

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



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

Public Hearings

Audience publique

Commissioner

L'Honorable juge /
The Honourable Justice
Bruce Cohen

Commissaire

Held at:

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

Monday, October 25, 2010

Tenue à :

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

le lundi 25 octobre 2010

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Chris Buchanan	B.C. Public Service Alliance of Canada Union of Environment Workers B.C. ("BCAUEW")
David Burse	Rio Tinto Alcan Inc. ("RTAI")
Alan Blair	B.C. Salmon Farmers Association ("BCSFA")
Michael Walden	Seafood Producers Association of B.C.
Christopher Sporer	("SPABC")
Gregory McDade, Q.C.	Aquaculture Coalition: Alexandra
Lisa Glowacki	Morton; Raincoast Research Society; Pacific Coast Wild Salmon Society ("AQUA")
Margot Venton	Conservation Coalition: Coastal Alliance
Tim Leadem	for Aquaculture Reform Fraser Riverkeeper Society; Georgia Strait Alliance; Raincoast Conservation Foundation; Watershed Watch Salmon Society; Mr. Otto Langer; David Suzuki Foundation ("CONSERV")
Don Rosenbloom	Area D Salmon Gillnet Association; Area B Harvest Committee (Seine) ("GILLFSC")

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David Butcher	Southern Area E Gillnetters Assn. B.C. Fisheries Survival Coalition ("SGAHC")
Christopher Harvey	West Coast Trollers Area G Association; United Fishermen and Allied Workers' Union ("TWCTUFA")
Keith Lowes	B.C. Wildlife Federation; B.C. Federation of Drift Fishers ("WFFDF")
Tina Dion Joseph Arvay	Maa-nulth Treaty Society; Tsawwassen First Nation; Musqueam First Nation ("MTM")
David Robbins Gary Campo John Gailus Robert Janes Karey Brooks	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	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)
Barbara Harvey Rob Miller	Adams Lake Indian Band Carrier Sekani Tribal Council ("FNC")
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APPEARANCES / COMPARUTIONS, cont'd.

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Nicole Schabus

Sto:lo Tribal Council
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Allan Donovan
R. Keith Oliver
Steven Kelliher

Laich-kwil-tach Treaty Society
James Walkus and Chief Harold Sewid
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Lisa Fong
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Heiltsuk Tribal Council ("HTC")

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Opening remarks by Commissioner Cohen

Vancouver, B.C. /Vancouver (C.-B.)
October 25, 2010/le 25 octobre 2010

1
2
3
4 THE REGISTRAR: Cohen Commission is now resumed.
5 Commissioner Cohen is presiding.

6 THE COMMISSIONER: Good morning. Before I call upon
7 Mr. Wallace, I wish to make some brief opening
8 comments. The reasons for this inquiry are well-
9 known to us all. The steady and profound decline
10 in Fraser River sockeye has made it important to
11 thoroughly investigate the reasons for the decline
12 and the long-term prospects for Fraser sockeye
13 stocks, as well as to address the management of
14 the fishery.

15 This year's extraordinary return of in excess
16 of an estimated 30 million sockeye to the Fraser,
17 the largest in decades, has renewed hope for the
18 sustainability of the species; while at the same
19 time has raised new questions surrounding the
20 issues relating to past declines. Obviously the
21 declines, which triggered this inquiry, must now
22 be investigated and assessed in the context of
23 this year's exceptional result.

24 In the past months the commission's legal and
25 science teams and our administrative staff have
26 been working very hard in preparation of this
27 milestone in our activities, namely the
28 commencement of our evidentiary hearings. In the
29 weeks leading up to today, the commission has
30 conducted ten public forums on the mainland and
31 Vancouver Island. These forums have been very
32 well-attended and many in attendance have
33 presented articulate, sincere and fulsome oral and
34 written submissions covering most, if not all, of
35 the issues being investigated by the commission.
36 While these submissions have at times been
37 critical of all of the stakeholders in the inquiry
38 process, all have shared a common and at times
39 passionate commitment to the sustainability of
40 Fraser sockeye salmon, and many have offered
41 important insights into the issues under
42 investigation.

43 In addition to the public forum, the
44 commission made 14 site visits. The first site
45 visit was to view a First Nation driftnet fishery
46 at Cheam Beach near Agassiz which was followed by
47 visits to hydro-acoustic counting stations,

Opening remarks by Commissioner Cohen

1 hatcheries, land and ocean-based salmon farm
2 facilities, a First Nation dip net fishery and
3 traditional fish drying practices, operating and
4 historic canneries, a museum addressing all of the
5 aspects of the history surrounding the salmon
6 fishing industry in this province, a pulp mill, a
7 sockeye randomization project and spawning
8 grounds. The final public forum held in Kamloops
9 this past week was followed by a visit to the
10 amazing site at the Roderick Haig-Brown
11 Interpretation Centre on the Adams River where we
12 all viewed first-hand the majesty and wonder of
13 the thousands of sockeye who have returned to
14 their spawning grounds in this most beautiful of
15 wild rivers to carry out a ritual of rebirth that
16 is thousands of years old.

17 In every public forum we were welcomed by a
18 First Nations elder who underscored the importance
19 of our work to that First Nations territory and
20 which launched the presentations from a truly wide
21 cross-section of interested public. I am grateful
22 to those who attended the public forums, including
23 those participants and their counsel who were able
24 to attend. I am also grateful to all of the hosts
25 of our site visits who were so gracious with their
26 time and hospitality while they explained in
27 detail their operations and practices and helped
28 to educate me, commission staff and the
29 representatives of the participants in attendance
30 on the many elements and facets involved in the
31 different aspects of the fishery.

32 For me, it was an honour and a privilege to
33 have the opportunity to travel to many locations
34 in the Fraser watershed and along sockeye
35 migratory routes where the Fraser sockeye has
36 played a key role in the cultural, social and
37 economic fabric of these communities and where
38 there is a commitment to preserving this iconic
39 fish in the interests of all British Columbians
40 and Canadians. On a personal note, I was often
41 moved by the warmth and passion with which
42 presenters made their submissions at the public
43 forums, addressing the sustainability of the
44 Fraser sockeye.

45 I observed commercial fishers heading out for
46 the openings and returning with their catches. I
47 observed sport fishers on the Fraser and along the

Opening remarks by Commissioner Cohen

1 coast. I observed the joyful atmosphere on the
2 Steveston dock this summer as the fishers and
3 public came together to celebrate the large return
4 of Fraser sockeye.

5 I was particularly moved by the openly
6 expressed excitement of the scores of young
7 children on school field trips to the Weaver Creek
8 spawning grounds and the Adams River as they
9 watched in awe the spawning habits of thousands of
10 Fraser sockeye. This emphasized to me the
11 importance of this inquiry and how its outcome
12 will resonate with future generations of citizens
13 who deeply appreciate the work that is being done
14 to research and observe the Fraser sockeye in the
15 context of the human and environmental impacts
16 upon their survival.

17 Along with the education I received as part
18 of my attendance at the public forums and site
19 visits, I also came away with a sense of the
20 complexity of the issues being investigated and
21 the challenges we all face in addressing those
22 issues within a short timeframe and with limited
23 resources. The submissions we have received at
24 the public forums and on our website will no doubt
25 help to enlighten us on the issues at hand, as
26 will the review and research of the many
27 scientists who will soon be filing their reports.
28 In this regard the hearings will be informed by
29 the results of as many as a dozen contracted
30 research projects being undertaken by leading
31 salmon biologists and aquatic scientists.

32 It is within this context that information
33 and preparation that we commence the evidentiary
34 hearings which will hear from many witnesses over
35 the coming weeks, giving their testimony covering
36 the areas that the inquiry is mandated to
37 investigate. All of this past work and the future
38 work of the commission has been and will be
39 conducted not to seek to find fault on the part of
40 any individual community or organization, but with
41 the overall aim to respect the conservation of
42 Fraser sockeye salmon and to encourage broad
43 cooperation among the stakeholders.

44 At this point I wish to express my
45 appreciation to the participants and their counsel
46 who have worked diligently in preparation for the
47 hearings in the spirit of cooperation that is

Opening remarks by Commissioner Cohen
Opening remarks by Commission counsel

1 expressed in the commission's mandate. It goes
2 without saying that this proceeding is not a trial
3 but an inquiry with a specific purpose, set of
4 goals and strict limits on time and resources that
5 I believe can be achieved with the continuing
6 cooperation of all involved in the process.

7 Time and again at the public forums and at
8 the site visits, I heard the expression that "we
9 are all in this together and must work in unison
10 if we are to ensure the survival of Fraser
11 sockeye". I was struck by the common will to do
12 what is necessary to conserve Fraser sockeye and I
13 remain cautiously optimistic that while principled
14 and reasonable people may disagree on the process
15 or the path to achieving this result, that
16 nevertheless with a collaborative effort, answers
17 can be found and recommendations achieved to
18 address the concerns of everyone involved in the
19 process.

20 In saying this, I am old enough and hopefully
21 wise enough to be under no illusions about the
22 difficult issues we face together and the
23 different viewpoints and solutions which exist
24 amongst the stakeholders in this process. But I
25 firmly believe that all are committed to
26 implementing steps towards achieving the goal of
27 securing a sustainable Fraser sockeye salmon
28 resource for all of the generations to come.

29 Finally, I wish to say that the commission's
30 interim report which will be filed with the
31 government on October 29th will contain a thorough
32 listing and summary of the reports which over the
33 decades have dealt with some or many of the issues
34 this commission is mandated to investigate. These
35 past reports have served as a valuable background,
36 context and resource to me and commission staff;
37 however, the findings of fact, conclusions and
38 recommendations that I am directed to deliver as
39 part of the mandate of this commission will be
40 based on the whole of the evidence gathered in
41 this inquiry process.

42 Thank you all for being here this morning,
43 for your patience in listening to my comments. I
44 now invite Mr. Wallace to get the proceedings
45 underway.

46 MR. WALLACE: Thank you, Mr. Commissioner. Good
47 morning. My name is Brian Wallace and I'm senior

Opening remarks by Commission counsel

1 commission counsel and I would ask -- what I'm
2 about to say is really just a number of
3 housekeeping things. The first one is that we'd
4 ask you to introduce yourself each time you come
5 to the mike, even though you're all becoming more
6 and more familiar to us all. We need to have a
7 record that clearly identifies who is speaking, so
8 I'd ask you to do that.

9 I just have a couple of things to say. This
10 week is really just an introductory overview week.
11 Today we start with a primer on the lifecycle of
12 the Fraser sockeye and that is essentially the
13 first building block to establishing our -- the
14 evidence in this commission. Tomorrow and
15 Wednesday participants will have the opportunity
16 to make submissions on the aboriginal and treaty
17 rights framework that informs decision-making on
18 Fraser sockeye and on Thursday and perhaps Friday
19 we will hear from four witnesses who will provide
20 their perspectives on the meaning of conservation
21 in the context of the Fraser sockeye. I just
22 remind you that detailed evidence will be called
23 later in the hearings, the things that will be
24 raised this week, and as such it's our expectation
25 that examination by participants on these issues
26 this week will be limited, if any.

27 A couple of things I'd like to mention. Each
28 week I plan to update the hearing schedule. You
29 received an updated hearing schedule on Friday and
30 any week in which there has been changes made to
31 what's coming up or additions, we will again
32 circulate a new revised hearing schedule on Friday
33 afternoons. One thing about documents. We hope
34 to run this inquiry as mainly a paperless hearing.
35 Exhibits will be tendered through Ringtail, so
36 that participants will all have access to them
37 that way.

38 Please try to give John Lunn, our hearing
39 coordinator, advance notice of documents that you
40 wish to put to a witness. If a document is not in
41 Ringtail, commission staff will need to scan it
42 and enter it so again, advance notice would be
43 very helpful. There will be a file in Ringtail
44 field for exhibits which should make searching
45 easy.

46 Last Friday I also circulated a note on
47 hearing process overview. I'd ask you to review

Opening remarks by Commission counsel

1 that. It covers a number of issues that we think
2 may come up. For example, it sets out the order
3 for cross-examination and submissions, the default
4 order. We leave it open to participants to
5 negotiate changes if they wish to do that and to
6 advise again John Lunn in advance.

7 Now, these plans, of course, will not hold up
8 ultimately because there will be lots of things
9 that will intervene and I would be pleased to hear
10 from anyone at any time during the course of this
11 as to how you think we might make this work more
12 effectively. At the end of the day, we all want
13 this to be efficient and for the commissioner to
14 have the information and submissions he needs in
15 as straightforward a way as possible.

16 Those are my opening remarks and I -- again,
17 I'd be pleased to speak to any participants about
18 how we might better organize things. At that
19 point, Mr. Commissioner, I would introduce Wendy
20 Baker, who will introduce our first panel.

21 MS. BAKER: Thank you. Mr. Commissioner, what we have
22 intended to do on our first day is have three
23 Fisheries biologists come and speak to the
24 commission about the lifecycle of the salmon.
25 What I intend to do is qualify each of the
26 witnesses, then each witness will produce -- will
27 go through the PowerPoint presentation. They've
28 each prepared a PowerPoint presentation. They'll
29 go through that pretty much on their own, and
30 we'll do all three PowerPoints in sequence and
31 then the witnesses will be available for cross-
32 examination. We will mark the PowerPoint
33 presentations as exhibits as we go through.

34 We have, just by way of overview, we have Mr.
35 Mike Lapointe here to talk about the overview of
36 the Fraser sockeye in the fresh water beginning
37 phase of their life; Dr. Welch to talk about the
38 marine phase of Fraser River sockeye and Mr.
39 English, who will be talking about the migration
40 of Fraser River sockeye through -- from Alaska to
41 their spawning destinations.

42 So I'll start -- we have one other point, we
43 have the three witnesses sitting as a panel and
44 they do have a mike that is on them that -- so
45 which will allow them to walk around if they want
46 to go to the PowerPoint presentation and point
47 things out. They've suggested that might be

Panel No. 1 affirmed
David Welch
In chief on qualifications by Ms. Baker

1 useful for them, so they're -- they may be doing
2 that, if there's no objection. The PowerPoints
3 will be shown on all of the monitors around the
4 room as they go through their evidence.
5 So I'll start with qualifying Mr. Welch to
6 begin. Mr. Welch will be --
7 THE REGISTRAR: Excuse me --
8 MS. BAKER: You need to affirm all these people? We'll
9 do that and then I will begin the qualifications.
10 THE COMMISSIONER: Yes, Gentlemen, I need you to stand,
11 please.
12 THE REGISTRAR: Do you solemnly affirm that the
13 evidence to be given by you to this hearing shall
14 be the truth, the whole truth and nothing but the
15 truth?
16 Witness number 1, how do you respond?
17 DR. WELCH: I do.
18 THE REGISTRAR: Witness number 2?
19 MR. LAPOINTE: I affirm.
20 THE REGISTRAR: Witness number 3?
21 MR. ENGLISH: I affirm.
22 THE REGISTRAR: Witness number 1, would you state your
23 full name?
24 MR. WALSH: My name is David Warren Welch.
25 THE REGISTRAR: Thank you. Witness number 2?
26 MR. LAPOINTE: Michael Francis Lapointe.
27 THE REGISTRAR: Thank you. Witness number 3?
28 MR. ENGLISH: Karl Christopher English.
29 THE REGISTRAR: Thank you. You may be seated,
30 Gentlemen. Thank you.
31 MS. BAKER: I'll start with Witness Number 1, Mr.
32 Welch.
33
34 EXAMINATION IN CHIEF ON QUALIFICATIONS OF DAVID WELCH
35 BY MS. BAKER:
36
37 Q You have a degree from the -- a B.Sc. from the
38 University of Toronto in Biology and Economics?
39 A Correct.
40 Q And a Ph.D. in Oceanography from Dalhousie
41 University?
42 A Correct.
43 Q You are the president and CEO of a company called
44 Kintama Research Corporation; is that right?
45 A Yes, it is.
46 Q And you are the chief architect of POST OTN array
47 and can you describe what that is?

Panel No. 1

David Welch

In chief on qualifications by Ms. Baker

1 A It's a marine telemetry array to measure the
2 movements, migration and survival of fish such as
3 salmon.

4 Q Okay. And over your career, you have published
5 many articles in peer-reviewed publications; is
6 that correct?

7 A Yes.

8 Q Including such papers as a paper in 1998 *Thermal*
9 *Limits in Ocean Migrations of Sockeye Salmon*?

10 A Yes, I did.

11 Q Okay. And in 2004 *Early Ocean Survival and*
12 *Comparative Marine Movements of Hatchery and Wild*
13 *Juvenile Steelhead*?

14 A Correct.

15 Q And other -- many, many other peer-reviewed
16 publications; is that correct?

17 A Yes.

18 Q And you've also received a number of awards and
19 recognitions for your work with respect to sockeye
20 and other fish in the Pacific Northwest; is that
21 right?

22 A Yes, it is.

23 Q All right. Including Prix d'Excellence from
24 Fisheries, Oceans in Canada in 2008 and 2007,
25 dealing with the POST project which you described
26 earlier?

27 A Well, that's actually incorrect. There's two
28 different awards, but it was for my global warming
29 and thermal limits work from the 1990s.

30 Q Okay. But you have lectured, of course, on POST
31 at various conferences and other...?

32 A Yes, many times.

33 Q Okay. And you have -- your research has been
34 highlighted on Knowledge Network TV and in other
35 forums?

36 A Yes, it has.

37 MS. BAKER: Mr. Commissioner, would you like me to
38 qualify the witnesses individually or to go
39 through the qualifications of all three and ask
40 them all to be qualified at once?

41 THE COMMISSIONER: I think it would be just as
42 efficient and convenient to do all three now and
43 come back to each one for their PowerPoint
44 presentations.

45 MS. BAKER: Okay. Thank you. Next I would ask --
46 sorry. I'll wait till the end.

47

Michael Lapointe

In chief on qualifications by Ms. Baker

Karl English

In chief on qualifications by Ms. Baker

1 EXAMINATION IN CHIEF ON QUALIFICATIONS OF MICHAEL
2 LAPOINTE BY MS. BAKER:
3

4 Q Mr. Lapointe, you have a Master's in Zoology from
5 the University of British Columbia?

6 A That's correct.

7 Q And you currently work at the Pacific Salmon
8 Commission; is that right?

9 A That's correct.

10 Q As the chief biologist?

11 A That's correct.

12 Q And you've been a biologist with the Pacific
13 Salmon Commission since 1992?

14 A That's correct.

15 Q You also have published many articles on salmon
16 and salmon biology?

17 A Not quite as many as David but yes, I have.

18 Q Including publications on stock identification of
19 Fraser River sockeye using micro-satellites and
20 major histocompatibility complex variation is one?

21 A Yes, that's an example, yes.

22 Q And abnormal migration timing is another area
23 you've published on?

24 A That's correct.

25 Q Okay. Papers with respect to DNA identification
26 of salmon stocks?

27 A That's correct.

28 Q Okay. And many other -- many other topics.

29 A Yes, that's correct.

30 Q And you've spoken widely on Pacific salmon biology
31 and particularly the Fraser River sockeye salmon?

32 A Yes, I have.

33 MS. BAKER: Okay. Thank you.
34

35 EXAMINATION IN CHIEF ON QUALIFICATIONS OF KARL ENGLISH
36 BY MS. BAKER:
37

38 Q Mr. English, you're a fisheries scientist. You've
39 been a fisheries scientist for 29 years?

40 A That's correct, yes.

41 Q And you are the senior fisheries scientist -- or
42 a senior fisheries scientist with LGL Ltd.?

43 A Yes, that's right.

44 Q And what is that company?

45 A It's a private consulting company operating
46 Canada-wide and in the U.S.

47 Q And is your work with LGL, does it include work on

Panel No. 1

Karl English

In chief on qualifications by Ms. Baker

1 Pacific salmon fisheries?

2 A Yes, quite extensive, almost all that 29-year
3 period has been spent on Pacific salmon.

4 Q Okay. And you have designed and implemented
5 studies to improve the quality and quantity of
6 information available for management and
7 assessment of Pacific salmon?

8 A That's correct.

9 Q Okay. And you have done projects throughout B.C.
10 and Washington State, Alaska and the Yukon on
11 salmon?

12 A That's correct.

13 Q All right. You have also -- have a Masters in
14 Zoology from the University of British Columbia?

15 A Yes, that's correct.

16 Q And a B.Sc. in Aquatic Sciences from Cornell
17 University?

18 A That's also correct.

19 Q And do you have any publications in peer-reviewed
20 publications?

21 A Yeah, there's quite a variety spanning from
22 juvenile fish feeding studies right through to
23 Fraser sockeye studies, very similar to the
24 information I'll be presenting today.

25 MS. BAKER: Mr. Commissioner, I would ask that all
26 three of these gentlemen be qualified as experts
27 in fisheries biology.

28 THE COMMISSIONER: Yes. I think perhaps because I'm
29 used to a different forum, Ms. Baker, that before
30 I qualify them, I would offer to participants --

31 MS. BAKER: Absolutely.

32 THE COMMISSIONER: -- and I would ask Mr. Wallace if
33 this would be appropriate, the opportunity to
34 cross-examine on qualifications.

35 MR. WALLACE: Clearly, Mr. Commissioner, if there's an
36 objection or someone wishes to challenge
37 something, this is the appropriate time to do
38 that.

39 THE COMMISSIONER: Are there any of the participants'
40 counsel who wish to ask any questions of these
41 three witnesses at this time? If not, then I'm
42 content, Ms. Baker, to qualify them in the areas
43 of expertise which they have just addressed.

44 MS. BAKER: Thank you.

45 THE COMMISSIONER: Thank you.

46 MS. BAKER: So the first witness will be Mr. Lapointe,
47 who will be providing a PowerPoint presentation on

Panel No. 1
Michael Lapointe
In chief by Ms. Baker

1 the Fraser River sockeye freshwater life history.

2 And if that could be brought up.

3 MR. LAPOINTE: That's actually David's. Sorry.

4 MS. BAKER: That's...

5 MR. LAPOINTE: Perhaps, John, while you're firing that
6 up, I'll just start with a few introductory

7 remarks.

8 MS. BAKER: Can I -- is the mike on for you?

9

10 EXAMINATION IN CHIEF BY MS. BAKER:

11

12 MR. LAPOINTE: Can you hear me? Everybody hear me?

13

Okay? Good.

14

Commissioner Cohen and commission counsel and
15 staff, participants, participant counsel, guests,
16 media, I guess today we're going to kind of turn
17 the courtroom into a bit of a classroom and the
18 purpose of doing that is not for us to kind of
19 impress you with the breadth of our knowledge and
20 go into some intricate detail about the different
21 topics we're going to speak to, but it's really
22 actually to empower you with a common set of
23 information that will hopefully help us
24 communicate better with each other, because after
25 all, you know, the success of these hearings is
26 going to largely rest on our ability to
27 communicate with each other.

28

So I want to acknowledge right off the bat
29 that the perspectives that David and Karl and I
30 are going to provide to you today are a particular
31 perspective. They're a science perspective.
32 They're based on years spent in the university, in
33 classrooms and labs, some time in the field, but
34 it's certainly not the only form of knowledge or
35 way of learning about Pacific salmon and their
36 ecology and life history.

37

There's another form of knowledge called
38 traditional ecological knowledge, which is the
39 knowledge of Canada's first peoples and
40 unfortunately, neither David or Karl or myself are
41 qualified to speak from that perspective, but we
42 certainly acknowledge its importance and I'm sure
43 there will be an opportunity at some point in the
44 future for that perspective to be brought to bear
45 on this important issue. So we just hope that
46 what we provide you provides a foundation and it
47 complements whatever information may follow over

Panel No. 1
Michael Lapointe
In chief by Ms. Baker

1 the course of these hearings.

2 So that -- I'd like to start off by trying to
3 advance my first slide here, which when I point
4 the arrow, John, it does not seem to be doing.
5 I'll try the other arrow. We're going to try to
6 restart this. Sorry for the technical
7 difficulties.

8 MS. BAKER: Mr. Commissioner, while we wait for that, I
9 wonder if it would make sense to have the first
10 PowerPoint marked as an exhibit for the reference
11 on the transcript?

