February 10, 2011
Cohen Hearings
Witnesses: Carl Walters, Jim Woodey & Brian Riddell
Cross – Examination: by Federal Government lawyers (DFO)

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MS. BAKER: Thank you, Mr. Commissioner. The next examiner is for Canada, Mr. Taylor.

MR. TAYLOR: Mr. Leadem advised me that he has concluded his questions, 1 Mr. Commissioner. Mitchell Taylor, for the record, and with me is Hugh MacAulay. For the benefit of the panellist, we act for the participant Government of Canada in this commission.

CROSS-EXAMINATION BY MR. TAYLOR:

Q *I've listened with interest to your evidence, panel members, and found it very interesting. If I might tally, there's over 100 years, well over 100 years worth of fish science expertise and knowledge on the panel. It's quite inspiring to listen to you. In dealing with over-escapement, there seems to be three questions as I hear the panel members and read some of the material.*

The first is what is over-escapement as a biological concept, and Ms. Baker has asked each of you about that and you've given evidence and definitions speaking to that point.

Then secondly, as a question, there is the matter of what is over-escapement as a number in concrete terms?

I'll come back to that. Dr. Riddell and Dr. Woodey spoke to that in particular. Or, in other words, in terms of a number, what is an escapement number that's too high a number.

Then the third matter that seems to arise is what are the consequences, if any, of over escapement?

So I want to focus for a moment or so on the number, what is too high a level of escapement? As I mentioned, I heard in evidence Dr. Woodey and Dr. Riddell speak to that yesterday and put what's too high as being two times MSY, or Maximum Sustained Yield.

Is there - and I put this to the panel members - is there a place that we can turn to in order to see what is commonly accepted as being the MSY for the 19 or so Fraser sockeye stocks, because in order to find out what's two times MSY, one has to know what MSY is, of course. Or is it a case where MSY is quite variable depending on

who you talk to, what model you use to come up with numbers, what year or time period you're speaking of or some other factor or some combination of factors. So I put that to the panel, any one of you who wants to speak first.

DR. RIDDELL: Maybe I can start, Mr. Commissioner. To start with, there is not an unlimited number of values that people could use. The Fraser sockeye, in particular, the common use is the set of data that people refer to as the Pacific Salmon Commission production database. In many of the papers you've looked at, particularly from forecasting and in the benchmark paper that Sue Grant and others wrote in the fall. In there, you'll talk about the 19 production stocks, and these are the stocks that have the best sets of data through time. I think probably the best source of the current estimates of the MSY values are likely from that database and should be essentially the same numbers in the Grant et al paper in November 2010. I think it was November, the last PSARC.

Q *And I believe the --*

DR. RIDDELL: And also the FRSSI should be using the very same values.

Q *All right. Thank you. That's helpful. Does any other panel member want to add anything to that? That's a clear answer as I hear it. Dr. Woodey?*

DR. WOODEY: Mr. Commissioner, just to be clear, every year we gain another datapoint because we have an escapement and a return, and when those incremental datapoints are put into the dataset, there's going to be some changes to the parameter estimates of stock/recruit relationship so that MSY point is going to shift a little bit each year, and when you have a very small return, as in 2009, it would tend to create a shift one direction, and then the next year you have a massive return, it's going to shift the datapoint the other direction. Until we have 1000 datapoints -- and I don't think anybody's going to be here. Right now we have perhaps 55 datapoints, 57 perhaps. I don't know. But that's the maximum that we have because that's the length of time that data are available.

Q All right. Thank you. Is that, Dr. Riddell, what Dr. Woodey just said, what you were alluding to when you said "a range"?

DR. RIDDELL: No, not quite. Jim, of course, is right, that every year you add a piece of information to the 55. But, really, the other aspect is how you use that data. If we were to look at production by cycles, then of course in every population you have four cycle years. We tend not to do that. We tend to look at the productivity through all the cycles, but now we can look at the interaction between the lines within one common recruitment function.

So if you've got good data, unless you have a very abnormal point, it's not been my experience that these values change by very much due to one datapoint.

Q All right.

