

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

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701, rue West Georgia
Vancouver (C.-B.)

le mercredi 6 juillet 2011

APPEARANCES / COMPARUTIONS

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Tim Timberg Geneva Grande-McNeill	Government of Canada ("CAN")
Clifton Prowse, Q.C. Heidi Hughes	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")
Alan Blair Shane Hopkins-Utter	B.C. Salmon Farmers Association ("BCSFA")
No appearance	Seafood Producers Association of B.C. ("SPABC")
Gregory McDade, Q.C.	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")
Katrina Pacey	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")
No appearance	West Coast Trollers Area G Association; United Fishermen and Allied Workers' Union ("TWCTUFA")
No appearance	B.C. Wildlife Federation; B.C. Federation of Drift Fishers ("WFFDF")
No appearance	Maa-nulth Treaty Society; Tsawwassen First Nation; Musqueam First Nation ("MTM")
No appearance	Western Central Coast Salish First Nations: Cowichan Tribes and Chemainus First Nation Hwlitsum First Nation and Penelakut Tribe Te'mexw Treaty Association ("WCCSFN")
Brenda Gaertner Crystal Reeves	First Nations Coalition: First Nations Fisheries Council; Aboriginal Caucus of the Fraser River; Aboriginal Fisheries Secretariat; Fraser Valley Aboriginal Fisheries Society; Northern Shuswap Tribal Council; Chehalis Indian Band; Secwepemc Fisheries Commission of the Shuswap Nation Tribal Council; Upper Fraser Fisheries Conservation Alliance; Other Douglas Treaty First Nations who applied together (the Snuneymuxw, Tsartlip and Tsawout); Adams Lake Indian Band; Carrier Sekani Tribal Council; Council of Haida Nation ("FNC")
No appearance	Métis Nation British Columbia ("MNBC")

APPEARANCES / COMPARUTIONS, cont'd.

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

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In chief on qualifications by Ms. Baker

1 Vancouver, B.C./Vancouver
2 (C.-B.)
3 July 6, 2011/le 6 juillet 2011
4

5 THE REGISTRAR: The hearing is now resumed.

6 THE COMMISSIONER: Good morning, Ms. Baker.

7 MS. BAKER: Good morning. So today, Mr. Commissioner,
8 we have -- I'm Wendy Baker for the Commission and
9 Maia Tsurumi. We have two new counsel in the room
10 as well, Katrina Pacey for Area D and B, and
11 behind me is Heidi Hughes for the Province.

12 Today we're dealing with marine ecology in
13 our first three days of our marine theme. We have
14 with us today three doctors. We have Dr. Beamish,
15 Dr. Welch and Dr. McKinnell, who will all be
16 testifying this morning. So Dr. Welch has already
17 been sworn in these proceedings, but Dr. Beamish
18 and Dr. McKinnell need to be sworn.

19 THE COMMISSIONER: You'll need to turn your microphones
20 on, gentlemen, if you could. Just press the
21 button. Thank you very much. Thank you.

22
23 DAVID WELCH, recalled.

24
25 STEWART MCKINNELL, affirmed.

26
27 RICHARD BEAMISH, affirmed.
28

29 THE REGISTRAR: State your name, please.

30 DR. BEAMISH: Richard Beamish.

31 DR. MCKINNELL: Stewart McKinnell.

32 DR. WELCH: David Welch.

33 THE REGISTRAR: Thank you very much.

34 MS. BAKER: Thank you. Mr. Commissioner, I'm going to
35 have all three of these gentlemen qualified as
36 experts and I'll do that first with all three, and
37 then I'll begin my questions with Dr. McKinnell.
38

39 EXAMINATION IN CHIEF ON QUALIFICATIONS BY MS. BAKER:
40

41 Q So starting in that order with Dr. McKinnell,
42 first of all, your c.v. is in Tab 7 of the
43 Commission's list of documents. I'll just get you
44 to identify that's your c.v.?

45 DR. MCKINNELL: That's certainly the first page.

46 Q Okay. And we'll take you through a few pages in
47 that c.v. All right, so we can identify that?

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1 DR. McKINNELL: Yes.

2 MS. BAKER: Thanks. I'll have that marked, please.

3 THE REGISTRAR: The next exhibit is 1284.

4

5 EXHIBIT 1284: *Curriculum vitae* of Dr.

6 Stewart McKinnell

7

8 MS. BAKER: Thank you.

9 Q Now, Dr. McKinnell, you have a Ph.D. in Fish
10 Biology?

11 DR. McKINNELL: Correct.

12 Q And reviewing your c.v., you're currently the
13 Deputy Executive Secretary for the North Pacific
14 Marine Science organization also known as PICES?

15 DR. McKINNELL: Yes.

16 Q And you actually began at the head of Scientific
17 Computing with the Pacific Biological Station at
18 the Department of Fisheries and Oceans in 1981?

19 DR. McKINNELL: Yes.

20 Q And you've held positions as a fish biologist
21 since then, first, following your head of
22 Scientific Computing at Pacific Biological
23 Station, you then became the principal
24 investigator of ecosystem effects of large-scale
25 Asian driftnet fisheries at DFO?

26 DR. McKINNELL: Yes.

27 Q And following that, you were the program head for
28 Fisheries Production and Variability at DFO?

29 DR. McKINNELL: Yes.

30 Q And you left DFO in 1999 to move to your current
31 position at PICES?

32 DR. McKINNELL: Yes.

33 Q And over the years, you have done research and
34 presented papers and presentations on a variety of
35 subjects involving marine life in the North
36 Pacific Ocean?

37 DR. McKINNELL: Yes.

38 Q And just to highlight in your c.v., at page 3, I
39 think it is - the pages aren't numbered - next
40 page. You've received research grants studying
41 marine life in the North Pacific which you see
42 there, "Census of Marine Life" grant?

43 DR. McKINNELL: Yes.

44 Q And then just reading down a couple of other
45 highlighted points here, you received from Canada
46 GLOBEC research money to do research on the Gulf
47 of Alaska Zooplankton Intercalibrating the

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- 1 SCOR/NORPAC/Bongo nets?
- 2 DR. McKINNELL: Yes.
- 3 Q And you actually prepared a peer-reviewed
- 4 publication following that research; is that
- 5 right?
- 6 DR. McKINNELL: Yes.
- 7 Q You've also done work on density-dependent growth
- 8 of juvenile Baltic salmon?
- 9 DR. McKINNELL: Yes.
- 10 Q And then flipping through to some of the work that
- 11 you've done - next page, yeah, thank you - you've
- 12 been editor of primary scientific literature on a
- 13 variety of topics relevant to what we're dealing
- 14 with in this inquiry including "Effects of climate
- 15 variability on sub-arctic marine ecosystems"?
- 16 DR. McKINNELL: Yes.
- 17 Q "The ecology of juvenile salmon in the Northeast
- 18 Pacific Ocean"?
- 19 DR. McKINNELL: Yes.
- 20 Q I won't read them all, but I'll move forward to
- 21 the next page which sets out some of your peer-
- 22 reviewed articles and book chapters. You have
- 23 written on dynamics of marine ecosystems, which is
- 24 the first paper listed under peer-reviewed
- 25 articles?
- 26 DR. McKINNELL: Yes.
- 27 Q And the next one, Fraser River sockeye salmon and
- 28 climate, a re-analysis that avoids an undesirable
- 29 property of Ricker's curve?
- 30 DR. McKINNELL: Yes.
- 31 Q The fifth one seems particularly relevant, the
- 32 ocean ecology of salmon in the northeast Pacific
- 33 Ocean, and of course your c.v. goes on for many
- 34 more pages which I'm not going to review.
- 35 MS. BAKER: Mr. Commissioner, I'd like to have Dr.
- 36 McKinnell qualified as an expert in salmon biology
- 37 and marine ecology with a particular expertise in
- 38 the Pacific Ocean including the Gulf of Alaska.
- 39 THE COMMISSIONER: Yes. Thank you very much, Ms.
- 40 Baker.
- 41 MS. BAKER: I'm going to move now to Dr. Beamish, and
- 42 I'll move to Canada's list of documents for this
- 43 c.v. It should be at Tab 11 of Canada's list of
- 44 documents. Thank you. Again this is a multi-page
- 45 document.
- 46 Q Dr. Beamish, you recognize this as your c.v.?
- 47 DR. BEAMISH: Yes, I think so.

4

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1 DR. BEAMISH: Okay. I'll have that marked, please.

2 THE REGISTRAR: That would be Exhibit 1285.

3

4 EXHIBIT 1285: *Curriculum vitae* of Dr.
5 Richard Beamish

6

7 MS. BAKER: Thank you.

8 Q And just quickly reviewing your c.v., you've got a
9 Ph.D. in zoology, and I take it in fisheries?

10 DR. BEAMISH: Yes.

11 Q And you have a long career as a fisheries
12 biologist, particularly with the Department of
13 Fisheries and Oceans?

14 DR. BEAMISH: Yes.

15 Q You started at the Pacific Biological Station in
16 Nanaimo in 1974?

17 DR. BEAMISH: I think so, yes.

18 Q All right. And you've been there ever since; is
19 that right?

20 DR. BEAMISH: I started with DFO, though, earlier than
21 that.

22 Q But you've been with PBS in Nanaimo since '74?

23 DR. BEAMISH: Yes.

24 Q And you've received a number of R.E. Foerster
25 awards for outstanding scientific publications?

26 DR. BEAMISH: Yes.

27 Q You've also been awarded the Prix d'Excellence by
28 Fisheries and Oceans for your contributions in
29 fishery science; is that right?

30 DR. BEAMISH: Yes.

31 Q And that's been awarded a number of times
32 including in 2008 and 2009?

33 DR. BEAMISH: Sorry, I couldn't hear you.

34 Q That's been awarded a number of times including --

35 DR. BEAMISH: Yes, yeah.

36 Q -- 2008 and 2009?

37 DR. BEAMISH: Yes.

38 Q And your work as a fisheries biologist has been
39 looking at Pacific salmon generally for the most
40 part; is that right?

41 DR. BEAMISH: No, I've done a lot of things including
42 working on acid rain, and I worked on groundfish
43 for a number of years, and am recently working on
44 salmon.

45 Q Okay. And when you look at salmon, you've been
46 looking at Pacific salmon as a whole, including
47 coho, chinook, chum and other species?

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1 DR. BEAMISH: Yes.

2 Q And you have a couple of publications that deal
3 with sockeye, but most of your publications where
4 they deal with salmon would be more focused on
5 some of those other species like coho or chinook
6 or chum?

7 DR. BEAMISH: That's mostly correct, but I probably
8 have maybe five primary publications on Pacific
9 salmon, and maybe a dozen or more others on --
10 sorry, five papers on sockeye specifically.

11 Q Yes.

12 DR. BEAMISH: Including one in Russia, by the way, in
13 Russian. I didn't write the Russian. And then a
14 bunch of other ones on sockeye too.

15 Q All right. And two of the ones that I've been
16 able to identify that deal with sockeye are on
17 page 9. You can correct me if I'm wrong on this,
18 but the sixth article down, which is a publication
19 with you and Sweeting and Neville which is
20 actually called, "Improvement of juvenile Pacific
21 salmon production in a regional ecosystem after
22 the 1998 regime shift," actually does deal with
23 sockeye salmon in that paper; is that right?

24 DR. BEAMISH: Yes.

25 Q Okay. And then on page 14, the fourth paper down,
26 which is a paper you did with Neville and Cass in
27 1997, deals with production of Fraser River
28 sockeye salmon in relation to decadal-scale
29 changes in the climate and ocean?

30 DR. BEAMISH: Yes.

31 Q And, as you said, there are a few others as well
32 that deal specifically with sockeye.

33 DR. BEAMISH: Yes, there's some other ones on sockeye
34 somewhere.

35 MS. BAKER: Okay. Mr. Commissioner, I would like to
36 have Dr. Beamish qualified as an expert in fish
37 biology with particular expertise in factors
38 affecting survival and abundance of fish including
39 climate and oceans.

40 THE COMMISSIONER: Yes. Thank you.

41 MS. BAKER:

42 Q And finally Dr. Welch. Your c.v. is in Tab 2 of
43 the Commission's documents. Do you recognize that
44 as your c.v.?

45 DR. WELCH: Yes, I do.

46 MS. BAKER: I'll have that marked, please.

47 THE REGISTRAR: Exhibit number 1286.

6

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1 MS. BAKER: Thank you.

2

3

EXHIBIT 1286: *Curriculum vitae* of Dr. David
Welch

4

5

6

MS. BAKER:

7

Q Dr. Welch, you have a Ph.D. in Fisheries,
Oceanography; is that right?

8

9

DR. WELCH: Correct.

10

Q And you also have received the Prix d'Excellence
from Department of Fisheries and Oceans a number
of times?

11

12

DR. WELCH: Prix d'Excellence once.

13

14

Q Pardon?

15

DR. WELCH: Prix d'Excellence was once.

16

Q Oh. And one is the Prix de Distinction.

17

DR. WELCH: Correct.

18

Q Thank you. And you've also received the R.E.
Foerster Award for outstanding scientific
publications?

19

20

DR. WELCH: Yes.

21

22

Q A number of times. And at page 4 of 4, you've
given us a redacted version of your c.v. which
just set out the most relevant publications to the
work we're doing here today, and those
publications are set out on the screen there at
page 4.

23

24

25

26

27

DR. WELCH: Correct.

28

29

Q And they include your paper, "Thermal limits and
ocean migration of sockeye salmon, long-term
consequences of global warming," is the first one.
"Early ocean survival and comparative marine
movements of hatchery and wild juvenile steelhead
as determined by acoustic array; Queen Charlotte
Strait," correct?

30

31

32

33

34

35

DR. WELCH: Correct.

36

37

Q All right. And next one, "Survival of migrating
salmon smolts in large rivers with and without
dams."

38

39

DR. WELCH: Correct.

40

41

Q "Experimental measurements of hydrosystem-induced
mortality in juvenile Snake River spring chinook
salmon using a large-scale acoustic array."

42

43

DR. WELCH: Correct.

44

45

Q And the last one I'll just identify, "Freshwater
and marine migration and survival of endangered
Cultus Lake sockeye smolts using POST, a large-

46

47

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1 scale acoustic telemetry array."

2 DR. WELCH: Correct.

3 MS. BAKER: All right, thank you. Mr. Commissioner, I
4 would like to have Dr. Welch qualified as an
5 expert in fish biology, fisheries oceanography and
6 acoustic telemetry with particular expertise in
7 Pacific salmon.

8 THE COMMISSIONER: Yes. Thank you, Ms. Baker.

9 MS. BAKER: Thank you. All right. Now I'd like to
10 return to Dr. McKinnell.

11

12 EXAMINATION IN CHIEF BY MS. BAKER:

13

14 Q Dr. McKinnell, you have prepared a technical
15 report for the Commission of Inquiry which is
16 described as "Technical Report 4, The Decline of
17 Fraser River Sockeye Salmon in Relation to Marine
18 Ecology".

19 DR. McKINNELLS: Yes.

20 MS. BAKER: Could I have Technical Report 4 pulled up,
21 please?

22 DR. McKINNELLS: Just for clarification, it was a report
23 generated by the North Pacific Marine Science
24 Organization where I was the lead author, one of
25 several.

26 MS. BAKER:

27 Q All right, thank you. I'm going to take you to
28 the c.v.'s of the other authors once we get this
29 on the screen.

30 MR. LUNN: It's not listed on the Commission's list of
31 documents, is it?

32 MS. BAKER: Technical Report 4?

33 MR. LUNN: (Indiscernible - not at microphone).

34 MS. BAKER: It's possible.

35 MR. LUNN: I'll need just a moment just to get that for
36 you.

37 MS. BAKER: Sure, okay, no problem. While you're
38 getting that up on the screen, I can at least
39 identify the authors. Is that going to cause you
40 a complication if I ask you to go to c.v.'s while
41 you're trying to do what it is you're doing?

42 MS. TSURUMI: It's number 3 on our list.

43 MR. LUNN: There we go. I don't think this is it.

44 Yes, it is.

45 MS. TSURUMI: It's not in colour.

46 MR. LUNN: I'll get a colour one for you while we're...

47 MS. BAKER: Okay. All right, thank you.

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8
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1 Q So the authors of this report -- as you said,
2 you're the lead author, but the other authors are
3 Enrique -- I'm going to butcher his name I think.

4 DR. McKINNELL: Curchitser.

5 MS. BAKER: Thank you. Cornelius Groot - I'll butcher
6 the next name as well - Masahide Kaeriyama, and
7 Katherine Myers. And those c.v.'s, just to
8 identify them for the record and mark them, Tab 8
9 is the c.v. of Enrique Curchister (sic) -- that's
10 not correct, I know how I pronounced it, but...

11 Q We can pull number 8 up so you can just identify
12 that as his c.v.

13 DR. McKINNELL: Yes, looks like it.

14 MS. BAKER: All right. I'll have that marked, please.

15 THE REGISTRAR: Exhibit number 1287.

16

17 EXHIBIT 1287: *Curriculum vitae* of Enrique
18 Curchitser

19

20 MS. BAKER:

21 Q And the next, Tab 9, is a biography of Cornelius
22 deGroot (sic); is that correct?

23 DR. McKINNELL: Yes.

24 MS. BAKER: All right. I'll have that marked, please.

25 THE REGISTRAR: Exhibit 1288.

26

27 EXHIBIT 1288: Biography of Cornelius Groot

28

29 MS. BAKER:

30 Q And next tab, Tab 10, is the c.v. of Professor
31 Kaeriyama.

32 DR. McKINNELL: Yes.

33 MS. BAKER: Thank you. I'll have that marked.

34 THE REGISTRAR: Exhibit 1289.

35

36 EXHIBIT 1289: *Curriculum vitae* of Masahide
37 Kaeriyama

38

39 DR. BEAMISH: Thank you.

40 Q And then Tab 12 is the c.v. of Katherine Myers; is
41 that right?

42 DR. McKINNELL: Yes.

43 DR. BEAMISH: Okay. I'll have that marked, please.

44 THE REGISTRAR: Exhibit 1290.

45

46 EXHIBIT 1290: *Curriculum vitae* of Katherine
47 Myers

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1 MS. BAKER: Thank you. I won't take the time to go
2 through those c.v.'s but they are the c.v.'s of
3 the co-authors of this report.

4 Q Because you're the first witness today, I'm going
5 to ask you to just set some background information
6 for us just to set the stage for what we're going
7 to be talking about. We're talking about the
8 marine environment for sockeye salmon in the
9 Fraser River and I'd just like you to identify
10 some of the areas that we're going to be talking
11 about today.

12 If you could turn to Tab 37, which is
13 actually Exhibit 2 in these proceedings.

14 MR. LUNN: I have multiple documents for Exhibit 2.
15 There's a Powerpoint --

16 MS. BAKER: It's a Powerpoint.

17 MR. LUNN: Okay.

18 MS. BAKER: And it --

19 MR. LUNN: Oh, I see. The others are supplementary.

20 MS. BAKER: Okay. So if you could turn to page 4 of
21 that Powerpoint?

22 DR. WELCH: Ms. Baker, that's the wrong presentation.
23 That's mine from --

24 MS. BAKER: That's right. That's what I want to go to.
25 I just want to go to the map on page -- maybe it's
26 the next page, page 5. I have it as 4 but it
27 could be 5. There. All right, yes.

28 Q So this was presented in evidence by Dr. Welch in
29 October, but I think it's just useful as an
30 overview to identify the areas we're going to be
31 talking about, so if you could identify for us the
32 main marine habitat areas for sockeye salmon from
33 the Fraser River.

34 DR. MCKINNELL: Sockeye from the Fraser River enter the
35 ocean at Georgia Strait, Strait of Georgia, and
36 emigrate by one of two routes along the
37 continental shelf. They exit either by the Juan
38 de Fuca Strait or via Queen Charlotte Strait,
39 Broughton Archipelago.

40 As far as is known, most of them emigrate via
41 the Queen Charlotte Strait route. Most sampling
42 has found that the juveniles are migrating
43 northward along the continental shelf, which you
44 see is the lighter blue area on this particular
45 figure, through Hecate Strait, up through
46 southeast Alaska and generally have a restricted
47 distribution along that region until they reach

1 Alaska.

2 At least the historical studies, when this
3 was looked at in the 1960s and 1970s, came to the
4 conclusion that as they were migrating westward
5 along the Alaska shelf, they were eventually
6 peeling off into the deeper parts of the North
7 Pacific. The distribution of Fraser sockeye
8 extends approximately to the dateline, 180
9 degrees, and generally is north of about, I would
10 say, 50 degrees north latitude. So they occupy
11 the region in the North Pacific known as the sub-
12 Arctic Pacific. South of that, you have a
13 transition zone into the sub-tropical regions and
14 Fraser sockeye do not go into that region.

15 They spend the next several years -- well,
16 depending on what kind of animal they are -- some
17 of them mature in the following year, they do not
18 migrate as far and they return after one year at
19 sea. Some of them spend one, two and three years
20 at sea. The bulk of Fraser River fish return
21 after two years at sea. They feed in this sub-
22 Arctic part of the Gulf of Alaska.

23 Q Right. If I can just ask you, then, just in terms
24 of the actual areas that we're going to be talking
25 about today, the Strait of Georgia on the map that
26 you see in front of you would go from where the
27 words are printed "Juan de Fuca" up just to where
28 the words are printed, "Johnstone Strait,
29 Discovery Pass"; is that right?

30 DR. MCKINNEL: Yes. I would take it from just south
31 of the Fraser River, Haro Strait, which isn't
32 labelled here, up to, say, Redonda Island which
33 isn't labelled. But Discovery Pass, that would
34 do.

