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SPECIAL COMMITTEE ON
SUSTAINABLE AQUACULTURE

Vancouver
Monday, January 29, 2007
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ROBIN AUSTIN, MLA, CHAIR

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**SPECIAL COMMITTEE ON
SUSTAINABLE AQUACULTURE**

Vancouver
Monday, January 29, 2007

Chair:

* Robin Austin (Skeena NDP)

Deputy Chair:

Ron Cantelon (Nanaimo-Parksville L)

Members:

* Al Horning (Kelowna-Lake Country L)
* Daniel Jarvis (North Vancouver-Seymour L)
John Yap (Richmond-Steveston L)
Gary Coons (North Coast NDP)
Scott Fraser (Alberni-Qualicum NDP)
* Gregor Robertson (Vancouver-Fairview NDP)
* Shane Simpson (Vancouver-Hastings NDP)
Claire Trevena (North Island NDP)

**denotes member present*

Clerk:

Kate Ryan-Lloyd

Committee Staff:

Brant Felker (Committee Research Analyst)

Witnesses:

Jennifer Ford
Dr. Patrick Gargan (Central Fisheries Board, Ireland)
Dr. Sigurður Guðjónsson (Director, Institute of Freshwater Fisheries,
Iceland)
Dr. Craig Orr (Executive Director, Watershed Watch Salmon Society)

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MINUTES

SPECIAL COMMITTEE ON SUSTAINABLE AQUACULTURE



Monday, January 29, 2007

9 a.m.

20 ICBC Concourse Salon B
Morris J. Wosk Centre for Dialogue, Vancouver

Present: Robin Austin, MLA (Chair); Al Horning, MLA; Daniel Jarvis, MLA; Gregor Robertson, MLA;
Shane Simpson, MLA

Unavoidably Absent: Ron Cantelon, MLA (Deputy Chair); Gary Coons, MLA; Scott Fraser, MLA;
Claire Trevena, MLA; John Yap, MLA

1. The Chair called the Committee to order at 9:12 a.m.
2. Opening statement by the Chair, Robin Austin, MLA.
3. The following witnesses appeared before the Committee and answered questions:
Craig Orr, Executive Director, Watershed Watch Salmon Society
Jennifer Ford, Dalhousie University
Sigurdur Gudjonsson, Director, Institute of Freshwater Fisheries, Iceland
Patrick Gargan, Senior Fisheries Research Officer, Central Fisheries Board, Ireland
4. The Committee adjourned to the call of the Chair at 10:57 a.m.

Robin Austin, MLA
Chair

Kate Ryan-Lloyd
Clerk Assistant and
Committee Clerk

MONDAY, JANUARY 29, 2007

The committee met at 9:12 a.m.

[R. Austin in the chair.]

R. Austin (Chair): Good morning, and welcome. My name is Robin Austin. I am the Chair of the Special Committee on Sustainable Aquaculture of the Legislative Assembly of British Columbia.

We are here today to meet with a group of scientists — a couple from Europe and one from eastern Canada — who will be speaking on a variety of aquaculture-related issues. I understand that we have three short presentations today and would like to suggest that after each presentation, we will open the floor to members for questions.

I'd like to point out that the Deputy Chair, Ron Cantelon, and Scott Fraser are delayed due to the fog but will be joining us as quickly as they can get here.

I would also like to note that today's meeting of the committee is a public meeting which will be recorded and transcribed by Hansard Services. A copy of today's transcript, along with the minutes of this meeting, will be printed and will be made available on the committees website at www.leg.bc.ca/cmt/aquaculture. As well, an audio recording of today's meeting will be archived on this website.

Before we begin, I would ask committee members to introduce themselves, starting on my far right.

D. Jarvis: My name is Daniel Jarvis, and I represent the area of North Vancouver.

A. Horning: I'm Al Horning. I'm the MLA for Kelowna-Lake Country.

G. Robertson: Gregor Robertson, Vancouver-Fairview.

S. Simpson: Shane Simpson, Vancouver-Hastings.

R. Austin (Chair): I would now like to ask Craig Orr, who I believe has been travelling with these scientists for the last few days, to introduce the scientists to us.

C. Orr: My name is Craig Orr, with Watershed Watch Salmon Society. I was also on the steering committee of the recent Alert Bay sea lice meeting, which was a very exciting chance to hear from international members of the scientific community working on the issue of aquaculture. We're very fortunate to have several of them agree to come and speak to this committee.

We had been planning this meeting for well over a year, so we didn't do it to coincide with this committee's deliberations. It was just a fortunate coincidence. We would have had more people here, but apparently British Airways is going on strike tomorrow, and we could not change the flights of some of the folks that would come. But we have an excellent cross-section from that meeting, and I'd just like to introduce them, starting on my left.

We're very fortunate to hear from Jennifer Ford, who has been doing research around fisheries and marine conservation in Nova Scotia for several years. She has recently completed a master of science thesis entitled *Demonstration of an Impact of Salmon Farming on Survival of Wild Salmonids in the North Atlantic and Pacific, Using Population Dynamics Data*. She gave an excellent presentation in Alert Bay, and we're happy to have her here to tell you what she's been filing for her research.

[0915]

On her left we have Sigurður Guðjónsson. We know him as Siggy. He has been working at the Institute of Freshwater Fisheries in Iceland, first as a scientist and since 1997 as the director. The institute's role is to do research and development regarding freshwater fisheries and aquaculture. The institute is governmental and works closely with the authorities and the ministries regarding management of the resources.

Dr. Guðjónsson's research has been mainly with Atlantic salmon, studying life history strategies and river classification as well as salmon population genetics. In later years he focused on fisheries management and management of the freshwater fisheries resource. He's going to tell you how they deal with the regulation of aquaculture in Iceland.

On his left, I'm happy to introduce Paddy Gargan, who's a senior research officer with the Central Fisheries Board in Dublin. The Central Fisheries Board has responsibility for the management, development, protection and research of salmon and sea trout stocks in fresh water. The board has been concerned regarding potential impact of sea lice from marine salmon farms and wild salmonid stocks for many years, and Dr. Gargan is making his third trip to British Columbia to participate in scientific workshops.

We're very pleased that all three of these scientists have taken the time to make their presentations today, and we feel that they'll be very important for this committee's deliberations. I won't take up any more time. Did you want to go in the order of how...?

R. Austin (Chair): That'll be great — in the order that you just introduced them. I invite Jennifer to make the first presentation.

Presentations

J. Ford: Thanks for having me today. As Craig said, I've just finished some work at Dalhousie University, so I'm going to go through the study that I've been doing there. The title of the talk is "Demonstration of an Impact of Salmon Farming on Survival of Wild Salmonids in the North Atlantic and Pacific."

I'm sure you've been hearing about a lot of prior research on this topic in this meeting. There have been a lot of scientific conferences held, and there are a number of well-established interactions between wild fish and salmon farming, including transmission of disease and parasites, genetic introgression of escaped farm salmon into wild populations — certainly in the Atlantic is really well established.

There are non-native species escaping from salmon farms and establishing in British Columbia, Chile and other places. That's known to happen. Predator enhancement — concentration of predators around farms and their effects from pollution. So there are a lot of well-understood impacts of salmon farming on populations, a lot of well-understood interactions, but it's been really difficult to get at the question of how important those interactions are on a population level for salmon. Even if we know that disease and parasites get transmitted between farms and wild populations, it's been hard to work out how important that is for salmon populations, especially because we know that a lot of other things affect wild salmon, like climate and fisheries. Teasing out that impact of salmon farming has been really difficult.

There's a lot of information about wild salmon in many locations, so we wanted to see if we could use that existing information about salmon populations to tease out that impact of salmon farming at a population level.

We've used a variety of different kinds of data — estimates of returns to rivers. In the North Atlantic there are a lot of counts of salmon in individual rivers. Here you have escapement estimates that are usually, because the rivers are so much larger and so much more remote, more approximate. We have them for lots of rivers. There are catch records, I think both commercial and recreational, anywhere that salmon exist. Also, there are records of production of farmed salmon in different regions. So we've taken a lot of different kinds of data from different places to try to get at this question.