DR. RIDDELL: It may be true after a 2010 value is put in though. But, right now, we're still dealing with about 2005 would be the last complete brood year that would be included in that dataset.

Q Dr. Walters?

DR. WALTERS: I believe that on ringtail you have a paper by Martell, myself and Ray Hilborn. That has a figure in it that reviews how the stock recruitment parameter estimates changed over time, starting about 1960 and running up to the late '80s -- no, to the late '90s. Two comments:

One of them, there has been a fairly distinct change in using the last decade's data, the 2000s data. The thing we call the Ricker B parameter has increased. That is, there is stronger apparent density dependence, but we're not sure if that's due to actual density effects, or to something confounding with environmental factors.

The other thing is that if you look at the *Wild Salmon Policy* paper, you'll see two quite distinct estimates from any of the stocks of the optimum spawning stock, one from the Ricker model.

And then, for most stocks, a much lower optimum for the Larkin model. In other words, we have strongly divergent predictions about the best spawning stock for harvest and production from the two models.

Q Okay. Thank you. Does the panel accept that high escapement, or a high escapement number is not necessarily the same as over-escapement, as that term is being used in a biological sense. Does anyone want to take that first?

MR. WILSON: Yeah, I'd agree that large escapements are not necessarily over-escapements.

Q And it seems to me this ties to the evidence that Dr. Riddell and Dr. Woodey spoke of yesterday about two times MSY. You can still have a high numbers that's not over-escapement because it's less than that two times figure that you spoke of.

DR. WALTERS: Excuse me, can I interject here? I don't know what you're talking about, two times MSY.

Q Well, yesterday --

DR. WALTERS: The spawning stock that produces MSY is typically at about one-third to one-half of the spawning stock that would occur on average naturally if there

were no harvesting. So somebody said two times MSY, I don't know what they would mean by that.

Q Well, Dr. Woodey, in evidence yesterday, said that from a management point of view, over-escapement is the level of actual escapement that reaches spawning grounds. That's, in my context, more than double the MSY point. So it would be a larger than what we call the p-max or the maximum escapement level that produces maximum returns on average.

Then Dr. Riddell, following on that evidence, said, now, Jim has just made a very important point in all of this, I think, is that many times escapement that subsequently occur in a year will be on a particular point that might be called MSY, but it's only the very large escapements that should be probably at least twice the target escapement that I think people would readily become concerned about the so-called over escapement --

DR. WALTERS: Oh, I see, okay, yeah, yeah. Become concerned about in terms of possibly resulting in a big decrease in escapement, yes, that would be right.

Q Yes. For reference --

DR. WALTERS: (Indiscernible - audio cutting out) base in recruitment, rather.

Q *Okay. For reference, Mr. Commissioner, that's at pages 24 and 25 of yesterday's transcript. Really, my question in this part of my questioning comes down to:*

Can a high escapement number be a large number, but nonetheless be neutral as to impact on productivity, or have a minimal impact. I think that's what I was hearing in evidence yesterday. Am I right in that?

DR. WALTERS: No.

DR. RIDDELL: No. Then maybe I can start –

DR. WALTERS: We (indiscernible - overlapping speakers) escapements higher than the one that produces MSY to result in substantial decreases in productivity, not necessarily substantial decreases in recruitment, but certainly decreases in productivity.

Q Right. And you're speaking now of the over two times MSY, are you?

DR. WALTERS: No. I'm talking as soon as any spawning stock larger than the one -- well, even up to and beyond the one that produces maximum average yield involves declining productivity as the spawning stock increases.

Maybe I could explain a point here about this idea of MSY spawning stock. What we do in analyzing the data, is we fit a curve relating the recruitment to the spawning stocks that produced it, called stock recruitment curve. It's a line that tries to locate the average recruitment associated with each spawning stock.

What we then do is move up in spawning stock size incrementally. In economics, we say we look on the margin as spawning stock increases. And as we increase spawning stock, a spawning stock size looking at management options for it, the productivity drops.

So we're getting a positive effect on recruitment from having more spawners, but a negative effect from declining productivity of those spawners. So we look for that point in the spawning stock of diminishing returns where adding additional spawners produces less additional recruits than that added number of spawners would require to replace itself.

