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

Commaissaire

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Boris Tyzuk, Q.C.	Province of British Columbia
No appearance	Pacific Salmon Commission
No appearance	B.C. Public Service Alliance of Canada Union of Environment Workers B.C. ("BCPSAC")
No appearance	Rio Tinto Alcan Inc. ("RTAI")
No appearance	B.C. Salmon Farmers Association ("BCSFA")
No appearance	Seafood Producers Association of B.C. ("SPABC")
No appearance	Aquaculture Coalition: Alexandra Morton; Raincoast Research Society; Pacific Coast Wild Salmon Society ("AQUA")
Tim Leadem, Q.C.	Conservation Coalition: Coastal Alliance for Aquaculture Reform Fraser Riverkeeper Society; Georgia Strait Alliance; Raincoast Conservation Foundation; Watershed Watch Salmon Society; Mr. Otto Langer; David Suzuki Foundation ("CONSERV")
Don Rosenbloom	Area D Salmon Gillnet Association; Area B Harvest Committee (Seine) ("GILLFSC")

APPEARANCES / COMPARUTIONS, cont'd.

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

APPEARANCES / COMPARUTIONS, cont'd.

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

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Vancouver, B.C. /Vancouver (C.-B.)
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THE REGISTRAR: Hearing is resumed.
MS. BAKER: Thank you, Mr. Commissioner. Today we will be dealing with the Fraser River Sockeye Spawning Initiative, also known as FRSSI in these proceedings. My plan is to begin the day with Mr. Al Cass, who you've met before in this hearing and then have him cover the background for the development of the model and then have him join -- be joined with -- by a few other people. We're going to have him joined by Rob Morley, Mike Staley and Ken Wilson and then I'll complete my direct evidence with that panel in the stand and then once I've completed that, we'll open it for cross-examination. So that's the plan for today. I guess we can just reconfirm his oath.
THE COMMISSIONER: Mr. Cass, you've been in before, so your oath is still in effect.

AL CASS, resumed.

EXAMINATION IN CHIEF BY MS. BAKER:

Q And I understand that when Mr. Cass was here before, his c.v. was not marked, so I wish to probably just do that for consistency, so his c.v. is in Tab 7 of the binder before you, Mr. Cass, if that's helpful, and it's CAN185914. This is your c.v. that you've provided to us; is that right? Can you turn your mike on? Thank you.
A Yes, that's correct.
Q And bring it -- thank you. And it's -- you do need to speak quite close to the mike, so...
All right. And just to recap, you have a Master's of Science in Environment and Management from Royal Roads University?
A That's correct.
Q And you have been a research scientist with -- a research biologist with the Department of Fisheries and Oceans from '77 to -- well, probably you're still considered to be a research biologist, but you certainly had --
A Seems like a long time ago, but that's correct.

Q Had that title from '77 to '85 and since '85 to '82 you were the head of assessment and forecasting within stock assessment at the department?
A That's correct, yes.
Q And 2002 to 2010 you've been the head of the Centre for Science Advice Pacific and the chair of the Pacific Science Advice Review Committee at that Department of Fisheries and Oceans?
A That is correct.
Q Okay. So as you heard me outline for the commissioner, what we want to do today is go through some of the background for what's known as the FRSSI model and just to recap, we've heard from Mr. Grout and from Mr. Rosenberger and others about how the FRSSI model is used in in-season planning -- oh, sorry, your c.v. that I've just reviewed with you, I need to mark that as an exhibit.

THE REGISTRAR: Exhibit 394.

EXHIBIT 394: *Curriculum vitae* of Al Cass

MS. BAKER:
Q So we have heard from people so far in this commission about the use of the FRSSI model. Just to set some background, it's a tool that's used by the department in setting escapement targets for Fraser River sockeye; is that right?
A Yes, that's correct, Mr. Commissioner. It was developed as a -- to help guide with some consistent principles in an open method to advise or at least allow managers to assess the consequences of different alternative harvest strategies.
Q Okay. So just before we get to the FRSSI model, I think it's useful to just know where we came from and I just want to ask if in '86 the -- when the setting of escapement targets became the responsibility of the department following the '85 treaty, were you involved in setting escapement targets at that time?
A My capacity at that time was technical support for a working team, Mr. Commissioner, that was developing the so-called 1987 rebuilding plan.
Q And that rebuilding plan, was that a plan developed to help the department set escapement

goals for Fraser River sockeye?
A The way I would -- that's correct. The way I would characterize it is that it was an experiment to test the production levels for the purpose of increasing or at least assessing how much production in terms of yield could be achieved given the uncertainty at the time about what the habitat capacity was and the productivity of Fraser sockeye, so, yes.
Q All right. If you could turn to Tab 5 of the binder before you, this is CAN185434. It's described as a draft document December 19, 1988 but I understand this to be an outline of the 1987 rebuilding strategy; have you seen this before?
A Yes, that is correct.
Q And is it as I described?
A Yes.
MS. BAKER: Okay. Can I have that marked, please, as the next exhibit?
THE REGISTRAR: Exhibit number 395.

EXHIBIT 395: Fraser River Sockeye Management and Enhancement Plan Summary Report prepared by Fraser River Sockeye Task Force for Area Planning Committee, December 1988

MS. BAKER:
Q Thank you. Just -- there's a few terms that I think might be useful for you to give us an understanding of because they do come up again and again during escapement planning and harvest management planning. And I wonder if you could just explain what the term "affixed escapement strategy" or "affixed escapement policy" is?
A Affixed escapement strategy in theory is one of, say, three classes of strategies, but it really refers to a plan, a management plan, that allows a fixed or constant number of spawners to reach the spawning grounds in order to result in recruitment and sustaining population. So it is a term that's used to describe a particular management strategy that puts the same number of spawners on the spawning ground, Mr. Commissioner, year after year.
Q And then the harvest would be anything in excess of that fixed escapement goal?
A That's correct.

Q And then another term that we hear quite often is a "fixed harvest rate"; can you explain what that is, as well?
A A fixed harvest rate or exploitation rate is where a fixed or constant removal rate of the abundance of fish that is the target for fisheries, so for example a 60 percent harvest rate would mean that 60 percent of the available fish would be removed from a fishery and that would be -- allow some sharing at that level. Sixty percent goes to catch and 40 percent would then be the escapement target. There are nuances of that which would include for Fraser sockeye the management adjustment, for example, for -- example for accounting for environmental conditions in the river, but fixed escapement and fixed exploitation rate strategies are the two classic management models, if you like, for managing fisheries.
Q Okay. Thank you. Now, the 1987 rebuilding strategy, can you describe what that is and if it's helpful to talk about fixed escapement or fixed harvest rates in the context of that plan, then please do so.
A Yes. Mr. Commissioner, the -- at the time in the late or the mid-'80s with the signing of the Salmon Treaty, there was added benefits to Canada inferred by the treaty and so there was a process at the time which had some buy-in from industry to attempt to rebuild escapements and hence returns on the Fraser to -- with the purpose of increasing the returns and hence the yield. And this was planned over a three- to four-generation period, which is in terms of Fraser sockeye of 12 to 16 years, so from, say, '87 up to 2002, in that range, this plan was in operation. And it essentially developed a strategy for increasing escapements at intervals over the rebuilding period.

It was designed to reduce harvest rates that were at the time in the order of 75 percent or higher, to reduce harvest rates to 65, 75 percent in that range, the minimum of 60, I believe, but the notion was to, Mr. Commissioner, was to increase escapements that was with interim goals that were set for each of the cycle lines and the goals were described as interim because there was high uncertainty based on a couple of sources of

analyses. One was the estimates at the time of spawning ground capacity, estimates at the time of the rearing or in-lake capacity, if you like, which were quite different. And so there was this uncertainty about what exactly we may be able to build to in order to increase production yield on the system. And so there was escapements, interim escapement goals set to reach the interim -- or an attempt to reach the interim goals over the course of 12 to 16 years or three to four cycles.

And so now that's the premise of the '87 rebuilding plan and at the time, there had been fair success in rebuilding or increasing escapements before the signing of the treaty and going way back to, you know, post Hell's Gate slide in 1913, the old International Pacific Salmon Fishery Commission had increased escapements and increased the returns of most of the productive stocks, those stocks which contributed to the main economic yield at the time. So in 1987 or post-Pacific Salmon Treaty, Canada, again with the benefit of receiving the gains, invested in a rebuilding plan that, as I said, was designed to increase escapements with foregone catch in the early years, so that there would be some economic loss certainly in the early years of the plan and that with the hope of achieving higher economic yields through rebuilding and to assessing the factors that are responsible for maintaining production on the Fraser.

Now, so that was -- that was from the outset, that was the intent of the plan, and so by the time the mid-'90s rolled around, it was -- there was indications that productivity was declining and the plan as it was set at that time, Mr. Commissioner, was therefore somewhat constrained because of the -- one of the rules was to maintain at a minimum the brood year escapement. In other words, you wouldn't go below in a given year, you wouldn't have a target that was designed to go below the target, say, four years before and otherwise it would have been a rebuilding strategy.

But the intent was to, of course, take advantage of those years where productivity was on the rise and -- but then as I said starting in

around the mid-'90s when things started to slide, there was concern amongst -- certainly amongst the stakeholders who had invested in this rebuilding plan, that things had gotten off the rails and that the benefit that they were potentially would have reaped had productivity not declined was in their minds not to be realized. So that was sort of where I would say, you know, in 2000, 2002, with the decline and the loss of yield that was not achieved, that's where rethinking about the '87 plan started to take hold.

Q And do you know why the plan didn't work, why there started to be a decline in the later years?

A Why there was a decline in --

Q Why the stocks --

A -- productivity?

Q -- didn't rebuild in the way that was anticipated under the rebuilding strategy?

A Yeah. We didn't understand why it was declining. I mean, there's a number of hypotheses that you will hear or have heard throughout these proceedings but, you know, the current thinking, I guess, was that productivity was declining because of changing environmental conditions, primarily in the ocean and it was a natural occurrence and part of fluctuating changes in productivity over time. But in this particular case in the 1990s, it turned out to be a rather persistent decline.

Q And during that timeframe, the 1987 rebuilding strategy, did the escapement targets that were set using that policy or that rebuilding strategy, did those targets take into account cyclic dominance of Fraser River stocks?

A There was, as part of the design of the rebuilding plan, the population dynamics, the models at the time that were designed to attempt to represent the population dynamics of Fraser sockeye had taken into account or had considered models that accounted for the cycles that had been seen on the -- in the Fraser system, as well as a -- that was -- has been called the Ricker model, which we'll talk about later I'm guessing -- the Larkin model, rather, and then there is a Ricker model which did not purport to account for cycles in terms of interactions between the different year classes.

In answer to your question though, Mr. Commissioner, there was an attempt at the time to

assess rebuilding plans based on the notion that needed to account for cycles in the populations.

Q All right. Now, just to kind of carry the sequence around you said 2000 to 2002 there started to be some concern that the strategy, the rebuilding strategy, wasn't working and I take it that the department started to look at new ways to determine escapement strategies?

A That is correct.

Q And there was an initiative that began in 2002 which is known as the Fraser River Sockeye Spawning Initiative or FRSSI, and that is a modelling tool and that was developed as a way to look at new ways to develop escapement strategies?

A Yes, that's correct. It -- it -- I should have added, though, that in terms of the 1987 rebuilding plan, there was also an experimental plan that was designed to reduce harvest rates rather aggressively down to 50 percent, to learn quickly, more quickly, about which dynamics may have been affecting or are affecting or are important to understand in managing Fraser sockeye.

So the FRSSI, which is the question that you're asking, or the spawning escapement initiative, was really trying to look at a fresh look of how you actually balance or assess the trade-offs between reading spawning escapement targets to avoid having stocks or, in the vernacular of the Wild Salmon Policy, CUs, which would be at risk because of low escapements or low numbers of spawners reaching the spawning grounds. So when we say escapement, Mr. Commissioner, we're talking about -- or escapement targets, we're talking about ensuring or considering the trade-offs in the management system that would allow some certainty of maintaining or reaching spawning targets, reaching the number of spawners that -- on the spawning grounds for future propagation of the -- and sustainability of the population.

And so -- but then obviously, that's one objective was to ensure that escapement targets were reached. Another objective was to balance the rate at which escapement targets were achieved or at least the amount of escapement that reached the spawning grounds, with harvest management. And so FRSSI was really a method of or a tool that

takes into account (1) the population dynamics, the biology of the beast, as well as the objectives of management in terms of realized catch and so a set of performance indicators or performance measures were developed to try to assess how well you met those objectives.

And in a sense, that is the nutshell or at least the overriding purpose of FRSSI was within a consistent framework allow the inclusion of what we know about the biology, i.e., the population dynamics that are described by currently, at least, the Ricker model and a Larkin model, but also to include the objectives that were at the time starting to be thought of in a more of an open process. In the ensuing years after 2004, certainly, there was a series of public engagements in terms of workshops to elicit preferences by stakeholders in an attempt to identify the range of preferences that would become the objectives and then also to build on the understanding of what is -- our understanding of the population dynamics, which model should we use, taking into account uncertainty.

Q Okay. Let me break some of that down. That's quite a big history there. So if I can you to a paper that you authored in 2004, this is in Tab 1 of the binder before you, and its CAN002790 and this is a research paper prepared by you, Michael Folkes and Gottfried Pestal called Methods for Assessing Harvest Rules for Fraser River Sockeye Salmon. Just before I ask the question about this document, if I could just back up and ask you, FRSSI has a model component, but it also has a process component that you were just alluding to at the end there in terms of workshopping with stakeholders and others; is that a fair characterization?

A Yes, that's a fair characterization, yes.

Q Okay. So this paper I take it goes to the analytical tool like the mathematical model that is part of FRSSI; is that right?

A That's correct.

Q Okay. And can you give us an overview of what this paper in 2004 and the model that was developed at that time was intended to do? How does it work?

A Yeah, okay. Just some context. This was the

first review, scientific review, if you like, of a few years of work that started in 2002 and led up to the development of this particular research project -- or, sorry, research report, research document in the vernacular of CSAS. And so it was a description of the methodology that was used at the time to provide management input and ultimately to set escapement goals for Fraser sockeye. And as I was saying, it includes -- it describes the biological components, the models that were considered at that time, as well as the objectives that were considered at the time and it -- two things that are -- I guess the main features, I think that are worth pointing out in this particular paper compared to where we are now is that these were the early years of development of this model within a technical group. And so we explored how we -- what's the range of methods that we should be exploring in terms of assessing the stock dynamics of the model. So we considered a Ricker model and we considered a rudimentary model in my words that looked at just the data in the very dominant years and also in the Larkin model. So it had some models which are not included now in the way that we described the biology.

It also used a harvest rate curve that is quite different than what is applied now. And this particular curve was solved for, if you like, analytically given the underlying biology and given the objectives, but it could not be described as a fixed escapement policy because it did have this notion of increasing escapement at higher run sizes and but also not a -- in the theoretical sense a fixed exploitation rate policy in that it did not have a constant harvest rate policy at some -- over some range of run sizes. So -- and that's quite different than what's done today. So -- and I can talk about what's currently -- what changes were made from that particular construct.

The other thing was that we -- sorry. We changed the shape of the -- so the -- we had a particular curve that is different that we use today, but we also had a different way of evaluating what the -- how the curve should look. And this was in the spirit, if you like, of

optimization. It's got various jargons attached to it, but solving for multi attributes within a -- in a modelling context that actually weighted different attributes of a function. So, for example, one of them might be to avoid low number of spawners, avoid low catch or -- and maintain catch at some constant level, so those are three objectives that would be built into this multi-objective function.

And then stakeholders would then, in terms of their preference, weight each of those objectives and then that would be solved analytically. So the curve that would be the outcome of this would be determined by how you might choose to weight the various factors that were in this objective function, so typically would weight the avoid low spawner objective at a higher rate than avoid low catch objective, or maybe not. But that was the state of this particular paper and so, Wendy, that's where -- that's kind of where we got to in the 2004 review that occurred.

Q Okay. And then I think you had mentioned that this model, once it was presented, was then followed with workshops with different stakeholder groups to work through some of the objectives that you just identified; is that right?

A Most of the stakeholder kind of involvement started to occur - now I may be -- this might be a good question for the panel, but I think 2005 is where we felt the model was at a state where it was -- we needed -- we thought it would benefit from inputs from a broader stakeholder community. So we started on this road of having multiple staged workshops that helped inform the development of the tool and helped solicit preferences from the various stakeholders involved in the process.

Q Okay. And I'll come back to that in a little bit. You also had -- I take it there was a workshop that dealt with cyclic dominance and its application to the goals that are described here in 2006; do you remember that?

A Yes, that's correct.

Q Okay. And the proceedings from that 2006 workshop are at Tab 9 of the binder before you and it's CAN002835. And what was the --

MR. LUNN: Ms. Baker, did you want to mark the previous

document?
MS. BAKER: Oh, sorry. Yes, please. Mark that.
THE REGISTRAR: Marked as Exhibit 396.

EXHIBIT 396: Cass, Folkes et al - Methods for Assessing Harvest Rules for FRSSI

MS. BAKER:
Q So the proceedings from the workshop on cyclic dominance, what -- why was this done? Why was there a workshop to assess population dynamics and implications for management?
A Mr. Commissioner, this was one of the most widely debated scientific issues that has emerged in the last 50 years with regard to Fraser sockeye which is to address the question of why is it that we see in sub populations in the large lake systems, in particular in Fraser sockeye, that have persistent cycles, have had persistent cycles, back to the origins of data in which you have varying patterns that emerge, but the most striking was -- one was you had a very strong what was called the dominant year within the four-year cycle, followed by a lesser what was called a subdominant year, followed by two off cycles. And for some populations, that particular pattern, for example, Quesnel Lake sockeye, Adams river sockeye, Stuart Lake sockeye, that pattern has persisted with uncanny regularity over time. And so, you know, as I said, in 50 years of scientific inquiry there has been no consensus on what exactly is the cause of these cycles.
And so the workshop that -- the proceedings that are before us, the workshop was an attempt to bring together the issues in a DFO-sponsored workshop, but that also included academics from UBC and SFU, if you like, as well, and -- but it was to start looking at how we could deal with cyclic dominance in the context of its implications for management of the Fraser River sockeye. So it was seen as something that needed to be done in order to move forward on how we would incorporate this notion of cycles in the population of the dynamics of Fraser sockeye and in the simulation testing that went forward to account for cycles. So that was the impetus, the motivation, Mr. Commissioner, for this particular

workshop at that time.
MS. BAKER: And I'll have the proceedings marked, please, as the next exhibit.
THE REGISTRAR: Exhibit 397.

EXHIBIT 397: Workshop to Assess Population Dynamics of Cyclic FRS and Implication for Management, Feb 7-8 2006

MS. BAKER:
Q Did the workshop make -- result in changes being made to the FRSSI model?
A Yes, it did. This was, in my mind, sort of the fundamental workshop that reshaped how we proceeded forward from the -- from what's documented in the 2004 CSAS research document. And the fundamental change was an acceptance that probably the best way to model the dynamics of Fraser sockeye was to include this so-called Larkin model which essentially is a Ricker model, but with some added terms to account for the importance of previous spawning escapements on determining the survival of a brood year in the sense that there was a delay density impact of depending on the size of the spawn, numbers of spawners, and on the degree of interaction between the spawners. So essentially it was a way to account for the cycles in terms of how these particular year classes interacted to result in differences in mortality associated and driving cycles. So that was one fundamental change, I think, in the way that we chose to model the population dynamics in the FRSSI model.

