animals are using based on our best sets of information. How do they overlap?

And in the end, all I can is for major projects developed, they are under a rigorous review that obviously all those things can be improved greatly. But the review sets out four proponents of developing these projects, an approach where they say, if you lose one square metre of habitat, you need to replace it with two. Now, how that's functionally developed in terms of

the compliance and the monitoring framework that's involved into all of those things, that's what I develop in a fair amount of detail, as requirements out of protection strategies.

Q Do you know who Patrice Leblanc is?

A I have read his hearing testimony.

Q You've read the hearing evidence of Patrice Leblanc, Rebecca Reid and Jason Hwang?

A Yes.

Q Okay. Patrice Leblanc is the director of Habitat Policies and Practice, NHQ, DFO?

A Yes.

Q Okay. And Rebecca Reid is the former regional director Oceans, Habitat and Enhancement Branch, OHEB, DFO, currently the regional director of FAM?

A Yes.

Q Okay. And Jason Hwang is the area manager of British Columbia Interior OHEB at DFO?

A Yes.

Q And you've read their evidence regarding whether or not no net loss is being achieved in the Province of British Columbia?

A Yes.

Q Okay. What did you take from the review of their evidence as to -- well, maybe I'll just put the proposition. Maybe I'll just put a couple of questions and answers and ask if you've read them. I'm going to turn to page 3 of the April 5th transcript.

A Just one second.

Q Certainly. It will appear on the screen before you if you'd want to look there as well. And I'm going to be reading to you starting at line 25. This is counsel for one of the participants putting a question first to Mr. Hwang. I'm going to read you some excerpts from this exchange, as opposed to reading the whole thing, in the interests of efficiency but you've had a chance to read the whole transcript; is that right?

A Yes.

Q Okay. Starting at line 25:

> Q And I won't put words in your mouth but I would like to ask that question again. Are we achieving no net loss today in the province?
>
> MR. HWANG: Well, I think I spoke to that

yesterday fairly directly and in my opinion, no.

Turning over the page to page 4 of that same transcript, feel free to look back at the page before. You'll see it's a question put to Ms. Reid starting at line 10:

Q So is it fair to say then, in your opinion, we are probably achieving no net loss -- I mean, we're probably not achieving no net loss but there is insufficient information to clarify that for certain?
MS. REID: I would agree with that, yes.
Q Mr. LeBlanc?

So now Mr. LeBlanc is weighing in.

A Yes, I would agree that we're not achieving no net loss.

So the Commissioner has before him evidence from these three from the Department of Fisheries and Oceans, which I think can fairly be described as asserting that no net loss is not being achieved. Do you disagree with the evidence given by those three individuals?
A If I can speculate on this, because this report was, again, conditioned for sockeye and sockeye habitat use. If I were to extend this discussion about the results and understanding that we have seen for habitats and issues associated with some of the other species of salmon and fish, I would say that we are, in fact, losing habitat. That's just the association that you cannot help but see. One of the documents that DFO has produced through the Fraser Action Plan a number of years ago was the lost streams of the Fraser in the Lower Mainland. And it's a very interesting read. And when you go back to actually the atlas of Vancouver, there's a really nice composite atlas book of Vancouver that shows original plans of Stanley Park and across the Lower Mainland, it's really interesting to see where we had streams and where we don't have streams any longer. And all those things condition a discussion is human development and its association related to losing

habitats generally, that a coldwater species like salmon might use. Well, it's speculation on my part but I'd suggest that that's probably the case.

Now, when I make comments in this report about sockeye habitat use, that's something else. And it's over the reference in the timeframe that I've tried to specify given the information and understanding that we have.

Q To the extent their evidence may have applied to Fraser sockeye, would you agree or disagree that no net loss is being achieved?

A Conceptually, I would say that we are, during this last time period, there is no net loss conceptually. If I had opportunity to look at the compliance records and the audits and the detailed information, I don't know what the answer might be because certainly that's not an audit that's been easily functioned and it's certainly not transparent. So I'd say during this period of time given what has happened to sockeye habitat in the past century and what is happening now, I'd say there is not necessarily a loss of habitat.

Q And are you talking about a loss of square footage or a loss of productive capacity?

A Square footage.

Q Do you know whether there's been a loss of productive capacity during the last 20 years in the Lower Fraser specific to sockeye?

A Again, all I have to go by is the records of distribution and information on it. I would say that in the Lower Fraser for those races and sub-populations of sockeye that might use the Lower Fraser, there's probably been no net loss.

Q And do you base that on anything aside from your experience and professional judgment?

A Well, I base that, in part, Quigley and Harper's discussion about tidal marshes. I'd base that on the three inserts that I've shown as examples and I base that on Table 3 that say there are areas which were formed and not available to sockeye because of the diking history of the Lower Fraser that now have been opened up as restorative project actions that have allowed them. That said, the speculation at a population level for the Fraser sockeye is that probably less than 1 percent of the Fraser sockeye population at whole

might use those lower portions of the Fraser as specific productive-related habitats.

Q And one of the reasons that you're separating out sockeye, I take it, from other species is because of the limited duration many of them spend in the Lower Fraser as they're returning or up-migrating; is that correct?

A In a small part, yes.

Q Yes. Did your analysis take into account some specific stocks such as the Late-Run sockeye that have traditionally spent longer periods of time in the Lower Fraser/Strait of Georgia prior to returning?

A You're referring to the river type race of the Harrison River sockeye?

Q No, I'm referring to the Late-Run sockeye, which have traditionally held at the mouth for a period of weeks before starting their up-migration.

A Just at a population level. I didn't go into the details specifically of that distinct race or sub-population from the Fraser sock. No, I did not. In terms of consideration, I make one or two statements within our characterization that there may be substantive influence on those populations because of some of the conditions associated with the Lower Fraser climatologically.

Q I'm going to come back now to your Table 2 and ask you some specific questions about some of the human activities. And we'll start on page 40 with the population. I'm going to start under the box that says "Significance of Potential Interactions". And the first bullet under "Significance of Potential Interactions":

> While there is moderate geographic overlap as a result of potential edge effects, the magnitude of interaction with sockeye habitat is considered to be low given the effective application of environmental mitigation practices and habitat compensation...

When you say the effective application, you've told us earlier that you don't have information about whether the replacement habitat replaces the productive capacity. Are those words, "effective application", an assumption or is that an assessment you've made?

A Oh, that's an assumption conditioned by the results that we've already spoken about.
Q All right.
A And the assumptions again conditioned by my own experience.
Q Okay. Moving to the next bullet:

> Although the duration of interaction is high, it has been ranked as low because it is expected that habitat conservation strategies will avoid and limit negative interactions with sockeye habitat.

Tell the Commissioner, please, why you have that expectation.
A The expectation is given the rigours of a project's review and the understanding and the characteristics that, as a biologist, I need to go through to carefully have a project environmentally reviewed. And so it's not an expectation, it's a requirement, a legal review requirement for a project. Again, it's how the information falls out of the compliance audit that would...
Q So it's on the basis of the legal requirement that you have your expectation, as articulated in that paragraph?
A Yes. And since the no net loss policy has been implemented in '86, the effects and the rigour with which individual projects have been reviewed and the characteristics and conditions that they've been followed has been enhanced.
Q Okay.
A Again, from the review perspective.
Q Turning now to the number 2, "Land Use: Agriculture and Forestry". When considering the potential impact at agriculture on sockeye habitat in the Lower Fraser, did you consider the use of pesticides?
A Let me just qualify that that "Land Use: Agriculture and Forestry" is associated with a number of map sheets that I have in the report. And so I'm getting to the answer to your question. I make some comment about the general practices and application of herbicides and pesticides on Map 6-C. And so all the characteristics that I have there is coming from the Agricultural Census

information that talks about land use and input of the use of those general characteristics and conditions, application of herbicides and pesticides.

And this was the best expression that we could come out with in terms of expressing general trends in this type. I did not qualify this about particular speciation of herbicides and pesticides and types like that. All I did was, here are some statistics that associate to different parts of this area in this project that suggest what's being applied onto the land.

Q Did you do any sort of calculation to the degree to which pesticides may be finding their way into sockeye habitat and consider that potential impact?

A No, my understanding is that's a completely different chapter of this technical review and reporting series.

Q Okay. Turning now to page 45, please, "Dredging and Diking". I want to ask you about the third bullet under your potential links, the final box.

> Dredging activities and dredged sand volumes have declined annually for the past two decades.

Are you able to tell the Commissioner, whether, despite the decline in dredging volumes, the amount that is being removed continues to exceed the amount that's replaced with dredging?

A Those statistics were hard to come by but all I can say is when you look at the characteristics, and I have it as a figure and I'm not sure which area I cited in just yet but I can find it.

Q I think it's page 29 that you're thinking of, and that may assist you in answering the question.

A Thank you. And this associates back to Map 10, I believe. No, Map 11-A and Map 11-B where I kind of go into the characteristics of this. And what's important about your question here is when you look at the information provided in Figure 2, is, as long as that ratio is above 1, then the amount of sand and gravel moving into the Lower Fraser, more of it's being extracted than there is flowing in. And that's what that volume relationship means and that comes from some of the

work by Michael Church and others. And then within that 11-A, what I try to show is the characteristics of where dredging activities are being located over time in terms of where they're dredging and where they're not dredging.

Q So if I'm looking at Tab 2, between 2005 and 2010, am I looking at between two and three times more is taken than is replaced?

A So we're looking at the --

Q I think the blue is the total dredge volume?

A That's right. And then it's the red line that we're looking at, which is this ratio --

Q Okay.

A -- of dredge-to-inflow. And so dredged volume on the top, inflow on the bottom.

Q Okay. Thank you. So wherever we see that red line above 1, more is being taken than is being replaced?

A Yes. But again, you can see that's a fragmented series of information.

Q Yes.

A We do wish that we had more.

Q Okay. Did you consider the potential cumulative effect of the removal of the gravel by dredging?

A Yes, there's one comment that that amount of dredging has caused. And I think I articulate that in one of the maps, Map 11-A. There's something about a loss of three metres in depth or an increase of three -- reduced three metres of depth over a 30-year period in the bottom level of the bottom of the Fraser.

Q Yes, thank you. If you could turn to page 48, please? Looking again at the very bottom box of this chart, the last bullet:

> In areas of sockeye production, contaminant levels are low and exposure duration is brief.

I just wanted to ask you about the phrase there, "areas of sockeye production". Does that include spawning areas and incubation areas?

A Areas that are key areas for sockeye production are places where numbers and biomass weight gain occur and those are some of the key habitats, yes.