Q All right. Thank you. Dr. Walters, has page 19 of yours and Dr. Riddell's 2004 report come up on your screen now?

DR. WALTERS: Not on mine, but I know which one you mean. It's Figure 1-A, the Ricker stock recruitment curve.

Q Yeah, that --

DR. WALTERS: Is that the one you're referring to?

Q That's correct. And what you are just saying in evidence is in reference to that, is it?

DR. WALTERS: Or the same thing with the Beverton-Holt curve below it, but yes, what we do is we basically move along the axis called salmon spawning, the "x" axis, the horizontal bottom line increasing the size of the spawning stock, and then looking up to the curve above it, the dome shaped curve, to predict the average recruitment. At the point marked "C" in spawning stock in that example, about .3 million fish, at that point, in order to stay at that point, we have to allow the point B, .3 million spawners, to spawn, and still -- so we'll have that .3 million spawners the next cycle. Then we can take on average the difference between that "B" and "A". That's the yield. If you look marginally, if you just move that blue line to the right, you'll see that when you move beyond the point "C", you're getting higher recruitment until you pass the dome, but you're having to add more spawners to get that recruitment, then you're getting back in the way of a difference or a sustainable yield.

Q So you're speaking of diminishing returns at this point.

DR. WALTERS: Absolutely, yeah. So the Alaska definition of over-escapement is when the spawning stock is above level "C", i.e. when it has passed the point of diminishing returns with respect to producing yield on a sustainable basis.

If I could add a comment here, we hear this business about higher spawning stocks producing other benefits, ecosystem benefits and so on. Precisely this same marginal analysis should be used to look at the addition of those other benefits, and that has not been done. So, for example, at point "C", it may well be that most ecosystem benefits, like feeding the bears and the eagles and so on are perfectly well satisfied, and that moving past point "C" will not add anything to those benefits.

That's also true in terms of benefits associated with ecosystem fertilization. I think anyone who's ever raised a garden or looked at a forest or anything else knows that there's such a thing as too much of a good thing, too much fertilizer. So I find that when people make arguments about those additional spawners having additional benefits beyond yield benefits, my immediate question to them is show me the marginal values.

Q Okay. Dr. Riddell, you had something you wanted to add, I think.

DR. RIDDELL: Well, I just want to caution that this stylized diagram obviously is to make the sort of description that Carl was able to provide you verbally. When you actually apply this to real data -- and this is another document that I read through the submissions -- you get a much less well-defined optimal spawning value. For example, I think Carl had presented a current analysis of Chilko Lake, and on that, you would find that their MSY is not a very well-defined peak in that there's a very broad dome, not a well-defined dome.

So this leads into another comment made about the Alaskan sockeye paper looking at over escapement. In there, something that's interesting to consider is that they acknowledge the uncertainty of a particular point, but they use a range around that point as their escapement goal. They define over-spawning as any spawning level beyond the range. But the paper does also support the concept of you need about twice the MSY value to see the contrast and to detect over spawning. They actually use that as how they define which populations they do the analysis on.

So, I mean, I think people, just for more convenience, in terms of how big the difference has to be and sort of fixed a -- if it's twice that, we should see some effect. I don't think it has any strong basis like Carl's implying in any sort of technical analysis.

But even the plot you're talking about there, which is one that came from sort of a normal salmon set of data it's just -- it's been smooth and it's been indexed, so it's all relative to one. So what you get, then, is something that's approaching the intersection point that we talked about yesterday where the recruitment function intersects the replacement line, which is that straight line at about a 45-degree angle here.

Anything below that implies that there are fewer recruits than spawners. So clearly that population is in a sort of over-spawning sense 'cause it's got to decline, even in the absence of fishing. So biologically, you would expect that population to decline. So the idea that you have large, but not excessive into over-spawning is really a very subjective sort of question. I think that's why we're having trouble answering it.
You can definitely have escapements beyond a point estimate MSY that is likely to still give you very good returns until you get quite a bit out on the margin where you're really starting to see density dependence become much more of a factor in the recruitment function.