12 MR. LAPOINTE: Thank you, John.

13 THE COMMISSIONER: Yes, Ms. Baker. Do you wish to do
14 that now?

15 MS. BAKER: Yeah. I think we should mark this now as
16 the first exhibit.

17 THE COMMISSIONER: All right. Does Mr. Registrar have
18 that exhibit?

19 THE REGISTRAR: Yes.

20 THE COMMISSIONER: He has it. All right. Thank you.
21 Exhibit 1 then.

22
23 EXHIBIT 1: PowerPoint presentation titled
24 "Overview of Freshwater Life History"
25

26 MR. LAPOINTE: Okay. We're in business here. I
27 thought I'd start off with a roadmap of today, the
28 rest of today. I'm going to start off here --
29 well, you are here first at the egg stage and
30 we're going to get to the egg stage in a few
31 minutes, but before I do that I'm going to
32 probably walk you through this lifecycle more
33 times than you'd care to see it. We're going to
34 start off on the right-hand side. There -- I'm
35 going to provide a few remarks about life history
36 in general and a little bit more detail on the
37 freshwater phase and then David Welch is going to
38 come up and talk about the phase from smolt to
39 subadult and then finally, David will pass the
40 baton to Karl English, who will talk about the
41 return migration.

42 Now, if you guys are really good students and
43 you're getting a little weary, the commissioner
44 might give us a little bit of a caffeine break at
45 some point in here, but that's certainly up to his
46 discretion. It could get a little weary for you
47 guys, but hopefully not too weary as we go along.

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1 So I'm going to start off first talking about
2 sockeye habitats and I'm going to go around the
3 lifecycle once again, beginning from the time that
4 these fish spawn until they emerge from the gravel
5 as fry for about a period of eight to ten months
6 they spend time in rivers and streams of various
7 widths and lengths. Following that phase, they
8 migrate to a lake where they spend approximately
9 one year; a little bit of time in a stream,
10 migrating from their lakes to the ocean, where
11 they spend between two and three years. For
12 Fraser sockeye, about 90 percent of these fish on
13 a parent year basis would come back after two
14 years at sea and about ten percent after three
15 years at sea.

16 In between these phases in the ocean and in
17 their streams, they're in estuaries so the Fraser
18 River estuary, which is just outside our windows
19 here, and for the juveniles, that would be a
20 period of about a week or so. For some of the
21 adults, late-run sockeye, for example, might spend
22 several weeks off the mouth of the Strait of
23 Georgia prior to migrating upstream.

24 Now, these estuaries can be particular
25 stressful times for sockeye at both phases. It's
26 a period where they're adjusting to either going
27 from freshwater into saltwater or the opposite,
28 from saltwater to freshwater, and that involves a
29 lot of physiological changes and so forth, so they
30 can be particularly stressful periods during
31 migration.

32 One more time around the loop here, I want to
33 just give a timeline, and I'm going to focus on
34 the 2009 return as an example because it was the
35 events of the 2009 return in part that were
36 responsible for stimulating the formation of this
37 commission, so the parents of the 2009 return by
38 and large would have spawned in 2005 in the Fall.
39 In the winter of 2005, the eggs would be in the
40 gravel, overwintering in the gravel.

41 In the late winter, so now I'm talking about
42 January, February, March of 2006, it would be
43 overwintering in the gravel. They would -- the
44 alevins would form and they would be in the
45 gravel. In the Spring the fry would migrate to a
46 lake, as I say, where they'd spend one year, so
47 this is now the Spring of 2006. In the Spring of

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1 2007, they enter the ocean and migrate to sea.
2 And then they leave the Strait of Georgia, migrate
3 following that red path here which I can point out
4 to you, following the red path on this map and I'm
5 going to try not to blind the gentleman that's
6 sitting right here, making this loop in the Gulf
7 of Alaska, spending, as I said, about two years
8 for the four-year-olds, three years for the five-
9 year-olds, returning in 2009 in the case of the
10 four-year-olds or 2010 in the case of the five-
11 year-olds.

12 So one more time around this loop with some
13 jargon which you may get exposed to over the
14 course of these hearings. The year that the
15 parents spawn is commonly referred to as a brood
16 year, sometimes abbreviated BYR or BRYR. And
17 again, that would be 2005. There's this period of
18 overwintering, '05, '06 when the eggs and the
19 alevin are in the gravel. Emergence would occur
20 in the calendar year following the year of
21 spawning. Lake entry year, again, 2006, migrated
22 to a lake. Ocean entry year would be 2007, that's
23 frequently abbreviated OEY in the literature. And
24 then return year or recruitment year, 2009.

25 Now, when we use the term "return" or
26 "recruitment" in Pacific salmon, we are talking
27 about the number of maturing offspring that come
28 back. Some of them may be harvested, some of them
29 may end up on the spawning grounds and in the case
30 of the Fraser sockeye, some actually may die en
31 route and neither be harvested or be found in the
32 spawning grounds. So it's important to know that
33 that recruitment term encompasses both fish that
34 are caught, fish that end up on the spawning
35 grounds and also fish that may in some cases die
36 en route in the case of a very adverse migratory
37 condition, for example.

38 Okay. So now that you're all experts in the
39 lifecycle of Fraser sockeye, I can ask my first
40 question. Now, I have to actually check with the
41 commissioner here because I'm not actually sure if
42 a witness is allowed to ask a question in this
43 kind of proceeding, so, Mr. Commissioner, would it
44 be okay if I asked a question of our group here
45 this morning?

46 THE COMMISSIONER: You're the expert, Mr. Lapointe.

47 MR. LAPOINTE: Okay. I have a feeling that I might

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1 have a bit of a reluctant classroom here, so I
2 need to ask if I could exempt their answers from
3 cross-examination, sir, because I have a feeling
4 that they might be a little reluctant otherwise.

5 All right. Let's go ahead then. The
6 category is scale aging, so it's kind of like *Are*
7 *You Smarter Than a Fifth Grader*, but please don't
8 hesitate to jump in with an answer.

9 This is a picture of a sockeye scale and the
10 question, it's a little bit cut off on the bottom,
11 "How old is the fish that this scale came from?"
12 I gave you a little bit of a help here. I've
13 highlighted some things in colour there and but
14 you still have to think about (indiscernible).
15 Anybody want to offer a guess?

16 MS. GAERTNER: Four years.

17 MR. LAPOINTE: Four years? Did you say four years?

18 You said four years? She's right. Excellent.

19 Okay. So if you look at this scale, on the
20 bottom right, your bottom right, that kind of
21 rough bit, that's the shiny bit that makes a fish
22 shiny when you look at it from the side. It's
23 kind of like the white of your fingernail. It's
24 the oldest part of the scale. And as you move up
25 from the bottom right to the top left here, in
26 this direction, you can see there are these dark
27 rings that are formed periodically as the fish
28 grows, and little white spaces in between. Those
29 are called circuli, okay? And what I've tried to
30 help you see here is areas where these circuli get
31 closer together.

32 There's three areas here on the scale which
33 -- where the circulis are close together. Those
34 are called annuli and they're formed in the
35 winter, when the growth slows of these fish. So
36 you can see on this scale there's three annuli, so
37 there's the freshwater zone right in the very
38 middle there. There is the first marine year, and
39 then there is the second marine year, so this fish
40 has three winters on its scale and it's a four-
41 year-old because the first winter they're eggs in
42 the gravel, right? They don't yet have a scale.
43 So you count up the number of winters and add one
44 and that's how old the fish is. The little bit of
45 growth at the very end at the top left there,
46 that's just the growth that happens after the
47 winter, before it comes back to its natal stream

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1 to spawn in.

2 So it's pretty hard for anybody for the
3 Pacific Salmon Commission to give a talk about
4 life history without showing you a scale. It's
5 just one of the things that we have to do.

6 The spacing between these circuli is roughly
7 proportional to the amount the fish grows, so you
8 can see as you move -- oops, go back. As you move
9 from the freshwater zone to the marine zone, they
10 get farther apart and that's because the fish is
11 growing more during those phases. Okay?

12 Now, I need to talk a little bit about the
13 Harrison sockeye because you're going to hear over
14 the course of the hearings, I think, something
15 about Harrison. They have a different life
16 history and they have been showing some trends in
17 their abundances of -- in recent years that are
18 different from some of the other sockeye. So in
19 red there is what I've just described to you a
20 number of times in terms of the most Fraser
21 sockeye have this life history and I just want to
22 walk through and contrast the Harrison for you.

23 So rather than spending a year in a lake,
24 Harrison fish basically go to sea almost
25 immediately after they emerge from the gravel,
26 spend time in sloughs and estuaries for a few
27 months, so they're entering the marine areas less
28 than a year, the following calendar year, after
29 spawning. It does look like these fish are
30 spending some time in Georgia Strait, perhaps a
31 few months, and maybe Georgia Strait is kind of
32 like the Harrison Lake, if you like.

33 The rest of the life history is pretty
34 similar, two and three years at sea. Harrison
35 come back as three- and four-year-olds because
36 they don't have that year in the lake and their
37 age of maturation is much more variable than the
38 other Fraser sockeye stocks. It's not like 90
39 percent and ten percent. It's quite -- quite
40 variable from year to year.

41 So the ocean entry years would be 2007 for
42 the age three Harrison fish compared to 2007 for
43 the age four fish from the other sockeye or 2006
44 for the age four fish compared to 2006, the age
45 five fish. So this may become important. It's
46 more just kind of a note for you to have in your
47 back pocket as you go along, because you're going

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1 to hear more, I know, from David, about Harrison
2 in a few minutes.

3 Okay. So let's start with the egg phase
4 then. This is a picture of five sockeye eggs and
5 just to give you an approximate scale, and there
6 is variation, you could fit those on a dime
7 probably. Okay? If someone has a dime in their
8 pocket, you kind of know how big these eggs are.

9 Now, these particular eggs have reached
10 what's called the eyed-egg stage, so you can see
11 some little eyes in there that are the eyes of the
12 fry. The length of time to reach the eyed-egg
13 stage is really dependent on water temperature, so
14 there's some experiments that are -- have been
15 ongoing recently by Jenn Burt and Scott Hinch's
16 lab at UBC and what she's found is that Weaver
17 Creek sockeye eggs would reach the eyed stage in
18 about 25 days at ten degrees Celsius, but only 12
19 days at 16 degrees Celsius. So the warmer the
20 water, the faster the development.

21 How many eggs do Fraser sockeye have? Here's
22 just a sampling of egg stocks in the watershed.
23 You can see the number of eggs per female ranges
24 anywhere between about 3,000 to 4,000 eggs.
25 Again, fecundity varies with the body size.
26 Bigger fish tend to have more eggs and sometimes
27 larger eggs. Egg size also varies with the
28 substrate that these fish spawn in. If you spawn
29 in fine substrate you're likely to have smaller
30 eggs than if you spawn in very coarse substrate.

31 After the egg stage comes the alevin stage
32 where these alevins carry around this backpack, if
33 you like, of food that nourishes them from -- for
34 six to ten weeks. They're not particularly good
35 swimmers and I'm sure that if you had a backpack
36 strapped to your chest with six to eight weeks
37 provisions, you wouldn't be a very good swimmer
38 either. And as a consequence, they tend to be in
39 the gravel because it's kind of hard to escape
40 from predators when you've got this load on them.
41 This is about their size, as an example, a handful
42 of alevins, if you like.

43 So again, they're nourished by the egg sac,
44 still in the gravel, poor swimmers and again, that
45 stage lasts somewhere between six to ten weeks,
46 depending upon water temperature again. When the
47 yolk sac is actually absorbed into the body

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1 cavity, it's called buttoning-up, it's just a term
2 that you may see if you're in the literature.

3 Okay. What can cause egg and alevin
4 mortality, this is a diagram that I borrowed from
5 Tom Quinn. You can't quite see the
6 acknowledgement at the bottom of the slide there,
7 but it will be in your hard copies. Anything
8 inside this oval is what we would call approximate
9 cause of mortality, so predation, there's one on
10 the right here I can't see that's called dig-up -
11 a very scientific term, desiccation or freezing,
12 scouring, suffocation, these are all things that
13 can cause mortality at this stage. And then I'm
14 just going to bring in some things from the
15 outside that affect these different approximate
16 sources, so things like the density of spawners.
17 If you have more fish in the spawning grounds,
18 you're more likely to have your red dug up by a
19 fish that spawns subsequent to you than if there
20 are fewer. Obviously, the earlier-spawning
21 females are more likely to have their eggs dug up
22 than the later timed ones. Bigger females do dig
23 deeper reds and so if you're a bigger female,
24 you're less likely to have your red dug up.

25 There are low flows that can result in
26 desiccation or freezing. If you were at the Adams
27 this year, the river is about two feet higher than
28 normal and I suspect if that does drop, some of
29 the fish you may have seen spawning near the
30 margins, their eggs may actually end up being
31 frozen and they may not end up contributing to
32 future generations.

33 You can also have things like high flows, the
34 Seymour River, there's a very big storm event
35 around the 20th of September, washed out five
36 bridges on the Seymour River. It was after all
37 the early fish had spawned and I suspect that it
38 had probably a pretty negative effect on the
39 spawning success of those animals in that
40 particular stream. Fine sediments, obviously, can
41 create situations of suffocation or low oxygen and
42 then, of course, there's predators and I don't
43 know if you can quite make that out. That sculpin
44 is just about to fit that egg in its mouth. So
45 fish and birds are all predators of these animals
46 and they can certainly key in at certain key times
47 during life history.

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1 Tom did not include diseases and parasites
2 here but clearly, they can play a role in
3 mortality. So there's a lot of things that can go
4 wrong when you're one of these small animals
5 growing up to become a fry.

6 Speaking of fry, here is the fry stage.
7 There's different terms used to describe fry. The
8 term "parr" is quite often used in Europe and it
9 refers to these vertical bands that you can see.
10 They're called parr marks. It's juveniles is
11 used, fingerlings are used, lots of different
12 terminology and it's really not worth getting into
13 a debate about when to use one or the other.
14 They're sort of synonymous in many ways.

15 Fry now have to feed. So they no longer have
16 this backpack of food. They've got to find some
17 food. They're about an inch long, 28 millimetres
18 long at emergence. Again, these are averages.
19 And it's obviously very important to get to your
20 lake when the zooplankton are available. One of
21 their favourite treats is something called
22 daphnia. This is obviously not drawn to scale.
23 Daphnia might be a few millimetres long. And
24 they're very abundant in many of the B.C. lakes.

25 Okay. So fry migration downstream to lakes,
26 sometimes this can be as short as a few hundred
27 metres. In other cases, it might be more than a
28 hundred kilometres. That's a fairly significant
29 journey for a fish that's, you know, about an inch
30 long.

31 Lake residence for a year, they say, from
32 about May to May in sort of round numbers. One of
33 the interesting things about fry and actually,
34 David Levy has done quite a bit of work on this
35 topic, is that they actually undergo vertical
36 migrations through the water column. At dawn and
37 at dusk they're near the surface where they're
38 feeding, and then during the daylight, bright
39 daylight hours, they actually migrate deeper and
40 that's thought to be a predator avoidance type
41 situation. They are visual feeders. They have to
42 see to feed, but so are their predators. So
43 there's quite a bit of work that's been done on
44 the vertical migration of these animals.

45 Okay. After fry stage comes a process called
46 smoltification and one of the main things that
47 happens is this physiological change that's

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1 required to now go from living in freshwater to
2 living in seawater. There are also behavioural
3 changes. So they don't vertically migrate any
4 more. Now they're migrating in a certain
5 direction, hopefully towards the outlet of their
6 lake. Sockeye don't tend to be that territorial,
7 but other juvenile sockeye are and so they lose
8 that territoriality behaviour, so now they're
9 migrating in a direction and they're schooling up
10 more.

11 They develop an ability called compass
12 orientation. There's actually been some very
13 interesting work done putting a juvenile sockeye
14 in a magnetic field and changing the direction of
15 the magnetic field and the fish actually change
16 the direction that they're pointing with their
17 head. So this is thought to perhaps help them
18 navigate their way out of their lakes and
19 downstream. They get that silvery body
20 colouration and they're leaving the lakes at about
21 three inches in length, 80 millimetres.

22 The downstream migration now of the smolts to
23 the ocean can be quite extensive, anywhere from 40
24 kilometres for a population like Widgeon Slough to
25 1200 kilometres for something like the Early
26 Stuart. Now, I'm going to show you some
27 information about Chilko sockeye a little later on
28 and just for your information, they migrate about
29 midpoint of this. It's about 650 kilometres from
30 Chilko Lake down to the mouth of the Fraser.

31 The sources of mortality here are very
32 similar to the sources of mortality. These are
33 just, as I say, not a complete list. Obviously,
34 if you're a fry and you get to your lake at a time
35 when the food is not there, that's not a good
36 thing and you might, in fact, potentially starve
37 or at least have slow growth and be vulnerable to
38 predators. Predators, again, fish and birds, and
39 they do key in on the times when they're either
40 migrating in high densities or when they're
41 feeding. Disease is another factor, either
42 directly or indirectly through increasing
43 vulnerability to predators. Environmental
44 stressors, temperature, that transition from
45 freshwater to saltwater, those are all factors
46 and, of course, these things can all interact in
47 some way.

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1 Now, I've talked about water temperature. I
2 think three or four slides now have mentioned it
3 and it's really important for the spawning time of
4 these animals. The idea is that the development
5 of the egg to fry is controlled by water
6 temperature and the offspring that reached the
7 lakes when the zooplankton are abundant are going
8 to have the highest probability of surviving. So
9 there's a very strong selection to spawn at a time
10 such that your offspring are going to go through
11 that temperature environment and emerge and reach
12 the lake when the food is abundant. And as a
13 consequence, within Fraser sockeye if you look
14 across over 60 years of records, the peak of
15 spawning in these populations will be with almost
16 the same calendar week from year to year, maybe
17 within ten days. That's how strong the selection
18 is to spawn at the right time.

19 Okay. What are kind of the survival rates
20 from egg to fry survival? Here I've got data for
21 seven populations here. There's a little bit of
22 difference, if you look at the right-hand columns
23 here, the time of the fry estimate, there's a
24 difference in the time of the life history when
25 the fry estimates are made, which has an impact on
26 some of these numbers, so, for example, for Early
27 Stuart and Stellako, the fry are estimated as
28 they're migrating out of their streams into a
29 lake, and the average egg-to-fry survival across
30 the time series for those two populations is
31 around 21 percent.

32 Quesnel and Lake Shuswap are measured in
33 their lakes in the Fall about six months after
34 spawning, so this is acoustic survey that you use
35 to estimate the populations of those juveniles.
36 Their egg-to-fry survival is lower, four and five
37 percent. Weaver Gates and Nadina all have very
38 high egg-to-fry survival and some of you probably
39 know that these three populations all have
40 artificial spawning channels. I don't know if any
41 of you have visited Weaver, Weaver is just a --
42 it's an artificial stream. Usually it's
43 groundwater-fed. The flows are controlled. The
44 predators are excluded. Everything is just, you
45 know, the perfect habitat for these fish, and not
46 surprisingly, they have much better egg-to-fry
47 survival.

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1 Now, I'm going to talk a little bit about the
2 Chilko smolt program, and Chilko, for those of you
3 who don't know, is right about there in the middle
4 of the watershed, highlighted in red circle there.
5 And the reason I'm going to talk about that is
6 that Chilko is the only Fraser sockeye population
7 in the watershed which has a very long time series
8 of estimates of smolts leaving their lakes or
9 leaving the lake, I should say.

10 So I happened to visit the Chilko smolt
11 program in 2008 and Chilko has had this weir since
12 1949, there's been a weir and this is the weir
13 here, this V-shaped fence here. This walkway
14 that's going from the shore outward is actually
15 the catwalk to get to these two small little
16 aluminium shacks here, and in the evening, these
17 are all little juvenile Chilko smolts here. The
18 smolts school at the opening of this weir, funnel
19 into this opening. And I think you should be able
20 to see at the very bottom of that photo a white
21 sort of what looks like a window and, in fact,
22 that is a window, and that's what's used to open
23 up and allow the smolts to migrate through these
24 two little aluminium shacks that you can see.

25 When they get into that -- into that shed,
26 there is a digital camera which is mounted looking
27 down towards the bottom and that digital camera
28 takes pictures periodically on a certain sampling
29 protocol - I don't know exactly what the timing of
30 the pose is, but the photos look something like
31 this photo in the bottom right there. So these
32 white rectangles are about two feet by four feet
33 and you can see the individual smolts that are on
34 there, the time is recorded. This is taken with
35 my camera and not with that camera that's used in
36 the actual sampling. And so you can get an
37 estimate of the number of fish per unit time,
38 expand it by the time that you're sampling and not
39 sampling, you get a total estimate of the number
40 of smolts leaving Chilko Lake.

41 Now, of course, in 1949 we didn't have
42 digital cameras and so forth. It was a four-by-
43 eight sheet of plywood and big lights and a single
44 lens reflex camera with black and white film and
45 so forth, but the methodology has been pretty
46 systematic since 1949. So you can get a lot of
47 information from the Chilko program. It would be

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1 nice, obviously, to have this in other spots in
2 the Fraser watershed.

3 So what I've developed is this sort of
4 lifecycle survival table, just to give you a bit
5 of a reference on average. Now, Chilko does have
6 a fry program, but the fry program doesn't
7 enumerate all of the fry, so I couldn't actually
8 use the fry data from Chilko to fill in some of
9 the blanks on this chart. The egg-to-smolt
10 survival for Chilko is about four percent on
11 average, egg-to-smolt survival. And all I've done
12 is I've partitioned the egg-to-smolt -- or egg-to-
13 fry and fry-to-smolt survival, the two components
14 of that egg-to-smolt survival, with data from the
15 literature. And Quinn, Tom Quinn's book suggests
16 that the egg-to-fry survival is about half of the
17 fry-to-smolt survival, so that's why I've got kind
18 of Chilko in quotes. I don't have the actual data
19 for Chilko to fill this table in.

20 But just walking you through, starting at the
21 top, again Chilko females have about 3,000 eggs.
22 At a one-to-two ratio of egg-to-fry survival to
23 fry-to-smolt survival, about 14 percent of the fry
24 or 433 fish would make it to the fry stage. And
25 then at 29 percent fry-to-smolt survival, another
26 127 would make it to the smolt stage. The average
27 smolt-to-adult survival for Chilko is about nine
28 percent, so nine percent of 127 is about 12, so
29 that means that of those 3,000 eggs, 12 or 4 out
30 of every 1,000 survive to the adult stage.

31 Now, historically on an average basis
32 historically, maybe 70 percent of those fish would
33 be harvested. The exploitation rates have been
34 lower in recent years, but about 70 percent, so
35 that would mean eight would be removed for
36 harvest, leaving four for spawning for future
37 generations. So, you know, this mass of eggs
38 shrinks pretty fast to a pretty small number.

39 Now, I want to introduce this concept of
40 productivity. It was in some of the videos that
41 were on the commission website. In fact, I
42 probably should go back here and just mention that
43 on the video on the Cohen website, I think it
44 mentions the figure of about ten percent egg-to-
45 smolt survival and maybe three to five percent for
46 smolt-to-adult survival. For Chilko I have those
47 numbers roughly transposed, but they both work out

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1 to about four out of a thousand eggs making it to
2 adult stage. There's certainly a lot of
3 variation. These are just averages, examples for
4 your reference.

5 Okay. Productivity - how many offspring from
6 a given pair of spawners return as adults? Well,
7 for Fraser sockeye, the average would be about
8 five returns per spawner. Now, it should be quite
9 self-evident but in the absence of harvest, you
10 need at least one return per spawner to replace
11 yourself, right? So on average, five returns per
12 spawner would leave some fish available for some
13 other purpose, 'cause you need one -- and this
14 concept of replacement is often -- you may run
15 into it if you get some presentations on stock and
16 recruitment, that you need one spawner for every
17 spawner to replace the previous generation.

18 So let's come back to our little lifecycle
19 diagram here and talk about this number 12 here,
20 so 12 adults were produced by 3,000 eggs, that's
21 two spawners, right? There's one male and one
22 female, so 12 divided by two is six returns per
23 spawner. It's right about the average. Okay?

24 Now, I'm going to turn this concept around on
25 you and talk about mortality. So rather than
26 talking about the fact that you have 14 percent of
27 the eggs surviving, I'm going to talk about the
28 fact you have 86 percent dying, so rather than
29 having 433 survivors, you're going to have 2567
30 dying. Okay? Just to show you in a pie-chart
31 kind of the disposition of those 3,000 eggs. So
32 these are now mortalities. Okay? So of the 3,000
33 eggs, about 2567 are lost in the egg-to-fry stage,
34 okay? About 306 lost in the fry-to-smolt stage,
35 about 115 in the smolt-to-adult stage. If the
36 fishery takes 70 percent of the 12 that are left,
37 then that would be eight in catch and four in
38 spawners.