Q I'm just wondering how the conclusion that duration is brief applies to those areas where

spawning and, particularly, incubation occurs.
A At a population level, and I can speak of the sort of Lower Fraser River estuary, even the Lower Fraser watershed specifically. I can't speak of areas like Chilko and Francois, Stuart, and areas like that but contaminant levels are generally thought to be quite low in those upper watershed areas that support sockeye spawning and rearing, incubation and lay systems. Contaminant levels may be higher in the Lower Fraser and the Fraser estuary, but again it's duration of exposure, how much habitat is being used by certain races of sockeye and, at the population level, what habitat is being used there.
Q So I take it the brief duration comment doesn't apply to areas where incubation or lake-rearing takes place in the Lower Fraser?
A It does insofar as that the contaminant levels are low there.
Q Yes, and I'm speaking about the duration is brief comment.
A Yes, as I articulate in here, they spend a long time in those areas, a lot longer than almost anywhere else.
Q Turning to page 49, the final bullet under the "links to Fraser sockeye decline", or the only bullet I wanted to ask you about, you conclude:

> The number of non indigenous species in freshwater and marine environments which coincide with sockeye use are limited and have remained stable over the study period.

Do you have any information about -- and essentially what you're saying there is the number of species hasn't changed; it's remained stable. Is that a fair --
A Yes.
Q Okay. Do you have any information about the population of those species and whether they've remained stable over time?
A No.
THE COMMISSIONER: Mr. McGowan, I think we'll take the noon break. Thank you.
MR. McGOWAN: Yes, thank you, Mr. Commissioner.
THE REGISTRAR: The hearing is now adjourned until 2:00 p.m.

(PROCEEDINGS ADJOURNED FOR NOON RECESS)
(PROCEEDINGS RECONVENED)

THE REGISTRAR: Order. The hearing is now resumed.
THE COMMISSIONER: Mr. McGowan.

EXAMINATION IN CHIEF BY MR. McGOWAN, continuing:

Q Mr. Johannes, I just have a few more brief questions for you. Throughout the report and throughout some of my examination this morning, I was asking you about each of the ten human activities which you had identified, and you had identified ten and then assessed them individually; is that correct?
A Yes.
Q Did you in the course of your report, or have you considered at all the possible cumulative effect of these different human activities which you've identified?
A Not in the true sense of accumulative effects within this report, and within the concepts of how sockeye and sockeye habitat use interacts with these things, on a general level, certainly, yes.
Q Have you drawn any conclusions on a general level about the potential for cumulative effects to be connected, of all of these factors to be connected to the decline?
A At a very general, almost speculative level in this case. It very much is, I've used this phrase before, death by 1,000 cuts kind of approach, and so not each of them is a potentially a smoking gun of an evidence. But if you look at Map 17 and you accumulate the issues, it's hard not to see how some of these things accumulate in some ways. That particular focus and assessment has not been done in this report, though.
Q Okay. Your report, as we know, focused on the Lower Fraser and Strait of Georgia areas.
A Yes.
Q Did you give any consideration to developments that may impact on sockeye habitat, either before or after and the possibility that human development in the Lower Fraser, for example, might be additive to human developments elsewhere and in that manner potentially contribute to difficulties for the sockeye?

A Yes, in some ways. You couldn't help but look at the characteristics of pulp mills, for example, that have a long history of discharge into a receiving environment and not have an idea that they may be part of the issue. Similarly, wastewater treatment plants and other things like that. The lower dike development in the Fraser, the Lower Fraser dike development certainly had a large accumulated influence. And so I speak about some of those issues, yes.

Q A number of times in your report and in your evidence today, you made reference to the brief duration of sockeye presence in the area that you were looking at, specifically the Lower Fraser. Does that same analysis hold true if one considers their exposure in the Lower Fraser in an additive way together with quite a substantially longer period of time of exposure to potential human development. For example, some of the stocks that migrate quite far up the river.

A I think you're going to have to rephrase that question just a touch for me to really capture what I'm...

Q Sure, let me try it a different way. The duration in the Lower Fraser for many stocks is low, and you've made that point.

A Yes.

Q But these same stocks are also exposed to the impacts of human development during the rest of their migration, either outmigration or returning migration.

A Yes.

Q Would you consider the exposure to human development activity brief if one considers the entirety of the migration in either direction?

A The very first question I was asked in my Ph.D. defence, to answer this question, was do animals think? The resulting answer is, sure, animals think, but in this case both in and outmigration of sockeye, the end result is in fact survival. Survival's the ultimate outcome, production is part of that puzzle in terms of its growth and development. So if animals come back less abundant and smaller in size, then they have had an accumulated experience across that area.

So I don't know if I can fully almost comprehend all the issues associated with the

accumulation of issues that might be faced by young salmon moving out of the Fraser and an adult salmon returning.

One of the ways I've encapsulated that little bit of thinking is expressed in the way Dr. Scott Hinch has spoken a little bit about adults and some of the hanging migration for Late run animals, and it's a temperature accumulation of some sort that they're exposed. And so it's resulting stresses and issues associated with that stress that results in some accumulation of expression. And similarly, the young salmon that don't grow as fast because they're not finding enough food, that's an accumulation of the series of stresses. So I don't know the full answer to that question, but I can imagine or at the least speculate that there are accumulations that are important.

Q To the extent some of the things you've considered may be stressors, does your conclusions on no net loss discount the possibility that they might have an additive effect to other stressors or difficulties encountered by the species?

A I'm an optimist in believing that these animals are very incredibly plastic in behaviour. The success of a sockeye-like species is one of an invader-type evolutionary behavioural kind of system. These animals know when they're in bad environments and tend to move or adapt and change in many different ways. So there is no simple answer to that question at all, and I don't even know if I could speculate on all the details. And I'm hoping that the rest of the authors in accumulation can provide Mr. Commissioner with an insight some way.

Q Yes. Development, of course, is not unique to the lower Fraser.

A No.

Q It's something that the sockeye would encounter throughout their migration, at times when they're close to land or in the river, at many points along their journey; is that a fair statement?

A Yes.

Q And would the impacts of those developments throughout the course of that journey be additive, in your opinion?

A I'm just considering it.

Q Yes.
A That's both a yes and a no. It depends on the stress, and it depends on the stressor, and it depends on how you express how both, as we try to do, the animal has a geographic overlap, the magnitude of that interaction and its duration of that interaction. So it's wholly dependent on those issues.
Q Thank you. And finally, I wanted to come to the area of potential recommendations. It's something I think you've given some thought to, and I wanted to ask you whether you have for the Commissioner any recommendations which might be worth considering in relation to either assessing or protecting sockeye habitat in the Lower Fraser or Strait of Georgia.
A Yes.
Q Please.
We were not able to look at causality in this review. And it wasn't necessarily just because of the short duration of review, it was because the information about the association and statistical association is not possible at this time. And what I mean by that is without understanding the extent, and qualifying the extent of habitat sockeye use and habitats in beyond simple lineal areal extent, we have no reference point to say whether there's been disturbance over time or not. And as a scientist, you know, you test a hypothesis that says has there been a loss or has there been a gain associated with that, you'd need a metric of some sort to do that. That was not possible in this case.
Similarly, the indicators that we've identified, they're simply that. There is no underlying underpinnings for the metric that allows them to be used in a continuous fashion and that the data is often discontinuous, so it's a bit of a fragmented story. And the reason this hangs together in a certain way, this whole report, is because of an approach that we've tried to use to help develop the issues. So that's my explanation.
My recommendations are:
I would very much appreciate seeing some ongoing mechanism to assess and quantify habitats, and that means identifying the habitat suitability

for sockeye, whether it's a sockeye or chinook or chum or coho, or any of those species, but being able to identify that in clear definitive terms.

Being able to then measure that, and measure a change. Whether that's even in an index stock or some other characteristic of monitoring that allows you to measure a change over time. That's second.

Embedded in that is an understanding of this is a world that we live in that is being developed. There is economic development and demand. How do we make that suitable for a world that has fish and salmon particularly as an icon within it. So how do we do that? Well, we've got this environmental review process that's in place. We've got some sort of an approach that applies a gain and a loss across habitats and their particular implications. And so how do we audit and monitor that? What is the framework for actually looking at those habitats? Is there a standard methodology to applying that some way. Those things are still fundamentally missing. The transparency of that audit database, we've got a couple of reports from the mid-1996 period or so, and they're published. We have no other additional information to actually rectify what's there and what's not.

The final part of this recommendation is if we truly are going to either restore habitats from dikes and systems that have been diked, or compensate for habitats in some other way, we really need some professionals that know what they're doing. I've been teaching restoration at University of Victoria for almost 15 years now, and the way the technology, the actual technology, the learning, the approaches that have come about, it's not consistent. It certainly is not consistent by species, and it's not consistent by professional.

So how do we impose some sort of recommendation that allows us to develop an approach that builds this into what we do on an effective scale, knowing that we have demands for industry to develop projects, and we have demands for urbanization that have multiple indirect effects rather than direct effects that we might measure in a project. So how do you balance all

that stuff? Well, some of the sophistication that's happened is, you know, incremental gains here and there by regulatory structure or other pieces. But, you know, it has to be concentrated, it has to be focused, our thumb has to be on that stuff if it's really important.

The last little part of this discussion for me is if you go to Oregon.gov, you will see licence plates for sale, and the licence plates for sale has one of them with salmon on it. And the salmon licence plate was first voted in by the Oregon public to say how many people would support salmon restoration, salmon habitat monitoring through purchase of this licence plate. And some percentage said yes. The reality of it is when it hit the pocketbooks of people to buy licence plates, it wasn't even near what they suggested that they might be in terms of buying a licence plate to support salmon.

So on my impassioned kind of recommendation of this issue is we need some, both government, public, stewardship, First Nation combination of things that allows us to have with strong focus something that's fundamental in support of habitats for salmon, habitats for wildlife and people's use that works, and right now I'm not sure it does.

MR. McGOWAN: Mr. Commissioner, during the course of my examination of this witness I did refer to three articles, two of which have been marked, one of which has not, I believe, been marked. The third article which I referred to, "Compliance with Canada's Fisheries Act - A Field Audit of Habitat Compensation Projects" I don't believe we've marked yet, and I suggest that be the next exhibit.

THE REGISTRAR: That will be marked as Exhibit 737.

EXHIBIT 737: Harper & Quigley, Compliance with Canada's Fisheries Act - A Field Audit of Habitat Compensation Projects, January 2006

MR. McGOWAN: If I might just have a moment.

Thank you, Mr. Commissioner, those are my questions.