35 Q All right.

36 DR. MCKINNEL: The lower part of Johnstone Strait.

37 Q And then when people talk about Queen Charlotte
38 Strait today, which area are they talking about?

39 DR. MCKINNEL: To be precise, they would be talking
40 about a region that extends from approximately --
41 well, it's hard to describe on this graph, but it
42 would be the upper part of the narrow ocean
43 between Vancouver Island and the Mainland. That's
44 essentially from probably Port McNeill or -- if I
45 had to describe where Queen Charlotte Strait ends,
46 it's probably around Telegraph Cove, if you've
47 ever gone whale-watching up there.

- 1 Q So at the top of the Island, Vancouver Island?
2 DR. McKINNEL: Yes. Queen Charlotte Strait is the
3 region where Vancouver Island and the Mainland
4 start to diverge. They start separating after
5 being in a narrow channel, which is Johnstone
6 Strait, it starts to open into a wider area, and
7 that's Queen Charlotte Strait.
8 Q All right.
9 DR. McKINNEL: And then it opens into Queen Charlotte
10 Sound which is the broader region.
11 Q Okay. That was the next area I wanted to go to.
12 The diagram we have in front of us has Queen
13 Charlotte Sound printed out in the ocean, but
14 that's actually just to the -- where you see the
15 "d" on "Sound", it's the area just above that?
16 DR. McKINNEL: Precisely.
17 Q Okay. And it goes right to the bottom of Haida
18 Gwaii; is that right?
19 DR. McKINNEL: Well, technically I don't know where
20 you would --
21 Q Draw the line?
22 DR. McKINNEL: -- draw the line. But eventually, when
23 you get into the part between -- a strait is a
24 region between two bodies of land, and so Hecate
25 Strait, I would assume, is the part between Haida
26 Gwaii and the Mainland.
27 Q All right. So we often refer to Queen Charlotte
28 Sound and Hecate Strait as sort of this one
29 continuous mass of water from the top of Vancouver
30 Island to the top of Haida Gwaii to --
31 DR. McKINNEL: I mean, certainly the water mass is
32 continuous. The topography differs.
33 Q Okay. Then we also will hear about Dixon
34 Entrance, and is that just at the top of Haida
35 Gwaii?
36 DR. McKINNEL: It is.
37 Q Okay. And then on this diagram, there's a lighter
38 blue that follows the coast and then a darker blue
39 that's more in the ocean. What's the significance
40 of that demarcation?
41 DR. McKINNEL: That's the continental slope. So it's
42 a region where the ocean becomes much, much deeper
43 very quickly over a short period of time.
44 Q All right. And how much is known right now -- and
45 when I talk about this, I don't mean you in
46 particular but just in the science community, how
47 much is known about the length of time sockeye

1 spend in each of the different areas we've just
2 talked about?

3 DR. MCKINNELL: I think that is relatively well-
4 determined. I mean, certainly the recent work
5 that's been done, say, by the Department of
6 Fisheries in the last ten years is getting a much
7 better handle on the juvenile migration out of the
8 Fraser River and poleward along the west coast up
9 through Hecate Strait, Hecate Sound.

10 In general, their findings are not all that
11 different from what was described, say, in the
12 '60s and '70s, but they're getting much better
13 resolution on the timing and the fish stocks
14 involved. So that has been improving.

15 Alaskans are working on the continental shelf
16 off southeast Alaska, and so there's a region
17 there where the sampling of juvenile salmonids has
18 improved. It's done in conjunction with a pollock
19 study that's going on along that area.

20 But as you go around and get later into the
21 season of the juvenile salmon, what you find is
22 that the period between when they are migrating on
23 the continental shelf and the period when they
24 appear in deep water, that's probably one of the
25 least well-known periods of time or areas of
26 migration for these animals, in part because
27 winter sampling is involved.

28 Then there's the period of feeding in the
29 open ocean and, as I say, that can last -- these
30 immature salmon can feed there, for Fraser sockeye
31 generally, two years and return as maturing fish
32 through the sub-Arctic region.

33 Q How much is known generally about how important
34 each of these different habitat areas is to
35 sockeye survival relative to the other?

36 DR. MCKINNELL: Well, that's a good question. In
37 general, the assumption has been that most of the
38 mortality occurs soon after they enter the ocean.
39 But in fact this has rarely been measured for
40 Fraser River sockeye. To estimate the mortality,
41 you need to have a census of abundance at time
42 "x", and then the census of their abundance at
43 time "x plus 1", and to note the difference in the
44 abundance between those two periods. This will
45 vary by stock within the Fraser because each has
46 its own unique characteristics. Those repeated
47 measurements where you have a representative

1 sample of abundance are generally, even throughout
2 their lifespan into adulthood, not available.

3 Q Okay. What about food requirements for sockeye
4 throughout this life cycle that they spend in the
5 marine time, do the food requirements vary for
6 sockeye during their life cycle?

7 DR. McKINNELL: Certainly they vary with season. If
8 you look -- Dr. Beamish did a study on coho salmon
9 where it showed that within Georgia Strait, what
10 everybody was eating in April was pretty much
11 similar between years, and what everybody was
12 eating in September was pretty much similar
13 between years. But the diets changed between the
14 early sampling and the later sampling.

15 The same kind of pattern holds for sockeye.
16 When they leave the Fraser River, they're only
17 large enough to capture certain kinds of prey.
18 Their mouth gape isn't large enough, so they tend
19 to feed on certain kinds of items. But salmon are
20 very opportunistic feeders and so it's not as
21 though if a certain prey is missing, they will
22 spend a lot of time seeking it out. They will
23 choose alternative preys as they're migrating
24 through the ocean.

25 MS. BAKER: In the report that we looked at initially,
26 which is Technical Report 4 - if we can just get
27 that pulled back up - first, I should have this
28 marked as the next exhibit.

29 THE REGISTRAR: Exhibit 1291.

30

31 EXHIBIT 1291: Cohen Commission Technical
32 Report 4 - Marine Ecology - Feb 2011
33

34

34 MS. BAKER:

35

35 Q In this report, you were asked to answer two
36 questions, the first being: Do marine conditions
37 explain the 2009 decline, and secondly, is there
38 evidence of declines in marine productivity or
39 changes in Fraser River sockeye distribution which
40 are associated with declines over the last 15
41 years. Those were the two big questions you were
42 asked.

43

43 DR. McKINNELL: Yes.

44

44 Q All right. So I will get to those questions, but
45 in your report, you go through the state of
46 knowledge of a number of different features of the
47 marine environment over different life cycles, and

1 I just wanted to review some of those overview
2 points before we come back to the questions.

3 So if I can just start in Chapter 2 of your
4 report. It deals with the post-smolt year and
5 looks at migratory routes and timing and speed and
6 things like that, for that year. First of all,
7 what are post-smolts?

8 DR. MCKINNELL: I wanted to have a precise terminology
9 for the period of time or life history stage that
10 I was looking at. So, in this report, what you
11 should be aware of is that most of the juvenile
12 sockeye that rear in nursery lakes in the Fraser
13 watershed go through a process called
14 smoltification. That's a physiological
15 preparation for life in the sea and is part of the
16 package of migration and changing. They're
17 getting their ability to regulate salt balance in
18 the different environments established.

19 So the smolt phase I considered to be the
20 period when, through this process of migrating to
21 the mouth of the Fraser, and then the post-smolt
22 process to be the year they enter the sea, so from
23 the time they enter Georgia Strait through to the
24 end of that calendar year. So in this report,
25 when I refer to a post-smolt, it's after they -
26 post means after - so it's after they've
27 smoltified and entered the sea. I considered that
28 to be the post-smolt phase up to the end of that
29 calendar year.

30 Q So to the end of December.

31 DR. MCKINNELL: Yeah. And from that period, from
32 January 1st, I considered that to be the immature
33 period. So an immature period is the period where
34 they are spending the entire year feeding without
35 maturing.

36 Q Okay. Well, let me stay with the post-smolts --

37 DR. MCKINNELL: Okay.

38 Q -- and then we'll get on to the next ones. I'll
39 just make a note of that there.

40 So when you looked at the post-smolt year
41 phase, you referred to smolt migration timing, and
42 you used Chilko smolts for that analysis. Why did
43 you use Chilko smolts?

44 DR. MCKINNELL: Chilko Lake is one of the few places in
45 the Fraser watershed where the timing of their
46 emigration from the lake and their abundance as
47 they leave the lake is measured - or at least

1 estimated - and so this has become rather common
2 practice to use the only substantially long time
3 series, and that's Chilko Lake, so I used that.

4 I also used it because in 2010, at least for
5 some of the timing work, acoustic tags were being
6 placed on this Chilko Lake fish, or at least the
7 larger ones as they were emigrating out of the
8 lake. So going over the arrays that Dr. Welch is
9 involved with, you were able to determine exact
10 times for at least the tagged fish.

11 Q Okay. I don't want to get bogged down in too many
12 details because your report is very clear, but I
13 just wanted to -- and then we have talked about
14 some of this already -- but when you look at the
15 post-smolt time of life, what is understood about
16 the migration route and the timing of Fraser River
17 sockeye post-smolts?

18 DR. MCKINNELL: Generally what you find is that the
19 post-smolts will enter Georgia Strait somewhere
20 around the beginning of May. Certainly there were
21 sockeye in Georgia Strait in late April in some of
22 the sampling that was done in the 1960s. But the
23 bulk of them are coming down into the southern
24 strait in May and they migrate rapidly. Most of
25 them migrate rapidly northward, although I note
26 that in the 1960s there was an abundance of post-
27 smolts in Saanich Inlet even. So the routes
28 northward in Georgia Strait will vary from year to
29 year, at least from the sampling that has been
30 done to date. Dr. Welch could probably provide
31 some more details on that, of what he's found with
32 the tagging.

33 Q Are there any particular stocks within Fraser
34 River sockeye that enter the Strait of Georgia
35 later than May?

36 DR. MCKINNELL: Nobody has ever actually sat off the
37 mouth of the Fraser River watching things come out
38 of it, to my knowledge. But, in general, it's
39 felt that the eco-type that is born in the
40 Harrison River emigrates later because they do not
41 spend a year or two in fresh water. They hatch
42 and emigrate to sea in the same year, a behaviour
43 that's very much like pink or chum salmon.

44 Q All right. And what is known about feeding habits
45 of post-smolts?

46 DR. MCKINNELL: The post-smolt diets, at least such as
47 I was able to find, indicated that if they are in

1 the Strait of Georgia in April, the predominant
2 dietary item was copepod. But there aren't that
3 many sockeye smolts that have been sampled in
4 April. They will eat decapod larvae, larvations,
5 generally small planktonic animals that are in the
6 water column and that will fit in their mouth,
7 small euphausiids. Is that enough?

8 Q That's great. Have there been changes in the
9 available prey for post-smolts, Fraser River post-
10 smolts in the last 15 years?

11 DR. MCKINNELL: I think if we choose to focus on the
12 word "available", I would point out that most
13 sampling of the planktonic environment involves
14 net tows that go from depth to the surface. So
15 they integrate over a water column from the very
16 bottom, or at least from depth up into the
17 surface, where as the sockeye are migrating
18 through a planktonic field that's very near the
19 surface. I believe Dr. Beamish's results indicate
20 that most of the fish are caught in their zero to
21 15-metre layer. Most of the sockeye are caught in
22 the zero to 15-metre layer from his sampling.

23 It's actually rather rare to have plankton
24 that are available to them studied in this way.
25 What you often see are the stomach contents from
26 sampling, so you know what they picked. You know
27 what went into their stomach, but you don't
28 necessarily know what the available prey field
29 was.

30 Q Okay. And have there been changes in what's been
31 observed over the last approximately 15 years?

32 DR. MCKINNELL: I would say yes, based on my
33 discussions with planktologists who are looking at
34 this region. In fact, it would be a surprise that
35 there haven't been changes in some sense. The
36 plankton community is very, on orders of
37 magnitude, differences (sic). But there are low
38 frequency trends and I know that one of the most
39 common copepods, for instance, is the neocalanus
40 plumchrus. It has been reported to be in lower
41 abundance in recent years than it was
42 historically.

43 But if you go back to the early 1970s, there
44 was a copepod called calanus marshallae that was
45 in quite high abundance during a very cold period
46 back then.

47 Q Okay. In your report at pages 25 to 28, you

1 review the growth of Pacific salmon generally, and
2 there's graphs and tables relating to chinook,
3 chum, coho and pink, but there's nothing directly
4 relating to sockeye salmon, so how is this section
5 relevant to Fraser River sockeye salmon?

6 DR. MCKINNELL: Well, the sockeye would be there if Dr.
7 Beamish had published it in the paper that I
8 extracted this information for. But, at the time,
9 he felt it was difficult to interpret the sockeye
10 data, and so it wasn't published.

11 What I wanted to do in this section was to at
12 least show you how the patterns differ among the
13 years for at least the species that were reported.
14 I also wanted to show in here the uncertainty in
15 the mean values that were reported. In this
16 particular graph that's on page 27, here you see a
17 sampling from 1997 when the Strait of Georgia
18 survey started through to 2002. What was reported
19 in the paper were the individual dots in the
20 middle of those lines, but no indication of how
21 uncertain those mean values were, were presented.
22 But fortunately, a table was prepared that allowed
23 these to be computed.

24 What you can see from the coho table, for
25 example, in the bottom left, is that if you can
26 draw a horizontal line that crosses all of those
27 individual vertical lines, you can say that they
28 are not statistically different, and so in this
29 case, it shows that the mean lengths of the coho
30 that were sampled were not statistically
31 significantly different from '97 to 2002.

32 Whereas you can see that for the chinook plot
33 in the top left, 1997, they were significantly
34 smaller than the ones in 1998. That was the point
35 of including these data was to show the kinds of
36 variability that one could get from these Georgia
37 Strait samples.

38 Q All right. And just how does that relate, then,
39 to Fraser River sockeye?

40 DR. MCKINNELL: Well, in fact there are four different
41 species so we don't know exactly how they relate
42 to Fraser River sockeye. Each species has its own
43 behaviour. It's evolved its own characteristics
44 and feeding habits and has its own diets. So what
45 you could infer from Fraser River sockeye from
46 these plots is not clear.

47 Q Okay. Is the current status of scientific

1 knowledge of post-smolt migration and distribution
2 adequate? Do we know enough or is there still
3 work to be done?

4 DR. MCKINNEL: I would suggest that given the debates
5 we've been having on various topics relating to
6 timing, migration, abundance, that there are still
7 many uncertainties that need to be resolved.

8 Q And the next phase talks about immature sockeye.
9 You've told us the life time that that is
10 referring to in your report, and maybe you can
11 just go through some of the same points. What is
12 known about the distribution and migration routes
13 of immature sockeye?

14 DR. MCKINNEL: As I mentioned before, this is what I
15 considered to be the least well-known life history
16 phases for sockeye, and so there are some things
17 it was possible to understand from the high sea
18 sampling in the 1960s and 1970s. But I think one
19 of the things that becomes very evident when you
20 look at this data is that the immature fish on the
21 high seas have been under-sampled. And there are
22 challenges to sampling. I know Dr. Welch here was
23 involved in some winter cruises to go out and look
24 at the immature phase in the Gulf of Alaska, and
25 had tremendous difficulties finding them with the
26 gear that they were using.

27 Likewise, the Japanese vessels have taken
28 winter cruises looking for immature fish and found
29 remarkably few using the gears that they're
30 currently using.

31 So my view is that the life history of
32 immatures is not well determined. There have
33 been, at least when the early diet studies were
34 done, there was evidence that the diets of the
35 immature fish were considerably different from the
36 diets of the maturing fish that were out there.
37 They also found, from the tagging data that's been
38 done, that the immature fish tended to have an
39 average distribution which was further south than
40 the maturing fish.

41 But this might be a consequence of the
42 maturing fish having to get home. Because once
43 you start maturing, you have to undertake your
44 homeward migrations and so the extent to which the
45 immature fish have a true distribution in winter
46 that's different from the maturing fish is not
47 clear in my mind.

1 Q Are density-dependent effects possible for
2 immature Fraser River sockeye?

3 DR. MCKINNELL: At that stage, it's hard to determine
4 exactly, because density-dependence, first, is the
5 idea that animals are affected by their own
6 abundance. So in my report, I have identified
7 intra-specific density dependence and inter-
8 specific density dependence. Intra-specific means
9 that sockeye abundance affects the sockeye growth
10 or survival. Inter-specific means that the
11 abundance of other species affects the sockeye
12 size and survival and growth.

13 This has been shown for Bristol Bay sockeye,
14 for Alaskan sockeye, that the abundance, the very
15 high abundance of pink salmon from eastern Russia
16 has an effect on the growth of the sockeye from
17 Bristol Bay.

18 I'm not sure of any studies on immature
19 Fraser River sockeye where that's been looked at.
20 One of the difficulties is that nobody has
21 measured what the immature abundance is. If you
22 don't know the immature abundance, then how can
23 you know if it has an effect on the immature
24 stage?

25 Q Is climate change a feature that could have an
26 impact on immature Fraser River sockeye?

27 DR. MCKINNELL: Absolutely, but I would not want to
28 guess whether it would be positive or negative at
29 this stage without doing some research.

30 Q Okay. What kinds of effects could be seen?

31 DR. MCKINNELL: Well, for instance, one of the things I
32 want to first express on the climate change issue
33 is that you've probably heard of the IPCC analysis
34 and the projections of future climate and those
35 sorts of works that have been done for which Nobel
36 Prizes were awarded, and there is currently an
37 assessment going on now.

38 What you find in these global climate
39 assessments is that regional representations --
40 there are difficulties representing the finer
41 scale climate, say, within British Columbia or the
42 Gulf of Alaska, and that you find variability
43 among the different models. So I wouldn't be
44 comfortable, first off, saying that I know what
45 climate changes will occur in British Columbia and
46 what the response of the marine ecosystem will be
47 in the northeast Pacific, because I don't think

1 the models are yet at the stage where they can
2 accurately get the places, the precipitations
3 right, and those sorts of things.

4 And so one can imagine that if you're an
5 immature sockeye in the Gulf of Alaska and that
6 the climate change allows perhaps for an earlier
7 timing of the spring bloom, that the spring bloom
8 is a period in the ocean when there's
9 productivity, biological productivity, food
10 available, you can imagine that that might improve
11 the growth of sockeye.

12 On the other hand, if the climate change
13 increases the winds and delays the spring bloom
14 and keeps the region cold with lower food
15 abundance, that that potentially might have a
16 negative effect. So I would say that this is an
17 academically interesting topic right now.

18 Q Is it an area that requires further research and
19 understanding?

20 DR. MCKINNELL: If you want a better answer from me, I
21 think it does.

22 Q Does the scientific community have more
23 information on that or does the scientific
24 community need more research to be done on that
25 issue, on climate change and impacts in the time
26 frame that these immature sockeye are in the
27 marine environment.

28 DR. MCKINNELL: Well, my impression is that climate
29 effects seem to dominate our discussion of the
30 biology of salmon. It's interesting that we don't
31 talk so much -- in the scientific community, we
32 don't talk so much about fishing or other effects
33 that could affect the salmon. But maybe that's
34 just the group I'm involved in. The focus of the
35 research is trying to understand these climate
36 variability effects on survival and growth.

37 Q So it is important.

38 DR. MCKINNELL: Absolutely.

39 Q All right. And is it your view that further work
40 -- well, let me just ask it this way: Is the
41 current state of scientific knowledge as to the
42 impacts of survival of immature sockeye adequate
43 at present, or do we need to do more work in that
44 area as well?

45 DR. MCKINNELL: Well, "adequate" is kind of a value
46 judgment. If the interest is in improving our
47 understanding, then I would say, no, it's not

1 adequate.

2 Q I'd like to move to maturing sockeye, so that's in
3 Chapter 4 of your report. Just continuing that
4 line of questioning, what's known about the
5 distribution of maturing sockeye and what's the
6 time frame, I guess, of their life that you are
7 referring to when you talk about maturing sockeye.

8 DR. MCKINNELL: Yes. As I said before, the immature
9 phase on the high seas can last one, two, and some
10 cases - rarely - three years for sockeye salmon.
11 Let's just focus on the fish that return after two
12 years at sea. So after their one immature year,
13 it's my understanding that the go/no go on
14 maturity is established in the winter preceding
15 the year they will mature. So a physiological
16 decision would have been made in the fish that
17 it's time to mature and time to come home.
18 There's a genetic component to this and there's a
19 growth component to this.

20 From that stage on, the maturing fish have a
21 different life from the immature fish. They have
22 to find enough food to put on -- probably 50
23 percent of their weight is put on in that last
24 spring at sea. So there's a huge energetic demand
25 on the maturing fish that does not exist for the
26 immature fish, because they have to be able to
27 have enough resources to get from the Gulf of
28 Alaska to fresh water, to swim up the rivers, to
29 mate and produce gametes and everything that goes
30 along with maturation. That's an energy
31 intensive-process.

32 So they end up with different behaviours as a
33 consequence of this. The one that we notice the
34 most is the migration behaviour, because we see
35 them start moving closer to the coast and the
36 fisheries take advantage of that when they get to
37 the coast.

38 Q And what do we know about their feeding? You say
39 that they have this energetic demand. Do we
40 actually know what they're eating during that life
41 phase?

42 DR. MCKINNELL: The studies that I've seen so far
43 indicate that the prey item that's found perhaps
44 most commonly, at least in the southern part of
45 their range, is a small squid. It's energetically
46 rich and tends, if you look at page 53 - this is
47 the contribution by Masahide Kaeriyama - where you

1 can see one colour tends -- this is sampling of
2 stomach contents in sockeye on the high seas. One
3 colour tends to dominate all the years from 1958
4 through to the present. That's the fraction of
5 small squid. So you can see in this particular
6 image, there is a very high fraction of the small
7 squids there in the diet.

8 Although I would point out that the Fisheries
9 Research Board sampling in the Gulf of Alaska in
10 the 1950s - you see the 1958 data there - if you
11 actually look at what they found in the northern
12 Gulf of Alaska, they found higher fractions of
13 fishes in the diets. It was in the more southerly
14 regions in the Gulf of Alaska where they found
15 these high concentrations of squid. This is what
16 Masahide Kaeriyama has found with his work here.

