**UNITED STATES DEPARTMENT OF AGRICULTURE**

**IN RE: NATIONAL ORGANIC STANDARDS BOARD MEETING**

Meeting held on the 27th day of November, 2007

at 8:00 a.m.

Holiday Inn-National Airport
Shenandoah Ballroom
2650 Jefferson Davis Highway
Arlington, VA

TRANSCRIPT OF PROCEEDINGS

**11-27-07 NOSB Meeting Participants**

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|---|---|
| Chair: | Andrea Caroe |
| NOSB Members: | Gerald Davis |
| | Rigoberto Delgado |
| | Steve DeMuri |
| | Tina Ellor |
| | Kevin Engelbert |
| | Daniel Giacomini |
| | Jennifer Hall |
| | Katrina Heinze |
| | Bea James |
| | Hubert Karreman |
| | Tracy Miedema |
| | Jeffrey Moyer |
| | Joseph Smillie |
| | Julie Weisman |
| NOP Staff: | Barbara C. Robinson |
| | Mark A. Bradley |
| | Katherine Benham |
| | Valerie Frances |
| | Robert Pooler |
| | Jonathan Melvin |

Richard Mathews
Valerie Schmale

Public Comment: Urvashi Rangan
Carrie Brownstein
Corey Peet
Jim Pierce
Joe Mendelson
Patty Lovera
Felipe Caballo
Becky Goldburg
Rhonda Belluso
Sebastian Belle
Jonathan Shepherd
Barton Seaver
Rob Mayo
Ernest Papadoyianis
Brad Hicks
Spencer Evans
George Lockwood
David Guggenheim
Mike Picchietti
Alice Chiu
Dick Martin
Mark Kastel
Harriet Behar

P R O C E E D I N G S

November 28, 2007

MS. ANDREA CAROE: –do work and create a draft standards, which they did after numerous hours of work and conference calls. I had the pleasure of being one of the liaisons for the board on that group so I was able to see the good work that they did and appreciate how hard an effort this was.

Once the aquaculture working group had finished with their work the board accepted their report and published it for public comment. At that time there were two issues that elicited a lot of comment and concern. The board, being not that we're technical experts in aquaculture, decided that we needed further understanding of these two issues before we moved forward. So I the March meeting of the NOSB we did pass an aquaculture standard that was void of these two particular issues, being that we wanted to go back and look at these a little bit further.

These two issues for today, we will explore. The livestock committee of the board has received papers on these subjects and selected presenters to give us some understanding of the depth of the issues that the board would be prepared to make a decision on. And our livestock chair, Hue Karreman, will go into great detail about how that selection process happened.

At this time though, I would like to thank a couple of people that got us to where we are today. First I'd like to thank the secretary and the program for allowing us this working group, and this task force, and this symposium. With tight budgets this was a Herculean effort and we appreciate that. It's important for this industry to explore this issue so I thank the program and the secretary. I also thank wholeheartedly the aquaculture working group and George is in the audience, and the countless hours that these volunteers put into this we certainly respect the work that was done and we appreciate the work that was done. And then lastly I'd like to thank the livestock committee, who has done a lot of work for today's meeting and taking the work from the aquaculture group and implemented it well into the work plan of the NOSB and the work that you folks have done. So I appreciate that.

And with that, I will open up this Aquaculture Symposium. We will be hearing from these presenters. We have six presenters on the two separate issues, each. We will have a presentation by the Aquaculture Working Group—give us a chance to understand the thought process that went into their presentation and their recommendation for these two issues so that we can understand the items that were discussed and why the working group came to the conclusions that they had.  So with that I turn it over to Hue Karreman, the chair of the livestock committee of the NOSB.

MR. HUE KARREMAN:  Thank you, Andrea. Good morning and welcome to the Aquaculture Symposium.  I just have a few notes that I want to go over about how we chose the panelists, and I certainly want to say that without the aquaculture working group having come forth with a really comprehensive set of standards we would not even be here to day as far as talking about aquaculture at any rate.  So in March, the NOSB voted to recommend adding the AWG, aquaculture standards, to the regulation and that was based on being consistent with OFPA [phonetic] 2102.11 under livestock.  So aquaculture does come under livestock.

I don’t know whose idea it was to have a symposium but it wasn't mine, I can't take credit, but I'm glad we're having this, and what we found out from the March meeting is that there were two issues of controversy, two broad issues. One being the issue of net pens and the other one being the issue of feeding fishmeal / fish oil to agriculture livestock. And so what the livestock committee did with numerous phone call conferences was to basically come up with a set of questions that we then put out to the public that we asked to have answered with an abstract so that we could choose the panelists for today. And so within the topics like net pens, we were looking at questions, or answers actually, and that's what we want to hear today, get insight into the ecological ramifications of net pens, the issue of sea lice, possible escapes, the assimilation of wastes, predators, and migratory issues. So that when people were submitting their abstracts to become a panelist for, let's say, net pens, we were really looking for answers to those questions and we hope to hear some today.

And then the other broad question was about alternative nutritional technologies to the proposed fish meal of 12 percent and fish oil of 12 percent, giving a 24 percent of the total feed with those inputs, and are there possible alternatives being developed, and what are the prospects for research to decrease fish meal and fish oil levels. Would these alternative type feeds meet organic production principles? Would these alternatives be considered to yield high nutrition fish to the consumer? What is the feed conversion rate of these different kind of alternative feeds? And is utilization of wild caught type fish for meal acceptable to the organic community? And also would these, let's say, wild caught fish be able to be segregated to guarantee that they were from sustainably fished species?

So they're the two broad questions with the sub-categories that we are hoping to hear about today. So we chose our presenters today based on how they answered those questions as well as giving priority to original research versus basically reviews of synthesized previous research. However that can be very important as well, but we looked at the original research a little bit more strongly. And then also we were trying to get a balanced approach, discussing various aquatic species. The aquaculture is certainly not a one-issue type topic. We want to hear about lots of different aquaculture species.

And then also please be aware, and I

think you can see over in the far side of the room there are some posters being presented today of people that did submit abstracts but then were not selected as panelists but obviously they have very meaningful input, and then also two people that have posters today that I wanted to mention that we didn't select, and as I said, we selected on these questions I just went through, is Urvashi Rangan [phonetic] from the Consumers Union and Linda Odierno [phonetic] from the New Jersey Department of Agriculture. I think it's really worth mentioning, the whole national organic program is under the agricultural marketing service and so their two submissions were basically looking at the marketing aspects and the consumer aspects of aquaculture, organic aquaculture. I just wanted to really point out that we need to, as the National Organic Standards Boards, maintain organic consumer confidence. That is part of our mission, and a big part of it. And so I would urge you to look at their input on the posters because it really shows how the consumers view what they want organic aquaculture to look like, and we do need to take that into account. And so we need to balance that with, hopefully, a scientific basis in our decision making and hopefully we will be able to vote on these two issues at our spring meeting next year. Thanks.

MS. VALERIE FRANCES: So just a simple review then of what our process will be for today. I'm Valerie Frances, I'm the Executive Director of the National Organic Standards Board, and I've spoken with many of the panelists or had email exchanges, trying to help pull all this together.

If any of you went to the dairy symposium, you'll recall we had panelists come up and address various issues, and we did not take public comment in the usual way. And we will be having public comment tomorrow, Wednesday, the first day of the business meeting, where I have grouped a large number of aquaculture folks early on to accommodate travel schedules and just sort of force some coherency. But what we'll do today, along with hearing from the panelists in their presentations, first covering fish meal and then in the afternoon covering the net pens, I'm going to pass out index cards and little pencils, and you are free as the audience to write out questions as they come up, and help get them to me, and I will give them to the livestock committee, and they can move through those questions, and help get different questions out there in case you've thought of things that the livestock committee and the board haven't thought of in the course of the presentations.

So I'm going to run through real quickly each of the panelists according to their panel. So in the beginning of each section I will introduce the panelists and then they will come up in the order that they have selected out of the cup. So it was a random selection. And am I covering everything? And then before each of the panelists, as well the actual panels, George Lockwood is going to present an overview of each section in terms of what the aquaculture working group came up with.

MALE VOICE: Valerie, we're going to try to seat the panelists along this seating that would normally be for the program, so we're going to yield six seats over here while they're in there in their panel mode, so they'll all be together. We'll move some microphones down there so that they can speak at that.

MS. FRANCES: Thanks for improvising. So I'm going to run through, real quickly, the panelists for the record and then George you are more than free to have the stage at that point, so hang on a second.

Our first speaker is, I hope I get this right, Md. Shah Alam. I think that's right. He is with the University of North Carolina, Wilmington, the Center for Marine Research. His topic is replacement of menhaden fish meal by soy bean meal for the diet of juvenile black sea bass. He is a research assistant professor at the Center for Marine Science and has a PhD in aquaculture, nutrition, and feed technology from the Lab of Aquatic Animal Nutrition out of Kagoshima University in Japan.

Our next speaker will be Dr. Craig Browdy with the Marine Resources Institute, with the South Carolina Department of Natural Resources. His topic is alternative approaches for removing fish meal and oils from farmed shrimp using plant and poultry meals and marine algal products. He is the Senior Marine Scientist responsible for the development and execution of R & D programs on marine shrimp. He's doing research on the farming and husbandry of marine shrimp in South Carolina at the Waddell Mariculture Center in Bluffton, South Carolina.

Brad Hicks is next. He's the chair of the Pacific Organic Seafood Association, out of

Canada, British Columbia.  His topic is feeding fish fish meal and fish oil, fulfill organic tenets?  He has a background in fish and wildlife biology, veterinary medicine, and fish pathology, and is a certified fisheries scientist.  Published a great deal.  Just to remind me, make sure I'm covering everything.

Number four is Dr. Steven Craig from the Virginia / Maryland Regional College of Veterinary Medicine, out of Virginia Tech, my alma mater as well.  Total replacement of fish meal and fish oil in diets for Nile tilapia, and the marine obligate carnivore, kobia.  He has a doctorate in marine science from Texas A&M and is currently associate professor in the large animal clinic sciences and a joint appointment at the Department of Fisheries and Wildlife Sciences.  Conducts his nutritional research at the Virginia Tech aquaculture center. Also with the Virginia Aquaculture Association, and the World Aquaculture Society, and a founding member of the Organic Aquaculture Institute.

Jonathan Shepherd is with the International Fish Meal and Fish Oil Organization. His topic is sustainable marine resources for organic aquafeeds.  Qualified vet with doctorate in aquaculture economics, also with a number of management posts in aquaculture with a variety of companies, and the managing director for Danish fish feed company, Biomar until he's with the Fish Oil Organization.

And last but not least is Dr. Torbjorn Asgard from Akvaforsk, Norway. Sorry for my pronunciations. Flexibility in the use of feed ingredients can turn the farm salmon industry sustainable. He is the research group manager with the fish feed nutrition in Akvaforsk, and fish nutrition at Norwegian University of Life Sciences, and has a field of fish nutrition research with emphasis on salmonids, a wide variety of nutrition and physiological related research.

So I think that covers it. And George, you're on, thank you.

MALE VOICE: Valerie? Where was Shepherd?

MS. FRANCES: Number five. Yes.

MALE VOICE: One question, Valerie. When the panelist are giving their discussion, will they be taking any questions in their 20 minutes or is that all at the panel discussion time?

MS. FRANCES: We discussed keeping that to the end, and now of 20 minutes, B. James is going to have a little one minute sign for the panelists to let them know they have one minute left. We're going to try to stick to our time clock as much as we can. We have a lot to cram in. And I'll pronto be passing around index cards.

MR. GEORGE LOCKWOOD: Madam Chair, I want to thank you all very much for the effort you're making to understand organic aquaculture, a complex subject, and for being here today. You're all very busy people and to come here a day early is much appreciated by your aquaculture working group. I'm George Lockwood, the chair of the Aquaculture Working Group.

As Mrs. Caroe has said, we are a diverse group of twelve that were officially appointed by the secretary. Four of the aquaculture working group are research scientists at various universities across the land. Three are growers, one is a former grower. One is a trade association executive, another is a fish health expert, another is a potential supplier of omega-3 fatty acids produced by algae, and we have a member of the environmental community as one of our members.

As we worked over the last several years, and incidentally, this all began in 1999. We've come a long ways. Since 2005 we've been working intently on the regulations that we have proposed that you have before you.

During our work we've always had one member of the staff participating in our telephone conference calls and almost always at least one member of the NOSB. Mrs. Caroe, you were with us from the very beginning and we are very appreciative of all the time and effort you've put in towards what we are trying to accomplish here.

Let me point out that our interim final report, which is a document basically that the fish meal and oil section and the net pen sections was a consensus document. There is no minority report. The twelve of us reached a consensus on what the feed standard should look like and what the net pen standard should look like. It was not an easy task because we had a lot of diversity and a lot of diverse opinions, but nevertheless, while each one of us might think differently if we were to propose a standard we all speak with one voice. We were unanimously behind this consensus document. Every voice was heard.

Since then we have received numerous public comments having to do particularly with feed issues and net pen issues, and those have been digested and reported. You'll recall that in February of 2007 we put together a commentary based upon all the public comments with a revised proposal. In that is a table that we have drawn up showing the requirements for fish meal in a wide range of either crops now grown in—fish now grown in aquaculture or our prospective candidates. It shows clearly the dependence for every specie, including tilapia, on fish meal. In tilapia's case, it's very low but the simple fact is if you don’t include fish meal or other sources of the critical amino acids in that diet, the animals do not grow well and they are not healthy.

In the proposal before you we have a number of features. One is we address the sustainability issue of marine ecosystems including but not limited to fishery resources. We address contamination from persistent organic contaminants. We have included a maximum for a seven year period of 12 percent for fish meal and 12 percent for oil. And we've also, in the case of reduction fisheries, namely Peruvian anchovies or American menhaden, require a maximum of one pound of wild fish to produce a pound of farm fish. You'll undoubtedly hear today and you've seen in the literature, people are making claims that it takes a large quantity of fish from the ocean to produce a pound of aquaculture grown fish. We're saying that if any fish is coming from the ocean in a reduction fishery, that it's one pound maximum and our nutritionists believe that that is a practical rule.

Also we are favoring strongly the use of trimmings. In the case of Alaska, the Alaska pollack industry, it is a very, very large fishery. It is sustainably managed, it's recognized as being sustainably managed. When the pollack is harvested, the filet is cut off, which might account for maybe 30 percent of the total weight. The rest is wasted. If it is within Alaskan waters, state waters, the carcass is reduced to fish meal and oil. Because of the economics of the oil, it is burned as—mixed with diesel fuel and boiler fuel, and burned for its energy content, and that very valuable source of omega-3 fatty acids does not make it into the human chain. Our proposal would heavily weigh recovering the Alaska pollack by-products.

We also have a clause in here that the use of fish meal from wild resources will expire in seven years. Our nutritionists believe that is a practical period of time and the questions you'll be answering today, hearing answers to, will go to that question. Is it reasonable to expect that in seven years aquaculture can no longer require fish products from the wild?

And finally I'd like to say that you've heard a great deal in the public comments and you probably will hear today about conventional aquaculture. We are not attempting to codify conventional aquaculture. We have something substantially different and we hope that you will recognize that as you go on.

So that's all I have to say. I guess you're the moderator, Valerie? Thank you very much.

MS. FRANCES: If we have any other comments for George right now or any questions for him real quickly? Anything anyone wants to say right now?

MS. CAROE: I just want to point out that the document that George has referred to is posted, so that is available to get a more detailed explanation of the response to the concerns with these issues. So that is available on the web site.

As we tee up for these presentations, I

will reiterate that public policy is important for this program.  This is a marketing label and today we're going to be hearing a lot of the science but we will also be taking into account the public's concern on these two issues, as a marketing claim and protection of the organic label as Hue has indicated, is important to this board.  This regulation is about protecting the consumers when they're purchasing these organic products, that they meet their needs for organic for that label. So this is kind of an interesting combination.  We are entering into a symposium here which largely is based on science but the outcome of what this board does will also take into account those public policy issues.

I thank you George and with that, we're ready for the first speaker.  Valerie?

MS. FRANCES:  Our first speaker then is Md. Shah Alam, with the University of North Carolina, Wilmington.  And amazingly, we're ten minutes ahead of schedule.

[pause]

MR. MD. SHAH ALAM:  Good morning everybody.  I'm Md. Shah Alam.  Came from the University of North Carolina, Wilmington.

MS. FRANCES:  Do you want to bring your

mike a little closer to yourself?

MR. MD. SHAH ALAM: Thank you.

MS. FRANCES: If you could give us your name and your association and then spell your name for the court recorder, we'd appreciate that.

MR. MD. SHAH ALAM: Okay, my name is Md. Shah Alam. M-D. S-H-A-H A-L-A-M. And I came from the University of North Carolina at Wilmington. I'm working as a research assistant professor with Professor Dr. Wade O. Watanabe, who is also present here. And one of our other quarters of this research is our graduate student, Katharine B. Sullivan.

Okay, before going to details I would like to a little bit brief introduction that organic aquaculture, what we are thinking now for organic fish feed and fish meal is one of the most important topics today. How can we get it sustainable and what level of fish meal we can use?