The other, I think, fundamental change was in the way that the harvest rule is -- changed from how it was characterized in the 2004 document to how it exists now. And it was recognized at the workshop that the -- by trying to optimize a particular curve to meet some objectives, was not a fixed exploitation rate strategy, nor was it a fixed escapement strategy, but that the more appropriate way to manage according to a rule was to have a fixed exploitation rate applied across a large run size range with some contingency for ramping down on that harvest rate at low run size abundances. And so that was the second sort of fundamental change in the way that the tool was

designed, so the shape of the harvest rule curve or what's called a total allowable mortality curve now, was changed and is quite different from what was reported in the 2004 report.

Another thing that occurred around that time was -- well, maybe I'll leave that there 'cause I think that's the fundamental importance of that particular workshop at that time.

Q All right. And just as we're talking about the curves and the harvest rules, I think it might be helpful for the commissioner to relate that discussion to the -- an example of an escapement strategy that was in use, is currently in use, the -- and we've already gone to it once in these proceedings, the 2009 escapement strategy which is Exhibit 322. If you turn in that to CAN page number 9. This shows a curve. Is this -- can you relate what you were just talking about to this curve?

A Yes. So the top curve, the top curve, the -- if you look at the run sizes which is shown on the bottom axis, the X-axis in millions, so this is a range of run size over which a harvest curve has been developed. So in this example, at one million fish, there is a dotted line, vertical dotted line that represents a point on that curve where you would start ramping down on the total allowable mortality, which is shown on the vertical axis as a total allowable mortality, which would include the harvest. And so the cap at which is described as the cap at that -- right at the point of the one million run size, is the exploitation rate cap that would be applied to a particular run if the run was above, in this case, one million fish. And so as the run -- if a run comes in below one million fish, then there -- the harvest rule implies that you would reduce harvest rates in the way this curve is shown down to a minimal fishing point at somewhere below half a million fish and then minimal fishing from then on. Now, so that's the relationship between the run size, Mr. Commissioner, that would be observed, and the total allowable mortality, which would include harvest.

Now, if you flip that and ask what -- how that translates into an escapement strategy and you can see from the plot at the bottom of that

figure, Figure 1, that between -- what is that point just below half a million fish and the one million fish, where those two vertical lines are, the strategy there is to have a fixed escapement strategy over that range of the run size that corresponded to the decline or the cutback in the harvest rate should the run size in this particular example, fall below a million fish. And then to the left of the dotted line, the vertical dotted line, which is called the no fishing point on the top graph is results in a decline in escapement. There is no fishing, but as run size declines, the escapement will also decline. So this is the, if you like, really the fundamental way in which the tool that the harvest rule -- I keep calling it a harvest rule because of my lengthy history in this, but which is now called the total allowable mortality or TAM rule, this is the construct that exists today.

Q Right. And these curves are generated through the model that you have just been talking about?

A The -- there's a range of curves that would be explored given some benchmarks that would be used to assess whether the -- you know, how well the -- a particular curve, total allowable mortality rule, how well that worked in meeting the objectives of not falling below a particular spawning escapement with some frequency, say nine out of ten, over the course of the forward simulations. And -- I've lost my train of thought, but -- could you help me, Wendy?

Q I was asking if the curve that you see there is what's created by the use of the FRSSI model and then you were explaining the --

A Yeah, the --

Q -- different curves can be created --

A Sorry. The particular curve that satisfies the constraints, that is, you don't want to fall below the spawning escapement or don't want to fall below some particular catch value --

Q Sorry. I'll just ask if you could turn to page CAN15 and that may help you in explaining what you're talking about now. Go -- show the whole page, if you could. There. You see the different options at the bottom.

A Right. So at the bottom, those are, in fact, the harvest control rules or the TAM rules, and then

the panel at the top corresponds to the performance indicators, in this case for Early Stuart sockeye that over the long haul would result from the -- applying these various options. And so ultimately there's a large number of options that you run with this model and are assessed against performance indicators and those harvest rules or inputs that do not meet the options, for example, do not meet the performance of -- or the goal of avoiding low spawners by some frequency, then those are filtered out. Likewise -- or could be filtered out. Likewise, options that result in catches that fall below some agreed-to level get filtered out.

So the notion here is to -- Mr. Commissioner, is to exclude those options which do not satisfy the objectives and to, if you like, home in on a set of objectives that satisfy -- or home in on a set of curves, if you like, that meet the objectives based on the performance indicators that are identified.

Q And the idea of having a fixed exploitation rate ceiling, the 60 percent, was that a new addition in 2006 following the workshop, as well?

A Yeah. So then it became okay, what do you set the cap at? Once we agreed that the control rule would be a fixed exploitation rate across a range of run sizes, then the question is what would you set the total allowable mortality rule at? And so it's at that stage where we, throughout the workshop environment, came to a value of 60 percent and it's important, I think, to note that that's not based on an outcome from modelling the population dynamics for the stocks that we included in the model. It was designed to reduce the probability of doing harm, if you like, to stocks that had a lower productivity that weren't reflected in the model, so it was a way to guard against populations, reduce the harvest rate from what might be the optimal to guard against over-fishing small stocks in mixed stock fisheries. It was also designed to mitigate, if you like, or reduce the impact of uncertainty in in-season management, so uncertainty in run sizes that higher exploitation rates could have the undesirable impact of removing too many fish if the run size was estimated to be lower than it

actually was. And it also guarded against what's been called sort of implementation error. You can't precisely implement a fishery with an exact harvest rate, so there's some uncertainty about what exactly the harvest rate you can achieve, given your target.

And so those three things resulted in a policy choice, if you like, to have a 60 percent cap, which is what is currently in the plan.

Q And one other --

THE COMMISSIONER: Ms. Baker, could I just --

MS. BAKER: Yes.

THE COMMISSIONER: -- ask a -- so I continue to follow this evidence, just ask a question of the witness. Earlier on, Mr. Cass, you talked about fixed harvest or exploitation rate and there you talked about 60 percent as an example. I've heard about total allowable catch or TAC and now you're talking about TAM. Are all these terms the same?

A They're not the same. They're related and they're part of the jargon in this whole affair. But a total allowable mortality rate, if you like, includes harvest, the harvest rate, and the harvest rate would determine the TAC. So translate the harvest rate applied to a run size, the total allowable catch, the TAC, would follow from that.

But the TAM is -- includes the harvest rate that would ultimately result in a TAC, but also include environmental losses that are developed through the management adjustment.

THE COMMISSIONER: Sorry, the environmental losses then are...?

A Environmental losses in the river that would be projected based on environmental conditions in a given year which would be removed from what would be allowed to be taken.

MS. BAKER:

Q These are the -- what have been referred to as management adjustment numbers; is that right?

A Yes.

MS. BAKER: So we've started to talk about management adjustments, Mr. Commissioner, but that evidence has not been completed yet.

A Yeah, maybe a different way to say it is there are projected losses in the river because of environmental high river temperatures, high flows,

for example, removals of catch up-river, unaccounted for removals of catch, so those would be, if you sum those all up in a given year, those would be subtracted from the total number of fish that would enter the river but would eventually result in less fish reaching the spawning grounds. They would be fish that would be either caught or die en route towards the spawning grounds, but that would be -- that would reduce the actual number that reached the spawning grounds. So the TAM rule was a way to account for that -- those differences.

MS. BAKER:

Q You had talked about this idea of having weighting different objectives, that how you might weight some more heavily than others in the prior version, the 2004 version, was that continued following the 2006 workshop, that weighting of objectives?

A The weights, explicit weights that were used to -- sort of as knobs on this objective function were not used following -- I think they were disbanded probably in the plan for 2006, and went to more as I was trying to describe, went to more of assessing the range of options available in terms of a TAM rule and how they satisfied the meeting objectives in terms of the performance measures that were used to assess the performance of how each of these TAM rules performed.

Q Okay. When did the FRSSI model first -- when was the first use of the FRSSI model in setting options for Fraser River sockeye escapement planning?

A The TAM rule first appears formally as a method for guiding escapement targets, options, occurred in 2006, I believe, IFMP. It had been used in 2005 as sort of a transition between the rebuilding plan, if you like, and into FRSSI, but it was not explicitly used on its own in 2005. 2006 marked the first year that its influence on setting escapement targets was viewed.

Q And have changes been made since the 2006 year to the model?

A There's been a number of changes made to the model, to the actual biological model, the tool, if you like, Mr. Commissioner. There was certainly at the time an interest in developing

plausible forward simulations that accounted for changing productivity over time, so given the atmosphere at the time or conditions at the time, that populations were declining. There was an interest in looking at more research or more assessment of how you would evaluate the impacts of changing future productivity changes over time. That was key to the changes that were made in around 2005 and built on right up till now.

There was also changes or thinking around how you include the en route mortality that's used to remove the effect or partition the effect of environmental conditions in the river from the actual harvest rate or the human removal. There has been thinking around how you account for declines in productivity at very low stock sizes. That's this so-called depensatory effect, that if you -- in theory, that if you cross or have spawning escapements that are below a certain level, then the high productivity that is modelled if you do not consider losses that -- other losses that occur at low spawning escapements will over-estimate the productivity in that range. And causes of this with -- what's in this depensation thinking is that genetic effects, that perhaps fish can't -- they get so low in abundance they can't find mates, genetic bottlenecks, predators that, Mr. Commissioner, that could swamp out low abundances of their prey, in this case Fraser sockeye, if they're at such low abundance.

So the FRSSI model, while it didn't purport to estimate what that degree of depensation was, it -- just as in trying to account for future changes in productivity, the future model allowed users of the model, if you like, to run scenarios that included this kind of low mortality at low stock sizes to assess the impact of that on the actual long-term harvester energy that would result from including depensation, including things like various scenarios of future productivity, declines in productivity and how you model en route mortality to potentially account for increases that may occur over time as a result of climate change.

Those were some of the changes that have been -- in addition to ongoing data refinements, so we moved from 12 stocks that had a longest data set

of the spawning and escapement data set. We added on seven more populations that had or stocks that had less routine data and higher uncertainty in the actual population models, the parameters that are the outcome of these models, and so we moved from 12 stocks to 19 stocks and we -- as each year went on, we added on additional years of data and so there were some refinements of the actual data and the models that were used.

Q Could the depensatory effect that you just mentioned there in that answer, I wonder if you could explain that more simply, just so that we have it on the record. The concept, if I understand it, is that there -- if you can imagine productivity on a slope, the theory is, and I think the way the model was originally run was that the lower the number of spawners, the higher the productivity of those spawners. But there's some point on that line where that theory stops working right and you can actually have lower productivity with a lower number of spawners.

A It's been called a number of things - a predator pit, but whatever the cause, yeah, if you don't account for that and it actually exists, then you're over-estimating the productivity in that range of low stock size, correct.

Q What about all these things that you have just described, are those a kind of sensitivity analysis? Is that how you would explain some of those factors you've just reviewed?

A Yes. So sensitivity analysis, Mr. Commissioner, would be a way within the simulations, simulation testing, to evaluate how important various assumptions, in this case various assumptions about future changes in productivity, various assumptions about depensatory mortality, various assumptions about en route mortality, how that translates into an outcome in terms of the harvest rule or the behaviour of the performance indicators that you're using to come up with the harvest or allowable TAM rule.

So the idea behind sensitivity analysis is one, to assess how -- what's the influence of assumptions of going into the model, and then to evaluate whether there are robust management procedures that can alleviate to the best extent the occurrence of those factors that may or may

not occur.
Q All right. In 2008 Gottfried Pestal, Paul Ryall and you prepared a report on the development of FRSSI and that included a number of the improvements that you've just reviewed and outlined some of the workshops that were held with participants over the years and that document is called Collaborative Development of Escapement Strategies for Fraser River Sockeye - a Summary Report 2003 to 2008 and it's Tab 3 in the binder and it's CAN002907; is that right?
A Yes.
Q And this document sets out the history really of how the model was developed and what workshops were held with different stakeholders and the outcomes of those workshops and sort of the refinements to the model as time went on; is that right?
A That's correct.
MS. BAKER: Okay. Can I have that marked, please, as the next exhibit?
THE REGISTRAR: Exhibit 398.

EXHIBIT 398: Collaborative Development of Escapement Strategies for Fraser River Sockeye - Summary Report 2003 to 2008S

MS. BAKER:
Q If you could turn to page 25, which is CAN33 but it's 25 in the actual body of the document. That set out the simulation model. This is again just a summary of the model that you've been talking about. But at the bottom it might be helpful for the commissioner just to outline, you have some policy choices set out there. And are these the kinds of choices that FRSSI is designed to allow managers and stakeholders to assess, for example:

Policy choice: Trade-off between harvest benefits versus providing protection to individual stocks;

Policy choice 2: Trade-off between short-term and long-term benefits

Policy choice 3: Trade-off between stability in catch and maximizing opportunity

A Yes.
Q Okay. And the -- those sorts of policies, how are those policies incorporated into the model or dealt with in the model; can you just give the commissioner an understanding of how that fairly non-mathematical sort of summary finds its way into this model and this process?
A Yeah. First of all, I think it's, Mr. Commissioner, you need to understand that this is a long-term -- or model that looks at long-term strategies, if you like. In this particular case it goes out to 48 years and so it's important to realize that it's assessing the trade-offs in terms of harvest benefits, as well as sustaining escapement in a long-term sense. Now, the model has been and can be used to look at more shorter-term trade-offs and, you know, this was an interest by stakeholders, if you like, to sort of separate in terms of eight years versus the long-term. But, yeah, essentially it's -- in terms of trade-offs, and given the harvest rule that was just described or the TAM rule that was just described, it's a way of looking at given some objectives, don't want to fall below a certain number of spawners, and don't want to have the catch -- now, that was -- that's a stock-specific or CU-specific objective. Don't want the catch to fall below some particular low catch limit which would -- from the perspective of stakeholders would -- is not a desirable outcome, and so essentially the model then looks at how can you meet those objectives and satisfy the interests of conservation? What particular harvest control or TAM rule is best for reducing impact or staying above some particular benchmark, i.e., don't want to result in a conservation risk, and at the same time to result in the best harvest benefit, given those constraints.

And so choice 3, which really refers to you could maximize catch but you would have potentially high variability from year to year whereas the long-term catch which might satisfy the best long-term catch, but which results in higher frequency from one year to the next of whether you get good catches in one year and poor catches in the following year.

So the simulation model was set up to explore

those choices and ultimately to come up with a plan, i.e., a TAM rule, that met the performance -- the preferences that were used to evaluate these trade-offs.

Q If you could turn then to page 39 or CAN39 which is page 31 in the actual report. And go down to the bottom of that page. It sets out how alternative escapement strategies were chosen and it -- if you go -- we read at the bottom and turn over the page, it describes -- this document describes how the spawning initiative workshops went through some of those choices and identified the different trade-off options. You'll see that there's a bullet at the top of the page which you can go past and then the first bullet following says:

> Participants were asked to assign preference scores to different management objectives and performance indicators.

The next one, bullet, describes how they were asked to assign preference scores to alternative options, and then finally, there's a review of the trade-off analysis that showed where things landed following these workshops and where the participants settled on their different options. And that sort of describes, does it, what happened at those workshops, where people tried to work their way through this model and work their way through different performance indicators and objectives to come up with what was going to be workable going forward?

A Yes, that's correct. That was the idea to look at the broad suite of outcomes from the model and given the objectives and, you know, the preferences of those at the workshops, at least, way to render down, if you like, the various options down into a set of options and eventually a single option that would be part of the plan.

Q And the third bullet under the paragraph that beings with the word "briefly", it says:

> Options deliberately designed as a compromise weren't strongly rejected or endorsed, and established a middle-ground that served as a platform for 2007 pre-season planning.

Is that what happened, in fact?
A Yeah. This was the sort of search for the common ground among the participants.
Q And just to identify the participants at those workshops are set out or at least some of them are set out on page CAN3 which is Roman numeral III on this document, sets out some of the individuals who attended the workshops in 2007 and 2008, that's right?
A That's correct.
Q Can I ask you to identify whether the FRSSI model at this time in 2008 was able to model the effect of the rules on overlapping run timing groups or did it simply address a TAM rule on each run timing group in isolation from each other?
A Yeah. Now, you know, before I saw this document I couldn't pin down the chronology very well, but, yeah, the idea was that we -- you know, it's recognized that this, the TAM rules, were modelled on -- they were modelled on run timing groups that were themselves contained where a roll-up of various stocks that were assumed to be -- have similar timing groups. So the history of it is, you know, you have the Early Stuart, which is a timing group which in many respects is the first -- it overlaps to some extent but it's usually passed through the system before the large summer groups. But the Summer, Early Summer and Lates all have timing group -- or their timing groups have some overlap.

So the way to assess the impacts of the overlap, in other words, to take into account that the TAM rules could well be different on each of the run timing groups, where they overlapped there was a need to account for the fact that there are -- there would be constraints on a harvest rate, simply because the overlap of -- and mixture of the stocks within a timing group that overlapped may have had a TAM rule that is different than what is -- what would be operating on another run timing group, Mr. Commissioner, so the idea was to assess what the actual realized harvest rate would be, given the constraints of the TAM rule on -- in overlapping stocks.

So within the model, to assess that there was a need or an interest in doing some simultaneous modelling of each of the run timing groups to

estimate what the impact of the overlap would be.
Q All right. And has that been done? Does the model now allow you to address that overlap?
A There are methods that are applied currently that -- with that objective, yes.
Q And I just wanted to touch on something that you raise there, the FRSSI model does create TAM rules for these run timing groups that we've heard a lot about in these proceedings and run timing groups or management groups, but the Stuart and the Summer and the Early Summer and the Late runs, could you do escapement strategies using the FRSSI model for a different set of groups or for the individual 19 stocks that are modelled in it; is that possible?
A Well, Mr. Commissioner, you can, because we have the information for each of the discrete populations that get rolled up into the run timing groups, you can come up with a TAM rule for each of those populations. However, implementing that particular strategy, in other words, if you were attempting to manage each of those populations in mixed stock fishery environments where there are certain sampling requirements or precision requirements in test fisheries or within the in-season inputs, there are problems associated with certainly with small stocks in large populations that are sampled in attempting to estimate what the abundance of each stock is. So the more populations you have within a mixture that you assume within a mixture, there is an issue with one stock ID in the actual fisheries based on the test fisheries, to estimate the abundance of the larger number of stocks that would be managed for in the example that counsel has used.

So one of the big drawbacks is the precision of the stock ID for small runs. There's also issues related to the fact that we have en route mortality which is based on run timing groups, so we have estimates on en route mortality in the river based on run timing groups and not currently isolated by stock, so the -- there's some loss of precision there if -- but, you know, that's something that maybe one could test. I would say the major problem, Mr. Commissioner, with trying to manage large numbers of populations in mixed stock fisheries is the current sampling regime in

test fisheries that does not result in precise or accurate estimates, particularly of small stocks.

Q All right. Now we've talked about the 60 percent ceiling and you described that as being kind of a management decision that was made to put the ceiling at 60 percent. Did you consider trying to understand the optimal ceiling for the stocks that are made up within any given aggregate? Like why is it always 60 percent and not different for different run timing groups?

A Yes, I did mention that the 60 percent was a policy choice given the data gaps and the inability to account for all the populations, all the stocks that would be within a timing group. So that's an area where I would say some priority in terms of research should be attacked. I mean, we have assumed a 60 percent since the outset and the IFMPs, but that's an area where we need to look at the -- from a scientific point of view, given the understanding about population dynamics, about that. But I don't think we're going to completely solve the problem. There may be populations that are -- have a low productivity that aren't accounted for in the suite of stocks that we currently use, and certainly the small populations would not be -- they're very small, very difficult to detect in the test fisheries.

Q And there's also -- it's -- you'll recall from looking at the graph when we had it on the screen, and maybe it would be helpful, Mr. Lunn, to put Exhibit 322 back up on the screen and go to page 15, CAN15 in that document, just might be useful to have that while I'm asking these questions. So the 60 percent that we were just talking about is that top line on the escapement strategies table or graph, right?