17 Q Okay. The next section in your report following
18 the table you just took us through are the next
19 two sections over, it's called "Trends" and it
20 looks at growth size. You say, on page 57
21 underneath the heading, "4.3.2 Trends" that --
22 first of all, you're describing trends in the mean
23 size of Fraser River sockeye in relation to
24 increasing sea surface temperatures and you say
25 that "there is a significant low-frequency
26 variability in mean size." What is that referring
27 to?

28 DR. McKINNEL: If you could go to the previous page --
29 Q Where there's a table, Figure 35?

30 DR. McKINNEL: It's a figure, yeah, Figure 35. Here,
31 each panel represents a different age class. I
32 believe the top one is the fish that return after
33 one year. The middle panel is the most common
34 one; these are fish that return after two years.
35 The bottom panel is fish that return after three
36 years at sea.

37 When I say "low-frequency variability", what
38 you'll notice is each - let's just go to the very
39 top one - there are a series of about 16 trend
40 lines through that figure, and those represent the
41 trends of these stocks over on the right-hand side
42 and these have been measured on the spawning
43 grounds.

44 So what you see is that by a low-frequency
45 trend, I mean a trend that doesn't change very
46 quickly. So generally you see the length anomaly
47 on the "y" axis. It represents the number of

1 centimetres higher than the long-term average or
2 lower than the long-term average. So, as we go
3 along, most of those lengths prior to the mid
4 1970s are above the average, and then there was an
5 abrupt shift to sizes below average. In recent
6 years, these trends have started to come back up.
7 So low frequency is the idea that you have slowly
8 varying changes in mean length in this case.

9 Q All right. And just going back to the paragraph I
10 was reading from earlier, you identified that
11 there had been this downward trend and you say
12 that it was from '52 to '93, there was a decrease
13 in mean size. Then you're now seeing that
14 starting to go up since '93?

15 DR. MCKINNELL: Yes. The mean size has started to
16 increase. You look at most of those trend lines,
17 it wasn't back up to a zero anomaly, but it was
18 increasing.

19 Q What's the significance of that?

20 DR. MCKINNELL: The significance of that is smaller
21 sockeye tend to have smaller eggs. In general,
22 large size is said to confer on an individual
23 better fitness, and fitness in the sense that your
24 genes will survive because you are more robust.
25 So I guess, in part, it's one of the long-term
26 implications of sea surface temperature is that it
27 does affect the biology of the spawning fish that
28 are coming back to spawn.

29 Q Was there a corresponding change in sea surface
30 temperature, then, from '83 to the present?

31 DR. MCKINNELL: Yeah, if you look at Figure 36 on page
32 58, this is a map that shows the correlation
33 between sea surface temperature and the grand mean
34 size of all the sockeye that were coming back to
35 the Fraser. This is essentially a look at how sea
36 surface temperature and the overall mean length
37 varies from year to year. The reason I chose
38 only from 1993 to 2007 was because this was after
39 the period when Dr. Cox and Hinch had found that
40 there was this kind of relationship, I wanted to
41 take the more recent data and say what kind of
42 correlations do we see.

43 Anywhere where it's blue or purple in this
44 plot means that increasing temperature means
45 decreasing size. So what you see, this
46 relationship, because we have a grid of
47 temperatures available through time over the Gulf

1 of Alaska, you can make these comparisons from
2 year to year. So if the Gulf of Alaska gets
3 warmer, the sockeye get smaller.

4 Q Okay. That's pretty simple. We can probably
5 understand that concept.

6 You next, in this section dealing with
7 maturing sockeye, again deal with the density-
8 dependent issue, again inter and intra-specific.
9 What are the issues, I guess, with respect to
10 density-dependent growth in maturing sockeye?
11 What has been observed and what does it tell us?

12 DR. MCKINNELL: Yeah. Most of the studies of density-
13 dependent growth in sockeye have identified that
14 it is the year when the fish mature has the
15 greatest effect on the mean size of the fish that
16 return. So I've just previously talked about the
17 influence of sea surface temperature. There's
18 also another effect which is the abundance of the
19 fish. When the abundance of the fish is high,
20 their mean size tends to be low.

21 When this effect occurs seems to be in the
22 last year at sea in the year that they are
23 maturing. Because two fish from the same brood
24 year that return in different years, their mean
25 sizes are not correlated, but two fish from
26 different brood years that return at the same
27 size, their sizes are correlated.

28 Q You said "when they return at the same size". You
29 meant return in the same year?

30 DR. MCKINNELL: Sorry, yeah, when they return in the
31 same year. So the dominant effect is the
32 abundance in the year when they mature. That's
33 when the density-dependent growth is in evidence,
34 and it's been in evidence -- well, I put the quote
35 up here on the screen here. Charles Gilbert
36 thought of this in 1914, or at least wrote about
37 it. The first studies on this were done in 1980.
38 Don Rogers reported this.

39 Q And is there a difference between inter-specific
40 effects or inter-species effects and intra-species
41 effects?

42 DR. MCKINNELL: Absolutely. So then we have to look at
43 the effects on Fraser River sockeye, how are they
44 affected by the abundance of other species? I'm
45 aware of studies in Bristol Bay where there's an
46 apparent effect, but I can't recall whether that's
47 an effect on maturing Fraser River sockeye,

1 whether there's an inter-specific effect on Fraser
2 sockeye.

3 Q Is this an area that requires further analysis,
4 further work?

5 DR. MCKINNELL: Actually, this should be -- it may have
6 been done. It would surprise me if it hadn't been
7 done, but I just can't recall an example right
8 now.

9 Q Is there a better understanding of the maturing
10 phase of sockeye salmon that, for example, the
11 immature phase where you said there was very
12 little understanding of that phase?

13 DR. MCKINNELL: If I -- yes, I would say yes, and I
14 would say yes simply because the maturing fish
15 were more vulnerable to the gear. They're the
16 animals that are caught in fisheries and they're
17 the animals that escape to the rivers. So I would
18 say we know quite a bit more about them than we do
19 about the immature fish.

20 Q Right. Is it an area that requires further
21 research or have we --

22 DR. MCKINNELL: I think you have to have a specific
23 question. If you have a good question, then I
24 think, yes, we need to do more research.

25 Q Okay. The next section of your report deals with
26 survival, which is Chapter 5. First of all, how
27 is survival currently assessed for Fraser River
28 sockeye? For example, is it assessed for total
29 survival, total returns or survival with respect
30 to different life stages?

31 DR. MCKINNELL: It's my understanding that there's a
32 variety of methods used to assess survival in
33 Fraser River sockeye. I mean, there are many,
34 many populations. The most common one is what
35 I've called here "Total Survival", which is a
36 census of the population when they are spawning,
37 and a census of the population when you see the
38 children of that spawning return. So then you get
39 a sense - based on some assumptions about how many
40 eggs were produced - you get a sense of what the
41 survival through their whole life cycle was.
42 That's the most common method of estimating
43 survival in sockeye.

44 Q All right. And does that kind of total survival
45 assessment allow us to understand the different
46 life stage impacts on survival?

47 DR. MCKINNELL: Absolutely not. The point is that if

- 1 you want to understand -- survival is a change in
2 abundance in a period of time. Right now, you
3 have the period of time is one complete
4 generation. If you actually want to understand
5 where survival is being affected, you need to
6 census the population at different periods in
7 time. This is the example with the Chilko fish
8 where they census the population of smolts leaving
9 the lake. So all of the mortality in the lake has
10 occurred and you see what is leaving the lake. So
11 it's one of the few populations where you get this
12 intermediate value. But, in fact, that isn't
13 adequate to partition it even finer.
- 14 Q All right. And what would be needed to allow that
15 further partitioning?
- 16 DR. MCKINNELL: Well, let me say that when I had my
17 chapter out for review, one of the reviewers said
18 you in fact have no estimates of marine survival,
19 which is in fact true because, to get that, you
20 would have to census the population at the mouth
21 of the Fraser River.
- 22 What we have is a census of Chilko fish
23 anyway at the outlet to the river. It's much more
24 convenient to do it there.
- 25 Q So if you had a census at the mouth of the Fraser,
26 that would allow you at least to have --
- 27 DR. MCKINNELL: It would at least allow you an honest
28 partition between the freshwater survival and the
29 marine survival. But you need to do it by stock.
30 You cannot just take a collection of genetically
31 different animals, put them in a pool and assume
32 that they share common characteristics. You need
33 to understand stock-specific abundances.
- 34 Q Could that be done with sampling at the mouth of
35 the Fraser?
- 36 DR. MCKINNELL: In theory.
- 37 Q And then what about the other phases? We've been
38 talking about post-smolt, immature and maturing.
39 Do we need to further partition --
- 40 DR. MCKINNELL: Well, one of the debates that has gone
41 on for at least a year now is about whether there
42 was additional mortality in Georgia Strait or not.
43 One way to solve that problem would be to have a
44 census at the exit to George Strait, and then one
45 would know what came out and what didn't come out.
46 Part of this has been done. I would say it's
47 a pilot study by Dr. Welch's tagging work with his

1 colleagues, but I don't think that would be
2 adequate for an assessment of the kind we're
3 talking about.

4 Q But that would still only help us understand what
5 happened in the Strait of Georgia. It still
6 wouldn't help us understand the next two phases.

7 DR. MCKINNELL: Absolutely.

8 Q Okay.

9 DR. MCKINNELL: So then you'd have to look at
10 establishing a way of censusing the Fraser
11 population perhaps as it migrated along the
12 continental shelf. One of the challenges to that
13 is you don't know where exactly they come off the
14 shelf, so you might have fish swimming off the
15 shelf that you interpret as a reduced population
16 size, but in fact they're just leaking off the
17 continental shelf where you assume that they're
18 living.

19 Q Just maybe the last question before the break.
20 When you looked at what information you had
21 available for this section, you did look at
22 survival of Chilko in fresh water versus the
23 ocean. What did you find when you did that
24 assessment?

25 Sorry, if I can just stop for a minute, you
26 also looked at the different age classes in Chilko
27 as part of that work. What did you find?

28 DR. MCKINNELL: I was interested because, in general,
29 there's a feeling that larger individuals survive
30 better than smaller individuals, and the older age
31 classes of smolts, the two-year olds, two-year-old
32 smolts from Chilko Lake are larger, on average,
33 than the one-year-old smolts. So this gives an
34 opportunity to -- you almost have a replicate.
35 You can look at what's going on with the older
36 smolts and what's going on with the younger
37 smolts.

38 Certainly one of the things that we found in
39 this report - and I think there's a figure here --

40 Q Is that on page 79?

41 DR. MCKINNELL: Yes, it's Figure 50.

42 Q Page 79.

43 DR. MCKINNELL: Yeah. This graph shows a weak positive
44 correlation between the proportion of one-year-old
45 smolts that eventually survive and the proportion
46 of two-year-old smolts that eventually survive.
47 If they were perfectly correlated, they would lie

1 along a straight line in this graph, but of course
2 they don't. There's lots of scatter.

3 But there tends to be a positive correlation
4 between smolts of different ages that enter the
5 sea in the same year, whereas there is no
6 correlation in the survival between smolts of the
7 same brood year that enter the sea in different
8 years.

9 Q So what does that tell you?

10 DR. MCKINNELL: It tells us that after leaving the
11 lake, the one-year-old and two-year-old smolts
12 tend to experience some of the same environmental
13 characteristics. It says that the environmental
14 characteristics that they experienced after they
15 left the lake were shared commonly.

16 But you can see, because these points don't
17 lie on a nice line, that it's pretty noisy.

18 THE COMMISSIONER: Dr. McKinnell, you may have answered
19 Ms. Baker's question on this, and I may have just
20 missed it. But in terms of taking census, getting
21 a handle on numbers, you talked about Chilko and
22 the reason why Chilko is used. Dr. Welch earlier
23 has addressed, as Dr. Riddell did, the ability to
24 place the tags and the technology around that
25 science at the current time. But is there a more
26 critical stage? In other words, do you have to
27 have reasonably sophisticated census-taking in the
28 freshwater stage - that is, when they leave the
29 rearing lake and head out to sea - before you
30 start focusing on assessment of numbers in Georgia
31 Strait or after Georgia Strait? Is the first
32 critical stage having a sophisticated methodology
33 of assessing numbers as the sockeye leave the
34 rearing lakes and head out to sea?

35 DR. MCKINNELL: If you had suggested having that
36 estimate at the mouth of the Fraser River, I would
37 have agreed with you. Having that estimate as
38 they are leaving the lakes would be better -- if
39 we had more lakes -- certainly the most productive
40 lakes. There are many lakes in the Fraser system
41 that produce sockeye. But certainly to at least
42 have the most productive lakes censused as they're
43 leaving the lake would be good.

44 But it's my understanding that in-river
45 mortality can be quite high, and so just because
46 you saw the fish leave the lake does not
47 necessarily mean that they popped out into Georgia

1 Strait.

2 THE COMMISSIONER: That's why I asked the question of
3 when scientists are trying to get a picture
4 painted of what's going on, is each stage critical
5 to complete that picture, or is it more critical
6 in the marine environment to do the work you're
7 talking about than it is to spend funds in
8 research of this calibre with respect to the
9 freshwater migration of the fish -- out-migration.

10 DR. MCKINNEL: I guess at issue, Commissioner, is
11 where the greatest variability lies, and I think
12 that there's certainly a lot of debate about where
13 that location is. In the ocean environment, you
14 will find that the early marine period is thought
15 to be the time of greatest mortality. But I think
16 there's evidence to suggest that it may not be,
17 and in the absence of a good census, there will be
18 lots of debate and not very many answers.

19 THE COMMISSIONER: And if I could just finish, in
20 layman's terms - and I'm sure Dr. Welch and Dr.
21 Beamish will address this - but you mentioned
22 uncertainties that still exist in the marine
23 environment, and that has been mentioned here
24 frequently by your colleagues in the science
25 field. But if you don't resolve uncertainties in
26 the freshwater environment around the life cycle
27 of the sockeye as it out-migrates, can you ever
28 really tackle other uncertainties, be they in the
29 marine environment or in the in-migration of the
30 sockeye?

31 In other words, do you have to have each of
32 these components reasonably well tested in order
33 to complete your analysis of what is happening at
34 the different life cycles of the sockeye?

35 DR. MCKINNEL: Commissioner, I think that for most
36 Canadians, the life history stage that's of most
37 interest to them is the maturing adult phase when
38 they return to the coast. The ideal census, from
39 a theoretical point of view, is that why count
40 them early on when what you're really interested
41 in is how abundant they are in the final stages?
42 The challenge is that that is technically very
43 difficult at the current time to do that, but the
44 further you get away from the life history stage
45 of your greatest interest, the more variability
46 you will encounter over the period that it takes
47 for them to get there.

1 So that's why I would suggest that the mouth
2 of the Fraser River might be a better place to do
3 it because you've at least accounted for the
4 freshwater mortality in the river. If you did it
5 at the mouth of the entrance to Georgia Strait,
6 say up where it narrows into Johnstone Strait, you
7 would have accounted for the mortality up to that
8 point.

9 So the question is what is your interest?

10 THE COMMISSIONER: Right. Thank you very much.

11 MS. BAKER: Would you like to take the morning break
12 now?

13 THE COMMISSIONER: That would be great. Thank you.

14
15 (PROCEEDINGS ADJOURNED FOR MORNING RECESS)

16 (PROCEEDINGS RECONVENED)

17
18 THE REGISTRAR: The hearing is now resumed.

19 MS. BAKER: Thank you.

20
21 EXAMINATION IN CHIEF BY MS. BAKER, continuing:

22
23 Q Turning to section 5.6.1 of your report, again
24 this is in your "Survival" section. You make a
25 comparison between coho salmon survival, and if
26 you have a look at that, why is that relevant to
27 Fraser River sockeye? Why did you make that
28 comparison?

29 DR. MCKINNELL: This would be coho in the Strait of
30 Georgia and their survival. A few years ago we
31 established a kind of an informal salmon sockeye
32 -- or a salmon forecasting forum. A group of
33 scientists on the West Coast who were interested
34 in looking at the ocean and trying to figure out
35 what it meant for the future returns of adult
36 salmon, and trying to find leading indicators of
37 their survival was the motivation for looking at
38 the survivals of coho salmon in Georgia Strait.

39 Coho smolts and sockeye smolts go to sea in
40 the -- from the same brood year, go to sea in the
41 same year, but the coho return one year earlier.
42 And so you can, if you're collecting the data, you
43 can get an estimate of how the -- how well the
44 coho salmon survived that year. And the advantage
45 there is that they return one early year. You get
46 an estimate of some salmon that went into the
47 ocean environment, spent the winter, and then

1 returned, and you get a sense of their -- of their
2 mortality or survival.

3 And this, the idea that it's a leading
4 indicator, if there's any correlation between the
5 sockeye, in my case I used Chilko sockeye, because
6 that's the marine survival time series. I was
7 interested in the forecasting the marine survival.
8 You can get a leading indicator of what the Chilko
9 survival would be. And the relationship between
10 the coho survival and the Chilko sockeye survival
11 for fish that enter the ocean at the same time is
12 weak, but not -- but not zero. And so I felt that
13 there was some advantage to examining what was
14 happening with the coho.

15 Now, I should point out that there's no
16 particular need to focus on the coho in Georgia
17 Strait, because in fact the survival signal for
18 coho salmon, the year-to-year survivals are quite
19 correlated along the West Coast. What you find is
20 that from Oregon, Puget Sound, Georgia Strait, so
21 the -- whatever it is that's affecting the coho in
22 Georgia Strait, there's an element of that that is
23 shared by a lot of populations of coho on the
24 salmon -- sorry, along the coast.

25 Q Salmon that don't go to the Strait of Georgia.

26 DR. MCKINNELL: Yeah, salmon that don't even go to the
27 Strait of Georgia.

28 Q And on the next page, page 84 of your report, you
29 address forecasts, starting in 2007, that were
30 based on Strait of Georgia surveys. Do you have
31 any views on whether the conditions in the Strait
32 of Georgia can be used to predict sockeye returns?

33 DR. MCKINNELL: The reason I put this in here was just
34 to point out that the several forecasts had been
35 made, and anybody who does forecasting needs to
36 assess the skill of their forecast. And the skill
37 of their forecast is measured by its performance,
38 repeated year after year. And in this particular
39 case, a forecast had been developed from the
40 Strait of Georgia surveys for three years in a
41 row, each year I think perhaps using some
42 different formula. But in two years the forecast
43 was quite wrong and in one year the forecast was
44 quite right. And so I was simply pointing out
45 that that's something that could quite easily
46 occur by chance.

47 Q The next chapter of your report deals with

1 "Oceanography and Climate", and you look at a
2 number of different oceanographic features from
3 the Strait of Georgia through to the Gulf of
4 Alaska. Was your focus in this section to look at
5 -- when reviewing these different features to look
6 for extreme events, or general trends, or both, or
7 something else?

8 DR. MCKINNELL: Because the events of 2009, the low
9 returns were such an extreme event, actually it
10 was more extreme compared to the pre-season
11 forecast than -- but, you know, that certainly
12 brought this to a head. It was an attempt to look
13 at the oceanography and climate of the Northeast
14 Pacific in relation to whether anything like this
15 had been seen previously. And so our approach was
16 to seek out any evidence of extreme observations
17 that would match the relatively extreme low
18 survival for that particular year of sockeye.

19 Q Okay. And then I want to just go through each of
20 the different geographic areas bit by bit.

21 DR. MCKINNELL: Yes.

22 Q So the first geographic area that you talk about
23 is the Strait of Georgia.

24 DR. MCKINNELL: Yes.

25 Q You've already sort of identified the bounds of
26 that today. Were there any extreme events that
27 you saw in the Strait of Georgia in 2007, which
28 would be the relevant year for the 2009 return; is
29 that right?

30 DR. MCKINNELL: Yes. In fact, in any of the figures
31 that I've produced for the Strait of Georgia,
32 looking at whether it was sea surface properties
33 from 75-year-old time series at lighthouses, or
34 recent surveys, oceanographic surveys done in
35 Strait of Georgia, I didn't find any extreme --
36 values that were extreme across the entire length
37 of observations. There were certainly some
38 patterns in Georgia Strait that went along with
39 2007 being a relatively high year of Fraser River
40 discharge, but in fact I think it was -- if you
41 look at the discharge during the peak in 2007, it
42 was something like the 17th highest year peak
43 discharge in the record, which doesn't really
44 constitute an extreme. And then we looked at its
45 influence in the Strait of Georgia at various
46 places where there are other long time series and
47 didn't find extremes. We certainly found that

1 they were not average, but certainly not extreme.
2 Q Now, you talk a little bit about Nanoose
3 hydrography in your report and I wonder if you
4 could explain what that is and why it's relevant,
5 what it told you.

6 DR. MCKINNELL: The Nanoose station is unique in that
7 it gives you a long-term idea of the vertical
8 structure of the ocean in Georgia Strait. And so
9 since about 1972 -- no, '79, '78 it allows,
10 because it's done relatively frequently by the
11 Department of National Defence and augmented by
12 observations from DFO, it allows you a chance to
13 look at the vertical structure of the ocean, which
14 you do not get from many of the surface properties
15 that are measured at lighthouses and other
16 locations.

17 Q And what did the Nanoose hydrography tell you?

18 DR. MCKINNELL: We looked at the surface, the density
19 of the water column in the surface and found that
20 -- that was the thing that we were most interested
21 in, in the springtime was there anything anomalous
22 about the density layer of the surface water, and
23 we did not find anything.

24 Q And what does that mean to sockeye, density layer
25 of surface water?

26 DR. MCKINNELL: Ah, yes. Yes. Well, it's associated
27 with something that's known as the mixed layer.
28 The mixed layer of an ocean is a region that has
29 common water properties, and it separates from the
30 deeper water as a consequence of salinity.
31 Decreasing salinity, or increasing heat will cause
32 the upper layer of the ocean to stop mixing with
33 the deeper parts of the ocean.