So before going into details, a little bit of background of this fish. My title was how we can replace the fish meal with soy bean meal, because soy bean meal is [unintelligible]. Now black sea bass are found in waters along the Atlantic coast from the Gulf of Maine to north

Florida, and of course this is an excellent food, and this is overharvesting. So the culture of black sea bass is increasing day by day, especially in the North Carolina region.

Now how are the resources on black sea bass culture? By the way, before going into details I'd like to say that today, this morning, I'm going to present this as original research. That is, that research will give some information for the fish oil, especially for the menhaden fish, the level of the organic feed.

Okay now, the research on black sea bass is for captive spawning larviculture grow out of [unintelligible] and economic evaluation is done. But unfortunately, nutritional requirements or feed development of this species not yet. We just did one study about protein requirement of hatch [unintelligible] fingerlings and at present we are doing several studies on this species for nutritional study.

Now, alternative protein sources in organic aquaculture diets. So this is very simple things that now today we know that primary protein sources is fish meal, which is limited and of course this is expensive. And of course, day by day, the use of fish meal is increasing.

The reason we chose the alternative protein sources is because it is less expensive, especially plant protein sources, and this is available, sustainable, and this is environmentally friendly. Phosphorus and nitrogen, two important things that is the problem in the water for fish meal. So in this case we can reduce this. And of course we have to think that these plant protein sources are deficient of some essential amino acids, which is really needed for fish to grow.

So the target of my research is to determine the maximum percentage of fish meal protein that can be successfully replaced by solvent extracted soy bean meal in black sea bass diets. So for that purpose, initially we did two experiments. One is partial replacement of fish meal protein by soy bean meal, which is from zero to sixty percent. Zero means no soy bean meal, all 100 percent fish meal based, and we replaced 10 percent protein, 20, 30, and 60. And we did another experiment is partial and full replacement of fish meal protein by soy bean meal protein from 60 to 100 percent. It was possible to do it in one experiment but unfortunately, due to limited space and time we did two experiments. And of course we wanted to see initially how many percent we can get.

So these are the basic formula for the diet formulation. We used about 48 percent protein and lipid 12 percent, vitamin, minerals we used high quality starch, attractants, and others. Now these are the formulation for these diets. Here I want to mention that as we have no clear organic feeds, what it must be, this is not yet finalized, so this was initially our target was to replace the fish meal by soy bean meal, not the organic point of view, but we have planned now to improve, to go to the organic diets. So that's how we use attractants one percent, because to make the palatability, which may be not allowed for organic. And we used solvent extracted soy bean meal, which may be not, but we can change this one also. So we used menhaden fish meal, 50 percent, for the control diets, if you can see. Unfortunately I don’t have any pointer. And then we decreased the fish meal for each, you know can see, and here is we increased the soy bean meal.

Here I have to mention that we used the soy bean fish meal protein replacement, and then others we used squid meal, krill meal, and fish oil, soy bean lecithin. These all formulations according to the recent nutrient requirements information for carnivorous fish, especially menhaden fish. And we used the protein. This is analyzed, lipid level 12 percent. And this soy bean meal, we know that it's deficient of two essential amino acids, methionine and lysine. So we just calculated what methionine and lysine is available here.

Now these are our feed preparation room. This is our University of North Carolina Center for Marine Aquaculture facility. Thank you very much. And then this is our feed room that we prepare feed and everything. Everything we purchased locally, either maybe United States or maybe some from Japan, especially like vitamins and minerals. And we prepared diets in our facility.

Now this is the rearing conditions. Here, one thing is that we used a recirculating aquaculture system. So we used for the first experiment we used 6.6 to 7 gram black sea bass, 75 liter tanks, and 15 fish per tank, and we used it in triplicate tanks. The other water quality parameters were according to the suitable conditions for black sea bass maintained. And we fed two times a day and 42 days we continued this experiment.

Now, by chemical analysis, some analysis we did in our facilities, our newly established aquaculture nutrition laboratory, and some of this equipment still we don’t have so we used the New Jersey feed laboratories. And all data we analyzed by [unintelligible].

Now this is the results from our experiment. What we found after the 42 days feeding trial. So you can see that we did sampling in each of two weeks, I mean, 14, 28, and 42 days. So you can see we did not find any statistical difference during 42 days, even from zero to 60 percent. It means even 60 percent replacement of fish meal by soy bean meal, we did not find any statistical differences. So on the basis of this we continued.

Then this is the weight gain. So you can see this is the effect on weight gain. There is no statistical differences. Now this is the other parameters, like SGR. As I said, this scientific research so we did specific growth rate, feed intake, FCR, feed conversion ratio, survival. No statistical differences. We did not find any differences for this species. And this is after feeding trial, we did body proximate composition, like moisture, protein, lipid. We did not find any differences except some in ash content.

So what did we find from this experiment? One, we found that no significant differences on growth performance. And we found no significance on body growth, protein, and lipid, and moisture. And we found that replacement of fish meal protein by soy bean meal could be more than 60 percent. So on the basis of this experiment we continued another experiment.

This is the partial and full replacement of fish meal protein by soy bean meal protein. So you can see that from zero percent, this is the control one, and then 60, 70—we did again 60 even though we did before—until 100 percent replacement. So this is a guide formulation as we did before. Exactly same things we did, just only in this case we just increased soy bean meal and decreased the menhaden meal, and you can see the finally 100 percent replacement is zero percent. And the other [unintelligible] similar to experiment one.

So the whole thing is like a methodology for diet, rearing, and protocol. Everything is the same as experiment one, just different batch of fish. So in this case we used initial weight of the fish was nine grams and then you can see that we did this experiment until 70 days. After 40, 50, 60, and 70 days, you can see the—significantly different, the growth is, we found. This is the body weight gain. If you can see that if we use more than 70 percent, the body weight gain was statistically decreasing. Whereas less than 70 percent there's no differences.

So what we found from this experiment? Looks like that we cannot use more than—we can use if we want but in this case growth will be lower than the control diet. So these are the other parameters. As I said, specific growth rate, feed intake, feed conversion ratio, all were significantly decreasing if we use more than 70 percent.

Now could you please? Now these are the whole body proximate composition, I mean, body composition. We can see that if we use more than 70 percent then protein and lipid level is significantly decreasing.

So what we found from this experiment? We found that if we use more than 70 percent replacement then growth is decreased, feed conversion and protein efficiency is decreasing. And more than 70 percent replacement decreased the whole body protein and whole body lipid. Now we can recommend that replacement of fish meal protein for black sea bass diet, not more than 70 percent. Here I want to mention that I used with attractants like glycine, alanine, taurine, and [unintelligible] which may be not allowed for the organic aquaculture. But why I use here? As I said, this is the first study we did. We wanted to know how many percentage of fish meal could be replaced, then we can gradually improve. And these are for the palatability.

So on the basis of these two experiments, we designed another experiment. Let's see what happened without attractants if this is not allowed. So we did experiment, exactly like experiment one but in this case we did not use any attractants that makes the fish eat the soy bean meal. We used zero percent, 10 percent, to 60 percent. So in this case, I'll not say details as we did—everything is the same as experiment one but different batch of fish. So initial weight was one gram and after 42 days, you can see that after 14 and 28 days we did not find any statistical differences. But after 42 days we found that 50 percent and 60 percent replacement gave lower growth, without attractants. If you can remember, the previous experiment was 70 percent with attractants.

So the next experiment we designed let's see [unintelligible] 50 to more than 50 percent, I mean, 100 percent, without attractants as we did experiment number two. So we did experiment number four to replace 50, 60, 70 to 100 percent, of course without attractants. Then what we found. I just showed only the result, body weight gain. You can see that if we use more than 60 percent then growth is significantly decreased. Just compare with the previous experiment we did, experiment with attractants, which was 70 percent. If no attractants then it's 60 percent replacement. So maximum replacement of fish meal protein is not more than 60 percent without supplementing attractants. That is—we are want to organic thinking.

So we tried to see another species like southern flounder, which is also a most important species in North Carolina region. So what we did in this case just change the species. So this will give us information that how species, water carnivorous species, how species to species difference the utilization of soy bean meal. So we did the experiment zero to 60 percent.

Now the results. We're just showing only the growth performance. We have a lot of data like proximate composition, fatty acids, amino acids, that we'll do later. So we can see that this result, just after 42 days, not more than 40 percent we can replace. Because if we use more than 40 percent then growth is significantly decreased. Water carnivorous species, one can use more than 60 percent, the other cannot use more than 40 percent. So my thinking is that before deciding that 12 percent fish meal or something, we have to think that species is of concern.

So final remarks from these, my five experiments. We can conclude that assuming no reduction in growth, if we think that there will be no reduction in growth, we don’t want it, then about 70 percent of menhaden fish meal protein could be replaced by soy bean meal protein, with attractants, that is alanine, taurine, vitane [phonetic], but I did not use any methionine and lysine. But if we add methionine and lysine, it could be more. This experiment is going on now.

In another sense if we [unintelligible] the calculation from the diet formulation, I found that 15 percent fish meal plus 47 percent soy bean meal, if we use 7.5 percent squid meal and krill meal, and ten percent lipid for all, equal to the 40, 50 percent fish meal [unintelligible] no reduction on growth. So we can use 15 percent fish meal, but of course it depends on the formulation. If we change something, vitamins or minerals, it could be different. [Unintelligible] no effect on growth. But if we think for organic feed we want to compensate on growth then maybe you can use 10 percent, 12 percent no problem.

So without attractants. That is the organic point of view, that we need to use 20 percent fish meal to make the equal growth that is 100 percent fish meal based diets.

Okay, now in the case of flounder, we cannot use more than 40 percent menhaden fish meal replacement with soy bean meal protein. So on the calculation of feed formulation we found that 30 percent fish meal we need. Of course, I said this is on the basis of my formulation that I did, a combination of squid meal and krill meal equal to 50 percent fish meal. This is for the case of flounder.

So my consideration on the organic feed aquaculture, that today we are going to debate for that 12 percent fish meal and 12 percent fish oil, my thinking is 12 percent fish oil is enough for the fish growing, especially for black sea bass and southern flounder that we are doing an experiment. But 12 percent fish meal, if we want to use, we have to use something protein different like soy bean meal of other combination, animal protein sources. So diet containing 10 to 12, 15 percent fish meal, of course in combination of these protein sources like soy bean meal, squid meal, krill meal, produce slightly lower growth but in the case of flounder it produces 50 percent lower growth. So if we want to make an organic flounder—of course I said this is intensive recirculating aquaculture system. I'm not talking about pond or any other thinking. Okay, now we can get half growth but future, we'll do future studies with non-solvent extracted soy bean meal, which could be slightly different or—we don’t know. We'll do it. But most of the market we can find the solvent extracted soy bean meal.

Now we need to think about the culture system. My thinking is like extensive culture, same intensive, or intensive, or recirculating, because we know that intensive culture, we are not going to provide any other natural—it's not possible to produce. Is it possible to use this kind of system for organic, because if that is not a level for pond or other system.

Now we all need to think feeding behavior [unintelligible] omnivorous, carnivorous, herbivorous, or [unintelligible] especially protein requirement. We know that for the menhaden fish, protein requirement is high. More than 50 percent. And especially they need higher animal protein sources to grow. If we can feed them lower protein based diet but in this case there is a possibility for disease outcrop or maybe some other negative effect.

So this is all about my research, what I did. As I said, this is all information about the original research which maybe gives some information, some data for you to decide organic feed, organic [unintelligible].

So I'd like to acknowledgement for the funding of these experiments is [unintelligible] Biotechnology in North Carolina, our ENCW [phonetic] program, and NOAA, also grants from the National Menhaden Aquaculture Initiative, and of course our staffs of ENCW, our aquaculture program, and finally thanks everybody for your attention. Thank you very much.

[applause]

MS. FRANCES: Thank you. I just want to

remind folks too that the presentation will be posted on our web site so you'll be able to go through them like a PowerPoint right on the web site.

Our next person is Dr. Craig Browdy from the Marine Resources Institute, South Carolina Department of Natural Resources.

DR. CRAIG BROWDY: Thank you Valerie. Before I get started can I ask, does anybody in the room have a laser pointer?

MS. FRANCES: Once again, if you can announce yourself, and then your affiliation, and the spelling of your name please for the court recorder.

DR. BROWDY: Yeah sure. My name is Craig Browdy. I work for the South Carolina Department of Natural Resources and my name is spelled, C-R-A-I-G, Browdy, B-R-O-W-D-Y.

As part of the South Carolina Department of Natural Resources, we have a marine resources research institute that has been around since the early 1970's and has engages in aquaculture research. In fact, our department has been doing aquaculture research since the 1950's. And in 1984 we built the Waddell Mariculture Center in Bluffton, South Carolina, where we've been doing a lot of work on aquaculture, various aspects of aquaculture research.

This particular study builds on a lot of studies that we've done over a lot of years to try to make aquaculture a bit more sustainable and this is working on different things having to do with the feeds, the diets, building it towards organic certification, and it also builds on work we've been doing with systems, and with water quality, and with a lot of other aspects of sustainability in aquaculture.

The work that I'm going to present today is multi-disciplinary and has a bunch of people that helped me out with it. And if I can't answer any of the questions that might come up, I'm certainly not, number one, a nutritionist by any means, I'm more of a generalist, but my co-author, certainly Alan Davis and others, can find answers to questions that may come up that I may not be able to answer very quickly.

The two from DNR that worked on this was myself and Dr. John Lefler. The diet formulations were mostly done by Dr. Alan Davis from Auburn University. Some of the testing was done by Dr. Tsahi Samoha [phonetic] at the Texas Agriculture Experiment Station. And Bob Bullis has been working with us on this. He was part of the aquaculture board and works for Advanced Bionutrition Corporation that makes these oils, which are alternative sources of DHA and ARA.

The diets were all manufactured by a company called Ziegler Brothers in Gardiners, Pennsylvania, for the large scale pond trials. The diets for the small scale trials were manufactured at Auburn. And then we did some work on post harvest flesh quality and that was done by Gloria Seaborn, who works at the NOAA Center for Coastal Environmental Health and Biomolecular Research in Charleston. She's the lipid lady.

We have a couple of different sources of funding that went towards this research. We have some grants from the base funding for many years from the U.S. Marine Shrimp Farming Program, that's funded through the CSREES, USDA. We did get a small business innovation research grant through Advanced Bionutrition and subcontracted on that for some of the large scale studies. Recently we've gotten some funding from NOAA from a program called Oceans in Human Health and when we saw that program we felt like it was a good opportunity for us to get our feet a little bit wetter in the area of seafood and human health.

And it seems like a direct relationship between what's going on in the ocean and what happens to humans.  And so we've been focusing on that. We've done a bunch of surveys.  For example, we've done 70 different sources of shrimp and looked at contaminants and fatty acid profiles of those shrimp.  And we've done the same with red drum from Asia and from farms in the United States and from wild, different estuaries around the United States, looking again at 79 different contaminants with NOAA partners and looking at fatty acid profiles in terms of human health benefits.  So the benefits and risk and weighing the benefit and risk.  So that paid for part of the forensic analyses that we did.

And then finally we just got a grant from the Integrated Organic Program last year. Unfortunately, the first studies that we've been doing on that program have only been over the last season so we don’t have a lot of that really digested yet and ready to present but I'll show you some of the directions that that research is going.

I guess we all know, I'm here to talk about shrimp.  Shrimp is a really important seafood product, particularly for consumers when we're talking about public policy and we're talking about what people want. I think in a lot of cases what people want is shrimp. It's the number one consumed seafood, and the quantities keep increasing, and people really enjoy it. This is just a little bit of data on fish meal use with shrimp culture. Today a lot, more, and more, and more of the shrimp that we're eating comes from aquaculture. Today globally I think it's almost, it's over 50 percent already. And it keeps increasing. This is the increase in global aquaculture production of shrimp. We've got a tiger by the tail here and trying to increase opportunities for sustainable production of shrimp and to deal with some of the problems that have come up with this kind of explosive growth. But I think that in general the world shrimp farming industry is doing a better job. There's opportunities for improvement in a lot of places but there's also standards now that are making it more environmentally sustainable. But one of the issues is certainly this fish meal and also, we haven't talked about it much, but fish oil use.

World feed production is about 630 million tons. Aquaculture does about four percent of that. Now that four percent from aquaculture uses 57 percent of the world's fish meal and of that 57 percent used for aquaculture, some of it goes to shrimp culture. It's only four percent by volume of world aquaculture production. Most of aquaculture production is fresh water species like carp, but it's 20 percent of the value of world aquaculture production so it's very important. And importantly it uses 23 percent of the total fish meal used by aquaculture so if we can reduce fish meal use with shrimp then we can basically make a big dent in the amount of fish meal that's used by aquaculture.

A lot of this data comes from a paper by Albert Taycon [phonetic] that's cited in my testimony. What do you call it? White paper?

The simple fact is that fish meal supplies are limited, that use is increasing, price is going up, and toxin levels are a concern. So even the aquaculture industry has impetus to try and replace some or all of the fish meal, whether or not they're going to try to be organic. So we decided to go ahead and do some testing of the fish meal and fish oil free diets for shrimp. We're blessed to have a very interesting critter in Panaeus vannami, which is the shrimp of choice for shrimp culture in the world, in that it really takes advantage of natural productivity. So we felt there were some real opportunities here and we decided to shake it out and test it.