Q *Okay. Is there a difference in the seriousness of over-escapement once you get to the high levels that you've been speaking of as between small stocks versus large stocks, or are they both – do they both get affected in the same proportional way? Dr. Woodey?*

DR. WOODEY: The basic philosophy in regard to over escapement would hold that is -- but at a much proportional level (sic). In other words, if your MSY in a small stock was 10,000, an over escapement of roughly double that, 20,000, would be deemed over-escapement for that stock, whereas a stock with an MSY of a million, the two million would be considered the over-escapement; in other words, doubling regardless.

But as long as I'm speaking, I might as well throw in what -- reiterate what Carl's talking about in regard to cyclic dominant stocks and the application of the Larkin model which is distinctly different. It has some of the same components as Ricker, but because of that delayed density dependence, the issue becomes one of how do you estimate what the MSY is for a cyclic dominant stock?

I was mentioning yesterday that we, that is, the IPSFC and the PSC in some situations, have looked at just the dominant line of cyclic dominant stocks to estimate what the dominant line MSY is and the subdominant line is going to be different, and the offlines different yet. So it's another issue there.

Q Other panel members agree with Dr. Woodey, do you, that the impact of over-escapement on small versus large stocks is proportionately the same in all cases, or roughly the same?

DR. RIDDELL: Well, again --

DR. WALTERS: We can draw these stock recruit plots with -- if I drew you one for the Kvichak stock in Alaska, the "x" axis would go out to 25,000,000 fish. If I drew the same curve for Cultus stock, it would go out to just over 100,000. There's a couple of little stocks for which it would go up to just a few thousand. We have no reason to believe that the fundamental structure depends on whether it's a small or a large stock. The density dependence pattern that causes this curve to bend over has to be there in any viable natural population.

Q Okay. Dr. Riddell, you wanted to add something?

DR. RIDDELL: Well, I just wanted to come back to what we talked about for a bit yesterday, in that you have to really assess why a population is small.

If it's been small because of an environmental event in the past, or historical over-fishing that's driven it down there a long time ago possibly, and the lake still has significant production capacity, then you may find that as you put more fish on the ground so you won't see over spawning, you'll see growth. So you could see recovery in that case. If, on the other hand, as we said yesterday, it might be small because it's actually got a fairly unproductive lake. We have literally maybe hundreds of lakes like that in the small central coast islands of British Columbia. But, in the Fraser, I'm not too aware of too many of those, in which case, you could significantly compound the problem if you put a wad of fish on the grounds and you have no productive capacity in the lake.

So you really have to look at the particular system and its environment.

Q Okay. If we turn this around and leave for a moment over-escapement and talk about under escapement which comes from too much harvest, is it correct that under-escapement will have a disproportionately more serious impact on a small stock than a large stock because you might be taking away a similar percentage, but you're starting from a smaller number so you're driving it down to a greater harm or greater degree than with a large stock. Dr. Woodey?

DR. WOODEY: I was kind of actually pointing to Brian to answer that because Brian is a geneticist, and you start getting into these genetic issues, Mr. Commissioner.

The small stocks, for example, one stock in the Thompson called Fennell Creek has an MSY of something like 5000 fish because the stream is small and the lake-rearing area is small. We have seen that stock build up over time, but it still is -- some of the escapements are so small, that is, on some years getting down in the 100 or 200 fish range, that you start getting concerns about genetic effects, that is, reduced gene pool and possible consequences of that.

But, for the most part, the answer to your question is under-escapement on small stocks has basically the same consequences as under escapement on large stocks; that is, yield goes down. So you want to stay up close to your MSY so that your harvestable surpluses each year are there to be able to harvest.

Q All right. Dr. Walters?

DR. WALTERS: The point I want to add to this is, there is a term we use in fishery science called sustainably over-fished. It's entirely possible for a stock to be held down near the origin of the stock recruitment curve by a harvest rate close to the maximum that the stock can withstand, because relative productivity is highest down at low stock

sizes that really low stock can withstand that high harvest rate on an indefinite basis over time. So we can have stock sustained at very low levels, sustainably over -- some of the off-cycle line are large stocks, are down around a couple, three, four thousand fish and were historically fished at very high rates, around 90 percent, and they persisted over time.