[0920]

The basic technique is to use paired comparisons. This is just a cartoon involving hypothetical salmon farms. In the Atlantic it works really well, because nobody recognizes where this is. If you recognize this place, just pretend that you don't. The little red boxes are hypothetical salmon farms. The idea is that if we know something about the population in the black river and the blue river, and in the blue river salmon are out-migrating past salmon farms and swimming up the coast along the arrow there, then we would consider the blue river to be exposed to salmon farming and the black river not to be exposed to salmon farming.

Because we have information from the black river, we can use it to control for changes from climate and to a certain extent fisheries management — although ideally we would have fisheries data for both rivers, and normally we would — and other habitat impacts sometimes. But climate would be the big one.

That's the idea — to use paired comparisons in this way to tease out the impact of salmon farming on populations. In practice, we usually have a group of rivers that we would consider to be exposed to salmon farming and a group of relatively nearby rivers that we would consider to be controls.

I'm just going to go through this. The process, basically, is to learn about the salmon-farming industry in an area; learn about the wild salmon and trout populations

and get an understanding of their history, enhancement, fishing; develop the comparison and then work with local scientists in each place to get the data, to understand it and to get feedback on what we're doing.

I've been in contact with lots of people at DFO here in the Pacific and in the Atlantic to talk about the data from their regions. I'm just going to go through what we've got — comparisons in Ireland, Scotland, Newfoundland, New Brunswick and Nova Scotia, and then here in British Columbia. We're looking at salmon farming in Johnstone Strait and near Discovery Passage and comparing salmon populations for pink, chum and coho salmon in Bella Bella — it's marked there as area 8 — and then, I think, in Smith Inlet and Rivers Inlet — areas 9, 10 and 11 — using those areas as controls and then comparing to Johnstone Strait and Discovery Passage and mainland rivers considered to be exposed to salmon farming.

The way this actually happens is by using a river model, which is a very common model in fisheries that just compares the number of salmon that spawn in a river to the number of their progeny that return. It's a way of measuring how well salmon are surviving over their life cycle. We add into that model the amount of salmon farming that happens in a given area.

Basically, you measure their survival, and then you look for an impact of salmon farming in the area statistically. When we do that, we can get an estimate of the percent change in salmon survival that is related to salmon farming on a per-tonne basis. These are the estimates that we get running the model two different ways.

What's important here is that we see negative impacts in almost every case. They're statistically significant in most cases. Where we don't see statistically significant impacts is in Ireland, which may be a problem with data or may not — I don't know — B.C. coho and B.C. chum. But we do see a significant reduction in survival associated with aquaculture in the pink populations here, as well as the Atlantic Canadian populations that we've looked at.

The diamond at the bottom is a random-effects mean, which is a weighted mean of all these other measurements. The reason for doing so many comparisons is that in every case, you can't be totally positive you've captured everything that's important that is happening in the population. What's a more robust estimate of impact is to combine all of those together and get the average.

That's the average, essentially, at the bottom, and the tallest part of the diamond is the point estimate, I guess. That works out to be about a 1-percent reduction in survival for each generation of salmon per tonne of aquaculture. Then the width of the diamond is the confidence intervals. It's an interval like all of those others, but it's just displayed differently, graphically, to draw attention to it.

This is per tonne of salmon farming — a 1-percent reduction per generation. Then we've multiplied that up to look at the amount of production that actually happens. In British Columbia you have, I think, in the

area of 30,000 tonnes of salmon harvested from farms every year. Maybe two-thirds of that happens in the Johnstone Strait and Discovery Passage areas.

[0925]

If you've got 20,000 tonnes of salmon farming, then you have these reductions in survival. Most of these are down around 50 percent. Our overall estimate is a reduction in survival that is around 50 percent for a lot of these populations related to salmon farming.

I should say that in most of these cases, our control areas have experienced declines, as have the exposed areas. But this is a measure of how much faster exposed populations are declining than controls. Those are the results.

When I talk about this, there are a couple of points that I think are important. One is that we focused on places where juvenile salmon migrate past farms, not necessarily places where other types of impacts of salmon farming like genetic introgression might be occurring — so looking at probably disease impacts more than genetic impacts.

There have been reductions in fisheries in all these places that are really large, though. I'm sure you're all aware that in southern British Columbia, there have been big reductions in salmon fisheries in the last ten years. That's true in most places. The reductions in survival that we're finding are really large — 50 percent is a huge reduction — but we know there are reductions in survival in all of these populations that are extremely large.

We used to fish out maybe 70 percent or 50 percent of the fish as they came back to the rivers. We don't do that anymore, and the populations have continued to decline. So there is a big reduction in survival to look for in these populations.

Also, the last point there: temporal dependence. In each case we've looked at the beginning of salmon farming in a region. I think there are good reasons to think that the beginning of salmon farming... Or maybe there's an intermediate period where the impact on a per-tonne basis would be higher because maybe you haven't got a handle on escapes or disease yet. Presumably, as time goes on, if you manage your farms better, then these impacts would come down on a volume basis. If I added another ten years of data in each of these places, I think you might get a different impact.

I think these represent sort of what has happened to salmon populations. What will happen to salmon populations may be different, depending on how differently farming operates. That's the end.

The conclusion is that the random-effects means are significantly below zero. I think that's strong evidence that salmon farming has negatively impacted the populations that we've looked at, and the weighted mean, again, is about a 1-percent decrease in survival per tonne of farmed salmon production in each region. That's it.

R. Austin (Chair): Thank you, Jennifer. I'd like to open the floor to members' questions.

S. Simpson: You talked about the reductions that we would potentially anticipate in returns separate from... I know that you may not have this data. There's a level of reductions based on other factors — whether it be climate, food, whatever those might be — and we're seeing that. We're seeing that throughout the fisheries everywhere. We're not getting the kinds of returns we did before.

The 1-percent decrease in survival per tonne — is that before or after you've factored out what those other implications might be?

J. Ford: That's after. That's a relative decrease. That's how much faster salmon populations in areas with farms are declining than salmon populations in areas without farms, for example.

S. Simpson: So then, just to be clear, there are other factors that might be there. There's a level that you can kind of project or set what that level might be, based on other experiences in other places, and then say: "On top of that, there appears to be this 1-percent decrease per tonne farmed in addition to that." That's the figure that we're talking about here — the 1 percent.

J. Ford: That's right. You're right — yes.

D. Jarvis: Jennifer, can you go back again to your charts up there? The first one — to start with, I guess — on survival and return. I'm assuming that on the dotted line on the right side of each chart... Where is the return on there? I noticed you showed the pinks. I haven't got my charts here, but the pink one looks like it's very low, where we've had in the last few years quite a large return in pinks.

[0930]

J. Ford: Oh yeah. In this case, we can look at how pinks are returning along the entire coast, sort of from Bella Bella south. Where we've had large returns, it tends to be on the entire coast. So a result like this would occur when... For example, if you had a large return on the entire coast, but that return was somewhat smaller in areas where salmon farms are, you would get a signal like that.

There's kind of a change happening in all the populations together, but in areas where there is salmon farming, it appears that things are slightly lower. Does that make sense? All the populations are changing together, to an extent. But in areas where there are salmon farms, there is more change, or there is a lower return on average.

D. Jarvis: Were you afforded the opportunity to look at that chart of pink salmon returns back since the...? As I say, I'm sorry I didn't have my chart with me, but it was approximately 1940 or 1950-ish, showing the returns in the Broughton Archipelago, which is exactly in that area.

J. Ford: I know what you mean, yeah.

D. Jarvis: It showed that the normal return of the pinks was up and down, as you say. Then there were lows, which were lower than today's lows, prior to salmon farming going in. One of the largest runs we ever had was after the salmon farms were put in, just one or two years ago.