We did test some, what we call organically certifiable diets, whatever that means without a certification protocol, but we tried to use some organic ingredients and we tried to move towards what we thought would be certifiable when we did this in 2004, 2005, some of it. One thing that we wanted to pay attention to was the PUFA levels in the animals at harvest, especially DHA and EPA. It's some of the most important components of seafood in terms of human health. The benefits continue to—new papers coming out all the time. Yesterday I just saw something come out on juvenile diabetes. There's a lot of work on brain development and health, and certainly heart disease is the big one. So it's very important for human health.

So where does this DHA and ARA, where does the DHA, which is critical for human health coming from. And this is a slide I borrowed from Bob Bullish showing the marine trophic pyramid that basically it's coming from phytoplankton. That's the original primary producers, and then it works its way up through the food chain into the carnivorous fish such as tuna or salmon that have very high levels of lipids and very good for you in terms of DHA.

Other than fish, which when the bioaccumulation, algae is really the only source of DHA. Now this product that we were testing in this aqua grow is made from an algae called schizochytrium. It's fermented in a large factory in South Carolina in Kings Tree, and then algal meals are produced that are very high in DHA. So we did quite a few studies trying to look at the opportunities for replacement by using some of these products and we started out with small scale tank studies that were done at Texas Agricultural Experiment Station. These are tanks that are about 650 liters. It's in a shaded area with heavy aeration and we added SPF, Panaeus vannami, at about 30 shrimp per meter which is a relatively low or moderate stocking density. To give you an idea today, I'm growing shrimp in some of my super intensive systems as high as 550 animals per meter in large open ponds. Very low density shrimp are typically grown at 20 per meter or less.

We did a lot of water quality monitoring. Over the last 15 or 20 years we've developed techniques to grow shrimp without exchanging any water in the system. So it's a very environmentally sustainable technology in that all the nutrients are cycled within the system and you get this sort of waste recycling within this closed system. And it's natural microbial processes within the system, not only maintain your water quality but also have a benefit in terms of the nutritional contribution to the animal that you're growing. And it's these nutritional contributions that we very much wanted to take advantage of. So all of the diet studies that we do are done in these brown water systems that allow us to determine what we can get from the environment, what we can get from the water itself. So water quality monitoring becomes very important when you're not exchanging any water and you're just running these, what we call, bioflock systems that we use.

The oil again was from these microbial fermentation—was supplemented with oil from these microbial fermentation products. And then we did two types of protein replacement or fish meal replacement. One uses Profound, which is a co-extruded poultry by-product meal with soy beans and it has an egg supplement. This was not for the organic diet, obviously, but more for just producing a fish meal free diet that could be commercially viable in terms of a replacement for farmers in the world today. Can we go out and sell them a diet that they can actually get cheaper and better with less fish meal use?

The second is organic plant protein sources. I know you can't see this. That's even worse than I thought it would be but [laughter] it is in the handout so if anybody has the thing that's on the web and you can see it there. Basically, the point I want to make is that there were two experiments that were done. This shows the two experiments. And this was done in two separate years, and in both cases the diets were compared to a commercial formulation. Basically, we had—this was one of our first experiments. We wanted to test the use of these algal meals so we tested them at two different levels of inclusion and then a third diet with no inclusion of those oils, rather using the menhaden oil. So what we're comparing is fish oil to a no fish oil diet that just uses these algal meals. All of these meals in the first year used Profound, the poultry meal replacement and soy bean meal. No fish meal.

The second year, we chose one of the levels of oil replacement and here we compared it to a diet that had no dish oil and no replacement. So here there is actually no marine fish oils in the diet.

The last diet here that we tested in the second year in the small scale study was an organic diet, and if you look at the products that were used we got rid of the soy bean meal and used organic soy bean meal, organic [background noise] gluten. Again, these oils and different types of organic soy oil, organic flax oil, etc.

To give you an idea I'm going to put the two experiments on one slide just to go through it quickly so you can see what happened. There was no difference in survival. All survivals were well above 90 percent. No difference in feed conversion, feed conversions were reasonable. I'm showing you here the growth data and all of that data is in the paper in a table. But just to show you visually the growth data, you can see that we were able to—

[sound cut]

[END MZ005001]

[START MZ005002]

DR. BROWDY: This is the control diet and it obviously did a little bit better although not statistically significant. Notice that this has been truncated so that you can actually see the differences but these differences are not significant. Basically you could replace the menhaden fish oil with the algal oils, even at the lower inclusion rate with very good success in terms of growth of this shrimp in the brown water system.

In the second year where we actually completely removed the oils we were surprised to see how small the difference was but in fact it was a statistically significant difference from the control. At our first shot at the organic diet it didn't do quite as well as we had hoped. We were down significantly lower than any of the other diets. But we learned from that and we came back with some new formulations for our pond trials. Again I think that the diet with the algal oil replacements did almost as good as the control diet.

So we decided to go prime time and to take our studies out to the ponds, which is no small matter because it's very expensive and very difficult to run pond trials. One of the disadvantages with pond trials is you don’t get the replication that you can get with a tank trial. So we used these tenth hectare ponds for our trials and basically this is the Waddell Mariculture Center in Bluffton, and we had three ponds for each of our diets that we were testing, so we had some replication. But probably not enough.

Basically we did two series of studies that I'm going to present. One using this plant based organic diet. And again, here we used almost all organic ingredients. I say it's organically certifiable. We did have to include some liquid fish solubles and squid liver oil at about one percent for attractability, but by and large it's what we call an organically certifiable diet. And again we used these algal oils. So it's no fish meal and significantly no fish oil as well. So no marine products. And then again, the second year we did a study with using the poultry by-product meal and again, this is to provide a more cost effective formulation that could go into some replacement right away.

Six ponds, 89 day study. It's basically a complete grow-out and we compared it to a control 35 percent protein shrimp grow. Here you can see the harvest size was not significantly different. In fact it was even a little bit higher with the plant based diet but not statistically significant. These production levels are very reasonable. Five thousand kilograms per hectare per crop. And then a good growth rate and high survival. So this showed us that actually in the pond in this kind of a heterotrophic bioflock based system we could already use basically an organic diet with no fish meal and fish oil and get reasonable production results with this species of shrimp.

So then we ran a second study and this time-- Significantly, that first study, I failed to mention was that 25 shrimp per meter squared. So again, that's at a relatively low stocking density. Shrimp are very different from terrestrial animals. They like being crowded. These guys live in schools in the wild, I mean, you put more in per unit area. I told you we're up to 550 per square meter. We never thought it was possible and the shrimp are perfectly happy. They love it in there. So the crowding in marine organisms, the schooling effect, is very different mindset than in land organisms. But we went ahead and increased the stocking density in the second study to 80 per meter so that we could get more production out of them and we used again, nursed animals. This is something that could go into commercial use right away to replace fish meal in these kinds of diets. So we thought we'd try it out at high density. Limited water exchange here. We did do some water exchange in this study. Once we had a power outage, had to do 20 percent exchange, and then again we exchanged towards the end.

Here again, this time we got a significant increase in size with the poultry meal based diet. So we showed that it can work, we got production as high as ten or eleven thousand kilos per hectare, which is very reasonable commercially in the world today. And then a reasonable harvest size growth, good survival, and FCR with the poultry meal based diet with no fish meal and no fish oil.

So basically there wasn't any differences in harvest biomass and we concluded that these kinds of diets with these replacements can be comparable to conventional feeds even at high stocking densities. So I think Bob is out there now in the world kind of beating the bushes and showing the growers and the feed companies that, you know, hey, we can cut back on our fish meal use, we can cut back on our fish oil use, even if this never has significant implications for organic, which I think it does, it also has significant implications in terms of sustainability of shrimp farming in the world. Now hopefully we'll make a step forward that we'll be able to start cutting back in a large scale in the amount of use of these meals and oils with these replacements.

So then we asked the question, do these diets produce an equivalent nutritional product from the human health perspective. Valerie, how many minutes do I have? Just one? Okay, I can't tell you about the human. Hopefully I can get an extra minute.

From a human health perspective we ran these fatty acid analyses. And we found that the differences in the lipid—there were differences in the lipid profiles between the diets. And to cut to the chase I'll show you the graph and explain it from there. Here you've got the plant based diet in blue and the fish meal based diet in red. The top is showing you what's in the diet, the bottom is showing you what's in the shrimp. And we're looking at four different fatty acids here, four very significant ones. We've got linoleic, linolanic, EPA, and DHA. Now the linoleic is very high in the plant based feeds, obviously. It comes from the soy beans. This is not as good for you in terms of heart health as the EPA and the DHA, which we're looking for. The EPA and DHA are much higher in the fish meal based diet with the fish oil, the conventional diet, than they are in our replacement diets. The replacement diets are relatively low. And it's not surprisingly when you come down to look at the shrimp you find that in the plant based diet the linolanic and linoleic are higher and the EPA and the DHA are somewhat lower.

What surprised us and what really kind of made us take a double take was that it wasn't that much lower. If you look at how low it was in the diet the fact that the shrimp had such nice levels of EPA and DHA, we found to be somewhat surprising. So they either bio-accumulated it or it came from the natural productivity.

So this takes us to where we are today with the Integrated Organic Program. We're trying to use a holistic approach to put all this together—to increase the amount of fatty acids and essential amino acids that's coming from the bioflock, we're doing this through a number of different types of studies that are focusing on that in order to create a holistic approach to formulating diets for organic standards and utilizing natural productivity within the system. Thanks.

MS. FRANCES: Thank you very much. [applause] We're having some technical difficulties with some of the mikes. They have a life of their own up there and they keep popping on so that's what you're getting.

Our next speaker is Brad Hicks, who is chair of the Pacific Organic Seafood Association from British Columbia, Canada.

MR. BRAD HICKS: Good morning. For the record, my name is Brad Hicks, that's B-R-A-D, H-I-C-K-S. I am with the Pacific Organic Seafood Association from British Columbia. And I guess technically, Valerie, you're doing the advancing of the slides? Well this should be interesting.

First of all I'd very much like to thank the National Organic Standards Board for inviting me to come. I've been involved in fish farming, and fish health, and in fish nutrition for about 35 years. I've raised six different species. I've raised fish in Maine, Florida, Chile, Ontario, British Columbia, and I've raised oysters as well. In addition, about ten years ago I got involved in the organic movement in British

Columbia and a group of aquaculture people in British Columbia, some shellfish farmers, and some fin fish farmer got together and put together some standards for raising finned fish and for oysters. Those standards are currently before the, what's called the COABC, which is the local regulatory board in British Columbia, which has in terms of I guess political science has about the same position provincially as the NOSB has federally in the U.S.  So it's about the same stage.

My topic is basically that I think feeding fish meal and fish oil does fulfill organic tenets and in addition I'm going to talk to you about the concentration of biological capital, which I will explain as we go forward here.

The other thing is I should mention is that although you've listened to a couple of technical talks, mine will not be technical.  I'm going to perhaps more address the challenge from the chair this morning about protecting the USDA organic label, which is obviously part of your decision making process.

The goals for my talk are three.  First of all I'm going to convince everybody in the room that fish are not [background noise] trophic level carnivores, that they're actually the same trophic level in the system as our regular farmed animals are. Secondly, the main controversy over organic fish farming is political and not scientific. And third, that organic aquaculture standards should be encouraged [audio feedback] biological capital.

MS. FRANCES: I'm going to pause for a second. We're going to pause while we get this microphone so we can pay attention to your presentation.

MR. HICKS: I'd be delighted to pay attention. [laughter]

MS. FRANCES: Thank you. This is a phantom mike.

[off-mic comments]

MR. HICKS: So my goals for today are to get everybody to understand that fish are not top level carnivores, that in fact they operate at the same trophic level as the rest of our farm animals do. That the main controversy in organic fish farming is political and not scientific, and that organic aquaculture standards should encourage the preservation of biological capital. And during this talk you will get to understand what biological capital is.

Okay, this is Biology 100 here or Ecology

100, trophic levels. It will be on the exam so please pay attention. See I told you this would be tricky because I thought I'd have the button.

Basically in terrestrial systems, carbon is fixed by plants, and in farm animals that's primarily the grains, some fruits and vegetables end up in animals, but primarily it's the grains and grasses. They also feed, of course, terrestrial invertebrates. Terrestrial invertebrates, in turn, feed chickens and pigs. Chickens and pigs are both essentially omnivores. That's why they spend a lot of time digging around the earth looking for bugs to eat. Top carnivores, typically the bears and the eagles, and the tigers and the wolves, then eat the omnivores and the herbivores. That's kind of the way the system works, and to a large extent humans are top carnivores.

Major trophic levels in aquaculture systems—something happened in the translation here. Sorry about this. Essentially you have zooplankton at the bottom, they fix the carbon. That moves through a system of planktivorous fish, fish which each the plankton, and those include primarily the sardines and the herring group of fishes, menhaden you've heard of earlier, and aquatic invertebrates including shrimp.

Piscivorous fishes, and I use the term piscivorous rather than carnivorous because in aquatic toxicology fish eating fish are called piscivorous fish. These are the tuna and the salmon. There are also omnivorous fishes, the tilapia and the carp for instance.

So you can see the plankton produces, goes to the next level. Some of the omnivorous fishes are direct consumers of plankton. But primarily they get their food from other sources that have already basically concentrated the plankton. And then you have the piscivorous fishes, the salmon and tuna, which primarily eat planktivorous fishes and invertebrates. And just like the other slide, the top carnivores in this system are the bears, the eagles, the toothed whales, not the baleen whales but the toothed whales, and predatory birds such as the osprey, and of course humans.

So if we put this all together you'll see that the fish that we farm are actually the same trophic level as other farm animals. So I'm just going to take all those lines out and I'm going to replace them with a whole bunch of new lines. Okay, now in organic systems are essentially prescriptive ways of rearing plants and animals. Organic systems have been set up to deal with grains and oil seeds. Organic systems are in place to deal with omnivores and herbivores, our usual farm animals. We have the rules that show how the food value moves from the grasses up to the farm animals. We also globally and the NOSB to a certain extent now has, I guess, preliminary rules for organic aquaculture. And globally, 14 standards are available globally that look after piscivorous fish and my sort of reading of the NOSB is they're already pretty well accepting of the omnivorous fishes.

In addition, it seems to me that the organic rules have accepted that we can take terrestrial plants and animals, or terrestrial plants and feed them to aquatic species. That's generally accepted is my understanding. It's also generally accepted in most organic systems that you can feed fish meal and fish oils to terrestrial organic animals. In addition, aquatic protein fish meal can be used as a fertilizer. So this is a bit of a circuitous route by which aquatic animal protein is moved into the organic food system. It goes down fertilizes a plant, that plant then is fed to an organic animal.

Humans, although there are some organic dog foods available, the primary top predator or the top trophic level individual that organic standards focus on is human. So currently we have a system that allows farm animals, through the organic system, to go to people. We have tentative rules in place to allow omnivores. The only place there's a question in this whole system seems to be with piscivorous fishes, okay? So that's what I want to focus on.

So why is that? Why is it we can accept all these other standards and yet we get hung up on piscivorous fishes? Well having been at this for many years my sense is that it's politics and not science. The science is actually quite simple once you understand it. The politics is extremely complex. Hence the protection of the label is as important as the science.

Organic aquaculture is a small sector of the aquaculture industry, just like organic agriculture is a small sector of the agricultural industry. They both rely on organic principles as the underpinning of the rule making. In addition, they are both open farming systems. All the farming systems we deal with, deal in the open. They are not closed systems. They deal with diseases, parasites, waste, interaction with wildlife, and interaction with predators. That's primarily for this afternoon but I just caution the board to understand that there is a political overlay in most of what they'll hear today.

One of the ways this has come to the attention of something I refer to as advocacy science, the development of science or the conducting of science to support a specific thesis. This is from the Moore Foundation. The Moore Foundation is one of the supporters of this group down here. Integration of Aquaculture Science Messages into the Anti-Farming Campaign. That refers to the anti-fish farming campaign. The pure salmon campaign is part of that. So essentially there has been an attempt to develop science that supports the anti-fish farm movement.

The board, of course, very familiar with this. You have received two letters that I know of and probably a whole lot more I don't know of. The two letters I know of are from the Organic Consumer Association. I read the letter. Not a whole lot of science in the letter, but I did see that they represent 850,000 people. I feel the pressure on the NOSB already. In addition you've received another letter from what I refer to as the 44 Organizations letter.  Together we represent millions of voices.  So the NOSB now has a lot of political pressure on it and a little bit of science to try and solve this.

Well, somebody else thought about this before I did.  Science is a part of your input, but scientific debate is readily clouded by scientists who fail to recognize the boundaries between intrinsically scientific and intrinsically political questions and advocate their own ideological beliefs.  So not all science is perhaps as we believe.  Public acceptability of a given policy is a political not a scientific issue.  For me, that is what the NOSB must deal with.