So when we say that a stock is over harvested, we do not mean that it is driven towards extinction. We mean simply that it will be driven down to an average size over time, lower than that size that produces the maximum average yield. Cultus, over much of its history, has been like that. It has been sustainably over-fished.

Q *Now, in that regard, though, some of what you're speaking of there is premised on there being an ideal world, isn't it? We don't really have certainty as to what is the level that is the one you're speaking of.*

DR. WALTERS: Oh, we have lots of stocks, though, where we have observed empirically in the Fraser that they remained at relatively stable but relatively low levels. In the recent period of reduced harvest, they've responded fairly dramatically, indicating that they were, for a very long period of time, sustainably over-fished, but still relatively stable.

Q *Dr. Riddell?*

DR. RIDDELL: Yeah, I mean, I think what Carl is pointing out, we should keep in mind that where we talk about this production database of being 19 stocks that we use for a lot of our assessments, that there are currently, I think the number is 38 conservation units in the Fraser. So we have about half of the populations that we currently use in our assessment, and many of the others are small. They continue to exist probably for exactly the same reason that Carl is describing.

DR. WALTERS: I went to a body count on DFO's complete database for spawning escapement from 1938 forward, and in that database, we can get time series patterns for about 105 stocks which is ten years or more of data. Of those, something like 38 have been stable since between 1950 and 1990 under high harvest rates, and 56 were increasing, actually over that 1950 to 1995 period, and only 11 of them were decreasing. So we had a large number of stable stocks and, for sure, at least some of those were at far below the abundances sustainable by their habitat.

Q Dr. Riddell?

DR. RIDDELL: Well, just to complete, what I was going to come back to there is -- the discussion you're having now is exactly why I wanted to clarify this notion of "weak" yesterday. Because now we're talking about small populations that are not weak in productivity. They only exist because the habitat still exists. They have been fished down below what their full capacity is, and because they're at the lower of their

production range, they're quite productive. They have a high rate of production, so they are sustaining that current harvest rate.

It doesn't mean that that's where we want to keep them. It does mean that if you could restore some of those, you're going to get pretty good return. But some of these returns are small exactly because of what Jim said. Some of these populations are indeed small. So you can look at -- this is the debate that Carl was introducing yesterday about the value of recovering all the biodiversity. If you want to sustain these populations through time, there's absolutely no question in sockeye that if you lose a population, you have lost that genetic lineage. We know this from a number of practical applications or trying to restore fish in systems by transplanting other sockeye, and they do not take. So you even lose the production if you lose the line.

But this is a case where you do have the opportunity to restore. if you have a fairly modest harvest rate, these populations will probably continue to build through time.

Now, we're kind of a long way from your first question in the sense, can you -- is the risk at the very low end high -- you have to get down to pretty small population before you really put the stock at risk because of population dynamics in genetics. The animals do have a finite number of eggs, so they can only recover so quickly. But you'd have to drive them down very low.

They become much more at risk as a very small population because of random events, or when we had higher fishing pressures, just due to the accident of fishing occurring in a limited period of time when a certain stock was going by. But these are all "if" type things. I mean, small is at the higher risk, but small is not unproductive.

Q *All right. Now, some of you have already spoken to aspects of this next question that I have, particularly as regards the evidence on the 2004 paper.*

But my question of the panel now is does the panel agree that there is no historic evidence of catastrophic recruitment failure coming about as a result of extremely high escapement.

I think that's in large measure what the 2004 paper is speaking to.

But am I right in what I say, that no historic evidence of catastrophic recruitment failure from high escapement levels?

DR. WALTERS: No. As we indicated yesterday, there are data more recent than we had that do hint at that possibility for a couple of the stocks, Quesnel, most spectacularly, and Chilko.

Q *You say "hint at", but we haven't seen it, have we?*

MR. WALTERS: No, we see radical drop in recruitment.

Q *Okay.*

MR. WALTERS: Following a period of high spawning stock.

Q *But have you seen it to the level of it being catastrophic to the stock?*

DR. WALTERS: Well, I'd say in the Quesnel case, a drop from in the millions down to in the hundred thousand or so is pretty catastrophic, yes.