J. Ford: Right.

D. Jarvis: But that was all in that specific area.

J. Ford: Yeah. I can picture the kind of chart that you're talking about. There are a couple of factors. One is that when we had good years in the Broughton — and you're right; there were some very high return years — we also had high return years all along the coast. But there were years that returns were much higher in other places than they were in the Broughton area, so something like that would show up in this estimate. The data that actually goes into this starts in 1970 instead of the '50s, on the advice of B.C. salmon scientists, who said that you can't compare data from the '50s because the collection methods were so different.

The other thing that has happened that we're adjusting for, which may not be adjusted for in the diagram that you're talking about, is that a couple of very large salmon spawning channels were built in the Broughton area in the 1980s. Those seem to have been very successful, so there's been a big increase in some of those rivers. Hundreds of thousands of salmon have started to come back to those spawning channels. So if you were looking over time, there's a big jump there.

We've taken those rivers out, because if you want to compare the trend in survival, it sort of fudges it, I guess, to have this big.... It's sort of like having a hatchery there and adding it in to your wild returns, starting in 1985. It looks like you're getting way more wild fish back, but really what you're getting back are these other salmon.

Those are some possible explanations. I do know what you mean. We've also closed fisheries in that area, so some of the returns to the rivers are large because the fisheries are gone.

D. Jarvis: What do you attribute all this to?

J. Ford: What do I attribute the good returns to?

D. Jarvis: No, the fact that the basically low returns since 1970 have been diminishing.

J. Ford: Well, I expect that on a coast-wide basis, they are probably attributable to a combination of climate and habitat change. But I think we're also seeing, statistically, a signal from salmon farming. There is habitat change. There is climate. And probably, in addition, there is salmon farming, which has changed all of those.

D. Jarvis: Is any of your information based on the fact that there has been — how do I put it? — offshore predation?

J. Ford: Offshore...?

D. Jarvis: Predation of the salmon — you know, animal and/or human.

J. Ford: Well, we've got fisheries in B.C. included in the models here. I think that by including all these different regions together, we are, in this model, accounting for those kinds of really broad-scale changes. Things that would affect all the populations together — like changes in predation at sea and also fisheries that happen on the high seas, and climate — would all be sort of rolled in here.

[0935]

D. Jarvis: Did you do your own study out here?

J. Ford: I'm using data from the Department of Fisheries and Oceans

D. Jarvis: All this information is from the DFO?

J. Ford: Yes.

S. Simpson: What is the time frame for this piece of research — from when to when?

J. Ford: It varies a little. Most of the data starts in the 1970s and ends around 2002-2003.

G. Robertson: So the last data used is 2002 or 2003?

J. Ford: I think so, yeah.

G. Robertson: And is there more recent data available than that? We've seen the numbers on the farms, I believe, increase significantly, even since that time.

J. Ford: Right. I did finish this part in the summer, maybe about six months ago. Since then, possibly, 2004.... There is a lag from when the Department of Fisheries and Oceans gets it worked up and feel they understand it well enough to release it to the public.

I guess we're in 2007 now, so 2005 may or may not be available. I'm not sure. I didn't have it at the time, but it might be available now.

G. Robertson: Do you have a model built where you can turn that data around relatively quickly?

J. Ford: Yes. If I had the data, I could turn it around relatively quickly.

G. Robertson: It would probably be valuable for us to see if there's been any increase or change since that related to more density on the farms — if that happens in the next month.

A question: were chinook purposefully left out of this research?

J. Ford: No, I wouldn't say.... Well, chinook are not there, for a couple of reasons. One is that in areas where we are, chinook populations are relatively small, so problems with counting become a bigger deal. They're counted in fewer rivers than those in the mainland — like in the archipelago — fewer rivers, for example, than pink, coho and chum.

There's also been a change, apparently, in the way the chinook populations specifically are counted in a lot of rivers. So they're left out for a variety of data availability reasons.

G. Robertson: Final question. It looks from your data like the impacts in the Maritimes are significantly larger than your data show for B.C. Has there been a response or a change in policy in the Maritimes resulting from this data?

J. Ford: Not resulting from this data, no. The inner Bay of Fundy salmon populations are COSEWIC-listed now, so they're considered to be endangered. It's a very different situation in that our salmon populations are very small now and in very bad shape everywhere, I guess. Salmon farming itself has been down the list of things that people are concerned about as far as salmon out there. It just hasn't attracted the same kind of attention as it has here.

D. Jarvis: I wanted to go back to your charts again, because I'm trying to visualize, in your 0.04 and your 0.00.... That's per what?

J. Ford: That's the percentage change in survival of the salmon population per tonne of salmon farming. The dashed line, which you mentioned, is no change in survival. If the point is on the dashed line, then we don't find any impact of salmon farming. There are changes in survival of the population, but none of them in the models are related to salmon farming.

D. Jarvis: Which is the best — 0.04 or 0.00?

J. Ford: The best is 0.00.

D. Jarvis: Why is Ireland...? Do they not have any impact from salmon farming?

J. Ford: Well, I think Paddy will describe that. No, I don't think that's the case. In the data set that I've used from Ireland, I didn't find an impact of salmon farming. It may be that the data I had on salmon farming itself was not spatially.... It was just for the entire country, not on a bay-by-bay basis. I've been talking to Paddy this weekend about this.

[0940]

It's possible that it would be different if you had salmon farming in Ireland on the bay — if you had the salmon-farming data on the same spatial scale as the

farm so that on the bay you knew whether or not there was salmon farming there in a given year.

I didn't find an impact in the data set that I had. It may be a data problem, or it may not. I don't know.

D. Jarvis: Could I ask one more question? For example, on the chart on the left where B.C. coho and B.C. chum are bordering that line or on the line, there's been no significant difference in the survival and returns of those stocks since 1970. Is that ostensibly what you mean?

J. Ford: What I mean is that there have been changes in survival of those populations, but none of them appear to be related to salmon farming. When we do the model, statistically they don't seem to be correlated, I guess, with the increase in salmon farming.

R. Austin (Chair): Great. Thank you very much for your presentation, Jennifer. I'd now like to invite Mr. Guðjónsson to make his presentation.

Also, Jennifer, can we have a hard copy of your presentation? Maybe you can give it to Brant. Thanks.

S. Guðjónsson: Committee, Mr. Chairman, it's very nice being here with you all today. It's been a pleasure being here in your beautiful surroundings for the last two days. I did my PhD study down in Oregon. It's always nice to come back to the west.

What I'm going to present to you today is really a short version of what I did up in Alert Bay, and I'll try to give you some insight into how we deal with those things in Iceland.

Just to give you some information about the situation in Iceland, we have a very diverse environment in our rivers. They are very different from each other, mainly because we have different kinds of bedrock. We have old bedrock, and then we have these volcanic zones cutting through the island. The rivers in those different areas are very different from each other.

Also, since we are on an island in the middle of the Atlantic Ocean, we have few species, so we have a very special kind of fauna. That, I think, is very valuable for us to preserve.

I and my colleague did a study of Icelandic salmon stocks. In short, we have a special population, genetically different from each other, in all our major salmon rivers. We have also imported salmon from Norway for farming, and they are very different from the Icelandic ones.

[0945]

We have a rather special situation, I think, regarding the management of salmon in Iceland. Since 1932 the ocean fishing of salmon has been banned. The rivers are very strictly managed. They only allow a certain number of rods for a limited number of days in each river. Like in other places we have lots of fluctuation in our populations, mostly due to environmental conditions.

One thing that is rather different from other places is that the fishing rights in our rivers are privately owned. This goes way back from the settlement of Iceland. Mostly these are farmers that own the land

along the rivers, and these landowners, farmers in most cases, had to form a fishing association for the watershed. That's the management unit, really, and these fishing associations have a federation.

We've got about 100 salmon rivers in Iceland. Twenty of them are very good, with some thousands of salmon caught every year. They offer very sophisticated facilities, good houses, and usually people buy packages where everything is included for some days. It's expensive to fish in the best rivers at prime time, but the prices have been going up as the demand has.