39 And there's a few points I want to make on
40 this pie chart. First one is that most of the
41 mortality, the blue and the yellow here on this
42 chart, occurs in fresh water. So that's the
43 importance of freshwater habitat. I'd be willing
44 to bet, Commissioner Cohen, that you heard a lot
45 about habitat in your hearings over the -- in your
46 public meetings that you've had. Well, habitat is
47 critical. Most of the mortality occurs in fresh

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1 water.

2 The other thing you can notice here is that
3 within a cohort the fishery actually accounts for
4 a teeny fraction of the mortality, eight out of
5 the 3,000 eggs. And so fishermen are often
6 frustrated, say well, gee, you know, you're always
7 pointing the finger at us. We only impact 8 of
8 these eggs and there's all these other force
9 mortality. Well, within a cohort, they're right.
10 Within a cohort, fishery doesn't impact.

11 But, and it's an important but, and that's
12 why I've put it in big font and underlined it,
13 when you're talking about the next generation, you
14 have to remember that the fishery harvest, every
15 female that's harvested has potentially 3,000 eggs
16 that are going to contribute to the next
17 generation. So within a cohort, fishery is a
18 small fraction of the total; but if you're talking
19 about between cohorts and future generations, the
20 fishery is a large component.

21 So you can get battles between groups talking
22 about this, but really, they're both right. It's
23 just a perspective, the part of the life history
24 that they're referring to is slightly different.

25 Last point I want to make with this pie-
26 diagram is that even though all that pie is sucked
27 up by the freshwater mortality, almost all of it,
28 you know, what is it, 2873 eggs or something of
29 the 3,000 eggs, even though that's where a lot of
30 the mortality happens, there's still enough
31 variation in the marine mortality - in other
32 words, this number of 115 smolts that might die on
33 average at that stage - there's still enough
34 variation in that to cause quite a bit of
35 variation in the overall returns even though it's
36 a small fraction of the total mortality.

37 And I'm going to give you an example, again
38 going back to our little table here, so on average
39 over 60 years for Chilko about nine percent of the
40 smolts survive to the adult stage and that leaves
41 12. What about the variation from year to year?
42 Well, we're very lucky to have that Chilko program
43 and we can show you this chart, and this is just
44 the marine survival, smolt-to-adult survival, the
45 comparable numbers to that nine percent average on
46 the previous slide for each of the parent years,
47 the brood years, years of spawning, from 1949 to

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1 2006 brood. And you can see that in 2009 that
2 horrible return that we had of 2009, the survival
3 was only .3 percent. That's three out of 1,000,
4 .3 percent. Okay?

5 In contrast, if you look at the 1986 brood or
6 the 1990 return, we have had smolt-to-adult
7 survival estimates as high as 23.4 percent. Now,
8 if you're curious, we just have our in-season data
9 so far. They're still -- we don't have the
10 estimates from the spawning grounds for Chilko yet
11 for this year, but it looks like this year's run
12 for Chilko anyway will have about a six percent
13 smolt-to-adult survival. So think about .3
14 percent versus 23.4 percent applied to the number
15 of smolts, 127 smolts on average that would make
16 it out of these lakes.

17 What it would mean is that instead of nine
18 percent, if you had a worst case scenario, let's
19 say .3 percent, that means of that 127 survivors
20 to the smolt stage shown in yellow there, you'd
21 only have .4. That's like one out of every 7500
22 eggs making it, right?

23 In contrast, you go to the best case
24 scenario, the 23 percent, you've got 30 of these
25 animals surviving to the adult stage. So you can
26 imagine that over the last couple of months here,
27 I've had quite a few people come up to me and say,
28 "Hey Mike," you know, "why are these returns so
29 variable from year to year?" I mean, we had 1.5
30 million in 2009 and then we've got 30 million in
31 2010, what the heck is going on? Well, as I think
32 I've shown you, at the extremes, and this is over
33 a 60-year period, marine survival variation alone
34 can result in returns that differ by about a
35 factor of a hundred. It's actually a factor of
36 75, 30 over .4. And as I just told you, the last
37 two years it's about a factor of 20, right - 1.5
38 million versus 30 million. So it's the variation
39 in the marine stage that can create huge
40 variations in these returns on an annual basis.

41 Now, I guess kind of the kicker on this
42 stuff, and one of the issues is that we don't
43 actually know very well -- we know -- we have
44 hypotheses, but it's not very well understood what
45 causes this variation. We have ideas. And more
46 importantly, the magnitude of this variation
47 really can't be predicted in advance. So this

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1 variation is something that, you know, the Fraser
2 panel, the groups I work with, is used to dealing
3 with. It's the reason that we have things like
4 in-season management, but it's not something that
5 we can predict and we shouldn't as a public at
6 large be expecting forecasts to be that accurate
7 because of this inability to predict this
8 variation.

9 Okay. I talked about the Chilko program.
10 I'm just going to bring in some information from
11 the Quesnel and Shuswap Lake programs to talk a
12 little bit about density dependence here. As I
13 said earlier, Quesnel and Shuswap Lake have
14 acoustic surveys in their lake. They survey the
15 lake, get an estimate of the abundance of fry in
16 the summer and the Fall following spawning so
17 their first year in the lake. And what I've got
18 here is a chart for the Quesnel Lake sockeye with
19 the average number of spawners here in different
20 ranges, so zero to 250,000 up to greater than a
21 million and then the column on the right is the
22 average fry per effective female. It's kind of
23 like the freshwater productivity. How many fry
24 per female are associated with these different
25 levels of spawner abundance? And you can see a
26 decreasing trend from about 305 there on the far
27 right, the top far right there, with low numbers
28 of spawners to about 39 with abundances greater
29 than a million.

30 Now, I needed to define one more piece of
31 jargon here and this is this effective female
32 term. This is a kind of a Fraser sockeye specific
33 piece of jargon. Every year on the major spawning
34 grounds, female carcasses are surveyed to see how
35 many eggs they have in them. Now, if you die with
36 all of your eggs, you're obviously not a very
37 effective female spawner, so that would count
38 zero. If you're a dead female and you don't have
39 any eggs, you're a hundred percent effective. And
40 then they have a score of about 50 which relates
41 to a female that has some of her eggs.

42 So what they try to do is adjust the number
43 of females for this proportion of them that retain
44 or not retain a number of their eggs when they're
45 surveyed on death. So that's just a piece of
46 jargon that you may run into later on in the
47 course of the proceedings.

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1 So we can take this information and we can
2 plot it. We can actually look at the absolute
3 number of fry here now, so on the vertical access
4 there is the total abundance of fry in millions
5 that are in Quesnel Lake in the Fall. The -- and
6 it's plotted against the number of effective
7 female spawners. And the point I want to make
8 here is that beyond some level of spawner
9 abundance, fry abundance remains roughly the same.
10 And I've just drawn by hand that red dashed line
11 for you to help you see that.

12 This pattern is consistent across all the
13 Fraser sockeye lakes and I'm going to show you
14 some more examples here. Here's the Shuswap Lake
15 sockeye, so this is where the Adams River, where
16 the Adams River fish weir, if you went to the
17 Adams River, this is where these fish are headed
18 next Spring. Again, low abundances of spawners,
19 very high rates of fry per female, dropping down
20 at the very extreme level of spawner abundance to
21 about 43 fry per female. Same plot, there's fewer
22 data points out there at the extreme range, but
23 you don't get this continuing increase in the
24 abundance of fry with -- as you put more females
25 on the spawning grounds.

26 Chilko sockeye, but now we're talking about
27 smolts now, so there's the abundance of juveniles
28 leaving the lake. Same pattern. Okay? And the
29 same kind of a plot here, where you can see that
30 you could almost make an argument for Chilko that
31 at some levels of spawner abundance, you actually
32 get fewer fry than you do otherwise.

33 Now, if you draw that dashed line across to
34 the vertical access there, and you look at for
35 Chilko perhaps around 40 million, that's sometimes
36 called the juvenile habitat capacity. Okay? And
37 there's been work done within the Fraser, and this
38 is work largely done by Jeremy Hume and his
39 colleagues at Cultus Lake lab, where they can
40 relate the capacity of these lakes to the surface
41 area of the lake. Okay?

42 So that's the next slide and what I've got is
43 a table of the surface areas of the Fraser sockeye
44 nursery lakes. There's 26 of them. I've cut it
45 off, so that you can actually see this from the
46 back of the room, so there's probably about 14 or
47 so on there. Stuart Lake, 357 square kilometres.

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1 For a reference, Stanley Park is about four square
2 kilometres. So Stuart Lake is a pretty big lake,
3 right? Okay.

4 And they're just ordered and a couple points
5 I want to make, one is that these top eight,
6 largest eight lakes, account for about 80 percent
7 of the rearing capacity for Fraser sockeye. Okay?
8 And if you look at that list and you look at lakes
9 like Shuswap, Quesnel and Chilko, those three
10 lakes alone are probably accounting for most of
11 the adult production right now. So there isn't a
12 ton of diversity in large production of these
13 nursery lakes.

14 Now, what I've done is I've just added these
15 on top of each other. The total nursery capacity
16 is about 2500 square kilometres and plotted it on
17 a graph, display the information in a slightly
18 different way, and that's this next slide. Those
19 are the eight lakes. They're just ordered across
20 there, so you can see some of the other lakes that
21 are contributing here.

22 Now, I don't want to give the misimpression
23 that somehow the biodiversity of Bowron or
24 Chilliwack or these lakes that are small on your
25 far right is not important. Okay? There are lots
26 of reasons that biodiversity is important. Maybe
27 some of these lakes will be more resilient to
28 climate change, for example. Okay? Harrison
29 sockeye don't even rear in a lake. Harrison
30 Lake's on there but that's where the Weaver Creek
31 sockeye rear, so Harrison sockeye aren't even on
32 this chart and they've been doing something --
33 their life history, something about them has
34 obviously been favourable for them 'cause they've
35 been on the increase over this time. So that's
36 not the point. The main point I want to say is at
37 least from the perspective of juvenile production,
38 the juvenile production that's going to produce
39 the very big runs like we had this year is going
40 to come out of these big lakes. Okay?

41 So this is a movie that I took at the Chilko
42 -- or I didn't take it, Steve Latham took it at
43 the Chilko smolt fence and these are -- Chilko
44 smolts kind of gathered at the mouth there. They
45 were bouncing off his snorkel. I just thought
46 since you guys have probably had a chance to see
47 the abundance of adults, you might appreciate

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1 seeing the abundance of juveniles. There is a lot
2 of smolts gathering in, trying to come out of
3 Chilko Lake. And next I've got to send them kind
4 of on their way to David, because he's going to
5 talk about the ocean phase, so these are smolts
6 now that are swimming downstream out of the Chilko
7 River towards the ocean and David is going to tell
8 you all of what happens to them after that.

9 So, you know, these are pretty amazing
10 animals. I hope that you've got that impression
11 and these pictures kind of point it out. They're
12 sort of sauntering their way down the Chilko
13 River.

14 Now, that is the conclusion of my formal
15 presentation. I just want to point out to you
16 that in your distribution you'll see a couple of
17 supplementary slides. I referred to some
18 references in my talk. The references are here.
19 There's also some additional references that I
20 didn't cite that you may find helpful. There's
21 some good books out there on juvenile sockeye.
22 There's a couple slides here on how we age fish
23 that I thought you might want to refer to at some
24 point. I'm not going to speak to those, but they
25 will be part of the packet that is in your
26 distribution.

27 So thank you for your time. I hope you're
28 hanging in. And I guess we'll pass it on to David
29 here, Wendy, or...?

30 MS. BAKER: Thank you. Mr. Commissioner, do you want
31 to carry on with the next? I think it'll be
32 another half-hour or more of evidence. Or did you
33 want to take the morning break now?

34 THE COMMISSIONER: No, I think, looking at the time, it
35 might be most convenient to take the break at this
36 point.

37 MS. BAKER: Thank you.

38 THE COMMISSIONER: And then come back with the next
39 presenter.

40 MS. BAKER: Thank you.

41 THE COMMISSIONER: Thank you.

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

44
45 (PROCEEDINGS ADJOURNED FOR MORNING RECESS)
46 (PROCEEDINGS RECONVENED)
47

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1 MS. BAKER: Mr. Commissioner, the next witness will be
2 Dr. David Welch, and again, he has prepared a
3 PowerPoint presentation to deal with the marine
4 phase of the Fraser River lifecycle and once
5 that's called on the screen, I would ask that that
6 PowerPoint be marked as the next exhibit in the
7 hearing.

8 THE COMMISSIONER: That'll be marked as Exhibit 2.
9 Thank you.

10
11 EXHIBIT 2: PowerPoint presentation titled
12 "Marine Phase of the Fraser River Sockeye
13 Lifecycle"
14

15 EXAMINATION IN CHIEF BY MS. BAKER:

16
17 DR. WELCH: Okay. Well, thank you very much.
18 Commissioner Cohen, a housekeeping note associated
19 with the PowerPoint there are notes on each page
20 and I'm going to leave off the attribution of my
21 colleagues that have developed the scientific
22 research that I'll refer to here. But there are
23 notes that provide that entry into the scientific
24 literature.

25 I'm also reminded of a famous British South
26 African writer in Britain called Laurens van der
27 Post who wrote a book almost fifty years ago
28 called *A View of All of the Russias*. And his
29 point was that in his 300-page book there were
30 over 200 language groups in Russia, so it was
31 almost impossible to write a book of that nature.
32 My task here is similar today because we know even
33 less about what happens in the ocean than what
34 happens in Russia, even in the time of Soviet
35 Union. But my challenge here is to give you a
36 relatively simple overview that is focused on the
37 Fraser River and try to frame what we do and don't
38 know.

39 So first slide, please. All right. Not yet.
40 All right. So in my general outline I'm going to
41 take you through a two-and-a-half to three-and-a-
42 half-year period. The juvenile year the smolts
43 enter the Strait of Georgia and then beyond, they
44 migrate up the continental shelf and then in their
45 immature years, most but not all stocks of Fraser
46 sockeye spend their life in the open ocean. And
47 the question mark there is because it's so

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1 important but so little known relative to the
2 other areas. And then my remit is to cover
3 briefly the return migration back to Vancouver
4 Island and the survival. Where can it change?
5 What could in the particular context of the Cohen
6 Commission's mandate, why could 2009 have seen
7 such poor adult returns?

8 The brief life history here, the marine
9 phase, has -- covers a two-and-a-half to three-
10 and-a-half-year period as my colleague, Mike
11 Lapointe, has pointed out and I'm going to cover
12 the periods covering the smolt and the immature
13 fish. I'll also be referring to the smolts as the
14 juveniles in their first summer and fall in the
15 ocean.

16 Some geography is appropriate here for the
17 members that are attending to give you a broader
18 perspective on where we are going to take you.
19 From the lower right, we have Juan de Fuca Strait,
20 the Strait of Georgia, Johnstone Strait, Discovery
21 Passage, Queen Charlotte Strait and, of course,
22 within that the Broughton Archipelago and then
23 Southeast Alaska where the panhandle to the north
24 there.

25 Offshore we have Queen Charlotte Sound in
26 yellow, which is the marine area between Vancouver
27 Island and the Haida Gwaii, formerly the Queen
28 Charlotte Islands, now Haida Gwaii to the north
29 and then farther west you'll see Kodiak Island,
30 the Alaska Peninsula, the Bering Sea to the far
31 left, the Aleutian Islands are a chain of volcanic
32 islands arcing out from the Alaska Peninsula and
33 then in the North Pacific Ocean there is, in the
34 right-hand area, the Gulf of Alaska, which is, I
35 point out, is where most Fraser sockeye take up
36 residence ultimately. So these are landmarks that
37 I'll be referring to in my presentation.

38 So the known ocean distribution of British
39 Columbia sockeye was defined in the 1960s and '50s
40 by research done by U.S., Canada and Japanese
41 scientists and the blue line which I've just
42 outlined here shows the approximate location of
43 British Columbia sockeye of all known populations.
44 And that's determined from work that occurred in
45 the 1950s and '60s, tagging fish with simple tags
46 that at sea they were caught in this area and then
47 at least one was returned and was caught in a

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1 British Columbia river or in British Columbia
2 coastal waters, so that defines essentially the
3 known limit to the distribution. It does not mean
4 that there are no B.C. sockeye that moved beyond
5 this. It simply means this is -- this is what's
6 known in terms of direct measurements of adults or
7 subadults that returned to British Columbia
8 waters.

9 Within the juvenile marine migration phase,
10 there's two aspects that I'm going to focus on.
11 One is the Strait of Georgia and then the second
12 is the coastal shelf northwards. And the key
13 point that I'd like to emphasize here for
14 Commissioner Cohen is there's a mixture of
15 migratory and non-migratory sockeye populations
16 from the Fraser that have different behaviours.
17 So most Fraser sockeye stocks are going to migrate
18 north rapidly.

19 Harrison Lake sockeye - and I apologize, this
20 should be Harrison River sockeye remain as long-
21 term residents within the Strait of Georgia and
22 some other stocks such as rivers in Smith Inlet on
23 the Central Coast that collapsed back in the
24 1970s, are thought to remain as residents in Queen
25 Charlotte Sound, based on DNA sampling. I won't
26 be mentioning them further here, but it's an
27 important point that it's not just the Fraser
28 sockeye that have collapsed in the past.

29 The next graph shows the trends in
30 productivity that I think most will be well
31 familiar with. The point that I'd like to simply
32 make here is that in the lower left Harrison,
33 which is outlined in yellow, has a productivity
34 trend that's the opposite of virtually all other
35 populations. It's been going up over time. And
36 the Harrison sockeye have both radically different
37 marine migration behaviours and different marine
38 survival patterns. So where that's known, I'm
39 going to contrast it in my presentation simply to
40 make the case as to something about what's
41 different between these.

42 The early sea migration was really defined by
43 the late 1970s and early -- pardon me, the late
44 1970s and early 1980s with the majority of fish
45 being detected using conventional nets as moving
46 north as shown in this diagram and out through
47 Discovery Passage to Johnstone Strait to the

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1 north, with only a small number of fish moving to
2 the southwest through Juan de Fuca Strait. Some
3 of the work I've been involved with the POST
4 telemetry array will be used to motivate an
5 animation to show this afterwards and give a
6 broader concept of the rates of movement and the
7 directions.

8 So for the timing, as Mike Lapointe has said,
9 the Fraser sockeye are near the southern limit of
10 their distribution and on this chart I've marked
11 two populations from the Fraser River which are
12 Cultus Lake and Chilko Lake, showing the mean date
13 that they migrate out of the respective locations.
14 Cultus Lake is down near the mouth of the Fraser
15 and they leave in very late April and Chilko Lake,
16 they leave in early May. And acoustic tag data
17 that we've had in the past indicates that for the
18 Cultus Lake stock, they reached the mouth of the
19 Fraser River four days after release at Cultus
20 Lake and some work I've done with my colleague,
21 Scott Hinch at UBC on Chilko sockeye this year
22 that's not yet complete, we found that they
23 reached the mouth of the Fraser River from Chilko
24 Lake in eight days.

25 So at the speed that -- most fish move at
26 about one body-length a second when they're
27 migrating. That implies that they're moving at
28 just under ten kilometres a day out so to reach
29 the north end of Vancouver Island, they will
30 achieve that in about another 45 days, 46 days,
31 for the normally-sized while smolts. So the
32 average Strait of Georgia, Johnstone Strait, Queen
33 Charlotte Strait residency is thus about 1.5
34 months and making the entry into Queen Charlotte
35 Sound as mid to late June.

36 Now, within the Strait of Georgia, here's a
37 plot from some of the DFO data on the July Strait
38 of Georgia survey that goes on and it shows the
39 trawl survey dates where trawls were done, the
40 black horizontal lines show the range of dates
41 that the trawling occurred over and the red dot
42 shows the middle point. And it simply makes the
43 point that sockeye catches are dropping off very
44 rapidly in July because it's the tail end of the
45 run for most of the smolts that have migrated out.

46 If we then move to the outside waters, my
47 colleague, Dr. Mark Trudel at the biological

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1 station in Nanaimo has carried on work that I
2 started a number of years ago and this is a
3 summary for all Fraser River sockeye that was
4 recently published and it shows the distribution
5 along the coast. So in the upper right we have
6 the May/June samples from all years; the lower
7 left the July/August; the upper right the
8 October/November or autumn period; and then
9 February/March of the subsequent year. So this
10 gives you a sense of where sockeye are caught.
11 There was sampling in virtually all of these areas
12 so the triangles showed the locations where Fraser
13 sockeye are caught.

14 So in the May/June period -- which one was
15 the -- so in the May/June period, we can see that
16 the sockeye are caught -- yeah, maybe that one
17 will work better. In the May/June period you'll
18 see that the sockeye were caught just to the north
19 of -- sorry, the Fraser sockeye were caught just
20 to the north of Vancouver Island. In July/August
21 they were captured all the way along from Southern
22 Vancouver Island up to Kodiak Island in the Gulf
23 of Alaska and then in October/November, there are
24 still sockeye and again, to emphasize this is all
25 stocks found in Queen Charlotte Sound and off the
26 Alaska panhandle, as well as sockeye out off the
27 Alaska Peninsula about 3,000, 3,500 kilometres
28 away. By February/March, there are still sockeye,
29 Fraser sockeye, caught off the west coast of
30 Vancouver Island and a sporadic scattering of them
31 up to the north along the continental shelf.

32 If we look at contrast, the West Coast of
33 Vancouver Island sockeye, so these are not Fraser
34 sockeye, there's quite a remarkable difference in
35 one aspect, which is by October/November, none of
36 the West Coast Vancouver Island sockeye are found
37 off the West Coasts of Vancouver Island except a
38 single individual in over these multiple years.
39 They are found to the north, essentially following
40 the Fraser sockeye migration route, as well.

41 And if we look at Harrison River sockeye, for
42 the first three of those periods there are no
43 Harrison River sockeye collected anywhere on any
44 of those samples, but by February and March of the
45 year after ocean entry, they've appeared off the
46 west coast of Vancouver Island. So they have a
47 unique timing. They presumably stayed within the

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1 Strait of Georgia. In fact, you'll see that in
2 the next slide. They've stayed within the Strait
3 of Georgia for a long period of time when the
4 other Fraser sockeye stocks have left.

5 This is some data that my colleague, Dr. Dick
6 Beamish, at the Biological Station in Nanaimo has
7 given me and it shows samples -- it's from a paper
8 that he's currently completing for publication and
9 it shows samples of the DNA composition of Fraser
10 -- of sockeye caught in the Strait of Georgia in
11 September or November, September to the left and
12 November to the right, and almost 99 percent of
13 the fish that are caught in that period are
14 Harrison River sockeye. There's only a tiny
15 sliver of the other Fraser stocks that are
16 remaining there by September or November. So
17 presumably the Harrison fish stay sometime in the
18 winter, move to the West Coast of Vancouver Island
19 and the theory is that they then remain as coastal
20 residents off the coast of Vancouver Island for
21 the rest of their life history until they come
22 back in.

23 Now, the early summer juvenile sockeye
24 abundance in B.C., if we want to now turn our
25 sights somewhat farther offshore -- sorry, along
26 the coast but outside the Strait of Georgia, Dr.
27 Trudel at DFO very graciously gave me this data
28 that's under preparation. I've contrasted here
29 the 2007 smolt migration with the 2008 smolt
30 migration. This is for, of course, the failed
31 2009 return and the very abundant 2010 return of
32 sockeye in the Fraser River. So the graph, if we
33 take the 2007 graph, 2008 is the same. From the
34 bottom to the north we have West Coast of
35 Vancouver Island in the bottom and then moving
36 north off the north coast of Vancouver Island,
37 Triangle Island, Queen Charlotte Sound, the West
38 Coast of the Haida Gwaii and Hecate Strait and
39 then up to Southeast Alaska to the north. And
40 there's -- Dr. Trudel has pointed out both an
41 outer coast, an outer route, and an inner route
42 movement pattern, so the second column for 2007,
43 there's a sample here that's all green for
44 Triangle, Queen Charlotte Strait, Queen Charlotte
45 Sound area and then to the east of the Haida Gwaii
46 area within Hecate Strait. So 2008 is similarly
47 interpreted.