A Yes.

Q Okay. And then there's also a no fishing point which is the bottom, zero percent line. How is that no fishing point set using FRSSI or in FRSSI?

A Well, the way the TAM rule is set up now with a fixed exploitation rate over a wide range of run sizes and a ramping down at some point, the way the TAM rule is set up now with a fixed exploitation rate over the period that the -- that triggers the reduction in harvest rate, because the fixed exploitation rate at that period, the

actual no fishing point is -- simply falls out from trying to find the -- that one point on that curve that determines the cutback rule, given that you have a fixed escapement below that.

Q All right. And what is that cutback rule related to? Is it related to a benchmark of some kind?

A Yes. So the benchmarks that we have been using, the interim benchmarks up till now, the cutback is designed to look at the frequency of a particular TAM rule that results in a -- that compares the -- or looks at the frequency with which a particular rule would result in an escapement that is below or doesn't meet the benchmark.

Q Right. And the interim benchmark that you described is a number of fish that you don't want to fish below, right? Just in plain language?

A In the WSP language, it's a value or an escapement or that is considered to be -- put the CU at risk and it's actually defined as -- in various ways, but it's really some proportion, if you like, or some number less than a fully-seeded population. So it's really the point between the red and the amber in the WSP diagram that's often used to show the various -- the health of a CU in terms of its abundance level.

Q All right. And those interim benchmarks that you've described, those are interim why? Why are they still interim?

A Well, I mean, we started -- the FRSSI process started before the WSP was finalized and certainly it's carried on during the implementation phase, Mr. Commissioner, of the WSP but interim benchmarks were used as surrogates or proxies, if you like, to guide the process up until the point when we actually do adopt the WSP benchmarks. So the WSP benchmarks would be -- like once they're finalized and agreed to would be used as -- they would be used as the actual benchmarks and there would no longer be interim benchmarks.

Q Thank you. And then I just have a couple of questions left and I'll be able to -- we'll be able to take a break and then we'll move to the full panel. So I'll just try and get through that next set of questions.

In 2010 there was a CSAP review of the FRSSI model; is that right?

A Correct.

Q And the paper which outlines that review is found at Tab 6, which is CAN185438. Okay. So this is a working paper prepared by Gottfried Pestal, Ann-Marie Huang and you appear as the third author and the FRSSI working group. You're familiar with this document?
A Yes.
MS. BAKER: Okay. I'll have this marked, please?
THE REGISTRAR: Exhibit number 399.

EXHIBIT 399: Updated Methods for Assessing Harvest Rules for Fraser River Sockeye Salmon - May 18, 2010

MS. BAKER: Thank you.
Q All right. Why was this review done in 2010?
A It was felt that there had been progress made on a number of fronts in the development of FRSSI since the last peer review, the last PSARC review in 2004. So this was really a catch-up to document and have review of the current state as it existed at that time.
Q And this document appears as a working paper, so it's unlike the 2004 document that we've marked as an exhibit in this proceeding. How far along the process is this document now? Is it now finalized?
A This document is not finalized. It was reviewed, as I said, I think in May and the report was accepted, endorsed, if you like, by the participants at the meeting which means that the methodology as it was presented in the paper is accepted. And so the loose ends, if you like, Mr. Commissioner, are that it's accepted but with revisions, which is usually the case in reviews, so as long as the authors or the leads on a particular research paper agree to revise the paper pending the recommendations from the actual peer review process, the paper is not accepted until the revisions are made, at which time if the revisions meet the standards and are agreed to by the chair of the meeting, then the paper stands as a research document which would be in this case the course of events.
I might say that the methodology was strongly supported by external reviews and so it was a good signal that the process -- the tool itself was on

the right track. So that's, Mr. Commissioner, where this sits.

Now, there's also -- Ms. Baker, I'm not sure if you want me to go here, but there's also a product that comes out of these peer review meetings that's called the Science Advisory Report, which isn't authored by individuals. It's a summary, if you like, of the peer review meeting and it's authored by DFO and that is the actual advice that flows from the meeting in terms of the acceptance of the paper and the review. So there's two -- these two documents, if you like, which will -- neither of which are finalized and approved, which would be the outputs from these meetings.

Q Right.

A This meeting.

Q For our purposes does Exhibit 399 that you see before you, does that set out the state of the model that is currently in use?

A That is correct. Yeah. The model that is currently developed that could be used by end users, put it that way.

Q But the tool, I guess, that is described in that document, Exhibit 399, is the tool that's available for the department to use in --

A That's correct.

Q -- doing its planning? Okay. I take it one of the things that this paper, the Exhibit 399, didn't address is whether the FRSSI model is an appropriate tool for using -- to use in making management decisions; is that fair? It reviews the model but it doesn't kind of look at that broad overview of is this the best tool or should we be using this?

A The model, I must say, doesn't come from a vacuum. It, Mr. Commissioner, is the current thinking globally, if you like, on how you do these kinds of policy evaluations and so it's really, I think, considered certainly by reviewers who -- and experts who work in these kinds of environments, that it does represent the state of the art, if you like, for how you evaluate fisheries management and outcomes in terms of preferences as far as meeting objectives and doing it in an open transparent consistent framework.

Q Is a further review intended to see how -- this

model, I guess, has been in use for four years going on five years, so you've seen one full cycle come back after using the model. Is it intended that there will be a further review to see if the model is performing and it's a useful tool in management planning for Fraser sockeye?

A My understanding that is correct, so each year that we apply the model or if it gets used in setting escapement targets is a learning experience. So after one complete cycle, it was agreed that we would review where we stood at that point, which would be, I guess, 2011, and yes, so it would be a review of the performance of this model.

Q And is that happening now? Is there a review like that in place now?

A The review is not -- is not in place as yet.

Q Is it intended for this year, 2011?

A It was intended to be this year. Whether or not that will occur, I don't know.

MS. BAKER: All right. Thank you. Mr. Commissioner, I think this would be a good time to break and I'll bring the panel up after the break to complete the evidence on this.

THE COMMISSIONER: Can I just ask a couple of questions before the full panel comes on?

Do I understand your evidence to be that there were two unknowns, if I can use that term, that you described earlier: one was -- and you described a pattern of persistent decline in the stocks in I think you mentioned the mid-1990s or thereabouts. And the other was you mentioned a persistent pattern of the dominant cycles followed by subdominant. And so both of those were unknowns in the --

A Certainly the decline in production that you referred to first, you know, it was occurring --

THE COMMISSIONER: No, I apologize. I think I may have misled you. Not unknown in the sense that it was occurring, but unknown in the sense as to why it was occurring.

A That's correct. That's correct.

THE COMMISSIONER: And similarly with the persistent decline, why that was occurring. So you had two patterns that you didn't have knowledge of as to the why or an answer as to why they were occurring?

A Yes. The cyclic dominance, the persistent pattern of high/low populations over time, I mean, it's quite apparent in the data, the -- and given how apparent it is in the data, there was no scientific consensus, if you like, about what was causing those. There was a number of theories but uncertainty about what was causing those.

THE COMMISSIONER: And if I could just -- I don't know which -- I've forgotten the exhibit, Ms. Baker. It's Tab 3 of the binder, which is the 2008 --

MS. BAKER: Exhibit 398.

THE COMMISSIONER: On small Roman vii, Mr. Lunn, that document, I just wanted to ask Mr. Cass, there are two paragraphs there at the top, just under the names, if you can see them. It talks about FRSSI being a six-year process, et cetera, but the second paragraph, I wonder if you could just explain to me what that second paragraph means.

A So, Mr. Commissioner, are you -- you're trying to make the link between FRSSI and the Wild Salmon Policy?

THE COMMISSIONER: Yes.

A Yes. Yeah, initially prior to the Wild Salmon Policy being adopted in 2005, we had -- FRSSI had a couple of years under its belt, if you like, and but we did see that it did meet the standards, if you like, of the Wild Salmon Policy in that it was clearly dealing with a Strategy 1, if you like, of the Wild Salmon Policy. It was adhering to the five-step process, which I think is in Appendix 2 of the Wild Salmon Policy. It was designed to be open and transparent, consistent and involve stakeholders and user groups and as well as environmental groups that had an interest in the resource.

So it melded well with the intent of the Wild Salmon Policy and it was ahead of other regions in the province, if you like, in the sense that it was developing harvest rules with benchmarks and included design to get preferences or solicit preferences from stakeholders. So it met the test at the time, I guess, of the direction of the Wild Salmon Policy.

THE COMMISSIONER: And it makes reference there about the pilot implementation and then it goes on to say the new escapement strategies were fully implemented, so was it no longer considered a

pilot in 2007?
A It, I think, met the tests of the pilot. There was an interest in pilots in other areas, as well, Barkley Sound, for example, where there was a fairly mature consultation process as well as -- it was a smaller contained place with multiple species whereas the Fraser was focused on Fraser sockeye, so I think it's still a pilot, still met the conditions of a pilot. It has not been abandoned. But there are other pilots being thought of as well, so -- but it wasn't dropped as a pilot from being a pilot because it didn't meet the test. It continued to meet the test, I believe.
THE COMMISSIONER: Okay. And in Tab 6, again, I'm not sure of the exhibit number, it's the 2010.
MS. BAKER: Exhibit 399.
THE COMMISSIONER: Thank you. I think it's page 25 in my tab in any event. It's under the Part 4 discussion - I apologize to reading to you but it might just help me ask you this, Dr. Cass. It says:

> The model presented in the Working Paper, as well as the planning process it supports, focus on long-term strategies, and don't attempt to capture all of the operational complexities of in-season management.

And then on the next page -- I'm sorry, no I think it's just on that one page. What I was trying to gather from you is because just in the last few questions you answered for Ms. Baker you were talking about sort of a year-by-year analysis of how it's working. But is it a policy that is aimed for in-season use or is it --
A There are some shortcomings of this particular model for in-season application. It does not account for, you know, the fish and fisheries that change over time and space. So it is an overall long-term strategic approach but it is and has an annual -- it runs on an annual cycle, but the performance measures are based on the sort of cumulative forward simulations that occur. But it does not -- it's not a tool that apart from overall setting escapement targets, it's not a tool that allows you to differentiate between

where harvest might occur and certainly doesn't purport to make any recommendations about how the resource is allocated amongst stakeholders. So it is not an in-season model from that perspective. It's a pre-season model with -- that advocates a long-term plan that avoids or attempts to avoid changing course and a lot of the rhetoric and finger-pointing that goes on in season with uncertainty about what the run size is and what management action should be taken. So it's an attempt to minimize the in-season issues by having a prescribed plan that applies across that is agreed to and applies across a range of run sizes. It does not, as I said, deal with nuances of harvest rates from various fisheries or strategies that might change where fisheries occur.

THE COMMISSIONER: So its use as -- is primarily for pre-season forecasting?

A Pre-season in the sense of it is agreed to, if you like, the strategy is agreed to for developing the plan pre-season, so it's a tool to guide the development of a plan pre-season. But I wouldn't want to say that it is not useful in-season because it is the tool by which you say okay, here's a particular run size at some date in-season; what's the corresponding harvest rate for that particular run timing group in-season to achieve the escapement goal? So it does have a purpose in-season but it's not the tool that's used in-season to manage all the complexities about changing run sizes and changing run timing and it doesn't have those -- that capability.

THE COMMISSIONER: So is it --

A Long-term planning.

THE COMMISSIONER: Is it used for the Integrated Management Plan?

A Yes.

MS. BAKER: Mr. Commissioner, I wonder if I just -- it would be helpful if I just took you back to Exhibit 322, just to illustrate that, that link.

THE COMMISSIONER: Three --

MS. BAKER: So it's Exhibit 322 and if you could turn to page 15 again.

THE COMMISSIONER: Which tab is that?

MS. BAKER: It's not a tab. It's an exhibit. It's on the screen. It was brought -- we used -- we brought -- marked this exhibit when Mr. Grout was

in the stand.
Q And so this, as we've been talking about the FRSSI model develops these different options, correct, which show these different curves that you see under the escapement strategies, correct?
A Yes.
Q Mr. Cass?
A That's correct.
Q And then once a decision is made to choose one of these options, say Option 3 was chosen, then that curve would -- so that decision-making is pre-season, right? So you use the FRSSI model to create the options and then the stakeholders and the department review the options and a choice is ultimately made as to which of these options will govern a run timing group in-season, right?
A That is correct.
Q And then that option finds its way into the IFMP as a harvest rule, correct?
A That's correct.
Q And then that harvest rule, which has been described through one of these options, then governs as the fish come in, when you actually see the fish coming in and you actually see the run size materializing, this rule tells you when you're allowed to start harvesting that run size and at what rate, at what point in time; is that right?
A The tool, once there's a run size pegged in-season, then -- and it's assumed that that is a -- represents the actual run size, then this tool is the tool that is used to guide what the harvest rate is, given the uncertainty in the en route mortality, as well as what the escapement target is.
Q Right. So it says before the run starts pre-season, we say -- say we choose Option 3, that tells us that when the run size gets beyond 110,000 or whatever Option 3 shows here, then we can start harvesting that run size and the percentage that you can harvest is shown on that curve, up to a maximum of 60 percent?
A That's correct.
Q And that's how it works between pre-season and in-season, so you're not re-running this model in-season, but you're using the decision that was made pre-season to create the harvest rule that's

then -- governs in-season?
A That is how it's designed, that's correct.
MS. BAKER: Is that helpful? Shall we come back maybe after the break and --
THE COMMISSIONER: Why not?
MS. BAKER: -- do that again? Okay. Thank you.
THE REGISTRAR: Hearing will now recess for 15 minutes.

(PROCEEDINGS ADJOURNED FOR MORNING RECESS)
(PROCEEDINGS RECONVENED)

MS. BAKER: Thank you, Mr. Commissioner. We're now joined, as I said, by Rob Morley, Mike Staley and Ken Wilson. And Mr. Morley has already been a witness in these proceedings, but this would be the first time you've met Mike Staley and Ken Wilson so they both need to be sworn in as witnesses.
THE REGISTRAR: Thank you. Mr. Cass and Mr. Morley, you've already been sworn when you were last here.

AL CASS, recalled.

ROB MORLEY, recalled.

MICHAEL STALEY, sworn.

KEN WILSON, sworn.

MR. STALEY: I do.
MR. WILSON: I do.
THE COURT: State your full name, please.
MR. WILSON: Ken Wilson.
THE REGISTRAR: Thank you. And your name?
MR. STALEY: Michael James Staley.
THE REGISTRAR: Thank you. Counsel?
MS. BAKER: Thank you.

EXAMINATION IN CHIEF BY MS. BAKER:

Q Mr. Morley was here already in these hearings. His c.v. has been marked as Exhibit 7 already so I won't need to take you to that, but I'll just ask you, Mr. Morley, to identify that you have been involved with the FRSSI model and you've been to several workshops, or at least one workshop dealing with the implementation of that model?

MR. MORLEY: Yes, several workshops.
Q Okay. And you are familiar with the review of the different options through the IHPC process, as well as through work on the Fraser Panel?
MR. MORLEY: Yes, I am.
Q Thank you. Mr. Lunn, were you able to find --
MR. LUNN: I don't have it here --
MS. BAKER: Okay.
MR. LUNN: -- but I'm checking with the office.
MS. BAKER: Okay. Okay. Thank you. Mr. Commissioner, we don't have ready access right now to Mr. Staley's resume for some reason so we'll probably mark that after lunch.
Q But if I could just identify that you have a Masters of Science from UBC in 1978, and your work was on the optimization of sport and commercial salmon fisheries in B.C.?
MR. STALEY: Yes, it was.
Q And you were a consultant to the Pierce Commission in 1982?
MR. STALEY: Yes.
Q And you have been involved in fisheries planning throughout -- from 1978 until the present; is that right?
MR. STALEY: Yes.
Q And from 1988 to the present, you have been an advisor to various First Nations and aboriginal groups on fisheries issues?
MR. STALEY: Yes.
Q And from 1995 to the present, you've been a member of the Fraser River Panel Technical Committee?
MR. STALEY: That’s correct, yes.
Q And you are a member of the fisheries working groups for several First Nations present; is that right?
MR. STALEY: Yes.
Q And what are those First Nations?
MR. STALEY: Well, there's First Nations organizations, the current one would be the Fraser River Aboriginal Fisheries Secretariat.
Q Okay. And you are also familiar with FRSSI; is that right?
MR. STALEY: Yes.
Q And in fact, you prepared a report for this Commission on FRSSI which is in Tab 8 in the binder before you. It doesn't have a CAN number, but it was prepared for the Cohen Commission and

it was prepared in October 2010, that's --
MR. STALEY: Yes.
Q Thank you.
MS. BAKER: I'll have that marked as the next exhibit.
THE REGISTRAR: Exhibit number 400.

EXHIBIT 400: Fraser River Sockeye Spawning Initiative (FRSSI) - A review for the Cohen Commission by Michael Staley

MR. LUNN: I have that resume now.
MS. BAKER: Oh, thank you. And then I'll have your resume pulled up. I think we've got a bunch of personal information on this so I won't have this one marked, but we'll provide a redacted version after the break that we can mark as an exhibit so maybe we can just have this flagged that it will be marked as Exhibit 401, and we'll provide the redacted copy after the break.
THE REGISTRAR: Exhibit number 401.

EXHIBIT 401: *Curriculum vitae* of Michael Staley

MS. BAKER: Thank you.
Q And Mr. Wilson, your resume is in Tab 12 of the binder before you.
MS. BAKER: His resume is in Tab 12 of the binder.
MR. LUNN: Thank you.
MS. BAKER:
Q You have a Masters of Science with Dr. Larkin from 1980; is that right?
MR. WILSON: Yes.
MS. BAKER:
Q And you were a biologist with the Department of Fisheries and Oceans from '84 to '96?
MR. WILSON: Correct.
Q And from 1997 to the present, you've been a consulting fisheries biologist for a number of groups, including First Nations and conservation organizations?
MR. WILSON: Correct.
Q You're a member of the Canadian Caucus of the Fraser River Panel?
MR. WILSON: Yes.
Q And you're a member of the Marine Conservation Caucus?

MR. WILSON: Yes.
Q And you're also a member of the COSEWIC Marine Fish Species Specialist Group?
MR. WILSON: Not any more.
Q Okay. And when did that -- you were?
MR. WILSON: I was, yes.
Q And when did that -- what were the years that you were involved in that?
MR. WILSON: I was involved for several years.
Q When did that stop?
MR. WILSON: It's a good question. If it's not on the resume, I don't remember, but it's probably three or four years ago now.
Q All right. And you also have been involved in the development of the FRSSI model. You were part of the FRSSI working group for a number of years?
MR. WILSON: I was never a member of the working group proper, I don't believe.
Q Okay. You were -- but you did participate in some meetings and --
MR. WILSON: Consultations, yeah.
Q Consultations okay. And have you been involved in consultations with the -- with respect to the FRSSI model recently?
MR. WILSON: Well, as part of my work with the Integrated Harvest Planning Committee, I received the usual reviews and updates from the Department on the development of the FRSSI model, and most recently, I was under contract to the Upper Fraser Fisheries Alliance, Upper Fraser Fisheries Conservation Alliance, and I attended meetings on January 21 and 22, 2009, on their behalf, in order to provide them with a review of the model as it was at that time.
Q Okay.
MS. BAKER: Could I have your resume marked, or Mr. Wilson's resumed marked as the next exhibit?
THE REGISTRAR: Exhibit number 402.