We did a study on the economy of the sport fishery in Iceland, and as you can see, we are getting a lot of money from the salmon fishery. It's about ten thousand million Icelandic krónur. I tried to convert that into Canadian dollars. Some of that income goes to the landowners along the rivers. I think we are getting a very high income per salmon.

Sport-fishing is very popular in Iceland, so about one-third of the Icelanders are active in that sport. You can also fish for low prices in many of the trout and char lakes and streams. Just to give you some idea, in the west of Iceland about half the income of the people in the rural areas comes from the fishery. But it's lower in other parts, as fishing is not so much.

Sport-fishing creates about 1,200 jobs every year in Iceland. It has also been estimated that if we were to lose all our salmon, the net loss to the economy has been calculated as being one-third of the turnover in the business. We are now developing the fishing of trout and char, and it has high potential for getting higher income from that sector. That's the development of the fishing of Icelandic salmon. As you can see, it's going down most of the time.

The situation for the species as a whole. We lost 27 percent of our salmon stocks worldwide, and it's endangered in about one-third more. We don't have much left on a worldwide basis, but the reasons are numerous, as you can imagine.

[0950]

To go to the salmon farming in Iceland, we started in the mid-'80s, and it was not so successful in those days. People tried in many places. Some of the farms are still going, but they are usually small. Many of them stopped their operations because they were not making money, and there were all kinds of problems in the very beginning.

From that time salmon have also been bred in some land-based units. They pump sea to those tanks on land, and they also use geothermal energy to heat up the breeding water or the breeding sea.

In 2000 the commercial fishing companies wanted to go into salmon farming, so there was a lot of discussion in Iceland as to how to manage these things. People didn't want to relive the past experience of the '80s. The parliament changed the law to make it easier to manage and regulate the farms. It also made it possible to protect certain areas from salmon farming there.

The risks were analyzed. We know that the salmon escape from cages. The fish farms were using a Norwegian strain that in New Zealand caused greater

concern. There are problems with diseases and parasites. But what people feared most was the genetic mixing, the breakdown of the local adaptations of the different salmon stocks. There are also ecological effects because of feces and food that accumulate around the farmsites.

There is a lot of knowledge about how escaped salmon might behave. The survival of stocks of salmon depends on their size and the time of the year when they escape. To make a long story short, the rivers that are closest to the farming sites will be heavily influenced. Rivers that are further away are at lower risk. We know from the '80s and the '90s that in some places we have problems with sea lice if the farms were outside salmon rivers.

There were three main things that we wanted to protect. There were our salmon stocks, just as part of our nature, and the salmon fisheries, which are very valuable for the economy of the countryside. Then we protected some areas by banning salmon farming closest to our main salmon rivers. That's how it went.

Inside those red lines at the base of the fjords — you can't farm salmon in there. In those areas we have about 85 percent of our salmon stocks. But in other areas you are allowed to farm salmon. Still, you have to go through an environmental assessment. Those farms that are allowed today have very strict regulation, and they have to behave in a decent manner. That was the end of my presentation.

[0955]

R. Austin (Chair): Thank you very much, Mr. Guðjónsson. I'm going to open the floor to questions.

A. Horning: I noticed at the beginning where you had the figure of \$200 billion. Is that correct, or is that an incorrect figure you have there? Go back to about the second or third slide. Right there — \$200 billion Canadian.

S. Guðjónsson: I think my conversion is right, yes. It's a lot of money. It's the total turnover, you know.

P. Gargan: Is it not \$200 million?

A. Horning: Instead of billion?

S. Guðjónsson: Well, it could be wrong. But you know there are 50 Icelandic krónur in one Canadian dollar.

A. Horning: I don't know the conversion, but....

A Voice: It'd be million.

S. Guðjónsson: Okay. I'm sorry. Better correct that, then. So that should be....

D. Jarvis: Thank you for your presentation. We're going to let you out of here, but I wonder if you could tell me if there's any difference in the way we farm salmon and yourselves. Are we doing a reasonably good job or a bad job? Don't be afraid to tell us the truth.

S. Guðjónsson: Of course, I don't know exactly how you are managing your salmon farms, but from what I gathered during these few days I've been here, I think we have more.... Well, first of all, I think we do better environmental assessments before they start, and I think they also have tighter or stricter management on a day-to-day basis than you have. In some of these places along the major migration route of the juveniles coming from your rivers — we would never allow salmon farms in there.

D. Jarvis: We've had our escapes down to very few escapes, and the latest figures of our farm fish are, basically, minimal. It used to be quite high at one time, where you'd see thousands of them escaping. Now it's down to a matter of less than hundreds in most instances.

What I was going to ask you.... You were mentioning about genetic mixing. We only have one type of Atlantic here. There's always a worry here that the escaped Atlantics are going to genetically be involved with the coho and the chum and all the rest of it. You said you had genetic mixing in there, but you're talking about the same species — aren't you?

S. Guðjónsson: Yes. In Iceland we have Atlantic salmon, and we are farming Atlantic salmon of a different strain. So that's why we are worried. But you are farming Atlantic salmon here, and you don't have it in your rivers. So you will not have genetic mixing. There is nothing to mix to. But they could probably establish themselves in some of your more fertile rivers, I would guess.

D. Jarvis: So far there are reports, but there's been no specific scientific evidence to show that they have been multiplying in the rivers in British Columbia.

S. Guðjónsson: Many of your rivers will not foster Atlantic salmon.

D. Jarvis: Yeah, right. They don't survive there.

S. Guðjónsson: But in other small, fertile rivers they could.

[1000]

D. Jarvis: Yeah. Okay.

Last question, if you don't mind. In your map there, the last diagram of Iceland and those restricted areas, it showed that basically — it seemed to me, anyway — you had maybe 75 percent of Iceland restricted.

Like this Latrabjarg — that area there — up to.... I can't speak your language, but what areas are down here? Are there no rivers down in this area? Or are there lots of rivers where the farms are, down through here on this southern border, say?

S. Guðjónsson: There's really no need to protect the southern coast, because it's so exposed. There's no way to have salmon farms in there.

D. Jarvis: Oh, I see. Yes, okay.

S. Guðjónsson: But in the fjords in the northwest and in the east they have very few and very small salmon rivers but very good sheltered sites for farms. That's why it's open.

D. Jarvis: So where the red lines are....

S. Guðjónsson: Inside the red lines it's banned.

D. Jarvis: And that looks like it's about 80 or 90 percent of the good salmon area.

S. Guðjónsson: Yeah.

D. Jarvis: It is. And you're still bringing in a couple of hundred million dollars a year on those small areas that you've allowed salmon farming. Do you understand what I mean?

S. Guðjónsson: I'm not quite sure.

D. Jarvis: I mean, you're making a very good return on salmon farming, dollar-wise.

S. Guðjónsson: Well, that's salmon fishing.

D. Jarvis: There are minimal areas up there that you're allowed to salmon-farm.

S. Guðjónsson: Yeah, those figures were from the fishing.

D. Jarvis: So that's fishing generally.

S. Guðjónsson: No. Salmon fishing, sport-fishing for salmon.

D. Jarvis: Okay, I see what you mean. I was misinterpreted there. Thank you.

R. Austin (Chair): Could I just ask for clarification for us? How many salmon farms do you have in the areas that are actually open for salmon farming in Iceland?

S. Guðjónsson: Well, the companies.... There are some sites, but there are maybe within ten companies that are farming salmon.

R. Austin (Chair): How many farms do they have?

S. Guðjónsson: One of them is by far the largest, and it has four farms.

S. Simpson: The way that you choose to regulate. You talked about the regulatory regime in Iceland. I'd be interested to know how proactive that is, because here in British Columbia we use a stewardship model, a results-based model, for much of what we do, which is a situation where there are a series of standards set

by government. Then, essentially, in large part the industry is left to regulate itself to achieve those standards. Then there is some reporting out.