Okay, now back to a little more pragmatic issues.  Preservation of biological capital.  This has been a pet peeve of mine for a very long time.  I think we should use our biological capital wisely.  What do I mean by biological capital?  Essentially all our food is generated by the sun, plus carbon, plus water, plus minor nutrients, to produce biological capital.  I'm sorry how these slides turned out.  They don’t look like that on my presentation, but--  So this biological capital is essentially the plants and animals that are derived and driven by essentially the sun. Fish meal and fish oil are unique forms of biological capital. Fish meal is very high in the limited sulfur containing amino acids. The very first speaker this morning, I'm sure you're not that technical, but at the bottom of one of his slides he showed in yellow, meaning it's not organic, the addition of lysine and methionine. The reason why most organic standards allow the use of fish meal in diets is to supply the lysine and methionine. So it is unique. It is valuable. In addition, everybody knows about EPA and DHA, you've heard lots about that already.

So what so we do with our biological capital? Well old school, when there was no conservation, basically we used fish meal and fish oil to produce industrial chemicals, fertilizer, paint, fuel, and lubricants. So all of that EPA and DHA we just burned it folks, we didn't use it. Okay? New school, if you will, with conservation ethic, about 50 years ago we started to use these products in farm animals because we found them very useful and we found it a better use than using it as a fertilizer or industrial chemical. Then about 30 years ago we started using it in amounts in farmed fish primarily tuna, salmon, and shrimp. Most recently, we've been using some in pharmaceuticals, fish capsules. In addition, I think it's important to understand that if we accept the use in farm animals, fish are about two to ten times more efficient at conserving this valuable biological capital than other farm animals. So if we're going to use it in farm animals we should use it in fish.

Next please? Okay, it didn't work. Sorry about that, I emailed this in which probably didn't work. Essentially on this slide, these are actually movies and for me the choice is we can burn up this beautiful biological capital in a diesel engine pulling tractors around at a tractor pull or we can use it to produce a food that we can celebrate, i.e. fish. And for me, this is the actual decision that's trying to be made.

I've been at this for quite a while. I haven't been alone. And as a pioneer it's always a little bit difficult sometimes. You have to change some people's attitudes a little bit along the way. So I would like to acknowledge and thank the members of the Pacific Organic Seafood Association for their help and their perseverance in this process. And fish farmers, like all farmers, are proud of the things they produce and

I would like to thank you for your attention.
[applause]

MS. FRANCES: Our fourth speaker is Dr. Steven Craig with the Virginia / Maryland Regional College of Veterinary Medicine from Virginia Tech. And after talk we will have a break.

[off-mic comments]

DR. STEVEN CRAIG: Good morning. It's a pleasure to be here this morning. Last time I saw you guys it was about 9:30 at night, last March, after a long day of public comments. Hopefully we'll wrap it up a little quicker today.

I'd like to present some research we've been doing at Virginia Tech. Kind of on opposite ends of the spectrum, if you will, in terms of-- Oh sorry, Steven Craig, S-T-E-V-E-N, C-R-A-I-G. Again, with Virginia Tech.

Again, we've been looking at alternate proteins from a little bit different perspective than most labs around the country and the world, in that we went straight to the organic alternate protein sources in terms of fish meal replacement. There's a need in conventional aquaculture to move away from fish meal inclusion. We took it a step further to go ahead and look at some organic source.

And so again, we've been looking at this since about 2003 in the laboratory, certainly with tilapia and kobia. Talk a little bit about kobia later. Tilapia is very well known in North America certainly. And then we've also done some commercial field trials with the marine shrimp that Craig Browdy talked about at the Organic Aquaculture Institute in Imperial, Texas. We have a poster in the back there that describes the three years of data we've collected there. Again, pulling all the fish meal out of aqua feeds for shrimp and having pretty good production under organically certified guidelines. And we're moving on, as we look at the alternate protein work, we're moving on to investigate the alternate lipid work using some of the ingredients Craig talked about in terms of the DHA algae and other sources.

So our problem is, as a nutritionist, the organic protein sources, the certified organic protein sources, there are very few of them, and those that are out there, there are even fewer that are suitable for aqua feeds. Fish tend to require higher levels of protein. They're more efficient converters of protein but they typically require higher levels of dietary protein for optimal growth. These organic protein sources are very expensive and that compounds that problem certainly when you're looking at the economics of it. And so what we've looked at, at the Virginia Tech Aquaculture Center, soy bean meal, soy concentrate, soy isolate. These are pretty easily obtained. There's a relatively good market for them. We went and found some hemp meal out of Canada. It's a very interesting protein source. I'll talk about that a little bit later in terms of blending protein sources to achieve the amino acid requirements of some of these animals we're working with.

We've also done a considerable amount of work with a product called NuPro by All Tech out of Nicholasville, Kentucky. This is a certifiable protein source, if you will. It's the contents of the yeast cell and that's basically how we started our alternate protein work with kobia and we've advance from there just recently.

We've conducted over ten feeding trials to date. We have two in the water right now and all of these have been bouncing between 40 and 100 percent fish meal replacement. Now again, with the tilapia it's fairly easy to do. They don’t require that much fish meal. In fact they don’t require any. We can do that very easily. With the kobia it's a high level carnivore, piscivore is probably a more appropriate term, and like the salmon, you can usually replace about 40 percent of the fish meal protein pretty easily across the board without any impacts on growth. Once you go higher than that you have some problem in terms of weight gain and performance.

So again, tilapia is a relatively easy fish to start with. As I mentioned last March, I think there's some animals that you can look at right now that are very conducive to organic aquaculture. Tilapia would be one of those. This was a ten week feeding trial. Again, zero to 100 percent fish meal replacement, or in this case we actually replaced the soy bean meal component of the tilapia diet. We kept four percent fish meal in most of the diets—all the diets except for one. And then that final diet, we're always looking to replace 100 percent of the either fish meal, or in this case soy bran meal, with an organically certified protein source. And again, as with all our studies, we monitor weight gain, feed efficiency, biological indices. I'll just present the weight gain data today.

And so this is the growth, percent

increase from initial weight after ten weeks. You can see the zero represents a control diet and basically no differences in growth after the ten week study, especially that one bar on the far right. That's the 100 percent NuPro. That's no soy bean meal or no fish meal. That's 100 percent yeast based protein.

This is just a different way to present it as a percentage of the controls. Again, you can see all of the diets basically out-competed the control diet as we replaced the soy bean meal with the NuPro. Again, on the far end, that 100 percent diet again, a total yeast based protein, a totally certifiable organic diet had very good growth over the ten weeks.

So we kind of moved away from tilapia very quickly. In 2002 we looked at kobia as being really one of the exciting fishes for the future of aquaculture. It's a very rapidly growing fish, again, a marine carnivore or piscivore. Rapidly growing—we can grow this fish from a one millimeter egg to ten pounds in one year. So it's a very attractive fish for aquaculture.

We've conducted over 20 trials with this animal at the VTAC [phonetic] over the last five years, so we know the animal pretty well in terms of nutritional requirements. And that's a key to, as we start replacing fish meal and pulling the fish meal out, you really need to know the quantitative nutritional requirements so that you can hit these fatty acid, amino acid levels, as you replace the fish meal.

And again, as I mentioned, we're a little bit unique in that all the alternate protein sources we use were certified organic. I'll talk about kind of a novel source we've just recently completed a follow up trial with. It's a Nereid worm diet that's very attractive for the future. And we've had success replacing 100 percent of the fish meal. Now we have some caveats. With some amino acid additions we found taurines very important and conditionally indispensable when you pull a lot of the fish meal out of diets for kobia. And again, those are things that are going to have to be discussed later in terms of national listing and such.

So again, zero to 100 percent. That 100 percent is always the holy grail. We want to pull all that fish meal out of this diet. We know we can do that now with and without amino acid supplementations. Again, as we move forward and move past this proof of principle if you will, I think we can start blending some of these unique protein sources that are out there to achieve the amino acid requirements necessary so that we can move away from amino acid supplementation. In most of these trials we did utilize menhaden oil to supply the essential fatty acids that all marine fish require. Again, six to eight week studies and the same parameters—weight gain, feed efficiency, biological indices, to see the impact of these dietary manipulations on the animal's final product quality.

So this is the initial study again. This is with the NuPro, with the yeast protein if you will. And again, 25, 50, 75, and 100 percent replacement of fish meal. You see the decline in growth after we hit the 25 percent level. We analyzed these diets and saw some deficiencies in some specific amino acids so we re-ran it and just looked at the 50 and the 75 percent inclusion levels. In one set of diets we added methionine and tryptophan because they seemed to be a little deficient. Then we took that diet and added taurine to it, and you can see the dramatic impact that dietary taurine had when we're pulling out this fish meal. Taurine is relatively high in fish meal. So this got us really excited thinking we had the silver bullet for alternate plant meal inclusion in diets for kobia.

So repeated the first trial. All these diets were supplemented with a half a percent taurine in the diet and once again, that 100 percent we're always trying to push that wall. You see the decreasing growth but it was a substantial improvement from the previous trial. So not quite there. Again, this is a yeast protein with taurine but it gave us some hope that kobia was be amenable to 100 percent fish meal replacement.

And then this one masters student did all this work. She did a wonderful job. She was interested in the organic aspect of it, so again, we came back, we looked at the NuPro at 25 and 40 again, just to repeat our trials to see if we could repeat those results, and we did. And then that soy bean meal, soy isolate, and then that hemp meal at the end.

Really good growth. We call this—this is our Katrina control. We got some menhaden meal out of New Orleans right after Katrina hit so something was wrong with that fish meal. But these growth rates represent pretty typical rates for our lab that we've seen over the years. So again, at 40 percent inclusion or replacement of fish meal we can get adequate growth.  Now this is important because these different protein sources we can utilize as a blend possibly to attack the problem about supplemental amino acids, specifically with kobia.

Something that we've just finished.  I mentioned it in March.  We still had the trial in the water.  We've been working with a company out of the UK called Sea Bay.  They grow these marine worms, these Nereid worms.  They're certified organic by the British Soil Association and they're rag worms, they're fish bait, so marine fish typically love to eat these worms.  They’ve got really nice protein content, 50 to 55 percent. About 18 percent lipid.  Now that's very important because it's a marine lipid, so you're bringing in these N-3 [phonetic] fatty acids that are required by marine fish.  Again, this is an organically certified protein source.  Very expensive but very interesting in terms of what we're able to do with the kobia.  We've run two separate trials to repeat these results to insure that what we saw the first time was indeed happening and thankfully it was.

So this was the first trial.  The control is a straight 100 percent fish meal diet, herring meal in this case. And then again, the 25, 50, 75, 100 percent replacement of that fish meal. That diet on the end is what we called our organic diet. It was a mixture of the worm meal, organically certified soy concentrate, and then the NuPro, which again is able to be certified as organic. You can see we got really good growth, particularly with the 75 percent replacement level. The organic diet represents the first time that we know of that a marine fish has been cultured on a fish meal and oil free diet. So you can do it. It can be done and we've done it. And we did it again. And we just finished this last spring. Step back—again the control is fish meal. We looked at 50 and 100 percent as well as we repeated our organic formulation, and again, we're seeing the same thing. So this makes us very excited in terms of the potential to culture at least a kobia, and we feel if you can do a kobia you can probably do any other marine fish.

So in conclusion, the work we've done at the Virginia Tech Aquaculture Center and in conjunction with the Organic Aquaculture Institute in Texas is we've produced shrimp, tilapia, and kobia on diets that could be certified as organic and certainly have no fish meal or fish oil in them. You might need the supplemental amino acids at the start but again, I think by blending some of these sources, what we've seen, we can move away from the supplemental amino acids. Naturally, some fish are going to be easier to culture than others under organic certification and our mantra and our position is it should be difficult to do this. It's not for everybody to go out and produce an organic aquaculture animal. It should be hard, it should be expensive. But you've got to protect that label and that's our concern is that if the standards aren't high enough then the label loses its validity in the marketplace. And once you lose that you've kind of lost everything.

And so to tie this all back into the proposed rules in terms of the 12 / 12, as I mentioned in my paper, I kind of just rambled on for three pages. I didn't present a pure scientific paper for you, but I think it's a very good start. But what we could like to see is the phase out. We think it can be done. We feel like we've proven it can be done, and I think that we need to get something going now and the 12 / 12 rule is a great place to start. But we should set our sights higher in terms of the phase out. Thank you very much. [applause]

MS. FRANCES: We are scheduled for a break, about a 15 minute break. We definitely need one. We'll resolve the technical problems, we hope. It's now ten o'clock? Quarter of? So come back at ten o'clock. Good?

Anybody has index cards with questions, you want to leave them over here by my laptop, that would be helpful.

[sound cut]

MS. FRANCES: How are we doing on mikes? Not yet?

Our next speaker is Jonathan Shepherd. He is with the International Fish Meal and Fish Oil Organization.

DR. JONATHAN SHEPHERD: Good morning. Thank you to the NOSB for inviting me. Ron Hardy and I presented a paper on sustainable marine resources for organic aqua feed to this conference. Ron sends his apologies. He's away in Asia right now and he's asked me to present it on our joint behalves. I'm originally veterinarian, turned fish farmer, with a career in the fish feed business, and for the last three years with the International Fish Meal and Fish

Oil Organization.

Firstly some background comments. With wild fish capture facing a number of severe constraints, global aquaculture production will have to double by 2030 to keep pace with the demand. According to FAO, the United Nations, that means in absolute terms an increase of almost 40 million tons.

Analysis of food conversion efficiency according to the International Council for the Exploration of the Seas, ICES, suggests a closely regulated combination on the one hand, of human consumption fisheries, and on the other hand, of industrial fisheries, by which we mean feed fisheries, by which we mean reduction fisheries, will provide the only solution to the long term demands for fish protein.

Then again, it's worth adding that in an ideal world, fish would be fed directly to humans, but where this is not currently feasible, farm fish are the best converters to high quality food for human consumption. Look, if you could get a higher price for selling a menhaden or for that matter selling processing offals into the human food market, then of course you could and you should do so.

Given that the organic rule book was not designed originally, as I understand it, with aquatic products in mind. I've tried to focus on the key points, which should influence our thinking during this debate. I'll seek to show firstly that as regards sustainability, feed fisheries will be a finite or a sustainable resource. I'll paint the picture of eco-efficiency, which is that of an improving wild to farmed fish ratio. Thirdly, human health. The massive positive impact on human health is totally disproportionate to the minor contaminants risk that we hear about a lot in the media. And finally, fish health and welfare. Fish, of course, have an essential fatty acid requirement. That not only means as a veterinarian I have an ethical obligation to promote fish welfare and take account of dietary requirements, but in my experience it's a sound economic driver for keeping fish healthy, otherwise they don’t grow as they're expected to.

The view has got about that demand will outstrip supply within the next decade and this position was reinforced by a period of strong prices. As some of you know, the price has come down from over 1,300 to $1,400 a ton to about $800 a ton right now. On the other hand, the fish oil price has risen sharply to over a thousand tons [sic], influenced as it is by the whole bio diesel market, and rapeseed oil, and so on. The truth is that with the ongoing pattern of substitution with complementary ingredients, be they soy or whatever, reallocation from pig and poultry on the one hand to aquaculture on the other, and the more strategic use of fish meal and fish oil, there really is no current crisis. And I'll point out why we don’t have to fear of any crisis in the next ten years. So my conclusion is that increasing demand for fish meal and fish oil from aquaculture is not leading to an imminent supply crisis.

But let's look at the catch and production data. As you can see, from the last thirty years, these are FAO statistics, the global supply of feed fish, industrial fish, reduction fish if you like, has varied between 20 and 30 million tons per year and the variations reflect natural variation to a large extent and you can see the marked effect of El Niño, in this case in 1987, and minor ones along the way. El Niño being so important to the global catch because of course Peru and Chile together are approximately half of the world's supply.

This overall picture of feed fish catch globally, of course, is mirrored by the fish meal and fish oil production statistics. This is from '86 to 2006 and you can see fish meal varying between five and six million tons per year with blips following the El Niño again and fish oil likewise at around one million tons per annum.

Let's look ahead for a moment and I believe there is no evidence of an out of the ordinary alteration to raw material supplies, but there are a lot of factors, of course, affecting this. On the one hand you've got—we've been talking about it—El Niño, which has a negative effect. You've got a more precautionary approach to fishing, which I think is a wise and responsible thing and it's very much in the minds, particularly of the Peruvian market, their government at the moment. Then there's more fish going to human consumption as for example in Chile with jack mackerel there are now processing innovations to try and utilize the bigger jack mackerel for human consumption. And these, if you like, negative in terms of feed fish and fish meal supply, negative factors of course offset by certain positive effects. La Niña, the opposite of El Niño, krill coming on stream. I doubt if that will be used for commodity fish meal but it's becoming commercially available. And then more processing waste to the fish meal and fish oil industry.

So in summary our belief is that there will be certainly good years and bad years but the overall effect on fish meal and fish oil volumes will be neutral. In other words, it will stay a relatively flat curve over the period, certainly not getting higher.

So much for supply then. What about demand? I think the interesting message I want to put over, of the last two, three, four years really, has been the effect of increasing price leading to market reallocation based on value. In other words, that the pig and the poultry sectors are using less and less fish meal and that is therefore available for aquaculture or whoever indeed is prepared to pay a higher price. And if you look at the left hand column, 2002, I would say there was a high use of fish meal of course in aquaculture diets and in pig diets, including grower pigs, and moderate amounts, certainly in Europe, in poultry diets, and at that stage in the USA as well.