EXHIBIT 402: *Curriculum vitae* of Ken Wilson

MS. BAKER: Mr. Commissioner, before we move to the panel's evidence, I just want to take one more run through the use of the FRSSI model to create preseason and in-season plans. Could I have exhibit -- and these questions are, again, to Mr. Cass, Exhibit 322, again, in front of us, page 15,

CAN 15 of that document.
Q So again, Mr. Cass, those options that we see at the bottom are the different options that are created by the model for consideration in the planning process; is that right?
MS. BAKER: That is correct. And Mr. Lunn, if you could pull up, please, Exhibit 325 and turn to CAN 68.
Q And you see on -- this is the Integrated Fisheries Management Plan, one of the drafts before the final, and it sets out for the different stocks at the 50-percent probability level all these different options, options 1, 2, 3, 4, et cetera. Those options, I take it, correspond with the options that would be presented in an escapement strategy document like we have seen marked as Exhibit 322?
MR. CASS: That's correct. That would be an outcome from that document, or from that process.
Q Okay. So the escapement strategy memo, which we just had a look at, and that shows the different options and the curves, with the different curves for the different options, those correlate to the text that we see before us, now -- of the different options. That translates those curves into actual numbers.
MS. BAKER: Can you, yeah, pull that bottom one up a little higher, if you could. Oops. There. No, a little more. There.
Q Okay. So those options would then translate into the different numbers that you see on the screen, the cutback points and the TAM sizes, et cetera; is that right?
MR. CASS: That's correct. I'm assuming that that Table 10(a) references those curves, yeah.
Q Right. And I could have the wrong curves, but just for --
MR. CASS: Yeah. No. Yeah.
Q -- reference, I think this is correct. And then finally -- so the draft that we're looking at on the top of the screen, which is Exhibit 325, and it's draft number 2 of the IFMP for 2009, that shows the options that are being considered by the people reviewing the draft IFMP document. Ultimately, an option is settled upon and finds its way into the final IFMP, and that document is Exhibit 317. And if we turn to page CAN number

67, this shows the choices that were made for the different options, and it translates those options into the different points, the total mortality guidelines, the run size. So it shows that if you have a run size for Early Stuart of 255,000, you're going to have -- the reference points show there that if you have less than 255, there's going to be no -- that's within the no-fishing point. All right. But below 156, sorry, is within the no-fishing point. 156 to 390, it's in that curve that shows the percentage increasing up to 60 percent; is that right?

MR. CASS: That is correct.

Q And then the 390 and above, is that a fixed 60-percent rate?

MR. CASS: That is correct.

Q And the rules that you see on this table, here, in the final IFMP, those are the -- that's the fishing plan for the year that will be implemented by the managers; is that right?

MR. CASS: Correct.

Q So that's how we kind of move from the pre-season planning using the FRSSI model to create these curves and these options. Once an option is settled, it translates into actual numbers that will be used in-season by the managers; is that right?

MR. CASS: That is the current process, yes, correct.

MS. BAKER: Does that clear things up a bit?

THE COMMISSIONER: It does, Ms. Baker. I think I was able to follow that earlier. What perhaps just sidetracked my thinking a little bit was the use of the term "in-season management" to the extent that there are significant changes that appear from the run size assessment once Mission starts to develop some numbers for the managers. And I understand the meetings that take place in April and May, and into June, but once harder numbers arrive and are then reviewed, how FRSSI would operate or how these models would operate, because I understood these to be preseason numbers --

MS. BAKER: Right.

THE COMMISSIONER: -- not actual in-season, but you used the term "in-season management" and that was confusing me a little bit.

MR. CASS: Yeah, and I apologize. I think that was confusing. I think the way Ms. Baker has taken us

through this, it -- FRSSI, while it's the plan that's developed preseason, it is the plan that goes forward for management.

MS. BAKER: Thank you.

Q All right. Now, I'd move off of that. Oh, sorry, apparently I'm not to move off that yet. Just to be clear, where you see the run size reference points, that's telling the managers that when the run comes in zero to 156, this is what's going to happen, there'll be no fishing. If the run size comes in between 156 to 390, there'll be an exploitation on that curve that we saw so it will vary as it reaches 390, and then once it's beyond 390, it will be fixed at 60 percent. That's what the plan is for the Early Stuart on this example, Mr. Cass?

MR. CASS: Yes, that's correct.

Q Okay. All right. Thank you. Now I think we can move on. One thing I think we've established already, but just to be clear, the FRSSI model uses the 19 stocks that there is good stock recruit data for in modelling the outcomes through the FRSSI model; is that right, Mr. Cass?

MR. CASS: Yes, that's correct.

Q Okay. Now, is that data that is available for use in the model from those 19 stocks, the data that's been collected for over 50 years, is that adequate to provide a stock recruit relationship that explains enough variability in the data to be a sound basis for management? Is the data good enough for what we're using it for in this model? And I guess I'll start maybe with Mr. Morley.

MR. MORLEY: Could you repeat the question?

Q Is the stock recruit data that we have for the 19 stocks that are used in the FRSSI model adequate for the use that it's put to in the FRSSI model? Like, do we have good enough data to run this model?

MR. MORLEY: In my opinion, absolutely, yes. It's probably the best that you can expect to get anywhere in terms of managing sockeye populations for this kind of purpose.

Q Mr. Cass?

MR. CASS: I would just add the caveat that because not all the stocks are included, there is some risk that the uncertainty described by the 19 stocks may not represent all the populations that are in

the watershed. Having said that, of course, you know, the 19 stocks, certainly in terms of abundance, represent, you know, well over 90 percent of the fish in the system, but just by the fact that it does not include all the populations, there is some risk that there could be populations which would be at lower productivity and, therefore, vulnerable to a management plan that doesn't account for some losses that way.

Q All right. But for the 19 stocks that we do have data for, is the data that we have adequate for those stocks?

MR. CASS: Adequate in the sense of for -- well, the top 12, let's say, which have data going back to the '50s, early '50s, late '40s, there's a long-time series of spawners and associated recruitment for those. The other seven were added on, but have typically shorter time series and more uncertainty in the actual parameter estimates. But those are as good as it gets, globally, probably, in terms of fisheries science data for managing.

Q Mr. Wilson, what are your views on the adequacy of the data that we have to use in this model?

MR. WILSON: Well, I have several concerns. First of all, while the data for the 19 stocks may represent 90 percent of the catch, it represents less than half of the conservation units, or half of the conservation units on the Fraser, and it's each and every one of those conservation units that needs to be protected through management.

I'm also of the opinion that 50 years of data, while it may seen enormous to a fisheries manager, is a relatively brief window of time when you're looking at the long-term dynamics of salmon populations in the Fraser.

And finally, I guess, my concern has to do with the variance in the quality of the data from stock to stock and the way those data are used to enlighten us about what might happen in the future. These are historical data and so we're essentially looking through a very limited frame of reference backwards at a set of information and trying to understand how the world might work in a way that's consistent with those data. But it's one thing to, you know, fit a model to historical data, it's another altogether to forecast the

future. And in evaluating harvest policy, that's really the problem, we're setting the model. We're trying to understand how this policy applied into the future for 48 years, how we will manage the risks and benefits that are associated with that management policy, and I think there's a high degree of uncertainty that may not be adequately reflected in the model. Although, I totally agree with Mr. Cass's point that stocks that aren't modelled, aren't modelled.

Q All right. And Mr. Cass referred to 12 stocks that have data back to the '50s, and seven with a shorter time series. Do you agree that the 12 that have data going back to the 1950s do provide a good data set for running this model, for at least in relation to those stocks?

MR. WILSON: Not really. My concern is a simple one. If you have 50 years of data and you're going to use those data to understand how a system behaves, you're making an assumption about how stable the relationships between the various factors that affect the population will be over that time period. 50 years of data may seem like a long time, but it is what it is. Is it representative of the 50 years going forward that the model's attempting to help us understand? And that's where the problem occurs in my opinion. Yes, I think that those data, to some degree, are an adequate representation of the past performance of these stocks. Whether the past performance of these stocks will enlighten us very much about the future performance of these stocks is really at the heart of the matter.

Q All right. So your concern is whether we can use the past to predict the future, but in terms of looking at the data we have for the past, you do agree that it's adequate for 19 of the stocks; is that fair?

MR. WILSON: I don't think I would agree with that, no.

Q Okay. Mr. Staley, what's your view on the adequacy of the data that we have?

MR. STALEY: Well, adequacy would have to be looked at in context of the purpose you're using it for. We, in the FRSSI model, are the analytic tool. As Ken points out, we are suggesting that we're projecting into the future, but I think it's -- and there, there's all kinds of issues about

whether that's an appropriate purpose, I guess. But certainly in terms of projecting or testing whether our prescriptions on what to do would be consistent with what happened in the past, it is adequate. I agree with Mr. Wilson that, you know, we don't know what the future holds, but we have to learn from the past.

I think there are some of the stocks in the 19 that have a short time period and perhaps some more exploration as to the relative weight one should place on those versus the other ones may be a useful exercise that I don't think has been done yet. But I would say for those that we have 50 years of, or more, of data, that they are adequate in the context of the art of the science that all of us are involved in.

Q When Mr. Cass was here this morning, we talked a little bit about this dispensatory effect. And maybe, Mr. Wilson, you can just explain what that is again, just as a recap.

MR. WILSON: Sure, at very low run sizes --

THE RECORDER: Microphone, please.

MR. WILSON: Sure. At low run sizes, the sort of standard model generally predicts that stocks will become more productive because competitive pressures and other pressures are relieved. So at low run sizes, stocks are highly productive and have a tendency to grow quite rapidly. The concern is that at extremely low run sizes, there may be an abundance of predators that eat all the available sockeye in the lake. I think Mr. Cass referred to it as a predator pit. There's a number of other mechanisms which might lead to lower productivity at small run sizes and it's a very important issue if you're trying to evaluate the risk of small stocks and on modelled stocks to a particular fishing regime and evaluate that risk in the context of the probability of extinction. So it's quite a critical assumption and we really have very little data to help enlighten us.

Q And does the FRSSI model take into account that dispensatory effect? I think you touched on this earlier, Mr. Cass. Is there anything you want to add to what you said earlier, before I turn it over to the other members?

MR. WILSON: No, I mean, Mr. Commissioner, the model has, you know, a knob in the model that you can

adjust what assumptions you want to make about dispensatory mortality. It doesn't estimate dispensatory mortality, it's just a way of exploring the effect that it may have on the outcome of the model.

Q And Mr. Wilson, are you satisfied with the way the dispensatory effect is treated in the model as described by Mr. Cass?

MR. WILSON: Well, I think it would be very helpful to have real data to show us whether or not the assumptions we're making are correct, or not. So I guess, I don't see it as a key issue in terms of my concerns around the model, but it is a significant issues in evaluating, particularly, the impact of a particular policy or fishing regime on small stocks that may not be in the model at all.

Q Mr. Staley?

MR. STALEY: In terms of the TAM rules and the structure of them currently that are being used, it's hard for me to see that the dispensatory issue which happens at low abundance would be something you'd be too worried about. I think the reason being is that the difference between the various alternative TAM models is the cutback point at abundance. And certainly, the model, the way it's structured, at the low abundance is that -- which we -- dispensatory processes might be -- as someone characterized this morning, might be operating, in those population levels, the prescription would be to do as little fishing as possible. So the policy is to avoid those when you're down in those areas, and the prescriptions that are coming out of the FRSSI process are dealing with when to cut back at much larger abundances than where those dispensatory issues are carrying out.

I suppose, and I believe that's been done in the past, one of the sensitivity analyses one could do is to see whether the presence or absence of dispensatory construct at the low population sizes affects significantly where the best cutback point might be when the population is in abundance. And my recollection, if that work's been done, it wasn't sensitive, but I'd have to refresh my memory on what -- there's been a significant amount of sensitivity analysis been

done on the model by the people who have been working on it. Some of it's available in reports and others are in gigabytes of data that I have sitting on my computer that I haven't been able to figure out how to look at.

Q So if I can put it in layperson's language, is it your -- would you agree that the dispensatory effect is not a particular concern because the model is being used to evaluate harvesting decisions and escapement decisions and there's already -- the interim benchmarks already require no fishing at low levels so that you're not going to be making a fishing decision that would be impacting or creating a dispensatory effect, something like that?

MR. STALEY: Under the assumption that the dispensatory effect is occurring at very low population sizes.

Q Okay.

MR. STALEY: And I mean, if we look at the stock and recruitment data from all of these populations, there's very little statistical evidence for that dispensatory effect. That's because there's a lot of noise around the data in that lower area, in part, or it may be because it is or isn't there, and it's hard to distinguish those alternatives.

Q All right. Mr. Morley?

MR. MORLEY: I mean, I have to actually agree with my colleague, Mr. Wilson, on some of this because I think that, in fact, the unmodelled stocks, if they're not behaving the same as the modelled stocks, and they're at different population levels when we're talking about the application of these TAM rules that certainly, there could be some impact. And the issue here is that we're never going to know because we don't collect enough information on those unmodelled populations to understand that. And although I tend to agree that looking at the overall what we're trying to do in managing the four run timing groups, I would agree with what Mr. Staley is saying in terms of the situation.

Q All right. You say we're never going to know because we don't collect enough data on the smaller stocks. Is it the case that we collect spawning enumeration data on the very small stocks?

A We have some -- as I think you went through the

other day in terms of looking at stock assessment, that you do collect some visual surveys of all of these populations, but the reliability of the estimates is a lot lower than some of the more accurate methods and certainly, the dispensatory impacts would probably be, as Mr. Wilson indicated, perhaps in a lake kind of environment and you do very little in terms of monitoring what's going on with the ecology in those ecosystem. So that's why I think you're not going to know a lot about it and we're not putting our monies into looking at some of the smaller populations which potentially, depending on how the Wild Salmon Policy is implemented, could have a significant impact on how you might want to manage the 95 percent of the fish that we all are involved in harvesting.

Q Right now, the FRSSI model, as I think you touched on, Mr. Cass, only models the 19 stocks for which the Department does have stock recruit data and a long time series. And as Mr. Wilson and you have both noted, there's a number of stocks in the watershed which are not accounted for in those 19 data sets that we have. So what is the mechanism by which FRSSI accounts for those small stocks for which there is no time series for stock recruit relationships?

MR. CASS: Well, there's a buffer built into the --

MS. BAKER: You need to put your mike on.

MR. CASS: Oh, sorry. Mr. Commissioner, as I touched on this morning, there is a buffer built into the TAM rule by way that the fixed exploitation rate that's prescribed the large range of run sizes is in the low range of what the analysis on stock recruit would tell us in terms of productivity and the exploitation that it can withstand. So in answer to the question, there is a mechanism built in there to guard against over-harvest of less productive stocks.

Q This is the 60-percent maximum rate?

MR. CASS: Yes. Yes. Yes.

Q Okay. Mr. Wilson, what's your view on this?

MR. WILSON: Well, the TAM rules apply to aggregates of multiple stocks. So within an aggregate, there may be stocks that are relatively unproductive and stocks that are more productive. I don't think a rising tide lifts all ships equally in this case.

Some stocks, for example, the Adams, might come back very strong, and as a result, the entire aggregate is fished at 60 percent, notwithstanding Cultus for the time being. That could lead to a situation in which because we're only harvesting at 60 percent, we may have more fish on the spawning grounds in the Adams than we might like, but other stocks would have escapements that are far below the levels that we would like to see to protect them from extinction and to ensure that they're not listed. So it's not clear to me how aggregate escapement goals applied to a mixture of stocks with different productivities necessarily protect the weaker stocks from over-harvest.

Q Okay. Mr. Staley?

MR. STALEY: Well, I think there's two quite different types of stocks we're talking about. One is the ones that are modelled that are in the current FRSSI model, but are part of an aggregate for which an aggregate TAM rule is being applied. In those cases, it's my understanding that the performance measures that are used to sort of look for inflections on one of the graphs you showed, where the choices of the cutback points, there were slight inflections in those performance measures. Some of those performance measures are the probabilities or likelihoods of individual of the modelled stocks that are in those aggregates falling below some benchmark. So to a certain degree, the existing construct sort of accounts for individual stocks. If your performance measure is that one or two or some individual stocks within the modelled stocks within that aggregate don't fall below some threshold, and that's your performance measure, then the TAM rule, appropriate TAM rule would be obvious from those -- the kinds of graphs you were looking at earlier.

The other issue is the ones that -- stocks that are not represented and I guess there's a couple of things you might say to that. One is that the 60 percent, while albeit a somewhat arbitrary number, it's at the lower range of what, in general, we believe the sockeye stock's productivity on a coast-wide basis would sustain, at least at some level. Those that are still with us now and who are with the -- have sort of

average productivity or recent productivity would probably still be with us after a regime of 60 percent for some time. That's the sort of general rule of thumb.

That being said, you know, we've experienced a decline in the productivity and perhaps, you know, the world has changed and 60 percent may or may not be still appropriate, but that's related to the -- but I think there has to be a distinction between those populations that are not included in the analysis from those that are included in the analysis because the current analysis does address at least the potential for one of the model stock, one or more of the model stocks in an aggregate falling below some benchmark.

Q All right. Mr. Morley?

MR. MORLEY: I don't have anything to add to Mr. Staley.

Q Okay. So you talked about using a 60-percent ceiling as a buffer or to create some protection. What about using a proxy stock? Has that been considered, using a proxy for some of the stocks that we don't have a good time series of data for? Mr. Cass?

MR. CASS: We have, Mr. Commissioner, entertained the notion of a proxy stock which would represent, or the intent was to have it represent a less-productive stock, for example. So the model does have the capability to model proxy stocks with the idea of looking at the impact on that stock, even though we may not have stocks representing the low productivity that the proxy would be designed to do. It's one way to look at how the model deals with a fictitious stock, if you like, that has the properties of a low productivity stock.

Q And how would you know what the characteristics of that fictitious proxy stock would be?

MR. CASS: Yeah, I mean, that's the rub, of course, is if we don't know what the range of productivities are for the full suite of CUs, say, then you're forced to make an assumption about what the proxy should be representing. So you know, my view is in the range of populations that we're seeing now, you know, Cultus falls in the low range with, say, a mean productivity rate in terms of exploitation might be 50 percent. I'd have to look at the

numbers. So that might be some lower range that you might want to attach to a proxy stock.

And I honestly am not sure where that work has led. I mean, others may know about it, but I do know that we entertain the idea of a proxy stock, but I'm not sure if it's followed through or continues to be one of the bells and whistles that we have in the current version.

Q Okay. Mr. Wilson, do you think a proxy stock would be a reliable or a useful way to understand the impacts of the stocks we don't have a full data set on?

MR. WILSON: Well, I agree with Mr. Cass, the problem is how do you, if you'll pardon the jargon, parameterize this proxy stock? How productive do you think it is and what is the carrying capacity of its habitat? You have to make some assumption about those things if you're going to put it in the model as a proxy stock. So I think it's a useful way to provide general guidance about what might happen to a stock of any particular low productivity under a long-term fishing regime, but it doesn't necessarily protect you from the downside risk of driving small stocks to extinction if they're not in the model. Your proxy stock will be as productive as you say it is and since you have no data, you simply have to pick a number and that's my concern about the whole approach to managing unmodelled stocks within the FRSSI process.

Q Mr. Morley?

MR. MORLEY: I mean, I agree that the proxy stock will only be as good as the assumptions you put into what the productivity is so I don't think it's particularly instructive in terms of moving us forward or --

Q All right. Mr. Staley?

MR. STALEY: All the caveats that the others have said about parameterizing an unknown stock are appropriate and -- but it occurs to me that one of the places -- and this may be a piece of work that needs to be done, would be to search for, you know, the types or levels of productivity of a so-called virtual stock or a proxy stock that would not be sustainable. So how unproductive do stocks have to be that would not sustain the kind of exploitation and mortality that's in some of these

TAM rules, such as the 60 percent. That would be an informative thing to do, and then it would be up to a group of experts, perhaps, to sort of think broadly about how viable those stocks may be anyway, and that sort of thing. Thank you.