Much of the records-keeping is kept by the industry itself and held by the industry, and there is some reporting out to government about meeting those standards, reporting out on things like escapes and those kinds of things. But most of the information is held, and it's largely self-regulatory within the standards set by government. There's a lot of debate about whether that is the best approach to take or whether government has to have more oversight itself and actually be actively on the farms regulating more directly.

I'd be interested to know how that gets pursued in Iceland.

S. Guðjónsson: Mostly we depend upon the companies themselves, but the government officials can come into the farms at any time and do their own inspections. The company also must have a diary of everything that is going on — how much scope they are using, how many fish they are putting into their cages, how many they are taking out. If there are any major escapes, they must report them immediately and start fishing around their cages, trying to minimize the damage. So yeah, that's more or less how we do it.

[1005]

S. Simpson: For the current fish farms you have.... There's generally a size of farms that we have that's pretty standard in terms of number of fish that will be there when the farms are active. Is there a standard size for the farms that you have?

S. Guðjónsson: Not really. Salmon farming isn't that big. I think this year we are producing 5,000 or 6,000 tonnes. The largest farms are on the coast of east Iceland, and they are producing maybe 2,000 to 3,000 tonnes a year. I think in a few years it will decrease. These companies are going more and more into char farming — getting a better return from that business.

R. Austin (Chair): Thank you very much for your presentation, Mr. Guðjónsson.

I'd now like to invite Paddy Gargan.

P. Gargan: Thank you very much. I'm delighted to be here to be able to give you some experience from over the last 20 years in Ireland. I work for the Central Fisheries Board, which is a government body, a government board managed with protecting wild stocks. We have been working on the salmon-farming issue since 1989 — I personally from 1989. We've a long history of investigating the problem, and I hope I can give you our experience.

I've taken the liberty of then comparing our situation with yours and making some suggestions based on what I've heard and our trip around the Broughton Archipelago. I may not understand fully everything that's happening, but I just thought it worthwhile to give my opinion on what possible solutions there might be.

Salmon farming began in Ireland in the mid-1980s. We have salmon and sea trout fisheries. We noticed very quickly after the advent of salmon farming that our sea trout stocks collapsed. The graph on the bottom is just one area, one district. There are 17 districts in the country, but this was the one impacted severely by salmon farming. We did see very severe....

These are sport fisheries. These are all angling-caught fish, and a lot of industry built up around people coming, mainly from Britain, to fish for sea trout in the west. We almost lost our stocks. There were quite a bit of management initiatives put in to try and achieve better management on salmon farms. We had some recoveries, but we're still hovering around a very low level compared to what it was in the previous 20 years.

[1010]

All our salmon farming is on the west coast. In this area on the west we have done a lot of research — in the area of river 20 to about river 37. In this area here I do a lot of my work. We have installed traps on our rivers. We count the number of fish going down, we count the number of fish coming back, and we count lice on our fish.

Most of what I'll be talking about is impacts of sea lice. We have done genetic work — some of my colleagues. But the biggest impact that we have seen is sea lice problems from salmon farms — associated — getting onto our wild fish.

We have monitored 56 rivers around Ireland, from river 1 to 52. The rivers in red are the rivers where there are serious sea lice problems on our sea trout stock.

I should explain. Our sea trout are very like your Pacific salmon. They come out of the rivers, and they use the bays to feed. Like in the Broughton, they come out of these rivers, and they use these areas here.

Our salmon stocks come out of these rivers, and they go to West Greenland, to the Faeroes and to the north Norwegian Sea. So they go off the coast, but I'll talk about that in a moment. They still have to pass through these bays, and we have had problems, even with those salmon passing through the bays.

When I'm speaking about sea trout that are living in these areas, they're very similar to your species of Pacific salmon. Our fish are also much bigger. Many of your pink salmon are only three centimetres long. Our sea trout are on average 18 centimetres long. They're five times bigger, but they still get infested. That particular sea trout had 700 lice.

People often wonder: how can a small sea louse cause such damage? This is a photograph of a sea trout where the lice are eating away the dorsal fin. There will just be small rays left. They'll eat the whole lot.

The problem is that when these lice are very small, there's no physical damage. But when the lice moult to the pre-adult stage, when they get to a bigger stage, they cause severe skin erosion. The fish simply isn't able to regulate itself in the salt water. It's bombarded with chlorine, and there's all sorts of physical damage done.

You can imagine. We have had those problems with fish 18 centimetres long. Your pink salmon are only three centimetres long, so the level of impact is going to be much greater, even by smaller numbers of lice.

The first question that I'm often asked: do sea lice kill fish? Absolutely. If they are in large numbers, sea lice will cause severe mortality.

Some of my colleagues in Norway have shown that salmon smolts migrating through Norwegian fjords.... Ninety-five percent of the salmon smolts are killed by sea lice on the way out the fjords. There are long fjords. They migrate out through the salmon farms. There are papers published in Norway indicating that 95 percent of the juvenile salmon are killed by sea lice on their migration. So there's no question that lice will kill fish.

The question, then, is: what is the situation close to salmon farms and away from salmon farms? We sampled lice. What happens with sea trout in these rivers is that they go out to bays with salmon farms, and they get heavy lice infestation, and they come back into fresh water. We catch them when they come back in. We sample them, and we count the lice.

The salmon smolts don't come back in. The salmon smolts will keep going, and if they're heavily infested, they'll die at sea. The sea trout have come back, and we've been able to do large-scale studies over 16 or 18 years.

We've shown that, on average, close to salmon farms — less than 20 kilometres from a salmon farm — there will be a very high level of lice. Once you get 60 kilometres, a hundred kilometres, these are background levels — two or three lice per fish. These are the different stages — the juvenile and the adult, in the black. There's no question that we have shown statistically that sea trout stocks close to salmon farms will have very high or much higher lice levels on average than from rivers away from farms.

[1015]

This is just looking at the stages of the lice. In the light bar are the juveniles, and in the black bar are the adults. This is simply to demonstrate that there are many more juveniles around in the salmon-farming areas simply because there's a constant production of juvenile lice, and it implies recent transmission of lice, whereas when you go away from the farms, the lice are bigger and older. They're not getting continually reinfested, or there isn't a settlement of larvae.

Just a graph to show you.... This is a river in the salmon-farming area. We have had, on average, up to 90 lice per fish — many 60, 70, 40 lice per fish. Studies in Scotland at the University of St. Andrews have shown that ten lice will kill a fish, and we have had, on average — these are average figures of fish in the sample — in many years lice levels way above what are going to kill our fish.

The experience in Europe. The presence of salmon farming has had serious consequences for wild salmon and sea trout stocks in Ireland, Scotland and Norway. There's a large body of literature published to demonstrate that.

In Norway they have long fjords. The salmon smolts migrate through the fjords, so there is a definite, very significant impact. In Scotland they don't have such long fjords, but they have enclosed sea lochs. There are serious problems with salmon as well as sea trout in Scotland. In Ireland we don't have as enclosed sea lochs, but in experiments we have undertaken for the European Union — European Union-funded studies — we have found serious problems with salmon migrating through these areas.

Just to give you an example, we've taken salmon and we've treated some of them with the SLICE that the salmon farmers use, and we have not treated others. We've watched them return the following year as salmon in our commercial fisheries, and there is a much poorer survival of those fish back one year later when they're not treated with the SLICE.

I've mentioned earlier that we can't catch them because they don't come back to the rivers, but we've been doing experiments to determine whether our salmon stocks have been impacted in some of these bays. We know our sea trout are. We have been finding differences in the return of the salmon that haven't been treated.

European Union-funded studies have categorically shown this, and there is no longer any debate as to the potential impact of poorly managed salmon farms on wild stocks.

We have been debating this issue since 1989. It took a number of years to satisfy people of what the problem was — sea lice infestation. It took a lot more years to satisfy people where the lice were coming from. Now in Europe we're no longer asking the question: do sea lice kill fish, and do sea lice from poorly managed salmon farms cause serious problems with our stocks? That now is taken as read in Europe.