Also, I have not put on this slide, but here in the States I shouldn't pass up the importance of the pet food market in terms of usage of fish meal and fish oil. And then of course nutraceuticals is a growing but small—high value, small volume usage.

But then by 2007, by this year, of course the use in aquaculture has moderated quite considerably. We've heard already about the success in terms of substituting with complementary ingredients in a number of diets. In pigs I would say that worldwide it's more and more restricted at the moment to baby pig weener diets. It's gone out of pig grow-out diets almost completely and that's based on price. And certainly in the UK, where I live, we don’t see any fish meal in poultry at the moment except perhaps in small niches like turkey poults and so on.

Looking ahead then, I think this trend will continue. I think in 2012 it will be start of finish of brood stock and recovery diets. In other words, fish oil for example, will only be as a washout in the last two, three months before slaughter to raise the long chain omega-3 levels. It won't be in the main grow-out diets. And I think the same will pertain in terms of pigs and poultry where it will be in niches like breeder diets, and recovery diets, and so on.

So to summarize that picture I would say if you look at the foot of the table, the three green points, one has a picture of increasing animal production worldwide, a picture of decreasing fish meal inclusion rates, and a relatively constant availability of fish meal, a sort of plateau. Therefore, I mean, it's obvious that we've got a situation that's traditionally been a commodity and is becoming increasingly a strategic ingredient for use at critical stages in the life cycle. In other words, where people are prepared to pay the price to get the insurance and nutritional security that they need in the critical life stages, but not as a generality throughout the life cycle.

So if we stay with the picture of six million tons thereabouts, about a million tons of fish oil, we reach a point in 2012 where you'll see that approximately 60 percent of world fish meal production goes to aquaculture, compared with 52 percent in 2005. And 88 percent of fish oil will be used by aquaculture, compared to 84 percent in 2005. Now obviously, these are rather difficult projections to make. They're published by Andrew Jackson based on Albert Tacon's [phonetic] data. But I think the point is that increasing demand for fish meal and fish oil from aquaculture is not leading to that imminent supply crisis. And it's worth just adding to that, that by 2012 fish oil will be getting tight if there's no production of industrially manufactured EPA and DHA by then, which I'm sure will come about. So that's the worry. It's the fish oil that's the worry in terms of longer term availability and fortunately there are substitutes in development.

Coming then to this vexed question of ratios of fish in / fish out, if you like. There's a popular misconception that, you know, there's eight to one, or four to one, or ten to one, or I've heard everything I think, and you've got to actually examine the data of course. And if you look up at the top left you see a little green spot. Belona [phonetic] the NGO, did a study in Norway in 2003 with Norwegian salmon and concluded that the figure there was 2.67 to one. And of course, since then it's been improving somewhat due to continually improving food conversion rate of feed to fish and increasing substitution particularly in Norway now as well of fish oil by rapeseed oil. But I'll say more about salmon in a moment.

I want to concentrate on the other two, the red and the blue line, which is trying to take a global picture, input / output picture, and this by the way, is all fed compounded diets, right? Whether they're carnivorous fish, so-called, or all aquaculture. This is fin fish and crustacean aquaculture fed compounded diets. Again, Albert Tacon and the FAO have supplied the data and Andrew Jackson has looked at it. And you can see that, first of all, if you take the picture of all aquaculture, that's the blue line, by 2005 or 2007, it's already about 0.6 to one, below one to one. But of course, I think that's an unfair comparison. I think we should focus on fish which have a relatively exacting nutritional requirement, and so the red line is the carnivorous fish and today, in 2007, that's about 1-1/2 to one. But of course, the devil's in the detail, and if you feed back the offals from those farm fish to other species of fish, other species for preventative medicine reasons, then you'll get it at one to one or even less than one to one, even today. So it's a picture of continuing improvement due to the substitution [audio problem] continuing improvement due to the strong substitution push.

Coming back then to salmon, I know this is of interest to a number of you, so I'm said that the Bolona figures, 2.7 in the early 90's and published in 2003 for Norway, this is now down to close to one to one on the protein side. But of course, it's the high fish oil which makes this something of a special case and now the growing use of rapeseed is the sort of secret factor which will help that. And logically, I believe that feed formulators can and should replace down to about 12 percent fish oil and make the rest up with vegetable oil in order, not for the benefits of the fish so much, they need less, they need probably only two percent, but in order to ensure there's enough long chain omega-3's in the filets for human consumption.

And it's worth reminding ourselves, I think Brad Hicks said that conversion efficiency is based on the edible protein and energy recovery basis and fish are about twice that of poultry and many more times efficient than in cattle. And why is that? Well of course that's due to biological fundamentals. The fact they're cold blooded, the fact of neutral buoyancy, and they don’t have to worry about gravity, don’t have heavy bones, and all the rest of it. So it's inherently more efficient. And going to your proposed 12 and 12 rule, those levels of inclusion as proposed in salmon would make the ratio around one to one, while with other carnivores with less oil it would be better than one to one. And especially of course if one then utilizes the salmon offals into non-salmonids for farming purposes.

But looking at sustainability then, what are the options here? Peruvian anchovy, as I said, is far and away the biggest fishery in the world. There is a highly precautionary approach by the government. There was a problem in the 90's with lack of compliance by the big fishing boats in Peru but the government has now imposed a whole system of satellite tracking, and seven day a week independent auditing by SGS, and it seems to have pretty well eliminated all that illegal fishing. And you've got to remember there, it's such an important part of the Peruvian economy, it's the second or third biggest export, fish meal, they can't afford to kill the goose that lays the golden egg. So it's a fundamentally strategic fishery for the Peruvians and fortunately for us too, who can take advantage of it.  But here in the USA, of course, you're exceptionally lucky—

[sound cut]

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-in having access to trimmings from the Alaskan Pollock fishery. Also, that it’s MSE certified. And both of Pollock canvas [phonetic] salmon on managed targeted fisheries. So the segregation and traceability of fishmeal and fish are derived from. It was not a big deal.

As regards international organic standards, the Europeans, we Europeans, would regard fishmeal, fish offen [phonetic] certified sustainable fisheries as our gold standards. So we’re very envious of you guys with your Alaskan Pollock. But given our lack of current certified volume sources of supply in Europe, our default position is an acceptance of fishmeal and fish offen trimmings of fish processed for human consumption. Of course, with only natural antioxidants and so on.

Next slide. Human health. I’ll skip these two. I’m running out of time. But I just want to say the benefits to human and animal health from long-chain Omega-3s are overwhelming and eating salmon reared on fish oil reduces atheromatous plaques. That doesn't occur when you eat salmon reared on wholly fish vegetable oils. And that's in the view of most commentators, is very important compared to the minor diminishing and manageable risks from persistent [phonetic] to organic Pollock pesticides.

Human health. Again, the only thing I would say here that's relevant is it's not really a deal here, because the levels found in pelagic fish from Alaska and the South Pacific are so very low. And less than 12%--going back to your 12 and 12 rule—less than 12% runs the risk there are not enough long-chain Omega 3s in the final product. Next slide.

Fish Health and Welfare. What I want to say there is fish cannot convert the Omega-3s found in plant oils. So—and virtually all species are carnivorous during at least some parts of the life cycle even if it's only as fry [phonetic]. And so the reality, ladies and gentlemen, is if fish were eliminated from all aquafeeds, production of nearly all fish species would be difficult, if not impossible on a general point.

So my final slide, including points. Most international organic standards have recognized the inherent differences between terrestrial and aquatic ecosystems and allow the use of meal and oil produced from fish processing byproducts in organic feeds. So the organic movement in the States is unhappy about using Peruvian anchovy meal or Manhattan [phonetic] meal, despite the sustainability record that I've talked, you have this waste stream of MSE certified Pollockical [phonetic] salmon processing on your doorstep in Alaska. And if the NOSB or any other organization rejects organic darts [phonetic] for aquaculture then I believe they remove the incentive for aquaculture to move further towards the responsible and eco-efficient approach to production which I'm sure you advocate. And if you don't encourage its use, you know, the alternative could be to waste it. And surely, feeding it to fish and retaining the EPA and DHA has got to be better than using it for power up in Alaska. Thank you very much. [Applause].

MS. VALERIE FRANCES: Thank you very much.

FEMALE VOICE: Valerie, we have one more speaker? Can you hear me. Can you hear me now? Yeah. I'm not seeing any heads moving.

FEMALE VOICE: I can hear you.

FEMALE VOICE: Okay. All right. So we're good. Thank you.

MS. FRANCES: Our last, but not least speaker is Torbjorn Asgard from Akvaforsk in Norway. I hope I got that right. And you're [unintelligible]. Okay.

MR. TORBJORN ASGARD: Thank you, and thank you for the invitation—

MS. FRANCES: Hang on one second. I'd like to ask you to give your name and your affiliation, and spell your name.

DR. ASGARD: My name is Torbjorn Asgard and I'm affiliated to Akvaforsk, the Institute of Aquaculture Research in Norway, owned by the Ministry of Fisheries. It's the main owner. My name is spelled T-O-R-B-J-O-R-N OR S-G-O-R-D. If it's difficult you can change the ur or oe and the or to aa. [Laughter]. And my coworkers on this presentation are Dr. Gedmaled Barga [phonetic], Dr. Tuti Mofkara [phonetic] and Dr. Stolaresti [phonetic]. And we want to stress this point that flexibility in the use of feed ingredients—that's very important for the sustainability and it's very important, we think, for sustainability in any food production that there is flexibility. Next.

It has been said some words about the efficiency I heard in a unit in just draw the attention to different figures. This is a study from 1996 where they were studying what was actually the situation in the Bjorn [phonetic] Sea for the Northeast Atlantic cut [phonetic]. How much was it consuming? How big was the standing biomass [phonetic]? How was the annual harvest? Sustainable harvest. And how much was the fillet output from that.

And then this is compared to what would be the situation if Atlantic salmon got the same feed fish as their only feed. No vegetable ingredients in the feed. What would then be in the parallel output. And you see at the bottom line, the fillet output is considerable higher. And I think this is actually showing why we, as humans, switch to culture production in agriculture on land too. It is much more efficient when we can feed animals to situation and where they don’t have to go and starve for long periods. Next please.

And also this relation of efficiency between our most efficient meat producers are very important for where we should use the most valuable feed ingredients. And as long as we among the aquaculture species find the most efficient uses of these feed ingredients, I think that's where we should use this limited sources. Next please.

And if we go 15 years back, of course, the salmon diet, for example. It was very marine-based. You could find diets consisting more or less of fishmeal, fish oil and some wheat just to get right the physical quality of the feed. This is now showing more the feed composition today. It's a considerable content of fat protein sources. This is then from Europe. Next.

And here is a feed composition based on good plant protein sources and what that would look like. And you can see also the relative prices at the bottom line here, showing that there is actually a very strong drive for going for the plant protein sources because they are cheaper than the fishmeal. But there are problems relating to using this plant protein sources. As in salmon there are several problems you have to deal with. And that's why we haven't reached this level yet. Next please.

In South America it's a different situation. We have—the industry have access to more alternative protein sources, like animal byproduct meals, blood meals, hydrolases [phonetic] of all different kinds. But in Europe that has been prohibited due to BSE from 2000. So it has not been legal to use these animal byproducts. Blood meal from non-ruminants were again, legal from 2003. In Norway it was again legal now from 2007. but hydrolases, they have to have a very small molecular size. All molecules smaller than 10,000 deladoltants [phonetic] and that means that most of the products available are not approved.

But we have several ingredients here where—excellent amino acid profile that would largely improve the possibility for using plant proteins sources without adding additional amino acids.

Then I would like to go a little bit more into this fish-in, fish-out [inaudible] we'll say into [phonetic] and we have actually salmon producers today are using as low as 15% fishmeal in their feed. And what is the situation then? It means they are using then 150 grams of fishmeal per kilofeed. And if we say an average feed conversion ratio here is around 1.2, they are using 180 grams of fishmeal. And if that is on an average containing 67% protein, we see that the fish protein spent for producing one kilo of salmon is actually 121 grams.

And in one kilo of salmon there is 180 grams of protein. Which means a net gain of 59 grams of protein. And if we then should pick a fish in, fish-out that balance around one, this means a fishmeal inclusion of around 20% when the feed conversion is 1.2 or 55%. Now, 25% of fishmeal, if the FCRA’s around 1.0. Next please.

Expressed in another way, how much marine protein did we spend at  fishmeal inclusion levels. And how much fish protein do we produce? So here if we put the spending at one, how much do we then produce? And you see that it’s in the range between 20% and 30%. We balance on the protein side. On the fish-in, fish-out equal to what. Well, if we can go lower it’s considerably better. Next please

And then again, it’s important to think about what are we using of the fish if we make a fishmeal, and what are we using if we want to use it directly for human consumption. There is a considerable difference. In the—if we should use the, the fish just for filleting it’s a fairly small pollution [phonetic] that is recovered. But, of course, we can also use the rest for fishmeal production. But here you see, if we look at fish fillet spent and the fish fillet produced, we are even on the—actually on the positive side, already at 35% fishmeal inclusion level. Next.

And here you see just the possibility we get if we can use the animal byproducts. The next one in addition to please. Yeah.

And you see here the comparison then between the plant protein based diet with a low fraction of fishmeal and the animal byproducts based diet and of course, it's a growing concern, at least in Europe, about these animal byproducts that are actually very highly valuable protein. Why are we not using this for food production in feed? So I think that is an important ecological concern. Why should we not use this extremely valuable protein sources for feed and food. Next please.

On the lipid side, the picture is a bit more difficult. And of course, the lipid content in fishmeal varies to some extent. But on an average, the fish used for fishmeal production contains 7% lipid. And some of this lipid roughly 2-1/2% of the 7% is actually in the fishmeal. Meaning that the oil fraction will only be 4-1/2% of the lightweight [phonetic]. So if we should have a fish-in, fish-out ratio of one here there should not be more than 7% of fish oil in the, in the diet. But of course, more fish oil can be used if the fish contains more lipid. Next please.

So just to show you the calculations here too, if the industrial—if the fish contains 7% lipid, what is decide then if fish lipid level in the feed is 16%. You have discussion also about 12 or 14. well, fishmeal contains 10% lipid which means 100 gram of oil per kilo. And if it contains 25 fishmeal this gives 25 grams of fish oil. Next.

And the first kilo of fish we catch, of course, it contributes with all its lipid. The next kilo will only contribute with the lipid, we can separate out, which is 45 gram. And the next kilo, again, 45 gram, so then we are using actually three kilo of wild caught fish to reach the 160 gram or lipid in the diet. But of course, all the protein—that will be possible to convert to fishmeal and that will give us roughly half a kilo of fishmeal. Which can then be used to other animals.

So this means that the real fish-in, fish-out factor here is actually 1.09, but it’s at the same true that we need three kilo of one fish for this production. Next please.

But then again, to the—what is the demand from the consumer and what are the difference of course, between the fish species of the natural lipid content. And what is actually needed for the health of the fish. And what do we want for humans. But the fish itself requires somewhere between one-half and one percent.

Can we do something about the efficiency and retention of these essential fatty acids? Well, there are differences between species in their ability to elongate and desaturate their fatty acids. And carp and eel have quite some ability. It’s also some ability in rainbow trout and Atlantic salmon. Not very much. But maybe enough so that we can actually retain 100% of what we put in in feed in the product we get. While in the marine species there doesn’t seem to be ability for such elongation. Next.

And then I think it’s one aspect that is not raised here and that is the relation to the genetics. I think it’s very important that we work with domesticated animals. And they are much more efficient than the wild ones. And when we try to take care of resources I think it’s important that we utilize this possibility. And you see it’s in Atlantic salmon, the difference now between the selected and the wild is really important. Next.

And it’s also very important, actually the growth we achieve. If we look at the feed conversion ratio here in relation to the growth of the fish, you see that if you slow down the growth too much you will spend much more feed resources on producing a kilo of fish. Next.

So to conclude here, commercial feed production is gradually become more independent of fish meal and oil from the fisheries. And increased use of protein from vegetable and animal byproduct sources will make Atlantic salmon a net producer of marine protein. Vegetable oil sources can be used at high levels in salmon feed as long as the minimum needs for essential fatty acids are met. And the fatty acid profile of the fish will, of course, be reflected according to the feed we are using. Next.

So in the early 19s, roughly 2-1/2 to three kilo of wild fish was spent in the production of one kilo of farmed salmon. And this has now been reduced to approximately one to one on the protein side. And it is possible to improve this further. And the slaughter offal from the salmon industry are used for other species. And this is actually an important point because if we say that the aquaculture industry has an offal production of roughly 40% of the lightweight, if that is converted to fishmeal it will be roughly 10% of the weight of the fish we produce, and that will mean that at 10% fishmeal inclusion level we are actually not using any protein, or we don’t have to use any protein from wild catch at all. So it’s not necessary to go to zero to be independent of fish protein from the wild. Thank you for your attention. [Applause].