Q *The 2004 paper, as I read it, says that there's no evidence that over-escapement will cause a stock collapse. Are you changing your view on that?*

DR. WALTERS: Yes. As we explained yesterday, for two reasons: newer information and the failure in that 2008 paper to have looked at both the Gilhousen work, showing strong cycles back historically, and also the newer data.

Q *Okay. Now --*

DR. WALTERS: (Indiscernible - audio cuts out).

Q *Now, Dr. Riddell, I know has something he wants to say, and I saw Dr. Woodey. I'll leave it to you two to sort out who goes first.*

DR. RIDDELL: Well, I can finish. I think I said yesterday that at that time I would still support what we wrote. So we're kind of mixing two elements here. If your question was is the paper still sound, well, then I agree with Carl, that we have seen an even greater range in escapements now. We have done more analyses, so I think people now would have a different conclusion to be drawn.

Would I personally say that we're still seeing a high risk of catastrophic loss? I don't think so. But Carl is more familiar with the interline interactions than I am at this point, and so it's --

DR. WALTERS: No, it's not a high risk, but we have seen it.

DR. RIDDELL: We have seen it. There isn't any question that there's a time trend in poor marine survival as well in Chilko Lake that we have to be careful that we're not confounding density dependent freshwater effects with marine effects. But there isn't any question that there's a trend in the production from Chilko Lake that we need to be concerned about. And 2010, 1 again, is going to change our outlook on that one.
So, now, in terms of we didn't do the analysis, I think probably a more fair way to express that at this point, if we go back to 2003 when we're doing the work, people are always looking at recruitment analyses in these. Every year, DFO, and in particular Al

Cass, at that time, was going through the recruitment analyses looking at how to improve forecasts, or looking at what changes in production were going on. FRSSI was developing at that time, so there was extensive examination of recruitment functions.

I think really it's in the very much more recent years where the Larkin model was starting to show a better fit. So as I said yesterday, I think it's a matter that we've evolved in the more recent years in terms of looking at things more critically with the Larkin model. At the time, I think we would have drawn the same conclusions, but things have changed.

Q *I haven't forgotten, I'll come to you Dr. Woody. In the 2004 paper at page 16, Exhibit 417, which I think is going to come up on the screen, yes, thank you. It says there at the top:*

> *Our ability to test for effects of over escapement remains limited, but the examples compiled in the technical paper do not indicate any evidence of stock collapse after large spawning escapements.*

Now, I'll start with you, Dr. Riddell, and then Dr. Walters and the move to Dr. Woodey.

Are you in a position now to say - firstly, that's what I understand to be your core conclusion on no evidence of stock collapse after large spawning as put in this paper - are you in a position to now say what your conclusion today would be with the new information that each of you have seen?

I'm not asking you to rewrite your paper as such, or redraft it in today's terms, but are you able to come to a conclusion in a sentence or so as you have in that paper?

DR. RIDDELL: And I think Carl answered that. The examples where we have seen concern building about stock collapse would be the -- is it 2002 brood you're referring to in Quesnel?

DR. WALTERS: Yeah, I think, or -- which one? Jim can answer.

DR. RIDDELL: So what's happened since then? Well, this year, we've had a very good recovery. The other part was Chilko. As I say, Chilko has got a very serious trend in marine survival and production. That is a concern. But there are a number of others. There are 17 other populations that we need to be including as well, and they don't show as much of a change.

So I don't think there's any question that we've seen more evidence that there are interline interactions and because of that, then you would have more concern about stock collapse. But I don't think the evidence strongly supports that stock collapse is a major concern at this point.

MR. WILSON: Mr. Commissioner, I feel I need to jump in here. This issue is quite an important one. We're being asked to entertain the idea that escapements, large escapements on the Fraser bring with them a risk of catastrophic collapse. I noted on my computer yesterday the escapements for the 2010 return are now in. Just over 13 million fish spawned in the Fraser River. It's the highest since we've been keeping adequate records.