Q Has any work been done in that respect with this model, or has that been a proposal that's been considered?

MR. STALEY: That has been -- I don't know of any work that's been done with it. I know that was briefly discussed when the capacity of putting a virtual stock in the computer model was discussed, but I don't believe any work explicitly on that, and, actually, it just occurred to me today.

Q We've talked a few times about the TAM rule, the 60-percent ceiling, and my question is whether -- we've talked a little bit about where that came from. Mr. Cass has talked about that, but my question is whether that is an appropriate ceiling in years where there's a very large abundance like 2010 as an example. And let's start with you, Mr. Cass.

MR. CASS: Well, you know, I mean, these things, Mr. Commissioner, are case specific and in the perfect world, I guess, where you knew what the optimal escapement would be, then perhaps you could manage to that, but in the world of mixed stock fisheries, in particular what we saw in 2010, where Cultus, for example, is mixed in with the very abundant Late Run group, then you have to ask yourself about how you trade the biodiversity, the conservation issue off with a reduced benefit to the harvest sector and a potential for too many fish on the spawning grounds for future production. So there are -- certainly, the model could be adapted to constrained escapement at some level. It's your case-by-case world in mixed stock fisheries that may have impacts other than on large populations.

Q Do you agree, then, that the 60-percent level should be reassessed, then, on a yearly basis in relation to the different aggregates to see what is the appropriate ceiling, rather than --

MR. CASS: I think that is a healthy exercise. I think that research to look more at where we are now, given the uncertainties, and I think it's worth a review of the cap.

Q All right. Mr. Wilson?
MR. WILSON: Well, it's a matter of compromise, isn't it? On one hand, we can fairly quickly evaluate the economic benefit of fish that are killed in harvest and sold. And the future production benefit of putting a spawner on the spawning grounds, we evaluate through our view of stock recruit dynamics, the so-called Ricker curves or Larkin curves. But that said, there's also a whole host of benefits that can come from large escapements that aren't captured by the model or evaluated in any way. And by this, I'm talking about the nitrification of freshwater ecosystems, the benefits to the zooplankton populations and even salmon. Salmon, in fact, benefit substantially from the nutrients their parents bring to the watershed and some authors have suggested that both the care and capacity and productivity of stocks can be influenced by the escapement strategy, in particular, by allowing larger escapements to provide nutrients to support the entire ecosystem. Those benefits are not included. But I do agree that it's a conversation around values that we all have to have. So not all values are captured by the models and not all values are equally well quantified in terms of dollars and sense.
Q Well, the question was -- your evidence is helpful, without doubt, but the question was really whether the 60 percent is something an appropriate level, does it provide enough buffer and it should be maintained going forward, or is it something that should be looked at an reassessed and perhaps changed for the different aggregates in any given year?
MR. WILSON: I'm not confident that a 60-percent exploitation rate will be protect weak stocks and unmodelled stocks. There is an argument to be made that more than 60 percent of some stocks in strong years can be harvested without facing a penalty in terms of future production. If your primary focus is yield, then there would be reason to reconsider these TAM rules. If your major objective is conservation of all stocks and protection of weak stocks, there may be times when very large returns should not be harvested at 60 percent. So I'm struggling with a way to provide

a general answer to something that can really only be evaluated in the specific context.

Q All right. Mr. Morley?

MR. MORLEY: I guess I have a -- I agree with Ken in the sense that one of the drawbacks in the entire FRSSI model in my opinion is that it is trying to develop -- it's a simulation model based on sort of looking forward 48 years and applying some very general rules that if you had them in effect for 48 years, that this is what is likely to happen. And that in reality, we don't make decisions on harvest or escapement for 48 years, we made a decision every year based on what is coming back. And in fact, those decisions need to evaluate the consequences of adjustments to that even within season depending on the relative strengths or the runs we see coming back. So there are tradeoffs to be made of the kind that Ken talked about in terms of evaluating them, but those evaluations need to be done in a dynamic sense as you see the actual -- because the trade-off may be very different when you're potentially giving up 10 million fish in order to put an extra thousand fish on the spawning grounds for a run that is somewhere in the 20,000 range. But if it's putting an extra 1,000 fish on the spawning grounds on a run that's down to less than 100, maybe there's a different impact there, it's a different weighing of those values. And that can't be done in a simple application of a rule for 48 years. And that's one of the drawbacks that I'd like to get into in more detail.

The other issue here is that we keep talking about exploitation rates and we're not -- it's a total allowable mortality rate. So our exploitation rates are -- given what we're assuming about en route losses and en route mortality is that our exploitation rates are very much lower than that in the vast majority of cases. We're not harvesting anywhere near 60 percent.

Q Right.

MR. MORLEY: And we're harvesting more in the 30-percent range, and sometimes we might get up to 50, if we're really, really lucky, but most times we're way, way well below 60 percent.

Q Can I just ask you if your first comment that you

made, it's really a reflection on the fact that the FRSSI model creates pre-season harvest rules and is your comment really that those rules need to be more flexible in-season, that you can't -- not only can you not project a rule forward for 48 years, but even to make a rule hard and fast in the spring may not be the right rule by the time we're in the end of the summer? Is that the point?

MR. MORLEY: Both cases, I think, are important.

Q Okay.

MR. MORLEY: That you need to evaluate it based on the expected returns and the makeup of the populations in any given year, what cycle of year you're on, those kinds of things, relative to, again, the returns that are coming back from all the populations. And even within season, if we set these fixed rules for each of the run timing groups and, again, the relative strength for the run timing groups may provide a different kind of trade-off decision in the middle of the season than you thought it was going to be at the beginning of the season and we have been stuck with some fairly inflexible rules in the past that have hamstring -- and really have provided any huge additional conservation benefits to stocks that are at risk but have certainly prevented some significant harvesting opportunities for all of the user groups.

MS. BAKER: Mr. Commissioner, I wonder if Mr. Staley could answer this question and then we'll stop for the break.

MR. STALEY: Maybe you could repeat the question?

Q My question was whether the 60-percent ceiling is a ceiling that should be in place even on high-abundance years, and I used 2010 as an example.

MR. STALEY: Well, I think that the -- whatever the cap is, it's currently 60 percent, is there regardless of the abundance. It's purpose is to protect components or populations that are not abundant and not strong, and which we suspect are there and we may not have hard evidence to show, but we suspect there are smaller populations and weaker populations that are mixed in. So I don't think you'd want to change it just because of the run size. In fact, you know, the analysis is done on the assumption that the analysis includes

occurrences of very strong run sizes, as well as very weak mixtures in the FRSII model, as it's constructed.

That being said, you know, I don't know whether 60 percent is or isn't the right number. It's a number that was chosen and I expect it should be reviewed in an informed way with a fair amount of discussion. But the other side of it is there are, you know, as with the changing nature of the fisheries, there are opportunities to harvest some of these surpluses, for lack of a better word, in places where the mixtures aren't quite the same or strong. And so the FRSSI model, unfortunately, only has one fishery and one time and doesn't represent the sort of suite of possible responses that a management -- that could be used to access unexpected abundances like we had in 2010.

Q Thank you.

THE REGISTRAR: The hearing is now adjourned until 2:00 p.m.

(PROCEEDINGS ADJOURNED FOR NOON RECESS)
(PROCEEDINGS RECONVENED)

THE REGISTRAR: Order. The hearing is now resumed.

MS. BAKER: Thank you. Mr. Commissioner, you'll recall when we started with this panel, I didn't have a redacted copy of Mr. Staley's c.v., which we now have. And we had flagged Exhibit 401 for this c.v., so if that could be now officially marked, that would be appreciated.

THE REGISTRAR: So marked.

MS. BAKER: Thank you.

EXAMINATION IN CHIEF BY MS. BAKER, continuing:

Q All right. Just before we broke, we were talking about the TAM rule and the 60 percent ceiling. And I want to -- I don't want to talk about that particular piece anymore but I do want to talk about the TAM rules and ask you a question around their appropriateness of TAM rules being developed for each run-timing group. Right now, the way the FRSSI model is run and the way the IFMP is developed, there is a TAM rule, TAM harvest rule, developed for each run-timing group, which, as we

know is an aggregate in many cases of various stocks. So my question is, is that the right way to make management decisions? Should the TAM rules be formulated for the run-timing groups, as we know them, or should they be created for a smaller, a finer resolution, perhaps on a different aggregation of stocks or a CU level or should all of the stocks be run together and a rule be developed -- one rule for all of the stocks in the system? So I'll start with you, Mr. Morley.

MR. MORLEY: Well, Mr. Commissioner, I think that the -- with the extent of overlap between the run-timing groups, that it is difficult having a separate TAM rule for each of the four run-timing groups. I know that some of my colleagues here are going to suggest that we should be looking at separate run-timing rules for each of the individual conversation units and I'll let them speak to that. I don't think that's at all practical, if you want to have any kind of a fishery in a mixed area, which is where 95 percent of the fisheries, First Nations and recreational and commercial take place currently.

But I do think that we could, in fact, look at simplifying things a little bit because although Early Stuarts are probably reasonably separated from the other run-timing groups, the extent of overlap between Early Summers, Summers and Lates has, in many cases, been increasing in recent years and it makes it very difficult to operate separate TAM rules for each of them and that we could perhaps look more at TAM rules that would apply to time periods rather than run-timing groups that if you wanted to fine-tune it a little bit you could have one that operated for a two or three-week period then change it for the next two or three weeks and then change it for the next two or three weeks. But that could identify some of the issues between the different stocks.

But I don't think that having -- that the current problems with the overlap is causing us to lose some production in terms of yield for all the fisheries and really when we are not creating any significant conservation problems for the one whose run-timing rule at that time period is ruling the day in terms of managing the fishery.

So I do think that we could simplify a little bit more from what we currently are and have something that would meet conservation goals as well but provide for better opportunities for yield.

Q All right. Mr. Staley?

MR. STALEY: I'm not as certain as Mr. Morley is about what the appropriate aggregation/disaggregation should be. To date, I don't believe there's been -- although there's been a lot of sensitivity analysis done, I don't think we've actually -- the model's been actually challenged or the process has been challenged with exploring all the various combinations and permutations of aggregation and disaggregation yet. That being said, I don't think -- well, the FRSSI -- the calculation framework that's in the model right now only has the capacity to deal with one fishery at one time per year. And so it, by design, I guess, reflects a single, mixed stock area.

There's been attempts to try and disaggregate a little bit by having some approximations to overlapping timing represented on the annual time step but it's been -- they are only, you know, approximations. So as I said, I'm not certain at this point. I don't think I can answer that question one way or the other. I suspect that there is value, certainly from the conservation side of things and probably, if they were to consider having the types and locations of some of the fisheries that are represented in the model changed so add more fisheries and so on, there might be some utility in exploring a more disaggregated set of management groups.

One of the other issues with the current set of management groups we have is that they were established with a certain set of assumptions about timing and distribution. And one, either that timing and distribution has changed in reality, or our ability to observe it has changed. Certainly, our ability to observe it has changed in the sense that we're now using DNA as a stock identification tool, as opposed to the scales that were used prior to, I guess, the turn of the century. And the consequence of that is that, I think, there's probably room -- whether there should be four or not, probably the current set of four may not be the most appropriate set of four.

There are stocks within some of the current management groups that are quite separate from the other members of that group in both timing and geography. So I think some more work needs to be done on that and I guess at the end of it I can't answer the question one way or another without doing more work.

Q When you said that right now the model only can deal with the one single mixed stock fishery at one time, do you mean -- are you describing one run-timing group at one time? Is that what you're indicating?

MR. STALEY: Whatever the aggregation is --

Q Yeah.

MR. STALEY: -- it is only fished together with all the other members of that aggregation --

Q Right.

MR. STALEY: -- in the model construct.

Q So there's not a concept of having them overlap or the model can't run the overlap effectively; is that what you're saying?

MR. STALEY: Well, as I say, there's been an attempt to approximate the overlaps and it doesn't represent the sort of richness the decision-making that can go on in-season to try and separate stocks or the information that challenges people in-season. So while it may be a useful sort of guide or indicator, it's not going to, you know, really get at what the costs and benefits are of various aggregations and disaggregations. There needs to be some more detailed work on an in-season basis. And trying to replicate that in-season over the many seasons that this longer-term view has to accommodate. And that's work-in-progress, as far as I can see.

Q And just one final question for you on this. If the models were run down to a very small, fine level, like a level of CUs, for example, would you have the same problem that those CUs are not running independently; they're running in a mixed stock run all the time? So would you continue to have this problem of knowing what stocks -- or what the impacts of stocks running together at the same time?

MR. STALEY: Well, I'm not sure if you're talking about the modelled world or the real world.

Q I'm talking about if the model could be run not

for an aggregate but for an individual CU or an individual stock, I take it you would still run into this problem of not being able to understand the overlap of that stock or CU with other stock runs with at the same time.

MR. STALEY: You wouldn't be able to replicate it completely. You could certainly scope out or expose the regions of where there may be some advantages to complete the segregation and where there's no difference if they are aggregated from a management perspective. In terms of the performance and conservation performance, yield performance, catch performance, measures that Mr. Cass talked about earlier, you'd want to look at the response of those to -- the sum of the responses of the individual groups, as compared to the response of the aggregate to those groups and see. If there's a big difference, then it's important to disaggregate.

Q All right.

MR. STALEY: If there's not a big difference, then it's not so important.

Q All right. Mr. Wilson?

MR. WILSON: I agree with Mr. Staley's comments. My concern is that within the modelled world, a fishery takes the same proportion of each of the constituent stocks but in the real world that's not the case. And as you correctly point out, it's not the case because the timing of migration and other behavioural characteristics in the location of fisheries can cause the harvest of a higher proportion of one stock than another even though they're part of the same timing aggregate. And that places the stocks that are less abundant, in my view, at risk.

Q Mr. Cass?

MR. CASS: I guess the only thing I have to add from what's already been said is, Mr. Commissioner, to disaggregate them all, you know, down to the CU level. And you may want to check with the Salmon Commission staff on this but from an in-season management point of view, the resolution on some of these small stocks where there's an assumed large number of them, or at least management is focusing on all the stocks independently, the stock ID error, as I said before, is something that needs to be considered. You know, so that's

an example of some practical issues that you need to take into account. But I thought the issue was -- I agree with my colleagues here.

Q What about modelling -- instead of having the four aggregates, all of the stocks together in one big aggregate; is that a --

MR. CASS: So one TAM rule.

Q Yeah.

MR. CASS: One TAM rule that covers all stocks. Yeah, not been tried that I'm aware of. You know, it becomes a harder problem in trying to then post-season, if you like, evaluate how well you've met your escapement targets because those are CU-based. And so one TAM rule to fit all -- I'm assuming now without having done the work and I agree with Mike that this is an area that could be explored, this issue of timing and how much the information can actually help you, what data do we actually have, needs more work. Yeah, I think the work needs to be done. I think trying to manage to a single TAM rule is the resolution there to do that. I couldn't answer that question without...

Q Mr. Morley, you touched in your answer on some of the practical issues in managing to a selective CU harvest. Could you elaborate? Do you think that is a practical -- is it possible to manage to a CU level?

MR. MORLEY: Well, taking into account two things. One, that Mr. Cass just went through, which is the question of being able to differentiate individual CUs when you're in certain areas given that some of these are so small that in test fisheries or in any kind of data generation sampling, that you're unlikely to find a representative enough size of sample to, in fact, find out what you've got in many of the individual CUs and put that together with where most of our fisheries currently are. I think that would mean that if that was your objective, to set a TAM rule for each of the CUs and that you wanted to manage that, that would mean that you would have to do it in a place where you could identify the individual harvest and distinguish them enough which, in my opinion, would be when they were essentially separated from each other given some of the small CUs.

So you would have to only implement that rule when you could find them separate, which would be

when the fish were on their natal stream spawning grounds. So that the only fisheries that you could manage under that regime would be ones where, in fact, you were fishing when the fish were completely separate on the spawning grounds. We don't really have any fisheries that match that at the current time to any great degree. And so you would be basically shutting down all of the fisheries in Johnstone Strait, the lower river and Sto:lo area. In fact, until you got essentially onto the individual stream spawning grounds.

Q And have you thought about whether there are any risk management issues, which arise comparing a mixed stock in the marine environment to a selective CU harvest in the river?

MR. MORLEY: The selective CU harvest is -- again, we would be developing a number of very new fisheries. Presumably, if you wanted to take advantage of the full yield, they would, in some cases, have to be fairly large fisheries. So you would have to have a whole new slew of assessment programs to evaluate the run sizes in those areas because right now we do not do in-season run-size evaluation for each of the individual populations. We wait until we see how many fish respond and we do an assessment of how many fish we saw on the spawning grounds to determine how many there are on each of those individual CUs. And we do run reconstruction based on sampling at the catches to make up the rest of it. If you wanted to manage fisheries on each of those CUs, you would have to do in-season run-size assessments in each of those areas. And that are brand new programs that would be very expensive to implement and would have, certainly in the initial years, a very high degree of uncertainty and a high degree of risk as to what actual levels of population you were measuring.

Q And the next topic I want to talk about is something, which has been called "stationarity". And I might have this wrong but perhaps you could just confirm for me, Mr. Wilson, is stationarity the concept that historical data can be used to predict the future so that we sort of look at the past and say that the assumptions that we can draw from analyzing past data will be consistent and valid assumptions moving into the future? Is that

a fair...?
MR. WILSON: I think you've captured the essence of it.
Q Okay.
MR. WILSON: But for the most part, our concern is around productivity and how productivity changes over time. These models actually assume that productivity is, in some way, stable because you have to make some assumptions about the relationship between past data and the likely out come of things in the future, if you're going to evaluate alternative policy. The concern, of course, is that when we look at Fraser Sockeye or any other biological system, for that matter, stationarity is hard to find. The world isn't a stable place and in many areas it's quite chaotic. And although you can fit a model to historical data, that doesn't necessarily mean you're going to be reliably predicting the future.

And that's a fundamental issue that we haven't, I don't think, adequately addressed, common filters or not. Trying to track changing productivity, particularly if there's a time trend through the course of your data where productivity is in relatively constant decline for some time period, you're left with the problem of what's going to happen if the trend continues? Will the trend break? At what level will productivity recover to and how long will it stay there? And those are all questions that you have to have answers for, if you're going to run the model 48 years into the future. And I don't believe we have answers for those things and it causes me to fundamentally question whether maximum sustainable yield is anything more than a theory.
Q Mr. Cass, what's your response to that? First of all, do you agree that the past productivity is an assumption of future productivity in the FRSSI model and, if so, is that a reasonable assumption to make?
MR. CASS: Well, I mean, as Ken pointed out, Mr. Commissioner, the world is non-stationary. As we know, things change. They change to varying degrees. The difficulty is, of course, in predicting long-term let alone the short-term. And the approach that's been taken is to go down the track of, as Ken mentioned, common filter, which is a way to track productivity over time.

But it's tracking productivity that we've already seen. And so the notion is that, okay, if we are in a period of productivity that differs a fair amount from the overall historical trend, then perhaps we could use that tool or other tools that identify or estimate productivity for a more recent period and then use that as one scenario, if you like, to project forward into the future.

And of course, that's a way to hedge against, you know, low productivity continuing into the future, is to use a period of productivity in history to give you some bounds about what you think -- or some plausible scenarios that might play out in terms of future productivity changes. But as I think I heard Ken say, even accounting for what you might think are plausible changes for future productivity based on historical information, we don't know how future productivity is going to play out. So all you can do is create scenarios. What we've done anyway is create scenarios that we are hoping would bound future productivity changes and then assess, based on a model like this, what's the impact or how rigorous or how sensitive are those future scenario productivity changes? How sensitive is, in this case, a TAM rule or is there a TAM rule that's robust to what we think are the reasonable ranges of productivity in the future? So it's a difficult challenge to do that.