34 Q And do we need the layers to mix? Is there some
35 significance to a mixing of these layers?

36 DR. MCKINNELL: It is significant if one of two things
37 happens. One is if the mixed layer prevents the
38 supply of nutrients for plankton growth from
39 reaching the euphotic zone, the region of the
40 water column that has light, and where plankton,
41 phytoplankton can grow. And so if the mixed layer
42 is much deeper than the euphotic zone, the
43 phytoplankton cells mix down into the dark areas
44 where they don't -- they can't reproduce, or they
45 can't create the fixed carbon that becomes part of
46 the base of the food chain.

47 The other consequence of a mix of -- reason

1 for paying attention to a mixed layer is if as a
2 consequence of a mixed layer being relatively
3 shallow, it gets much warmer. You realize that if
4 the ocean is mixing to depth, if you've ever been
5 swimming in a lake, you stick your toes deeper
6 into the water and you feel that cold down below.
7 Well, the idea is that this -- the winds will mix
8 this cold water up and -- but if you -- if you
9 create a density layer, a much lighter surface
10 layer, the atmospheric temperatures, you know, the
11 heat from the day or will restrict the depth of
12 the circulation of the ocean, such that only the
13 top of it gets the heat. And so you can, as a
14 consequence of that, in extreme cases, you end up
15 with sea surface temperatures that are undesirable
16 for sockeye salmon.

17 And certainly what is known about Fraser
18 River sockeye with some certainty is that years
19 when the surface layer is warm, are years when
20 they enter the ocean, are years when the survival
21 tends to be worse. And years when the ocean is
22 cold, tend to be years when the survival is
23 better.

24 Q Now, we will be dealing with four reports that
25 were prepared by -- well, Dr. Beamish wasn't the
26 lead off on all of them, but he was an author on
27 all of them. And one of them is a paper by Dr.
28 Thomson and Beamish, which we're going to get to
29 later, but let me just identify it now so we know
30 what we're talking about. And that you'll find
31 that in the Commission's document book at Tab 14.
32 So I won't mark this now, but I'll just -- just so
33 that the Commissioner knows what we were talking
34 about, we'll come back to this when Dr. Beamish is
35 answering my questions. But this is a paper
36 that's been prepared by Dr. Thomson, and you've
37 read this report?

38 DR. MCKINNELL: Yes. I believe this is an unpublished
39 manuscript that was --

40 Q That's right.

41 DR. MCKINNELL: -- but I have gone through it, yes.

42 Q And Dr. Thomson et al, they actually estimate a
43 different mixed layer depth at Nanoose than you
44 do. Do you have any comment on that?

45 DR. MCKINNELL: Yeah, my comment is that I didn't
46 actually estimate the mixed layer depth at
47 Nanoose. There are many ways of doing this and

1 Dr. Thomson has his own particular method, but
2 it's not in common use as far as I know. There
3 are other methods that are more commonly used.
4 But I didn't -- I didn't estimate the mixed layer
5 depth.

6 Q All right. So how does your work then relate to
7 the work that Dr. Thomson has done?

8 DR. MCKINNELL: Well, probably the best comparison for
9 Nanoose station is that at least I was looking for
10 density differences between two layers, the upper
11 surface layer I picked, I think, for one
12 calculation I tried five metres, and for another
13 calculation I tried ten metres. But the idea that
14 if there's -- to figure out what the difference is
15 between the density below five metres and the
16 density above five metres, by computing the
17 averages above and the averages below, and looking
18 at the delta, the difference, because the delta
19 will give you some indication of how -- how
20 resistant the water column is to mixing. And then
21 I did this across the entire range of years for
22 the time series, and certainly found that in 2007
23 that the difference was relatively high compared
24 to the average of most years. But I also found
25 that other years were -- had similar values.

26 Q And what does that mean, when you say it was
27 relatively high? What does that (indiscernible -
28 overlapping speakers).

29 DR. MCKINNELL: It just means that the water column was
30 more resistant to deeper mixing than -- in 2007
31 than in other years. But it certainly wasn't the
32 most extreme observed in the record. There are
33 other years that were equally -- that had equal
34 kinds of values.

35 Q All right, thank you. And then the next -- you
36 can put that report away for now. Thank you.

37 The next part of your report addresses the
38 coastal Gulf of Alaska. Now, that phrase,
39 "coastal Gulf of Alaska" isn't one that we've
40 really defined yet. So what do you include within
41 the coastal Gulf of Alaska?

42 DR. MCKINNELL: In my definition it's essentially what
43 happens to the fish when they get out of Johnston
44 Strait.

45 Q Until when? Does it include the whole open ocean
46 area?

47 DR. MCKINNELL: For the ocean, for the climate work, I

- 1 was looking mostly at southeast Alaska, from
2 southeast Alaska, northern southeast Alaska down
3 to Johnston Strait.
- 4 Q Kind of the coastal areas, as you've described it,
5 coastal Gulf of Alaska, but not the open ocean.
- 6 DR. MCKINNELL: That's right.
- 7 Q Okay. And were there any trends that you observed
8 in sea surface temperatures from 2005 to 2007,
9 trends or shifts?
- 10 DR. MCKINNELL: Well, let's put it this way. The year
11 2005 was probably one of the warmest years in the
12 surface ocean in the Gulf of Alaska generally in
13 decades. 1997 is a year that comes close, but
14 2005 was an extremely warm surface layer
15 throughout the Gulf of Alaska, including the
16 coastal region. These warm temperatures started
17 to abate in 2006, and between 2005 at the peak and
18 2008, which was one of the coldest years
19 throughout the Gulf of Alaska in probably 35
20 years, there was a transition moving from warmer
21 to cooler through those series of years.
- 22 Q Was there any shifts or any anomalies in sea
23 surface temperature in 2007?
- 24 DR. MCKINNELL: Yes, absolutely. In 2007 one of the
25 analyses I looked at was to say where in the Gulf
26 of Alaska over all time in all years is some of --
27 is an extreme value observed. And for the year
28 2007, the only most extreme values in the time
29 series from 1982 occurred in Queen Charlotte
30 Strait and Queen Charlotte Sound, for sea surface
31 temperature.
- 32 Q And you have those on Figures 69 and 70 on page
33 107?
- 34 DR. MCKINNELL: Yeah, the locations of those are --
35 where is that figure?
- 36 Q Is that page 130? I could be wrong.
- 37 DR. MCKINNELL: Yes, that's right. So this was in 2007
38 the only place in the entire time series with an
39 extreme temperature in the record since 1982
40 occurred in August in this location, in Queen
41 Charlotte Strait/Queen Charlotte Sound.
- 42 Q Right. For the people in the room who may not be
43 familiar with looking at these kinds of
44 diagrams --
- 45 DR. MCKINNELL: Oh, yeah. Okay.
- 46 Q -- maybe you can help us locate where maybe some
47 landmarks are to help us on this.

- 1 DR. MCKINNELL: Yeah, sorry. Now, this is, the plot
2 here, of course, the blue parts are the ocean, the
3 green parts are -- and brown parts are the land,
4 and because the resolution is not so good, and
5 what you see is the shading is the depth of the
6 ocean or the altitude of the land. And the point
7 I'm making is that that -- those three dots over
8 in the right-hand side, yes, are located, are the
9 three -- in the global sea surface temperature
10 time series there is one of the -- a time series
11 for every one degree latitude by one degree
12 longitude block throughout the Gulf of Alaska.
13 And this shows you the three grid points in that
14 whole mesh or sea surface temperature histories
15 where there was an extreme value, and it appeared
16 in the summer of 2007.
- 17 Q And those are, as you say, in Queen Charlotte
18 Strait or Sound?
- 19 DR. MCKINNELL: I would -- the resolution is probably
20 not good enough to distinguish whether Queen
21 Charlotte Strait is included in this or not, but
22 because the sea surface temperatures tend to have
23 a spatial scale, a larger spatial scale, I would
24 say that Queen Charlotte Strait is probably
25 included in this.
- 26 Q And Queen Charlotte Sound.
- 27 DR. MCKINNELL: Yeah. Oh, yeah.
- 28 Q Okay. Now, in the Queen Charlotte Strait or
29 Sound, either of those, were there any anomalies
30 in salinity observed in 2007?
- 31 DR. MCKINNELL: Actually it was these three data points
32 that led to an exploration of how -- how it would
33 be that in a year when the entire Gulf of Alaska
34 was generally supposed to be cold, we ended up
35 with some positive extremes, positive high extreme
36 temperatures in the record. And as I mentioned
37 earlier, one of the ways that you can generate
38 high sea surface temperatures is by having a
39 freshwater layer on top of a -- or at least a less
40 dense layer on top of a more dense deeper layer.
41 And I have a figure in here --
- 42 Q Is it page 107?
- 43 DR. MCKINNELL: We're going back -- so that shows the
44 DFO survey that was going on as this anomaly was
45 building up. It's on page 107, it's the bottom,
46 well, both figures on that page, actually, we
47 could look at. But the bottom one is a survey of

1 average temperatures across Queen Charlotte Sound,
2 and that dot at the bottom of your plot on page
3 107 in the lower panel is 2007. Much, much, much
4 fresher than anything that had been observed
5 during the period before and after.

6 And if you look up at the top panel on that
7 plot, this is a panel showing the salinity
8 measured at Egg Island, which is in the eastern
9 part of Queen Charlotte Sound. So what you see is
10 a much less saline, much fresher layer in the
11 surface than has ever appeared in the record.

12 Q And what does that mean for Fraser River sockeye?

13 DR. MCKINNELL: Well, for Fraser River sockeye, you
14 recall that one of the few things that's known
15 about their inter-annual survivability is that in
16 years when they go to sea in warm -- when it's
17 warm, they do not survive very well. And so here
18 was a region of warmth. For Fraser sockeye, I
19 think it's debateable how this actually affected
20 them, but on the --with the very simple
21 understanding that's around in the scientific
22 community now, I would suggest that that this
23 would just be seen as an unfriendly environment
24 for the fish to be swimming through.

25 Q And did you observe any anomalies in wind
26 patterns?

27 DR. MCKINNELL: In fact, we did. If you take -- and
28 the wind patterns, let's just go to -- okay, this
29 is Figure 72 on page 109. This is -- there is a
30 global dataset that reports on wind speeds on the
31 global basis, but it's possible to focus in on
32 particular regions by picking a grid point in that
33 global grid, and this one is very near Queen
34 Charlotte Sound. And let me explain what you're
35 seeing here. The wind speeds are measured in both
36 east-west direction and the north-south direction.
37 And the tendency is for winter winds to be blowing
38 toward the west from the east. And so the winds
39 that are -- the winds that are blowing toward the
40 east are on the left side of the dashed vertical
41 line. The winds that are on the right side are
42 blowing toward the west, and that's the normal
43 summer pattern.

44 And the normal summer pattern in this part of
45 British Columbia is that in the summer time you
46 get northwest winds with blue skies and, well,
47 maybe not blue skies up there, but at least the

1 wind patterns have this seasonal evolution from
2 north-westerlies in the summer time, to south-
3 easterlies in the winter time. And of course the
4 north-westerlies are associated with transition to
5 spring -- to the spring bloom, spring timing,
6 which other people have found to be an important
7 indicator in Queen Charlotte Sound.

8 So what you see is these are -- these are the
9 points on this graph are from year-to-year
10 averages in June and July of how these wind
11 speeds, the average wind speeds in each year in
12 June and July. And you see that 2007 is
13 identified in that top left corner. So in the
14 entire record of average wind speeds over Queen
15 Charlotte Sound, the most extreme winter-like
16 pattern, and these are southeast winds, or at
17 least not -- yeah, so these tended to be southeast
18 winds, winter-like winds, set up in 2007.

19 Well, one of the things that happens in the
20 northern hemisphere is that southeast winds will
21 retain the water within Queen Charlotte Sound.
22 They will blow water in -- surface waters into the
23 Sound. So you had this high -- this thick layer
24 of freshwater coming off the coastal mountains
25 into Queen Charlotte Sound that was being retained
26 within the Sound by these very anomalous south-
27 easterly winds in 2007. And as a consequence you
28 ended up building up both because of the volume of
29 the discharge coming off the mountains, and the
30 wind patterns, you create the anomaly that we
31 showed you before, which was the very low
32 salinities in the surface layer of Queen
33 Charlotte Sound and Strait.

34 Q Okay. So does it have any additional
35 significance, then, for Fraser River sockeye
36 beyond what you already described, which is that
37 impact on the fresh layer?

38 DR. MCKINNELL: No, I don't think so.

39 Q Okay.

40 DR. MCKINNELL: I mean, just to, you could end up with
41 the plankton community in that surface layer could
42 be different, you know, the animals living in the
43 surface layer that may not like the salinity or
44 avoid the salinity could be their prey, and so
45 there's an issue about how much it changed the
46 food web. But you'd have to have done the tows in
47 that layer to understand.

1 Q All right. And have you seen any changes between
2 the conditions that you observed in 2007, any of
3 the ones you've talked about today, and the
4 conditions in 2008 in Queen Charlotte Sound or
5 Strait?

6 DR. MCKINNELL: If you look on page 111, in the top
7 panel, the top figure, this shows the contrast
8 between 2007 in the upper row, it's July, August,
9 and September, across from left to right, 2007 is
10 in the upper row, 2008 is in the lower row. Blue
11 and purple colours are colder than the long-term
12 average, and yellow and orange colours are warmer
13 than the long-term average.

14 So what you see here is -- let's start with
15 the top left panel, which is July of 2007. The
16 Gulf of Alaska is generally experiencing this
17 cooling trend that I've described before. But for
18 some reason, the coast of British Columbia has
19 this -- has anomalies that are slightly positive,
20 the scale is on just the right of that. So
21 they're up to half a degree, maybe even a bit
22 warmer. The next panel over is August of 2007,
23 and you see how there's a whole coast that's
24 developed these positive sea surface temperatures
25 anomalies while it's remained cold offshore. And
26 then this began to abate in September in the top
27 right panel. So that was the evolution of sea
28 surface anomalies across 2007.

29 Then you look at 2008, the row below it. And
30 it's cold everywhere. Those anomalies are -- so
31 you see the kind of ocean that the fish entered in
32 2008, which ultimately led to the good returns in
33 2010, was markedly different than what they had
34 experienced in 2007.

35 Q All right. Do any of the conditions that you've
36 reviewed with us today indicate a causation
37 between those conditions and sockeye survival,
38 Fraser River sockeye survival?

39 DR. MCKINNELL: No.

40 Q What do they show us?

41 DR. MCKINNELL: This is not -- what we understand is
42 that there's a correlation between these
43 conditions and what we ultimately see.

44 Q So would we require further work to understand it
45 better, to get to that level of understanding
46 causation?

47 DR. MCKINNELL: Yeah.

1 Q Okay. And the last area you talked about, I'm
2 going to go through this one fairly quickly if I
3 can with you, the Gulf of Alaska, in the section
4 which you describe as the Gulf of Alaska, I take
5 it this is the open ocean off the coastline, is
6 that right?

7 DR. MCKINNELL: Yes.

8 Q Okay. And you talk about "Large-scale climate
9 processes", yes, that are at work in the Gulf.
10 Can you just kind of briefly describe what those
11 are and whether there's been -- you described in
12 your report positive and negative phases. So talk
13 about what those are and whether there's been
14 changes in recent years.

15 DR. MCKINNELL: Okay. I think the -- when we consider
16 the oceanography and climate of the Northeast
17 Pacific Ocean, the dominant influence of physical
18 processes is the seasonal cycle, the annual cycle
19 of going from winter to spring through summer.
20 Winter, there's very little food available. There
21 is a very, very deep mixed layer down exceeding
22 100 metres, low productivity, the light levels are
23 low, and then this changes in the spring, as you
24 get the mixed layer shallows, and you get
25 increased light and productivity. So that is --
26 the cause of that is well-known. It's the
27 position of the sun with respect to the equator.
28 So generally people, when they're looking at
29 variability in these large scale processes, they
30 remove that annual effect because they know what
31 causes that annual effect and they look for
32 deviations from the -- from the seasonal means.

33 The next largest common large scale climate
34 process in the North Pacific is associated with
35 the atmospheric forcing through the -- through
36 storms that come through in the winter, they mix
37 up, so they have ability to mix the ocean deeply,
38 which brings up more nutrients. So this, if you
39 look at the time series of climate variability
40 over the 20th Century, one of the things that's
41 been discovered is that there are abrupt shifts in
42 certain years from one phase to another. And
43 1976/'77 there was in fact a general warming of
44 the Northeast Pacific, and these appear in many of
45 the measurements that one might make of the
46 surface ocean properties.

47 So you have a physical system in the North

1 Pacific that is kind of bimodal, by bimodal I mean
2 it takes one of two states, and this is the --
3 this has an influence on our costal ocean. It has
4 an influence over the broad Gulf of Alaska, and so
5 I'll just move on now. So that's one of the major
6 influences is this ability of the climate system
7 to kind of shift from one state to another.

8 Q Is this when we've heard of regime shifts
9 interfering, is that what you're talking about?

10 DR. MCKINNELL: Yeah, this would -- yes. And you see
11 it in both the oceanography and in the atmosphere,
12 because they're a coupled system. The other major
13 influence in the Northeast Pacific of interest to
14 Fraser sockeye is probably the El Niño phenomena,
15 which is a tropical climate system that has extra
16 tropical influences. You know, in El Niño years
17 we tend to get warmer winters, we get sea surface
18 height elevations along the coast, which are
19 caused by enhanced storm activity in the Gulf of
20 Alaska. So those are probably -- the annual
21 regime shifts and the El Niño are the three
22 dominant large-scale forcings in the Pacific.

23 Q All right. And were there any significant
24 temperature shifts as a result of any of these in
25 2007 or '08 that may have affected Fraser River
26 sockeye?

27 DR. MCKINNELL: Well, certainly the winter of 2006 and
28 2007 there was a remarkable climate phenomena that
29 hit the coast of British Columbia north of about
30 -- starting at Johnston Strait north. It left
31 record snow packs in the -- whether or not it's
32 directly tied to the El Niño in the winter of
33 '06/'07 is not -- but ultimately what happened was
34 some of the most extreme snow packs recorded in
35 British Columbia occurred that winter, which was
36 the year before smolts of our interest went to
37 sea. And this led to that -- this incredible snow
38 pack led to the freshwater, the freshening that we
39 saw along the coastal ocean all the way from Queen
40 Charlotte Strait to Southeast Alaska.

41 Q I'm going to just move along to the 2009 decline,
42 the question that you were asked. What approach
43 did you take when answering the question of
44 whether there was a marine answer, I guess, to the
45 question of the 2009 decline.

46 DR. MCKINNELL: I mean, the approach we took in
47 answering that question was perhaps not very

1 satisfactory, in that it's -- our assessment of
2 the marine conditions through the life history of
3 the smolts from 2007 to 2009 was that it was
4 certainly possible that the extremes we observed
5 in the Queen Charlotte Strait region and Queen
6 Charlotte Sound, and even into -- there were even
7 expressions of this in Southeast Alaska, could
8 have led -- I mean, they're consistent with the
9 idea of poor survival of sockeye. And they in
10 fact may even have started in Georgia Strait where
11 the -- you know, there was a footprint of this
12 larger scale effect going on.

13 Q Did you -- you've talked already about the number
14 of extremes that you saw in various areas in 2007.
15 Are those extremes relevant to the analysis of the
16 cause of low returns in 2009?

17 DR. MCKINNELL: I think one of the things that I have
18 to do at this point is point out that it's not
19 just the low returns in 2009 that have to be
20 satisfied. There are a collection of observations
21 that go along with this that also have to be
22 explained. And in that same year we had double
23 the average returns of sockeye to the Columbia
24 River. We had better than expected returns of
25 sockeye to Barkley Sound. We had very low returns
26 of the one-year-old smolts from most populations
27 that entered the Strait of Georgia, and that's the
28 point you've raised about the 2009. But we had
29 record high returns from sockeye that were in the
30 Strait of Georgia in that same summer to Harrison
31 River. And in fact I think the two-year-old
32 smolts from Chilko Lake survivals were not --
33 measured at Chilko Lake were not affected as the
34 one-year-old smolts. And we have Dr. Welch's
35 observation of typically, typical survival of his
36 acoustically-tagged Cultus Lake sockeye through
37 the Georgia Strait in 2007. So what one needs to
38 do is develop a model that somehow satisfies all
39 of these concurrent observations.