THE COMMISSIONER: I'm sorry, Mr. Registrar, what

exhibit number was that?
THE REGISTRAR: Exhibit 737.
THE COMMISSIONER: I thought we had a 737. Thank you.
MR. McGOWAN: Have we clarified the exhibit number?
THE COMMISSIONER: Yes.
MR. McGOWAN: Okay. Thank you, those are my questions, Mr. Commissioner. Mr. East for the Government of Canada will be next.
MR. EAST: Good afternoon, Mr. Commissioner. For the record, it's Mark East of the Department of Justice, Government of Canada.

CROSS-EXAMINATION BY MR. EAST:

Q Dr. Johannes, your last, your summary of your evidence, I think is a good segue into some of the questions and topics that I'd like to discuss with you this afternoon. And, Mr. Commissioner, just to let you know, on my goal and expectation is to finish my cross-examination by four o'clock this afternoon.

Perhaps I could start, Dr. Johannes, by going to page 12 of your report, under the heading "Approach". And just following up on some of the questions and themes that my friend, Mr. McGowan, raised with you, and I won't belabour this because he's gone over it in some detail. But I just want to look at the sentence under the heading "Approach", the second sentence that starts with "A statistical analysis":

> A statistical analysis of the association of human activity and potential impacts on sockeye habitats and, in turn, on Fraser sockeye productivity was not possible in this review due to the limits on the nature of extent of data available for human activity and in particular the lack of quantitative information on sockeye habitats.

And you've testified to some extent this morning about the nature of that limitation on your report; is that correct?
A Yes, it is.
Q Would you agree that ideally, and obviously, as you've testified, there were time constraints and other constraints with respect to this particular

report, but ideally that the conclusions that you've reached in your report, you would be expected, if you were going to publish these in a peer-reviewed journal, to support them with more quantitative analysis and statistical analysis than you had at your fingertips for this report, would you agree?

A Depends on the journal, but generally, yes.

Q Okay. I just wanted to go next to page 62, your Table 4, which I think we'll probably return to this a few times in this discussion. I believe this is the same summary table that's at Map 17, which we looked at before. Something you said this morning interested me when you were talking about this particular table, and when you said that you and the researchers and authors that you were working with, in using your professional judgment, I think the language you used and forgive me if I've misquoted you, but looking at the factors and indicia conservatively, you made an estimate of what was going on, and I think you used the word "conservatively". Do you remember that, that you said that term?

A Yes.

Q And of course, you know, whether something is conservative or liberal, I suppose, depends on your perspective. So in your context, when you said that you were assessing these factors conservatively, was that another way of saying that you were assessing these factors from a precautionary approach, or was it some other definition that you were using, when you're saying you were looking at these factors conservatively?

A I don't know if "precautionary" is a correct word to apply to this, but I would say we were careful in our reviews. We sided on the side of implying or suggesting or identifying a stronger interaction than we might otherwise say.

Q Okay. So when there was an ambiguity, there is something was on the borderline, you say, between nil effect or low effect, you would err on the side of suggesting greater effect?

A Yes.

Q Okay. I wouldn't mind going to then to -- well, first of all, just to set some of the context, I'd like to talk a little bit about the geography. We see Table 4 there's the six areas, but I had some

questions about how you defined those geographic areas. Perhaps we could go to Map 1. And I think this is the best graphic illustration. And the inset at the very top, unless perhaps you could direct me otherwise, I think this is the only real graphic representation you had of the six areas, and I just want to, for my edification really, to get a sense of where, of what's in each of these six areas. And in particular if you look at the Lower Fraser Watershed, It's on both of sides of the Fraser River. And would you agree that much of the Fraser Valley would be -- and which is, I guess, an agricultural area in many respects, would be what would be within the Lower Fraser Watershed by your definition, or was that your intention?

A That Lower Fraser River and Estuary component that we've got identified in this map was part of the Lower Fraser Watershed.

Q Yeah. Well, I just notice when you look at Lower Fraser Watershed on the map there, it's on both side of the river.

A Yes.

Q So when you're assessing impacts on the Lower Fraser Watershed, we have to look at this from the context of impacts, first of all, I guess, in the watersheds of the Harrison, the Pitt and the Lillooet Rivers. But also assessing impacts as they may impact the Fraser Valley, which is perhaps a different type of area, a different ecosystem than, for example, the Upper watersheds.

A That was not the intent. The best representation for the six pieces are on Map 17.

Q Okay.

A And what the representation is, as you can see better represented through Map 17, is in fact both the physical geography, morphology, bathymetry of the area, and life history-related habitat use.

Q Okay.

A Those two combined into the definition of those sorts of things. This was the first map and we started to certainly identify those pieces. And what happened was the central basin of the Strait of Georgia was divided basically into a Fraser discharged influenced area, and then the larger pelagic area of the Strait of Georgia itself. So that's why that middle Strait of Georgia area was

divided.
Q Okay. So this is a generalization, I guess, it looks to me, especially of the estuary, the river. The reason I ask, you know, this will become apparent in a moment is I'm going to ask you some questions about river-type sockeye salmon and the habitat of that stock of salmon. And there's references to these salmon being in sloughs or backchannels of the Fraser River. And it wasn't clear to me in reading your report where those salmon fit on this map, whether it would be within what you would call the Lower Fraser River, or was that something that would be within the Lower Fraser Watershed? It's just a mater of terminology, and it's relevant when we get back to your charts. So where would you place the habitat for river-type sockeye salmon in their sloughs and backchannels of the Fraser River, under what column of that chart?
A In the off-channels and sloughs and other areas of the Lower Fraser River and Estuary, I would place them in the Lower Fraser River and Estuary.
Q Okay. So not in the Lower Fraser Watershed.
A Not in the Lower Fraser Watersheds where we have predominance of incubation and nursery and spawning activities, yes.
Q Okay. So issues of agricultural runoff, for example, pesticide runoffs, just being clear, where those occur in ditches, slough, backchannels in what we see as the Lower Fraser Watershed, that, I mean, obviously there seems to be some grey areas between the boundaries, between what you'd call the Lower Fraser River and the -- according to this map anyway, and the Lower Fraser Watershed.
A This is a simple first map representation (indiscernible - overlapping speakers).
Q Okay. Well, I won't belabour this point, then. And the Fraser River Estuary, how far out into the Strait does that go? Is that the same thing as I've seen references to the Fraser River plume in some of the articles.
A We represented it more by a bathymetric physical nature of the habitat, rather than the discharge of the Fraser River.
Q Okay. So the estuary itself is essentially generally as it's described on this map, or would

it be graphically illustrated better somewhere else?

A Oh, I think generally it's certainly fine. Again, it's a freshwater/saltwater mixing, defines an estuary, and the bathymetry of the area.

Q Okay. I'll now go on to my question, then, and that's at page -- I want to talk a little bit about the migration and lifecycle of sockeye, and I have some questions about that. So if you go to page 20, please, Mr. Registrar, the third paragraph. In the paragraph that starts "Sockeye habitats in the Harrison," and then the last sentence of that paragraph, and I want to start there:

> The 160 km portion of the lower Fraser River and estuary is used as a migratory pathway for smolts and adults with a residence period of often less than 7 to 10 days.

But then I think you talk about an exception.

> River-type sockeye aged 0+ originating from Harrison Lake use various sloughs and off channel areas in the lower Fraser River above the tidal area, for rearing for a period of 2 to 6 months...

Now, stopping there, the term 0+, sometimes you see reference to 1+ sockeye. 0+, I assume that means they're younger, somewhat younger at a less advanced developmental stage?

A Yes, smolts.

Q And would it be fair to say that, well, actually it says in the next sentence:

> The Harrison river-type sockeye fry are small sized and migrate slowly out of the Fraser River and estuary across the Strait of Georgia to use rearing habitats around the southern Gulf Islands for a residence period of 4 to 6 months. Harrison river-type sockeye juveniles were observed in the Juan De Fuca Strait and west coast of Vancouver Island in February through June, 1 year after emergence.

So Harrison river-type sockeye being 0+ sockeye are smaller, perhaps more vulnerable at that stage of development at the time that they're rearing within the sloughs and backchannels of the Lower Fraser River?

A Yes.

Q Okay. I want to discuss with you some of the implications of some of the habitat loss and habitat impacts we've talked about on this particular stock of salmon. But first I want to take you down to the last sentence of that page, page 20. Sorry, that's not it.

So actually page 3 of the report, second full paragraph under the paragraph starting "Increasing population size", the very last sentence of that paragraph.

A I'm sorry, where are you?

Q Sorry, we're on page 3, the paragraph that starts "Increasing population size, urban density, industrial".

A Yes, I have it.

Q And go right down to the last sentence of that paragraph.

A Yes.

Q Actually, we'll go up one more, because that puts it into context. You say here:

> For instance --

- and we just talked about this -

> -- river-type sockeye will make use of the mouths of urban creeks or off-channel areas for rearing prior to migration to the Strait of Georgia. Stormwater and wastes deposited directly or inadvertently would cause direct exposure to sockeye, particularly in freshwater rearing habitats used by river-type sockeye.

Then you say:

> The proportion of river-type sockeye within the Fraser sockeye population is estimated to be less than 1%.

I suggest to you that that statistic, that the

river-type sockeye is less than one percent is incorrect in the sense that in recent years at least, Harrison river-type sockeye make up a significantly greater percentage to the Fraser sockeye population than what you've indicated here. Would you agree with that? Do you have any sources, perhaps, with respect to the less than one percent?

A I am pretty confident that given a bit of data that I would probably estimate them to be less than .1 percent.

Q Less than .1 percent.

A Simply because when you have 100 million sockeye smolts coming out of the system, and if that's a gross exaggeration or underestimation, I'm not exactly sure this instant, that that capacity of the Harrison Rapids area for spawning and incubation is only so much. And so that characteristic just represents few, few fish, relative to the population level characteristics of Fraser sockeye.

That said, if we were to see really good use of a variety of these sorts of habitats by the entire Fraser population, we would be seeing hundreds of thousands of animals in different area. The catches that have been demonstrated and developed by Levings, Whitehouse, all the other sorts of studies we reference, the numbers are 10, 20 of animals in catches. And so that leads me to the other support of that number.

Q Okay. So you're talking about less than .1 percent of sockeye smolts.

A I will stick with one percent.

Q One percent of sockeye smolts. The reason I ask, and I'm just seeking this for clarification, just because I saw something in an article by Richard Beamish, and I'd like to bring this to your attention, and maybe you can just help clarify. What I see is on its face anyway, a potential inconsistency, and that's at Tab 3 of Canada's list of documents.

Now, you're familiar with the work of Dr. Beamish? I believe you've quoted some of his articles in your bibliography?