But we have come from a period where we have assumed the entire 50 years of historical data on Fraser Sockeye, likely representative of future outcomes. We have come from that particular base case scenario, if you like, which has been applied, to a lot of thinking around now about how do we create scenarios -- future scenarios that account for changing in productivity in ways that might bound it or at least some characteristic trends that we might see. So that's a hot area not just in this FRSSI world; a hot area more directly in forecasting. And also in the work being done on WSP benchmarks where benchmarks themselves are linked to future states of productivity, future states of nature because they're linked to, Ken mentioned SMSY.

They're linked to where we are, what's the state relative to, say, a healthy population? And

so that's state may change over time. So the benchmarks and those indicators that measure healthy populations are, in fact, changing. So it's an area of interest and research but very challenging to predict the future. The only thing we really can do, I think, is evaluate TAM rules, to look for rules that are more or less robust to the way we think things might play out in the future.

Q Mr. Morley, do you have anything to add to that?

MR. MORLEY: The only thing I have to add is that, if, in fact, we assume in the modelling here that the productivity is higher in the future than it turns out to be, that what that does for the course of this modelling is to allow us, or, in fact, lead us in the direction that would put the benchmarks higher than they would be in the low productivity scenario. So in fact, the TAM rule on the modelling process results in a situation where if you think it's going to be more productive then you're willing to put more fish on the spawning grounds because you're going to get more back from it. But if it turns out to be less productive and the run comes in lower, the TAM rule is such that you, in fact, harvest at a much lower rate. So the kind of feedback mechanism that we're talking about and robust rules is built into this model to a certain extent already in the sense that if the productivity ends up being lower, we actually are going to be harvesting under these TAM rules that we're delving in now, at a lower rate than if we had developed TAM rules with a lower projected productivity expectation. So there is some built-in conservatism already in the way these rules are constructed that deals with a significant part of the concern that Mr. Wilson is identifying.

Q Mr. Staley?

MR. STALEY: I like to think of it not as much are we trying to predict the future; that we're trying to find a control rule or policies or TAM rules, which are more robust to whatever future we might face. And by robust in this case we'd mean of a set of alternative TAM rules does the sort of rank order of those TAM rules, it's almost independent of what the future might bring. That would be a very robust TAM rule, if it was the best one no matter what happened. And so that's the search

that we really are under, not the search to be able to predict the future better or worse but to be able to find a set of actions that we can put in place that can be responsive and be the best set of actions or the better of the worst, I guess, regardless of whether we're in a productivity regime that's growing or shrinking or staying the same.

The extent to which the current model and the use of it to date has been successful at that, I think it's modest success. Some of the things Mr. Morley raised are appropriate. There's a fair amount of conservatism in the TAM rules we have that have been in play for the last cycle of salmon than there were for several decades in the latter part of last century. And so at least, if we've made an error, we've erred a little more towards the conservative side than we might have otherwise been. But I think our search is for the rule that will be the best rule no matter what the future is, not to be able to predict the future with any more accuracy than anybody else can.

THE COMMISSIONER: Could I just ask a question? just following up on that? I'm not sure I can articulate this adequately and I apologize for that in advance. But in the binder I have, and it probably appears in other places, but at Tab 1, again, I apologize, Ms. Baker, I'm not sure what the exhibit number is for that.

MS. BAKER: It's 396.

THE COMMISSIONER: 396. It's on page 1, Mr. Lunn. I think it's under "Introduction". Just after the first two paragraphs, which introduce the subject matter, and then it starts off:

> This modeling framework is intended to help assess the following questions.

And maybe I'll try and make this, for me at least, as simple as I can to ask you this.

> For each stock and stock aggregate, what are the optimal harvest rules given different management objectives and assumptions about population dynamics?

Just so I have some understanding where each of

you are coming from when you answer the questions of Ms. Baker, are you all on the same page about what is an optimal harvest rule? In other words, in the weighting of your answers, are some of you coming at it from more of a conservation perspective than others? Are you giving the same weight when you answer these questions to conservation versus harvest? Maybe there's a definition section in this document, which says was an optimal harvest rule but frankly, I'm not sure after hearing some of your answers that I really understand what an optimal harvest rule is.

MR. CASS: I can, Mr. Commissioner --

THE COMMISSIONER: Your mike is going to have to be on, Mr. Cass, I'm sorry. Your microphone.

MR. CASS: I'm sorry. I think you're right to point out optimal is different in different people's views. Optimal is only optimal given a set of conditions. So if the history of the numbers of spawners and the subsequent recruitment from that are in, say, the green zone, to use the WSP vernacular, then optimal might mean to maintain a harvest rate that keeps the population in that zone. But there may be optimal in the sense of optimal to account for or to hedge or provide a buffer against some of the knowledge gaps such as stocks that aren't in the model and are unproductive, optimal in the sense that we don't quite -- we know that estimates in-season of run size are uncertain so what's optimal to guard against errors associated with uncertainty in run size or optimal in the sense of given errors in the ability to, even if we knew run size perfectly, as it has been explained by some, to be able to hit the bull's-eye even though we know what the harvest rate should be given perfect information that there's going to be errors in the way we implement the harvest of a stock.

So optimal can be relative terms. It is used in fisheries science many times to mean that it is the harvest rate that maximizes the long-term sustainability of the population. And so in the FRSSI world, we have a 60 percent harvest cap and, as I mentioned, it's designed because of some of the knowledge gaps related to the number of stocks that we use in the model, uncertainty in run size, uncertainty in being able to hit the actual

harvest rate that we are trying to make. So that's the classic use of optimal.

In the FRSSI world, though, because we are developing a TAM rule that is conditioned on performance indicators, the performance of avoiding low populations with some frequency, the avoidance of falling below catch with some frequency and potentially the ability to stabilize catch. So optimal in those senses could mean different things. So I've gone on enough. I suppose I'm just trying to categorize what optimal is under certain circumstances. And certainly optimal changes with changing productivity over time. So if you're in a long-term low regime, the optimal for that particular regime could be different and would be different than for a stock that's in some other regime, to use the word. So it needs to be probably better described than what's in here maybe.

MR. MORLEY: Mr. Commissioner, going back to your more direct question in terms of different values between different people, I certainly believe that to be the case. And aside from all the technical aspects of optimal that Dr. Cass has identified, certainly the key item in that phrase, from my point of view is what your management objectives are. And certainly, your definition of optimal might be different between Mr. Wilson and myself. Mr. Wilson may, not putting words in his mouth, be more concerned about preserving every one of the conservation units and the genetic diversity in terms of his view of sustainability, whereas I, coming from my perspective as a user of the resource, might be more concerned about a balance between long-term sustainability of the total population and also trying to find some way to maximize yield over time. So in terms of optimal in the context here, I think was trying to balance both those kinds of objectives in determining what an optimal TAM rule might be.

Q Did you want to add something, Mr. Wilson?

MR. WILSON: Yes. I agree we all bring different values to this table. And those values will change the way we view the optimum solution. If you believe that conservation is our primary obligation and that each and every CU needs to be conserved, you'll take a different approach than

if your primary obligation is to sustain a commercial fishery. As I understand it, we have a clear commitment to conservation under the Wild Salmon Policy. We need to address that obligation. We have obligations to First Nations, which are not necessarily adequately addressed within the context of the FRSSI model since stocks from large geographic areas can all decline at the same time.

We can still meet our escapement goals but we're not fundamentally honouring our commitment. Those values all need to be expressed and addressed in the process of setting TAM rules for stocks and aggregates. And it's my concern that they're not so I think it's absolutely true that we bring different values to the table depending on where we're at. Most of the people at the table harvest fish. That's what they do. If you don't harvest fish, then your optimum solution might be quite different because you'll value other things. You'll value the opportunity to go look at the spawning grounds full of fish in the Shuswap or you'll value First Nations' catches in remote areas of the watershed. And different TAM rules will accomplish those objectives to a different degree and will weight the solution different ways.

Q Mr. Staley, I think you're the only one who hasn't had a kick at this can.

MR. STALEY: Yeah, I guess so. Yes, I agree with Mr. Morley and Mr. Wilson that we all have different values in this. But this question or discussion is more instructive about what Mr. Cass set out -- or this morning was discussed as the two components of the FRSSI. One is basically machinery that tries to replicate the best we can what the natural world may or may not do. And the other is how to gather the people that are going to be affected by that and articulate their interests and try and balance their interests.

And so in that context, I think the optimal harvest rules, given the different management objectives, are exactly those different management objectives we've just heard between Mr. Wilson and Mr. Morley and others but balance those against the various kinds of possible population dynamics that are out there and try and find a set of

responses and management controls that both maximize those are optimal in the sense that they maximize some weighted aggregate of the values

And the FRSSI process, we heard about some workshops earlier this morning, well, some of those workshops were explicitly there to try and quantify some of those weights and trade-offs. And how successful that is, is, I think, still for a matter of discussion and review. But you're quite right that those of us at this table probably all have different weights that we put on the conservation pieces, that we put on the catch piece, albeit that the catch and the conservation are intertwined.

THE COMMISSIONER: Thank you.

Q I was going to ask some questions about this area and I think maybe I'll just move ahead to those now and it touches on some submissions that we have heard at public forums as well. So I'd like to talk a little about some of the trade-offs that have to be made and I think that's another way of talking about the balancing of interests that we've just been discussing. I take it everybody would agree that, as part of the planning process, it's important to consider where those trade-offs are made between biodiversity or conservation and sustainable fisheries. That seems to be a given. Is there anybody who disagrees that that's an important part of the planning process? Nobody's speaking up so I'll take that as an agreement with me.

So the FRSSI model, as I understand it, has been designed to allow for some explicit discussions on those trade-offs. And that happens in different venues such as the Integrated Harvest Planning Committee, meetings with groups and just an interpretation of the options that are set out by the FRSSI model. How should decision-makers be making those trade-offs? Ultimately, it's the department who produces an Integrated Fisheries Management Plan. How should the department or decision-makers evaluate and make those trade-offs? And I'll start with you, Mr. Morley.

MR. MORLEY: Well, I think that the department needs to be much more explicit in terms of doing some evaluation of, as much as they can, the financial costs and benefits, as well as the social

implications of the various management scenarios that are available to them. And frankly, the process that has been undertaken in terms of FRSSI on this issue, I think, has been very deficient and it's not very good at any of those things. And if you could perhaps bring up Exhibit 322, page 15 again, I can kind of through an example here and explain. It was what Dr. Cass was on this morning and those two graphs that are on that page.

The process that has been described in the FRSSI process was that you get a bunch of stakeholders in a room and the model is here. I've tried to develop some kind of objective function that they can plug into this model that will sort of solve the equation for this social trade-off based on a group of people in a room defining their preferences. And that's resulted in this kind of a table. And you got sort of the -- ignore Option 1 on the bottom there because it's kind of a non-option because it's not evaluated at the top. But if you look at Options 2, 3 and 4, they describe very different TAM rules that have come out of this process.

And the performance indicators that the model has used based on this surveying of people, there's three lines graphed above. The bottom dotted line is the probability of the four-year average level spawners being lower than some lower benchmark. And the second line up is the probability that any individual year is lower than that lower benchmark. And then the top line is this so-called probability of whether or not the catch is lower than the low benchmark of a low catch benchmark, as being the evaluation from a catch or a yield point of view.

My problem with the way it's done in this process is that the interesting thing here is that, number one, Option 2, 3 and 4 perform almost identically on the two so-called conservation objectives. There's no difference in those options between them in terms of significant difference as to probabilities on this evaluation. There's a very small change in the low catch one. It does, in fact, if you've got a higher spawning goal like in Option 4 and you're cutting back your harvest at lower levels of run sizes to achieve

that, then clearly you're going to catch a little bit less from time to time. But none of those evaluations really look at what happens in-season. So we're making a decision on Option 2, 3 and 4 based on that kind of input. But if you look at what might happen in-season, there's a huge differential between choosing these options.

If you go down to the bottom graph, if we had decided, as a group, that Option 4 was what we wanted to take, and if the run size came at 200,000, you, under the TAM rule, your total level of mortality would be somewhere in the range of 20 percent. But if you had chosen Option 2, your TAM rule would be 60 percent. So if the run size on this particular run, and we're just using Early Stuart as an example here, then you were talking about at a 200,000 run size, a difference between potentially harvesting 120,000 or harvesting only 40,000. And the value of that in terms of all the harvesters, in this case, given the allocation framework for Early Stuart, these would be all First Nations harvesters. There'd be no commercial harvest on this at all. And yet we're at a situation where the FRSSI process has basically said there's no difference between those options. And yet I think when you look at in-season as the decision to be made here, there's a huge difference in social benefits to a large group of people. And yet, going through the FRSSI process, it leads you -- I mean we can't make that decision. And the actual evaluation of what you're achieving in terms of harvesting those different rates in-season needs to be looked at. What are the values to incomes to First Nations fishers in Johnstone Strait, to gillnetters in the lower river, to First Nations economic opportunity fisheries in the river to First Nations very important FSC fisheries all the way up the river?

That evaluation is not done in the context of analyzing these escapement goals. And once we set these rules, currently, they have been extremely inflexible in-season. So we're stuck with them. And so I just think that the kind of economic evaluation that lays out these numbers in dollars and cents and in benefits to people has got to be done more explicitly and in the discussion and evaluate it then, not just someone going into a

room and putting a little tick beside a box so that a modeller can develop an objective function, which is essentially what has been done so far.

Q And how would you see that kind of socioeconomic analysis being done?

MR. MORLEY: Well, first of all, you've got to include economists in the process. And they don't do that currently. The department has got a serious lack of in-house people who can actually do this work and do the evaluation. You have to actually go out and find out what incomes people are making in the fishery, what additional catch means to their income and means to the communities they live in and that kind of economic analysis of what's going on in the fishery, again, has not been done for many, many years.

Q Do you think that the people who participate in the IHPC or the different harvest sectors that meet individually with the department can provide enough information on those fronts?

MR. MORLEY: If the people who go there can provide their personal point of view. But what we need in addition to the information they provide is a professional evaluation from a socioeconomic directive, someone who can go out and, as far as possible, boil these things down into, for example, a treasury board cost analysis, that would be to acceptable, professional standards, as well as bringing in some of the environmental variables that you can actually quantify some of those and look at the scenarios and say if we adopt Option 3, for example, we can anticipate this level of income and this level of environmental benefit and this level of social benefit.

If we adopt Option 2, then you get this level of income, this level of each of the other attributes we're looking for and compare those results in a quantified sense. Not just using stakeholders' opinions and not just a popularity contest or a political issue but something that's done, evaluated on a more consistent, technical basis from year to year.

Q If you could turn to Tab 2 of the binder before you? This is CAN002915. This is A Framework for Socio-Economic Analysis to Inform Integrated Fisheries Management Planning and Fish Harvest

Decisions. Have you seen this document before?
MR. MORLEY: The first I came to see it was, in fact, when I was reviewing documents as part of this Commission. I didn't know it existed until I saw that.
Q Okay. So has this been brought to your attention in any of the planning work that you've done with the department?
MR. MORLEY: No, it hasn't.
Q And have you reviewed this document?
MR. MORLEY: I have looked at the document, yes, and I think it's an excellent start in looking at some of the things the department should be doing in both objective-setting process in terms of spawning objectives, as well as evaluating different management plan alternatives for sure. If they implemented this in a professional way, it would go a long ways to deal with some of the issues that I've been raising.
MS. BAKER: Can I have this marked, please, as the next exhibit?
THE REGISTRAR: Exhibit 403.

EXHIBIT 403: A Framework for Socio-Economic Analysis to Inform Integrated Fisheries Management Planning and Fish Harvest Decisions

MS. BAKER: Thank you.
Q Mr. Wilson, can I ask you -- I know the question is probably a long time ago, but the question was something along the lines of, how should policymakers or decision-makers, excuse me, be making trade-offs in making the decisions with respect to trade-offs between economic interests and conservation interests and any other interests, such as First Nation interest, I suppose, that you brought forward?
MR. WILSON: How should they? Well, it seems to me that the way we've framed the problem is an attempt to maximize the economic benefits while we minimize the biological harm. So we're trying to harvest the abundance from strong stocks while we protect the weaker stocks as much as we can. But in many respects, that sets us up for almost a lose/lose situation so we're making trade-offs that compromise the biological health of the

resource in some cases and we're doing that in order to achieve economic benefits, or social benefits or some other set of benefits.

Buzz Holling put it another way. He said that really we should be looking for Golden Rule management. In other words, you do what's best for the fish in the hopes that over the long-term what's best for the fish will also lead to the best stream of benefits for those that rely on fish for harvest. We certainly need to be explicit about the values that are on the table and how we're going to weigh those values in making this compromise.

Q Mr. Staley, have you got anything to add on this topic?

MR. STALEY: Just from my experience of working with First Nations, I would like to offer that, to date at least, the approach to trying to gather and inform itself of the values and whatever trade-offs, if that's a concept that's -- the trade-off concept is somewhat difficult for many First Nations to absorb it, but I don't think it's done a really good job of it, to put it bluntly. One of the reasons is that within and among the First Nations, there's a vast divergence and diversity of interests and values, particularly when it comes to Fraser Sockeye. And I haven't seen to date a place that and a process that grapples with that diversity and represents it well enough to be balanced, if that's an appropriate approach with the other interests.

Q And Mr. Cass, what do you say to the criticism that the model doesn't adequately allow for trade-offs between socioeconomic interests and conservation interests?

MR. CASS: Well, I certainly would accept the idea that if the model does not match the reality of the world that is the -- what are the important economic factors that the model does currently not entertain? Then that's an area where we should be looking. It comes back to the values. You are struggling with, what's the common currency in terms of values? One of conservation and protecting biodiversity? There is a consequence to economics and social benefits from the system. So I think it's a healthy discussion to consider how more realistic you could make the model. But

you're still down to some choices about what are the key indicators? And one is I have not heard a criticism about, other than the details about where the benchmark should be, is the trade-off that considers what's an acceptable frequency with which you would fall below a particular benchmark? So that's a very explicit performance indicator is the number of times, in this case over 50 years or so, that the indicator falls below the benchmark.

If you want to weight that with, you know, some more balanced economic or at least some method that takes advantage of the current thinking about managing economics, then I'm for that. But I still think it's -- you know, the trade-offs are, in my mind, pretty clear. It's conservation/biodiversity versus harvest in an uncertain world. Maybe part of the problem is, or one of the issues is, stretching this out for 48 years in this case and knowing that the world is going to change fairly dramatically over that time. It gets back to the original intention of this process and Mike has brought it out a few times, which is trying to come up with the best set of alternatives that meet the objectives of the community and stakeholders and user groups at large. And so that's, to me, where the search needs but perhaps flushed out with a better way to include socioeconomic indicators or considerations.

Q The Wild Salmon Policy says that we need to maintain existing diversity. Has there been any discussion or evaluation by the department as to how much biodiversity is required to maintain a long-term sustainability of Fraser River Sockeye?

MR. CASS: The Wild Salmon Policy in words at least, it's articulation is to maintain and recover. So there's a bit of a line in the sand there. If you cut down to the nuts-and-bolts, I suppose, if you're looking at trade-offs between human impacts, harvest, for example, and the percent loss of CUs that are vulnerable to a fishery, then for Fraser Sockeye, I'm not sure that analysis has been done. It's been done elsewhere. But I think whether it's been done or not, the Wild Salmon Policy is fairly explicit about maintaining biodiversity with the off-ramp, of course, that depending on how a particular case-by-case basis,

how a particular CU, if its status is poor, then it's unclear. There needs to be an evaluation of then what happens? What would that trigger, if anything?