There are two bodies in Europe. ICES, the International Council for the Exploration of the Sea, who are the scientific advisers on all fisheries stocks, including salmon, has just published a report saying that very thing. NASCO, which is the North Atlantic Salmon Conservation Organization, joined ICES in the most recent international symposium that took place in Bergen in 2005. It produced a very good set of results based on scientific evidence from all over Europe. Now it's clear that there will be a problem if the salmon farms are not adequately managed.

This has also been addressed in the European Parliament. The communication from the European Parliament on the strategy for sustainable development of European aquaculture as far back as 2002 said:

"A particular veterinary problem linked with salmon farming is due to sea lice. These parasites proliferate on farmed salmon, and the young wild fish of migratory species could be heavily infected during their estuarine movements. The reduction in wild salmonids abundance is also linked to other factors, but there is more and more scientific evidence establishing a direct link between the number of lice-infested wild fish and the presence of cages in the same estuary."

[1020]

In Ireland we have strict regulation. We have a strict environmental impact assessment. There are environmental impact assessment criteria laid down by the European Union that each country has to abide by. There is a study undertaken, and every application has to do an environmental impact assessment. There's a whole series of criteria that have to be met, looking at local rivers, how close a farm might be to a river, important fisheries. So there's a very strict environmental impact assessment undertaken.

If a licence is issued, it's issued with a lot of conditions. It's issued with many conditions. Some of them are that it will have staged increases in tonnage. If it's not meeting its requirements, such as lice regulation and other issues, it won't progress to the next staged increase of its licence.

There's an aquaculture licence appeals board. If a salmon farm licence is granted, there's a period of time for interested parties to appeal the licence that the minister has issued and make their case. There have been instances where the licence has been repealed, based on submissions made and the fear of impacting on wild stocks.

All farms must have a smolt site and a grower site. I'll come back to that in more detail.

Sea lice control. Sea lice monitoring is undertaken by the Department of Marine every month. The salmon farmers don't do the sea lice monitoring. The government scientists do the sea lice monitoring, and they do it 14 times a year. They do it twice in the spring, and the lice data is reported on. In what we call the critical period, which is March to May when wild smolts are going to sea, the sea lice are monitored twice per month.

We have a trigger for treatment of an average of 0.5 female lice with eggs, on average. So if the monitoring shows that there is more than half a female lice on average on the sample, the farm is instructed to treat. That treatment will be with SLICE, and a notice to treat is issued. If the farm doesn't heed that notice to treat, then it will be in breach of its licence condition.

We have quite a strict regulation. One of the issues we don't have is the trigger lice level related to the numbers of salmon on farms. My organization has been suggesting that it would be more precautionary to have a level of lice on the farm that is a trigger, rather than just a trigger regardless of the size of the farm. In other words, there should be a cap on the amount of lice produced in the bay.

We have strict regulations, but in many cases these levels are breached. So we have a very good monitoring scheme for sea lice. We're having difficulties in enforcing the levels and keeping the levels down to what we have in our licence conditions.

The similarities between B.C. and Ireland. Sea lice are a serious problem in both countries. Certainly they are in Ireland, and I understand from the publications I've read that they're also a serious problem here.

The impact of lice is potentially greater in British Columbia for a number of reasons. Your salmon smolts going to sea are much smaller. Our salmon and sea trout are between 12 and 18 centimetres. Yours are

down as low as three centimetres. You have a larger industry here in a more restricted area. You have shallow, enclosed sites, which are along the migration route of wild fish. We have about 12 different areas with the salmon farming spread out, and you seem to have these farms fairly concentrated. They appear to be on the migration route of wild fish.

The other important issue is that the juvenile salmon in B.C. use these areas as nursery grounds, similar to the sea trout in Ireland, whereas in Ireland our salmon go a long distance, many thousands of kilometres away, to feed and are only using these bays to get out into the open Atlantic.

[1025]

I can see much greater potential impacts, because your salmon farms are sited in the areas where your juvenile salmon are feeding for many, many months. Your fish are smaller, and in many of these sites I've seen they're shallow and enclosed. Although I can't speak, because I'm not familiar enough, I would personally think, looking at the situation in Europe, that there is certainly a great potential for impact from sea lice on your migrating smolts.

Possible solutions. Again, these are only my views. I'm not very familiar with how you manage your farms, but from an outside view, it would seem logical to suggest that you change the ways the farms are managed and put smolt sites on the likely migration route. What I mean by smolt sites is.... You put your fish that come from a freshwater hatchery into locations that are on the migration route, and you use other sites to grow your larger fish. That appears to have been successful here in 2003, when the farms were fallowed, from what I've read.

Now, just to explain the terminology. If fish have been reared at a site and then are moved away from that site and there are no fish there, that's a fallowing, because there are no fish on the site. I would be suggesting that you bring in your smolts to that site that has been recently fallowed — on those migration routes — and there will be no lice. When the smolts come from the freshwater hatchery, there won't be any lice. The site will have been fallowed for a number of months, so it will take quite a while before problems arise.

This may be a simplistic way of looking at it, but I think without great difficulty you could discuss with the industry how you might achieve something like this. I'm sure if you do consider this, there will be other alternatives, but this would be what I would consider a possible solution.

These smolt sites would be used from March to November. They are in Ireland. The sites would be fallow until the following March. The months might change a little because of how long it takes to grow your fish compared to ours. The grower sites are the sites with bigger fish. The fish that have been out from March to November would then become grower fish and be fed and reared somewhere else from November till they're harvested.

The whole point here is to try and keep your bigger fish, which have been in the sea for longer and are

going to harbour more lice, away from the major migration routes.

Just very quickly, some good news. It is possible to recover your stocks. This is a sea trout population in a salmon-farming area. After it was operating for four or five years, we had practically lost the stock. It was almost gone. With changes in farm management, they got a grower site and a smolt site. They kept the generations apart. I haven't updated this graph, but we have almost recovered the stock up to the period here — '99. That was largely due to a change in farm management practice.

The final comment I would make would be.... You obviously have to continue with your research on the migration routes of wild fish, on the dispersal of lice, on the impacts and the work that is ongoing. At the same time, I would suggest that you introduce a change in the management practice. I would suggest that you don't wait for more years to do more research. You do the research, but at the same time, you investigate with the industry whether it's possible to have a change in management practice, and you strictly control the lice. This gives potential for both the salmon-farming industry and wild fisheries to coexist.

Finally, I would say that you learn from the experience in Europe. There have been quite a lot of difficulties trying to manage this problem.

R. Austin (Chair): Thank you, Mr. Gargan.

A. Horning: Just some questions to do with European farm fishing. How many European countries are in the business of fish farming? Are there some that are not, and why?

[1030]

P. Gargan: Ireland and Scotland are, and Norway, Faeroe Islands and Iceland. It really relates to the.... When you come more southerly than Ireland, the temperatures are too warm. I think it's difficult to rear the fish. In the U.K., England doesn't have any salmon farming. I think they've probably made decisions to not develop salmon farming, but Ireland, Scotland and Norway — Norway in particular — have a large salmon-farming industry.

A. Horning: Are their rules and regulations basically the same, or are they different?

P. Gargan: Well, I know in Norway they have the same trader levels, but they have started moving salmon farms away from wild rivers. They've designated salmon fjords. They want to maintain their salmon stocks, and they have removed salmon farms out of those areas to protect their wild rivers.

I think that in Norway the officials are quite open in saying: "We know there's a problem with salmon farming if it's poorly managed. We know there's a problem with sea lice." They have problems with escapes as well because they have a very large industry. I think they're more open about saying: "We have problems. We're

tackling them, and we're making changes to try and...." They have a large sport-fishing salmon industry as well, so they're trying to find solutions to try and have both industries coexist.