A Yes.

Q Have you seen this particular journal? I don't believe it's yet been published, this particular

article.
A I have not seen this article.
Q Okay. Well, I'll just go to a citation or an excerpt from it, just to put this for your comment, and it's on this point. And it's actually page 39 of the paper, but it's actually page 45 in Ringtail, the Ringtail version. And then looking at this and listening to your answer, I think maybe I have a better understanding of the differences in these numbers. And I'll just put this to you. "In the Fraser River", and this is the text part above the table:

> In the Fraser River, the largest population of sea-type sockeye salmon occurs in the Harrison River... From 1950 to 2004, the Harrison River sockeye salmon accounted for an average of 1% of the total sockeye salmon return to the Fraser River.

That's similar to the number that you've used, and maybe there's a distinguishing characteristic. This is talking about returns. I believe maybe you were talking about smolts leaving into the Fraser River.
A Young fry or smolts, yes.
Q Okay.

> In the last five years, from 2005 to 2009, the Harrison River sockeye salmon accounted for an average of 9% and up to 21% of the total production of Fraser River sockeye salmon. Lake-type sockeye salmon also occur within the Harrison River drainage. The percentage that the Harrison River sockeye salmon contribute to the total production of all sockeye salmon in the Harrison River drainage was high in the 1950s and 1960s, decreased through to the early 1990s and in the last five years is at a historic high levels...

Would you agree with Dr. Beamish that the Harrison River sockeye are becoming a greater proportion, a greater significance as an overall proportion of sockeye in the last five years than they have been historically?

A Certainly his numbers on this page support some of that discussion. The Harrison river-type sockeye is defined, I only see it once at the bottom of the figure captioned 23, and that's inconsistent with what we spoke about in our report. I would look to Dr. Peterman's chapter for the Commissioner to actually clarify those numbers and estimates, and I'm not an authority on that right now.
Q And Dr. Peterman's report, is that in your bibliography?
A I don't believe we cited it, although we did cite Grant and Peterman from the summer.
Q Grant and Peterman.
A Grant is forecasting for the Fraser, and Peterman is the large June summary report from 2010.
MR. EAST: Okay. Well, thank you for that clarification. Perhaps if I could mark this last report, the paper by Dr. Beamish, as an exhibit.
THE REGISTRAR: Exhibit number 738.

EXHIBIT 738: Beamish et al, Ecology of Juvenile Sockeye in the Strait of Georgia and an Explanation for the Poor Return of Sockeye to the Fraser River in 2009, November 2010

MR. EAST:
Q I'd like to go back to Table 4 at page 62. So here we have a reference to "Lower Fraser River", and I note that you rated on this column under "Lower Fraser River", except for 7 and 8, which don't apply, you rated all the effects as "Low" except with respect to land use, the land use factors being agriculture and forestry for the most part as being "Nil". And all the other factors had a low summary of impact; is that correct?
A Yes, it is.
Q And on page 61 in your conclusions you write, and this is on the second full paragraph, first sentence, page 61:

In many areas where human activities and development are concentrated, sockeye often have limited residence periods in adjacent habitats. For example, the lower Fraser River and estuary are primarily used by both

adult and juvenile (with some exception) sockeye over periods of days as migratory corridors.

Your reference to the exception, is that a reference to the river-type sockeye that do linger within the Lower Fraser River?

A Yes.

Q Okay. I just want to go, then, to Tab 4 on Canada's list of documents, and I just want to explore a bit about the nature of the river-type sockeye salmon. This is an article which I believe is cited in your bibliography. Are you familiar with this article by Dr. Levings, Boyle and Whitehouse?

A Yes.

Q "Distribution and feeding of juvenile Pacific salmon in freshwater tidal creeks of the lower Fraser River, British Columbia". And just looking, just dealing with first some context for the abstract, it says:

> This study examined juvenile salmonid use of a freshwater tidal creek system draining a wetland on the floodplain of the lower Fraser River...

Talks about:

> Chum...chinook...and sockeye...salmon fry were abundant in the tidal creeks in spring. The fry were found in non-natal habitat up to 1.5 km from the main channel of the river.

Then it talks about some of the prey that these salmon fry ate.

I'd like to go then to page 9 of the pdf, page 307 of the document, where it says "In summary", and I just want to read the first six lines, then I'll ask you to comment, Dr. Johannes:

> In summary, the results of this study at Surrey Bend in the lower Fraser River showed that freshwater tidal creeks draining wetlands characterized by riparian vegetation such as reed canary grass and hardhack were extensively used by salmon fry. Chum,

sockeye and chinook fry immigrated into the habitats from the mainstem Fraser River, and therefore, the habitats were used by the progeny of fish from upstream populations.

Is this consistent with the conclusions in your report about the nature of river-type sockeye and the way they lingered in sloughs and backchannels in the Lower Fraser River?

A It says, yes, that's consistent. The comment here in the summary says salmon fry, which is distinguishing a certain size and type of animal, not a smolt.

Q Okay. So these, this actually, this article you're saying does not apply to the 0+ river-type sockeye smolts?

A No, it says 0+ river-type sockeye are not smolts, they're fry.

Q Okay.

A The physiological form of smoltification is a slow progression because of their size. They act somewhat like chum in their slow distribution.

Q So where would these sockeye fry then, in your experience, where would these fry, the sockeye fry they're talking about, where would they have come from, their natal streams, in your research?

A I'd have to go through all the conservation units in the Fraser and I'm not sure, those are not at my fingertips right now. Certainly the one in the lower Fraser watersheds is this river-type, Harrison Rapids.

Q Harrison Rapids.

A Harrison Rapids sockeye that are fry, and so they're a river-type characteristic fry that behaviourally act a bit like a chum salmon.

Q Okay. And as fry, then, they'd be even at a more immature developmental stage, even than smolts would be.

A The literature suggests that these fry, when they emerge from the Harrison Rapids spawning areas are not large enough to swim up into Harrison Lake to rear there.

Q Right. Right.

A And so they're flushed into more calm environments to raise and rear.

Q Okay.

A That said, given the timing of this study, I am

not sure what river-type sockeye are upstream of Hope and contributing to anything here.
Q Okay. These fry, then, Harrison River Rapids fry, you would agree that when they're being raised and reared and feeding in the sloughs and off-channels, they would be susceptible to human impacts from a number of sources perhaps. I'll give some examples: small scale diking, riparian, development, pesticide use, fertilizer runoff, would these be the kind of things that we would have to monitor for to assess impacts on these types of river-type fry? Would these be potential impacts on those fish?
A There's little information, potentially, and that's the caveat to that is there is little information on the feeding characteristics of these animals in some of these locations. They, sockeye as a species, is not considered a benthivorous animal, meaning feeding off the bottom.
Q Right.
A Like a chinook or chum might do. So the characteristics of their nutrient use, their feeding regimes, even their predators are subtly different.
Q Mm-hmm.
A And you'd have to explore that in a lot more detail to understand those characteristics and their links to production on the survival and influences.
Q And you would need more analysis of the nature of the prey of these animals and the potential impacts of the environment on the prey and how some of the -- how that may indirectly affect the lifecycle of these fish, would you agree?
A Yes, I would.
Q Okay. And some of these impacts that we just talked about, they might not necessarily be impacts that are caused by the major projects that you examined in the course of your report, wouldn't that be right, if some of these sloughs, the impacts on these sloughs and backchannels may be of a much more minor nature than the major projects that you discuss in your report, is that possible?
A I don't know the answer to that. I don't know, each project has its individual potential effect

and it's totally dependent on what the project is related to. Major projects is only one contribution of indicators that we've used to express some change.

Q Okay. Well, maybe we can go, then, to -- I just want to after setting this context go to your assessment of the risks in the charts on page -- and Table 2, page 40, first of all. And we've seen this from Mr. McGowan, this is the chart relating to impacts population size. And looking under "Lower Fraser River" again, you've noted that the magnitude of interaction and the duration of interaction is at the low end, and the summary risk of loss of degradation of the sockeye habitats is at the low end.

And then looking at some of the specific points, and again I might reiterating some of the points made by Mr. McGowan, but you say first of all in the very first bullet:

> Much of the population growth and urbanization (populations density) has occurred along the lower Fraser River and Fraser Estuary.

Again this is the area where the fish that we've just been talking about live for extensive periods of time, months at a time; is that correct? Where this is the area where the population and growth in urbanization has taken place in the Lower Fraser River and Estuary.

A Certainly the densification and some of the industries over the last 20 years have certainly been around that area, yes.

Q Okay. And then in the next, I guess the fourth bullet, where it says -- or first bullet under "Significance of potential interactions", you say:

> While there is a moderate geographic overlap as a result of potential edge effects, the magnitude of interaction with sockeye habitat is considered to be low given the effective application of environmental mitigation practices and habitat compensation during project review, design and construction.

Again would you agree that that mitigation, that

compensation, that's with respect to the major projects that you studied, not with respect to the area as a whole, all potential impacts.

A I'd characterize that in two ways. One is I was careful with discussing these as potential edge effects, and that is in part because of the duration of this review over the last 20 years.

Q Mm-hmm.

A The edge effects being, you know, how much has been implicated in some of the sloughs and backchannel areas, what do the edges of the Fraser riparian area look like now, as opposed to in history. So that's one aspect of this. The second is under true project reviews. And ones that I've seen and in part been part of, this understanding and development of design, mitigative features and compensation has been embedded in those projects, certainly as they are certified under the Environmental Assessment Review.

Q Okay. Thank you for that. Can I go back, I just want to take a look, actually, at the definition that you put in for "Low", and I'm particularly interested in your ranking of low for "Magnitude of Interaction" and "Duration of Interaction" under "Lower Fraser River". If you go to page 39, again Mr. McGowan brought us to this. I just want to look at some of these definitions a little more closely.

Under "Magnitude of Interaction", if you look at "Low", I have some questions about this. So you've rated this as low because:

> The nature (physical extent, extent of activity) of the human activity could result in low but reversible impacts (e.g., temporary disruption of feeding) on habitats used by sockeye. Unlikely to have a population-level impact.

What do you mean by that last sentence:

> Unlikely to have a population-level impact.