MS. FRANCES:  Thank you. And thank all the presenters. I will turn it over now to HUE, the livestock chair, to facilitate questions and answers from the board. Go right ahead. Do we have 80 more index card questions from the audience we want to get up like right this minute.

MALE VOICE:  Let’s have them.

HUE:  Please put who you want your questions addressed to when you send them up and don’t be afraid. Yeah, I know. Well, thank you to all our morning panelists. I really enjoy the fact that we’re hearing from people with different accents. I like that a lot. It means we have a real worldwide global input here, as the National Organic program is an actually globally based program so there’s a lot of interest, of course, and where all the salmon and aquaculture and big areas are in the world are not necessarily in the U.S. so thanks to the panelists and of course, we as the National Organic Standards Board have questions for you and we also have cards from the audience. And what we did at our last symposium was basically our questions certainly have priority in the question list so—and then we kind of look into the cards and maybe entertain some of them. But I should also say that, as at the last symposium in State College, Pennsylvania, if I'm not mistaken these cards will be scanned in to the public record so that they are officially put into the symposium, okay?

MS. FRANCES: Posted on the Web site.

HUE: Yeah. In case we don't get to them all, which I'm we won't. So I'll just open it up, I guess, to anybody on the board and just—Dan.

DAN: I'd just like to, first of all, with a slight clarification on the recommendation that was made from the aquaculture working group was to have a limit of 12 and 12 from wild caught sources. That was really only addressed with the last speaker. But if we're only looking at that requirement being from wild caught resources, how could any of the other speakers address how that would change their view of the recommendation, if they're looking at essentially no limit on fishmeal and fish oil coming from a natural growing organic fishmeal and fish oil that develops within the industry.

HUE: Any of the panelists? Brad Hicks [phonetic].

MR. BRAD HICKS: I put up my hand 'cause nobody else did. The reality is currently that source is quite a ways off. It does not exist. There are currently some small meal and oil supplies perhaps out of organic poultry rearing, but in its wisdom poultry has been excluded as an ingredient for fish.

The other issue is it has been suggested that people grow fish to produce the fish meal and grow fish in our organic system to produce fish meal and fish oil for rearing fish. If you actually look at the ecological footprint of that, as you look at the concept a little bit deeper you'll find it's really quite extravagant. And I'm not sure—certainly our group is not prepared to go in that direction.

In the event that organic aquaculture does grow significantly and is able to get to the position where byproducts are available from organic production they would certainly be used in preference to other sources. Thank you.

HUE: Joe had a question. You're up next.

JOE: Yeah, it's been mentioned solvent extracted soy meal in a couple of the presentations and the industry—the organic industry, as far as I know, is not able to provide certified organic soy meal because allowable extraction processes, which we do have, are too expensive at this point in time for soy meal. That's my understanding, but I'd like to just get a clarification on the availability of organically certifiable, if not certified organic soy meal that is—that only has allowable, you know, solvents. Carbon dioxide, et cetera.

MALE VOICE: We—in our—we used a, a certified soybean meal, but it wasn't extracted so I guess you would call that a full fat. But—and then the soy concentrate is becoming more available as the industry—as the fishmeal prices increase more soy producers are going towards a concentrate which give you a higher protein content. It bumps it up to about 68% of 70%.

MALE VOICE: So it doesn't necessarily—we don't need defatted soy meal meal. It's not a requirement for the aquaculture industry.

MR. STEPHEN CRAIG: No, the advantage of that in a traditional soybean meal is that it increases the protein content for you.

FEMALE VOICE: Please identify yourselves.

MR. CRAIG: Oh, I'm Stephen Craig [phonetic] from Virginia Tech.

MALE VOICE: Andrea, you had a question?

MS. CAROE: Well again, I just want to clarify what the AWG recommendation was. What we were looking at is a maximum of 12% from fishmeal, a maximum of 125 from fish oil. From wild caught sources; not organic sources. Not organic sources. This was a matter of—and I think George could speak on this, but it was a matter of without organic fish how do you have organic fish meal. It was—this provision was put in there with a sunset on it to develop other sources and to develop organic fish sources for feed. But we are not specifically looking at a diet for piscivorous—is that how you say it?

MALE VOICE: Piscivorous.

MS. CAROE: Piscivorous fish that includes organic fish or nothing. We're looking at the possibility and the reality of allowing a wild caught alternative for a period of time for the development of organic fish or the development of other protein and amino acid sources.

So again, that's really not a question, but I just want to clarify with the researchers that are here and the board, just a reminder of what we're looking at as far as this issue.

HUE: Questions? Tracy.

TRACY: This question is for any of the panelists who measured yields. I was wondering if there are any other metrics around say, the texture or the flavor of the fish that are also being measured as substitutions and the feed occurs?

MALE VOICE: Someone spoke to that, I know.

DR. BROWDY: I don't know about the fish, but we tasted—Dr. Browdy from South Carolina. I don't know about the fish, but we did some organelles uptil [phonetic] analysis of the shrimp that were fed the vegetable based protein diet. The "organic" quote/unquote diet that we fed the shrimp from the pond study. And what we found was that there was not a real significant difference. I can provide that data for you. For me personally, I can tell you that taste different. They're not as—they don't have that sort of fish, you know, kind of flavor. That sort of iodine ocean kind of flavor. They’re much cleaner in terms of flavor. And when I took it to some restaurants locally and gave it to the chefs and said try this, try this, and then they handed it out to the people in the restaurant, it was really interesting to see in these blind tests that, you know, some people preferred on; some people preferred the other. But they definitely do taste different and they definitely have lower levels of some important fatty acids even with the algo-oils [phonetic] that we used. So, you know, we’re going to have to beef that up some if we want it to be as healthy. But there’s definitely a difference in flavor.

HUE:  Jennifer.

JENNIFER:  I just have a follow-up question to that. Your research compared your control which was also farmed to your organically fed. Did your taste test also just compared both farmed or also to wild?

DR. BROWDY:  That’s a good question. It’s just both farmed.

HUE:  Tina? Or who had the—was it—

TINA:  This is also a follow-up to that question. The measurement most used was growth rate. And I know that it’s always our instinct to want to just produce bigger, better, faster. But is there a linear relationship across the board between growth rate and health? And other, you know, other factors. Health, nutrition, susceptibility to disease, all those things. And that could be for anyone.

MR. HICKS: Having grown lots of fish I guess I’ll try. It’s Brad Hicks from British Columbia. I guess I’ve grown lots of fish under lots of conditions and there’s no question that you can overgrow them, for lack of a better term. You can push them too hard. It’s not unique to fish. We certainly that in other farm animals as well. The standards that we have proposed, to a certain extent, take into account, for instance, we limit that energy quantity that’s available in the feed, is one of the standards we used to manage that issue.

Health-wise, I guess my experience is that crowding is more of an issue than growth. It’s one of the issues, of course that will go along with animal husbandry of any kind. So we certainly limit crowding. I think for this issue about the use of fishmeal and fish oil there is—we have not got enough production under our feet to look at the effect of this heavy substitution of vegetable proteins for fish proteins and vegetable oils for fish oils yet, to look at the health implications of doing so. We’re just too early on the system. We do not yet have enough experience. That may turn out to be a problem. I think from my talk I understand teacher 12 and 12, but I think even under that it is our responsibility, certainly our organization looked at it from an organic perspective that it is our responsibility to in fact use fishmeal and fish oil for the production of fish. That it’s a very good use of that material and our standards do require that half of that does come from fish processing processes. So it’s not virgin fishmeal and virgin fish oil per se. I don’t know whether that answers your question, but it’s an attempt.

MALE VOICE: I actually—Doc Asgard in a moment. Let me—I wanted to add on one thing on Tina’s question, if I may, which kind of related—I guess I’m a dairy veterinarian among the organic dairy farmers, and what I find is that—yeah, okay. Totally different terrestrial and their cattle, but I still work with conventional farms and what I find is that when conventional farming—I’m trying to phrase it in a more conventional and organic—the animals are pushed a lot harder so you get more production, more efficiency, everything like that. But with cattle that are pushed hard, there are certain health problems that happen. I won't go into them, but they do. Metabolically and everything like that.

And with the organic farms that are fed more—well, they're not pushed as hard and other aspects about it, they don't have those same kind of problems. I'm just wondering—I think it's in the same line of what Tina's asking, if you try to feed the animals to what the conventional paradigm all the time, you know, max efficiency, max everything to get max yield, are there some health problems that might come up with fish versus if you kind of back off a little. Does that make any sense? Anyway, it does to me.

MALE VOICE: I will try to answer this. And it's actually two sides of that. One is that in general you will see that where they have health problems there is, in general, very poor growth. So remember this aquaculture activity is still very young. And the problem is actually to meet the requirement of the animals to the extent that they express their growth potential. Or close to that. Because I would say on an average, if we see an Atlantic salmon, in an average the industry will express maybe 75% of the growth potential in the fish. And in some areas they are down to 50%. So and they far from growth rate being a stress.

On the other hand, when you reach very high growth rates then you are really challenging the diets. So if there are some deficiencies in the diets you will show it at the very high growth rates. Because then everything has to be precise. It has to be extremely well-balanced when you approach the maximum growth. And that is one of the things that appear here with the soya replacement. You will go into mineral deficiency as shown with reduced ash content. It’s very common to get a problem if you don’t care of the mineral balance in the diet.

So, and this complicates actually the balancing of the diet as you go for high growth. But actually it’s when the animal express its growth potential that it seems to be most in balance.

HUE: Okay. Thank you. Jeff, you’re—then you’re next.

JEFF: Thank you, HUE. My question is for Brad Hicks. Brad, in your presentation you showed an image that had a—indicated a traceable linkage between grasses, herbivores on up into humans. Then on the fish side of your presentation you started at the bottom of the slide with a zooplankton algae or plankton something like that, and then onto fish. But you specifically never highlighted the zooplankton, the plankton, or may any sort of linkage between that that was traceable on up through the food chain. You drew lines from grasses over to fish. And I'm just wondering why you specifically avoided that, or if there is a connection there that we could exploit.

MR. HICKS: Actually I'm not sure 'cause my original presentation, the lines weren't quite the same as turned out with this projector. In the presentation there actuallly are linkages between the zooplankton and the phytoplankton up into the invertebrates. And there is a line up into the omnivorous fishes. Okay? Because yes, that does occur and that can—is exploitable.

JEFF: A follow-up question then. So are you inferring or on the terrestrial side we manage our soil organically, we produce organic grasses, grains or anything else that's in the oil that moves up through the food chain. So are you explicitly saying then that you would work towards farming organic plankton, zooplankton that would then be traceable up through the system, through our organic system plan?

MR. HICKS: At this stage I would say no. The reason why I would say no is because in the terrestrial system the management of the soil is quite easy. Quite frankly, the management water is much more difficult. Even in a soil system. Where does the water come from? It's got the same issues for me as water, say, in the ocean. You know, when the rain comes down on your pasture do you know where your rain's been? Okay? The rain is—contains all sorts of interesting things besides water.

So the idea that organically we somehow manage everything, to me is not quite there yet. Because we don't manage the water system in terrestrial. The water portion of terrestrial agriculture we don't particularly manage. When we draw water out of a well, for instance, you have no idea necessarily where that water's coming from except upstream somewhere. And you don't know the inputs necessarily into that water as a result.

So in a roundabout way to answer your question, I think that in the aquatic system the plant portion, because the system is based on single cell organisms that in fact don't have a footing, if you will, don't have a root system, it is really much more difficult. And in the aquatic system, or sorry, in the terrestrial system plants bring billions of cells together already. So we've got a unit we can manage.

In the aquatic system that doesn't occur until the planktivorous fish level or the invertebrate level. Okay? We don't have that assimilation or that bringing together of a mess of biology until that level. So it's really quite—from my perspective, that is impossible to fulfill that desire.

But my other discussion point on that is it is really not that unlike terrestrial agriculture in the sense that the water portion are both from open systems. Okay?

STEVE: I'd like to add something to that. I work with the organic aquaculture institute with the shrimp. What we're proposing is managing the microbial food Web within the pond. Much like you—we call it treating the pond like a ruminant. Where you're actually feeding the bugs and the bugs feed the organism. And we've had tremendous success with organic compost additions as feed supplements. And actually managing and exploiting that microbial food Web. And in the case of marine shrimp it's very effective. So there are certain applications where you can exploit that aspect of the aquatic environment.

MR. BROWDY: This is Craig Browdy again. I think that the—what Steve said is very true for shrimp and it's true also for certain species of fish. But it doesn't work for other species that need clear water. So we need to make sure that we keep in mind that aquaculture is a very diverse industry. And one thing that works for one species might not work for another and making one rule that covers all species, you have to really keep that in mind all the time.

The other thing I wanted to mention specifically in answer to your question was that these particular algomeals [phonetic] that are produced by fermentative processes and similarly, I guess they're used to a certain degree, can produce some—it would be like farming up the food chain, I guess, except for that—I guess if you saw the factory in King Street I'm not sure that you wouldn't shudder a little bit because it's a big fermenter, but on the other hand they assure me that they're working towards organic certification of that part fermenter. So I guess that it is possible that we'll have organically certifiable phytoplankton meals that are high in DHA and possibly one day EI.

DR. ASGARD: This is Torbjorn Asgard again. It’s, I think it’s one thing you should think about in relation to this management of the whole food system. Not just organic; it’s any food production. I think one of our big challenges today is to manage to recycle nutrients back to the production systems. We are more or less stealing from the production areas and dumping in the cities. That is maybe the biggest challenge we actually have.

HUE: Andrea.

MS. CAROE: I’m going to circle us back around to the health issue a little bit. In my past careers I did a lot of work in water quality and bioassay work. And one of our prime indicators of water quality was looking at these indicator organisms for mortality first, of course, but also reproduction and fecundity. And I was wondering if any of the researchers have looked at these indicators for the overall sustainability of these, these aquaculture farms, and has there any research been done on egg production as it relates to a control, or the ratio of female to male population as fecundity and the selection, based on the environment or based on their health.

HUE: Before anyone answers, please, all panelists have to identify themselves every time that you're going to speak. It’s for their reporter.

MR. HICKS: I guess I’ll go. It’s Brad Hicks. Our experience with fecundity specifically and in salmon is that the fecundity in farmed salmon is not as good as the fecundity in wild salmon. That was particularly true 20 years ago. In the last 20 years we have, for lack of a better term, I guess, and I don’t think it’s a discovery, I still think we’re pioneering and in the art form—we have learned that if we feed the fish better diets, and in fact, if we actually restrict their feeding which occurs naturally in that particular species, just post-ovulation, that we’ve actually been able to dramatically improve the fecundity in salmon.

So I like, I guess, all terrestrial species, as the better we get at understanding, the more we learn about them the better we are at trying to mimic nature for lack of a better term and we do improve those things. I don’t—is that the issue you're looking at or are you looking at pollution?

MS. CAROE: No, I’m specifically trying

to find an indicator of, you know, these system were look—what I see in most of the research that was put there is production oriented, which certainly is important for the financial viability of these operations. But it doesn’t speak to us really about whether this is good for fish. So I was trying to get at indicators that would let us know if this is healthy for fish to be reared this way. And fecundity and reproduction definitely are indicators of whether, you know, that species of fish is thriving in this environment with this type of diet. So again, I’m just kind of trying to get some more, you know, sideways look at, you know, since the fish can’t tell us if they’re happy or not.

HUE: Okay. There’s no question that the diets that give us better fecundity, we have much higher levels of fishmeal and fish oil. At this point I don’t think we know the specific science behind it, but practically speaking, and we’ve got—our end [phonetic] here is very large. We have very large numbers to deal with. We’ve certainly discovered that much.

MR. SHAH-ALAM: Shah-Alam from the University of North Carolina, Wilmington. I just wanted to a little bit with this question—it’s true that yes, if we had more fishmeal, fish oil, that’s good fecundity. Good eggs. We did some studies, I think Dr. Otranovy, he’s here [unintelligible] and some studies with the black sea bass and southern flounder. So when we fed the fish with some kind of, I mean, wild light fish, like not frozen fish, wildcat [phonetic] like I call a sardine, anchovy or something like this, then the highest fecundity definitely we found.

And also we tried to develop some dyes [phonetic] with the different types of lipid. Because lipid plant could—important role for the, I mean, developing eggs. So we fed the lowly picked and highly picked one I think maybe 12 person and 18 person, lipid fish world [phonetic]. Let’s give the good excellent, I mean, fecundity sarbatar [phonetic] rate of this fertilization egg. So many parameters we look for this. So that’s true that for—if you think that for the high quality good stock we must add high quality diets. And again, same thing, that not only fishmeal and fish oil is the diet for molition [phonetic]. [Unintelligible] so many other parameter, well-balanced diets. So maybe due to nother small nutrients like [unintelligible] could be deference [phonetic]. So these things also we need to consider. Thank you.

HUE: Dr. Asgard.

DR. ASGARD: Torbjorn Asgard again. I think again it’s a question of how we look upon it. If we look at the salmon industry there’s no doubt there has been an improvement in fecundity. The whole production is much more predictable. Getting average better and better result in, in the industry overall. Not just organic, but generally in the industries.