A. Horning: Is there any closed containment in the European countries — in any of them at all?

P. Gargan: There were a number of land-based farms rather than closed containment in the sea. There were a number of land-based farms in the earlier years, but I think it has been proven expensive to keep them operating. I'm not aware of any large-scale closed containment or land-based farms in operation at the moment.

G. Robertson: Thanks for your presentation. A question on the control of sea lice. Is SLICE what's used in Ireland? And to what degree is it...?

P. Gargan: Yes. When the Marine Institute does the lice testing on the farms, when it breaches the level, they're instructed to treat, and the farm vet is then authorized to get the food manufacturer to introduce SLICE into the food. It's done by the vet. So SLICE is used. It's very widespread, but there have been problems developing with resistance to SLICE.

There are fears that there have been treatment failures where they have treated with SLICE, and it hasn't worked. There are fears of resistance. Now there's a hope that we can get a new chemical, which is a bath treatment, to give some other possible treatment for sea lice rather than SLICE. There is a fear in Europe that because it's been used for up to ten years that resistance is beginning to build up.

One of the key issues is keeping the age classes separated, because if you have smolts — recently introduced fish — beside bigger fish, there will be immediate cross-transfer of lice, and those young fish will act as reservoirs for lice as well. If they're separated, it may take many months before that happens.

G. Robertson: We saw in the recently released fish health report here that the use of SLICE in B.C. has gone up dramatically in the last couple of years. But the impact or the resistance is not clear — whether that is a factor yet here — because it's, I guess, more recent in terms of usage compared to Ireland.

Another question on the siting. How much change has happened to pull fish farm sites away from river mouths?

P. Gargan: There hasn't been any great progress, because some farms were developed in the late 1980s before we had any research done. We spent most of the '90s doing research. I think we've inherited a situation whereby farms were licensed in a particular area, some of them only two and three kilometres from a river mouth. When fish farmers have a location, it might be difficult to get another location, so they've obviously held on to their existing licences.

Certainly from a wild fish perspective, we would be prepared to look at relocating farms if it suited the

farms. Because we've inherited the situation that they were licensed 25 years ago, surely now, knowing what we know now, we should be able to suggest an accommodation can be reached that they may not have.... We know that many of them were not put in the right location. We're just beginning to discuss that now.

[1035]

G. Robertson: In terms of oversight, your central fisheries board is primarily mandated to protect the wild species?

P. Gargan: Yes.

G. Robertson: Do you have any jurisdiction or mandate around farmed salmon, or is that a completely different...?

P. Gargan: There is another state body that is responsible for the aquaculture development, which is two state bodies under the one minister. But our remit is to try and protect the wild fish.

G. Robertson: Maybe you could make comments on how effective the separation is and how effectively the two bodies compete.

P. Gargan: I think there has been quite a lot of discussion and disagreement on what has been the problem. We form our views largely based on the research we've done over the last 20 years, and we're quite firm in that. We know what we're speaking about. We've seen situations where farms have closed or been fallowed, and we have seen major increases in survival when farms have been fallowed. I have a number of papers published this month showing that if farms are fallowed, sea trout survival, for instance, can go from less than 1 percent to 19 percent.

We have had strong views on protecting the wild stock. Other organizations probably have their own views on how the aquaculture industry should be developed. It's not been plain sailing at home either.

S. Simpson: Thank you very much for the presentation. You talked about the EU and the discussion going on within the European Union and the European Parliament. I think you put up a quote from a report that went to parliament or a commentary in parliament.

Has the European Parliament formally taken positions around these management issues, or is that an ongoing discussion?

P. Gargan: I think they leave it to each individual country to manage their own inshore fisheries. When it gets to the common fisheries policy out in the Atlantic, there is obviously more European Union involvement. But inshore fisheries, out to the territorial 12-mile limit, would be managed by each country.

While they have made common state.... They sponsor quite a lot of research, and we've just finished a major research program funded by the European Union, which

categorically has shown these problems in Ireland, Scotland and Norway. I think they're looking at it with great concern, but they haven't given any mandates out.

There is one directive that is issued from Brussels. It's called the habitats directive. It's meant to protect all wild stocks, both flora and fauna. Salmon are listed as one of the endangered fish. That European policy is implemented in all European countries, and I think that is going to have some impact in the long term on how we manage our aquaculture. But at present each country is dealing with the issue themselves.

S. Simpson: The discussion that is going on now.... I'm very interested to see that we're talking here about more effective ways to manage the industry so that it can continue to be successful as an industry while protecting the integrity of the wild fishery. That is certainly the issue that we're struggling with here.

In terms of the proposals and plans that your board has put forward and that have been advanced around better management, around fallowing strategies, around better strategies related to sea lice identification and protection from them, how has the industry responded to that in terms of the economics of doing that on their ability to do business? That's certainly a discussion here. The industry has told us that....

First of all, there clearly are debates about impacts of sea lice and degree of impact. There isn't a consensus by any means in this province on that matter between the industry and proponents of the wild fishery. The industry also will tell us about the economics of doing that. I'd be interested to know how that discussion has unfolded in Ireland.

[1040]

P. Gargan: It is expensive to treat with SLICE. It is quite expensive. I think what we can say is that we have a lot of regulation in place, but we don't believe that the management is sufficient. Salmon farmers, I think, are looking at how they'll manage the farm rather than whether they'll impact on the wild fish, and they'll probably be more inclined to treat when they need to treat for the farm health issues rather than for the wild fish.

So while we have a lot of regulation in place, it's the implementation of that regulation that we have an issue with, in that we don't always achieve the control in lice that we would like or that is required under the legislation, and there may be a number of reasons for that. But while we have the regulation, we still have ongoing problems.

Just getting back to a point you made, I think farms are being managed in a haphazard way, from what I understand here. But with some thought and some discussion with the industry, you might be able to achieve quite a lot just by siting the right year classes in the right areas. I know industry might not like change, and it might cause them difficulties. But if they're going to stay in business in the long term, they're going to have to come to some accommodation, I think, with the wild fish interests.

It seems to me the first thing to do is try and get some dialogue going with how they manage the age classes and where they're located, and see if that can be done. Your experience in 2003 appeared to be very successful, and if you can mimic that with just small sites in those areas and your grower sites elsewhere.... They may need new sites to do that, but that seems to be something that should be given a lot of consideration.

S. Simpson: The presentation that you made focused very clearly on the question of lice.

P. Gargan: Yes.

S. Simpson: Is it your assessment, from your experience...? When we look at the array of issues related to fish farms, and there are issues about other diseases and a whole range of issues — escapes, etc. — all of those issues sit there. But would it be your assessment, in terms of protecting the integrity of the wild fishery, that lice are the critical issue, or are there other issues of equal importance?

P. Gargan: I do think lice are the critical issue for you as well, because of the size of the farms. We know that lice will reproduce in salmon farms, and we know they'll get into the water column. A large number of your wild smolts are very small, and they're going down definite migration routes. From what I have been told and have seen this week, those farms are placed, in a lot of cases, on those migration routes. So there's no question the lice will get into the water column and get onto wild fish if they're poorly managed. There's no question that the lice will kill the fish. So that is the immediate problem.

The escapes issue, I think, is not even as.... In Ireland and in Europe and in Iceland, our salmon-farming industry is based on Norwegian strains as well. So we have other issues with escaped farm salmon in Ireland getting into Irish rivers because they're Norwegian strains. That's an issue. But over here there isn't going to be any interbreeding between the Atlantic and Pacific salmon, although you might end up with small populations of Atlantic salmon, which might cause other problems. But I think there's less of a genetic potential impact here.

Disease-wise, we've had a lot of disease on the salmon farms. We've had furunculosis and pancreas disease. We haven't had many instances of identifiable impact from disease on the wild stock.

S. Simpson: Of disease transfer?

P. Gargan: Yeah. A lot of these diseases are latent in the wild stock. They may be present, but they're not manifested, and they only get manifested when the fish are under stress in low water and high temperatures or whatever.