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1 The key point for putting this up is that the
2 green shows the Fraser River sockeye caught in the
3 trawl based on DNA sampling and assessment of the
4 source of each individual. And if I then move
5 this forwards, I've crudely outlined here in red
6 where the Fraser sockeye are found and their
7 proportion. So there are two points here. So in
8 2007, the Fraser sockeye formed a component of the
9 run up in Hecate Strait and also in Queen
10 Charlotte Sound to the south. So in Queen
11 Charlotte Sound, virtually all of the sockeye
12 caught were Fraser sockeye and in the inner route
13 off Hecate Strait, the Hecate Strait Fraser River
14 sockeye formed just under half the catch. If we
15 move to 2008, it's somewhat more abundant than in
16 2007 but it's not the 20-to-one or 30-to-one, 20-
17 to-one change in the relative abundance one would
18 expect based on the success and the failure of
19 those runs to come back as adults.

20 If we then look at the sampling that was
21 done, so the sampling, of course, there are more
22 refined ways to do this than to just simply report
23 the numbers of fish that are caught. Technically
24 we'd also like to control for the number of trawl
25 catches that were done, but they won't be too
26 different and the key point here is that between
27 years, between 2007 and 2008 there is not a large
28 difference in the sockeye catch overall. So
29 neither the abundance of sockeye in the trawls or
30 the proportion of Fraser sockeye in these
31 locations really portend the 20-to-one difference
32 in the adult return rates that were achieved by
33 that time. So this is data that I just received
34 last week and it needs to amend something I'd said
35 in a submission I made to the commission some
36 months ago, which was the 2007 appeared to be
37 anomalous in the poor Fraser sockeye survival to
38 Hecate Strait. The 2008 data says it's not too
39 dissimilar.

40 We now turn our sights to the first autumn at
41 sea. The offshore migration was really thought to
42 be a movement along the coast shown by these large
43 broad arrows and then in the first autumn and
44 winter at sea, simply it was thought that the
45 smolts or the juveniles would turn left and move
46 out into the Gulf of Alaska at that point. And
47 this was based on work done from the 1960s. Some

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1 of the contribution that I made and which has been
2 continued since then at DFO is to look at the
3 juvenile distribution along the shelf. The key
4 point here is that the red dots show locations
5 along the shelf where one or more salmon were
6 caught in the trawl and the yellow crosses show
7 where there were no salmon caught of any species.
8 So that includes Fraser sockeye if they were
9 there. And the two black lines outlining the edge
10 of the continental shelf here are the 200-metre
11 and the thousand-metre depth contours, so that's
12 the true edge of the continental shelf or the edge
13 of the continent. So the smolts are staying
14 within this area for long periods of time, much
15 longer than that earlier conjectural graph would
16 have suggested.

17 If we look first in October, the salmon catch
18 for all species, in this case the peach-coloured
19 circles are scaled with the size of the catches
20 from the trawl per 30 minutes are found again on
21 the shelf within the thousand-metre depth contour
22 along here and offshore, although we catch -- we
23 do have zero catches on the continental shelf in
24 October, consistently offshore we never caught any
25 of the juveniles. So they seem to be staying in
26 this case resident on the shelf for many months
27 because these animals even at their size when they
28 first enter the ocean at ten kilometres a day,
29 they could have moved past this area had they
30 wished to. There's no question they could have
31 either swum offshore or swum north and swum out of
32 this area if they'd wanted to.

33 So some of these animals are remaining as
34 longer-term residents within the area and if we
35 take it to the next slide, this is the Alaska
36 Peninsula at the end of November and early
37 December. It's based on the one cruise that I did
38 in 1997 to this area. This is what got me
39 convinced that automatic sampling methods that
40 didn't require people going to sea was absolutely
41 critical because in the three weeks that it took
42 from Kodiak Island to the south, southwest, we
43 only had a day and a half of fishing and the rest
44 of the time on a boat that cost \$15,000 a day was
45 spent holding on, trying to wait for the weather
46 to come down, which is typical for that time of
47 year.

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1 The key point that comes from here on a
2 scientific perspective is that our first transect
3 in was four days of steady fishing heading in
4 towards Kodiak Island and at the end of November,
5 still none of the salmon were found off the shelf.
6 We reached the shelf edge and then there were
7 large catches of salmon on the continental shelf
8 off the Alaska Peninsula.

9 Subsequent to that, over a three-week period,
10 we sampled offshore on these two-day periods and
11 we found almost none of the smolts were off the
12 shelf. Finally, on December 7th, I can't show it
13 because the camera is in the way, but the far
14 left-hand side ten percent of the -- sorry, ten
15 percent of the juvenile salmon were caught off the
16 shelf with half the samples we did on the 7th of
17 December 1997, and this is the first real evidence
18 we had for salmon starting to move off the shelf.
19 So if this data is credible, what it's indicating
20 is that the juvenile salmon remain on the shelf
21 for very long periods of time, out to the start of
22 the Aleutians. The Dutch Harbour is the start of
23 the Aleutian Islands to begin with.

24 In the second and later years of life at sea,
25 we can move forwards and some data that's just
26 been published by some of our Alaskan colleagues
27 show the distribution of -- the distribution of
28 stocks of sockeye from different areas in the
29 Bering Sea. The peach-coloured area to the -- on
30 the right shows all of British Columbia and
31 Southeast Alaska stocks and what can be seen from
32 this is that only a very few B.C. and Southeast
33 Alaska sockeye combined were found in the Bering
34 Sea, in the central area of the Bering Sea, but as
35 a proportion of the overall sockeye out there,
36 it's only a very few fish that are found in that
37 area.

38 There was a conjectural model that was
39 developed by French and colleagues some 40 years
40 ago now on what the movements of sockeye were.
41 This is -- this is where science becomes -- meets
42 art. It was the best guess that the biologists at
43 the time could identify with the technologies at
44 their hands and the data that they'd collected,
45 and it shows a pattern of movement back and forth
46 which Mike Lapointe has already indicated to you.
47 My personal view on this is that it's simply the

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1 best guess we can make, but it's a lovely work of
2 fiction that fits the very thin amounts of data
3 that we have, but I don't think that it's
4 necessarily appropriate or correct for Fraser
5 sockeye or possibly for any species of -- any
6 stock of sockeye salmon. I think they're doing
7 something much more sophisticated than this, but
8 the data is too simplistic to really tell you what
9 Fraser sockeye are doing.

10 Some hint of this can be seen from the tag
11 recoveries in the offshore in June. Dr. McKinley
12 published this a number of years ago and he showed
13 that the centre of distribution of where sockeye
14 returning to these five river systems came from
15 was as shown here. So the dots don't say that all
16 of the Fraser sockeye are sitting at that
17 particular location. It says that's where the
18 average latitude and longitude of the returns
19 were. There were distributional overlaps amongst
20 these stocks, but one of the key points was that
21 the Fraser sockeye from a statistical perspective
22 had a distinctly different position in the
23 offshore Gulf of Alaska than the Skeena, the Nass,
24 the Rivers Inlet sockeye or the Columbia.

25 So even though this is one species of salmon
26 doing one thing in the offshore, it's -- all
27 sockeye are not the same. They appear to be doing
28 something different within this area which I, as a
29 biologist, can't tell you what it was or why it's
30 important for different stocks to be in different
31 areas.

32 Now, some of the work I did in the late 1990s
33 for the Department of Fisheries and Oceans
34 involved looking at the offshore distribution of
35 salmon relative to the temperature limits on where
36 they were found. We have this data for all
37 species, but this particular paper that I'm citing
38 here is for my own work with Japanese colleagues
39 for the North Pacific and it shows the sockeye
40 abundance for three areas of the North Pacific,
41 the Western North Pacific, Central North Pacific
42 and the Eastern North Pacific or the Gulf of
43 Alaska in the columns and in each of these panels,
44 which are the rows are by months, it shows the
45 abundance of the sockeye in the catches that have
46 been collected over the last 50 years.

47 And if we expand just the July data, we can

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1 look at this again on a larger scale just to give
2 you a sense of what's happening. There is -- the
3 dots show the individual catches and the abundance
4 of sockeye and if we take the Central North
5 Pacific here, where there's the most data, there's
6 a very sharp drop cut-off in the abundance of
7 salmon at just over ten degrees. It's about 12
8 degrees Celsius. And then the curve that's
9 through there is a statistical model that shows
10 how the average abundance of the sockeye drops
11 with temperature as the temperature increases.
12 And it's a precipitous drop which is pretty
13 evident from the data and it shows that the
14 animals stopped moving to the south in the
15 offshore at quite low temperatures. During
16 migration in the Fraser River, they're migrating
17 in temperatures up to 12 degrees Celsius -- sorry,
18 20 degrees Celsius. Essentially over the 45-year
19 period in the offshore we -- none of the
20 scientists involved in any of these many surveys
21 ever caught a sockeye in over about 12 degrees
22 Celsius water in the Central North Pacific. In
23 the Eastern North Pacific there is a little bit
24 more rough or ragged edge to this, that my
25 conjecture is that that's simply because the
26 sockeye are now choosing to migrate back home and
27 to get back into British Columbia you have to
28 migrate through warmer waters.

29 Well, the -- one of the more profound
30 implications of these very sharp limits to the
31 distribution comes from looking at what the global
32 warming models that the various models under the
33 IPCC, the International Panel on Climate Change
34 have looked at and projected it where they are.
35 This graph, the top graph, shows on the December
36 distribution of the seven degree Celsius isotherm,
37 that's in light blue, and that shows essentially
38 water that would be -- that sockeye choose to live
39 in at the current -- under the current climate.
40 It's pretty good match with what the real data
41 shows, that this is computer-generated data of
42 where the seven-degree temperature limit is and in
43 July the data that I just showed you, this shows
44 the offshore distribution of 12 -- sorry, 14-
45 degree Celsius temperatures in July. So it
46 doesn't quite cover the Gulf of Alaska and areas
47 where we have sockeye, but it's fairly similar.

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1 The reason this is of concern is that
2 essentially throughout the year these are just two
3 months for this. All of the global warming models
4 predict that under a doubled CO₂ climate, which we
5 should expect around 2050 at best guesses right
6 now, the temperatures that sockeye prefer to live
7 in move up into the Bering Sea or in the -- in
8 July actually mostly up into the Okhotsk Sea,
9 which is the sea to the north of the Bering Sea.

10 Now, whether sockeye will continue to do this
11 in the future and why they don't do it now and how
12 important it is for their life history is purely a
13 matter of conjecture and speculation right now,
14 but if they do do this, the point is that in July,
15 they would not actually be able to migrate back to
16 British Columbia at all because the Alaskan land
17 mass is between British Columbia and where the
18 projected temperature distribution is, acceptable
19 distribution of temperature is for sockeye. So
20 potentially in the future, there are some very
21 profound implications for the productivity of
22 these animals since it says that they're -- for
23 whatever reasons, they are choosing to respond to
24 temperature in a very sensitive way.

25 We now turn to the maturation and the return
26 home. The graph on the right-hand side -- sorry,
27 the left-hand side shows how the sea temperature
28 off Vancouver Island is related to the proportion
29 of the sockeye returning to the Fraser River that
30 choose to migrate north coming in through Queen
31 Charlotte Sound and Johnstone Strait. The other
32 alternative, of course, is to go south and around
33 Juan de Fuca Strait to the south. And basically
34 over about a two-to-three-degree Celsius change
35 from about ten to 12 or 13 degrees Celsius, it
36 switches from being entirely a migration in
37 through Juan de Fuca Strait to the south to a
38 migration at higher temperatures of being 80 or 90
39 percent coming in through the northern route
40 through Johnstone Strait.

41 Now, in the -- there are a number of papers
42 that have been published looking at this migration
43 of the adult -- of the maturing adults coming back
44 in. The one that I've chosen to highlight here
45 shows the correlation between the offshore
46 temperatures right across the Gulf of Alaska with
47 the returning -- the northern diversion rate as

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1 this is shown. And essentially what the authors
2 showed is there's a dashed line along here where
3 there's maximum correlation between the offshore
4 temperatures at any of these locations and the
5 proportion of fish coming around Vancouver Island
6 to the north. So essentially, anywhere along that
7 line has equally good predictive capability of
8 telling you where the sockeye would return. And
9 what I've put on here as the red star is where the
10 centre of the Fraser sockeye distribution was from
11 the tagging work that I showed you several slides
12 earlier. So although it's just -- they're
13 independent data sets. They do seem to correlate
14 fairly well, that the animals are in an area where
15 those temperatures are a pretty good predictor of
16 the diversion rate and the tagging data from the
17 1960s suggested that they were out there at
18 virtually where that dashed line indicates. So
19 it's fairly consistent.

20 If we turn to food and survival, this is very
21 complicated and I've chosen in my 30 minutes to
22 really minimize it because the short answer is
23 that sockeye eat just about everything. As small
24 animals they're eating plankton, as larger animals
25 they're eating fish and squid, as are most of the
26 salmon that are out there.

27 One of the key aspects is that there were
28 large changes in the zooplankton between the 1950s
29 and '60s shown in the upper right, and the 1980s
30 to 1989 period, when there was more than a
31 doubling of the abundance of plankton which would
32 fuel the basis of the food chain in the offshore.
33 And the key point here is that the offshore Gulf
34 of Alaska also changes over time. Sockeye
35 populations have built up around the Pacific Rim.
36 In this slide you see that there was a very large
37 change in the plankton out there that was
38 coincident with this.

39 Now, I have to apologize at this point. I
40 have left a slide out of my submission from next
41 -- from when I submitted it last week. It shows
42 the concurrent changes in the abundance of sockeye
43 caught during these two periods in the offshore,
44 showing the same matched abundance change. So
45 there's a much larger catch of sockeye everywhere
46 in the North -- sorry in the Gulf of Alaska in the
47 1980 to '89 period than there was in this earlier

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1 period, so not only did the plankton change
2 between the '50s and the '80s, but also the
3 sockeye did, which we know is true both for Fraser
4 River specifically but also around the Pacific
5 Rim. And Alaska had a very large increase in
6 sockeye abundance, as well. So I'll have to
7 submit that to the commission afterwards as a
8 correction to this once I get the slide.

9 If we take a look at the 2010 Fraser sockeye
10 return, and I should put a disclaimer in here. I
11 have a conflict of interest that I have to
12 declare. My wife is one of the co-authors on this
13 paper. This shows the offshore abundance of
14 chlorophyll, which is the pigment that's in plants
15 that fuels the bottom of the food chain. In
16 August of 2008 the upper left-hand graph shows
17 from two satellite measurements shows the
18 remarkable increase in chlorophyll within the Gulf
19 of Alaska. If you look in the upper right-hand
20 corner, there's a square here which is the area
21 that was sampled from the satellite record and it
22 -- and the peak shown in the line graph on the
23 left-hand side shows a very large increase in the
24 chlorophyll concentration in the offshore.
25 Chlorophyll is the pigment that plants use to grow
26 and produce and there was a massive increase.

27 The reason for that almost certainly is
28 because of a volcanic eruption in the Aleutian
29 Islands that occurred in August of 2008. The
30 lower left-hand graph shows a satellite composite
31 of several different overpasses by satellites
32 showing the plume of ash that goes out across the
33 North Pacific and into the Gulf of Alaska and the
34 lower right shows a computer model of the timing
35 of the ash dispersal. So this, for a time, the
36 magnitude of the eruption was sufficient to shut
37 down the airport in Anchorage, Alaska. So it was
38 a very large eruption and you can see the ash fall
39 in the lower right-hand side that basically within
40 three days the yellow dots, it had either reached
41 the centre of the Gulf of Alaska or some of it had
42 blown onto Northern British Columbia and Southeast
43 Alaska.

44 Now, the reason this is important is that ash
45 is a basalt material and it's rich in iron. The
46 North Pacific Ocean and the Antarctic Ocean are
47 the two ocean areas in the world where plant

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1 growth is not limited by nitrogen and phosphorus,
2 so the normal things that gardeners are familiar
3 with. They are, in fact, limited by the amount of
4 iron as a trace element that's out there and
5 because there's not enough of that, it prevents
6 the plants from uptaking the other nutrients that
7 are actually in abundance, super-abundance out
8 there.

9 So the reason for the slide is to show that
10 in August of 2008 there was a very large amount of
11 chlorophyll across the Gulf of Alaska, and if I
12 switch to the next slide which is from the same
13 paper, the top left shows August 2005 satellite
14 imagery, lower left shows August -- sorry, top
15 right shows August 2006, lower left shows August
16 2007 and lower right shows August 2008. So this
17 is just prior to the 2008 out-migrating smolts
18 going offshore which formed the 2010 return. So
19 what's quite visible from this is there is, in the
20 lower right-hand graph which is August 2008, far
21 more yellow out here which is the colour scale for
22 chlorophyll than in any of the prior years. So
23 what happened at that time was a volcanic eruption
24 just prior to the onset of winter of 2008 and
25 associated with that was a very large plankton
26 bloom that stretched across much of the Gulf of
27 Alaska, including where Fraser sockeye were.

28 So I'd like to switch to the animation now of
29 Cultus Lake sockeye migration, and if you can
30 start it and then just hold it, pause it right as
31 soon as it starts. So this work is based on some
32 of my current work on developing a marine
33 telemetry array for measuring survival of sockeye
34 -- well, not just sockeye salmon, but other
35 species of salmon, as well, and eventually other
36 fish, but the reason that we're going to show this
37 now is to summarize the overall movements of one
38 stock of Fraser River sockeye.

39 So if you could maximize that, just hit F11.
40 All right. And so this particular year we've
41 published this, it's in the notes. What's
42 published is the out-migration of 2007 smolts.
43 What's not published is a paper that we have now
44 in review talking about the adult returns that
45 have come back from this. So Cultus Lake is in
46 the Lower Fraser River and in the four years 2004
47 to 2007 we acoustic -- we surgically implanted

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1 acoustic transmitters into the smolts and then
2 released them at the outlet to the Cultus Lake to
3 go out and out the -- over the marine telemetry
4 array. So the -- if I can show you here, the
5 magenta lines show the Northern Strait of Georgia
6 line which stretches from Comox to Powell River.
7 It's sitting just off the sea bed or actually it's
8 in mid-water column, across the northern tip of
9 Texada Island. There's a line just north of Port
10 Hardy stretching across from Browning Pass to
11 Duval Point on the mainland side. These are about
12 20, 25-kilometre long sub-arrays of receivers. We
13 have a line across from Sheringham Point to Pillar
14 Point on the Washington Coast and then on the
15 outer coast, just north of Quatsino Sound, we have
16 a subarray sitting at Lippy Point, stretching out
17 to the edge of the continental shelf, to just
18 about the 200-meter isobath.

19 And then within this area, we have some
20 receivers in the lower Fraser River, the farthest
21 up the river that my company maintains is Mission,
22 just below Cultus Lake, and during the 2007 out-
23 migration there were also some receivers in Howe
24 Sound. So what we're going to do now is -- and a
25 little bit of geography here on the map, so there
26 is a graft -- sorry, there is a date down here
27 which shows the day of the year. What we will do
28 is we will animate the movements of each of the
29 animals that are acoustically implanted and then
30 released at Cultus Lake. There were 200 in 2007
31 so if you can start the animation...

32 We animate those movements out based on the
33 speed of movement to the detections at each of the
34 points and there's a couple of points here, so
35 there are only a few fish that go out Juan de Fuca
36 Strait, six in 2007, two of them then reach up to
37 Lippy Point on the northwest coast. All of the
38 others go up the Northern Passage through
39 Johnstone Strait to Queen Charlotte Sound. And
40 amongst those fish that have gone past, there were
41 two that were -- we've highlighted as red dots.

42 Now, if you can pause that. All right. So
43 those two animals are going to return in 2009, so
44 that's two out of 200 or one percent return, and
45 what we did was we programmed the tags, because
46 there's a limited battery power for the tags. We
47 programmed two periods of transmission into them.

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1 We turned the tags on on the 13th and 14th of May
2 2007. They turned off on the 27th and 28th of
3 June 2007 which was fortunately just after the
4 bulk of the smolts had gone out over the Northern
5 Passage and they're going to turn back on on the
6 26th and 27th of July.

7 Now, actually, if I can bring this animation
8 back, something I hadn't thought of. Pardon me.
9 If I can borrow the mouse. I'll take it back to
10 there and run it from there. There are going to
11 be two red dots moving up through Johnstone
12 Strait. Those are the two adults that will come
13 back. So one was at the leading edge of the pack
14 and the second one you can see up in Johnstone
15 Strait heading towards the northern end of
16 Vancouver Island now. So they've now passed --
17 they passed the northern end of Vancouver Island
18 about a week apart.

19 Now, when they come back in, what you're
20 going to see is they will come in off the
21 offshore, so the first one you'll see coming in
22 from the north and it arrives just a week after
23 the -- we guessed and turned the tag on and you'll
24 see it starting to move down. It was detected on
25 the outer edge of the Lippy Point subarray. The
26 other tag will now be coming in from the left.
27 We've simply had it flying in from Japan because
28 we didn't know where it came from, but the two
29 animals passed the Juan de Fuca Strait subarray
30 within 12 hours of each other, so pretty
31 remarkable, given they'd left a week apart and
32 they both took the route that they didn't go out
33 -- and then they were both detected with very
34 little delay going up through the Fraser River and
35 were detected as far as Mission, which was our
36 last receiver in the Strait of Georgia -- or in
37 the Fraser River, pardon me.

38 All right. So if we move forwards then, we
39 can use this as a concept of what happens. The
40 one thing that I can't show you off that animation
41 but from prior years, we've never detected any of
42 those animals up on the Alaska line. They should
43 have reached there, particularly in 2005 when we
44 tagged a lot of animals. So my suspicion is that
45 the Cultus Lake sockeye are staying somewhere
46 between the north end of Vancouver Island and
47 Queen -- and the Alaska Panhandle, but we can't

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1 say where.

2 If we now look at the overall movements, we
3 can break the survival into three patterns. So
4 one is from release to the mouth of the Fraser
5 River in orange; one is from the mouth of the
6 river to northern Strait of Georgia, Texada
7 Island; and the third is through Johnstone Strait,
8 Discovery Strait, Broughton Archipelago to the
9 Queen Charlotte Strait subarray.

10 And if we look at that, the 2007 smolts are
11 in yellow. Now, we published this in May 2009
12 just a few months before the collapse occurred and
13 what's completely evident is that we failed to
14 predict the 2009 adult return, as well. The
15 survival out of the Fraser River, the Northern
16 Strait of Georgia and Queen Charlotte Strait was
17 very similar to the other years. These are, I
18 should mention, larger smolts than the normal
19 hatchery run. We used those because particularly
20 it gave us the ability to put in a tag that was
21 large enough so that we could also monitor the
22 adult return back in.

23 So the survival was as high or higher than in
24 prior years, so where did the 2009 adult sockeye
25 fail to survive is obviously the key question.
26 Unfortunately, we didn't do the work in 2008, so
27 we have no idea what the baseline would have been
28 for the big adult return that came in in 2008.

29 Now, what we can do though is look at the
30 relative mortality that's occurring during these
31 two phases. So if we take survival from Cultus
32 Lake to Queen Charlotte Strait, survival was 28
33 percent or just over one in four fish made it up
34 to the north end of Vancouver Island. So I've
35 reversed the normal way we describe this and I've
36 set it as salmon per survivor. So for every 3.6
37 fish that were released, one made it to the north
38 end of Vancouver Island a little over a month
39 later, which is normally considered when most of
40 the mortality happens for salmon.

41 In contrast, the acoustic telemetry results
42 show that we had a one percent return of the
43 adults two out of the 200 came back which was in
44 line with what happened for the Cultus Lake run as
45 a whole. Well, we had 28 percent survival to the
46 north end of Vancouver Island and one percent
47 coming back, so the implication of that is that it

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1 took 28 fish that have passed the north end of
2 Vancouver Island to make one adult that came back.
3 So if the acoustic telemetry data is credible, it
4 suggests that almost four times more -- sorry,
5 seven times more mortality is still to come after
6 passing the north end of Vancouver Island as
7 occurred to the north end of Vancouver Island.

8 So I'd like to summarize this now. So Fraser
9 sockeye smolts travel long distances along the
10 continental shelf before eventually migrating to
11 the offshore North Pacific. That gives a narrower
12 focus on where the sockeye problems could have
13 developed during the first year. They're not
14 offshore. They are remaining on the continental
15 shelf. And when they do move to the offshore
16 area, the distribution of B.C. sockeye is mainly
17 in the Gulf of Alaska.