40 Q Okay.

41 DR. MCKINNELL: And certainly placing the mortality of
42 this brood year, of the 2007 age-one smolts in
43 Queen Charlotte Strait/Queen Charlotte Sound, has
44 the possibility to satisfy all of these
45 observations. Because the age-one smolts from --
46 and two-year-old smolts from the Fraser River
47 must, you know, that's just their nature, is they

- 1 generally swim through Johnston Strait and Queen
2 Charlotte Strait and Queen Charlotte Sound.
- 3 Q But they would also go through the Strait of
4 Georgia, so why would you eliminate that?
- 5 DR. MCKINNELL: Ah, the only reason I would -- I mean,
6 I'm not eliminating it. I just would not put so
7 much emphasis on it as the site, simply because of
8 what I've explained before, that I was looking for
9 extremes in physics and potentially in chemistry
10 that would -- and where those occurred.
- 11 Q I just want to try and wrap up a few questions
12 here. In your report in the preliminary section,
13 your "Executive Summary" section you say that the
14 extreme hydrographic and wind events in Queen
15 Charlotte Strait and Sound did not have the same
16 extremes in the Strait of Georgia, but that's
17 contradicted in the Thomson report. Do you have
18 any comment on that?
- 19 DR. MCKINNELL: I guess -- I didn't study Dr. Thomson's
20 report in detail, but in general his report was
21 restricted to a small subset of the total amount
22 of data that are available.
- 23 Q Mm-hmm. So you looked at more data, is what you're
24 saying?
- 25 DR. MCKINNELL: Yes. Yeah.
- 26 Q Okay.
- 27 DR. MCKINNELL: You know, part of the analysis that we
28 did, at least looking at the surface properties,
29 was that the Nanoose hydrographic station which
30 Dr. Thomson spent some time analyzing, is least
31 similar to the lighthouse stations around the
32 Strait of Georgia in June, which is the time when
33 many of the Fraser sockeye are migrating through
34 the region. And so the question then becomes how
35 representative is any finding from the Nanoose
36 station of general conditions in the Strait of
37 Georgia.
- 38 Q Dr. Beamish also in his work in one of the other
39 reports, that I haven't identified yet on the
40 record but we will go to this afternoon, he looked
41 at the condition of Fraser River sockeye and a
42 number of other species in the Strait of Georgia
43 in 2007 and noticed that there were similarities
44 in condition across species, but you seem to
45 discount that analysis. Why is that?
- 46 DR. MCKINNELL: In part Dr. Beamish's report at times
47 includes some of the fish and at times excludes

1 some of the fish, and in most of the plots that
2 show time series, there's no indication of how
3 uncertain the values are. It's typical to report,
4 say, if you want to make a case that some year is
5 different from some other year, it's very typical
6 to include standard confidence intervals on your
7 estimates of the mean value. The point I'm making
8 here is that sample size matters and inherent
9 variability matters. If you take a sample of 60
10 fish and you take a sample of 2,000 fish, chances
11 are you will have a better understanding of the
12 true meaning from a sample of 2,000 fish than you
13 will from a sample of 60 fish.

14 And the other problem I had was that some of
15 the statistics that are reported in Dr. Beamish's
16 paper, pool, for instance, in reporting mean size
17 or mean length, they pool two different age
18 classes. And, for instance, the under-yearlings
19 and the age-one smolts are just pooled, but the
20 relative proportions of those will affect the mean
21 value that you see. And it wasn't possible to
22 distinguish very clearly what -- how much the
23 pooling of these values was contributing to the
24 mean. You know, the fact that you had one age
25 that's a small fish and one age that's a large
26 fish, how much that influenced them compared to
27 the growth that they'd achieved to get to that
28 stage.

29 THE COMMISSIONER: Okay, thank you. We'll take the
30 noon break.

31
32 (PROCEEDINGS ADJOURNED FOR NOON RECESS)
33 (PROCEEDINGS RECONVENED)

34
35 THE REGISTRAR: Order. The hearing is now resumed.
36 MS. BAKER: Thank you.

37
38 EXAMINATION IN CHIEF BY MS. BAKER, continuing:

39
40 Q I'd like to just complete my questions for Dr.
41 McKinnell, with a last question. Do you have any
42 views on whether the 2010 return was influenced by
43 either an El Niño or La Niña event during their
44 marine life phase?

45 DR. MCKINNELLS: In a section of our report, we
46 described how the abundance of the 2010 return,
47 the high return, was evident in the test fisheries

1 the year before, in 2009. There was the younger
2 fish, the jacks, as we've called them, that return
3 after only one year, were seen in higher abundance
4 than has appeared for a very long time, and we
5 interpret this to be an indication that the high
6 abundance of the return in 2010 was established at
7 least a year earlier than the time when the 2010
8 return occurred, in which case the '09 - the 2009-
9 2010 El Niño would not have a marked effect on --
10 if, indeed, the jack abundance indicator in the
11 test fishery was indicating the returns to come,
12 which it seemed to be.

13 Q Thank you. I'd like to move, now, to Dr. Welch.
14 Dr. Welch, you appeared in October before the
15 Commission, and you gave us a presentation, at
16 that time, on your post work, and you provided us
17 with a presentation that involved a PowerPoint,
18 and we looked at a couple pages of that this
19 morning, or a page of that this morning, and I
20 don't want to review that material again, but what
21 I do want to ask you if you have done since that
22 time, you've published a paper that provides that
23 analysis or some commentary on that analysis and
24 some additional information, and that is at Tab 21
25 of the Commission's list of documents, if I could
26 just have that put up. That's the paper that
27 you've now published?

28 DR. WELCH: That's correct.

29 MS. BAKER: Okay. Could I have that marked, please?

30 THE REGISTRAR: This exhibit will be 1292.

31
32 EXHIBIT 1292: Welch et al, In Situ
33 Measurement of Coastal Ocean Movements and
34 Survival of Juvenile Pacific Salmon, 2011 [BC
35 Post Study, PNAS]
36

37 MS. BAKER: Thank you.

38 Q So based on the work as outlined in this article
39 and generally, have you been able to draw any
40 conclusions about the relevance of Cultus hatchery
41 fish, which is what you were tagging, to represent
42 Fraser sockeye, all stocks, and their migration
43 routes and timing?

44 DR. WELCH: Well, we can't -- from this paper, we can't
45 talk about the other stocks of Fraser sockeye,
46 because we don't -- we've only so far analyzed --
47 reported, in this paper, Cultus Lake sockeye, but

1 what I think counsel's referring to is figure 5,
2 which can be brought up. One of the large
3 questions about the telemetry system is whether
4 it's affecting the survival of the fish with
5 larger fish surviving better either because bigger
6 fish survive better or because the tag is reducing
7 the survival of small fish. And the top row shows
8 that for the four species that we've looked at,
9 which includes both Sakinaw sockeye and Cultus
10 Lake sockeye, that the average size of the fish at
11 release, in the second row, is no different than
12 the average size of the fish at release of the
13 fish that survived to make it out of the Strait of
14 Georgia or to the north end of Vancouver Island,
15 which includes the sockeye.

16 And then the other graphs that are within
17 that simply show that for the four species that
18 there was no change in other aspects of the size
19 distribution, so larger fish were not surviving
20 better relative to smaller. So that was one of
21 the two key points in the paper.

22 And the other one was that survival out of
23 the Strait of Georgia north to the north end of
24 Johnstone Strait and Queen Charlotte Strait was,
25 to my mind, high and stable across the four years
26 that we looked at it. It was about 28 percent
27 survival to the north end of Vancouver Island, but
28 only two percent -- pardon me, one percent, or two
29 fish, out of the 200 we released survived to come
30 back and were detected coming back in over the
31 array two years later.

32 Q What about the impacts of the tags, themselves, on
33 the fish; did you draw any conclusions from that?

34 DR. WELCH: Well, as figure 5 shows, there was no
35 difference between the size at release of all the
36 fish, and then the grey bars in the top row of
37 panels and the size of the fish that did survive
38 to make it up to the north end of Vancouver
39 Island, about 400 kilometres away, a month, month
40 and a half after release. So what the data is
41 suggesting is that surgery done properly does not
42 affect the survival of the fish over the size
43 range that we've tagged, which is down to 13
44 centimetres, a little larger than the wild smolts,
45 which are 10 or 11.

46 Q And in your paper you also talk about total
47 mortality versus a mortality rate, and I'd like

1 you to explain what those two terms refer to and
2 why that's a distinction that you think is
3 important.

4 DR. WELCH: Yes. In fisheries for about a century, the
5 theory has been that there's a critical period
6 early on in the life history, because the
7 mortality rate is very high. The key point there
8 is that the mortality rate is high, but it's a
9 relatively short duration relative to the rest of
10 the life history. So in the rest of the life
11 history in this case, after the first month and a
12 half after release, for Cultus Lake sockeye we're
13 able to do a calculation that's seven-eighths of
14 the total mortality after release at Cultus Lake
15 occurred north of Vancouver Island.

16 Q Okay. In 2010 you actually tagged some Chilko
17 smolts instead of Cultus Lake smolts; is that
18 right?

19 DR. WELCH: That's correct. That was the work you're
20 referring to with Dr. Scott Hinch of UBC and his
21 team as well.

22 Q Okay. And can you just describe -- we have a
23 slide that you've prepared that might be useful in
24 answering the question as to what the results of
25 that work have shown, and that slide is at Tab 20
26 of the Commission's list of documents.

27 DR. WELCH: Right. So what this graph shows, the
28 colours of the symbols -- well, let me step
29 through it. So from left to right it shows
30 survival from release to the Lower Fraser River,
31 the last detection sites we had in the Lower
32 Fraser River -- pardon me, this graph is different
33 from the ones that have been seen before. Chilko
34 Lake sockeye, in 2010, is the yellow dot on the
35 right-hand side. This is new data that hasn't
36 been published as yet. And to prepare this, we've
37 taken the survival from -- essentially from
38 Mission in each year, because Cultus Lake sockeye
39 are released in Cultus Lake; Chilko is almost 500
40 kilometres up the river, and we've taken the
41 survival from Mission, the first receiver in the
42 lower river each year, to the last receiver in the
43 river, a distance of about 60 kilometres, and
44 we've compared the survival for that section in
45 the Lower Fraser River.

46 So survival is very high in all years. The
47 Cultus Lake data for the prior four years, in

1 fact, we showed there was actually quite -- or
2 found there was quite high mortality in some
3 years, 50 -- only 50 or 20 percent of the fish
4 were surviving to the Lower Fraser River from
5 release. What this figure shows is that it's
6 isolated to the period immediately after release
7 from the outlet of Cultus Lake to the Fraser main
8 stem, just downstream from the Sweltzer Creek, the
9 conduit from the lake to the Fraser River.

10 So overall, the issue is that in the Lower
11 Fraser River the survival is high for all of the
12 stocks, or all of the years, and then in the
13 northern Strait of Georgia, which is from the
14 Fraser River mouth to the north end of Texada
15 Island, Comox to Powell River, survival is high
16 and fairly stable. And then the surprise for us
17 in 2010 is the survival from the north end of
18 Texada Island to near the exit of Queen Charlotte
19 Strait, survival was only about a third to a
20 quarter in 2010 for these smolts.

21 The Chilko smolts were wild, two-year-old
22 smolts. The Cultus Lake smolts, in prior years,
23 were hatchery smolts.

24 Q And does the fact that these smolts were -- the
25 Chilko smolts were two-year-olds make any --
26 should we -- how should we interpret that, I
27 guess, as against the bulk of the fish which are
28 one-year-old smolts?

29 DR. WELCH: Well, Dr. Irvine, of DFO, and Scott
30 Aikenhead, have an unpublished paper showing that
31 survival, marine -- sorry, survival of -- first,
32 one-year-old Chilko smolts and two-year-old Chilko
33 smolts, on average, is nearly identical, so one
34 would infer from this that you would see something
35 different for the one-year-old smolts, had we
36 tagged them, but one-year-old smolts would require
37 a revised version of the telemetry rate. It's now
38 possible to do that, but the existing array can't
39 handle those small, one-year-old smolts.

40 Q Sorry, just to make sure I understand, you're
41 saying that if you had been able to tag one-year-
42 old smolts you would have expected to see a
43 difference in survival, as against the two-year-
44 olds when they entered the ocean, or are you --

45 DR. WELCH: No, my personal view --

46 Q -- just -- sorry...

47 DR. WELCH: -- is we would expect to see the same

1 pattern, because the survival that Irvine and
2 Aikenhead report from Chilko lake for one and two-
3 year-old wild smolts is, on average, the same.

4 Q All right. So is it your view that the survival
5 rates that you see on your tagged fish, then, is
6 reasonably representative of what you would expect
7 for the one-year-old wild smolts?

8 DR. WELCH: That's my conjecture. What we've done with
9 the proceedings in the National Academy of
10 Sciences paper that just came out was show that
11 over the size range we can tag with the existing
12 technology that we're not seeing these differences
13 in survival with size that previously the theory
14 was that they would be there; in practice, we
15 haven't seen it when we've looked for it.

16 MS. BAKER: Thank you. I'd like this slide, please,
17 marked as the next exhibit.

18 THE REGISTRAR: Exhibit 1293.

19

20 EXHIBIT 1293: Fraser Sockeye Smolt Survival
21 Estimates, Welch et al
22

23

MS. BAKER:

24 Q All right, so this work that you've just described
25 showed the Lower Fraser, Mission to the mouth of
26 the Fraser, as having reasonably good survival.
27 What do you know about survival from the lake to
28 Mission?

29 DR. WELCH: So as I said, in Cultus Lake, most of the
30 mortality in the Fraser River that we measured
31 occurred between release and essentially the exit
32 from Sweltzer Creek into the main stem of the
33 Fraser. It's a small, clear river and it looks
34 like a lot of things do eat sockeye within that,
35 so there's predators there. And then the Fraser
36 main stem was not the location where the mortality
37 was observed.

38 In 2010, we observed something very similar
39 up in Chilko Lake. The first section of the
40 migration, a clear water river running from Chilko
41 Lake, we had much higher mortality there. And
42 then some differences in the behaviour of the
43 fish. And then once they reached the main Fraser
44 River, mortality rates dropped, the survival was
45 high down the Mission, and the behaviour also
46 changed, to suggest that they were not trying to
47 avoid predators at that point.

1 Q You've heard, today, and I think you're aware of
2 some works that have been published, relating the
3 time spent of Fraser sockeye in the Strait of
4 Georgia to their survival, or their returns two
5 years later. Do you have any views on the
6 importance of the Strait of Georgia in relation to
7 returns of adult sockeye, Fraser River sockeye?

8 DR. WELCH: Yes. So the Strait of Georgia is one of
9 the ecosystems that these animals move through in
10 sequence, and it's certainly relevant and
11 important. I wouldn't characterize it as the
12 determining location where adult returns are
13 determined in majority. It's one of the sections.

14 If we look at the rates of movement of the
15 fish, our acoustically tagged smolts are moving
16 about a body length a second, which is typically
17 what's expected for fish. The wild fish, Dr.
18 Trudel has caught the untagged wild fish up in
19 Hecate Strait from the Fraser River. Those
20 smaller wild fish are also moving at about a body
21 length a second. So take that as just under 10
22 kilometres a day that the wild fish would be
23 migrating. So to get to the north end of -- from
24 the Fraser River mouth to get to the north end of
25 the Strait of Georgia, 150 kilometres, so about
26 15, 20 days for the average smolt to clear through
27 the Strait of Georgia, and then something similar
28 to get up to the Queen Charlotte Straits sub-array
29 that we have.

30 Q Okay. And what about the influence of conditions
31 in the Queen Charlotte Sound and Queen Charlotte
32 Strait areas?

33 DR. WELCH: Well, unfortunately, we don't have the
34 array up in that area to measure the -- or census
35 the number of smolts that enter the Queen
36 Charlotte Sound and then exit to the north. We
37 have had, in past years, a sub-array up in Alaska,
38 but it has not detected the Cultus Lake or the
39 Chilko smolts up there. But it's almost 2,000
40 kilometres from the -- 1,500 kilometres from the
41 Fraser River.

42 Q Okay. In one of the reports, which we'll deal
43 with, with Dr. Beamish, it's a paper identified by
44 the author Preikshot, and it's -- just to identify
45 it for the Commissioner, but we'll come to it
46 later, it's Tab 15 in the Commission's list, and
47 it talks about the residence time of juvenile

1 Fraser River sockeye salmon. And in this
2 document, they estimate 35 days for residence time
3 in the Strait of Georgia. Would you agree with
4 that?

5 DR. WELCH: Well, I'd say it was an overestimate. The
6 estimate was -- I've reviewed the document, it's
7 based on the time of arrival at the -- an
8 estimated time of arrival at the Lower Fraser
9 River, the last one percent of the migrating
10 smolts, and then the estimated time of arrival of
11 the last one percent of the migrating smolts at
12 the north end of the Strait of Georgia. And that
13 tends to spread out the distribution, because we
14 know that sockeye smolts, some of them go into the
15 inlets, such as Howe Sound, so their average speed
16 drops. But even if we take that as the estimate,
17 that would be about 35 days. All of the acoustic
18 telemetry work is indicating four to seven days
19 for the smolts to get from release at the lake
20 down to the mouth of the Fraser River, so even if
21 I would -- my calculation would be, rather than
22 the 35 days that Preikshot, et al would suggest
23 the average would be closer to 15 days, couple of
24 weeks.

25 So since the peak of the run is leaving the
26 Cultus or Chilko Lake at the end of April, that
27 puts them out of the Strait of Georgia, the
28 majority out of the Strait of Georgia by the
29 middle of June.

30 Q And you may have already explained this, but when
31 you talk about the telemetry work you did, you
32 were dealing with larger hatchery fish and larger
33 two-year-old smolts. Does that affect the timing
34 or not?

35 DR. WELCH: Well, as I indicated, they seemed to be
36 moving at the same speed, in terms of physical
37 size and in terms of body lengths per second,
38 about one body length per second, and Dr. Trudel
39 has data from Hecate Strait for wild one-year-old
40 smolts that also indicating that they're moving
41 about a body length a second, or a little more.
42 So his estimate also, which is a paper in the 2010
43 DFO, called Ocean Distribution of Two Depressed
44 Sockeye Salmon Stocks, he obtains, for untagged
45 wild smolts, about 1.1 to 1.4 body lengths per
46 second, similar to what we do for the larger,
47 acoustically-tagged smolts.

- 1 So scaled for their size, the fish are
2 swimming at the same speed, about just over a body
3 length a second.
- 4 Q I just want to make sure we've got the right
5 documents here, because we've got a new production
6 that seems to be the same.
- 7 You'd mentioned Marc Trudel. He's a
8 scientist with the Department of Fisheries and
9 Oceans; is that right?
- 10 DR. WELCH: Correct.
- 11 Q And you're familiar with some of the trawl surveys
12 that he's done in Queen Charlotte Sound and Hecate
13 Strait?
- 14 DR. WELCH: Yes.
- 15 Q Okay. I want to show you some documents that have
16 been produced by him that I think you've seen
17 already. Tab 39 is a PowerPoint. We do have it
18 in black and white in another tab, but I think the
19 colour might be more helpful. And I probably
20 should have talked to Mr. Lunn about this, because
21 he's going to struggle to find it, because the
22 page aren't numbered. I would say it's about two-
23 thirds of the way through this document, so maybe
24 at about page 40.
- 25 DR. WELCH: It's before that, or it should be.
- 26 Q All right. So try going around 35. There.
- 27 DR. WELCH: There.
- 28 Q There we go. Okay. So I've got those -- these.
29 And also in Canada's documents, at Tab 9, there's
30 one for 2010. Okay. All right, so let's start
31 with -- first identify what these are, and then we
32 can go through them. If you could identify what
33 these graphs are showing?
- 34 DR. WELCH: Oh, sorry. All right, so this is Dr.
35 Trudel's data for, essentially, Queen Charlotte
36 sound, Hecate Strait and Southeast Alaska. So
37 from the bottom of the graph to the top it goes
38 west coast Vancouver Island samples, Queen
39 Charlotte Sound samples, west coast of Queen
40 Charlotte Islands and Hecate Strait, and then
41 Southeast Alaska is the top. And then within each
42 of the three main sections he's divided it into
43 outer -- farther from the mainland and inner route
44 samples.
- 45 So the essential point that I'd like to point
46 out here is that the bright green shows the Fraser
47 River sockeye salmon. This is all stocks of

1 sockeye salmon together. And essentially what Dr.
2 Trudel's data shows, in 2007 sampling during June
3 and July, that about 30 to 40 percent of the
4 Fraser sockeye off the Queen Charlotte
5 Islands/Hecate Strait are of Fraser River origin.

6 Now, in 2008, which is the central section,
7 there's certainly a larger section of the pie
8 that's bright green; it's around 60 percent.

9 The point that I'd like to make here, though,
10 is that we're expecting a 20 to one return of
11 adult sockeye back in 2009 versus 2010, about 1.5
12 million versus 30 million. So we're not seeing,
13 in my view, the very large difference in the
14 proportion of Fraser sockeye in 2008 that you
15 would expect. You would expect, if the abundance
16 of the other stocks was consistent with it having
17 been set by the Queen Charlotte island/Hecate
18 Strait area, you'd be expecting that green pie, in
19 2008, to be about 90 percent of the total sockeye
20 that was caught. So it's certainly larger in 2008
21 smolt out-migrating year than in 2007, but it's
22 nowhere near large enough to fully explain the
23 massive difference in adult returns between 2009
24 and 2010.

25 So there's evidence that by Hecate Strait
26 there was some difference in abundance, but not
27 nearly enough to explain the big difference in
28 returns.

29 And then in June/July 2009, the pie is even
30 bigger for the Central Coast area. So I would
31 argue that Dr. Trudel's survey is in about the
32 right place at the right time, given the speed of
33 movement of the smolts, but it's not showing that
34 the large differences in adult sockeye return had
35 been set by that time.

36 Q Thank you. I think I'd like this PowerPoint, or
37 document, marked as the next exhibit. And perhaps
38 for the record we can identify that this page that
39 you're looking at is page 34.

40 THE REGISTRAR: Exhibit 1294.

41
42 EXHIBIT 1294: Beacham et al, Ocean
43 Conditions Inside and Outside the Strait of
44 Georgia are Important Contributors to the
45 Fraser Sockeye Situation, April 2011
46
47

1 MS. BAKER:

2 Q I did ask you if you were familiar with the one at
3 Tab 9 in Canada's list of documents. This is just
4 an updated survey for the 2010 year. I don't know
5 if this adds anything. The sample sizes look
6 fairly small in this one, so I'm not sure if it's
7 helpful or not.

8 DR. WELCH: Sorry, is this the 2010 or 2009?

9 Q I understood this to be the 2010.

10 DR. WELCH: Okay. It looks similar to the 2009
11 results, which is that significant fractions of
12 the sockeye that are out there from Fraser River
13 populations. But as you say, particularly in
14 2010, these are, for reasons I don't know, the
15 sample size of sockeye is much smaller in this
16 year. The total -- the "n equals" number under
17 each of the pie says -- indicates the number of
18 fish that they had to do DNA analysis on.