I suppose if large escapements are a danger to us, then we have accepted some risk by putting these fish on the spawning grounds. But again, I go back to try and put this in some kind of broader, longer-term perspective, Mr. Commissioner, I'll go back to the Gilhousen data. I recognize that all the runs cycled on the same cycle line in that time prior to the Hell's Gate slide, and I recognize that there are some uncertainties in these data.

Nevertheless, the data that we have in front of us show that every four years, the Fraser River saw returns between 20 and 40 million on the dominant cycle. It's not too much of a stretch, in my view, to imagine periods of time when exploitation of these fish was limited. But the majority of these fish arrived on the spawning grounds unfished.

I find it very difficult to believe, with my experience with the aboriginal fishery in the Fraser, that a run of 40 million would be heavily harvested by First Nations. They simply would be unlikely to have the capacity to use that many fish.

So it seems reasonable to me that prior to Hell's Gate, we not only saw all the stocks cycling together, but we also saw, every four years, escapements that must reasonably have been on the order of 15, 20, 25, 30 million, 40 million would not be unreasonable. This doesn't require us to speculate about how large the runs might have been historically.

There's strong cyclic dominance in this pattern. There's no suggestion of stock collapse at all. To me, the idea that what was an entirely natural, normal and common state of affairs in the Fraser prior to the Hell's Gate slide is somehow detrimental to the biology of Fraser sockeye defies logic.

Q *Again, I apologize, Dr. Woodey. I remember that you wanted to say something. If you'll just bear with me for a few more minutes. It might help the Commissioner, Mr. Wilson, if you were to -- firstly, let me be clear. I'm not inviting anyone to suggest that high escapement gives risk. I'm simply asking the panel to say what they think, and that's what you're doing.*

But, with that, it might be helpful to the Commissioner if you were to speak, Mr. Wilson, to the work that Dr. Riddell and Dr. Walters have spoke of where since 2004, they've seen some new information.

Have you seen or are you familiar with that new information that they're speaking of?

MR. WILSON: I am unaware of what actually underpins the argument that these cycle line interactions are potentially associated with catastrophic stock failure.

Q All right.

MR. WILSON: But I think part of the uncertainty --

DR. WALTERS: You are completely aware of it, Ken. You just spoke of it.

MR. WILSON: Well, fair enough.

DR. WALTERS: (Indiscernible - audio cuts out) fact that three out four years, things are low. That's the counterside --

MR. WILSON: Sure.

DR. WALTERS: -- of saying that one out of every four is high.

MR. WILSON: I accept that --

DR. WALTERS: Three out of four that are low that represent the delayed density dependent or cyclic dominance effect.

MR. WILSON: Well, fair enough. Now, I am --

DR. WALTERS: Those are the --

MR. WILSON: -- not arguing that we should manage Fraser sockeye to allow these sorts of large escapements on a routine basis. I am not suggesting that human yield is not an important component of our deliberations here in any way.

I am simply suggesting that the data that we have in hand show that the Fraser cycled with what Dr. Walters called violent cyclicity in the time period prior to Hell's Gate. Perhaps what we're seeing now is a return to that pattern of production. But it's pretty clear to me that very large escapements, much larger than we saw this year, which is the largest we've seen since Hell's Gate, were absolutely routine in the Fraser and were part of the normal biology of these fish.

I just think we need to get on with the business of talking about how we divide the baby, the Fraser River sockeye returns, into catch and escapement, and what line of argument we want to make to do that work.

The idea that these escapements, even on the order of the escapement seen this year in 2010 are somehow associated with catastrophic stock loss I say is illogical, based on our historical data.

There may be increases in cyclicity that affect the way we manage our fisheries and work to the detriment of our harvests. That's not my point. My point is that very large escapements were once completely normal in the Fraser. We need to leave the idea that there's a bogeyman here that's associated with high escapements that make it a bad thing, and get on with the business of trying to decide how many Fraser sockeye to kill.

Q *Dr. Woodey, I should let you have a few words now. You've been wanting to get in. I think you initially wanted to get in on whether, still today, the idea that there's no evidence of over escapement leading to stock collapse, but I'll turn it over to you now.*

DR. WOODEY: Thank you. Mr. Commissioner, the reason that there was very little evidence of over escapement in the years up until 2000 or so was that the annual runs were managed for harvest, and so the dataset that we have to analyze our situations that we had relatively few individual year situations where individual stocks had escapements that were over about double the escapement; that is, it was intentionally managed to take the yield in the fisheries.