A If we take the assumption that there is a number of 100 million sockeye smolts leaving the Fraser at one year, at a population level their use of

those environments at a population level, their use of those environments is minor.
Q So at the macro level you're looking at all the Fraser juveniles, for example, as a population.
A We had to, and that's what we were asked, yes.
Q Okay. You would agree that if we focused in and zeroed in on a particular stock or species, for example, river-type sockeye, that this particular ranking of low would perhaps not be appropriate if we were preparing a study that focused specifically on this stock of Harrison River Rapids sockeye or fry in this area. Would you agree that that, if you zero in on that particular stock, that this ranking would probably not be appropriate?
A I have not done that review at all, and the things that go through my mind fairly quickly when you've raised this question are the following.
Q Mm-hmm.
A It has to do with what we spoke about this morning in terms of tidal marshes, and the gains in some of those habitats and the experiences with restoring and compensating for those habitats, and the types, given that the diking history and some of the dredging history have been almost a century long in terms of their duration.
Q Mm-hmm.
A Allowing the available habitat to be restored in some areas might provide them more opportunities. On the similar scale, as I said a little bit earlier, death by a thousand sort of knife strokes, incremental indirect diffuse changes from urban development, and the associated practices, undoubtedly have some sort of influence somewhere. Those are unmeasured, but may have implications. So the combination I am unsure of, how that will resolve itself, other than the statistic that you showed me with the characteristics from Dr. Beamish's paper indicating that that survival and production seems to be changing for them in some way.
Q Okay. Thank you for that. I just -- I'll just follow up a little bit more on this, but I won't belabour it. I'd like to go to the next page 41, which is your Table 2, "Land Use (Agriculture / Forestry)", and this was the source of questions, I was trying to determine where agriculture, most

of the agriculture fit within these columns, was it in the Lower Fraser Watershed or was it in the Lower Fraser River. I get the sense it's probably in a bit of both. And why I'm interested in this is because you have under "Lower Fraser River" from "Magnitude of Interaction" and "Duration of Interaction", the -- a risk level of "Nil". And again going back to page 39 definitions, "Nil" for "Magnitude of Interaction" means:

> The nature (physical extent, extent of activity) of the human activities is not likely to interact or induce effects on habitats used by sockeye.

And for "Duration":

> No or limited expected overlap over time between human activity extending over residence periods and use of spawning or rearing habitats, migration corridors or holding areas.

Would you agree with me that this finding of nil again is based on a kind of macro look at the population of sockeye as a whole and not on specific stocks that may use this particular habitat in the lower Fraser River.

A Yes, in part.

Q In part.

A In part, because the characterization of those sensitive other habitats for the major Lower Fraser Watershed stocks, Harrison, Pitt, Cultus, is different, it has different implications. And the other caveat to this, that's always important, and I'm afraid all the questions that I will be asked about all have to be truncated within the characteristic of the time span of this review. So if we talk about the Lower Fraser River, and even if we include some of the areas for habitat or land use changes, agriculture, forestry, those kind of implications, all I've found in those areas were a reduction in the land area for agricultural use.

Q Mm-hmm.

A The reduction in some of the issues in terms of loading for pesticides and herbicides, the

improvement of regulatory structures in some of those areas. So it's a relative expression, again, and it has nothing, in my view, the larger view, in terms of what the real degradation of those habitats over time has been.

Q Okay.

A If that helps with that explanation. I'm sorry to be longwinded.

Q No, no, that's helpful. I guess where I'm going is that you mention on page 41, and I think looking under "Significance of potential interactions" you do say in the third bullet:

> There are risks of water quality impacts due to over application of manure, fertilizer application and other activities, erosion and runoff in the lower Fraser watersheds.

I would say this also applies to the Lower Fraser River, as well, would you agree?

A I would agree that the Lower Fraser River is the conduit and final receiving area of some of this outflow.

Q Mm-hmm.

A The characteristics of dilution, which is the number one use of freshwater, is as dilution, is very high, given the timing and characteristics of the Fraser River discharge at that time. So I am not sure on how to fully apply it. I've made an assumption series that you've questioned here, in terms of geographic overlap and magnitude and interaction and the duration, and I think those are still fairly consistent.

It is and has implications, as you pointed out, to river-type Harrison sockeye and I don't have the answer in terms of the potential interactions there.

Q And but would you agree that if Dr. Beamish is correct that that number of river-type sockeye is closer to nine percent in the last few years, it's not really fair to say that the magnitude of interaction and duration of interaction in the Lower Fraser River for those sockeye would be considered to be nil, particularly when as you say in your fourth bullet under "Significance of potential interactions", your assumption here is that the:

...duration is brief adjacent to agricultural lands because of rapid outmigration of sockeye in areas near agriculture activity.

That's not the case with respect to these river-type sockeye salmon; isn't that right?

A That is undoubtedly true for the river-type sockeye, but I still have not got knowledge on the proportions or percentage of composition of young fish of river-type origin, and the way that Figure 23 in Dr. Beamish's paper clarifies this, he includes Weaver Creek, Harrison of other forms of Harrison type river sockeye, as part of his discussion, and it's quite clear that Weaver Creek don't rear in off-channels and sloughs in the lower Fraser. They move into Harrison Lake proper. So there's lots of unknowns to this.

Q Mm-hmm.

A It would be a very interesting area to explore and define and develop better. There are obviously implications on everything that we do on the landscape and the water quality. The saving grace for many of these sockeye are that there's lots of dilution there, there's lots of flow, and they use those sorts of environments.

Q Okay. Thank you for that. I think I'll move on with the time I have to another area of discussion. This is to the residence period in Georgia Strait. I just wanted to explore that with you a little bit.

Actually, perhaps just as a follow-up for the last discussion, and it's more of the same. You've said a few times this morning that the devil is in the details. Would you agree that this foregoing discussion we've had with respect to river-type sockeye salmon and what you've just said about the need clearly for further analysis on this particular subarea of the sockeye population, again I guess perhaps reveal some of the limitations of a report such as yours that when you allocate a risk level, it necessarily needs to be a bit of a generalization over the entirety of the stock of the species of sockeye salmon, would you agree?

A I would agree that the scope we were given was at a population level --

Q All right.

A -- or scope to define the characteristics of the issues.
Q Yes. And so for assessing the risk of a specific habitat or a specific stock or species, that assessment may be, for lack of a better term, diluted when included in a larger study sample, and this is perhaps a good example of that.
A Cultus Lake is a good example of it.
Q Yes, exactly. So would you agree that a more detailed and focused study of specific sockeye habitats, or particular sockeye stocks like Cultus Lake, may produce different assessments of the level of risk that you have in your nine or ten potential sources of human or environmental impacts, that if you broke it down and unpacked it, habitat by habitat, stock by stock, it might vary depending on what you're looking at. Does that make sense?
A It's the definition of the Wild Salmon Policy DFO supports and maintains. So absolutely, not because of the Wild Salmon Policy, but the nature of these animals are very, you know, habitat site specific, their behavioural plasticity, their population dynamics are extraordinary. The paper by Daniel Schindler, the 2010 paper, is one of those examples where they talk about this portfolio of opportunities, whether that's diversity and complexity of habitats, whether that's the race and the genetics of it and the phenotypic expression of it, it's the combination. And knowing the devil in those details is the way to understand what's going on in some cases.
Q Thank you for that. Okay. Then I'll get on to my next question. My area of discussion, that's residence periods in Georgia Strait. I'd like to turn to page 20 of your report, bottom of the page. And again I just want to get some more of the context, "Larger sized", this is the last two lines:

> Larger sized sockeye post smolts (juveniles) from the mixed Fraser stock (all upstream sockeye stocks) have a low residence period (<2 days) throughout the Fraser estuary and use a northern --

- let's go onto the next page -

-- migration route through the Strait of Georgia to Queen Charlotte Sound...ranging from 20 to 30 km / day in travel speeds...

So what I'd like to do here is just get a sense of how long these sockeye do live in Georgia Strait. Starting with them leaving the river and going through the estuary, which you say takes less than two days. This is why I was asking you, you know, how do you define geographically what the estuary is.

My understanding is that juvenile smolts exit the river quite rapidly, and again it depends on river flow and wind currents, but they move across the Strait of Georgia quite quickly, as you say, less than two days. Can you maybe just describe a little bit about what you understand is how these juvenile smolts move into the Strait of Georgia and how quickly.

A The Estuary and the Lower Fraser were packaged as one sort of larger habitat --

Q Okay.

A -- for those reasons, because of the tidal mixing and get up past Port Mann and so on. It's the characteristic of that environment. But what we do know, tend to know is with the freshet just about to start this time of year, what we know is there's a large movement of water out of there and it's got a certain discharge and it's got a certain flow rate out, too. And that sockeye as a species use the advantage of that increased discharge to move. That's the nature of this smaller animal is they use currents, flow, anything that they can to move, move quickly.

And so the literature that we support in Appendix 3, which is the reason we wrote that that way, and then the Maps 3 and 4, in all their complexity and all the citations that go with them, articulate a larger model that suggests that these things leave in large pulses out of watersheds, out of Harrison Lake or out of Chilko or out of Quesnel, or any of those locations, leave in large pulses and ride these currents out and do that quickly. And dependent on the size of the flow, dependent on the size of the discharge, depending on the size of the animal, they will have, you know, a different kind of travel speed.

The indication in the literature say somewhere between 20 and 30 kilometres a day in terms of travel speeds.

Q Okay. And I just wanted to follow up on the implications of that. But first of all, you mentioned your Appendix 3, so you do talk about this a bit more specifically there. If you go to page 12 of the report, please, at the bottom of the page. "Strait of Georgia - Rearing and Migration Habitats". And I'll just read these three lines and the top of the next page:

> With entry into the Strait of Georgia from the Lower Fraser River, sockeye smolts rapidly transition off-shore to clearer, more saline waters of the Strait of Georgia beyond the area of turbidity originating from the Fraser River discharge and plume...

This is what you've said earlier at page 20 of your report. Over on the next page:

> Barraclough and Phillips...found sockeye smolts transition more rapidly to the ocean environment than any of the other species of salmon. Smolts moved quickly out into the Strait of Georgia...

Now, what I'm interested to know is how quickly they transition out of the Strait of Georgia into the open ocean. And in particular would it be fair to say that first of all, going at a rate of 20 to 30 kilometres a day, and I've seen different rates of speed, what would be the length of time that most smolts will stay in the Strait of Georgia? How much residence time are we talking about here for most juveniles?

A Mid June, late June at the most, depends on the surface currents.

Q Mm-hmm.

A Peterman did a very nice study on modelling the effects of surface currents and prevailing winds and the characteristics of those things, and suggested that that transition can move very rapidly. Now, his results were predicated and based on lots of work by Cees Groot, Ken Cooke, even Carl Haegele in the herring work that I

described this morning, and catches, and lots of lots of catches and certainly it's been updated. And just to end that comment, it should be revised and updated again. in terms of the research and methodology and thoughts behind it, so...

Q Okay. Well, actually, and I wanted to take you to an article by is it -- I have it as C. Groot, this is Tab 7 of Canada's list of documents, and you said Chris Groot, did you say?