At the same time it has not been, as far as I can remember, any studies particularly on this replacement where you go very far down in fishmeal and checking then what is the quality. But in general, what I state as I had in my last slide, that it’s the nutrients that matters; not the ingredient.

So if we are able to understand what are the requirements of the animal and we can fulfill the requirements with the ingredients we are using, it will be working.

HUE: Bea.

BEA: First of all, I want to thank all of the panelists. Your information was very useful. A couple of questions that I have, there’re two separate question, but they interrelate to each other. From a consumer perspective I think it’s going to be very important for consumers to understand the animal welfare conditions of the farms. And I’m curious what studies have been done or what considerations have been made as far as the health and the environment of the fish that are being raised on the farm.

I her a lot about how important it is to make sure that their diets and their weight are maintained for their health through supplementation and the different types of feeds that you're changing out of its diet. So making sure that you maintain a certain level of nutrients. But I haven’t heard much talk about the actual, you know, conditions of how these fish are being raised and how that compares to their natural habitat.

MR. JONATHAN SHEPHERD: Could I try and lay a little bit about that.

HUE: Please state your name for the—

MR. SHEPHERD: My name is Jonathan Shepherd. I don’t know if this answers your question, but maybe it’s worth—I’ve been fortunate in many ways to have grown up in the last 30 years of my career with—simultaneous with the growth of the salmon farming industry in Scotland which I was very involved with. And we helped to pioneer the company I was with. Marine Harvest, Salmon Farming in the U.K. And then the Norwegians really sort of took over and Torbjorn can confirm or otherwise what I'm going to say, but I hope that—we helped each other really. Because in the very first years it was very much of an experimental thing and we didn't know the—talking specifically about infectious diseases, the viruses and bacteria. Of course, we knew we had a problem in the wild furonculosis occasioned in wild salmon, and that worried us a little bit.

And the book said that this organism, aramona salmon asadra [phonetic] only survived in fresh water. So we were relatively relaxed because we wanted to farm in sea water. But then we discovered the book's lying [phonetic]; we could take it to sea water and it caused a huge epizootic and we nearly gave up salmon farming in the early eighties in Scotland because of furonculosis.

And then fortunately, just in time we came up with an oil-adjuvanted vaccine because we were using a lot of antibiotics in those days and we knew it was an unsustainable setup. And we were using, this was largely undomesticated salmon, I would say. Our improvement programs hadn’t really got off the ground then. So our feed, we were, you know, learning. The fish were undomesticated. They had these organisms that interestingly came from the wild environment around them. And presumably, in the wild the collision opportunities, the chance of cross-infection and so on were so long that they didn’t usually cause epizootics. But when you brought these fish together in pens in a, as you could say, a sort of unnatural environment, the cross-contamination risks and so on were much greater and you could get some quite nasty strains of this.

Fortunately, you could boost the immune response and, and I could tell you the same story again for a variety of viruses which again, came from the wild populations and didn’t cause a particular problem, occasionally up and down in the wild, but in the farmed environment caused big problems. So I think, I think the point I’m trying to make is that you’ve got to be careful to sort of compare the wild populations of salmon and their disease cycles with the sort of the epidemic situations you can get in a farm environment. If you don’t know about—if you don’t have a—if you don’t, haven’t domesticated those fish to the extent that you’ve bred in disease resistance for the specific pathogen, and that you have a range of vaccines available as a routine so that these when they go to sea can happily live in this environment without it causing any problems. And of course, you’ve got to look after them very carefully. And then they’re that much more resistant.

DR. ASGARD: Torbjorn Asgard again. It’s, I think, the domestication is really important here. Because I think it’s wrong to produce meat in a zoo on wild animals. I think if we want to produce meat we should do it is on domesticated animals where we take full responsibility for the whole life cycle. I think that is the aim and that should be the aim for all the species.

And this requires actually that we develop very good breeding programs where we take care of genetic variation and avoid in-breeding. And that is no spreading in several species and in salmon it has become very far. It has been all the way very broad genetic program where you take care of the genetic variation, but I think that is very important for any cultured species. And I think that is even something you should think of in traditional domestic animals. When you start with small populations, again, in breeding is an important issue.

HUE: Okay. Sorry. Go ahead.

MR. STEVE CRAIG: To add, in terms of water quality—

HUE: State your name please.

MR. CRAIG: Steve Craig, Virginia Tech. Thank you, sorry about that. We work almost exclusively with recirculating aquaculture systems so water quality is paramount. It's got to be maintained at very high levels. The implications on growth are very apparent once your water quality decreases so—and then growth is often the first indication of a health issue. So it all kind of feeds back. You've got to maintain excellent water quality. You have to have very good diets to optimize the growth and keep these animals healthy.

HUE: Dan.

DAN: Thank you. As a trained ruminant nutritionist I completely agree with Dr. Asgard's statement that we feed for nutrients and not feedstuffs, and I think that's true in all species. But I also am very aware that—and I'll limit it to ruminant nutritionists without questioning any of yourselves there, but I think we tend to be a lot—we think we’re a lot smarter than we really are. And sometimes we are far more effective with a shotgun than a rifle. And in light of that, I’d like to ask Dr. Alam, what were you trying to accomplish, or what was the reasoning for maintaining the squid meal in all of your diets?

DR. ALAM: This is Alam. An excellent question. Squid meal, I—

[END MZ005003]

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DR. SHAH-ALAM: --in Japan, I did my PhD and postdoctoral research on Menhaden fish and shrimp. Squidmeal is the excellent [unintelligible]. If you add just a small amount of squidmeal that gives good palatability and [unintelligible] that if we have any other [unintelligible]. So my thinking is here I used a higher level of soybean meal, so I used a small quantity of squidmeal, which gave them more palatability and that's helped the [unintelligible]. This is the one reason. The other reason is squidmeal is not used a lot of in the industry so it's just a small amount, so we can use this. So this is the reason I used squidmeal.

MR. HUBERT KARREMAN: Do you have a follow up, Dan?

MR. DANIEL GIACOMINI: It's not a follow up [inaudible]. Actually, it's not related, but it will be my last one for this group. A couple of you have mentioned domestic fish and your belief in the importance of it. At least two of the papers this afternoon, at least from the paper, they're recommending no more than, I believe, F2 generation and mainly in relation to getting away from the problem with escapes. Is there any other nutritional aspect or any other aspect that the nutrition panel would like to address on that point?

MR. CRAIG BROWDY: I just want to, I guess reiterate--this is Craig Browdy--reiterate the points that were made earlier about, from the standpoint of nutrition, with the shrimp, we've been almost completely closed reproductions since about 1990. And they go about a year a generation, so we're pretty far along on domesticated stocks and the differences that we see in terms of all the measures that we talked about, reproduction, growth, how happy they are, it's unbelievable the difference between now and when we started. To think that we're going to go back to having to do no less than an F2 is just-- the animals wouldn't be as happy if you take them from the wild and put them in than an animal that's been domesticated for a number of generations. In terms of escapement, is the South Carolina Department of Natural Resources and growing an exotic species, the Pacific White Shrimp, we've had to deal with escapement for the last 20 years. And wearing both hats, it's a very significant issue, but I'm not sure that it's one that necessarily is for this particular panel. But there are probably technical solutions rather than necessarily trying to grow wild fish.

MR. KARREMAN: Rigo?

MR. RIGOBERTO DELGADO: I have three questions. The first one is for Dr. ALAM. You did your study with sea bass and I'm just wondering, did you carry out human nutrition analysis after your studies to see what the impact on those essential elements was?

DR. ALAM: Okay, thank you. I used, in this experiments, I used a small fish, so I did not use any [unintelligible] for this. But I did start using growth [phonetic] fish. I fed three months with the two lipid levels. One is a small, low level lipid, another one is a higher level lipid. So then after three or four months, I used this fish to test our [unintelligible] and some people who like fish, so we made some kind of test test, that's how, like flesh quality, fatty fish. But we did not use any human nutritionist for this kind of thing that--how this quality test on--but definitely we found that the people like higher quality, if that fish contains higher level of lipid, then it is tasty. And then we did several sashimi sushi, different types of food we prepare and then we found that instead of 12%, the diets containing 18% lipid is the more tasty in general what I found for black sea bass. And black sea bass contain high level of lipid, definitely, compared to the other southern flounder. Is it make any…? Thank you.

MALE VOICE: Just a follow up: do you think your results would have been different if you had used the soy malt concentrate instead of what you used in your experiment?

DR. ALAM: Okay, here is the question is that protein percent is how many percent of soybean, how many percent is of fishmeal protein we're going to use, I mean replace? So if it's exactly the same, I think maybe not. But if we change the formulation, it could be different, because soya protein content is completely different. This is only protein. It would be different. Here we are using soybean mill extrude and solvent extracted soybean meal which is contains fiber and so many other non proteinous substances. But soya protein concentrate I think is high level of protein, so it could be difference.

MALE VOICE: It seems to me that we're moving in the right track, that 12/12 and all the members of the panel more or less agree with that. There's going to be some trade-offs between the nutritional value for human consumption and how much we replace in terms of vegetable sources. I wonder, and this is a question for all the panel members--it points to the area of crowding--and I can picture our commercial farms trying to get the most out of their resources, so crowding would be an issue--I wonder if you consider that in your studies and to see if there's a confounding effect between the amount of vegetable sources that you can use and the actual number of fish per square meter of water or however you measure it. And if so, are there any other confounding effects that we should be considering, not only the overcrowding and so forth?

DR. ALAM: For me I think density is a factor, definitely because if you use intensive [unintelligible] so many fish [unintelligible] so the feed area [unintelligible] so many things. Lower density could be difference and lower density of some spaces have some carnivorous [unintelligible] catabolism effect of something--cannibalism. So this kind of thing, also. This is my thinking.

MR. KARREMAN: Okay, we have ten more minutes left for questions. I have Dan, then Kevin, then Jeff, then Julie. Dan and Jeff, would you mind seating to Kevin and Julie, just [inaudible]? So, Kevin, you're up.

MR. KEVIN ENGELBERT: Brad has something to add.

MR. KARREMAN: Huh?

MR. ENGELBERT: Brad wanted--

MALE VOICE: [Inaudible].

MR. KARREMAN: You wanted to add on to that last question?

MR. BRAD HICKS: Yeah, I think the question was to all the panelists, so I thought I'd--and the question related primarily to crowding. It's Brad Hicks from British Columbia.

Crowding is a very species-dependent phenomena, much as it is with terrestrial species. The number of quail and the number of leghorns that you can raise in a certain space is different. And fish are no different.

And I'll just give you an example amongst the salmon group of fishes, never mind all the rest of them. Arctic char can be raised at approximately 12% density, that's 120 kilos per cubic meter, which is very dense. And if they are actually raised at lower densities, they do more poorly. Atlantic salmon's about the middle. Atlantic salmon's optimum density of rearing is around 25 kilos per cubic meter. That varies quite a bit depending on water quality, not unlike the number of cattle you can raise on an acre of land, which depends upon the ability of the land to produce nutrients for the cattle. So there's variation which are very, very similar. And Chinook, or Pacific salmon, the Pacific Salmon that's raised in British Columbia, it's at about 15 kilos a cubic meter.

If we "break those rules, if," I used to say, "listen to your fish, they have a lot to say." If you don't listen to them and understand them, what we find is if we raise at densities greater than or less than, in the case of fish, and quite frankly the same in a lot of domestic species, we decrease their socialization, if you will.

Fish have a pecking order very similar to chickens, for instance. If you overcrowd them, you end up with both behavioral and health problems. Fish will begin to fight excessively, for lack of a better term, including salmon, if you get them too dense. Feed conversion goes to hell in a handcart. Feed conversion drops off dramatically once you get over density. So yes, fish, like terrestrial animals, are very sensitive to density.

MR. KARREMAN: Kevin, you're up.

MR. ENGELBERT: Thanks Hue, and thanks everybody. I think all your statements point to the complexity of this issue, but I'd like to bring it back to a basic question, yes or no, for each of you, back to what Andrea stated when we started this. The reason the 12% was on this proposed standard and the reason that I've heard is that we were told from the industry that you can't start an organic fish industry without fishmeal and fish oil being used as feed. We also heard from the organic community that they did not want that allowed because if it's not organic feed going into the product, it's not organic. So in a simple, yes or no from each of you, so that I can be sure I understand your papers and positions, if we did not allow wild-caught fish oil and fishmeal, could the organic aqua culture industry get started?

MR. KARREMAN: Go right down the line, I guess.

MR. HICKS: I'm at this end, It's Brad Hicks. No, we could not get started.

MR. JONATHAN SHEPHERD: Jonathan Shepherd. I totally agree.

DR. ALAM: No, I am not agree, because we need wild fish.

DR. STEVEN CRAIG: Steven Craig, Virginia Tech. No.

MR. BROWDY: This is Craig Browdy. For shrimp, yes. For fish, no.

MR. TORBJORN ASGARD: This depends on the alternatives you have and what is wise in the situation you are and not. Because it's not--don't think it's right to have a yes or no. It's depending on the situation. What is available where you are? What are the resources where you are producing? As now the huge difference between the American continent and the European, between whether you can use animal byproducts or not. I think that is very important for the answer of yes or no.

MR. KARREMAN: Thank you. Jeff.

MR. JEFFREY MOYER: Thank you, Hue. Jeff Moyer. My question actually follows up very closely to Kevin's comments, which were the recommended document that we have has this 12% and 12% in for seven years. As we work towards eliminating that out of the recommendation, what's the true potential of reaching that goal, given your current statements that you just made in answer to Kevin's question? And so what would the diet look like in seven years from now as compared to where it is today? That question is for all of you or any of you.

MR. ASGARD: I can start. Torbjorn Asgard again. This also depends on the species you are producing because it's huge difference between the species in what they are actually requiring. And also just during the life span of let's say salmon, it's huge differences in what is the right dietary composition. And it's huge variation in what is the expected feed conversion ratio. So what I think is necessary is to accept the complexity and actually make the rules according to what is right for this species, for this life situation. It makes it more complicated, but it is too tough a simplification to put up figures that is good for everything.

MALE VOICE: I think the Sunset Provision is important. I think we should eliminate fishmeal and fish oil in organic aquaculture. That being said, we need to get going. So in seven years, hopefully you'll have waste streams from organic aquaculture production that can be fed back in. I would strongly urge a consideration of at least organic poultry waste to be allowed to be incorporated into the fish--organic fish formulation. It ties in with the organic mantra of recycling nutrients. It's ridiculous that the poultry byproduct meal from an organically produced chicken cannot be used in an aquafeed. So I'm a very strong proponent of eliminating fishmeal and fish oil with the Sunset Provision, but we have to have other sources of organically certified proteins to do that.

DR. CRAIG: Steven Craig, Virginia Tech.

MR. KARREMAN: Hold on, Andrea wants to put something in.

MS. ANDREA CAROE: I just want to remind

the panel that, like I said in the very beginning, we're balancing consumer perception and science. And although I completely agree, or your science very well may show the benefits of poultry byproducts, we have heard from the consumers on these issues, and the consumers don't necessarily want to see animal byproducts fed to fish. So again, I know it's frustrating for the scientists in the room to consider this, but we as a panel and as an--working through the Ag marketing service for a marketing label have to consider that consumer perception.

MR. KARREMAN: Also I wanted to add in one thing. There was a question here on a card. I think it's pertinent to this. Says for Dr. Browdy. Do you have any prediction as to when the worms would be commercially available and would combining them with algal meals help move this along?

DR. CRAIG: That would be Steven Craig, Virginia Tech. They're commercially available now. They're just very expensive, so with increased demand and increased production, hopefully that cost will come down, but it is commercially available right now. In terms of combining this worm, marine worm source, with other protein sources, I think is really, could alleviate all these other concerns about protein sources and definitely would take poultry byproduct meal off the table because it does supply the N3 fatty acids that marine fish need. It can be produced under organic conditions. It already is. It's just a cost factor at this point.

MALE VOICE: As long as the consumers don't see it.

MR. KARREMAN: Hold on, Bea, because there's--Julie's been waiting very patiently.

MS. JULIE WEISMAN: I think a lot of my question was answered when Kevin asked his question, but I want to rephrase it from another point of view. I very much appreciate the complexity of the answers that have been given, but I want to go back to the really simple too. And so my question is, is the 12 and 12 enough? And this is more for Dr. Alam because you specifically noted 70% as the optimal level in your data, so really my question is for you. Is 12 and 12 enough?

DR. ALAM: I think for my study, what I did, I said that formulation is not only fishmeal 12 and 12, is contain other things like vitamin, mineral, so many other things. But anyway, if everything is fine, everything is okay, we believe that vitamin, mineral, everything is fulfilled requirement, then 15% seems no differences with the fishmeal even 50%. So 12% maybe not big differences [unintelligible]. So my thinking in this case for this species, black sea bass, those like so many kind of food they can maybe--it's okay, we can use it. But what happen for the southern flounder? Those who [unintelligible] other fish--at this moment, I don't have this other information. But for this in general, for my thinking, 12% lipid seems okay, looks they are growing good because I did some [unintelligible] 12% lipid. For my personal opinion, seems low, not bad. But for the fishmeal, if the other sources, if squidmeal is allowed as organic certification, if krillmeal 5% is allowed, if [unintelligible] high quality vitamin and mineral [inaudible] okay, then 12%, I think, without reducing growth, may be possible. But if we want to, like reduce growth--like we don't want this maximum growth--then maybe we can wait for long time. But in this case there is a possibility due to lack of some nutrient, maybe disease or some other things may happen. Or how many long days can we wait? So for my opinion, it's not bad at least for in general. Thank you.