18 Now, clearly the offshore phase is the least
19 well-understood but abundant sockeye stocks from
20 the Bering Sea also could occur here, as well as
21 other B.C. sockeye stocks that did not collapse in
22 2009. Now, 2010 we're receiving at least
23 anecdotal reports that there were high sockeye
24 returns occurring across the North Pacific, so the
25 causes of the dearth and the surfeit of sockeye
26 may well be different.

27 Essentially all Fraser sockeye stocks to our
28 knowledge other than Harrison migrate out of the
29 Strait of Georgia and quite quickly, at about just
30 under ten kilometres a day, migrate 400 kilometres
31 through the Strait of Georgia to reach the Queen
32 Charlotte Sound subarray telemetry array in about
33 40 days and they had good survival. Harrison
34 sockeye, which had been increasing in productivity
35 are an anomaly. They migrate to sea soon after
36 birth, remain long periods in the Strait of
37 Georgia and then apparently exit via Juan de Fuca
38 Strait and overwinter on the West Coast of
39 Vancouver Island. So very different behaviour,
40 very different survival patterns. And long-term
41 residence in the Strait of Georgia or not
42 migrating north through Johnstone Strait is thus
43 associated with the higher marine survival pattern
44 that's been seen for that stock.

45 A personal caution and thought based on my
46 career, adult returns in fisheries are generally
47 thought to be determined early in their life

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1 history, so typically for salmon, right after they
2 -- if not in the river right after they hit the
3 ocean, Mike Lapointe has spoken about that. As a
4 result of that assumption, there's a tendency to
5 assume that events early on determine the adult
6 returns. In my own view over the last 30 years,
7 what we as a profession have often done is make a
8 simplifying assumption to make the research
9 simpler, but we've not been successful at testing
10 whether that assumption is right. We've gone on
11 that basis of that assumption that things happen
12 very early on and that later on in life is not as
13 important for maintaining fisheries. My own guess
14 or prejudice is that that assumption and failing
15 to test it may be part of the reason why we're so
16 unsuccessful as fisheries biologists at really
17 managing fisheries and recognizing the collapses,
18 whether it's northern cod that collapsed on the
19 East Coast or Fraser on the West Coast.

20 And an important point which is my personal
21 professional opinion is that it's important to
22 remember that a survival drop to one-tenth of the
23 return can happen anywhere in the life history.
24 It doesn't have to happen early on. So long as
25 there's a one-tenth drop, you're going to get a
26 one-tenth drop in the adult returns, so that's a
27 key point. That simple point is often overlooked
28 because we're often trying to simplify a very
29 complex and costly phase of the life history of
30 marine fish, salmon included, to make the work
31 simpler, but that assumption is almost never
32 tested.

33 And I'll leave it at that point.

34 MS. BAKER: Mr. Commissioner, we could start with our
35 next witness for ten minutes and then break, or we
36 could come back a bit early.

37 THE COMMISSIONER: I would respectfully suggest that
38 just looking around the room, I think it might be
39 appropriate to break at this time and come back at
40 2:00 and hear the next witness all the way through
41 without a break.

42 MS. BAKER: Thank you.

43 THE COMMISSIONER: I believe the presentation we just
44 received has now been marked as Exhibit 2, is that
45 correct?

46 MS. BAKER: That's correct.

47 THE REGISTRAR: That's correct.

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1 THE COMMISSIONER: Thank you very much. We'll then
2 take an adjournment until 2:00 p.m. Thank you.
3 THE REGISTRAR: The hearing is now adjourned until 2:00
4 p.m.
5

6 (PROCEEDINGS ADJOURNED FOR NOON RECESS)
7 (PROCEEDINGS RECONVENED)
8

9 THE REGISTRAR: The hearing is now resumed.

10 THE COMMISSIONER: Ms. Baker?

11 MS. BAKER: Mr. Commissioner, the next witness is Karl
12 English who will be providing a PowerPoint
13 presentation on the migration of Fraser sockeye
14 from Alaska to their spawning destinations and
15 when that PowerPoint is pulled up on the screen, I
16 would ask that that again be marked as the next
17 exhibit.

18 THE COMMISSIONER: Very well, thank you.
19

20 EXAMINATION IN CHIEF BY MS. BAKER:
21

22 MR. ENGLISH: Thank you. My mike on? I'm good. Well,
23 I want to thank Mike and Dave for the two previous
24 presentations, Mike especially for setting the
25 stage, providing the life history data as he
26 mentioned. For those that may not have been here
27 this morning, this talk is just at the final
28 stages with the adults returning. Dr. Welch
29 provided some of that information and it'll be a
30 bit of overlap between our two presentations.

31 I'd also like to acknowledge the importance
32 of science in generating a lot of the information
33 I'll provide, but also the contributions of a
34 variety of First Nations that I've had the
35 pleasure to work with, both on the Fraser and
36 elsewhere. So it isn't just data that comes from
37 scientific studies. It's data that comes from
38 working with a lot of very knowledgeable First
39 Nation leaders and their fisheries people.

40 That's been a huge benefit to me over the
41 years, probably more in the north where I spent
42 more time than on the Fraser, but in the last ten
43 years working on the Fraser.

44 The first picture there shows you the pretty
45 striking difference between what a sockeye looks
46 like as it enters the lower Fraser River, and one
47 that's on the spawning grounds up in the Adams

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1 River. We're going to step back to -- if this
2 thing works -- maybe it might have to be restarted
3 again, or...

4 Okay. All right. So the first slide here
5 talks about the various fisheries that are
6 encountered -- that encounter sockeye, fishing
7 areas from the southern southeast Alaska right
8 through to Washington State. So in the top left-
9 hand side of the figure, of the map, shows
10 southern southeast Alaska and then Haida Gwaii and
11 then the north end of Vancouver Island. Then down
12 at the bottom right-hand corner, Washington State
13 fisheries and, of course, the entry to the Fraser
14 River.

15 Obviously, as David Welch described, the
16 ability of the sockeye to these various fisheries
17 depends a lot on their migration path.

18 Here's -- the first graph shows what we
19 typically call a northern approach or northern
20 diversion route where the sockeye have made a
21 landfall up off the Queen Charlotte Islands or
22 southern southeast Alaska. And I first
23 encountered this personally in '83 when we were
24 tagging for a northern tagging study and actually
25 putting tags on what we thought were Nass and
26 Skeena sockeye stocks out of southern southeast
27 Alaska, and a number of them were recovered in
28 Johnstone Strait. So this isn't just conjecture
29 that these fish go through these areas.

30 Subsequently, there's been stock composition
31 done in those southeast Alaskan fisheries and they
32 found significant numbers of Fraser sockeye in
33 certain time periods intercepted in those
34 fisheries.

35 When they go through from the north and go
36 through Johnstone Strait, it makes them accessible
37 to the major Johnstone Strait fisheries. This is
38 a more typical pattern in what we call El Nino
39 years, which is when there's warmer water further
40 north in the Pacific, and so the fish make their
41 landfall in Alaska. It's also more typical later
42 in the run, so you'll see in a few slides the fact
43 that sometimes -- or very often the diversion
44 changes over the course of the run quite
45 dramatically.

46 If you look at a more southerly approach
47 where they're making landfall off the south of

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1 B.C., they're not going to be as vulnerable -- or
2 vulnerable at all to Alaskan fisheries, only a
3 little bit in the north coast, and mostly coming
4 through Juan de Fuca Strait, and that's called
5 southern diversion. This is the typical pattern
6 for migration of sockeye in most years in June,
7 July and early August.

8 This graph shows very clearly this is for the
9 -- on the Y axis here, you have diversion rate.
10 On the bottom axis, you have the time through area
11 20. Area 20 is the Juan de Fuca Strait, and so
12 the diversion is referred to as the portion of the
13 run that's moving through Johnstone Strait. So
14 while they often put things up at area 20 dates,
15 the diversion is measured as the portion going
16 through Johnstone Strait.

17 You can see for -- this is -- shows three
18 years, 2002, 2006, 2010. These are all what we
19 call a dominant Adams River year or dominant
20 Shuswap cycle year, just like the year we're in,
21 obviously, 2010. You can see how the diversion
22 rate changes from being usually fair low early in
23 the season, and then rising dramatically around
24 early August, and then the vast majority of the
25 fish going through Johnstone Strait late in the
26 year.

27 So in terms of -- once they've determined
28 which direction they're going to come in, then the
29 other issue is what they do when they approach on
30 these different routes, and of course the timing
31 of their arrival in Johnstone Straits (sic) or
32 Juan de Fuca can affect all the fisheries or does
33 affect all the fisheries, and a number of the
34 other steps in their migration.

35 The next phase is once they're gone through
36 these approach fisheries, they now enter lower
37 Georgia Strait and there could be some delay of
38 the fish off the mouth or some number of fish that
39 just migrate directly into the river. And then
40 there's river entry timing. Obviously all these
41 things affect the availability to fisheries.

42 So if we break these down in terms of the
43 components that affect the timing for timing --
44 for movement into the George Strait area, or in
45 through these approach routes, it's mostly going
46 to be what's happening on the northeast Pacific,
47 either El Nino events or climate-related changes

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1 in the northeast Pacific ocean structure that's
2 going to affect when they arrive back. So it's
3 factors outside of Georgia Strait.

4 The amount of delay that occurs off the mouth
5 of the Fraser is going to be a function of run
6 timing group, so not all the different timing
7 groups behave the same, and I'll get into more
8 detail of that in a minute. It can also be
9 affected by the abundance of those groups and the
10 amount of overlap between the various timing
11 groups. Fish maturity will have a factor in there
12 as well, and a number of environmental conditions,
13 tides, river flow and temperature.

14 Then the factors that determine just when the
15 fish that are delaying off the mouth of the
16 Fraser, enter the Fraser River, will again be a
17 function of some of these factors. So again, fish
18 maturity, stock group -- so the stock group is the
19 timing groups of Fraser sockeye -- and then
20 environmental factors.

21 If you look at these, there's four different
22 timing groups and probably end up becoming more
23 familiar with as time goes on, but the three of
24 them here that exhibit similar behaviour as they
25 approach are the early Stuart timing, early summer
26 and the summer runs, and they all have different
27 management assessment sort of structures for each
28 of the fisheries -- each of the stocks, sorry.

29 The reason why I put these three together is
30 that each one of these groups enters the Fraser
31 River with little or no delay off the mouth of the
32 river. So when there's assessment programs in
33 Johnstone Straits or Juan de Fuca, they expect to
34 see the fish in the river in a matter of six to
35 ten days from Johnstone Straits test fisheries and
36 five to six days from the Juan de Fuca test
37 fisheries.

38 The fourth timing group, the late run group,
39 has exhibited two very distinctive types of
40 behaviour. They come in their late run because
41 they come in slightly later, but not a lot later.
42 Their migration is very similar to that of summer
43 run stocks when they're coming through these
44 approach areas, but they can delay off the mouth
45 of the Fraser for quite a period of time, 20 to 30
46 days or maybe even longer in some years. Or some
47 parts of the run will enter right at the same time

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1 as the -- or with little or no delay, just like
2 summer run fish. It's this variability in
3 behaviour that has been the focus of some major
4 studies started in 2002, 2003 right through to
5 this past year when we've been tagging on the
6 approach routes and looking at migration into the
7 river.

8 So as with the summer run, the amount of
9 travel time, they're usually a little bit slower
10 moving than summer run stocks, you know, six,
11 seven, eight days to get into the river, but when
12 they're moving directly through to Mission -- or
13 this 25-plus days of delay as we experienced for a
14 lot of the fish this past year.

15 Just to give you an idea of how fast they're
16 moving, these summer run stocks and late run
17 stocks are going to be moving between 35 and 45
18 kilometres a day in the ocean.

19 There's a few charts here that show for --
20 and these obviously can be done up for a variety
21 of the years. I focused in on this dominant late
22 run Shuswap cycle year, which is the same one
23 we're in this year, so 1990, 1994 are two years
24 prior to when we had observed a lot of fish
25 entering early. If you look in the time period
26 here, it shows summer run in blue, the early
27 summers in yellow. These are Scotch and Seymour,
28 the two primary early summer stocks, and red is
29 the late run, primarily the Adams River or Shuswap
30 stocks.

31 Prior to 2000 -- or prior to -- yeah, it was
32 2000 that the DNA analysis techniques allowed for
33 distinguishing stocks using their DNA as opposed
34 to scales. There really wasn't any way of
35 reliably distinguishing these yellow fish from
36 these red fish because they weren't yellow and red
37 in the water. They all look the same. Their
38 scale pattern, which Mike showed you earlier,
39 which is used to distinguish between the different
40 lakes, was very similar because they rear in the
41 same lake. They're both rearing in Shuswap Lake.

42 So this created a problem. So most of the
43 separation here between early fish and later was
44 based on the assumption that because they have
45 earlier spawning timing, they had to be those fish
46 that come in early.

47 What happened in 2000 -- in the year 2000,

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1 they developed the stock ID methods using DNA so
2 they could actually distinguish these two
3 populations and you can see in the lower graph
4 that there is timing -- times when, in fact, for a
5 lot of the run, were -- in both the lates and the
6 early summers are coming in at the same time.
7 Ninety-eight ('98) was the last year prior to --
8 for this particular run, this a four-year cycle
9 for the Adams stock -- that they didn't have the
10 DNA data. And for the latest two years, you can
11 see the pattern has been consistent where we have
12 Scotch and Seymour, the early timing stocks and
13 late run coming in at the same time, and starting
14 as early as late July. So we have late run fish
15 entering the Fraser River as early as late July,
16 where the bulk of them enter in early September to
17 mid-September in every one of these dominant cycle
18 years, but there's always some that enter early.

19 These -- I should have probably mentioned at
20 the beginning, this is timing at Mission now.
21 This isn't the area 20, so this is when the fish
22 actually migrate past the Mission hydro-acoustics
23 site. And these numbers are all adjusted numbers,
24 post-season, for 2006 and these numbers are the
25 preliminary for 2010 available on the Salmon
26 Commission website.

27 So if we move into the Fraser River now and
28 look at the various components of getting the fish
29 home, so now they've entered the lower River here
30 and they've got this long migration past Mission,
31 which is located near the -- just below the mouth
32 of the Harrison, past Hope, and all the way up to
33 the spawning areas as far up as the Stuart system
34 in the very top part of the figure you're looking
35 at.

36 We have, for a number of years, deployed
37 monitoring locations along the river, the main
38 stem and in the tributaries, and put radio
39 transmitters in fish to look at how fast they will
40 do this migration, and also assess their passage
41 through some of the challenging areas. This is a
42 picture of the Bridge River rapids location near
43 -- just above Lillooet. It's one of the areas
44 that -- a lot of people think that Hell's Gate is
45 the only place where there's a problem for fish
46 passage on the Fraser. Well, salmon are
47 challenged for quite a bit of their migration.

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1 This is another one.

2 Here, if you're looking just upstream, you
3 can see the degree to which the river is very
4 channelized, very canyon oriented with a number of
5 constriction points where the fish have to migrate
6 up against quite considerable current. This is
7 looking upstream from Kelly Creek. Kelly Creek is
8 just above Bridge River rapids area up to the
9 Chilcotin. You can see similar types of migratory
10 challenges, areas in the Lower Thompson as well.

11 So despite all those challenges, fish --
12 these sockeye have an incredible ability to swim
13 upstream at speeds, in freshwater, equivalent to
14 what they're doing in the ocean. This is an
15 example of just one fish that we tagged in the
16 lower Fraser in 2006. It's an early Stuart
17 sockeye and it's migrating from Mission all the
18 way to the early -- to the Stuart system up here
19 right in the top part of the graph in 16 days,
20 which is 800-some kilometres at a pace of 45 --
21 average speed of 45 to 50 kilometres a day.
22 Mother Nature has some pretty amazing talented
23 fish.

24 They're the fastest of the sockeye. Chilko
25 and a lot of the summer runs are a little bit
26 slower in their migration, but not much, thirty-
27 five to 40 kilometres a day. There's quite a
28 rigorous migration challenge that's between the
29 Chilcotin junction and the spawning grounds up
30 near Chilko Lake, which means that the length of
31 time it takes a fish to move from between those
32 two spots can be quite considerable, in fact is
33 almost half the migration -- the in-river
34 migration rates for these fish.

35 This is a fish that was tagged, in this case,
36 out in Johnstone Straits, took it seven days to
37 enter the Fraser River and then migrated up and
38 was 31 days reaching the spawning areas in the
39 Chilko system. So it's basically, you know, 24
40 days in migration in fresh water.

41 I put two up here for the -- these are Adams
42 River fish. Their DNA stock ID'd as Adams fish,
43 even though one did not make it back to the Adams
44 and the top one did. The top one -- they were
45 both tagged on the same day in 2006, in early
46 August, in Juan de Fuca Strait at the bottom
47 corner of each of these graphs, bottom left-hand

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1 corner. The first one on the top of the graph, it
2 took 30 days for it to reach Mission. Now, it
3 could swim very readily from Juan de Fuca Strait
4 to Mission in probably seven to eight days, and in
5 fact its fellow migratory out here did in fact
6 swim there in eight days.

7 But the first one likely delayed -- we didn't
8 have -- there's no way of detecting these radio
9 tags in marine waters. That's the reason for
10 using acoustic tags in what David Welch's studies
11 have done. The studies where we have applied both
12 acoustic and radio tags to migrating adult salmon
13 have shown that the fish move quite rapidly down
14 through the Straits -- or up through the Straits
15 here, and holding off the Fraser River mouth for
16 considerable period of time for those that delay.

17 The top one here is taking about 23 days to
18 migrate in freshwater up to Little -- past the
19 Little River receiver, which is just near the
20 mouth of the Adams, and then there's often another
21 delay there for a few days before they enter the
22 Adams River where I guess people have been seeing
23 them recently.

24 The bottom graph shows a fish that entered
25 right away with virtually no delay and, in this
26 case, it was tracked to a location just above the
27 Spences Bridge area near the Nicola junction. It
28 took it 17 days to get there from release or about
29 nine days in-river migration. But that was the
30 last place we detected that fish, and it was
31 during a period of high temperature and a lot of
32 the fish were observed dying en route in that
33 year, and hence the term "en route mortality"
34 which is -- you'll hear -- another one of those
35 terms you'll hear referred to quite a bit for late
36 run fish, because it can be quite significant in
37 years like this, 2010, and other late run years.

38 This chart shows a summary of just some of
39 the migration speed data, putting it all on a
40 single chart where you have the migration speeds
41 across the bottom, the different reaches, Mission
42 to Hope, Mission to Hell's Gate, Mission to
43 Thompson, to the Chilcotin junction, up to the
44 Quesnel junction, and then some of the reaches
45 within the Thompson system. The purpose of this
46 is just to show that late run fish in the brown
47 here are -- tend to be and have been consistently

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1 slower moving in-river and somewhat slower in the
2 ocean migrating than the other stocks.

3 The summer runs, whether they're early
4 summers or the summer in blue here, tend to
5 migrate at about the same rate through all these
6 reaches, and you can see the overall migration
7 speed for early Stuart is the fastest, getting
8 upwards of 40 kilometres a day compared to the
9 other runs.

10 This is where the fun really starts, when
11 you're putting transmitters in fish and you're
12 actually putting a temperature logger on the fish
13 to figure out what the fish is experiencing on an
14 hourly basis during an extended migration from the
15 release site - in this case in the Mission area -
16 all the way to the spawning site which is Scotch
17 Creek.

18 So this is actually a Scotch Creek fish.
19 It's an early summer timing group and it's -- here
20 we're referring to as a pre-spawn mortality. So
21 it didn't die en route, but it didn't successfully
22 spawn. And the only reason why we know that is
23 because when they recovered this tag on the
24 spawning grounds, it was a female and she still
25 had her eggs. That's what people will be
26 referring to when they talk about pre-spawn
27 mortalities, fish that's made it all the way to
28 the spawning ground but doesn't deposit the eggs,
29 dies before spawning. There's some ample examples
30 of those, I think, up in the Adams and Shuswap
31 system this year.

32 The concern obviously from the biologists,
33 and from all people concerned with the stocks, is
34 why these fish are going through this tremendous
35 migration and then not finishing their job and
36 spawning. So a lot of it we believe is due to
37 temperature, and you can see the temperatures
38 here. I talk about fish in the ocean choosing
39 temperatures in the 12 to 14 degrees or cooler
40 range, they're having to encounter temperatures
41 here in the lower river in the 18 to 20 degrees
42 range on a daily basis while swimming upstream and
43 encountering fisheries and everything else.

44 It can get warmer in periods. Like you can
45 see here, we're over 20 degrees for this fish.
46 This is the temperature experienced by the fish.
47 It isn't just something we're measuring, you know,

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1 somewhere else. This is actually the data
2 recorder on the fish.

3 Then once it's -- you can see where it is,
4 the different reaches as you move up this red line
5 from Rosedale to Hope to Sawmill, Hell's Gate,
6 Thompson, Spences Bridge. This particular area
7 here where the temperature was very warm was the
8 cause of a lot of fish not even making it further
9 than that point in 2006. This was again, just one
10 of the -- example of many fish tracked in 2006.

11 The other interesting thing is you can see
12 the temperature dropping down for the fish for
13 periods here, and this is when it enters a lake.
14 So it's typical if they have to migrate through
15 lakes, they use the cool water in the lakes to get
16 their temperature back down to where they want to
17 be, and you can see this fish choosing to go back
18 down to this 11, 12-degree water. This fish could
19 readily swim through Kamloops Lake in three days.
20 So while we don't know precisely where this warm
21 water is being experienced here for a day, we
22 believe that it's at the outlet of the south
23 Thompson going -- flowing into the upper end of
24 Kamloops Lake. That's where this fish wants to
25 go, wants to move through and up into the south
26 Thompson and then up into Shuswap Lake.

27 It's made three attempts here to come out of
28 the lake, back in the lake for a period, back out
29 the mouth for warm water for a period, then back
30 into the cool water, and then finally holding at
31 the mouth here for a day and then deciding it's
32 going to push through into Shuswap Lake.

33 The accumulation of temperature for an
34 individual fish -- so these are accumulated
35 temperature units, ATU's, could readily determine
36 and be related to the survivorship of fish both to
37 the spawning grounds and also the potential for
38 pre-spawn mortality. So these studies that have
39 combined both temperature and migration are
40 telling us a lot about what these fish are
41 encountering and potentially why they're dying.

42 For late run, the research done in 2002, '03,
43 '06 -- and these are the combined efforts of the
44 Salmon Commission, ourselves, DFO and a lot of
45 First Nations assisting with tag recovery and in-
46 river monitoring and catch-monitoring programs.
47 So piecing it all together to try and figure out

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1 what is the pattern of mortality for late run
2 fish? Why do late run fish that -- and are at
3 different times, from early August through to late
4 in September -- why do they have -- appear to have
5 different survivorships? So we quantified this
6 with these figures for tagged fish in these three
7 different years.

8 It became pretty clear that if they entered
9 before the middle of August, there was a very low
10 probability of survivorship to the spawning
11 grounds. These are the en route losses. You
12 could have pre-spawn mortality on top of this. So
13 if it's entering in late August and surviving at a
14 50 percent level, that doesn't mean that 50
15 percent are going to spawn. It just means 50
16 percent are going to make it to their spawning
17 grounds.

18 But you come in -- if you're a late run fish
19 coming in, in late -- in mid to late September,
20 you have a better than 90 percent chance of both
21 making it to the spawning grounds and usually pre-
22 spawn mortality drops off for those late arrival
23 fish. So there's better survivorship to spawn,
24 better spawning success.

25 This just is a picture of what the fish look
26 like up in the Adams River. People may have seen
27 something similar this year where they're doing
28 escapement monitoring. They apply tags to fish at
29 these sites, do mark or capture work to assess the
30 population size, but they also use that -- these
31 surveys to assess pre-spawn mortality as well as
32 the sex composition for the runs. They can get
33 their effective females numbers.

34 Of course, not -- Mike alluded to the fact
35 that sockeye in the Fraser seem to be very
36 specific into their timing for spawning periods,
37 so I thought I should put up one chart here that
38 shows the different run timing groups in colours
39 so for early Stuart in brown at the bottom, yellow
40 for early summers, summers in blue and late run in
41 red.