A Cees.

Q Cees, okay. And this is somebody that I believe you've referred to in your bibliography. And it's entitled "Are the Migration of Juvenile and Adult Fraser River Sockeye Salmon in Near-Shore Waters Related?" Without going into the purpose of this abstract, I just was interested in page 59 of the article, and that is some six pages in. Yes.

At the very top left where it says "Sockeye salmon smolts", and this is where I think some of his research comes in:

> Sockeye salmon smolts seem to migrate rapidly through the Strait of Georgia. The distance from the Fraser River mouth to the northern part of the Strait is about 200 km. The migration of smolts from the Fraser River into the Strait of Georgia ended in late May... By the end of June most of these fish had left the Strait...which suggests that they take about one month to travel from the river mouth to the northern part of the Strait. Thus, the smolts need to travel at a rate of 6-7 km/d to cover the distance through the Strait of Georgia.

And then at the bottom of that very paragraph it says:

> In general, young sockeye salmon are not seen for very long in inshore waters and it is inferred that they move seaward rather quickly...

So Professor Groot in this one says that they move around six or seven kilometres a day. Your research suggests 20 to 30 kilometres. But would you agree that at least for some of the juveniles

they're in the Strait for about a month after they leave the river?
A I certainly would agree that they're in there for about a month, and it's wholly, apparently wholly dependent upon prevailing winds and surface currents. If you've ever sailed a boat through the Strait of Georgia, you know when your keel catches a current, a surface current that moves you in some direction. These animals are very sophisticated in their approaches for this, and I think they would take courses of most direct. Some of the estimates that we provided, it's a very gross range, and I'll give it, and it's not my own research. This is a review.
Q Mm-hmm.
A This is work by POST and David Welch and some of the tagging experiments that they've done, some of the modelling experiments that again Randall Peterman and others have done, and lots of other empirical observations beyond the '82, '83 and '84 time series that Cees talks about here in his paper. So, yes, it's fully unknown about the characteristics and I think we explore that in lots of rigor. This is a compilation, as you'll see, of lots of information. And this isn't so many times that this kind of -- you get an opportunity to do this sort of review, and so it's comprehensive and it's not exact. And it needs to be followed up by some rigour.
MR. EAST: Okay. And, well, first of all, maybe I should mark this article as an exhibit.
THE REGISTRAR: Exhibit 739.

EXHIBIT 739: Groot & Cooke, Are the Migrations of Juvenile and Adult Fraser River Sockeye Salmon (*Oncorhynchus nerka*) in Near-Shore Waters Related? 1987

MR. EAST:
Q And as you say, or seem to infer, there's lots to learn about the nature of migration patterns, the juveniles, and if I suggest that perhaps not all juveniles, juvenile sockeye smolts, exit the Strait of Georgia as rapidly as is suggested by this article, or by other sources, that some actually do linger in the Strait of Georgia for some time, would you agree?

A I expand on that discussion in a bunch of different ways, and that makes the topic of Map 4 and Maps 12 and parts of the report much more poignant. So I think it's a very important area of discussion.

Q Okay, great, maybe we'll just talk a little bit about that. Page 20, I think is one of the first perhaps, I want to say exceptions, but I guess complexities when it comes to the residence time of sockeye in the Strait of Georgia. We're again going back to the river-type sockeye. When they do go into the Strait of Georgia, as you've said here, and this is again the full paragraph at the very bottom of the page, starting with "River-type sockeye aged 0+". If you get into the middle it says, where it talks about:

> The Harrison river-type sockeye fry are small sized and migrate slowly out of the Fraser River and estuary across the Strait of Georgia to use rearing habitats around the southern Gulf Islands for a residence period of 4 to 6 months.

So again you have this kind of different group of sockeye salmon, the numbers of which may be more than less than one percent, that are staying in the Strait of Georgia for longer than say one month, perhaps behaving differently than some of the other juvenile sockeye smolts that go into the Strait of Georgia, would you agree?

A I would agree that a small fraction of the entire sockeye population stays within the Strait of Georgia to some extent, and those areas appear to be the more southern areas, more closely associated with the Strait of Juan de Fuca.

Q I'd like to take you back then to Dr. Beamish's paper at Tab 3, it's Exhibit 738, and he talks about this in his paper. If we can go to page 49, page 56 in Ringtail, of this paper. Under the heading -- sorry, page 49, the previous page. Thank you. So under the heading "Gulf Islands surveys and sockeye salmon catches", he says here that:

> The Gulf Islands area has traditionally been a major rearing area for juvenile sockeye

salmon. In 2008 and 2009, we surveyed the area using the trawl net and using a purse seine with a small mesh bunt. Results are reported to show that many more juvenile sockeye salmon moved into the Gulf Islands area in June to July 2008 than in 2009, indicating that the movements of juvenile sockeye salmon within the Strait of Georgia differ among years. There also is evidence that in some years juvenile sockeye salmon are resident for about a month in the Gulf Islands area.

And I note here that in the next line, when he's talking about his "Trawl surveys" and the dates on which they're undertaken, he says:

In 2008, the CPUE --

- I think that's "catch per unit effort", I believe -

-- of lake-type, juvenile sockeye salmon in the Gulf Islands in June and in the Strait of Georgia in July was similar, but the lengths were larger...

So in this analysis he's not talking about the river-type sockeye. He's talking about lake-type sockeye spending time in the Gulf Islands; is that correct?

A I do not know the answer to that.

Q Okay.

A I'm not sure. When I look at Figure 2 of his report, then I see the kind of timing and overlap for the sorts of things that have been done there. And I'm not sure, lake-type juvenile sockeye indicated by size, it very well may be. Again, my earlier point of when you have, let's say, 100 million of these animals moving out through this area, a CPUE of 50 fish is not an extensive amount of animals. If you were to take that and expand that by the surface area caught, as people do, and indicate the population size, you know, what fraction would that represent of the entire population.

So I'm sure that Dr. Beamish has got these

characteristics correct and that they show trends and appropriate measures, but, you know, I don't know how it characterizes against the entire population.

Q Okay, fair enough. Fair enough. Maybe I'll -- I just want to take you to the next page, page 50, and it's more of the same, and I just want to put this to you for your comment. The last part of the page, starting "In 2009", middle of the paragraph:

> In 2009, the average lengths of the fish from the purse seine were smaller compared to those collected in the trawl study about 22 days later... This is evidence that the fish had grown an average of 8 mm over these 22 days and that these juvenile sockeye salmon most likely were resident in the Gulf Islands over this period. Although we cannot prove that the same fish remained in the Gulf Islands for about a month, it is the most likely explanation and an important observation because it shows that some juvenile sockeye salmon will remain in the Strait of Georgia and not migrate quickly out of the strait.

And I don't want to put words in your mouth, but based on your last answer, you suggest that we just don't know what percentage these "some juvenile sockeye salmon" are of the total.

A That's a perfectly plausible explanation. I don't see anything wrong with it. But again it represents what is the trend in these animals, what are they doing, and what is tending to control their production and characteristics.

THE COMMISSIONER: We'll take the break, Mr. East.

THE REGISTRAR: The hearing will now recess for ten minutes.

(PROCEEDINGS ADJOURNED FOR AFTERNOON RECESS)
(PROCEEDINGS RECONVENED)

THE REGISTRAR: The hearing is now resumed.

MR. EAST: Mr. Commissioner, Mark East continuing his cross-examination. Mr. Registrar reminded me that I neglected to mark as an exhibit Tab Number 4 of

Canada's list of documents. This is the article by Levings, et al, entitled, Distribution and Feeding of Juvenile Pacific Salmon in Freshwater Tidal Creeks of the Lower Fraser River, British Columbia. I'd like to have that marked as an exhibit.

THE REGISTRAR: Exhibit number 740.

EXHIBIT 740: Distribution and Feeding of Juvenile Pacific Salmon in Freshwater Tidal Creeks of the Lower Fraser River, BC, by Levings, Boyle and Whitehouse, dated 1995

CROSS-EXAMINATION BY MR. EAST, continuing:

Q Mr. Johannes, I know this has been a long day, so I'll -- in the time I have left I'll probably just focus on one remaining subject matter. And I had just finished asking you a bunch of questions about the time in which juvenile smolts reside in the Strait of Georgia. And perhaps the reason I'm asking this will become clear if we go to page -- I believe it's page 48 of your report. So I wanted to ask you some questions about the area of your report where you talk about contaminants.

I'm interested, in particular, and this is, again, with contaminants, and you look under the heading of essential Georgia Strait, Strait of Georgia, Northern Strait of Georgia and Juan de Fuca Straits, that you identified a magnitude and duration of interaction with contaminants as being nil.

And I just want to put it to you that obviously the magnitude and duration of interaction would depend on a number of factors, but one of them would be the residence time of the juvenile sockeye in question in the Strait of Georgia; would you agree?

A Yes.

Q So if there are, and we haven't come on a percentage number or a totality of the number of juvenile sockeye that reside or linger in the Strait of Georgia, but to the extent that they do linger in the Strait of Georgia, they would be, theoretically, at least, exposed to any contaminants that exist in that environment?

A Theoretically exposed? They live in the water,

the contaminants presumably are in the water and the sediments, then the answer would be yes, they're theoretically exposed to those things.

Q Well, let me put it this way: Not theoretically, perhaps, in your opinion, and based on what you've stated here, is it your view that the risk of contamination from contaminants to juvenile sockeye in the Strait of Georgia is nil, as is stated in this report?

A Relative to the period before 1990, the change is nil.

Q So that the change is nil but the total effect -- I'm talking about as between the period 1990 to 2010 the risks of impact by contaminants on juvenile sockeye in the Strait of Georgia, is it nil or is it some other ranking or is it some kind of higher ranking.

A This is an interesting area of discussion and I don't want to belabour the point, either, but, I mean, this ranking is associated with a couple of things: one, shut down of a number of pulp mills; two, enhanced regulatory structures that impose strict guidelines on discharges from lots of effluents, and other industries and other approaches; three, sockeye don't feed in those areas that contaminants are regularly deposited.

When you go to any Dr. Johannessen's work or Dr. deBruyn's work, which I cite, or Dr. Elliott's work, when they start to look at in the surface water column, in those areas that planktivorous sockeye feed, they're not encountering those things that move through the food web at really very high, if not perceptible, levels. And whether that potential interaction is causing a decline of the population level, I've ranked that nil.