19 MS. BAKER: Okay. I'll have that marked, please.

20 THE REGISTRAR: That would be 1295.

21
22 EXHIBIT 1295: Trudel, Interannual Variation
23 in Juvenile Sockeye Salmon Stock Composition,
24 Figures for 2010
25

26 DR. WELCH: But to put that in perspective, in 2009,
27 and in this case 2010, these are years that we
28 don't know what the adult returns would be like.
29 But this would suggest that we'd have even larger
30 sockeye returns to the Fraser relative to these
31 other stocks, relative to 2008, because the
32 section of the pie chart that's green, the Fraser
33 River, is even larger. We won't know for one or
34 two years, until the adults come back, whether
35 that's true or not.

36 MS. BAKER:

37 Q But before you draw that conclusion, would you not
38 want to have a look at the sample size which, as
39 you indicate in this, only 12 fish had DNA
40 sampling done?

41 DR. WELCH: Well, I've indicated that the sample size
42 here is smaller. The thing that I'd like to see
43 followed up, which I don't have available here, is
44 what's the relative abundance of the spawning
45 escapements for these others stocks that make up
46 the mix each year? We're assuming that it's
47 approximately the same. We're not expecting a

1 radical change in the number of spawners that
2 return, say, to the west coast of Vancouver
3 Island, and technically we're assuming that it's
4 remaining absolutely stable when I say that in
5 2008 we should have seen Fraser sockeye making up
6 90 percent of the Hecate Strait DNA stock
7 composition. We're not seeing that. It's a slim
8 possibility that the escapements in other areas
9 had dropped a lot that produced those fish, but
10 it's not very likely.

11 Q I'd like to move to another topic, now, talking
12 about distribution of salmon in the Gulf of
13 Alaska. And you touched on this earlier. You
14 indicated that your tagging -- your Cultus fish
15 that you had tagged weren't detected in the
16 receivers in Alaska. Does that tell you anything
17 about the coastal or open ocean distribution or
18 timing of Cultus?

19 DR. WELCH: Yes. it's unlikely that they're moving off
20 the shelf, as Dr. McKinnell had indicated, that's
21 a possibility. We have an unpublished paper from
22 the trawl survey work I did before I left DFO,
23 showing that in October through to December that
24 essentially all species of smolts or post-smolts
25 were staying on the shelf much later than people
26 had anticipated, and we're still migrating north
27 out of the area.

28 So that leaves two possibilities. One, is
29 that the array up in Alaska didn't detect them,
30 which is a possibility, because in the pilot phase
31 we essentially only could run it halfway across
32 the full width of the Continental Shelf. So if
33 the smolts had gone farther offshore in deeper
34 water than 200 metres, we would have missed them.
35 Or the other possibility is that they've taken up
36 residence somewhere south of the Alaska sub-array
37 and were over wintering there.

38 Q Do you think it's important to understand the
39 distribution of sockeye in the Gulf of Alaska?

40 DR. WELCH: On the Continental Shelf certainly, because
41 we need to understand what area is causing these
42 dramatic -- first off, the dramatic year to year
43 variation in survival, but also, perhaps even more
44 important, is this 20-year-long decline in
45 survival. If we really need to know what's
46 happening, we need to pinpoint the areas where
47 that problem is occurring.

1 Q And is it expected or understood whether Fraser
2 River sockeye randomly distribute in the Gulf of
3 Alaska, or does each stock go to a different
4 place, or do we have any information on that?

5 DR. WELCH: I think it's clear from the data that's
6 available that they're not randomly distributed.
7 We don't fully understand what it is, but there
8 are multiple sources of evidence that suggest
9 different stocks have, at least to some degree,
10 different areas of distribution within the Gulf of
11 Alaska.

12 Q And in the Technical Report 4, Dr. McKinnell talks
13 about a thermal limits issue, which, I think, is
14 reflecting work that you've done. Can you explain
15 what that is?

16 DR. WELCH: We collected the data from the 1950s to
17 about 1994-95, from Japanese, American, and
18 Canadian high seas research cruises, and then
19 looked at the distribution of sockeye salmon
20 across the north Pacific, and in that paper what
21 we showed was that there was a sharp southern
22 limit to the distribution of sockeye that was
23 related to temperature. So basically within about
24 a degree Celsius in most areas of the north
25 Pacific, sockeye salmon abundance for the immature
26 fish dropped by an order of magnitude, a factor of
27 10 or more, so a very sharp southern or warmer
28 thermal limit to the distribution.

29 Q All right. And why is that important?

30 DR. WELCH: It's important because the global warming
31 models are predicting large-scale changes in the
32 thermal -- or the temperatures of the north
33 Pacific, and if the sockeye maintain these thermal
34 limits and migrate or move to avoid what's
35 predicted to be a warming ocean by -- with the
36 most recent crop of global warming models, it's
37 suggesting that their thermal habitat for at least
38 parts of the year would be only found in the
39 Bering sea, and potentially could be excluding --
40 well, certainly excluding all of the Gulf of
41 Alaska.

42 Q And to understand the distribution of the Gulf --
43 excuse me, the distribution of Fraser sockeye in
44 the gulf of Alaska, are there research methods
45 that you know about that would be useful in doing
46 that kind of work?

47 DR. WELCH: Well, our work was an observational study

1 based on the capture of fish from various types of
2 fishing gears across the north Pacific. It's not
3 an experimental test. I would very much like to
4 see it tested -- the theory tested. We've put
5 forward the observation. That could be done with
6 what's called archival tags, for example, which
7 would establish the movements of fish, of sockeye
8 salmon in this case, and establish whether they do
9 or do not cross these apparent thermal limits or
10 boundaries.

11 There are suggestions that the animals could
12 go deep into the deep ocean, which has little
13 light and little food, and something that, so far
14 as we know, don't do now, but that would be one
15 method to escape the warming surface waters.

16 So a direct experimental test that refutes or
17 supports the observational data we have would be a
18 very interesting and useful method of looking at
19 that. More broadly, from a public policy
20 perspective, it's important, because if the
21 climate change come to pass, as we predict, or as
22 the models are suggesting, there are potentially
23 very large losses and further losses in
24 productivity of sockeye salmon, and we'd want to
25 understand whether that aspect of the life history
26 is causing them, or is it something else.

27 Q The Commissioner asked Dr. McKinnell about further
28 freshwater lake assessment needs, restriction
29 needs, and talked about counting at the lakes, and
30 Dr. McKinnell talked a little bit about counting
31 fish at the mouth of the river, so I have a couple
32 questions for you there.

33 The first one is, do we, in your view, do we
34 need to add additional freshwater counting or
35 assessment; and the second question is, just to
36 pick up on what Dr. McKinnell was talking about,
37 counting at the mouth of the river, is there any
38 ways to do that effectively, now?

39 DR. WELCH: Well, my personal opinion is that most of
40 the problems are happening in the marine
41 environment as opposed to freshwater, but sampling
42 at the mouth of the river to get, for example, the
43 total abundance of sockeye coming down each year
44 would be useful as a way to keep on the table or
45 take off the table the issue that changes in
46 freshwater are or are not contributing as a
47 significant driver what's happening, and that

1 could be done simply -- I believe there's still a
2 sampling program at Mission that's been going on
3 that catches the number of sockeye smolts going
4 down the river each year. That could be
5 supplemented, for example, by a DNA analysis of
6 the individual fish to get an index of total
7 sockeye out-migrant abundance, presumably at
8 Mission, since that's where the current sampling
9 is, and then supplemented by DNA so it could break
10 down what the relevant stocks are.

11 Q Thank you. I have a couple of questions, both for
12 Dr. Welch and Dr. McKinnell, relating to research
13 needs and priorities, so I'm going to hold those
14 to the end, because I'd like to move to Dr.
15 Beamish now.

16 First of all, I'd like to begin with the four
17 reports that you were either a primary or
18 secondary author on, and I'll just identify them.
19 The first one is at -- follows your primary one,
20 and I think that's at Tab 13 of the Commission's
21 documents. You're the lead author on this, and
22 it's titled, Evidence of a Synchronous Failure in
23 Juvenile Pacific Salmon and Herring Production in
24 the Strait of Georgia in the Spring of 2007; is
25 that right?

26 DR. BEAMISH: Yes.

27 Q All right. And I think as we're very short on
28 time today, so I'm just going to identify very,
29 very quickly, where the CVs are for the other
30 authors of this report. They're at Tabs 40 and 41
31 of Canada's documents. So that is one of the
32 authors, Neville, and then Tab 41 is Sweeting;
33 that's correct, those are the CVs of the other
34 co-authors?

35 DR. BEAMISH: Yes, they are.

36 MS. BAKER: I'd like those both marked, please.

37 THE REGISTRAR: Exhibit Number 1296.

38
39 EXHIBIT 1296: *Curriculum Vitae* of Chrys-
40 Ellen M. Neville

41
42 MS. BAKER: Is that for the Neville c.v.?

43 THE REGISTRAR: Yes. And the next exhibit will be
44 1297.

45
46 EXHIBIT 1297: *Curriculum Vitae* of Ruston
47 Matthew Sweeting

60
PANEL NO. 51
In chief by Ms. Baker

1 MS. BAKER:

2 Q And then that primary document is supported by
3 three other papers which address a number of other
4 issues, so the first one I want to go is one
5 called -- at Tab 14 of the Commission's documents,
6 and it's called, Anomalous Ocean Conditions -- or
7 it addresses anomalous ocean conditions in coastal
8 regions. And the lead author on this is Dr.
9 Thomson?

10 DR. BEAMISH: Yes.

11 Q And the other authors listed, I just should
12 identify their CVs for the record as well.
13 They're in Canada's documents. First of all,
14 Thomson's c.v. is in Tab 46. If that could be
15 marked, please, once it's identified. Is that his
16 c.v.?

17 DR. BEAMISH: Yeah.

18 THE REGISTRAR: Exhibit Number 1298.

19

20 EXHIBIT 1298: *Curriculum Vitae* of Richard E.
21 Thomson

22

23 MS. BAKER: Thank you.

24 Q Terry Beacham is the next author, at Tab 42 of
25 Canada's documents; is that correct?

26 DR. BEAMISH: Yes. Yeah.

27 MS. BAKER: Okay, the next exhibit, please?

28 THE REGISTRAR: 1299.

29

30 EXHIBIT 1299: *Curriculum Vitae* of Terry Dale
31 Beacham

32

33 MS. BAKER: Thank you.

34 Q Mark Trudel, Tab 44 of Canada's documents?

35 DR. BEAMISH: Yes.

36 Q We'll get it up on the screen, first.

37 DR. BEAMISH: Here it comes, yes.

38 MS. BAKER: Okay. If that could be marked, please.

39 THE REGISTRAR: Exhibit Number 1300.

40

41 EXHIBIT 1300: *Curriculum Vitae* of Marc
42 Trudel

43

44 MS. BAKER:

45 Q Tab 45 is Whitefield's c.v., yes?

46 DR. BEAMISH: Yes.

47 MS. BAKER: If that could be marked, please.

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61
PANEL NO. 51
In chief by Ms. Baker

1 THE REGISTRAR: 1301.

2

3 EXHIBIT 1301: *Curriculum Vitae* of Paul
4 Whitefield

5

6 MS. BAKER:

7 Q And then, lastly, Tab 47 is the Hourston c.v., if
8 that could be marked once it's --

9 DR. BEAMISH: Yes.

10 Q -- identified. Thank you.

11 THE REGISTRAR: 1302.

12

13 EXHIBIT 1302: *Curriculum Vitae* of Roy A.S.
14 Hourston

15

16 MS. BAKER: Okay, I'd like to have -- I'll mark Tab 14,
17 please, as the next exhibit. And then I'll come
18 back. I forgot to mark your primary document, but
19 I'll do that when we come to it. So if I could
20 have this Anomalous Ocean Conditions document
21 marked?

22 THE REGISTRAR: 1303.

23

24 EXHIBIT 1303: Thomson, et al, Anomalous
25 Ocean Conditions May Explain the Recent
26 Extreme Variability in FRSS Production, March
27 2011

28

29 MS. BAKER: Thank you.

30 Q The next report deals with residence time of
31 juvenile sockeye in the Strait of Georgia, and
32 we've referred to that, today, as the Preikshot
33 report, and that's at Tab 15 of the Commission's
34 document list?

35 DR. BEAMISH: Yes.

36 Q All right. And you're an author along with a
37 number of other authors whose CVs we've already
38 marked. The only one we haven't marked, yet, is
39 Dr. Preikshot. That's at Tab 43 of Canada's list.

40 DR. BEAMISH: Yeah.

41 MS. BAKER: If they could be marked once identified.
42 That's it.

43 THE REGISTRAR: 1304.

44

45 EXHIBIT 1304: *Curriculum Vitae* of David B.
46 Preikshot

47

July 6, 2011

62
PANEL NO. 51
In chief by Ms. Baker

1 MS. BAKER: And the report, itself, I'd like marked,
2 please.

3 THE REGISTRAR: 1305.

4
5 EXHIBIT 1305: Preikshot, et al, The
6 Residence Time of Juvenile FRSS in the Strait
7 of Georgia, undated
8

9 MS. BAKER: Thank you. And the final one dealt with
10 late ocean entry life history of Harrison River
11 sockeye and South Thompson Chinook sockeye, and
12 that's at Tab 16 of the Commission's list.

13 Q Correct?

14 DR. BEAMISH: Yes.

15 Q Thank you. And the c.v. for the only author we
16 haven't dealt with yet, which is Lange, is at Tab
17 23, I think, in Canada's list. Okay, if I could
18 have the c.v. marked. First of all, is that
19 Krista Lange's c.v.?

20 DR. BEAMISH: Yes.

21 MS. BAKER: Thank you. Mark it, please.

22 THE REGISTRAR: 1306.

23
24 EXHIBIT 1306: *Curriculum Vitae* of Krista
25 Lange
26

27 MS. BAKER: Okay. And the report, itself, we'll mark
28 as the next exhibit.

29 THE REGISTRAR: 1307.

30
31 EXHIBIT 1307: Beamish, et al, A Late Ocean
32 Entry Life History Type Has Improved Survival
33 For Sockeye and Chinook Salmon in Recent
34 Years in the Strait of Georgia, undated
35

36 MS. BAKER: Thank you.

37 Q All right, now, these four reports, as I
38 understand it, extend what's been described as the
39 critical size/critical period hypothesis that you
40 first composited in 2001; is that right?

41 DR. BEAMISH: It's a component of these reports yes.

42 Q Okay. Can you explain what that hypothesis is?

43 DR. BEAMISH: Well, the concept -- excuse me, I'll just
44 fix my voice here. I will have a few problems
45 with my voice, okay, but I think I can fix it with
46 water.

47 So the critical size - can everyone hear me -

1 the critical size/critical period hypothesis is a
2 concept that a colleague and I, named Dr. Connie
3 Menken, and I wrote about maybe 10 or more years
4 ago, and it's basically an extension of the
5 interpretation that many scientists have had for a
6 long period of time, that the early marine period
7 is a critical or very important time for the
8 survival of all species of salmon. And what we
9 proposed in that concept was that -- and again,
10 some of this, of course, is not new. But the
11 concept was that juvenile salmon, in fact,
12 juvenile fish in general, grow very quickly and
13 literally millions, or hundreds of millions of
14 juveniles will start off after they hatch and the
15 mortality is very large in that early marine
16 period.

17 And so the concept of the critical
18 size/critical period hypothesis is that fish that
19 grow really quickly are the ones that, usually
20 around the end of June, although that's pure
21 speculation, will begin to store their energy more
22 than they use the energy from feeding and to grow,
23 and so they begin to store energy as lipids and
24 reduce the amount of energy that goes into growth.

25 What can happen, then, is that the fish that
26 have grown quickly and have stored energy over the
27 summer then survive much better during the more
28 harsh periods for survival in that first marine
29 winter. Of course, the first marine winter can be
30 important, because if the growing conditions in
31 the winter are also -- well, if they are
32 favourable or unfavourable, it can influence what
33 happened in that critical period.

34 So in general, then, what we're saying is
35 that juvenile salmon enter the ocean and have to
36 grow quickly. There's large mortalities in that
37 first up to six week period, and the fish that
38 grow the fastest are the ones that are the larger
39 ones, store energy and continue to store energy
40 through the summer and survive the harsher
41 conditions when feeding is less available, and
42 prey are less available in the winter.

43 And then I said that you can have the
44 anomalies where you could have some very poor
45 growth in that first marine period and then you
46 might be compensated, to some extent, by maybe
47 exceptional conditions during the winter. But

1 those conditions would, in general, be rare.
2 Q And the article that you're referring to is
3 actually on Canada's list at Tab 3, I think, if we
4 could just pull that up.
5 DR. BEAMISH: I'm sorry, just say that again.
6 Q The article that sets out that hypothesis --
7 DR. BEAMISH: That's one of the articles, yes.
8 MS. BAKER: Okay, I'll have that marked, please.
9 THE REGISTRAR: Exhibit 1308.

10
11 EXHIBIT 1308: Beamish, et al, A Critical
12 Size and Period Hypothesis to Explain Natural
13 Regulation of Salmon Abundance and the
14 Linkage to Climate and Climate Change, 2001
15

16 MS. BAKER: All right. And I'd like to turn to the
17 report that's titled, Evidence of a Synchronous
18 Failure in Juvenile Pacific Salmon and Herring
19 Production in the Strait of Georgia. First of
20 all, I didn't mark this when we went over it the
21 first time, so I should mark that now.

22 THE REGISTRAR: Exhibit 1309.

23
24 EXHIBIT 1309: Beamish, et al, Evidence of
25 Synchronous Failure in Juvenile Pacific
26 Salmon and Herring Production in the Strait
27 of Georgia in Spring 2007, undated
28

29 MS. BAKER: Okay.

30 Q Can you just give us a very brief overview of this
31 report, what the intention was?

32 DR. BEAMISH: Okay. It's going to be maybe a little
33 longer than you might want, but this is really the
34 essence of what the four papers are about. We've
35 done a number of surveys in the Strait of Georgia
36 since -- well, since the mid-90s, but we report
37 them since 1998, and maybe, well, literally
38 hundreds of trawl sets. And in the surface
39 waters, in the surface 30 metres in the Strait of
40 Georgia - I can't remember exactly - but around
41 1,800 sets that we've made over that period of
42 time, almost 98 percent of the fish that we catch
43 in the surface 30 metres are juvenile herring or
44 juvenile salmon.

45 In 2007, the year that we're interested in,
46 pink salmon from the Fraser, juvenile pink salmon,
47 were rare. They spawn in the even-numbered years

1 - sorry - spawn in the odd-numbered years, and
2 then the juveniles enter in even-numbered years.
3 So 2007 being an odd-numbered year, you would not
4 expect pink salmon from the Fraser to be in the
5 Strait of Georgia.

6 So we then had juvenile fish that consisted
7 of herring, correctly, I guess, Pacific herring,
8 and then sockeye, chum, Chinook and Coho. And
9 I've now mentioned that they represent about 98
10 percent, so virtually all of the juvenile fish in
11 the surface 30 metres.

12 Now, all of those fish in 2007 ended up
13 having poor growth or poor survival or both. And
14 perhaps the most spectacular observation was with
15 juvenile herring. Juvenile herring, of course,
16 spawn early in the year, and then after the eggs
17 hatch, the larval herring, of course, feed and
18 grow. In September of the year, the herring
19 assessment group does a survey, they use purse
20 seines, and they've been looking at the relative
21 abundance of juvenile herring to -- as an estimate
22 of what would be recruited three years later,
23 recruited into the fishery.

24 And in 2007, their survey estimates indicated
25 that they had the lowest abundance of juvenile
26 herring in their -- in the history. I think the
27 survey went back to the early 1990s. In addition
28 to that, as a -- or maybe I'll just follow-up on
29 herring, let me finish that. So extremely poor
30 survival of juvenile herring in the Strait of
31 Georgia, in 2007, through to September. Now, we
32 saw the same thing in our surveys.

33 Then, when the herring that were spawned in
34 that year were recruited into the fishery in 2010,
35 the commercial fishery, those recruits usually
36 represent about 60 percent of the commercial
37 catch. And in 2010, if I remember correctly, it
38 was around six percent. It was the lowest
39 recruitment ever recorded of a year class.

40 In addition, when we look at the stomach
41 contents of the various species, Chinook salmon
42 are the species that feeds most heavily on
43 juvenile fish in the July period. And normally
44 juvenile Chinook salmon feeding in the Strait of
45 Georgia would feed on roughly 60 percent, 50 to 60
46 percent of their diet would be fish, and about 60
47 percent of that would be Pacific herring.

1 In 2007, the juvenile Chinook salmon had a
2 composition of less than 10 percent of fish in
3 their diet, and none of that was herring, and
4 that's in July. And that's very good evidence
5 that the juvenile herring, most of them had not
6 survived through to July 2007.

7 And then we then follow that up with the
8 other four species, and we know that juvenile
9 sockeye did not survive very well, and there is
10 this issue of exactly where the mortality
11 occurred. I guess I should have mentioned, when I
12 talked about the critical size/critical period
13 hypothesis, that the actual mortality does not
14 have to have occurred in the same location that
15 the poor growth occurred, and mortality can occur
16 later. I guess by inferring that it could occur
17 in the winter, that would also indicate that
18 that's possible.

19 But it's quite important to recognize that
20 when fish die they don't necessarily have to die
21 exactly on the spot where the problems that
22 eventually caused the mortality occurred.

23 Okay, so looking, then, at -- so recognizing
24 that sockeye salmon survive very poorly, and I
25 think there's no question about that.