42 These are the different conservation units.
43 It's another term people will be referring to
44 probably from time to time. There are 25
45 routinely assessed conservation units for Fraser
46 sockeye. There's more in total, but these are the
47 25 where there's good time series of data sets.

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1 They represent the vast majority of the
2 conservation units for Fraser sockeye and they all
3 have their own specific escapement timing period
4 and spawning period. You can see the range from
5 early Stuart and actually Chilko in the lower end
6 -- sorry, not Chilko -- Chilliwack in the lower
7 end which is just above the Mission area right
8 through to -- and they're coming in, in early
9 July, and moving right up into the spawning areas
10 very quickly 'cause it's a short migration,
11 through to the Shuswap complex and also Cultus,
12 which people will get very familiar with that
13 name. It's one of the latest timing for spawning
14 stocks of Fraser sockeye.

15 I just thought we should put up some pretty
16 pictures of the Adams River fish. These are the
17 grandparents, a couple of grandparents here, a
18 male and a female in this picture. In 2002 this
19 slide was taken and we had a number of these fish
20 tagged and tracked in that year, and this is the
21 Adams River spawning grounds.

22 There is lots more data, but I figured that
23 probably will cover it until there's questions.
24 Thank you.

25 MS. BAKER: Mr. Commissioner, I have no questions
26 arising.

27 What we have given all of the participants is
28 an order for cross-examination which we will
29 follow. Because Mr. Lapointe is an employee with
30 Pacific Salmon Commission, our rules provide that
31 his counsel has the first opportunity to ask
32 questions, and then we'll move back into the order
33 that the participants have been provided, which is
34 1 to the end. I can assist in that if people are
35 not sure where they go in the line-up, but we also
36 have the numbers of the front of the desk, so
37 people should know where they go. After the
38 Pacific Salmon Commission it will be the
39 Government of Canada followed by the Province, and
40 I can assist beyond that if we need to.

41 Now, again we have about a half hour before
42 the break and then 45 minutes after that, and
43 we're hoping that people will keep their questions
44 to a minimum. All these witnesses will be
45 returning in the hearing to give full evidence, so
46 the intention today is to provide more of an
47 overview than anything else, so clarification on

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1 what they have heard is appropriate, but in-depth
2 cross-examination, I submit, should wait until the
3 witnesses come back for a full day of proper
4 hearing. Thank you.

5 THE COMMISSIONER: Thank you.
6 Mr. Hunter.

7 MR. HUNTER: Thank you, Mr. Commissioner. I have no
8 questions of the panel.

9 MR. TAYLOR: I have a couple of questions, or a few
10 questions, if I may, and I will remember what Ms.
11 Baker has just said about the panel coming back
12 later on. My first question is of Mr. Lapointe.

13 MS. BAKER: Excuse me, Mr. Taylor, we do need to
14 identify ourselves each time we speak.

15 MR. TAYLOR: Oh, I'm sorry, Mitchell Taylor for the
16 Government of Canada.

17
18 CROSS-EXAMINATION BY MR. TAYLOR:
19

20 Q Mr. Lapointe, I expect you are familiar with the
21 terms "delayed density dependence" and "cyclic
22 dominance"; am I correct?.

23 MR. LAPOINTE: Yes, that's correct.

24 Q And those terms apply to the Fraser sockeye, do
25 they?

26 MR. LAPOINTE: Yes, they do.

27 Q Can you briefly explain what they are?

28 MR. LAPOINTE: I will try.

29 MR. ENGLISH: You wanted me to do that one, didn't you.

30 MR. TAYLOR:

31 Q I don't mean to put you on the spot if there's an
32 indication there that Mr. English is the better
33 panel member to do it.

34 MR. ENGLISH: No, no, he's the better one.

35 MR. LAPOINTE: I'll try to do it.

36 I'll start with "delayed density dependence".

37 Some of the figures that I showed at the very
38 end which related the fry production to the
39 abundance of females in the brood year, in the
40 parent year, delayed density dependence extends
41 that out to say that the parents in the brood year
42 might not just affect the abundance of fry that
43 they produce, but also subsequent abundance and
44 survival of fry of subsequent generations. So
45 it's extending the effect of density beyond the
46 effect of the parents on their offspring to the

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1 effect of the parents on subsequent offspring.
2 And there are a number of statistical models have
3 been fit to Fraser sockeye which demonstrate that
4 this -- that those models actually do fit the
5 pattern of returns of Fraser sockeye. But
6 basically it's an extension, and the reason for
7 the term "delay" is that it occurs not just
8 immediately after on their offspring, but on
9 subsequent offspring.

10 So that's the definition I would offer for
11 "delayed density dependence".

12 Now, "cyclic dominance" is going to be a
13 little bit more difficult I think for me to
14 summarize succinctly, but I will try as best I
15 can.

16 There are some theories that would suggest
17 that that delayed density dependence is something
18 that is inherent within the biology of the fish,
19 and that term has been called "cyclic dominance".
20 So the idea that the largest returns in this case,
21 and Adams River would be a great example because
22 this year was a great, very large return of the
23 Adams River. The Adams River pattern of returns
24 would show a very large run, which would be the
25 2010 return, followed by a run that's slightly
26 smaller, perhaps, you know, half, half the size,
27 followed by two much smaller runs that would be
28 orders of magnitude smaller.

29 Cyclic dominance refers to the concept that
30 that pattern is controlled intrinsically within
31 the biology of Fraser sockeye, and one of the
32 mechanisms that could be controlling that would be
33 this delayed density dependence idea, which we
34 introduced earlier on.

35 So I think I'll stop there and see if that
36 helps you, and if I can offer clarification, I'd
37 be happy to do so.

38 MR. TAYLOR: I think that is fine. Thank you very
39 much. My next few questions are of Dr. Welch.

40 Q You referred, Dr. Welch, to some tagging that you
41 had done where you tagged smolts. Can you say
42 what the implication on your study of using larger
43 smolts, which I gather was the case for tagging.

44 DR. WELCH: Well, there's -- so the question is whether
45 the larger smolts have an effect on their survival
46 and it would be different for the small smolts.

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1 Q Yes.

2 DR. WELCH: So since we don't have direct data on the
3 survival of small smolts we can't answer that
4 directly.

5 But last week I became aware of a paper
6 that's just being published by DFO staff member,
7 Dr. Jim Irvine and a colleague, showing that the
8 survival rates of Chilko one-year-old smolts and
9 two-year-old smolts was virtually identical over
10 the last half century. So those are not the runs
11 that -- or the run that we did the work on. But
12 that work suggests that the survival rate of
13 larger and smaller smolts is -- is very similar,
14 if not identical.

15 Q Would you expect, however, that the survival rate
16 for larger smolts, all things being equal, would
17 be better for the larger than the smaller?

18 DR. WELCH: That's a long-standing theory. There's
19 been very little data to support that over the
20 range of size of smolts that's been done.
21 Certainly large fish like adults coming back have
22 better survival per year than small smolts. But I
23 don't think there's any direct data to point to
24 that.

25 Work we've done in the Columbia River shows
26 that over the range of smolt sizes that we have
27 been tracking and measuring, the survival rate has
28 been independent of the size of the smolts that
29 we've tagged. So it's not a complete answer and
30 it doesn't apply to the Fraser sockeye, but most
31 of the very recent work that we've done, which not
32 all of it's published, indicates that survival
33 does not strongly depend on the size of the smolts
34 that we've looked at so far.

35 Q At the same time is it the case you don't rule out
36 that your study could be biased low for mortality
37 in Georgia Strait of the Fraser sockeye?

38 DR. WELCH: It's certainly a possibility. What we're
39 looking at is the survival across the life
40 history, and also the survival between years,
41 which seems to be constant, or similar, rather.

42 Q Have you heard the proposition or theory that in
43 2007 in July there was a low abundance of food in
44 Georgia Strait due to the shallow depth of the
45 water layer that supports nutrients?

46 DR. WELCH: Yes, I have.

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Cross-exam by Mr. McDade

1 Q And is that something that's a fairly well
2 accepted point? That is to say, there was a
3 shallow depth of the nutrient-supporting water in
4 that year?

5 DR. WELCH: I can't comment, because I haven't seen the
6 data.

7 Q Okay. Now, I understand from what you said
8 earlier that you have studied the sockeye and
9 specifically Fraser sockeye for many years now.

10 DR. WELCH: Correct.

11 Q And am I correct in what I take from your earlier
12 evidence that you didn't see the dismal returns
13 for 2009 coming before it happened?

14 DR. WELCH: That is -- that is correct.

15 Q Now, some of the slides that you used, I believe
16 were from Marc Trudel, were they?

17 DR. WELCH: That is correct, yes.

18 Q And you know him to be a DFO scientist?

19 DR. WELCH: Yes, he is.

20 Q And in fact am I correct that you and he
21 collaborate in some of your work together?

22 DR. WELCH: Yes, we do.

23 MR. TAYLOR: Thank you.

24 MR. PROWSE: C. Prowse for the Province. I have no
25 questions, Mr. Commissioner.

26 THE COMMISSIONER: Thank you.

27 MR. BUCHANAN: Thank you. Chris Buchanan for the PSAC.
28 We also have no questions of this panel.

29 MR. BLAIR: Alan Blair for the Salmon Farmers. We have
30 no questions.

31 MR. BURSEY: David Bursey for Rio Tinto Alcan, we have
32 no questions. Thank you.

33 MR. McDADE: Gregory McDade for Dr. Morton and the
34 Aquaculture Coalition.

35

36 CROSS-EXAMINATION BY MR. McDADE:

37

38 Q I just have a couple of questions for Dr. Welch in
39 terms of the migration of smolts in the 2007 year.

40 Am I correct, Dr. Welch, that in the 2007
41 year -- or let me ask a more general question. It
42 seems from your presentation that the Fraser River
43 sockeye migrate primarily up Johnstone Strait to
44 the north. There are other stocks, though, that
45 migrate up the West Coast of Vancouver Island, for
46 instance the West Coast stocks.

47 DR. WELCH: Sorry, the West Coast Vancouver Island

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- 1 stocks?
2 Q Yes.
3 DR. WELCH: Yes. So the majority of Fraser sockeye are
4 thought to migrate up Johnstone Strait, the
5 northern exit. The tagging work we did in
6 multiple years certainly showed over 90 percent --
7 well, probably over 95 percent of the Cultus Lake
8 sockeye that we studied migrated through Johnstone
9 Strait. A few percent in some years migrated out
10 Juan de Fuca Strait.
11 Q And the stocks of the Columbia River are also
12 thought to migrate up the West Coast of Vancouver
13 Island and not Johnstone Strait?
14 DR. WELCH: That's correct. So Dr. Trudel of DFO has
15 genetic data now showing the Columbia River
16 sockeye migrate up the West Coast of Vancouver
17 Island. I don't -- I'm not aware of any data
18 showing Columbia River sockeye migrating into the
19 Strait of Juan de Fuca.
20 Q Okay. And the Harrison stocks are largely
21 resident. They don't migrate up through Johnstone
22 Strait.
23 DR. WELCH: So I have a couple of slides that were
24 specifically on that. I think the most accurate
25 way to respond is that we don't know how Harrison
26 sockeye move out of the Strait of Georgia in the
27 fall. It's clear they're in the Strait of
28 Georgia, from Dr. Beamish's studies, at least
29 until September and November and then they move
30 out to the West Coast of Vancouver Island,
31 according to Dr. Trudel's analysis. It's thought
32 that they move out Juan de Fuca Strait but no one
33 knows for certain.
34 Q And is it -- am I correct that in the 2007
35 migration year, which would be the 2009 returners,
36 the Columbia River stocks did well?
37 DR. WELCH: 2009 adult return of Columbia River sockeye
38 was exceptional. The best in about 50 years.
39 Q And the -- the adult returners on the West Coast
40 of Vancouver Island were good, as well?
41 DR. WELCH: Average to slightly above average, I
42 believe, but I'd qualify that in that I'm not
43 positive of -- it's certainly not a reduced run.
44 Q And Harrison stocks were also doing well?
45 DR. WELCH: Very well according to the data we have,
46 yes.
47 Q So that the Fraser River problem in 2009 appears

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- 1 to be isolated to those stocks that were running
2 up Johnstone Strait.
- 3 DR. WELCH: That's correct.
- 4 Q And your telemetry study indicates that as of the
5 exit from Johnstone Strait, your view would be
6 that mortality rates were normally what would be
7 predicted?
- 8 DR. WELCH: They were not what would be predicted.
9 What would have been predicted was a much higher
10 mortality rate in the Strait of Georgia because
11 the preceding assumptions and science were that
12 most of the mortality happened -- that mortality
13 rates were very high after entering the ocean and
14 that most of the mortality took place at that
15 time. Our results show that most of the mortality
16 happened after they passed the north end of
17 Vancouver Island.
- 18 Q Now, you have suggested in a submission you made
19 to the Commission that much of the mortality may
20 have occurred in the 20- to 30-day range after
21 leaving Johnstone Strait; that's right?
- 22 DR. WELCH: That was my submission, yes.
- 23 Q And but let me go back to the Columbia River
24 stocks and the West Coast of Vancouver Island
25 stocks. They also go into the Gulf of Alaska?
- 26 DR. WELCH: I'm not aware of any information on where
27 West Coast Vancouver Island stocks go. There is
28 certainly evidence for Columbia River stocks going
29 into the Gulf of Alaska.
- 30 Q So in effect they go into similar environmental
31 conditions to the Fraser River stocks that have
32 left Johnstone Strait?
- 33 DR. WELCH: So far as we are aware. Yes.
- 34 Q So wouldn't -- so doesn't this suggest that
35 there's something happening to those fish who take
36 Johnstone Strait that is unique to those stocks in
37 the 2009 adult returners, that that's where we
38 should be looking for the problem?
- 39 DR. WELCH: That possibility is certainly one of the
40 top ones.
- 41 Q And that's where we have the concentration of
42 aquaculture facilities.
- 43 DR. WELCH: There's aquaculture facilities on the West
44 Coast of Vancouver Island, as well. But there are
45 certainly many in Johnstone Strait, as well.
- 46 Q And your -- your submission to the Commission
47 suggests that the time of disease transmission for

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- 1 many diseases is in that 20- to 30-day range, or
2 sorry, disease, fatalities from disease?
- 3 DR. WELCH: I would phrase it differently. What I had
4 said in the submission is that based on the data
5 from Dr. Trudel that I was privy to in June, it
6 appeared that the Fraser River sockeye were in
7 much reduced abundance by the time they reached
8 Hecate Strait, about 30 days after passing out of
9 Johnstone Strait, Queen Charlotte Strait.
- 10 The data that I received from him last week,
11 which -- about ten days ago in preparing the
12 submission for this Commission, I had asked him
13 for both the 2007 and 2008 data to compare that.
14 So I was surprised to see that the 2007 Fraser
15 sockeye proportionate abundance up in Hecate
16 Strait was not as small as I had thought. And I
17 was also surprised to see that the 2008 smolts
18 were not as abundant as I would have expected in
19 Hecate Strait, which was the point of one of my
20 slides.
- 21 Q Yes. But there is still -- you still -- there was
22 a significant difference. It wasn't in the
23 proportion you expected, but there's a significant
24 difference.
- 25 DR. WELCH: Significant difference in what, please?
- 26 Q In terms of the proportion of smolts surviving.
- 27 DR. WELCH: There was -- there were a smaller
28 proportion of Fraser River sockeye in the 2007
29 catches than in 2008.
- 30 Q And so it still continues to suggest that there is
31 some causation -- causative factor in Johnstone
32 Strait that could be the cause of some of this
33 mortality.
- 34 DR. WELCH: In my submission to the Cohen Commission,
35 which I've put together in June and was published
36 in mid-July, I said that this is correlation, not
37 causation, and it's very important to identify a
38 direct effect and not -- not assume that there is
39 causation. But those two events did co-occur in
40 2007. There was a very bad return in 2009 and
41 those smolts did migrate through Johnstone Strait
42 to Queen Charlotte Strait and appeared to have
43 good survival, but by the time they came back, as
44 I demonstrated, their survival was much lower.
45 Where that survival was lower, after passing
46 beyond our telemetry array, we can't specify.
- 47 Q All right. So we don't have the cause -- we don't

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1 have enough data at this point to prove causation,
2 but we do to suggest a correlation.

3 DR. WELCH: Correct.

4 MR. McDADE: Thank you.

5 MR. LEADEM: My name is Tim Leadem. I represent the
6 Conservation Coalition. I have a few general
7 questions to ask of the panel.

8

9 CROSS-EXAMINATION BY MR. LEADEM:

10

11 Q Mr. Lapointe, you mentioned the term
12 "biodiversity" without really explaining it in
13 full, and since this is the first time that we've
14 heard that term in evidence, I wonder if you can
15 take some time to elaborate on the terminology of
16 biodiversity and why it's important.

17 MR. LAPOINTE: I'll try. So when I use the term
18 "biodiversity", I mean the, I guess diverse groups
19 of populations that would contribute to the
20 overall aggregate population of Fraser sockeye.
21 Within the Wild Salmon Policy context the term
22 "conservation unit" is used, and Karl showed some
23 data for conservation units. So I would describe
24 it as the sort of geographic, bio-geographic suite
25 of stocks and populations and habitats in which
26 they live. Certainly probably obviously a genetic
27 basis for that because of the fact that Fraser
28 sockeye very much home to their natal streams
29 every year.

30

31 In terms of why it's important, a whole host
32 of reasons. But primarily because these stocks do
33 have different traits, and those traits may confer
34 them some survival advantage to particular
35 environmental factors or other factors that affect
36 them. It's very much analogous to, you know,
37 diversity of performance in, you know, like a
38 stock portfolio. If you have some populations
39 that do better in some circumstances than others,
40 then having a very diverse portfolio means that
41 your group of populations is much more likely to
42 persist in the event that there is some set of
43 environmental factors that would threaten their
44 existence.

44

45 A good example would be something like
46 climate change. Some of these populations may
47 very well be more robust to warmer temperatures in
adverse conditions than others. So I guess that's

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1 what I would try to offer up as my definition of
2 biodiversity.

3 Q That helps. So it's fair to say, then, that the
4 more diverse that you have in terms of the
5 conservation units, the better off you are in
6 terms of achieving some sustainability of the
7 species?

8 MR. LAPOINTE: Certainly, yes. From a species
9 sustainability perspective, diversity is
10 definitely an advantage.

11 Q You mentioned the Chilko Lake Weir. Is that
12 operated by Department of Fisheries and Oceans?

13 MR. LAPOINTE: Yes, it is.

14 Q Are you aware of any other weirs that count the
15 smolts as they exit the lakes?

16 MR. LAPOINTE: There is a weir at Cultus. Cultus has
17 had a weir sporadically and more intensely in the
18 last few years. And there's been a few other sort
19 of one-off or two-off events within the Fraser of
20 weirs that have occurred in some of the past
21 years. But Chilko is the primary one that's had
22 this very consistent long-term monitoring.

23 Q And as a scientist, you find that information
24 useful to be able to have counts on smolts that
25 are exiting lakes?

26 MR. LAPOINTE: Absolutely. It's the only way I could
27 have provided you the information about the
28 relative mortality of different life stages. So
29 in the context of 2009 and trying to understand
30 where and when to look for potential causes of the
31 low return, unless you have mortality at different
32 life stages, you really just would have a big
33 black box where you have some estimate of the
34 number of spawners and some estimate of the number
35 of returns and no way to know where in that four-
36 year life history the bottleneck might occur.

37 Q And you would argue certainly for a larger dataset
38 to be able to draw better conclusions; is that
39 fair to say?

40 MR. LAPOINTE: Yes, it is. Chilko is actually quite
41 unique in some respects. The fry of Chilko
42 actually migrate upstream. It's one of the only
43 populations where the fry actually migrate
44 upstream in that very narrow area near shore. So
45 Chilko may or may not be representative, and
46 obviously without other information from other
47 stocks, we don't know that.

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1 Q And generally speaking scientists like to have
2 more datasets available to them.

3 MR. LAPOINTE: Of course.

4 Q Dr. Welch, with respect to the work that you
5 performed, why did you pick the Cultus Lake
6 Conservation Unit to focus upon your study?

7 DR. WELCH: Well, there were two reasons. One is it's
8 one of the two endangered sockeye stocks in
9 British Columbia, the other being Sakinaw, which
10 we've also worked on, and the other is logistic
11 ease. It's of the sockeye populations it was one
12 where we could readily get our hands on to do the
13 surgical tagging.

14 MR. LEADEM: Thank you, those are my questions.

15 MR. ROSENBLOOM: It's Don Rosenbloom, and I appear on
16 behalf of Area D Gillnet and Area B Seiners. I
17 would like to direct my questions to Mr. English.

18

19 CROSS-EXAMINATION BY MR. ROSENBLOOM:

20

21 Q Mr. English, you have focused on the in-migration
22 or return of the sockeye into the natal streams.
23 I'd like to just spend a moment asking you
24 questions regarding the matter of the in-
25 migration, either internally through the Johnstone
26 Strait as opposed to heading down the West Coast
27 and into the Strait of Juan de Fuca. Do you have
28 information as to the percentage of the run, on an
29 average, that would choose one routing as opposed
30 to the other?

31 MR. ENGLISH: That graph that I showed up there shows
32 how the percentage changes during the year, and
33 the Salmon Commission would have overall for the
34 entire season the percent that shows one route or
35 the other for that whole season. But it really
36 depends very heavily on the amount of the run that
37 comes in early versus late that determines the
38 diversion for the year.

39 Q Can you give -- I'm sorry, yes. Can you give some
40 sense of the extreme from year to year of an
41 average that would go one route as opposed to the
42 other -- as opposed to another year?

43 MR. ENGLISH: I think the range -- Mike probably would
44 be a better person to answer that, but the ranges
45 I've seen have been usually on the order of 40 to
46 60 percent. So 40 percent going through Johnstone
47 Straits in a low diversion year, in total, and 60

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1 to 80 percent in a high diversion year.

2 Q Okay. Now, my question is this. Are you aware of
3 studies that have been done in respect to
4 mortality rate with one routing in-migration as
5 opposed to the other routing in-migration?

6 MR. ENGLISH: Well, we could take some inferences from
7 the tagging that we have done in Juan de Fuca
8 Strait, and similar tagging done at the same time
9 ion Johnstone Straits. And seen quite a range of
10 mortality, essentially measured as the portion of
11 the fish that we tag that actually make it to our
12 in-river detection sites. And then --

13 Q Mm-hmm.

14 MR. ENGLISH: Sorry.

15 Q Go ahead.

16 MR. ENGLISH: Yes. And in the year when we did it
17 exactly parallel, 2002, we saw some of the
18 pictures from that particular year, we had tagged
19 in both locations simultaneously throughout the
20 late run. We saw very clear pattern that when the
21 bulk of the tags are being put on fish on the
22 route where the majority of the fish were going,
23 and in that year -- if I had that graph up I could
24 show you, but it shows the proportion going
25 through Johnstone Straits was only about ten
26 percent early in the year in the beginning of our
27 tagging program. So most of them are going
28 through Juan de Fuca Strait. And we had what we
29 call pretty high survival for the tags, about 70-
30 plus percent of the tags were detected in the
31 river.

32 When the run shifted -- and early in the
33 season we had very low survivorship for the fish
34 going through Johnstone Straits. When the run
35 shifted and it exactly changed where 90 percent
36 was going through Johnstone Straits, later in the
37 year we had an almost identical shift in
38 survivorship. So the fish that we tagged were
39 surviving better with the bulk of the run. So
40 where the bulk of the run was going, the
41 survivorship was better. Now whether that was due
42 to the fish being -- the tagged fish being
43 selected by predators, or some other factors,
44 versus it being the tags were being completed
45 representative of the untagged population is still
46 a question. But definitely we had better
47 survivorship for fish that we tagged on the route

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1 where the majority of the fish were headed.
2 Q All right. And so listening to you carefully, you
3 did not see a correlation in respect to mortality
4 issues based upon the route, whereas you did based
5 upon whether the abundance of the stock were
6 heading down one route as opposed to the other.

7 MR. ENGLISH: That's correct.

8 Q Is that your evidence?

9 MR. ENGLISH: That's correct, yes.

10 MR. ROSENBLOOM: Thank you very much. No other
11 questions.

12 MS. BAKER: Mr. Commissioner, I notice that it's three
13 o'clock. Did you want to take a break now or
14 should we press on?