Q As nil. Well, I'd like to explore that a bit further, then. Perhaps we can go to page -- let's get into this issue of contaminants a bit more fully, recognizing that there is going to be another report on contaminants, I think PER #2, in a month's time. Because of this table, I think we should spend a little bit of time on it in the time we have remaining. Perhaps you could go to page 61 of your report. And I think my friend, Mr. McGowan, has actually already referred you to this. This is in the first paragraph, midway

down, and this is consistent with what you've just said:

> Contaminants in the Strait of Georgia show a general improvement over time, with decreases associated with effluent regulation and improved treatment in recent years. For example, upgrades and efficiencies in the sewage collection and treatment systems in Metro Vancouver have taken place over the period of study.

And then I want to look closely at the next sentence:

> Some contaminants are under either control (PBDE) or study (personal care and pharmaceutical products).

And now, also now going to page 35 of your report, I want to zero in on these latter two types of contaminants. And this would be at the second paragraph -- sorry, the first full paragraph where it says, "In contrast". So here you're talking -- previously you've talked about some of the improvements in -- or decreases in contaminants in the environment, and then in this paragraph you say:

> In contrast, there appears to be an increase in polybrominated --

- and I'm going to butcher this -

> -- diphenylethers (PBDEs) --

- I hope I've got that right -

> -- associated with increased use over the past decade or two and an apparent increase in contaminants associated with personal care and pharmaceutical products. The production and use of PBDEs has been banned in Canada and several other countries, but they are still present in fabrics (curtains, furniture, carpeting) and electronics. These substances have been identified as having a

similar combination of persistence, potential for bioaccumulation and toxicity that drew attention to the issue of PCBs...

I just want to explore that a little bit, and maybe I can just ask you this. If you could maybe just describe for Mr. Commissioner what PBDEs are and why they are considered to be a chemical of concern to the point where you discuss them in your report? And maybe it would be helpful to go to Map 13-A while we talk about this. And that's on page M-29, Map 29.

Well, maybe I'll just, while we're waiting for the map, I'll just ask you, Dr. Johannes, maybe just describe a bit, what are PBDEs, and I've heard the term "endocrine disrupters" and that they're similar to PCBs. Perhaps you could just help us out a little bit by explaining what you understand PBDEs are and what they do -- can do to the environment?

A I am not at all expert in this area.

Q Okay.

A Mr. Macdonald certainly will develop that discussion a lot. I relied on colleagues in Golder to help support some of that information and we truly use this as an indicator of change rather than a substantive stressor within the environment that have an accumulation. That said, the part that I will render in terms of understanding is there is a sedimentation rate that's associated with discharges, and again, Dr. Johannessen and Dr. deBruyn well articulate what that looks like and the association to those sediments, and Dr. deBruyn, Adrian deBruyn, is the paper I cite, speaks a lot about accumulation in mussels and then accumulation and changes in different trophic levels.

The association that we've made is the attempt to say, one, sockeye are not benthivores animals, and with limited association to that sort of contaminant; two, the work by most of the authors that suggest where that contaminant, whether it's a legacy contaminant or not, is being deposited is not a clear and direct association with the interaction of sockeye habitat use. And I just talk about the regulatory structure that's been imposed on the changes in those things, and I

look for Mr. Macdonald's chapter on this whole subject matter to be resolving of some of this issue.

Q And as you say, we'll probably get into this in more detail in PER #2 later on. But I just wanted to talk a little bit about this, because -- and then come back to your ranking of risk on page 48. But looking at the chart on the left side of this map 13-A, I'm struck by this trend in the -- as I think you've kind of summarized in your report between some of the chemicals, which we call -- sometimes I think they're called legacy chemicals, the leads, the PCBs, mercury and others that seemed to peak in 1970 and have been in decline ever since with increased regulation and waste remediation, it seems; would you agree with that? That's that last -- essentially the trends that are being shown on this map, and I think you discuss that in your report?

A This is a redrawn figure from Dr. Johannessen's work, yes.

Q Okay. And you can see that PCBs, one of the concerns with PCBs is their persistence in the environment. Although they're declining over time, they're still relatively significant, and they don't break down, is my understanding, very easily, anyway?

A That's my understanding.

Q They're persistent, that's one of the aspects of it. Of importance and the two kind of exceptions, perhaps, that you identified are the green bar, which is PBDEs, which are similar to PCBs, I understand, and there's also personal care products and pharmaceuticals. Now, those are products as you -- they seem to be on quite a significant increase.

And one of the comments you make, and I think, again it's on page 35, is that perhaps one of the reasons why there's such a significant increase in personal care products and pharmaceuticals, is because they've been only recently being monitored, so it's increase by discovery, I think is the term you used; is that fair?

A That is one hypothesis --

Q Hypothesis.

A -- for where they are now, that's for sure.

Q Wouldn't another hypothesis be, I mean, if you're looking at the 20-year timeframe for your report study, and as you point out, I think it was like 150 percent increase in population in the lower -- or the Greater Vancouver area in that time period. Assuming, and I don't know if it's safe to assume this, but assuming that people's use of personal care products and pharmaceuticals over that time stays the same, with an increase in population you would have a corresponding increase in the deposit of personal care products and pharmaceuticals into the environment; is that a common sense hypothesis, I suppose?

A A deposit into the environment is only associated with the six outflows of the wastewater treatment plants, specifically the large volume ones. And as one of the articles that you, in fact, pointed out to me, again by Dr. Johannessen --

Q Mm-hmm.

A -- I've cited Johannessen, Macdonald, Wright, et cetera, they point out the outfall of Iona as being one of the larger deposition areas, and that's associated with the sludge of wastewater treatment. So again, it's not a large distribution into the environment, it's a sediment benthic deposition into the environment. And that's a bit of the premise that I've used.

Q Okay. And that's, I guess, one of the key points, and we'll get into this, I think, later on, but my understanding is that most wastewater treatment plants were designed to filter out chemicals such as, they call them, BODs - I'll have to remind myself what BOD stands for - but BODs or TSSs are the other one, but they're not designed, necessarily, to filter out personal care products or hair care products, that's not what they're designed to filter out in the outfalls; would you agree with that?

A As a primary treatment system, they are not designed for that; as a secondary treatment system and tertiary treatment systems, which the wastewater treatment plants in the Lower Fraser are being articulated towards, there is a development of that pathway. But the primary treatment, like Iona, certainly doesn't deal with those issues.

BOD is biological oxygen demand.

Q Thank you.
A And total suspended solids.
Q And those are traditionally what the wastewater treatment plants are designed to filter out, but not necessarily these, what we call, endocrine-disrupting products that you would see in personal hair care products, pharmaceuticals or, for example, the PBDEs that you would get flame-retardant chemicals and some of these different types of chemicals that mimic or are very similar to PCBs. They're not necessarily what waste treatment plants are designed to filter out?
A Yes, I would generally agree with that, but I don't know what the information suggests in terms of the treatment wastewater, what it looks like. They're not necessarily monitoring through metro Vancouver for those distinct products just yet.
Q Okay. Well, I just want to actually take you to, I think it's, the Johannessen article we just talked about and you just referred to. It's in Tab 2 of Canada's list of documents, and I think it's an author's personal copy, but it's actually -- or it's reproduced from the web, but it's a journal called, Marine Environmental Research. Would you agree it's a peer-reviewed journal?
A Yes.
Q And if you look at page 2 of that, Mr. Registrar, the next page. The title of the article is Joined by geochemistry, divided by history: PCBs and PBDEs in Strait of Georgia sediments. I just want to read some things from the first couple paragraphs in the introduction. First of all, he introduces what they are.

> Polychlorinated biphenyls (PCBs) and polybrominated diphenyl ethers (PBDEs) are persistent, toxic, bioaccumulative, manufactured chemicals that are widely distributed in the environment...

By bioaccumulative, I mean that I understand that these are chemicals that don't necessarily breakdown in the environment but they pass up the food chain. So they may be consumed progressively by fish and then marine mammals and higher up the food change, ultimately to the animals that are at the top of the food chain, like killer whales, for

example. That would be an example of a bioaccumulative chemical; is that your understanding?

A I think there's subtleties in all those things, but yes.

Q Okay. And maybe down near the bottom, the last sentence of that first paragraph:

> Despite their having been banned about 30 years ago, PCBs continue to cycle in marine and terrestrial ecosystems, where they still present health threats, especially to high trophic level, long-lived animals like killer whales,

And that's what we just talked about. Next line:

> PBDEs are more recent arrivals, used primarily as flame retardants on household goods, including furniture and electronics,

talks about their production in the next line, and then I want to go to the last line on that page:

> PBDEs appeared in the marine environment in the late 1970s and have been increasing in concentration ever since. They have been measured in sediment, water and marine organisms.

So would you agree that from this statement, according to Dr. Johannessen, PBDEs are, you know, up until now, anyway, have been increasing in the environment?

A Have been increasing in the environment?

Q Increasing in the environment.

A Yes, and it certainly is reminiscent on Figure 6 in her citation that you just talked about.

Q Okay. And then at the last -- I just want to go to page 10 of the ringtail document, last summary paragraph:

> PBDE emissions are repeating the experience with PCBs such that we are now at the same point reached for PCBs in the late 1960s. PBDE discharge continues to increase and these compounds continue to load into all

compartments of the environment. The experience of PCBs suggest that once the discharge of PBDEs stops, there will be a period of readjustment in the sediments that will change the pattern of surface concentration and exposure of the benthos. Eventually, inorganic sediment will bury the PBDEs, but that will take decades [until] after the end of the discharge.

I guess it's fair to say, based on some of your earlier answers, that simply because we know that PBDEs are increasing in the environment, you need to be able to demonstrate a linkage, I suppose, to that increase in chemicals and consumption by sockeye salmon, and I guess that's where the causal link needs to be determined, we'd want to focus on that; do you agree?

A I would agree the page references and the introduction that Dr. Johannessen provides, Elliott, Ross and some others here, those link to either animals that feed on types of organisms that have a much closer interaction with benthos.

Q And would those animals that have a closer interaction with the benthos, because these chemicals are persistent and bioaccumulative, does it also follow that eventually those chemicals, because they persist, will make their way into the life cycle and the prey of sockeye salmon because of the nature of those chemicals?

A The simple answer is, yes, and there's some work by Bruce Finney, in Alaska, that talks about PCB transfer into the anadromy of a sockeye population back into an environment, and measuring the true accumulation of that kind of effort and transfer is a big question about how it moves and what it does.

Q Well, actually, I wanted to -- first of all, I should mark this article as an exhibit, Dr. Johannessen's article.

THE REGISTRAR: Exhibit 741.