26 Now, in our surveys in late June through to
27 mid-July, their catches of juvenile sockeye are
28 small. There's no question about that. And
29 they're also, I think it's fair to say they
30 represent the, as has been described, the tail end
31 of the migration. But it's also very important to
32 know that in the various publications that we've
33 produced, that that tail end of the migration,
34 when we do the DNA sampling, the stock composition
35 is entirely consistent with the expected stock
36 composition of all of the populations that compose
37 the total run for that year. In other words, the
38 tail end of the distribution we are sampling the
39 population, we are sampling all of the stocks, and
40 we've done that over three years, and the DNA is
41 consistent. So the tail end, we think, is
42 representative of the overall population
43 composition.

44 We know that the -- now, the sample sizes are
45 small, and that has been pointed out already, and
46 we accept that, but we know from the small sample
47 sizes, both in the Strait of Georgia and in Queen

1 Charlotte Sound, where it's important to actually
2 look at the sockeye in Queen Charlotte Sound,
3 rather than Hecate Strait, a rather unusual
4 situation, but in Queen Charlotte Sound in that
5 year, the juvenile sockeye, in June and in July,
6 were small and generally in poor condition. So
7 the fish that we were able to sample, both in Dr.
8 Trudel's survey and in ours, were, in our opinion,
9 not in really good condition.

10 We then switch over to Chinook and Coho, and
11 Chinook and Coho samples in July, and we show this
12 in the paper, that the sizes, both in terms of
13 lengths and weight, were very small, and when we
14 make a calculation on condition, the condition
15 also was the lowest in the time series.

16 The Chinook that went to sea in 2007, not all
17 of them will be back. They come back as both,
18 well, mostly fours and fives, mostly. And so we
19 still have to wait to get the final returns for
20 Chinook salmon. The Coho that went to sea in
21 2007, returned in 2008. The returns of Coho in
22 recent years, not so much in the last year, but in
23 recent years, has been very poor, and 2007 was the
24 poorest in the last four or five years, but, you
25 know, that's a little bit of an exaggeration,
26 because the returns are so poor anyhow, having a
27 poor return in a very poor period only indicates
28 that the overall survival was not -- well, was
29 exceptionally bad. So poor growth, poor
30 condition, and poor survival the next year.

31 The final species that was in the surface
32 waters in 2007, was chum salmon. The catches of
33 juvenile chum salmon in 2007 were, I think, the
34 lowest in the time series. The condition was a
35 little bit better, but the abundance of juvenile
36 chum was extremely low.

37 Those chum, most of those chum, or many of
38 those chum, returned in 2010, and in the paper we
39 point out that around B.C. it was publicized in a
40 local paper that the returns to Goldstream were
41 extremely poor. And subsequently, we noticed that
42 the returns to other streams or chum in other
43 streams had also been extremely poor. The data
44 are a little more than preliminary now, and I
45 don't think that people question the data that are
46 available, so I think it's fair to conclude that
47 the chum salmon that went to sea in 2007 had

1 extremely poor survival.

2 So in summary, then, what we saw was all of
3 the species in the surface waters, in the Strait
4 of Georgia in 2007, had extremely poor growth or
5 survival, and I've been in this business about 40
6 years, and I don't know of a situation of such a
7 synchronous failure in year-class strength
8 anywhere. I've given this talk a couple times at
9 workshops and conferences, and there has been a
10 suggestion from the audience about something that
11 might be similar, but I still say that, again,
12 certainly in my experience I hadn't seen anything
13 as remarkable as this.

14 So my conclusion is that this is absolutely
15 outstanding, which was the reason that we wrote
16 this paper. In other words, in my opinion, there
17 was absolutely no doubt that we saw a very
18 anomalous situation in terms of the factors that
19 effect the overall brood year strength of salmon
20 and, in this case, the year-class strength of
21 herring.

22 Now, I'm sorry that too a little longer,
23 but...

24 Q Well, you've kind of eliminated a lot of questions
25 I had for you, so probably, on a balance, it
26 probably works out just fine.

27 Just to pick up on a couple things, you
28 mentioned, though, you said the Coho go out and --
29 so the 2007 Coho came back in 2008. What did you
30 see with respect to the Coho that went out in 2008
31 and came back in 2009? Or have I got that wrong;
32 2007 they were in the Strait of Georgia and they
33 came back in 2009, or 2008?

34 DR. BEAMISH: 2007 came back in 2008.

35 Q Okay. So what did you see with respect to the
36 next couple of years, so 2008 coming back in 2009?

37 DR. BEAMISH: 2008 coming back in 2009, now, the marine
38 survival improved, okay? I can't remember exactly
39 what it was, and it might be in one of the papers,
40 but it went from -- it increased. And I'm
41 predicting three percent survival for this year,
42 in case anyone wants to check.

43 Q One of the things you say in your report is that
44 the - and I'll just take you to it at page 16 -
45 you say that the -- let's find it here. At about
46 lines 315:
47

1 The low volume of fish in the diet and the
2 complete absence of Pacific herring further
3 demonstrate the ecosystem-wide anomaly of 2007
4 and indicate a collapse of the plankton that
5 are normally consumed by larval and juvenile
6 Pacific herring.
7

8 First of all, was that -- did you do any actual
9 plankton surveys in the Strait of Georgia that
10 year?

11 DR. BEAMISH: No. We do not have measurements of
12 plankton or prey abundance.

13 Q Okay. So how did you make that determination,
14 that there had been a collapse of the plankton?

15 DR. BEAMISH: What we have said is that, in the paper
16 by Rick Thomson, where we show that the physical
17 conditions were, again, very anomalous and would
18 be very indicative of poor plankton production,
19 and so because the physical conditions were
20 consistent with what you would expect to result
21 in, well, poor prey production, and then when we
22 then looked at the other end of the relationship
23 that I just described to you, we said that it's
24 most likely that with very poor physical
25 conditions and very poor survival, that it's --
26 the mostly likely explanation is there was a
27 problem with prey production that year. Herring
28 is the best example.

29 Q All right.

30 DR. BEAMISH: So yes, we did not measure plankton
31 production; that's an inference from the other two
32 measurements.

33 Q In Dr. McKinnell's report, at page 102, he
34 references some work by Angelica Peña on
35 phytoplankton in the Strait of Georgia, and in the
36 salmon farmers' list of document, that article by
37 Ms. Peña is actually included. That's at Tab 6 of
38 the salmon farmers' documents. It's the CSAS
39 research document supporting the State of the
40 Ocean Report for the 2007 year. And if you can
41 turn to page 94 of that document. Sorry, 94 as
42 written on the bottom of the page. Thank you.

43 This report looked at phytoplankton in the
44 Strait of Georgia and it says, as you can see in
45 the top paragraph there, that phytoplankton and
46 nitrate concentrations were measured, in the
47 summer of 2007, phytoplankton concentrations were

1 higher at most of the stations, whereas in the
2 fall, phytoplankton concentrations were lower.
3 How does that -- and then it also says, the second
4 sentence says:
5

6 The distribution of phytoplankton and nitrate
7 concentration during winter and spring of
8 2007 was similar to those observed in
9 previous years

10
11 How does that reconcile with your determination
12 that there was a collapse of the plankton?

13 DR. BEAMISH: Well, I don't think this paper is saying
14 that the prey or plankton production was normal.
15 They're saying that -- they're reporting that they
16 had some phytoplankton and nitrate concentrations
17 that were measured, but I'm not aware of any
18 publication that says that within the Strait of
19 Georgia the plankton production in 2007 was
20 normal. And that's not how I interpret this.

21 Now, I want to make another point, too, and
22 that is that even if we had extensive plankton
23 measurements in the Strait of Georgia, it's not a
24 trivial matter to relate plankton production to
25 the prey consumption of fish. But the evidence,
26 in terms of the response of all of the fish in the
27 surface waters that show issue -- I think I forgot
28 to also mention that the Coho and Chinook also had
29 a high percentage of empty stomachs. I mean,
30 there's just no question that these fish were
31 having trouble growing and were not surviving
32 well.

33 So again, when you look at the physical
34 evidence that's in the Thomson paper and you look
35 at the biological evidence from the fish, I think
36 it's most logical that there was something that
37 was very anomalous in terms of the ability for
38 those fish to find food, which is our
39 interpretation, that there was something wrong
40 with the overall production of prey in that spring
41 of 2007.

42 Q All right. But this report by Dr. - I'm not sure
43 if she's a doctor or - Dr. Peña says that the
44 distribution of phytoplankton and nitrate
45 concentrations in 2007's winter and spring were
46 similar to those observed in previous years. Is
47 that not a statement that that is a normal,

1 average --
2 DR. BEAMISH: No, I don't -- I would not interpret that
3 to indicate that what I just said is not right.
4 Q Okay. And then if I could ask you to turn in your
5 own report, which we've now marked as Exhibit
6 1309, at page 46 there's a figure 9 which sets out
7 the different stomach content analysis that you
8 did, and it shows, as you say, the Coho had very
9 high number of empty stomachs, you can see that?
10 DR. BEAMISH: Yes.
11 Q As did the Chinook, chum -- I'm not sure if that
12 shows up for chum, but for sockeye it doesn't seem
13 to show that 2007 is dramatically different than
14 the other years, and the sample sizes are very,
15 very small for sockeye; would you agree with that?
16 DR. BEAMISH: Yeah, there's no question that the sample
17 sizes for sockeye are small.
18 Q And that the stomach content -- percentage of
19 empty stomachs, I should say, is not as
20 dramatically spiked for sockeye --
21 DR. BEAMISH: Well, we're only looking at - I can't see
22 the number exactly - but I recall it being around
23 65 fish. So it's such a -- well, the sample there
24 is 55, but the sample is very small.
25 Q Right, because you would expect millions of
26 juvenile sockeye in the Strait of Georgia, so...
27 DR. BEAMISH: I'm sorry, I can't hear that.
28 Q There's millions of juvenile sockeye moving
29 through the Strait of Georgia, obviously?
30 DR. BEAMISH: Yeah, except that those samples are
31 collected -- in 2007, they were collected in July,
32 about not quite the middle of July, and there
33 would not be that many juvenile sockeye in the --
34 not millions at that time of the year.
35 Q Okay. And certainly the sample sizes are much
36 smaller than what you saw for Coho and Chinook --
37 DR. BEAMISH: That's true, yes.
38 Q -- than any others? Okay. Mr. Commissioner, I
39 see it's 3:05. I don't know if we can press on,
40 or if you want to take an afternoon break now?
41 THE COMMISSIONER: No, we can go to 3:15, that's good.
42 MS. BAKER: Okay, thank you.
43 Q Is one of the assumptions in your report that the
44 freshwater rearing conditions for all of the
45 stocks are similar across all populations?
46 DR. BEAMISH: Well, we make the assumption when we are
47 estimating what the abundance of juveniles might

- 1 be, so yes, we do that. But we make that
2 assumption -- we make two estimates. One, we use
3 -- we make an assumption that you just described,
4 but another assumption, when we estimate how many
5 juvenile sockeye are produced in freshwater, is
6 simply the marine survival estimate that you heard
7 about this morning. So on one estimate, yes, we
8 make the assumption that it's equal amongst all
9 populations, and the other we use a marine
10 survival estimate.
- 11 Q Which is also similar for all populations, or
12 which is unique to each population?
- 13 DR. BEAMISH: It's a marine survival estimate that the
14 Salmon Commission provides, that Dr. McKinnell
15 described this morning.
- 16 Q And you also make the assumption that the sockeye
17 that you capture in your trawl surveys, which, as
18 you indicated, are from the tail end of the run,
19 are representative of conditions of fish
20 throughout the run?
- 21 DR. BEAMISH: I'm not sure I understand that. Just
22 repeat that, please.
- 23 Q Yeah, you make the assumption -- I think you said
24 that the sockeye that you catch are at the tail
25 end of the run --
- 26 DR. BEAMISH: Oh yeah.
- 27 Q -- and so you make the assumption that the
28 condition of those fish is actually representative
29 of the fish throughout the run?
- 30 DR. BEAMISH: At the tail end? No, I wouldn't
31 necessarily make that assumption, not the
32 condition.
- 33 Q Okay. So when you draw some conclusions from your
34 assessment of the condition of the fish you catch,
35 are you saying that the condition of the fish
36 earlier in the run may have been better than what
37 you caught, or worse, or what are you --
- 38 DR. BEAMISH: Well, the -- we use, in the report, we
39 use conditions for Chinook and Coho, in
40 particular, and chum, really. The condition that
41 we use in the report for sockeye, we actually us
42 size and more emphasis on size. Again, the sample
43 sizes are small, but for 2007, we point out that
44 the length of the fish that are caught in Queen
45 Charlotte Sound and then compared amongst the
46 years, and the length of the fish that were caught
47 in the Strait of Georgia, were small in 2007, and

1 that is an indication, recognizing the small
2 sample size, that the fish were probably not
3 growing well.

4 Q I see.

5 DR. BEAMISH: So I guess the answer to your question,
6 then, would be in combination with the
7 measurements that were made in Queen Charlotte
8 Sound and in the Strait of Georgia, recognizing
9 that it was a small sample size, that we use
10 length to indicate that the growth was not good.

11 Q And are you simply referring to the length of the
12 fish caught in the Strait of Georgia, or are you
13 also using these fish caught in Queen Charlotte
14 Sound?

15 DR. BEAMISH: In 2007, we're comparing the sockeye,
16 juvenile sockeye caught in Queen Charlotte Sound
17 and in the Strait of Georgia. There's a
18 complication here, which I should point out, and
19 that is, the fish in Hecate Strait, in Trudel's
20 surveys, are consistently larger than in Queen
21 Charlotte Sound, or in the Strait of Georgia.
22 It's not something that has been dealt with
23 extensively in any publication, but to me it
24 indicates that the fish, the sockeye that swim
25 into Hecate Strait, are definitely larger fish.
26 In other words, they're not typical of what we're
27 seeing in Queen Charlotte Sound or the Strait of
28 Georgia.

29 Q And how long -- we've heard from Dr. Welch, he
30 thinks that juvenile sockeye spend about 15 days
31 or so in the Strait of Georgia, and the Preikshot
32 report we're going to come to, says around 35
33 days. The other fish that you're looking at, the
34 Chinook and the Coho and the chum and the herring,
35 how long do they spend in the Strait of Georgia?

36 DR. BEAMISH: Well, first of all, I think Dr. Welch
37 has already published a paper saying that they
38 stay longer than 15 days. Now, he can correct me,
39 but I think in the -- if I had that paper I could
40 check and see what I said, but I'm guessing that
41 it's somewhere around 25 or 30 days that, in his
42 previous paper that he published, and maybe he can
43 correct me later, but I know it's longer than what
44 he just reported.

45 So you then asked me about the other species
46 and, you know, one of the issues when we wrote
47 this paper on residence time, was coming up with a

1 definition of residence time. We use it rather
2 loosely in biology, and it's not necessarily an
3 easy term to define, so we defined it as the time
4 that 50 percent of the population spent in the
5 Strait of Georgia. And when we looked at that
6 residence time, and I won't get into the details,
7 now, because you're going to ask me about that,
8 but that explanation is relevant to the other
9 species.

10 We know, for example, that Coho stay in the
11 Strait of Georgia well into the fall, so their
12 residence time is considerably longer. Pink
13 salmon, I'm not sure. I'd speculate that we catch
14 pink salmon in the Strait of Georgia when they're
15 there, through to September, but I suspect that a
16 lot of them leave earlier. So I think that the
17 residence time would be a little bit longer than
18 sockeye. Chum, the same, probably, similar to
19 pink salmon, and Chinook is complicated.

20 Very quickly, let me tell you about Chinook
21 salmon, that the juvenile Chinook salmon that
22 enter the Strait of Georgia first. By about
23 August, they have either disappeared or died. By
24 September, roughly 20 percent -- there's only 20
25 percent of the Chinook that entered earlier in the
26 year as juveniles, are still there. We've put
27 some acoustic tags on juvenile Chinook salmon in
28 2007, in the Strait of Georgia, and very few of
29 them passed over the listening lines that Dr.
30 Welch talked about.

31 So Chinook residence time in that first
32 migration is perhaps a little bit longer than
33 sockeye.

34 Q And herring?

35 MR. BEAMISH: Herring, a year or more.

36 MS. BAKER: Mr. Commissioner, I'm going to move to the
37 next report now. Did you want me to start that,
38 or did you want to take the break now.

39 THE COMMISSIONER: Well, we'll take a break, Ms. Baker.

40
41 (PROCEEDINGS ADJOURNED FOR AFTERNOON RECESS)

42 (PROCEEDINGS RECONVENED)

43
44 THE REGISTRAR: The hearing is now resumed.

45 MS. BAKER: Thank you, Mr. Commissioner. I need to
46 mark that last document I took Mr. Beamish to,
47 which was the CSAS research document dated 2008

1 and numbered "/013".

2 THE REGISTRAR: That will be Exhibit number 1310.

3

4 EXHIBIT 1310: State of Physical, Biological
5 and Selected Fishery Resources of Pacific
6 Canadian Marine Ecosystems, 2008 [CSAS]

7

8 MS. BAKER: Thank you.

9

10 EXAMINATION IN CHIEF BY MS. BAKER, continuing:

11

12 Q Now, the next report that I wanted to deal with is
13 the one titled "Anomalous ocean conditions", it's
14 now marked as Exhibit 1303, "Anomalous ocean
15 conditions may explain the recent extreme
16 variability in Fraser River sockeye salmon
17 production" and it, again, perhaps you can give us
18 a brief overview of this report.

19 DR. BEAMISH: And this is the Thomson report?

20 Q Yes.

21 DR. BEAMISH: Okay. Well, first of all, let me -- can
22 everyone hear me? Okay. That Rick Thomson, who
23 some of you know, I think is certainly one of
24 Canada's foremost oceanographers and he literally
25 wrote the book on the Strait of Georgia. What
26 Rick Thomson has done here, he has looked at the
27 -- now, I'm not the best person to go through all
28 of the details of his analysis.

29 Q Well, I'm sorry, I don't mean to interrupt, but --
30 I do mean to interrupt --

31 DR. BEAMISH: No, no, please,

32 Q -- but not in a rude way.

33 DR. BEAMISH: So I'm going to summarize what his
34 contribution is, all right?

35 Q Yeah. I was just going to say if you could give
36 us very much a high overview of what the intention
37 of the report was and then we'll get into some
38 detail.

39 DR. BEAMISH: That's all I can give you. All right?

40 Q Okay.

41 DR. BEAMISH: And it's going to be -- excuse me. There
42 we go. Okay. What Rick Thomson has done, is that
43 -- I do have to tell you a short story, I'm sorry,
44 all right? I have a saying, when Rick Thomson
45 and I disagree on something, he's right. All
46 right?

47 And when we first observed that, we saw

1 these, what I consider to be extremely anomalous
2 conditions in the fish, I called up Thomson and
3 said, "You know, if you can't figure out what's
4 going on in the Strait of Georgia, then I don't
5 think the taxpayers are getting their money from
6 both of us. And he accepted that as a challenge,
7 and that's how these all -- these reports all got
8 started.

9 And starting off with the freshwater
10 discharge. He and Whitfield, if I've got it
11 right, they actually looked at data that were not
12 normally available, and were able to show that the
13 freshwater discharge, not just from the Fraser
14 River, but from all of the small rivers flowing
15 into the Strait of Georgia, was exceptional and
16 was anomalous. And that did result in a very low
17 salinity.

18 He showed that the spring transition on the
19 West Coast which affects the wind directions in
20 the Strait of Georgia were again delayed or
21 anomalous, resulting in winds blowing up the
22 Strait and retaining that freshwater. And he did
23 use the lighthouse data, as well as the Nanoose
24 data, to show that there was this retention of
25 freshwater and that the surface salinity was low.
26 And he did make a calculation of a mixing layer
27 depth, and I believe that he's published the two
28 papers on it. And he did show in his calculation
29 that that mixing layer depth was again anomalous.
30 In fact, if I remember correctly, going back to
31 the '70s, they hadn't seen such a shallow mixing
32 layer depth.

33 So in summary then, he had clearly identified
34 extremely anomalous conditions in the Strait of
35 Georgia in 2007, in the spring, that we consider
36 matches perfectly with what we -- what we would
37 consider to be something that would affect the
38 prey production and then result in the very poor
39 survival that I've already reported.

40 Q And what was observed with respect to conditions
41 in Queen Charlotte Sound for the same years?

42 DR. BEAMISH: Well, you know, again that's all part of
43 this issue. And you've heard already that
44 conditions in Queen Charlotte Sound were anomalous
45 in 2007. And in this paper, we of course agree
46 with that. Now, he argues that the anomalous
47 conditions occurred for different oceanographic

1 reasons and, you know, leave that up to him to
2 describe why. But the bottom line for a biologist
3 like me is that the oceanographic conditions in
4 Queen Charlotte Sound were also anomalous, which
5 resulted in our interpretation that juvenile
6 sockeye entering the Strait of Georgia experienced
7 very poor conditions for growth and survival, and
8 then those conditions were exacerbated when they
9 moved through Queen Charlotte Sound. And in fact,
10 the poor conditions extended right into that
11 winter, and that's what's in that paper.

12 Q Okay. And what about conditions in the Gulf of
13 Alaska in the same year?

14 DR. BEAMISH: In that, in the -- yes, if I remember
15 correctly, that that winter was also a very poor
16 winter. I think it's already been -- I think Dr.
17 McKinnell already described that. So throughout
18 their distribution, beginning in the Strait of
19 Georgia, that the juvenile sockeye experienced
20 extremely poor conditions for survival.

21 Q And I take it you don't rule out the impact of
22 conditions in Queen Charlotte Sound or in the Gulf
23 of Alaska to the marine survival of Fraser River
24 sockeye?

25 DR. BEAMISH: No, not -- no, and, you know, obviously
26 that contributed to the extremely poor returns.
27 But, you know, I guess where the disagreement
28 exists with my colleagues to my left, is that we
29 said that the residence time was appropriate for
30 these fish, consistent with the bulk of the
31 literature, and believe me, there's dozens and
32 dozens of papers that support that interpretation.
33 That the conditions were appropriate, and the
34 residence time for the average juvenile sockeye in
35 the Strait of Georgia in 2007, all of the
36 conditions were appropriate to have this poor
37 survival.