15 THE COMMISSIONER: The hearing will now recess for 15
16 minutes.

17

18 (PROCEEDINGS ADJOURNED FOR AFTERNOON RECESS)
19 (PROCEEDINGS RECONVENED)

20

21 THE REGISTRAR: Mr. Commissioner, the last PowerPoint
22 was not marked yet. It is now Exhibit number 3.

23

24 EXHIBIT 3: PowerPoint presentation titled
25 "Migration of Fraser Sockeye from Alaska to
26 their spawning destinations"

27

28 THE COMMISSIONER: Thank you, Mr. Registrar.

29 MR. BUTCHER: Mr. Commissioner, David Butcher, I have
30 no questions for these witnesses today.

31 THE COMMISSIONER: Thank you, Mr. Butcher.

32 MR. HARVEY: So it's, Mr. Commissioner, Chris Harvey
33 for the United Fisherman Allied Workers' Union and
34 the Area G West Coast Trollers.

35

36 CROSS-EXAMINATION BY MR. HARVEY:

37

38 Q I have a question for Mr. Lapointe and it relates
39 to the slide and the evidence which went to the
40 spawning grounds. And what you were describing, I
41 think, Mr. Lapointe, if I'm not putting words in
42 your mouth, that each spawning ground has a
43 carrying capacity; is that a fair generalization?

44 MR. LAPOINTE: I guess what I was referring to, more
45 than the spawning ground per se, was the lakes
46 that the juveniles rear in have a capacity.

47 Q Yes. So the levelling off that you showed after a

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1 certain number of spawners is basically controlled
2 by the carrying capacity of the lakes?
3 MR. LAPOINTE: That's correct.
4 Q Yes. And does each system, then, have an optimum
5 carrying capacity, optimum level of spawners?
6 MR. LAPOINTE: I guess I would need some help in having
7 you define "optimum," relative to what objective?
8 Q Well, optimum in the sense of ensuring a
9 sustainable return, and optimum in the sense of
10 ensuring that harvest potential is not wasted,
11 because those two considerations can be achieved
12 at the same time, can they not?
13 MR. LAPOINTE: So when you use the term "wasted," what,
14 specifically, do you mean by that term, could I
15 ask, please?
16 Q Well, isn't -- "foregone harvest opportunity,"
17 isn't that a term you understand?
18 MR. LAPOINTE: Okay. So you mean that there would be
19 some level of abundance where there could be
20 greater or lesser foregone harvest opportunity,
21 when you use the term "wasted," is that correct?
22 Q Yes. Well, if -- what I'm trying to convey is
23 that -- and I got this sense from your evidence,
24 that when you reach the level where the -- where
25 you're not getting an increased production from
26 the number of spawners, or the increasing number
27 of spawners that you put on the grounds, what --
28 that situation will represent a foregone harvest
29 opportunity?
30 MR. LAPOINTE: It certainly could. So in terms of
31 sustainability, any of those levels of juvenile
32 abundance would be potentially sustainable. It's
33 not like a higher abundance level is not
34 sustainable, but from the standpoint of foregone
35 catch, if putting 2 million fish on the spawning
36 grounds produces the same number of returns as
37 producing -- putting one million on the spawning
38 grounds, then, clearly, the disposition of that
39 difference between those two numbers, one million
40 fish, could be available for harvest, potentially.
41 Q Yes. Yes. Now, the -- I just want to move on,
42 but with that in mind, to the importance of data
43 collection on the returning adults, you mentioned
44 that -- and you demonstrated a wide variability in
45 marine survival rates. I think one of your slides
46 indicated a survival range of 0.39 percent to 23.4
47 percent?

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- 1 MR. LAPOINTE: That's correct. That's for the Chilko
2 stock, yes.
- 3 Q That's for the Chilko stock. And you said that
4 the causes of that vast variation are not well
5 understood, and the magnitude cannot really be
6 predicted?
- 7 MR. LAPOINTE: That's correct.
- 8 Q Yes. That would seem to indicate that the -- that
9 early data collection on the returning adults is
10 of critical importance to in-season management?
- 11 MR. LAPOINTE: Yes, that's correct. And as you know,
12 that's our primary responsibility at the Salmon
13 Commission, is to conduct that in-season data
14 collection.
- 15 Q Yes. Yes. And just to generalize, that data
16 collection, in the past, was achieved largely
17 through the interception fisheries; was it not?
- 18 MR. LAPOINTE: Definitely, in years when there were
19 more consistent patterns of commercial fisheries,
20 that commercial fisheries data did feed into the
21 assessments.
- 22 Q Yes. And in more recent years -- well, let me use
23 a term, there's a term sometimes referred to as
24 gauntlet fisheries, and I think that is meant to
25 describe, correct me if I'm wrong, but meant to
26 describe commercial fisheries extending from the
27 mouth of the river out to sea, to the north end of
28 Vancouver Island, and along the west coast of
29 Vancouver Island?
- 30 MR. LAPOINTE: Sure, a gauntlet fishery would be the
31 sequence of fisheries from the marine areas right
32 through into the Fraser River.
- 33 Q Yes. And the seaward end of that gauntlet has
34 basically been cut down over recent years, has it
35 not?
- 36 MR. LAPOINTE: So are you talking about the geographic
37 extent, or the intensity, or both, or --
- 38 Q Both.
- 39 MR. LAPOINTE: Yeah. So there were fisheries, fairly
40 regular fisheries that would occur as far seaward
41 as the Queen Charlotte Islands, west coast Queen
42 Charlotte Islands.
- 43 Q Yeah.
- 44 MR. LAPOINTE: Those fisheries no longer exist. The
45 west coast of Vancouver Island fisheries no longer
46 exist. Area G --
- 47 Q Yes.

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1 MR. LAPOINTE: -- the group that you represent. And so
2 the fisheries, commercial fisheries now, in years
3 where we have fisheries, would typically start at
4 the top of Johnstone Straits. And so yeah, the
5 geographic extent has definitely decreased.
6 Intensity has also decreased in most years,
7 although 2010, in terms of intensity, wasn't that
8 different from some of the historical years, past
9 years.

10 Q And with the decrease in the geographic extent of
11 the gauntlet fisheries, has that, to some extent,
12 made it more difficult to arrive at an early
13 prediction of run size and to make the necessary
14 in-season management changes?

15 MR. LAPOINTE: To some extent, yes, although the
16 fisheries, particularly on the west coast of the
17 Queen Charlottes, weren't that well related to
18 overall abundance. In fact, it would be very
19 typical in years when we had -- when those
20 fisheries did occur, for the peak of the catch in
21 those fisheries to occur almost the same time as
22 the peak catch in Johnstone Straits. In other
23 words, there seems to be a group of fish that
24 would hit the west coast of Vancouver Island, and
25 even though there would be perhaps a very
26 significant catch, and those were troll fisheries
27 up in that area, there wouldn't be a lot of
28 abundance associated with it. It would almost be
29 like most of the run that hit that area was
30 harvested. So they didn't -- they provided a bit
31 of a signal, but they didn't provide a very
32 reliable signal of what was to come in the seaward
33 areas because they just weren't that well related
34 with the abundance that fell subsequent to that.
35 It's possible that something more seaward could be
36 designed, but it would require a broader and a
37 more systematic geographic extent than what
38 occurred in the traditional commercial fisheries
39 that occurred, say, in the west cost of Vancouver
40 Island in the past.

41 MR. HARVEY: Thank you. I think those are my
42 questions.

43 THE COMMISSIONER: Thank you, Mr. Harvey.

44 MR. LOWES: Mr. Commissioner, J.K. Lowes for the B.C.
45 Wildlife Federation and the B.C. Federation of
46 Drift Fishers, and I have no questions.

47 THE COMMISSIONER: Thank you.

Panel No. 1
Karl English
Cross-exam by Ms. Dion

1 MS. DION: Tina Dion for the Maa-nulth Treaty Society,
2 Musqueam Indian Band, and Tsawwassen First Nation
3 standing group. I have one question, and that's
4 for Mr. English, but I'll start with the comment
5 made by Dr. Welch.
6

7 CROSS-EXAMINATION BY MS. DION:
8

9 Q You've made reference to the importance of
10 traditional ecological knowledge with respect to
11 First Nations and the fishery, but Mr. English,
12 you specifically mentioned the contribution of
13 First Nation leaders and their fisheries people,
14 as you put it, that you benefited from their
15 knowledge up north, as well as in the Fraser
16 River. And I just wanted to ask whether it was
17 fair to say that your understanding of the
18 traditional ecological knowledge is based on
19 historical knowledge about fish cycles passed down
20 inter-generationally by First Nations people?

21 MR. ENGLISH: Well, it's a combination. The
22 experiences I've had working with First Nations
23 people in the field have provided their insights
24 into what's going on with populations, and I have,
25 in turn, provided my insights back to them, and so
26 it's a give and take process where we exchange
27 ideas and talk with elders at times, talk with
28 young people at times. And you know, I don't
29 profess to have a really in-depth understanding of
30 traditional knowledge, but I've been trying to
31 incorporate the opportunities to gain that
32 whenever possible. And, I guess, some of it
33 actually comes more from the Yukon and in the Nass
34 than more from the Fraser. I've had somewhat less
35 time and less opportunity on the Fraser to engage
36 in that as much as in the Yukon and in the Nass
37 River.

38 Q But as a general statement, you'd agree, though,
39 that it's information that is passed down inter-
40 generationally from one generation to the other?

41 MR. ENGLISH: Oh, yes, for sure. Yeah, and it's a long
42 history of some very interesting things that I'm
43 sure the people on the committee would like to
44 hear at some point, but maybe not now.

45 MS. DION: Good. Thank you.

46 MR. JANES: Robert Janes for what's been termed the
47 Western Central Coast Salish standing group.

Panel No. 1
David Welch
Cross-exam by Mr. Janes

1 Gentleman, I, for the most part, will direct my
2 questions to Mr. Welch, save where I direct
3 otherwise. Although, if any of you feel you have
4 something useful to contribute, please sail in as
5 they're relatively generic questions.
6

7 CROSS-EXAMINATION BY MR. JANES:
8

9 Q And I noticed, through all of your evidence, all
10 three of you, on a number of occasions, you
11 mentioned that there were areas of uncertainty, or
12 there were information gaps, or limits on the data
13 that were available. And I take it that good
14 science involves recognizing and accounting for
15 uncertainty in the data that you have and in the
16 conclusions that you draw from that data; is that
17 fair to say?

18 DR. WELCH: Yes, it is.

19 Q And as part of doing good science, you try to
20 identify uncertainty where it exists in your work;
21 is that fair?

22 DR. WELCH: Yes, it is.

23 Q And in certain cases, you can even try to quantify
24 the uncertainty, using statistical techniques; is
25 that fair?

26 DR. WELCH: Correct.

27 Q And again, you'd also try to provide explanations
28 for the uncertainty, where those explanations are
29 available?

30 DR. WELCH: Possibly. That's a rather broad question
31 to answer simply.

32 Q And just taking it a step further, then, as -- and
33 as I think you've shown in parts of your evidence,
34 you know, part of the scientific process is --
35 involves articulating the methods of trying to
36 shed light on the areas of uncertainty, or limit
37 the uncertainty, the areas of uncertainty where
38 that is maybe possible?

39 DR. WELCH: Correct.

40 Q And in terms of the scientific understanding of
41 the Fraser River sockeye lifecycle, I'm going to
42 suggest that there is -- there a number of areas
43 of what I'd call significant uncertainty, and I'd
44 just like to sort of take that apart, but as a
45 general statement, is that fair to say?

46 DR. WELCH: Yes.

47 Q And let's look first at the issue of trying to

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David Welch
Cross-exam by Mr. Janes

- 1 forecast sockeye returns. One reality is there is
2 a reality of natural variability in terms of how
3 the returns occur; is that correct?
- 4 DR. WELCH: Correct, in all phases of the life history.
5 Q Right, and that can be influenced by things like
6 weather patterns like El Nino?
- 7 DR. WELCH: Yes.
8 Q And I think you gave an example, and I just want
9 to try to take a moment to make sure I understand
10 the significance of one of your slides, Dr. Welch,
11 which is slide 32, I believe it is, in Exhibit 2,
12 which is where you referenced the 2008 volcano
13 event?
- 14 DR. WELCH: Correct, yes.
15 Q To make sure I really understand what you're
16 getting at there, as I understand it, this is a
17 situation where there was a volcanic eruption, I
18 believe it actually erupted into an unusual storm
19 system that resulted in a dispersal of ash over
20 the ocean; is that fair?
- 21 DR. WELCH: Yes.
22 Q And that resulted in a growth in plankton, as
23 measured by the abundance of chlorophyll in the
24 water?
- 25 DR. WELCH: Yes, and also the animal plankton that was
26 measured from direct measurements at sea.
27 Q Right. And the hypothesis, I think, that you're
28 putting forward is that -- or -- and it is just a
29 hypothesis at this point in time, is that that may
30 well be part of the explanation of the incredibly
31 abundant salmon this year; is that fair?
- 32 DR. WELCH: Yes, it's -- several slides there point out
33 that in the 1950s and '60s, plankton was much less
34 abundant than in the 1980s, presumably due to
35 climatic changes, and the sockeye abundance
36 offshore in those areas was much more abundant in
37 the period of high salmon -- high plankton
38 abundance. And the 2008 volcano resulted in a
39 very large plankton bloom in the late summer of
40 2008.
41 Q And then that plankton bloom may well have been in
42 the area where the Fraser -- what were to become
43 the Fraser River sockeye run in 2010 were living
44 at that time?
- 45 DR. WELCH: Yes, to the extent that we know it, yes.
46 Q So they have -- so possibly they have more food
47 and so possibly there's higher returns?

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Cross-exam by Mr. Janes

1 DR. WELCH: Correct.

2 Q But that's an example of natural variability. But
3 I'm going to suggest to you that there's also
4 uncertainty that we see that just flows from the
5 fact that there are data gaps or sparse data with
6 respect to many aspects of the lifecycle; is that
7 fair?

8 DR. WELCH: Well, as a scientist, the answer is we
9 always have data gaps. We always -- no matter how
10 much we study, we will always discover new areas
11 or avenues of research.

12 Q But isn't it fair to say that in science, there
13 are real differences in terms of your feelings
14 about being able to draw conclusions, depending on
15 whether you have very sparse data such as, for
16 example, one data set, as opposed to you have many
17 data sets?

18 DR. WELCH: I'm not quite sure the motivation for the
19 question so I'm having difficulty answering it.

20 Q Okay. Well, a number of times in all of your
21 evidence you mentioned, "I used such and such an
22 example because of the fact we have good time
23 series data."

24 DR. WELCH: Correct.

25 Q Right? And what that's an indication of is that
26 you have data that extends over many years, for
27 example; is that fair?

28 DR. WELCH: Yes.

29 Q So that it allows you to feel that you have some
30 certainty about the fact that the observation
31 you've made isn't an anomaly; is that fair?

32 DR. WELCH: That's one approach to science. Another
33 approach to science, which is the more -- not
34 common for fisheries, but the common one for
35 science is to do direct experimental tests and
36 manipulations.

37 Q Right, and in fairness, it's that we can't really
38 do that in the large with the pacific salmon
39 species. I mean, they're a natural species, you
40 can't control them in the laboratory or very
41 easily run large-scale experimental --

42 DR. WELCH: Well, in fact, we can now. It has not been
43 done as a routine basis, but it's certainly now
44 technologically feasible to do it.

45 Q But in terms of the types of work that you've been
46 doing and the types of studies you've been working
47 with, having more data, and you've mentioned this

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Cross-exam by Mr. Janes

- 1 in your evidence with Mr. Leadem, preferably over
2 many years, with separate observations, allows you
3 to feel more certain that what you're observing is
4 a regular phenomena rather than, for example, an
5 anomaly caused by a volcano in one year?
- 6 DR. WELCH: That's true, but the caveat that I would
7 put on that is that long-time series of data that
8 are simply observational do not allow you to
9 necessarily distinguish between events that occur.
10 The relevant one for the Cohen Commission is that
11 we have a 20-year decline in marine survival of
12 most stocks of Fraser sockeye salmon. Simply
13 having 20 or 40 years of data on plankton
14 abundances will not show proof of what is
15 occurring, it's simply a correlation. And there
16 are many examples in science where correlations
17 may be very high, but may be completely incorrect.
- 18 Q Fair enough. And there's no doubt that I'm not
19 trying to ask you to agree with the proposition
20 that gathering data is the whole of the scientific
21 process. There's obviously analysis and trying to
22 understand the causal relationships, but having
23 data and more data is a critical part of reducing
24 uncertainty when you're testing hypotheses; is
25 that fair?
- 26 DR. WELCH: Yes, I agree.
- 27 Q And in many areas of what you've been describing
28 in, really, all three of your evidence, there are
29 situations where you have relatively limited data
30 sets; is that fair?
- 31 DR. WELCH: Yes.
- 32 Q And so for example, one example, when we're
33 looking at the high seas example of where you show
34 the stocks in different areas of the Gulf of
35 Alaska, am I right in understanding that that's
36 essentially based upon one set of observations in
37 the 1960s?
- 38 DR. WELCH: Yes, and then a second set in the 1980s.
- 39 Q So we have two data sets, essentially?
- 40 DR. WELCH: Two periods of study in the offshore.
- 41 Q All right. And it may well be that there's a
42 number of factors that could vary there, such as
43 what happens over the course of one year, or maybe
44 from year to year, they -- you have different
45 areas; is that fair?
- 46 DR. WELCH: Yes, I assume so, yes.
- 47 Q And in the case of more complex systems, the

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1 uncertainty that's introduced in terms of a
2 general scientific proposition, I'd suggest, the
3 uncertainty that's introduced by having sparse
4 data becomes greater the more complex the system
5 is; is that fair?

6 DR. WELCH: Yes.

7 Q And the Fraser River sockeye cycle is, I suggest,
8 relatively high on the level of complexity in
9 terms of the number of variables in terms of
10 habitat and the changes over time that we're
11 facing; is that fair?

12 DR. WELCH: It's a philosophical point. I suspect my
13 personal view is that it's probably simpler than
14 we understand, but we don't have the data to
15 understand it well enough.

16 Q So maybe once we've got the data, it might turn
17 out that there's some simple things, but right
18 now, there seem to be a lot of pieces to the
19 system and we don't necessarily understand or have
20 the data to understand how all the pieces fit
21 together; is that fair?

22 DR. WELCH: Yes. Actually, let me rephrase it, it's we
23 don't have the data to fully understand the
24 system. I think we can go some way towards
25 addressing those points.

26 Q All right. I'd suggest compared to many types of
27 scientific questions, like, if you were taking --
28 at one extreme, you know, the question of does the
29 earth go around the sun, rather than the sun go
30 around the earth, we can say there's a high degree
31 of scientific certainty about that proposition; is
32 that fair?

33 DR. WELCH: Well, yes, but Copernicus was almost burned
34 at the stake for making that statement.

35 Q Right. My point exactly, is that if we come to
36 more -- but if we come to the day, we're a little
37 bit closer to Copernicus' time around the
38 certainty of some of the propositions that are put
39 forward about Fraser River salmon stocks than
40 perhaps we are about the situation in astronomy
41 today; is that fair?

42 DR. WELCH: Yes, I would agree.

43 Q I'm not offering you up for the stake, though,
44 trust me. And another thing I'm going to suggest
45 that complicates the scientific uncertainty that
46 you face is the reality that we have changing
47 environmental circumstances around the Fraser

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1 River sockeye; is that fair?

2 DR. WELCH: Yes, it's a very serious issue that I'm
3 concerned about.

4 Q And I'm just going to suggest that's not just
5 climate change that we're looking at. I'm going
6 to suggest to you that the introduction of human
7 harvesting has been an environmental change for
8 the sockeye salmon from the time that the
9 aboriginal people started harvesting; is that
10 fair?

11 DR. WELCH: Yes.

12 Q Essentially, an introduction of a new predator
13 into the system?

14 DR. WELCH: Yes.

15 Q And as harvesting techniques have changed and
16 increased, that has also changed the environmental
17 circumstances of the sockeye?

18 DR. WELCH: Well, in biological terms, it's increased
19 the evolutionary selection on the animals.

20 Q It's created an evolutionary pressure?

21 DR. WELCH: Correct.

22 Q Right. And another example that would come along
23 is the change in habitat that's been occasioned by
24 human settlement at the mouth of the Fraser and
25 along the Fraser that's also what I'd call a
26 confounding factor in the scientific analysis of
27 what's happening to the sockeye salmon; is that
28 fair?

29 DR. WELCH: Yes.

30 Q And I'm going to just try to get some components
31 of that. For example, the construction of
32 Vancouver, Surrey, Richmond, Chilliwack, all these
33 places going up the Fraser River is a significant
34 environmental change in the habitat of the sockeye
35 compared to the habitat in which they originally
36 evolved; is that fair?

37 DR. WELCH: Only if they went into the side channels
38 that were formally there. A lot of the delta is
39 now -- Richmond/Delta is now build on dyked land
40 that was originally the estuaries that haven't
41 been there for 100 years. So if they go straight
42 out to sea, and always have gone straight out to
43 sea, they wouldn't have had very much effect
44 relative to if they had gone into the sloughs and
45 backwaters that used to exist to a much greater
46 degree now -- then than now.

47 Q Right. So for example, if the original estuary

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1 and sloughs were rearing habitat, then there's
2 been a significant change in the rearing habitat
3 for the salmon, but we just don't know?

4 DR. WELCH: Well, the only stock that that would apply
5 to, so far as we know, is the Harrison that seems
6 to rear in the Lower Fraser somewhere, that we
7 don't well understand. The other sockeye
8 certainly go straight out to sea and up the Strait
9 of Georgia very quickly and don't seem to take
10 advantage of that habitat, cannot take advantage
11 of that habitat.

12 Q Today?

13 DR. WELCH: Today.

14 Q And sorry, and my point is but as to what happened
15 150 years ago, before these areas were built, we
16 don't really know what the situation was, do we?

17 DR. WELCH: Well, likely, those animals that took
18 advantage of the habitat that's no longer there
19 are simply extinct and they're not part of the
20 biodiversity that we are trying to manage now.

21 Q Or -- and looking at the sockeye salmon, to the
22 extent that they may have used those areas, it may
23 be that they are living now in a somewhat less
24 favourable habitat than the one in which they
25 evolved?

26 DR. WELCH: Give me a moment to try to phrase this.
27 Environmental change has been going on for over
28 12,000 years. So the end of the last ice age came
29 abruptly 12,000 years ago, and where this
30 courthouse is, and the Fraser River, was occupied
31 by a two-kilometre thick ice sheet. So there was
32 no Fraser River until the ice sheet started to
33 recede very rapidly, starting 18,000 years ago,
34 and it was gone by 12,000 years ago. Sockeye
35 repopulated the Fraser River at that point and
36 there have been radical changes in environment
37 since that time, going forwards. But the last ice
38 age took about 120,000 years so British Columbia,
39 as an environment, didn't exist for 120,000 years
40 and then in the interglacial that we're in now,
41 it's been around for 10,000 years.

42 So environmental change has always been with
43 us. It's likely to be increasing dramatically
44 under the projections of global warming.