EXHIBIT 741: Marine Environmental Research paper, titled Joined by geochemistry, divided by history: PCBs and PBDEs in Strait of Georgia sediments, by Johannessen, Macdonald, Wright, Burd, Shaw and van Roodselaar, 2008

MR. EAST: Thank you.
Q And the last article I'll take you to, today, Dr. Johannessen (sic), is an article at Tab 1 of Canada's list of documents. Now, it appears the version I have -- and it's in ringtail, ringtail CAN 320005. I understand that this has since been published in an article -- in a journal, called Marine Pollution Bulletin, and it's an article by a number of people whose names you might recognize, Peter Ross being the top of the list, but other names, Sophia Johannessen is another one, Robie Macdonald, some names that we've heard today, and it's called Large and growing environmental reservoirs of Deca-BDE - which I understand is a form of PBDE - present an emerging health risk for fish and marine mammals.

And I just want to take you to some of the conclusions of the authors, if I may. Starting, if you go to page 4 of the article, I want to go to the middle paragraph, the last sentence. It says:

> Recent research has found no evidence of their --

- this is the PBDEs -

> -- debromination and sediments...

I understand "debromination" is another scientific term for breakdown, I suppose, the decomposition of these chemicals? It's probably a gross simplification, but is that what "debromination" means in your understanding?
A I think you could link it to dechlorination.
Q Dechlorination, okay:

> ...they simply persist, and are therefore available to foraging organisms in the surface mixed layer, through which they may re-enter aquatic food webs.
>
> PBDEs have been in the environment for a much shorter time than have PCBs (PBDE manufacture ~from the late 1970s to present; PCB manufacture ~from 1929 to the late 1970s). Consequently, they are often in highest

concentrations near the immediate point of entry into a body of water, often near municipal and industrial outfalls...

And I think this is similar to something that you had said just previously, I hope. I hope I'm not mischaracterizing you:

However, where they have had more time to equilibrate with the environment, and at more remote sites, they seem to be distributed similarly to PCBs. Strong temperature-related gradients have been observed in the concentration of PBDEs in a remote area of the Pyrenees, compared to no such gradients near a current source of PBDEs...Similarly, the relationship between the 10-year accumulation of PBDEs and sediment accumulation rate in the Strait of Georgia, Canada, implies that the distribution is controlled by environmental processes once the PBDEs travel away from the immediate point of entry, and hence, that PBDEs are conserved during transport and burial...BDE-209 --

- which is, I guess, a commercial form of PBDE -

-- contributes about 80 percent of the total PBDE in Strait of Georgia sediments.

In other words, and if I can maybe simplify this, over time, like PCBs, PBDEs, although they originate through certain point sources, will become distributed through the environment, through sediments, but also through the aquatic food web; would you agree with that?

A I would agree that there's, if it's being compared similarly to PCBs, then that's certainly the evidence supported by PCBs. The caveat to that is, again, how these forms of PBDEs are used in the environment and changed. And as I was citing earlier, I have an article in front of me by Dr. deBruyn --

Q Mm-hmm.

A -- who speaks about how mussels uptake some of these ethers and change their structure and form

in terms of how they're distributed and changed. What it relays to me, like the early work on PCBs, is we don't know the whole story. We don't know how they're going to distribute beyond the benthic interface to other animals that use -- just use benthic organisms as food prey, or into the larger water column. But it's, you know, it's going to be a growing area of interest, for sure.

Q And that's something I want to -- that's definitely something I want to return to, as you said, we don't really know when there's something -- there's more that we need to look into.

I just want to finish up with this article and then get to that last point. On page 5, continuing the reading under the heading, Are PBDEs bioaccumulating in aquatic biota:

> Yes, but uptake of the parent BDE-209 congener is limited by particle-binding.

I'm not sure what that means.

> PBDE concentrations are increasing exponentially in fish and marine mammals in Canada's three oceans and other aquatic systems with concentrations in species from some areas doubling as rapidly as every 3-4 years...

Is this something that you've seen before, these kind of statistics?

A Certainly when you read the early work on PCBs it's the same sort of discussion, yes.

Q Okay. And the next page, on page 6, and this is the last thing I want to put into evidence, under the heading, Are PBDEs toxic to aquatic biota? And I think this, again, follows what you just said:

> Yes, but dose-response relationships from many PBD congeners in many aquatic species are at present not well established. PDBs possess endocrine-disrupting properties that may predispose fish, marine mammals, and their offspring to adverse effects...

And I won't ask you again what endocrine-

disrupting properties are, because I think we'll get more evidence about that, later, but I guess the point here is that there's no doubt, or there is concerns - I shouldn't say "no doubt" - there are concerns that PDBs are toxic to aquatic biota; would you agree with that?

A I say everything is toxic to aquatic biota in some concentration and level.

David Schindler, who is the father of Daniel Schindler, did a whole series of work in the Arctic on copepods and PCB accumulations in there. The Pyrenees article -- or the Pyrenees reference as associated with some of the rainbow trout or brook trout kind of references all indicate these types of ecosystems where nutrients and their movement are very, very concentrated and very controlled.

Whether all of those issues relate to the Strait of Georgia or the Lower Fraser and the movement of those types of contaminants into sockeye is a bit of an exercise of research that has to -- well, should be explored. Whether it's a control mechanism or a causality link at the population for sockeye salmon is something that's not supported right now.

Q Okay. So I think this is where -- an area where we probably agree, that this is an area that needs much more research before we can make definitive conclusions on the impacts of PBDEs, on aquatic biota in the Strait of Georgia; would you agree? I mean, I guess -- I think that's what you just said?

A I care about cormorants and killer whales and great blue herons, so I would say that's an area I, personally, would be interested in seeing additional work, so...

Q So can I take you back, then, to page 48, your Table 9, where you talk about contaminated materials, and you talk about the magnitude of interaction and the duration of interaction where you've identified the impacts as nil.

Based on our foregoing discussion and what we've just heard about the nature of PDBs and how they may potentially spread throughout the environment and their uncertain effects, would you say that it's probably unsafe to prescribe a ranking of nil to these rows that talk about

magnitude and duration of interaction, considering that juvenile sockeye live in the Strait of Georgia?

A So referencing back to page 39, where I really tried very carefully to identify the criteria for these rankings.

Q Mm-hmm.

A And again, it's an ordinal, qualitative ranking. I say:

> The nature (physical extent, extent of activity) of the human activities is not like to interact or induce effects on habitats used by sockeye.

I think that still stands in terms of the magnitude of duration and -- or the duration, interaction, the magnitude of interaction for the Strait of Georgia and the northern Strait of Georgia area.

I provide low rankings for the Lower Fraser and the Fraser River estuary for the same reasons that Dr. Johannessen identifies the distribution and outfall from some of the wastewater treatment plants in terms of the accumulation of sediment in some of those areas. Whether that holds true in the future, I'm not sure, but at the present time, given what I've tried to develop here, that's what I've said, I think.

Q When I was being briefed by people involved in this area in preparation for this day, one of the things that was always stressed on this area, especially on this area of contaminants and PBDEs, is this idea that the absence of evidence is not the same thing as the -- as evidence of absence. Did I say that right?

In other words, and I knew I was going to butcher that, because it was such a nice, pithy statement, but we're looking, here, at a situation where there's an absence of evidence, or at least an insufficient -- as we talked about, an insufficient amount of analysis done in this area. Is it -- taking a precautionary approach, is it unsafe to say that because of all the work that needs to be done, as we've just talked about in the areas of contaminants, to suggest that because we have insufficient evidence to show these

linkages between contaminants and sockeye habitat, that that leads us to the conclusion that there isn't any evidence, that the risk is actually nil? Would you agree that that's just an unsafe presumption to make, and an unsafe assumption to make?

A When you apply the term as "nil," meaning zero, nada, nothing, on that suggestion your comment is quite right. When you apply it using the terms of reference that I've attempted to apply in this report, then I still maintain that there is little to no interaction between where sockeye feed and use, because the adults are no longer feeding and the young certainly are feeding on plankton and other kind of organisms, they're not spending time feeding off the bottom, those kind of associations have a limited effect.

And if I were to rank the smoking gun evidence of the association to contaminants, all I can say is I hope Don Macdonald can do a better job explaining the issues and approaches than I can, but there isn't sockeye in the Pyrenees, so part of the issue is, where is it? And you developed this discussion already about PCBs being a moniker for its trend in its evolution in the environment, to some extent, and there has been no strong evidence linking PCBs with changes in population dynamics and structures of sockeye.

That's not to say that eating an amphipod in the environment and a sockeye grabbing that amphipod with PCBs or PBDEs and bringing it back into the watershed is not an opportunity or a possibility. It undoubtedly is. Whether that changes the way they use their habitats, I'm not sure what a sockeye nose is like in terms of smelling or perceiving that part of the environment, but I don't think it's a big issue in the Strait of Georgia where the water is diluted a great deal.

Q Mm-hmm.

A That said, I do give the ranking of low implications for risk of loss and degradation of sockeye habitats associated with the Lower Fraser and the estuary.

THE COMMISSIONER: Mr. East, I note the time.

MR. EAST: I'm actually -- I was just going to leave the last word for Dr. Johannessen (sic), and I've

completed my cross-examination, so we'll stand down.

THE REGISTRAR: Mr. East, you've --

MR. EAST: Oh yes.

THE REGISTRAR: -- referred to Item Number 1. Did you wish to have that marked?

MR. EAST: Yes, please, I'd like to have that marked as an exhibit.

THE REGISTRAR: Yes, that will be marked as Exhibit 742.

EXHIBIT 742: Paper, titled, Large and growing environmental reservoirs of Deca-BDE present an emerging health risk for fish and marine mammals, by Ross, et al

MR. EAST: Thank you.

THE COMMISSIONER: Thank you.

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

(PROCEEDINGS ADJOURNED AT 4:01 P.M. UNTIL TUESDAY, APRIL 19, 2011, AT 10:00 A.M.)

I HEREBY CERTIFY the foregoing to be a true and accurate transcript of the evidence recorded on a sound recording apparatus, transcribed to the best of my skill and ability, and in accordance with applicable standards.

_____

Diane Rochfort

I HEREBY CERTIFY the foregoing to be a true and accurate transcript of the evidence recorded on a sound recording apparatus, transcribed to the best of my skill and ability, and in accordance with applicable standards.

Karen Acaster

I HEREBY CERTIFY the foregoing to be a true and accurate transcript of the evidence recorded on a sound recording apparatus, transcribed to the best of my skill and ability, and in accordance with applicable standards.

Pat Neumann

I HEREBY CERTIFY the foregoing to be a true and accurate transcript of the evidence recorded on a sound recording apparatus, transcribed to the best of my skill and ability, and in accordance with applicable standards.

Karen Hefferland