Q Does anybody else want to take a stab at that question? Mike Staley?

MR. STALEY: I'm not certain it's a tension between biodiversity and sustainable fisheries. I think sustainable fisheries require a degree of biodiversity. I think your question is how much of a degree. Again, going back to my experience with people that I've worked with throughout the watershed who are in many of the communities, exist and reside on the CUs and not by accident do they live on those areas. They're there because of the fish. And perhaps some argue the fish are there because of them but is that that -- maintaining sustainable fisheries requires maintaining their fishery where they are accustomed to practising it. So diversity and sustainable fisheries are one in the same to them.

Q I just want to go back to one point. We talked before about the stationarity concept. And I just want to put it to the panel, if the past isn't necessarily a good indicator of what might happen in the future and we don't know what the future will hold, what else can we look at to make planning decisions except the past, however imperfect the past may be? And I can start with you, Mr. Wilson.

MR. WILSON: Well, I suppose one of the things we can use to manage our affairs is the present. I think we all agree that in-season management, because it can account for the actual returns and not just projected returns, is the key to successful fisheries management. Having said that, though, I think it's helpful to make as few assumptions as you have to -- the minimum number of assumptions you have to make about the future. Guarding against surprise is a serious matter for resource managers. We expect surprise. There are things outside the model that are un-quantified and unconsidered in the model that all affect the population dynamics of Fraser Sockeye. To me, the key to success is placing fish on the spawning grounds. It's as simple as that.

We need to maximize diversity and abundance

going forward in the hope that by sustaining these population and maintaining weaker stocks that may not always be weak, that over the long term will receive the maximum benefit. I don't think you need to speculate a great deal about the future. You can just deal with the present. But certainly, if you've got steady declines in productivity, there should be a huge note of caution in the way you manage because there's a message in the data in the past. I think Mike said it best, we have to learn from the past but we have to live our lives going forward.

Q Mr. Staley, you work with First Nations in understanding in helping to communicate the FRSSI model outcomes to them; is that right?

MR. STALEY: One of the elements of my work plan with the Aboriginal Secretariat is following the FRSSI process and, where possible, trying to communicate it, yes.

Q All right. And do you think that the people you're working with have an understanding or are able to understand the details of the FRSSI model in a way that allows them to make informed decisions?

MR. STALEY: I'd have to say yes to both of those but we haven't found out how to do it yet.

Q Sorry. Can you explain that?

MR. STALEY: Well, I think they are able to and they can. That's the optimist in me, in the sense they can. The reason I don't think that they have yet is because those of us who are supposed to do that haven't figured out to do it yet in a way that is meaningful to them. And there's a whole series of -- and there probably are a whole series of reasons why that's the case. I don't know if you want me to get into those in detail but I say in general I think they're certainly capable of understanding the complexity and a lot of the nuances that are present in a construct like the FRSSI. And I'm hopeful it can be done. We just haven't done it yet.

Q So are you satisfied then in the work that you're doing that the people you're communicating with are able to provide meaningful advice to the department on options and decision-making that is being required through the options developed through the FRSSI model?

MR. STALEY: I'd have to say on balance not yet, no.
Q Okay. And for the rest of the panel as well, do the different sectors that are being asked to respond to options created by the FRSSI model, do they have the capacity to understand and evaluate the impacts to them of decisions that are to be made based on the options developed? Mr. Wilson?
MR. WILSON: I think our primary concern, speaking now from the perspective of the marine conservation caucus, the analogy I use is a bus. The FRSSI process is going somewhere and we understood at the time that we were involved in it that the bus was not going where we wanted to go and we didn't really want to take responsibility for the decisions that were being made, nor did we have any confidence that changes were going to be made to the process that would made that process work for us. So we disengaged from the process. It's an expensive thing to be involved in.

I think there's a danger in replacing an extremely complicated reality with an extremely complicated model. If the model's going to help us make decisions, then we all have to understand the model, not just in its broad sweep but in the specifics. We have to understand that the devil's in the details and in the little assumptions, in the little errors in the data. It's entirely possible that the model behaves in a way that's quite different than we expect and perhaps different than we understand. So I think as a tool for helping us reach a consensus about what values to express through our management approach and coming up with rules to make those trade-offs, the FRSSI process has a long way to go. some of it's going to be a change in the way we express our interests in the model, describe the model so that it's accessible to people with sort of ordinary interests, that aren't specialists or scientists.

So we have a job to do in simplifying the models in a way that makes them most useful, as a tool for communicating. And at the same time, we also have to develop a group of people that are well enough informed about the model to actually understand how it might affect their interests. I don't think we're there yet.
Q Mr. Morley, what about the commercial sector? Do

you think that the commercial sector has the capacity to understand the models and understand and make informed decisions in response to the options presented by the models?

MR. MORLEY: I think the commercial sector, unfortunately, suffers from not having the technical back-up and capacity in terms of having scientific staff that are available and work for them on a regular basis to understand all the ins-and-outs of the model by any means whatsoever. We don't have the kind of capacity support that First Nations are getting through AFS kind of agreements and we certainly -- and from the marine conservation caucus, certainly the background of many of the members there are, in fact, biologists and scientists and probably understand the technical aspects better than many of the people on the commercial side.

So certainly I'd say that from the scientific capacity point of view, we lack that. Some of the people obviously are very intelligent and are smart enough to understand it, given the exposure to it. Not enough of them have been exposed directly to the inner workings of the model to fully understand what's going on in there. I think that most people only understand the output from the model, which has meant very low expectation rates and too many fish going up to the spawning grounds and have seen lack of commercial fishery as a result of the application of this. So we certainly understand the outcomes from the model but we don't really understand particularly well how it's put together and whether or not it reflects our values properly.

Q This is a question for the panel. Do you think that the sectors need to understand to a high level how this model works? Do you need to have the scientific background in order to use the outputs or can the department who provides the expertise simply explain the outputs to the sectors in a way that would allow the sectors to understand the outputs? We don't have to know how to create an MRI machine to listen to our doctor interpret the results. Is it the same thing here, that the model is maybe complex but maybe sectors don't need to know how it all works? They can simply have the outputs explained to them by

scientists who do understand it. I'll start with you, Mr. Morley, seeing as we left off with you.

MR. MORLEY: You know, I think this is a little different here because, in fact, the model purports to incorporate some of the sector's values in terms of how it is evaluating different escapement strategies. And so really people need to understand who their values are being incorporated and whether they're being represented properly in order to feel comfortable working with the outputs. And frankly, I know I personally don't feel comfortable with the way the model is incorporating commercial values when it talks about "a scenario that avoids low catch".

Okay. That's not all I'm interested in, in terms of yield from the fishery. So certainly I'm more in tune with maximizing some kind of benefit rather than just avoiding a minimum low level. So I do believe that given what the model is purporting to try to do, which is to "optimize the strategy" that people need to be much more involved in how it's put together and whether or not it does help us to reflect and model what people really want.

Q Okay. Mr. Wilson?

MR. WILSON: Well, to follow your analogy, I don't think I need to understand how an MRI works but I'd sure like to know that someone did. And of course, my doctor, I would hope, would have only my best interests at heart. So in that sense, I should be able to rely on him to provide me with good impartial advice. On the other hand, if MRIs could give you cancer, as well as detect it, you might take a very different approach to how you use that tool. It's a tool. And it's a tool that's supposed to help us make decisions and trade-offs.

And I think if we're the ones using the tool, as your doctor is using an MRI, then I think there is some positive obligation on the part of the person using the tool to understand the tool. Otherwise, it becomes one more black box and it leaves everyone not only abdicating their responsibility to manage the resource in a way that's best for all of us, but it also leaves us open to manipulation because we take the model output at face value because we don't understand

how the model works and we accept that the model can do what we can't and that's navigate through a complex set of trade-offs and tell us what to do. But to me, all we're really doing is trying to frame what is a political problem, balancing people's values and interests and trying to re-frame it as a technical problem so that science gives us the answer.

Q Mr. Staley?

MR. STALEY: I don't know what to say after that. I think that Rob sort of hit the nail on the head. I think the people who -- in order for someone to trust the doctor, they have to be sure, as Ken said, that the doctor has their interests. And if it's not really transparent how their interests are being expressed and dealt with in the process then it's difficult for them to trust anybody, including people who work for them, to explain how the model works or how it doesn't work. And so it's -- I think there's a threshold of trust in this, particularly for First Nation, which is a big one, one that's probably -- you know, it's generations old so it's not something perhaps we can all solve today but it's there as a trust issue. And until we get over or addressed a little bit more of the trust issue about whether the interests and values are being honoured appropriately, they're going to have difficulty listening to people like me talk about technical stuff.

Q All right. Mr. Cass, maybe we'll just end with you, if you've got any response to some of those statements.

MR. CASS: From the outset, Mr. Commissioner, I don't think we've said this is the perfect tool but you know I guess I would flip it around that here's a process, as Ken's described as a bus, and it has some elements of consistent framework, if you want to call it that, for evaluating trade-offs. And yes, there's a complexity there that if you're not close to it, you're not going to understand the nuts-and-bolts and the details and what it's spitting out. So this bus has learned a lot over time about what's worked and what hasn't worked. But I would sort of maybe flip it back to the people who perhaps have the most at stake here and they have to live with something like this, that

is going to be a guide about how you make decisions and how you wrestle with different values that different sectors have.

One of the steps that we've heard a few variants of these include a better socioeconomic framework that is used to assess performance of the economics. How do we assess values right down to the nitty-gritty? How do you assess values of the different sectors? But I would ask my colleagues here, what would they see as a next step to fix some of the problems? Mike has mentioned trust, which is an issue, a clear issue. If you don't understand how something works then how are you ever going to trust it? The hard part here is anybody with the kind of background being a technician to develop a model, anybody can develop a model.

You put the pieces together and it has an output. Where we've come in the last ten, 15 years is more of an acceptance that that's probably not the best way to proceed especially when there are competing trade-offs or there's a need to search for common ground because the hard part is trying to engage. It's trying to bring people to the table to inform the details to learn and to gain trust. So over eight years or whatever it is that this thing has been on the road and a dozen or so workshops, we're left in a situation where there appears to be some clear issues related to what is this thing called FRSSI supposed to be doing and how does it bring together the various interests of the different stakeholders and be useful and guide in terms of some long-term strategy for management. The people engagement is, in my mind, the difficult issue and it is costly and it takes an inordinate amount of people's time.

Q Thank you. Mr. Commissioner, if you'd like to take the break now. I'll try and be very quick when we get back or we can keep going, whichever you prefer.

THE COMMISSIONER: We'll take the break now.

THE REGISTRAR: The hearing will now recess for 15 minutes. Oh, sorry, ten.

(PROCEEDINGS ADJOURNED FOR AFTERNOON RECESS)
(PROCEEDINGS RECONVENED)

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

EXAMINATION IN CHIEF BY MS. BAKER, continuing:

Q Two small areas and then I'll sit down. FRSSI, as we've talked about, is a tool to manage the stocks and it reflects the productivity of stocks, and it allows for a management by controlling harvest rates, essentially; is that fair, Mr. Cass?
MR. CASS: Yes, the control of harvest rate.
Q Okay.
MR. CASS: Yeah.
Q But one thing that the FRSSI model doesn't consider, and even the FRSSI process, as far as I understand, doesn't consider, is the effect that habitat has on productivity; is that correct?
MR. CASS: I mean, the population dynamics, you know, there is a parameter in there that attempts to estimate the capacity, the habitat capacity, of a CU, say, in that case, so there are also other approaches that directly attempt to measure the carrying capacity, the habitat capacity, for sockeye based on in-lake assessment of the nutrients that are in-lake to support juvenile salmon.

So there is a concept of using what we know about the habitat and build that into the population dynamics. But I think you're going somewhere else entirely.

Q But the model doesn't look at how habitat could be changed to improve productivity; that's not a factor that goes into the model in any way?
MR. CASS: It doesn't look at how habitat could be changed.
Q Yeah, it makes no assumptions about how, if habitat was changed one way or the other, it could improve or make worse productivity of the fish; is that right? What you're talking about is more the retrospective; it looks at -- it's incorporated into the models that are run within FRSSI, right?
MR. CASS: Yeah. Now, you could, given the right data, you could use information from the habitat -- or changes in habitat, for example, that would -- that could change the way the model is parameterized, so it would use information from the habitat, if there's been a change in the model

to compensate for that change. You could do that, but it requires data.
Q And it's not being done now?
MR. CASS: No.
Q All right. Mr. Morley?
MR. MORLEY: Just to expand on that, I think one of the issues that Mr. Commissioner raised was the sort of relationship between the FRSSI model and the Wild Salmon Policy and how this is being put forward as a pilot implementation of the Wild Salmon Policy, and I guess I would say that it is -- it isn't really, in the sense that Dr. (sic) Cass answered the question, because the Wild Salmon Policy is supposed to include a significant habitat component in looking at the influence of habitat and the availability of habitat and potential alterations in habitat as ways to address a population that might be in the red zone or in a lower status in addition to harvest management. FRSSI only looks at -- your only way of controlling the status of population is through harvest management, and so it doesn't look at other ways that you could, either through removing obstacles, improving spawning ground habitat, lake enrichment, whatever you could do to alter the habitat to improve productivity to boost a population is not one of the things that is considered within the FRSSI model, and therefore it's not really a full implementation of an example of implementing the Wild Salmon Policy.
Q Mr. Wilson?
MR. WILSON: Could you give me the question again, please?
Q I wish I could kind of come up with a coherent question. I don't think it was coherent the first time I asked it. But it was really whether habitat impacts are contained within the FRSSI model right now to either look at how productivity could be improved or worsened, depending on habitat changes in the future.
MR. WILSON: Well, I think, to some extent - I hate to defend the FRSSI model - but to the extent that productivity changes that are related to habitat damage or loss are reflected in the historical dataset, they've had their influence on productivity within the dataset, so the FRSSI model will be assuming that those things have

happened, if you like.
Q But it's looking to the past.
MR. WILSON: Yes.
Q It's not looking to the future, if improvements were made to habitat that would then influence productivity; those assumptions are not put into the model?
MR. WILSON: No. We can imagine any kind of future productivity we'd like and have that in the model, and if we imagine that we're going to do something dramatic to not only reduce the loss of habitat and habitat damage but to actually improve habitat, for example, lake fertilization or some other process, we could speculate that future productivities will be somewhat higher than historical productivities and try to address it in that way.

Or if we imagined that ongoing climate change and loss of tree cover and changes in the hydrograph would all work to the disadvantage of sockeye, then we could speculate that future productivities would be somewhat lower.

So since we don't know what the future brings, it's entirely up to the people that run the model to set those things going forward, and the model will do whatever you ask it to do.
Q Mr. Staley?
MR. STALEY: I think habitat -- "habitat" is a big word. It plays into the historical data analysis at least in four places in the model. One, the so-called productivity parameter; the other is a carrying capacity parameter, both of which are habitat related. There's also a parameter which deals with how variable, innately variable, a population is, which has a habitat component to it, as well as the other mortality, other harvesting, is related to habitat issues as the adults move upstream.

So there are several places in the representation of the population dynamics where habitat plays a role, all of which, as Ken said, could be -- you could hypothesize changes in and look at how robust the control rules are to those changes. But, to my knowledge, that kind of analysis has not been done yet.
Q All right. Mr. Cass, did you have anything to add, or --

MR. CASS: (Microphone off) try to, sorry, portray, is that if there's a change in the habitat and there is a measure of that in terms of data, there are methods, now, to use that in the same construct as the stock recruitment model is used. As Mike said, there's a productivity parameter and a habitat parameter that can be -- that then you can add to include habitat, but we haven't done that. I don't recall instances of data being available that shows there's been some change in the habitat that we could account for somehow.

Q All right. My last question is just a big picture question. We've talked a lot about FRSSI today and heard some criticisms of it and some places where people think it provides useful information and places where people think it could be improved. Big picture; are the FRSSI escapement targets, as they're presently being developed, useful for managing Fraser River sockeye? Is it a useful tool? And I'll start with you, Mr. Staley.

MR. STALEY: Yes, I would have to say it's useful. It incorporates -- it's probably one of the best approaches to incorporating historical data that we have available. It uses the best available modern tools to analyze that data, and in that sense it's very useful. It provides some guidance, whether people like that guidance or not, at the beginning of the season.

Q All right. Mr. Morley?

MR. MORLEY: I think it has been useful. It is developing and it needs to continue to develop to make some of the improvements that I was talking about previously. I do think that it, as with a lot of our IFMP rules that are developed, it tends to be somewhat inflexible in-season and needs to have a built-in mechanism to sort of make changes to the goal post in-season, based on an in-season evaluation framework, because we have had a number of instances where those inflexible rules put you in perverse situations during the years. But it has been a good process and it needs to continue to improve.

Q Mr. Wilson?

MR. WILSON: Well, yes, clearly the TAM rules are useful, because we use them. That's how we set up our preseason plan. To me, though, the question is whether or not the guidance that the FRSSI

process is providing in the form of the TAM rules is reasonably impartial and unbiased.

So I have a number of reservations about the way these models are built and the kinds of information they use and the kinds of information they don't use that lead me to question whether the outcome, the long-term outcome from applying these TAM rules is what we think it is. For example, when it comes to weak stocks, one of the things we do is try to understand the probability of extinction of these weak stocks by measuring the frequency by which they drop down below a particular benchmark for escapement. It may, however, turn out that if our assumptions around productivity are incorrect, we may dramatically underestimate the likelihood of extinction from some of these stocks, particularly if we see a dramatic change in the future that was unanticipated in the use of the model.

So yes, they're useful, but they're also somewhat dangerous.

Q Mr. Cass, I'll leave the last word to you.

MR. CASS: Well, I'm not a user. I was involved in the technical level of the development of the tool, but I would have to say it's only as good as, you know, how good it is to take account preferences of those who are affected by it, and the only way it seems like, at least our experience over the last eight years or so, or the only way that we have been able to really see if we're making progress or taking steps back, is to learn from one season to the next, I guess, and build on what we have as the way forward.

You know, we came from a time when we, originally, when we'd just take the -- trying to assess how we would model future changes and productivity, and, you know, again, I think Mike said it best, it's difficult, if not impossible, to predict the future - that's sort of a joke - and so you look for strategies or TAM rules that are, as best they can, be robust and to whatever scenarios you think are important for the future.

The wrestling with different sector's view of the world and their value on the components of the model, and the ability to communicate, is, I think, where the challenges lie here.

MS. BAKER: Thank you. Mr. Commissioner, those are the

questions I have. The counsel who follow me will be Mr. Taylor, for Canada, followed by Mr. Leadem, for the Conservation Coalition.

MR. TAYLOR: Mitchell Taylor, for the participant Government of Canada, Mr. Commissioner, and with me is Hugh MacAulay. I have a number of questions for the panel. Just to let you know at the outset, I don't anticipate finishing my examination this afternoon. I understand that this panel is available and coming back tomorrow morning.

CROSS-EXAMINATION BY MR. TAYLOR:

Q I'm going to ask this question of the panel, and I'll start Mr. Cass, in part because Ms. Baker asked this of you in the first go, but then I'm going to ask the other panel members about this as well.

Towards the end of Ms. Baker's questioning, she asked you, Mr. Cass, whether FRSSI was all about managing by controlling the harvest rate, and you seemed to pause, in giving an answer, and then said something to the effect, "I guess so," or something like that, and it may be a case of how one approaches this or, by analogy, the glass half full/glass half empty, it all depends on your approach and attitude, but at the end of the day the glass is the same, however you characterize it being with half the total volume of water in it.

Is the focus of FRSSI really aimed at fixing escapement levels or targets, as distinct from controlling the harvest? Which is the overriding or most important aspect, if you like; fixing escapement targets or dealing with the harvest management? One flows from the other, of course, but which is the emphasis or the predominant -- of predominant importance, or does it all depend on one's view?