Since that time, because of the Late run sockeye issues that I harp on, we've ended up with seeing large escapements, much larger escapements than some of these more recent years, so escapements are exceeding the escapement level during that 60-year period of fisheries management where all of the stocks were behaving normally.

In a sense, **we're conducting big experiment by seeing these large escapements**, and as we are seeing these large escapements fail to produce, we're learning more as to what the optimal escapements are. But, at the same time, we're seeing these failures starting to show up, because it's been only in the last eight or ten years that we've experienced these very large escapements.

The 2010 escapements total - I'm not 100 percent sure that it is the largest - but I accept what Ken says because I think he's right. The 2010 escapement for the watershed is the largest since -- in recorded history.

But I'll turn to what Ken was talking about as far as escapement levels and productivity. In the late 1880s and early 1990s until the Hell's Gate slide in 1913, those large runs of up to 40 million were harvested heavily. We had up to 5000 gillnet vessels fishing in the Fraser River and lower Strait of Georgia. We had a large number of traps in the U.S. which are set nets that are corralling the fish and so on. The harvest rates were high, so escapement levels at 40 million total run may not have exceeded, say, 10 million.

I was looking in Gilhousen's. Somewhere in there he's got the numbers, the estimates.

Escapement levels were not high in those early 1900s either. But what had happened is that if you look back at the information -- and I doubt that it's in the files here, and Carl can answer that -- Sandy Argue and Mike Shephard's report on that earlier historical data indicate that you had the same dominant year cycle going through, but the off years were larger, and the dominant years lower. Those would have been at lower harvest rates, so I don't know, but I suspect that the escapement levels in those time periods were not excessive.

MR. WILSON: I agree with Dr. Woodey's point. I was referring to the data from 1893 to 1913 that are provided in Gilhousen as perhaps representative of a pattern of production that went back prior to the onset of commercial fishing. Salmon have entered the Fraser for thousands of years, and I'm simply making the argument that prior to the onset of commercial fishing, if the pattern that we've observed prior to Hell's Gate were to have held, that very large escapements would have been absolutely routine and expected on the Fraser River, and the 20 to 40 million fish is probably not an outrageous estimate of the spawning escapement on the Fraser River prior to the onset of commercial harvest on the dominant year. That's all I was trying to point out.

Q *All right. Just to see if the panel is -- oh, I'm sorry. Dr. Walters*.

DR. WALTERS: Yeah, it just occurred to me in this last little discussion that there's something that those of us who work on the system know about and others wouldn't.

That is that we speak about the Hell's Gate disaster as something really bad when the stocks were severely knocked down, but in a way, it was a lucky thing because it broke up the synchrony in the cycles so that as the stocks recovered after 1913 through the 20th century, instead of having only one good year out of four for returns, we, coming up into the '90s, had two good years out of four, for fishing.

One fear is that if stocks become synchronized again, we'll be back to just one out of four good years, which is not a good situation economically or socially for people who depend on the fish.

So in the sense that our high escapements may trigger that resynchronization or trigger the periods of low stocks regularly in between the dominant runs, I don't think we want to see that kind of over-escapement.

Q *All right. I think I'm hearing all of the panel members say that the work on the effects or consequences of over-escapement remains a work in progress. Am I right, Dr. Woodey? Is that a fair summary of what I think I heard you and others saying?*

DR. WOODEY: Yes, Mr. Commissioner. We're now experiencing these over-escapements, and because of that, I think our view of the world will change over the next ten years. But I personally don't expect that the MSY levels that we're currently

seeing in the datasets we have to analyze, I don't see those as changing. The optimal escapement I don't see changing.

We do have generally now datapoints beyond them as why they've shown decreased productivity principally because of juvenile survival and growth in the lakes that are causing the survival rates in the ocean to go down in those individual years.

But we are in the period of having a large experiment being conducted as a result of the current policy, which is to limit the harvest rates on Late run sockeye and thus allow large escapements of Summer runs.