38 And then recognizing that the critical size-
39 period hypothesis acknowledges that mortality does
40 not have to actually occur in the area where that
41 -- where those conditions initially started, you
42 can have mortality in other areas. And I have not
43 read or heard of anyone even talking about the
44 mortality in Queen Charlotte Sound and whatever
45 the residence time there is, you know, it's
46 unclear. But the concept that these fish, already
47 in poor condition - I'm talking about sockeye now

1 - moving through these other areas in the ocean
2 where they would experience equally poor
3 conditions.

4 Q And what is your view, then, of the relative
5 importance to Fraser River sockeye marine survival
6 of ocean conditions in the Strait of Georgia,
7 Queen Charlotte Sound and the Gulf of Alaska?

8 DR. BEAMISH: You know, that's an important question,
9 okay? Because what we're talking about in 2007 is
10 an anomaly, in my opinion. All right? And so
11 when you ask the question like that, that would
12 relate to sort of a general situation, the answer
13 is that to some extent, depending on the year,
14 these areas have importance. The relative
15 importance is maybe a little more difficult to
16 assign, but again, recognizing that huge amounts
17 of mortality occur early. Skipping to the next
18 year, 2008, with the big return in 2010, you would
19 still have large mortalities in the Strait of
20 Georgia, but that was followed by very good
21 rearing conditions in the other areas. So the
22 answer to your question is that depending on the
23 year, those various areas will maybe have
24 different levels of significance in terms of the
25 overall brood year strength.

26 Q And I take it the kind of work that has been done
27 in the Strait of Georgia has not -- and when I'm
28 talking about that, I'm talking about the analysis
29 of the condition of fish, stomach content, et
30 cetera, that you did in the Strait of Georgia,
31 that has not yet been done in the Queen Charlotte
32 Sound to any large degree, aside from the trawl
33 surveys that Marc Trudel has done; is that right?

34 DR. BEAMISH: That's true. And that Marc Trudel's
35 surveys are different than ours. He makes a
36 transect or a single transect and the sample sizes
37 are smaller. He has different objectives.

38 The answer to your question is no, the kinds
39 of surveys that we do in the Strait of Georgia
40 have not been done in Queen Charlotte Sound.

41 Q Okay. And also not further up, for example, at
42 Dixon Entrance or along the coastal Gulf of Alaska
43 or anything like that.

44 DR. BEAMISH: They have been done by the United States
45 scientists in Alaska.

46 Q To the same degree that you've done in the Strait
47 of Georgia?

1 DR. BEAMISH: Yes. Maybe over a bigger area, but to
2 the same degree. Yes.

3 Q And analyzing the relevance to Fraser River
4 sockeye?

5 DR. BEAMISH: No. No. They might have some
6 measurements, but...

7 Q Okay. And you've heard today some discussion
8 about the use of Chilko smolt data as they --
9 smolt data, smolt numbers, I guess, as they leave
10 the lake, and what happens to those smolts as they
11 move through the river on their outward migration.
12 If mortality in the river ultimately was found to
13 be very substantial, would that change your
14 assessment of the importance of the Strait of
15 Georgia in overall marine survival?

16 DR. BEAMISH: No. No, again the - sorry - there's a
17 couple of issues in that question. The assessment
18 that I reported is for 2007, recognizing that that
19 is an extremely anomalous year, all right? Now,
20 what happens to Chilko fish or any juvenile
21 sockeye in the freshwater is of interest. Now,
22 again, the literature recognizes that there is
23 mortality in freshwater, but in general most of us
24 around the Pacific accept that we don't what it
25 is, but we don't think it's a major issue. It may
26 turn out to be a major issue, I don't know, but it
27 would not affect what I reported for the 2007
28 issue.

29 Q Okay. I'd like to move to the next report, which
30 is in our Commission binder at Tab 15. It's
31 Exhibit 1305. And this is the report by -- with
32 Preikshot as the lead author, and it talks about
33 "The residence time of juvenile Fraser River
34 sockeye salmon" and I'm thinking you probably
35 could do a pretty brief overview of this one,
36 because we've touched on some of these issues
37 already, I think, so...

38 DR. BEAMISH: Well, we've already quickly mentioned
39 that -- I've already quickly mentioned that
40 defining residence time is not something that is
41 trivial, in the sense you can just look it up and
42 see what other people have said. But what we did
43 here is that we used the downstream counts at
44 Mission, as well as the Chilko counts, to identify
45 the movement of the juvenile sockeye salmon past
46 these counting sites. Okay? In other words we
47 were able to document the timing of the movement

1 of the juveniles out of the Fraser River,
2 recognizing that Mission is a little bit upstream
3 of the estuary.

4 We then took that distribution and we matched
5 it up with a couple of years, '97 and 2010, in
6 which we actually had surveys in June, so that we
7 could look at the relative abundance, or the
8 catch-per-unit effort of the juveniles. And we
9 identified what was almost a normal curve that was
10 that you had to have a bit of imagination, mind
11 you, but -- and then we matched that up with the
12 downstream migration, and we then estimated that
13 if the downstream migration pattern as it matched
14 what we saw in June in the Strait of Georgia, and
15 then knowing when they exited the Strait of
16 Georgia, which we got from our surveys in July, so
17 we had an entrance time, we had an exit time, we
18 had a mean migration time in the Fraser River
19 itself, and we had an estimate of the mean peak
20 abundance in the Strait of Georgia. We put that
21 all into one paper, came up with about 34 days
22 average.

23 Q Okay.

24 DR. BEAMISH: And I'm talking to my colleague here, and
25 I said that we actually quoted his paper, and
26 abstract from his paper in which he got the same
27 estimate. But I think he wants to defend himself
28 and say that he's probably changed that. But
29 anyhow, that's what he wrote, and our estimate was
30 similar to what he had published, and it wasn't
31 too far from what other people, including Mike
32 Healey and earlier investigators had said. And
33 some people said 30 days, and some people said
34 longer. Thirty-five days seemed to be pretty
35 consistent with what people had said.

36 Q All right. But you would agree, I take it, that
37 there are still some uncertainties with that
38 estimate?

39 DR. BEAMISH: Absolutely. And clearly that kind of an
40 estimate needs to be improved upon.

41 Q In fact, unless we have a consistent survey taken
42 at different parts along the migratory route, it's
43 pretty difficult to actually understand the timing
44 better; is that right?

45 DR. BEAMISH: How you would do that survey is, yes, I
46 think the answer is that you would need a
47 consistent survey. I wouldn't necessarily propose

- 1 to do it exactly the way you said, but it could be
2 done.
- 3 Q And you would --
- 4 DR. BEAMISH: It should be done.
- 5 Q And you would also agree that being able to track
6 individual fish moving through the Strait of
7 Georgia would also be a good way to try and
8 understand better the length of time?
- 9 DR. BEAMISH: Well, I'm not so sure I would agree with
10 that so easily. No. There's some issues there
11 that need to be considered.
- 12 Q Sure. But you would agree that if you could -- if
13 you were satisfied that the tagging was done
14 properly that it would certainly be a good
15 indication of timing?
- 16 DR. BEAMISH: Well, let me answer it this way. If we
17 -- if we put on a tag that we could be absolutely
18 confident in did not alter the behaviour of the
19 salmon, and we used sockeye that were
20 representative of the population of the size
21 range, and we had a listening line at Johnston
22 Strait rather than northern Texada, yes, then that
23 would be useful.
- 24 Q All right. And would you expect tagging to speed
25 fish or slow fish down if it was to have an
26 impact?
- 27 DR. BEAMISH: We're talking about the acoustic tag?
- 28 Q Yes.
- 29 DR. BEAMISH: I can't answer that. I don't know. But
30 there are other ways of tagging fish that would
31 give us that information.
- 32 Q All right. Would you agree that frequent sampling
33 at the mouth of the Fraser and at the north end of
34 Strait of Georgia in May and June when they're
35 moving through would help to identify when the
36 maximum abundance occurred for the Fraser River
37 aggregate?
- 38 DR. BEAMISH: I'm sorry, could you just repeat that
39 again?
- 40 Q Yes.
- 41 DR. BEAMISH: There was too many thoughts there.
- 42 Q Sure. Would you agree that frequent sampling at
43 the mouth of the Fraser and at the north end of
44 the Strait of Georgia in May and June, when the
45 fish are moving through, would help to identify
46 when the maximum abundance occurred for the
47 aggregate?

1 DR. BEAMISH: I would prefer to do the study in
2 Johnston Strait.

3 Q Why is that?

4 DR. BEAMISH: Because they have to leave through
5 Johnston Strait and we would get the -- and it's a
6 site that you could most likely carry on a purse
7 seine survey that would identify the timing when
8 the fish pass by. I just think it's a better
9 site.

10 Q All right.

11 DR. BEAMISH: I think it's easier to do, and it's --
12 and you would have to repeat it over a number of
13 years.

14 Q And you'd have to do it frequently?

15 DR. BEAMISH: Yes, over a number of years.

16 Q Yeah, but frequently within the season, I should
17 say.

18 DR. BEAMISH: Yes. Now, I would combine that with I
19 believe it was Dr. Welch earlier, that in one of
20 your questions, said that sampling at Mission,
21 sampling juvenile sockeye, absolutely. I have
22 suggested that before. We have that site where we
23 sample pink salmon, and if I remember correctly,
24 that's done only in the years that juvenile pink
25 salmon are migrating, which is in even-numbered
26 years. And I agree with Dr. Welch, that to extend
27 that sampling to all years, and to couple it with
28 DNA would give us a lot of information that we
29 need. You could most likely get an abundance
30 estimate out of it, too, and you would tell us the
31 stock timing or the population timing, and it
32 would give us a good estimate of the relative
33 abundance of juveniles coming down the river, and
34 then compare that with something in Johnston
35 Strait, and that would be an excellent study.

36 Q All right. Are you aware of work being done by
37 some members of the Stock Assessment Group in
38 Department of Fisheries and Oceans to sample
39 Fraser smolt out-migrants in the lower estuary
40 this year?

41 DR. BEAMISH: I retired a little while ago, so no one
42 tells me anything any more. That's fine. I like
43 that, actually.

44 I'm vaguely aware of it. The information
45 that I had originally was that it was a valiant
46 effort, but not large enough to really give us the
47 kind of thing that we need to know.

1 Q All right. But you would --
2 DR. BEAMISH: But remember, I'm guessing a little bit.
3 Q You would agree then, I take it from what you've
4 just said, that a sampling program at Mission as
5 described a little bit by Dr. Welch would be
6 beneficial in understanding the ocean impacts.
7 DR. BEAMISH: More than that, I think it's invaluable.
8 Q Okay. And you recall earlier today Mr.
9 Commissioner asked Dr. McKinnell whether there
10 should be additional work done in freshwater lake
11 assessment before we start moving into more marine
12 assessment. Do you have any thoughts on that?
13 DR. BEAMISH: Well, I would have answered the question
14 exactly how we just answered it. I would have
15 said that, you know, that carrying on the work at
16 Chilko is obviously very important. But I would
17 -- my next priority would be the Mission count.
18 That's how I would answer that. And I think it --
19 I think it will work fine, and I don't think it's
20 all that expensive.
21 Q And we don't need to do further lake assessment,
22 smolt outmigration at the lakes?
23 DR. BEAMISH: Well, you know, that's a little bit
24 unfair to the people who do that for a living, but
25 in terms of you -- you know, money's tight and in
26 terms of priorities and some of the other things
27 that have to be done, that my highest priority
28 would be to do the Mission one.
29 Q Thank you. I'd like to move to the last report
30 that I want to cover with you today, and that's
31 Exhibit 1307. It's at Tab 16 in the Commission's
32 documents. And this one is titled "A late ocean
33 entry life history type has improved survival for
34 sockeye and chinook salmon in recent years in the
35 Strait of Georgia", and you're the lead author on
36 this one?
37 DR. BEAMISH: Yes.
38 Q All right. Again I'm conscious of time. I'm
39 wondering if we can get a brief overview of what
40 this work was about and what you found.
41 DR. BEAMISH: Can you give me an idea of how many
42 minutes you want?
43 Q Well, I could just go through my questions, and
44 maybe that would be a bit faster.
45 DR. BEAMISH: Okay. I'll give you -- I'll try.
46 Q Okay. First of all, Harrison River fish have been
47 identified as having a different life history than

1 other sockeye. We've heard that already. In your
2 work that's reflected in this document and
3 otherwise, have you -- well, let me just ask you
4 this. In your work that looked at the 2007 and
5 the 2008 conditions in the Strait of Georgia, were
6 Harrison River sockeye affected in the same way as
7 other sockeye?

8 DR. BEAMISH: No, I don't think so. The -- we've heard
9 a little bit about Harrison sockeye, and what this
10 -- what this paper does is it also includes what
11 we call South Thompson River chinook salmon, and
12 again if I remember correctly, it's about 14
13 populations or stocks that compose that aggregate.
14 And they also enter the Strait of Georgia much
15 later, so the chinook enter later than the -- all
16 of the other chinook. And they're doing very
17 well. So the -- and then I think I said six to
18 eight weeks later for Harrison.

19 Very quickly, we know that because now they
20 -- they do maybe, and actually I think Dave Levy,
21 who is in the audience somewhere, did some of the
22 original work on this. But we know that they're
23 in the estuary, and the timing that they're in the
24 estuary, maybe we don't know that exactly. But we
25 know that they move from the estuary, a lot of
26 them move into Howe Sound, and then by late July
27 or mid-August they are in the open Strait of
28 Georgia, and then by September they're quite
29 abundant. And then we know from the returns that
30 they're coming back.

31 But this is where the condition that we
32 talked about earlier, I think is relevant. Here
33 are sample size is much larger in September. And
34 when we look at the condition of these juvenile
35 sockeye in September in the Strait of Georgia, now
36 and we compare it to the condition in July, now
37 there's a bit of a problem in making that
38 comparison, but the fish are in much better
39 health. In other words, they're fat little guys
40 that look like they're well fed and having a nice
41 time swimming around the Strait of Georgia.

42 So it is the conditions improve in the Strait
43 of Georgia for these late ocean entry fish. It
44 could be in 2007 that they probably couldn't get
45 any worse, but in general the conditions I think
46 are better in part because a lot of the juvenile
47 salmon are leaving the Strait so there's less

1 competition for food. But I also think that
2 there's also -- we're seeing increases in
3 production. So we showed that the late ocean
4 entry, what I call life history type rather than
5 ecotype, but what I call life history type, we
6 showed that that consistently is producing better
7 survival.

8 Q I just have a couple of questions just following
9 up on the critical size, critical period
10 hypothesis. And I think I did ask you some
11 questions already about the kind of work that's
12 been done in some of these other areas like Queen
13 Charlotte Sound. I'm not sure if I asked you if
14 you've done -- if any work's been done to
15 determine residence time in the Queen Charlotte
16 Sound area.

17 DR. BEAMISH: No, I don't think there has been. There
18 was, you know, some reference to it, but it's part
19 of this issue, and they, I would assume, that once
20 juvenile salmon start their migration that they're
21 going to continue on that migration. So
22 recognizing that conditions in Queen Charlotte
23 Sound in 2007 were also anomalous, indicating that
24 there was poor feeding conditions, I'm guessing
25 that the residence time in Queen Charlotte Sound
26 is much shorter than the Strait of Georgia. Now,
27 it's a guess. All right? But if someone has
28 data, that would be very interesting to see. I've
29 never seen it.

30 Q And why would you say it would be longer -- or
31 shorter, excuse me, in Queen Charlotte Sound than
32 the Strait of Georgia?

33 DR. BEAMISH: Because they've already started their
34 migration. They've -- you know, they've left the
35 Fraser River. They have to make an adjustment to
36 the salinity. I suppose I was trying to keep this
37 short, so I'm going to have to tell you a little
38 bit more.

39 In looking at the residence time, and looking
40 -- I actually made an estimate of the ocean entry
41 time, and I did that by looking at the otolith.
42 And if you -- the otolith of the fish, which is an
43 ear bone, it records the daily growth in like
44 lines like you would see on a -- on something that
45 you would purchase, all right? And we were able
46 to identify the freshwater lines of growth, a
47 period in which there was an adjustment the fish

1 was making to the marine environment. So there
2 was an amorphous material in the otolith that
3 didn't have any structure to it. And then you
4 would see the first distinct annulus, or I'm
5 sorry, circulus -- I'm sorry, daily growth ring,
6 all right, or zone on the otolith. And then you
7 could count the number of daily growth zones on
8 that otolith and then you would count back from
9 the day that you caught it.

10 I'm telling you that because you could then
11 identify when the lake type first entered the
12 ocean, and then when the -- and when the late
13 ocean entry type entered the ocean.

14 Q Okay. But in if -- it may show that, it may show
15 that they've been in the water for a month or six
16 weeks, but I don't -- are you telling me that
17 those otolith markings can tell us what days they
18 spent in the Strait of Georgia versus Queen
19 Charlotte Sound, or anything like that?

20 DR. BEAMISH: No. No, that -- you're right, that
21 doesn't tell us how long they spent in the Strait
22 of Georgia, but it does tell us when they started
23 to feed. And if we know that on average they
24 passed Mission in say mid-May, all right, or that
25 all of them were past Mission by the end of May,
26 and if the first feeding checks are mid-June, you
27 know that there was a period of two weeks in which
28 they were adjusting to the -- now, there would be
29 some feeding, all right, but there wouldn't be the
30 prominent feeding that you would expect.

31 And that's a bit -- I probably used some
32 timeframes there that are not consistent. It
33 wouldn't be two weeks. It would be, you know,
34 maybe five or six days.

35 So it gives you an indication of the time, or
36 what the -- what the fish was doing when it left
37 -- as it was leaving freshwater and before it
38 started to feed in the Strait of Georgia.

39 Q All right. But it doesn't actually tell us how
40 long they were in the Strait of Georgia, or how
41 long they were in Queen Charlotte Sound, or Hecate
42 Strait, or Dixon Entrance.

43 DR. BEAMISH: No. No, it doesn't say anything about
44 Queen Charlotte Sound or Hecate, or the Strait of
45 Georgia.

46 Q Okay.

47 DR. BEAMISH: And that, you know, I think that the data

1 that we get from Marc Trudel's survey indicates
2 that what is the sockeye, juvenile Fraser River
3 sockeye that are in Hecate Strait, are different
4 than the juvenile sockeye that we find in Queen
5 Charlotte Sound. They're smaller. I didn't get
6 into this, but we do have DNA stock composition,
7 and there are some anomalies there. In other
8 words, the fish from the Fraser that are in Hecate
9 Strait are not necessarily the same stocks that we
10 find in Queen Charlotte Sound.
11 Q And how many days does Marc Trudel do his surveys
12 each year?
13 DR. BEAMISH: It changes, but over the years that he's
14 been doing it, he had one or two days, maybe two
15 days in the Hecate Strait area, Queen Charlotte
16 Sound one day, and I think he's added something to
17 Queen Charlotte Strait, one in Queen Charlotte
18 Sound, but he's just changed a little bit. He's
19 probably added a day or two to it.
20 Q It's a pretty small amount of surveying.
21 DR. BEAMISH: It's a small amount, but he has a big
22 area to cover. But the work that he's done has
23 been very useful. You've heard people use it
24 routinely.
25 Q Earlier in these hearings an exhibit was marked
26 which is now -- which is a 2009 briefing note in
27 relation to the poor returns that came back in
28 2009. And that's Exhibit 616A. All right. Are
29 you familiar with this briefing note?
30 DR. BEAMISH: Only since someone sent it to me in a
31 binder.
32 Q So you were not involved in the preparation of
33 this?
34 DR. BEAMISH: It's December 2009, is that what that --
35 Q That's what it says.
36 DR. BEAMISH: -- December 3rd?
37 Q Yes.
38 DR. BEAMISH: No, I don't think so.
39 Q All right. Could you turn to --
40 DR. BEAMISH: There's a small problem here. I'd better
41 take a -- should I take a couple of minutes and
42 tell you what the problem is?
43 Q Okay.
44 DR. BEAMISH: About this time, a few weeks after that
45 in early January I did have a medical problem, and
46 because my wife knew CPR and some paramedics knew
47 what they were doing, and an emergency room doctor

1 and some intensive care doctors, I was able to
2 actually be here today. But I did lose some
3 memory. I was on ice for a while. And so there's
4 some things I don't remember about this time. I
5 don't remember this at all.

6 Q Okay. You may not be able to answer these
7 questions, but if I could just -- I'll just try
8 and see. Could you turn to page 2? Thank you.

9 THE COMMISSIONER: Ms. Baker, I have a telephone
10 conference meeting --

11 MS. BAKER: Oh.

12 THE COMMISSIONER: -- at 4:00, and I don't want to --
13 if you're going to start into a new area, or go to
14 some areas, I think it might...

15 MS. BAKER: Yeah, I have maybe ten minutes of questions
16 left, so I'm afraid we'll have to come back, I
17 guess, tomorrow with that.

18 THE COMMISSIONER: All right. But you have a
19 different panel at 9:15, I understand?

20 MS. BAKER: We have the continuation of the gravel
21 panel at 9:15 tomorrow.

22 THE COMMISSIONER: Until 10:00, is that correct?

23 MS. BAKER: Well, I mean, we may get through it sooner,
24 in which case we might be able to start with these
25 witnesses sooner, which would be great. So we are
26 reconvening at 9:15 tomorrow.

27 THE COMMISSIONER: All right, then, perhaps just warn
28 them that if they came a little bit earlier, they
29 might get on...

30 MS. BAKER: Yes, I will.

31 THE COMMISSIONER: Thank you. Thank you very much.

32
33 (PROCEEDINGS ADJOURNED TO JULY 7, 2011 AT
34 9:15 A.M.)
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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.

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