45 Q Right. And in fairness, is that -- that while
46 evolution can happen very quickly, is that rapid
47 changes in habitat can be -- in fact, be quite

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- 1 difficult for species to adapt to; isn't that
2 fair?
- 3 DR. WELCH: Rapid changes in the environment, yes.
- 4 Q Right. And many of -- I'm going to suggest to you
5 that many of the human-induced changes that we've
6 seen in the Fraser system, I'm going to suggest to
7 you, have been, on an evolutionary scale,
8 relatively rapid; isn't that fair?
- 9 DR. WELCH: Certainly, yes.
- 10 Q And so I talked about urbanization, but also there
11 are other habitat changes like the effects that
12 forestry may have had on the river system?
- 13 DR. WELCH: There are certainly impacts potentially,
14 yes.
- 15 Q Right. The Hells Gate event, just another
16 example; is that fair?
- 17 DR. WELCH: Yes.
- 18 Q I'm going to suggest to you another recent example
19 of an environment change which we'll be looking at
20 in the course of this hearing, I'm going to
21 suggest to you is the introduction of salmon
22 farming into the runs in which the -- the areas in
23 which the salmon pass through; is that fair?
- 24 DR. WELCH: It's certainly a topic that should be
25 looked at, yes.
- 26 Q Right. But it carries with -- it's effectively
27 changed the environment, I'm going to suggest
28 relatively abruptly?
- 29 DR. WELCH: Well, that's a statement that I have no
30 data on to comment on.
- 31 Q In evolutionary terms, the change from having no
32 salmon farming to having salmon farming has been a
33 relatively abrupt change. I'm asking you what the
34 effect of it has been, just that it's been a
35 relatively abrupt change.
- 36 DR. WELCH: If salmon farms have an effect on wild
37 sockeye stocks, they -- that is an abrupt change.
38 If salmon farms have very little or no effect on
39 wild salmon, they will not have an effect on those
40 stocks.
- 41 Q Right. So --
- 42 DR. WELCH: So the essential question is what is the
43 degree of an effect that salmon farming,
44 aquaculture, has on the wild sockeye runs.
- 45 Q Right. But in terms of the effect, if salmon
46 farming had been introduced over a period of 5,000
47 years, the salmon would have a chance to adapt to

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- 1 it in a Darwinian sense of the word, in a way that
2 they might not, say, by becoming extinct in this
3 sense of the word; is that fair?
- 4 DR. WELCH: As with any other stressor, if it was
5 introduced over a longer period of time, there's
6 more time for adaptation.
- 7 Q Okay. And the last one that we've all talked
8 about is climate change is obviously another
9 significant factor in terms of change in habitat.
- 10 DR. WELCH: Did you -- sorry, did you say the most
11 significant factor?
- 12 Q No, no. Another --
- 13 DR. WELCH: Yes.
- 14 Q -- significant factor. Who knows if it's not
15 significant or not?
- 16 MS. BAKER: Mr. Commissioner, I note we have six other
17 participants and 15 minutes and I wonder if Mr.
18 Janes is going to be much longer?
- 19 MR. JANES: I'll be very quick.
- 20 Q So just -- then just catch onto the question of
21 aboriginal knowledge, I'm going to suggest to you
22 that one of the values that aboriginal knowledge
23 can bring is that it can bring a perspective which
24 scientists can use over the question of a historic
25 perspective on what the habitats and the behaviour
26 of the salmon were historically; is that fair?
- 27 DR. WELCH: Yes.
- 28 Q And that's something that may not be easily
29 accessible through ordinary scientific methods
30 today; is that fair?
- 31 DR. WELCH: Correct.
- 32 Q And just one question about your Slide 36 which is
33 the smolts to adult return numbers, this is the
34 one where you point out that there seems to be a
35 great deal of mortality in the ocean, rather than
36 in the Strait of -- in the strait. The fact that
37 the mortality occurs in the ocean does not
38 necessarily imply that the thing that killed them
39 happened in the ocean. And let me give an
40 example. If, for example, it's sea lice is the
41 hypothesis that we're -- that attach themselves to
42 the smolts while they were passing through the
43 Johnstone Strait, but it didn't kill them till 20
44 or 30 days later, when they're out in the ocean.
45 That would give the appearance of higher mortality
46 at sea, correct?
- 47 DR. WELCH: Yes. So any disease that would have a

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1 latency period between infection and mortality.

2 MR. JANES: Right. Thank you.

3 MS. GAERTNER: Good afternoon. It's Brenda Gaertner
4 for what has been called the First Nations
5 Coalition. For those of you -- perhaps I'll just
6 introduce it. I represent the Haida Gwaii and
7 then I come down and I represent people from the
8 South Vancouver Island and then into the Fraser,
9 all the way up to the far points of the Early
10 Stuarts. And I also represent organizations that
11 some of you may have had some involvement with
12 over the years.

13 I'm not here -- I'm just going to ask a
14 couple of introductory questions. I understand
15 I'll have an opportunity to ask each of you
16 questions later on as we proceed. But I have a
17 couple of clarifying questions that I wanted to
18 ask and I'll just start in the order that you guys
19 presented and then go back.

20

21 CROSS-EXAMINATION BY MS. GAERTNER:

22

23 Q So Mr. Lapointe, at Slide 9 and 10 of your
24 presentation you talked about the -- you have a
25 word -- you have a sentence called:

26

27 Overall returns will continue to depend on
28 production from largest systems.

29

30 And by that I take it to mean you're talking about
31 the larger lake systems?

32 MR. LAPOINTE: That's correct.

33 Q And it's fair to say that any one of those large
34 lake systems are divided up into a lot of natal
35 streams; is that correct?

36 MR. LAPOINTE: Absolutely.

37 Q And so when we get to something like -- let me
38 just get to your slide, the Stuart Lake, for
39 example, we've got about 39 streams or so or 40
40 streams that go into the Stuart Lake; is that --

41 MR. LAPOINTE: That sounds about right. Yeah.

42 Q Is about right?

43 MR. LAPOINTE: Yeah.

44 Q And something in the Shuswap we've got even more?

45 MR. LAPOINTE: Yes.

46 Q Yeah. And so when we're talking -- when you're
47 talking about the rearing lakes accounting for 80

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1 percent of the juvenile varying capacity, that's
2 not breaking down to those smaller streams yet,
3 are we?

4 MR. LAPOINTE: No. Absolutely not. It's an
5 aggregation of streams in each case.

6 Q All right. Mr. Welch, I just have a question of
7 -- and I think it picks up from where Robert Janes
8 just stopped, and it's just a clarifying question
9 again. Were you involved in the PSC work in June
10 of this year? Were each of -- I was going to ask
11 each of you. There was a workshop that the
12 Pacific Salmon Commission held amongst -- in June
13 for three days and there has been a report that's
14 come out.

15 DR. WELCH: David and Karl were not. I was. I was
16 there.

17 Q Okay. Great. What I -- and again, I'm not a
18 scientist, but what I got when I read that was an
19 influence of the Georgia Strait on some of the
20 questions that are being asked about the 2009 year
21 and Mr. Welch, I see that you've taken it one step
22 further at Slide 15, if I may and I just want to
23 ask this question, which is if salmon are exposed
24 to one of a multiple number of impacts, be they --
25 I've heard lethal, sublethal and all the various
26 different levels of impacts that one may have,
27 it's quite clear that when they die by those
28 impacts is hard to predict.

29 DR. WELCH: As a -- as a broad blanket statement, yes,
30 that's correct.

31 Q Okay. I'm going to go to -- I'm going to be very
32 broad today and we'll get to more specific. Mr.
33 English, I have a couple of questions for you.
34 Was I to interpret from the slides that you gave,
35 especially when you got to where we're now having
36 DNA samples in addition to the tagging, that the
37 lates are coming back earlier or that we're just
38 learning that the lates are spread out as much as
39 they are into the early summers?

40 MR. ENGLISH: Well, it's probably both. We've learned
41 a lot more since we had the capability to do the
42 DNA analysis and separate out the early time
43 Shuswap stocks from the later time one, but
44 there's also late run stocks that spawn in the
45 lower part of the Fraser, as well, Cultus being
46 one of the best-known, the Harrison that we've
47 talked about today, as well, and Weaver Creek are

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- 1 all late-run stocks in the lower end of the system
2 and they are doing things somewhat differently
3 than -- at least the Harrison has been doing
4 things quite a bit differently than other stocks
5 in coming back quite a bit earlier. And that
6 appeared to begin in the mid-'90s and so it was
7 the reason for a lot of concern in the mid-'90s
8 about early entry and higher en route and pre-
9 spawn mortality for late-run stocks.
- 10 Q Is there an indication of why they're coming back
11 earlier?
- 12 MR. ENGLISH: Well, the -- there's speculation that
13 it's due to shifts in climates. It's also
14 determined by the possible effects of other --
15 it's both the timing of return and the entry into
16 the river, and there's some indication from some
17 of the work we've done with looking at the
18 relative abundance of summer-run fish that summer
19 -- the growth of summer-run populations is having
20 an influence on late-run stocks and drawing them
21 into the river earlier. These are all theories
22 we've been testing for a number of years, but some
23 of them seem to be pretty consistent and pretty
24 supported by the data.
- 25 Q Okay. And then I just had a -- this is a very
26 simple question. When do the returning sockeye
27 stop eating?
- 28 MR. ENGLISH: Well, it's a good question, but -- do you
29 want to try that or...?
- 30 DR. WELCH: It's a simple question. There's not a
31 simple answer to it, unfortunately.
- 32 Q Sorry.
- 33 DR. WELCH: The trawlers that drag baited lures behind
34 the boat catch sockeye despite the fact that
35 they're not supposed to be feeding in the Strait
36 of Georgia, so they're still biting at things even
37 when they're supposed to have terminated their
38 feeding. They're certainly feeding before they
39 reach Vancouver Island and I think they're still
40 feeding on the West Coast of Vancouver Island, but
41 the thought is that they're shutting down their
42 digestive tract by the time they're coming into
43 the Strait of Georgia.
- 44 Q So by the time they hit the mouth of the river,
45 they're pretty well finished eating and they're
46 going to make that last trek of their life without
47 further food?

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David Welch/Michael Lapointe/Karl English

Cross-exam by Ms. Gaertner

1 DR. WELCH: Well, the digestive tracts actually --

2 Q Too cold.

3 DR. WELCH: -- energetically, it's the third-most
4 energy-demanding organ in our bodies, the brain
5 being the first, the heart the second. So it
6 makes sense to, if there's not much food around or
7 if you're going to be moving into the river to
8 shut down your digestive tract, so you're not
9 running an expensive piece of machinery.

10 Q Now, I've been trained much more by indigenous
11 experts rather than scientists, and so I have a
12 couple of questions that are trying to bridge that
13 world view, if I may, the first being today I've
14 heard a lot about the lifecycle of the salmon, but
15 I sure haven't heard a lot about the other species
16 that are involved in the lifecycle of the salmon
17 and I wonder if all three of you might comment on
18 that. As I understand it, the ecosystem of the
19 salmon is a very complex ecosystem that's affected
20 by a lot of other animals and a lot about -- a lot
21 of other health of the ecosystem. Would any of
22 you like to comment on that?

23 DR. WELCH: Well, I can speak from my presentation, the
24 remit was to frame it in terms of what we know
25 about the migrations and survival of Fraser
26 sockeye, so certainly they're embedded in those
27 ecosystems throughout their life history. But the
28 need really, as I understood it, was to set the
29 terms on the general knowledge for the start of
30 the commission.

31 Q I guess the -- Mr. Lapointe?

32 MR. LAPOINTE: Sure. I'll try, Brenda. That's one of
33 the reasons why I asked the clarification about
34 the term "waste".

35 Q Mm-hmm.

36 MR. LAPOINTE: Clearly, salmon carcasses provide
37 nutrients that feed forests. Lots of predators on
38 salmon-bearers, sea gulls, eagles, lots of the
39 components of the ecosystem feed on either the
40 fish themselves or nutrients that the fish
41 provide, so it's very broad ecosystem, you're
42 quite correct in pointing that out.

43 MR. ENGLISH: I can add one last point 'cause I think
44 it will be remiss in not saying that the salmon
45 are really important for people and been that way
46 for a lot of years, but they're -- in the
47 ecosystem they represent actually a very small

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Karl English
Cross-exam by Ms. Gaertner

1 part of the biomass that's out there, and you
2 really need to be aware of the fact that if other
3 things happen with other prey species -- there are
4 very small salmon, the size of your finger, are
5 very -- very attractive target for a lot of other
6 predators, and if you have an abundance of other
7 prey species in that size class like sardines and
8 anchovy and sand lance or needlefish, other prey
9 organisms, then there's a buffer, if you like, for
10 salmon. If things happen with those other prey
11 species, such that they're not as abundant, then
12 salmon could become a more important part of the
13 target for other predators.

14 So on top of all the other complexity that
15 we've talked about in terms of their migration,
16 you have a whole series of other predators other
17 than humans that are out there wanting to eat
18 something and depending on the timing of the
19 arrival of salmon and the relative abundance of
20 the other prey that are out there, you can have
21 quite dramatic changes in these -- and it's
22 probably -- has a lot to do with the marine
23 survival, why you see such large range in marine
24 survival. It's a big ecosystem; lots of other
25 things happen.

26 Q The other part of the -- I'm going to say the
27 difference of the world views, perhaps, but -- or
28 maybe it's the complement between the world views,
29 it's a better way of putting it, is that I've
30 heard a lot today about measuring the health of
31 the salmon by the number of salmon, and I would
32 think that there are other indicators for salmon
33 health besides the number of salmon. Are there
34 other indicators that scientists typically use?

35 MR. ENGLISH: In almost every -- like Mike got into the
36 discussion with biodiversity and what you want to
37 see is not just one population which is super-
38 abundant and therefore you think you're in good
39 shape because there's lots of one of your
40 populations out there. You want to see that
41 there's a variety of populations that are
42 contributing a variety of age classes, so that
43 you're buffered against changes in environmental
44 conditions, so it is -- it's much different than
45 just a straight numbers game. You're looking at
46 the overall health of the population of the
47 species, whether it's sockeye in this case or

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Cross-exam by Ms. Gaertner

1 chinook or coho, there's lots of different river
2 systems, different lake systems that are
3 contributing and you want to see that you're not
4 eliminating, you know, elements of that equation,
5 so that you're just relying on a few.

6 Q Thank you. The other area that I was going to
7 touch on with respect to indicators of health are
8 the actual quality of the salmon itself, and over
9 the years I've heard from elders up on the Fraser
10 River a lot about the quality of the salmon and
11 I've heard things like soft and mushy, and then
12 I've heard wormy. And then more recently I've
13 heard stunned and shocked a lot. And then again
14 more recently I've heard lesions and an increasing
15 number of lesions on the skin of the sockeye.
16 These are all, I would say, more qualitative
17 rather than -- well, more qualitative measures,
18 but I would like each of you or any one of you to
19 comment on what we're seeing or what you imagine
20 you're seeing when you're seeing those changes to
21 the actual sockeye themselves.

22 DR. WELCH: I'll start off. That's a very interesting
23 observation that I wasn't aware of. Soft tissue
24 actually is probably a reflection that there's not
25 much fat in the animals. Sockeye store fat as oil
26 in the muscles and as they migrate up the river,
27 for example, they burn that oil or fat to fuel the
28 migration and they replace it with water. So as
29 they progress up the river, their shape doesn't
30 change, but they replace fat, which is energy-
31 rich, with water and they become softer.

32 One of the things when I was in DFO I often
33 regretted that we didn't do was over 20 years or
34 more measure the fat content of the animals moving
35 into the river because it would have been a very
36 interesting indicator. And the reason we didn't
37 -- I didn't start that was it was just a very
38 expensive program and there wasn't a source of
39 funding for it. But it's interesting that you've
40 said there's -- there is knowledge of that because
41 it would tie in with potentially the poor marine
42 survival that also perhaps the animals are not
43 feeding as well and they're --

44 Q Or working harder?

45 DR. WELCH: -- softer as a result.

46 Q Or working harder, I would suggest? Having to
47 work harder through the environment and getting

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Cross-exam by Ms. Gaertner

1 rid of their oil sooner as a result of that?

2 DR. WELCH: I won't comment on something I can't advise
3 on at this time.

4 Q Possible?

5 MR. ENGLISH: If I could recommend that when you haul
6 Scott Hinch up on the -- in front of the inquiry
7 here, that he can answer more directly to the
8 question of the fat content and the health of the
9 fish in terms of their physiology. It's been an
10 integral part of our telemetry work that we've
11 been working with the physiologists, taking
12 samples in a way that doesn't injure the fish,
13 doesn't affect their migration. We've been able
14 to track them to spawning ground after them taking
15 some physiological samples and doing fat probe
16 which is a technology which allows them to get a
17 reading of a fat content of the fish without
18 injuring the fish at all. It's just like a little
19 microwave scan of it, so there's methods that
20 Scott can probably help with that.

21 MS. GAERTNER: I'm just about finished.

22 MS. BAKER: Mr. Commissioner, I just note we -- we're
23 at four o'clock and we have five more participants
24 who have an opportunity to ask questions. I just
25 remind my friends, they -- these witnesses will be
26 back, we will be able to get into quite a lot of
27 depth with them.

28 MS. GAERTNER: I've been on my feet for ten minutes.

29 MR. LAPOINTE: I actually had something to offer,
30 Brenda, on the --

31 MS. GAERTNER:

32 Q Yeah. I saw that. I'd like you to, please.

33 MR. LAPOINTE: If you think about what's happened in
34 the last 15 years of Fraser sockeye there's been
35 two very, very significant biological changes.
36 One of them is that based on Environment Canada
37 records of river temperatures, we've had something
38 like eight of the ten warmest summer Fraser River
39 water temperatures occur in the last 15 years, so
40 when you have that kind of event happen, you're
41 going to expect fish to show some signs of being
42 exposed to those kinds of temperatures.

43 The second very significant biological event,
44 and Karl touched on it a bit in his presentation
45 is the fact that some of these late-run sockeye
46 are migrating upstream much earlier than they did
47 before. I actually had one of the First Nations

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1 fishers call me and tell me about the mushy
2 observation and it didn't surprise me at all that
3 fish that were coming in earlier than they
4 normally had or were being exposed to temperatures
5 that were significantly warmer than what they
6 would have would show some signs. All these fish,
7 after all, die eventually. I mean, you hope they
8 die, you know, after they spawn as opposed to
9 before they spawn. So they're all getting disease
10 and, of course, temperature accelerates the
11 progress of that disease, so I think these
12 observations are quite complementary with the
13 events that we have been seeing in the Fraser in
14 the last 15 years.

15 Q And the lesions?

16 A Again, it's a sign of disease, so disease
17 progression is accelerated in warm temperatures
18 and when you have some of these late-run Fraser
19 sockeye are coming in so much earlier, they're
20 probably exposed to temperatures that are perhaps
21 five degrees Celsius warmer than what they're used
22 to. That's a really big difference for a fish to
23 be exposed to that and have to be running this
24 effectively a marathon a day, if you like, on its
25 way to the spawning grounds.

26 MS. GAERTNER: Those are my questions.

27 THE COMMISSIONER: I wonder if I might just ask
28 commission counsel if he could just assess of the,
29 I think you said five remaining counsel who have
30 not yet indicated whether they're going to ask
31 questions, if I could just get a reading of who is
32 going to ask questions and how much time they
33 might need, that would be helpful.

34 MS. BAKER: Thank you. I don't have that information,
35 but perhaps they could each just identify if
36 they're planning to ask questions or not.

37 MR. DICKSON: Sto:lo Tribal Council, I'll be about five
38 minutes.

39 MS. FONG: Lisa Fong, Heiltsuk Tribal Council, no
40 questions.

41 THE COMMISSIONER: Is there anyone remaining of counsel
42 who are here today who would be intending to ask
43 questions other than the one that indicated he
44 would be? If not, would it be acceptable to all
45 counsel and to commission counsel if we just allow
46 counsel to ask his questions and conclude this
47 panel today? Is that agreeable? Thank you very

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Cross-exam by Mr. Dickson

1 much. Sir?

2 MR. DICKSON: Mr. Commissioner, Tim Dickson for the
3 Sto:lo Council --

4 THE COMMISSIONER: I think you're --

5 MR. DICKSON: Oh.

6 THE COMMISSIONER: You have to identify yourself and
7 just turn on your mike.

8 MR. DICKSON: Oh, my apologies. Tim Dickson for the
9 Sto:lo Tribal Council and Cheam Indian Band.

10

11 CROSS-EXAMINATION BY MR. DICKSON:

12

13 Q Dr. Welch, you were speaking of the increase in
14 the zooplankton in 2007 because of the volcano
15 eruption -- sorry, in 2008 because of the volcano
16 eruption and then that may or may not have
17 impacted on more food for the returns that came in
18 in 2010 and may have been an cause in their higher
19 returns and I'm just wondering whether you have
20 any data on the amount of zooplankton in 2007.

21 DR. WELCH: Well, my wife does. She's the plankton
22 biologist and she runs a program that transects
23 the Gulf of Alaska each year through the Spring
24 and summer months, but I would disqualify myself
25 as professionally competent to tell you the
26 details without checking first.

27 Q Fair enough. I certainly wouldn't force you to.
28 Mr. Lapointe, you spoke of the artificial spawning
29 channels and them having a higher egg-to-fry
30 survival rate. And so I'm curious whether you
31 would expect if more channels were constructed,
32 would this assist in sockeye productivity?

33 MR. LAPOINTE: It certainly could in that life stage.
34 I would hazard a guess that perhaps not all of the
35 effects of spawning channel would be viewed as
36 positive. When you provide fish with an
37 artificial substrate, it can and has caused
38 genetic selection for things like body size, so
39 you have to ask yourself whether a long-term
40 spawning channel would generate a fish that is
41 more robust or less robust to environmental
42 changes, so certainly from a stage-specific
43 survival, could be quite beneficial and that's, in
44 fact, why they were built in the first place, but
45 in the long term there can be negative effects, as
46 well, because you're creating an artificial
47 environment and, of course, the environment

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Cross-exam by Mr. Dickson

- 1 outside is changing, so I think there would be
2 some debate amongst geneticists about whether it
3 would be beneficial or not.
- 4 Q Thank you. And just in a -- on a topic somewhat
5 related, on biodiversity, you were speaking of one
6 of the benefits of biodiversity being that you
7 have a portfolio of stocks and so when conditions
8 change, some stocks may do better, some may do
9 worse. But it provides you with a buffer, some
10 more certainty and ability to weather change; is
11 that correct?
- 12 MR. LAPOINTE: That's correct.
- 13 Q And so would it be correct to say that in terms of
14 species survival, maintaining or improving
15 biodiversity becomes more important as variability
16 in the environment increases?
- 17 MR. LAPOINTE: Yes.
- 18 Q Mr. English, you were speaking of the late runs
19 holding off the mouth of the river and the timing
20 of that delay. I'm wondering when you close down
21 the assessment fisheries in a normal year and I'm
22 wondering whether they are closed now for this
23 year?
- 24 MR. ENGLISH: Well, that's probably more of a question
25 for Mike, because --
- 26 Q Right.
- 27 MR. ENGLISH: -- he does the assessment fisheries.
- 28 Q Fair enough.
- 29 MR. LAPOINTE: Our test fisheries basically are stopped
30 when we run out of fish and so I think this year
31 the last fishery to shut down was probably the
32 test fishery at Whonnock and it concluded about
33 the 4th or 5th of August -- of October, sorry,
34 sometime in that range, late September or early
35 October.
- 36 Q Thank you. Mr. English, the tagging studies that
37 you have conducted, I'm curious about how long
38 such studies of that kind have been performed.
39 How long do they go back historically?
- 40 MR. ENGLISH: The specific telemetry studies that I
41 referred to on the Fraser sockeye started in 2002
42 and they were not annual for the entire run. We
43 focused on different questions in almost every
44 year. 2002, 2003 we were focused on the late run
45 early entry question; 2004 was focused in on just
46 the Harrison run; 2005 focused on summer run
47 survivorship; 2006 involved all the run timing

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1 groups from early Stuart right through to the late
2 run, as did 2007 and 2009 and '10 have focused on
3 all the timing groups. But those are the --
4 that's the full extent of the telemetry studies on
5 the Fraser. Similar technology has been used on
6 the Nass, the Skeena, the Columbia River, for back
7 into the late '80s on some of those systems.

8 MR. DICKSON: Thank you. Those are my questions.

9 THE COMMISSIONER: Thank you very much, Mr. Dickson. I
10 just want to check again, does that conclude all
11 counsel who wish to ask questions today? Thank
12 you, counsel, for your cooperation. I appreciate
13 that. And thank you to commission counsel and to
14 the members of the panel.

15 I take it then, commission counsel, that we
16 are adjourned for the day?

17 MS. BAKER: We have no further questions, yes, and we
18 can adjourn.

19 THE COMMISSIONER: Thank you very much. Until ten
20 o'clock tomorrow morning then. Thank you.

21 THE REGISTRAR: Hearing is now adjourned until ten
22 o'clock tomorrow morning.

23

24 (PROCEEDINGS ADJOURNED AT 4:12 P.M. TO
25 OCTOBER 26, 2010 AT 10:00 A.M.)

26

27

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

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Susan Osborne

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2 true and accurate transcript of the
3 evidence recorded on a sound recording
4 apparatus, transcribed to the best of my
5 skill and ability, and in accordance
6 with applicable standards.
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11 Diane Rochfort

12 I HEREBY CERTIFY the foregoing to be a
13 true and accurate transcript of the
14 evidence recorded on a sound recording
15 apparatus, transcribed to the best of my
16 skill and ability, and in accordance
17 with applicable standards.
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21 _____
22 Pat Neumann
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