MR. CASS: I guess it would start, Mr. Commissioner, with it depends where the run size is relative to the TAM rule. You know, at low stock sizes, where there's -- the TAM rule declines at some point and reverts to a fixed escapement policy, then, at that stage, it's designed to -- or that level of run size is designed to provide the same number of fish with a declining harvest rate over that

period. However, above that trigger point, where there is the fixed exploitation strategy, then the purpose, Mr. Commissioner, is to divide, in some way, with a 60/40 rule, or whatever it turns out to be, and taking into account the environmental conditions during migration, then it's a fixed -- it's a harvest rate managed system where the, you know, equal proportions go to both harvest and to escapement, and that's in the traditional sense, a fixed harvest or exploitation rate strategy, notwithstanding the environmental -- the TAM part of the rule.

So it's a combination of both, but you can think about it as the way I think it's been described in our 2006 workshop that we had that looked at cyclic dominance, is it's a fixed -- in one sense it's a fixed exploitation rate strategy with this contingency down at the lower end to solve some of the conservation problems and ensure that there's adequate escapement for future propagation. So what I'm trying to say is there's two -- depending on where you are in run size, there's two different views of what that TAM rule is designed to do.

Q All right. Thank you, that's helpful. Would it be correct that the fundamental point, at the end of the day, is to get an appropriate number of spawners on the spawning grounds?

MR. CASS: That is the overriding priority of conservation, and it is a key to sustained populations in the future. That is the number one factor that you're trying to ensure.

Q Other panel members, do you have a comment on this; that is, what FRSSI is all about? Is it at one or both of escapement or harvest control? Mr. Staley, do you want to go first, or go next?

MR. STALEY: I'd say that, at the basis of it, it's about assessing performance, where performance has elements of catch, has elements of escapement, has elements about the variability in catch and escapement, and perhaps other things. And it's the assessing of the performance with regards to the harvest management, I think. That would be my -- in terms of the structure of the model and the inputs and outputs that are set there, we are measuring the model, measures performance of various aspects, and so that's what the model is

trying to do. The model is driven, given the control, which is on the harvest component of the mortality. So I'd have to say that those are the focuses.

Clearly, escapement is important, but it's one of many performance measures, and FRSSI was intended to try and assist when conservation, I guess, where conservation would mean that there aren't -- you know, there's some danger of the -- or some inability to sustain itself. Populations find themselves in -- inability to sustain themselves. Not just those kinds of situations, but situations where there's abundance of fish, and how much of that abundance should be taken now and how much should be put in the bank for future production.

Q Mr. Wilson, do you have anything to add?

MR. WILSON: Not at this time, no.

Q Mr. Morley?

MR. MORLEY: Mr. Commissioner, I would say this is a chicken and egg question, and we're actually interested in both the chickens and the eggs. So really, it's not just a -- it's easy for people to say, "Well, conservation is the number one objective and, therefore, we're really trying to get spawners to the spawning grounds," but as I indicated in my first session in front of you here, I said my view of conservation is broader than that, and it includes long-term sustainable use, and certainly we're interested in sustaining the productivity of the resource and looking at what mix of benefits it can generate over the longer term. So that's what FRSSI is attempting to assess, as Mr. Staley said.

Q All right, thank you. Now, I'll ask this of Mr. Cass, I think, and I'm picking up on a question that Commissioner asked this morning, where he asked about, as I recall, exploitation rate, harvest rate, TAM and TAC, and whether they're all the same or different, and you explained some of the differences at that time, Mr. Cass. I'm going to try this again by putting some number into it, to see if we can add some more clarity to this than what already exists.

If you have a forecast run size of two million fish and you identify that the escapement that you should have is 800,000, it follows, does

it, that the exploitation number would be one point two million; is that right?
MR. CASS: The harvest from two million, was that the first number?
Q Two million fish, 800,000 --
MR. CASS: Yeah.
Q -- escapement, so the total exploitation -- sorry, the TAM, rather, the TAM, I guess is what I'm --
MR. CASS: The TAC would be one point two, is that what you're --
Q Well, that's the TAM, isn't it, the total allowable mortality?
MR. CASS: The TAM, yeah. But the one point two, if you have a point one or 800,000 escapement, is that the number you're referring to?
Q Yes.
MR. CASS: Yeah, so then you take that from the total run, you get one point two. One point two is then what's leftover as the TAM, correct.
Q So that's the total allowable mortality
MR. CASS: Yeah.
Q And then the TAC would be a smaller number than one point two; it would be the TAM minus the management adjustments, would it?
MR. CASS: Yes.
Q And put another way, the harvest rate is whatever number plus management adjustment which equals your TAM?
MR. CASS: Yes.
Q Mr. Morley, earlier this morning, when one talked about a TAM of 60 percent, you then spoke of the actual harvest being less than 60 percent, sometimes being 30 or 50 percent, and that's what you're referring to, was it, Mr. Morley?
MR. MORLEY: No, that was -- I wasn't talking about the management adjustment in that context. I was talking about the overlap between different run timing groups. So if you had an Early Summer TAM that conflicted with a Summer TAM, you may end up going to the lowest common denominator, and so you would not necessarily be harvesting at the TAM rule that might be higher for the stock -- the stronger stock or the stock that was at a different level of MA.
Q Okay. Mr. Staley, you appear to be nodding as though you had something to say? Did you want to add anything?

MR. STALEY: No.
MR. TAYLOR: All right. Mr. Commissioner, have I added any clarity, or added confusion in putting numbers into it?
THE COMMISSIONER: I'd rather not say, Mr. Taylor.
MR. TAYLOR: Thank you.
Q Now, Mr. Cass, am I correct that in order to identify what the escapement should be, there is a suite of tools that are used, and that includes the preseason forecast and the test fishing, the hydroacoustics, and some of the other aspects that come into stock assessment, which we've heard about in evidence over the last 10 days or so, and you take the information from all of that and that is going to give you what you're looking at in terms of a run size and then the ability to develop your escapement target?
MR. CASS: So just walking through it, Mr. Commissioner, the preseason run size forecast informs the preseason planning process, one of the plausible scenarios to consider in developing a plan, and so then that becomes, I guess, a benchmark by which you can then develop a plan around that, but realizing, of course, that the preseason forecast is just that, with a lot of uncertainty which has already been presented here.
But the other tools that you described, for example, the hydroacoustics or other tools for estimating run size, is a way, in-season, to understand what the run size is and then, from that, is derived the target escapement, so that the TAM rule then would be applied to the run size that would be based on whatever methods are available, test fisheries in-season, hydroacoustics in-season, and so the TAM rule would be applied to those estimates of run sizes based on those tools -- those assessment tools.
Q All right. Thank you. Now, I'd like to ask about the 60 percent ceiling that has been talked about already, and how you got to that point. I'll start with you, Mr. Cass.
Can you explain how the department reached 60 percent, both in terms of who did you get input from and what factors or criteria with and apart from input from any number of people you had, what factors went into coming up with 60 percent; how did you get there?

MR. CASS: Well, I can tell you, as I think has already been said, the choice of 60 percent TAM rule was a policy choice, but with some background in understanding what the underlying uncertainty was in estimating what the optimal exploitation rate, or TAM, would be. So that's kind of a, you know, there's the background of data, there's the understanding that not all the data is -- not all the CUs are not included from which you derive the estimates of optimal escapement. So the 60 percent, the thinking around the choice of 60 percent is that it is on the low end for most of the stocks that we consider in the 19 stocks, say, that we consider in our estimates of productivity and, therefore, the optimal exploitation rate.

But to guard against the possibility that there are unmonitored stocks with limited or no data that have low productivity, the numbers that were considered were thought to be more precautionary by going on the low side of distribution of exploitation rate, you know, to guard against stocks that aren't represented and, as well, implementation error in the estimates of run size in-season as well as the ability to actually effect a perfect harvest rate.

But now, you asked about the process and who's involved and how did we get to that decision. It's a little vague to me how that was aired out or discussed within the stakeholder workshop process, and I'm not certain exactly to what level there was discussion about what are the alternatives other than 60 percent, but I do know that eventually it was a policy decision to hedge against uncertainty.

Q All right. And in the course of questioning, I think that Mr. Morley and Mr. Wilson, who I believe were at some of these workshops, may shed some light on that, and we'll come to that. Mr. Staley may have been there, I'm not sure.

In terms of the 60 percent figure, if you have one -- if you could identify one stock and fish one stock and that one stock was a healthy stock, is there a rule of thumb as to what the optimal harvest rate is, if you're fishing one healthy stock? What percentage, is what I'm getting at. Mr. Staley, or Mr. Wilson, do you have a view? Do you understand what I'm getting

at?
MR. WILSON: Well, there's no single rule of thumb, because different numbers of fish will return each year, even from a healthy stock.
Q All right.
MR. WILSON: So if you're trying to put a specific number of fish on the spawning grounds, then the number that you can harvest will vary by year. So will that be a constant percentage? No, because productivity changes over time, and so the number of offspring produced by each spawner will vary. So there really isn't a rule of thumb, unless you want to consider the, you know, the stock recruit curves that we developed that try to describe the general relationship between the number of spawners and the number of subsequent offspring, would be a rule of thumb.
Q Has 65 to 70 percent harvest on a healthy stock, if you could identify that one stock that you're harvesting, been used in the fish management world?
MR. WILSON: I don't know of very many places were fixed exploitation rates are applied regardless of the number of fish returning.
Q All right. Do Mr. Morley or Mr. Staley want to add anything to that?
MR. STALEY: I'm trying to recall. I haven't done recent research on that. I recall a discussion with some of the academics that I worked with, who referred a paper, which I haven't -- which I apologize, I was meaning to dig out before today, but the discussion, at least, was they had read a paper - so it's all second-hand - that had systematic -- had attempted to fit a stock and recruitment relationship, or Ricker relationship, to as many sockeye stocks up and down the Pacific coast as they could and sort of provide a sort of an average -- sort of the average healthy sockeye stock on the Pacific coast, and if that were to be managed. That's one of the points in the -- on the spectrum of abundance for any particular stock, is the point at which maximum sustainable yield, if the world was equal -- if equilibrium existed and the world behaved in some hypothetical way, and someone -- at that point your sort of sustainable harvest rate, if my recollection is correct, is in the 60 to 70 percent range.

But most of you -- if you look at the stock recruitment curves that you get from most healthy stocks, the 60 to 70 percent range is where you would find, theoretically, the MSY level.

Q All right. Thank you, that's helpful.

MR. MORLEY: I'd just like to add to that is that it's, again, I think it does vary according to the productivity regime you're in, and I'd certainly -- if you looked, for example, at Bristol Bay, with which I have some experience, since we've got operations -- our company's had operations up there for a couple of decades, and it is -- we're seeing a situation up there right now where they're probably harvesting more in the 80 to 90 percent range on a sustainable basis over a long period of time with healthy sockeye populations. During the time period when the IPSFC was managing the Fraser sockeye fishery, we did see building populations on a slow long-term growth curve over a long period of time when they were harvesting at in excess of 75 percent, on many populations. That was with the strong ones. And they were harvesting, in some of the non peak cycle years, at a higher rate than that, even.

So depending on the productivity regime and the situation you're in, it can be sustainable at much higher levels.

Q Now, the Bristol Bay situation that you refer to, is up in Alaska, correct?

MR. MORLEY: That's correct.

Q And that's a different situation than the Fraser, isn't it? There's not nearly the length of migration or river system up there, as compared to the Fraser, is there?

MR. MORLEY: None of the individual river systems are as large as the Fraser, but there's about six major systems there and each of them does have a number of different stocks in it. Certainly the fishery is somewhat different and it's managed somewhat different than what we manage here.

Q Is it the case that the geography is such up there that you're able to get a handle on what you're dealing with, in terms of the stocks, sooner than you can in the Fraser system?

MR. MORLEY: I wouldn't agree with that.

Q All right.

MR. MORLEY: I think that, again, it goes back to

certain time periods, and there was a time period when Bristol Bay populations were not as productive as they are today and where harvest rates were lower and the overall production was lower, and certainly we've seen a time period in the Fraser River where productivity was higher than the current situation.

So I think those are, you know, if you have to look at the number of returns per spawner, and if you look over the 50-year time period we have on the Fraser, you can see the number of returns per spawner in any given year are varying from less than one to one, which we've seen on a couple of occasions, very difficult -- 2009 being one of them, but other times when we've had returns per spawner for some of the populations in excess of 25 to one. So it's highly variable, and what a sustainable harvest rate is depends on the long-term regime. So 60 percent, I'd say, would be very conservative in terms of sustainable for healthy sockeye populations.

Q Now, Mr. Cass, are you familiar with the Ricker and Larkin models, both of which have been referred to today and other days, in evidence?

MR. CASS: Yes, I am.

Q Do each of them play a role in the FRSSI modelling?

MR. CASS: Yes, they do. And again, following the 2006 workshops, cyclic dominance workshop that we had here, there was a recommendation to adopt the Larkin model for in order to deal with the delay density impacts that were being estimated by that model.

Q Can you explain for the Commissioner in -- firstly, before I ask this question, which I'll have the word -- I'll be wanting you to briefly describe it --

MR. TAYLOR: -- but I just noted the hour, Mr. Commissioner. Do you want me to take another five or seven minutes?

THE COMMISSIONER: Okay.

MR. TAYLOR:

Q Can you briefly describe for the Commissioner, what is the Ricker model and what is the Larkin model and what is the difference between those two? These are models that we've heard about and they underpin some of the modelling that has been

considered in this evidence and elsewhere, and so it's important to understand what they are.

MR. CASS: Well a Ricker model, Mr. Commissioner, is a statistical model that looks at the, as you may have heard, looks at the relationship between the number of spawners that contribute to future progeny. So if you look at the relationship between the number of spawners in a given year over a range of years and the subsequent recruitment or progeny that are produced, there's a relationship that describes the productivity of that particular population, as well as the capacity limits of that particular relationship.

So it's formulated in terms of two parameters, really - Mike said it's three - which describes the innate variability in the data points, the individual spawner data point and the recruit data point over time.

But the Ricker model is really -- and then there's the other, the third parameter, if you like, so there's a productivity parameter, a capacity parameter, and a parameter that provides an index of the variability of the data around that relationship that's described by the Ricker model.

So that's the fundamental model. Now, there are, of course, one of the interests in fisheries science is to -- and one of the issues in terms of how you take a model and estimate of parameters is how you deal with the uncertainty in terms of the precision of the, say in this case, the productivity parameter and the capacity parameter, is how do you take account the uncertainty in those parameters. And interestingly, for the Ricker model, what is reasonably well determined is the productivity parameter, which is the productivity at low stock sizes. And so the productivity parameter is determined with much more confidence than the capacity parameter, and the capacity parameter is the measure of, you know, what's the number of fish, what's the optimal - I'll use that word again - the optimal number of fish to meet a certain objective, whether it's to fully seed the habitat with juveniles, or whether it's to seed sufficiently to have the highest surplus yield.

So it's really a three-parameter model that

statistically compares the number of spawners over time with the progeny that it's produced. So that's the Ricker model.

The Larkin model is a Ricker model but with added terms, we call them lag terms, that describe the degree of delay density that each of the preceding, in the way it's formulated in FRSSI, each of the preceding spawning years from the current years. So for example, in 2010, there are a number of spawners observed on the spawning ground. If you use that spawner in a Ricker model, which doesn't have the ability to assess the degree of interaction or the delay density, then you just simply project that spawning abundance forward in time a generation to come up with the progeny that are produced.

The Larkin model, on the other hand, takes into account the three preceding years, at least the way it is formulated here, on the -- to test the assumption that there is a delay density effect, large -- very large dominant years can effect the subsequent years by resulting in a large food resource - there are a number of hypothesis about this - result in a large food resource for predators, such as Rainbow trout in a lake, that then become conditioned and, themselves, becomes -- their dynamic is influenced by their -- their survival is increased by the fact that they have a lot of food to munch on, because you have had a strong year class come through, but that very healthy Rainbow trout population, to use the example, then is able to live long enough to munch on the three -- the next three years to come along, next year's results of spawning to come along.

So that's the notion of delay density, that there's some -- it doesn't have to be predation, it could be some predator -- or, sorry, some disease or parasite factor that's influenced by the population dynamics with sockeye, or food availability.

So the Larkin model is, again, a statistical model with added terms to test how important the lag -- the delay density effects of preceding year classes are on future production.

Q So is it the case that the Larkin model takes account of cyclic dominance, whereas the Ricker

model does not?
MR. CASS: Now, that depends on what you're assuming to be the cause of cycles, because you can have cycles in a Ricker model situation with very high harvest rates and, given the four-year age structure of the populations. So you can set up, in the way that you harvest, given the age structure of the population, you can set up cycles in a population, but that doesn't mean that there is the kind of delay density effects that are biological driven, or assumed to be biologically driven by the Larkin model.

So the Larkin model will, under many cases of harvest, or many ranges of harvest, will generate cycles because of the delayed density effect, the interaction between the cycles.

Q I think you've alluded to this, but is it the case that in 2006 that the Larkin model was added into the FRSSI modelling?
MR. CASS: Yeah, it had been considered previously in not just the FRSSI process, it started, say, in 2002, but it was also considered in the so-called '87 rebuilding plan as an alternative model.
Q All right.
MR. CASS: But in the FRSSI process, it gained significant ground following that workshop which there was some consensus there that we should be using the Larkin model to account for the assumed hypothesis that -- the biological explanation for cycles.
Q All right. And the workshop you're referring to is the 2006 one?
MR. CASS: Correct.
Q Mr. Wilson, is there anything you want to say about Ricker and Larkin?
MR. WILSON: Well, I guess the fundamental issue with the use of the Larkin model is that it allows us to model situations in which cyclic dominance appears to occur, but it doesn't really enlighten us very much about why there's cyclic dominance, when and how it might break down or re-establish, or any of the other important factors that might lead you to accept on particular kind of harvest policy over another.

So it's a little -- it's descriptive, all right? It fits historical data, but because we don't understand the mechanism it's somewhat hard

to understand how cyclic dominance will change, going forward, under particular harvest regimes.

Q All right. Mr. Staley, in terms of what is the Ricker model and the Larkin model, did you want to add anything?

MR. STALEY: Just that the formulation of the Ricker model is a special case of the Larkin model, with no cycle interactions. That's another way -- and that's the reason it was chosen out of that workshop, my recollection of the workshop, was that it embraced both alternative views of the world, that there were cycles that were there because of the interaction behaviour between cycle lines, and there were cycles there for which there were perhaps no interaction. So the Larkin model is a -- or the Ricker model is a special case of the Larkin model, so we didn't need the Ricker model, we just used the Larkin model with zero interaction terms.

Q All right. And Mr. Morley, am I right that by reason of your background, you would not be considered or feeling qualified to speak to the models, or are you?

MR. MORLEY: I don't feel a need to speak to the models.

MR. TAYLOR: Thank you. All right. Mr. Commissioner, this is an appropriate time to break.

THE COMMISSIONER: Thank you.

MS. BAKER: Mr. Commissioner, we'll begin, tomorrow, with David Patterson, on management adjustments, at nine o'clock.

THE COMMISSIONER: (Inaudible - microphone off).

MS. BAKER: That's correct.

THE COMMISSIONER: Thank you.

THE REGISTRAR: The hearing is now adjourned until nine o'clock in the morning, and the elevators will not be open until 8:30.

(PROCEEDINGS ADJOURNED AT 4:08 P.M. TO TUESDAY, FEBRUARY 8, 2010, AT 9:00 A.M.)

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

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Susan Osborne

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

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Irene Lim

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

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Karen Acaster

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

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Karen Hefferland