Looking at the last 20 years, lice have been the issue we can identify that has caused serious problems and collapses in our stocks and that we're trying to manage.

S. Simpson: One last question. I think you made this comment. We have the discussion about the precautionary principle here. A number of times that discussion has gone around this table. Certainly, we have received advice from interested parties that the precautionary principle has to be one that we adopt in terms of how we evolve any recommendations that come out of this committee.

Is the precautionary principle something that underlies the work that now gets done where you are?
[1045]

P. Gargan: Absolutely. That is a term that has been used for over ten years, and that's a term that has been used by our government and by our marine department.

Many of the initiatives we've taken have been based on the precautionary approach, and some of them have been more successful than others, but I think that is the basis of what most countries in Europe are trying to do. They're taking initiatives, sometimes without total agreement on the need for them, but they're taking them on the precautionary principle basis.

They're saying: "Well, if we do this, there's a good likelihood it will improve the situation. We might not have categoric, absolute evidence that it's needed, but we're going to do it on the precautionary basis." That's the way a lot of the policy on aquaculture has been developed.

Certainly, ICES and NASCO have been advocating the precautionary principle. They have signed a treaty with all European and North American countries and the East, called the Williamsburg agreement.

The Williamsburg agreement pulls together all the previous agreements in NASCO, which is an international treaty organization on Atlantic salmon, and it pulls together all the agreements about the impacts of aquaculture and genetic transfers. All that is pulled together in an agreement, which is based on the precautionary principle, to protect wild stocks. That Williamsburg agreement might be useful for you to consider.

S. Simpson: Great. Thank you very much. I just asked the Chair if we could get that agreement. I don't know whether we have access to that.

R. Austin (Chair): I will take care of that.

D. Jarvis: Thank you, Mr. Gargan, for your presentation. Our hatched fish come down the fresh water after a period of time up in the lakes and the rivers. Then they sit around the estuary, ostensibly, while they're sort of adapting to the salt water, etc. Also, their scales are hardening, etc.

Do the sea trout in your area go out to sea in a fleshy...?

P. Gargan: Yeah.

D. Jarvis: I'm going on here because I'm surprised at what you say about your lice levels. From all indications

we have here, we have nowhere near that amount of lice levels on our smolts going out to sea, nor on our salmon returning.

P. Gargan: There may be a reason that our sea trout and salmon smolts have full scales, all of them. They've lived for about two to three years in fresh water, so they have full scales on them. Obviously, the body size is dependent on how many lice can fit, literally, on a fish. I've seen photographs of your small pink salmon. I think the most they've found is.... I'm not sure if it's 20 or something, but body size is important, obviously.

The size of our fish. That's a sea trout there, which had large numbers of lice, but it's related to the body size. One of those small fins there, I think, would be even bigger than the size of your smolts, so it really is down to body size in terms of the number of lice that are getting on your fish relative to our fish. It's just a different order of magnitude with the size of our fish going to sea.

D. Jarvis: I appreciate that the number of lice on the smolts that are going to sea certainly would be disastrous to that fish — a matter of surviving or not surviving. Because the lice would not be multiplying on them, it may be two or three lice on every smolt that goes out there, if you could use that as a generalized figure. And salmon always have returned here with lice on them. But once they have their hard scales on, they don't seem to be affected at all, really — or to any degree.

[1050]

P. Gargan: Yes. Well, it's the same with us. Atlantic salmon coming back in areas a hundred miles from salmon farms have lice on them. But it's not the question that they multiply.

I think that when these smolts are going out, there's a much greater abundance of lice in the salmon-farming areas, so they get a much higher lice level when they're going into the sea. They're trying to cope with salt water and the physiological change, and your fish don't have scales. So I think there's much greater potential for impact.

While the numbers might not be the same, if ten sea lice are going to kill an 18-centimetre smolt, you can work back how many lice are going to kill a three-centimetre smolt. So I still think that while the numbers of lice you're getting on your fish are lower, they're still likely to have significant impacts.

D. Jarvis: Did you have discussions with Ms. Morton?

P. Gargan: She was at the meeting, and I spoke to her, yeah. I've read her published papers, and I would say that the work is very similar to the findings we've found in Europe.

D. Jarvis: Our fish do go long distances. They go out to Alaska and out in the chain almost into Russia, so they have quite a travelling aspect.

I want to know: have you figured out how much SLICE is necessary to treat...?

P. Gargan: There's a particular level of SLICE per kilogram of food, and that really depends on the number of fish in your cage. The vet, in our case, looks at the amount of fish in the cage, looks at the body size and advises the farm as to how they mix the SLICE to achieve a certain level of SLICE within the food. It's administered for seven days. The amount of SLICE is relative to the body size of the fish and the amount of fish being fed.

D. Jarvis: You must have pretty strong lice if you're treating them 14 times a year, or else they're very productive.

P. Gargan: No, we're not treating them. We're counting the lice 14 times a year. They're counted every month and two times a month in the spring. That's the counting, where scientists go out to each farm and count the lice to get a reading of what the abundance of lice is on the farm and when treatment should start. The treatment might only be two or three times a year, depending on the need.

D. Jarvis: I assume that the lice are genetically the same.

P. Gargan: Yeah. There's a paper published from the University of St. Andrews, which has said that in the Atlantic there's no difference between lice on the farm and in the wild. They're the same species genetically, and I think that's understandable.

D. Jarvis: Okay. I'm still trying to get into my mind how dangerous it is to compare our farming to your farming, in the sense that your fish go out with almost five or ten times as many lice as ours do.

P. Gargan: Well, they go out, obviously, with no lice, and then they pick up large numbers of lice feeding in these areas.

D. Jarvis: That's in the estuaries.

P. Gargan: In the estuaries. I would again say that if your fish were bigger, they'd have more lice, because there's a bigger capability of having more lice on bigger fish.

We've been surprised at how the lice are managing to get into the estuaries. You get pulses of lice. It's not that every time fish go to sea, they're going to be infested. But there are pulses of lice released on the farms, and if the fish are feeding in that area for a number of months, which they are, they're going to encounter lice in those bays. The difference between the numbers you're finding on your fish and our fish, I think, is not to do with the amount of lice in the water. I think it's to do with the body size.

[1055]

S. Simpson: Just to pick up on Dan's questions a little bit. Part of the concern that we hear is the issue around whether the fish that are picking up lice have developed their scales yet. Part of the concern is that many of the young smolts here are going out before they've developed their scales and that that makes a significant difference as a body armour to protect those fish.

I'm wondering what your science and your research have found in the difference between a fish that has a pretty well-developed system of scales versus fish that have not evolved their scales yet.

P. Gargan: It's a very good point, because if you can imagine.... On that photograph there the scales are an outer layer. When the lice get to the bigger stage on the fish, they start eating the scales and eating the mucus on the scales. Then they expose the skin underneath, and then there's a leaking of ions. The fish has trouble keeping its essential ions. It's getting bombarded with salt water, and it's just not able to osmoregulate.

A fish without scales is obviously going to have even greater difficulty doing that once the lice start feeding on the surface of the body. It's not something we have to deal with at home because our fish are all fully scaled. But I'm sure the physiologists will tell you

that there's a far greater impact straightaway, because it's really down to retaining salt in fresh water and retaining fresh water in the sea and being able to do that successfully. It must be a much greater challenge when you haven't got your scales formed and lice are feeding on the body surface.

S. Simpson: One last question. When you talk about the sea trout at 12 to 18 centimetres — in that area — what would the body weight of a typical fish be?

P. Gargan: Fifty or 60 grams. I think your fish are one gram.

S. Simpson: Right. They're one, two — somewhere under three grams, I think.

R. Austin (Chair): Seeing no further questions, on behalf of the committee I'd like thank the three of you for coming here and making this presentation today and for including us on your visit to British Columbia. I wish you all safe journeys home.

At this point I'd like a motion to adjourn.

The committee adjourned at 10:57 a.m.

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