MR. KARREMAN: I think Bea was looking at me first, Jennifer. You're next.

MS. BEA JAMES: This is actually a question that, George Lockwood, you might be able to answer also. In looking at the 12/12, and if we were to go more towards a plant-based diet using what I saw up there was soy, wheat gluten, wheat, that it seemed like supplementation of amino acids was an important component. So if all these species have different needs, are we going to end up with synthetic amino acids on the national list?

MR. GEORGE LOCKWOOD: We're not going to allow poultry byproducts. There has to be a source of certain amino acids.

DR. CRAIG: Steve Craig, Virginia Tech. I think the 12/12 is a good starting point and also not all fish are going to be able to be produced organically. So if you can't make it under those guidelines, you can't be produced organically. And I don't think it's very wise to think, with all the different species of fish cultured around the world, that every one of them is going to be able to be certified organic.

FEMALE VOICE: So are you suggesting that the aquaculture standards should be for specific species?

DR. CRAIG: No, I'm saying if you throw this 12/12 out there, certain fish species are going to be able to handle that. Others are going to take more research or maybe they can't make it at all. I think that's how you protect the organic--the notion of organic. If everybody can do it, then why is it special?

DR. ALAM: This is Alam. I'm just going to elaborate that methionine which is a really very important limiting amino acid for most of the plant protein sources. So if we use only 12% fishmeal, we must have something that gives methionine or good amino acid profile, otherwise due to only [unintelligible] or any kind of amino acid deficiency, there'll be something different--situation, like disease or so many thing. So if there is a possibility to add this methionine or lysine or some kind of organically certified or synthetic amino acids, could be fine, I think, for aquaculture industry. This is my opinion.

MR. HICKS: Can I say something?

MR. KARREMAN: Yeah, go ahead, Brad.

MR. HICKS: I'd like to actually be

extremely pragmatic for a minute on this issue of the 12 and 12. I've earned my living almost exclusively from growing fish or being very intimately involved with the growth of fish. If the 12 and 12 is fixed in stone and the Sunset clause is in place and it's only seven years away, and I say only because animal husbandry is a multi-thousand year process. We didn't get to the current organic chicken in seven years. I'm not sure how we're supposed to get to the organic fish in seven years.

So from a very strictly pragmatic producer's perspective, say we go this route. We begin to develop a market for organic fish with 12 and 12. And for whatever reason we're not able to get over the hurdle at seven years, we cannot produce the fish in seven years. What happens then? If you're the producer and you've invested a tremendous amount of time and effort, you've probably also behind you, dragged in a whole bunch of university research and tons of public money into this process and now you're over the cliff. From a strictly pragmatic perspective, I would guess it'll be pretty difficult, other than a very, very select few, to be able to go this route.

MR. KARREMAN: It's interesting you say that, Brad, because the issue of methionine in poultry is coming up again next year as its Sunset runs out for the second time. Joe, you have the last question. Then I'm going to read some cards and then it'll be lunch break.

MR. JOSEPH SMILLIE: Well, you took the wind out of my sails here 'cause that's exactly what I was going to say is that we did grant the poultry industry a Sunset synthetic amino acid. That was done, and we're coming to that sunset. So we will have an answer to your question. We'll see how we deal with the methionine issue with the poultry industry.

MR. KARREMAN: That will be interesting. Okay, let me read some cards here. As was mentioned, these will be scanned in and on the website just so the people that wrote them know also that you can speak with the presenters during our poster session this afternoon after the second panel. So here's--let me just go with this here then. Could we use organic poultry byproducts to grow nereid worms? Okay. Jonathan Shepherd, here's one for you. With regards to using [unintelligible] in fish feed, is there a difference in ash content when compared with meal from Menhaden anchovies, et cetera? And if so, has that caused problems in terms of fish health or affluence or any difference? Any genetic variation for ability to elongate fatty acids? How big on input is fish processing waste to fishmeal, fish oil supply? Here's one for Jonathan Shepherd again. In fisheries, for fishmeal and fish oil, how do you ensure that the fisheries are sustainable for the long term and not just stable especially in the face of climate change and the poor track record of fisheries management? Here's one for Dr. Asgard. What are the waste pollution implications of increasing the vegetable content and decreasing the fishmeal oil content? And does increasing the vegetable component lead to increasing waste pollution, especially via open net cages? Here's one for Brad Hicks. Well, they're for everybody, but these have the names on them. Your presentation implied that science on environmental impacts of fish farming in British Columbia is fraudulent. This is a serious allegation. Please clarify. Either retract your statements or provide evidence of fraudulent science. Is squidmeal--this one's a tough one to read--I'm going to hold on to that one for a second. For Steven Craig, what is the price differential between organic diets with nereids and convential diets? What's the price differential? Okay. How will supplemental protein sources such as krillmeal and squidmeal be handled? It appears that some of the studies have listed krill and squidmeal separately in their ingredient lists. Fish oil issue comment: farms show good replacement of oils in salmon feeds. However, informally, nutritionists indicate that salmon fed with low fish oil diets show obesity, low blood oxygen, less immunological responses. Results are not only related to growth. Eight more, okay? What is the effect of fish meal replacement on the cost of production? That's for Steve Craig. Another one for you. Does total replacement of fish meal with yeast change the cost of production? Another one for Dr. Steven Craig. You suggest a phase-out of fish meal and oil diets in organic agriculture. Do you suggest the same for organic agriculture? What studies have been done with the in situ production of organic herbivores integrated with omnivorous and piscivorous fish? That's a holistic type question there. Question to Brad Hicks: Why is the choice between burning up fish products and feeding them to fish--wait--why is the choice between burning up fish products or feeding them to fish? Couldn't fish used to make fish meal and oil alternatively be fed directly to people as Peru is now doing with some of its very large anchovy fishery or left in the ocean as feed for marine predators as the Atlantic States Marine Fisheries Commission is now considering for some Menhaden? For Steven Craig; you're popular. You specifically said in your presentation, protect the organic label at all costs. Where in your research did you consider the human factor and did you conduct any studies or testing on the taste, texture or flavor of the fish? I think we've--that's been answered a little bit. Two more, no, one more. Yeast and worms as fish fed replacer, are they really certifiable organic under NOSB, especially in light of unresolved issues? Yeast and worms, are they actually certifiable, is the question? Okay, I'll try to get through this one here.

MALE VOICE: This one is separate over there.

MR. KARREMAN: Oh it is? Okay. Is squidmeal different than fishmeal and cornfed--here, you want to try that Kevin? I'll get the last one. I've studied this one a little.

MR. ENGELBERT: Is squidmeal different from fishmeal? Are cornfed squidmeal allowed if fishmeal is not allowed? I think. What would be a source of lipids? How about the initial culture of algae, is it organic compliant? I can't get the bottom line there. Are there any data related to wild harvest versus conventional shrimp versus plant based diet? That's the best we can do with that one.

MR. KARREMAN: Okay, with that, we're going to wrap up the--what? No, no comments on these. Sorry, not right now. With that, Joe has one comment and then we're going to wrap it up.

MR. SMILLIE: I just wanted to point out one of the big issues that we didn't deal with this morning at all--we're talking about the 12 and 12. We still haven't really cracked the nut or even really discussed the sustainability issue. Again, we've had people talk about MSC certification of the Pollock Fisheries and we've talked about other sustainable markers for the Menhaden and the anchovy fishery, but that's going to be one of the issues this board has to deal with is what credentials for sustainability can we accept? And again, it's an open question to everyone. I just wanted to point that out.

MR. KARREMAN: Okay, I just want to thank the panelists and the audience, but especially the panelists for being here this morning. I think the livestock committee can congratulate itself. I think we've really put together a fine set of individuals and we certainly thank you for coming from everywhere where you did. And we look forward to after lunch hearing from the next set of panelists. So enjoy the rest of the day here and I'm sure you'll have questions coming to you later on.

MS. CAROE: Okay, so we will recess for lunch and reconvene at 12:40, not a minute later. We got a little bit shorter lunch than we expected.

MS. VALERIE FRANCES: So you don't want to do a full hour for lunch?

MS. CAROE: 12:40.

MS. FRANCES: 12:40.

MALE VOICE: 12:45. It'll be 12:45 when they get here.

MS. CAROE: Pithy issue for this symposium--

MS. FRANCES: Neil Sims is not in the room?

MS. CAROE: Neil Sims?

MALE VOICE: He's up number three, so we could start, but we'd like to have all six panelists here when we start.

MS. CAROE: Okay, well we'll give him a couple of moments. If anybody knows him or sees him could you--

FEMALE VOICE: [Inaudible]

MS. CAROE: He's in the restroom?

FEMALE VOICE: The restaurant.

MS. CAROE: Oh, restaurant. We're going to get started again with the net pen issue and as we started with the first part of the panel, we're going to have George Lockwood come up and tee up the issue, describing the rationale and thought process that the aquaculture working group went through when they came up with their recommendation. So, George.

MR. KARREMAN: One thing, George, before you start, extremely dumb question on my part, but I think there's some other people that have been confused at times, but if you could give us the definition of--it's really stupid--of net pen. There's open net pens, there's--are there closed net pens, or are there just net pens? Or could you just maybe also do that in your talk? Thanks.

MR. LOCKWOOD: I'm looking at our

proposed standard to see exactly--okay, we call them open water net pens. Open water net pens are a floating structure that have nets hanging from the structure that are open to allow water to flow back and forth. There are references to closed net pens, or closed pens, and that basically is a design that is being tested now that has a solid plastic barrier, a flexible plastic barrier and all the material that otherwise wouldn't move in and out of the pen is collected at the bottom. So those are--does that help?

MR. KARREMAN: That does, and also is there any relation to the sea coast versus out in the open water, way, way, way out? No? They're all just net pens, then, generally? Okay. Thank you.

MR. LOCKWOOD: They're also used in freshwater in some places for growing tilapia in lakes, it's just not salmon. I'm sure I want to thank the board for what I think was a very good session this morning, not only in the selection of the speakers, but in all the questions that came from you. And I hope you're getting a very good education on aquaculture.

We're now dealing with open water net pens and I want to again state that our standards were a compromise consensus and that we worked hard on this one as we did with the fishmeal and oil for marine resources. Let me just briefly outline for you the considerations that we have proposed for the standard. The consideration must be given of surrounding ecosystems for each location, and as you can imagine, location is very substantial.

A predator deterrence plan must identify potential predators, appropriate deterrence methods, how predator behavior will be modified by application of deterrence methods, documentation of control methods and effects, contingencies for failure to achieve objectives and how plan implementation can serve biodiversity in the ecosystem adjacent to and including the aquaculture facility.

Another condition is natural [unintelligible] capacities of discharges must occur within 25 meters of the site boundary without degradation beyond. 25 meters. The site must have a containment management plan to prevent escapes. With the objective of minimizing environmental damages to the seafloor beneath net pens, our proposed standards would require consideration of water depths, current velocities and directions, stocking densities and other factors, have a monitoring program, measures to prevent transmissions of diseases and parasites between cultured and wild animals. And the use of multiple species of plants and animals is necessary to recycle nutrients.

Now in two places in the proposed regulation, we mention, one, aquaculture facilities must be designed, operated and managed in a manner that seeks to prevent the spread of diseases within the facility and to all adjoining ecosystems and native fish species. We also state that facility managers shall take all practical measures to prevent transmission of disease and parasites between cultured and wild animals. So that's basically what our recommendation is and we look forward to this panel as well as we did the last one. Thank you.

MS. CAROE: Thank you George. Valerie, can you give us the line up of presenters for this issue?

MS. FRANCES: We have six open net pen panelists as we did have six fish feed this morning. We're going to start off--well--we have two substitutions today, so I'm going to read the bio as it was provided to us initially and then refer to the person who is substituting and they're going to have to fill in a little more on their background when they get up to the podium. The first is Sandra Bravo with the Aquaculture Institute of the Universidad Austral de Chile on the use of antifouling in the Chilean salmon industry. She had a family emergency and could not attend. And we have Pir Gunnar Kvenseth in her stead and he works with Torbjorn who spoke on the earlier panel. He is also a producer as well [unintelligible] I think is farm? All right. Sandra Bravo is a fishery engineer and full time professor at the Aquaculture Institute and her data that she analyzed in her study actually was provided by Per? Am I correct? Mostly? Okay. All right.

Next is Kenneth Brooks, Aquatic Environmental Sciences of Washington. He's doing a comparison of environmental costs associated with open net pen culture of Atlantic salmon and production of some other human foods. He's been studying the environmental response to finfish and shellfish aquaculture for 20 years, has focused on effects of organic waste on marine environments and published extensively in peer-reviewed literature. His doctoral thesis looked at epizootiology and genetics of hemic [phonetic], neoplasia and various species of marine mussels and the genus Mytelus. I hope I got all that right. And next on our list is Andrea Kavanagh, who's the director of the Pure Salmon Campaign. Looking at a review of the research on the causes and the quantities of farmed fish escaped from open net cage systems and a literature review of the impact of escapes on wild fish populations using farmed salmon as a case study. In her stead--she had a medical emergency today--is Thomas Natan, who is the Research Director at the National Environmental Trust of which the Pure Salmon Campaign is a part. And he is their scientist, staff scientist, so I think--and helped prepare the presentation today and will address her paper for us. Andrea has directed the Pure Salmon campaign since April 2005. The Campaign is a global project of National Environmental Trust, includes close to 80 partners and allies in major salmon producing regions aimed at raising the standards for farmed fish. From 2001 to 2005 she managed NET's Take a Pass on Chilean Sea Bass Campaign and has been with the Trust since 1997 as part of climate campaign activities. Follows Martin--I should have gotten the pronunciation--

Krkosek, the Centre for Mathematical Biology, University of Alberta, Canada on the disease threats of salmon aquaculture to wild fish. Martin is a PhD candidate at the Centre for Mathematical Biology at the University of Alberta. He's trained as both a marine field ecologist and a mathematical biologist and has studied sea lice interactions in wild and farmed salmon in the Broughton Archipelago for five years. George Leonard, formerly with the Monterey Bay Aquarium, Center for Future of the Oceans and now currently with the Ocean Conservancy. He is looking at performance goals for net pen production of organic finfish and he was with the Seafood Watch Program at the Monterey Bay Aquarium, where he oversaw the development science based sustainability standards and recommendations of wild cot and farmed seafood for consumers and businesses and acted as science lead on those activities. He did his PhD at Brown and then more recently took a position with the Ocean Conservancy. Neil Sims, a producer with Kona Blue and he's the president and co-founder of the Kona Blue water farms. 25 years experience in fisheries, biology, fisheries management and sustainable aquaculture development throughout the tropical waters of the world. His topic is applicability of organic principles to marine finfish aquaculture, comparing open ocean net pens and closed containment systems for production of Kona Kampachi. And the order is then been selected today by pulling numbers out of a cup. So our first up on deck then is actually Pir Gunnar Kvenseth.

MR. PIR GUNNAR KVENSETH: Thank you. And thank you very much for giving me this opportunity to give the presentation of Sandra Bravo. My name is Pir Gunnar Kvenseth and the spelling is P-I-R G-U-N-N-A-R K-V-E-N-S-E-T-H. And I work in a medium sized organic fish farming company called Villa [phonetic], and Villa is the name of a place and it's not a house. And my--usually that's a--my background is I'm a trained fisheries biologist from the University of Bergen and the Institute of Marine Research in Bergen. And my experience is mainly in the cold water marine species, as cod, halibut, torbut [phonetic], cleaner fish, salmon and trout. I've been involved in the development of organic fish farming in Norway for 10 years and now I'm also working as an expert in the E.U. commission in developing organic aquaculture in Europe. And through this work, I've been challenging a lot of different problems according to develop environmental friendly organic solutions. For example, for sea lice, also for net fouling, and that's the topic I want to speak today, antifouling in the Chiles.

MS. CAROE: Sorry, my computer is taking a minute. My power turned off, apparently.

MR. KVENSETH: You had it there earlier, so it's there.

MS. CAROE: Sorry.

MR. KVENSETH: It's not working? Slowly?

MR. KARREMAN: Oh by the way, it's a good time just to remind all the panelists today, the twelve panelists, that I guess you are required to be around during the poster session to answer any questions people have, even if you have not made a poster. But since you're a panelist, if there's follow up questions, okay? So you're here 'till 5:30, just like us.

MR. KVENSETH: I don't have any fish jokes, but I can talk a few words about how potential the seawater is. So more or less, whatever you put into the seawater, the algae, the mussels and everything will start to colonize it and grow on it, so that's also this topic about this antifouling. So even if you put a glass plate or whatever in the sea, it takes some longer time to colonize it, but--and one good thing from the sea is that a lot of animals have shells and mussels have solved these problems. So there are a lot of activities going on around the world trying to use enzymes or solutions from the animals themselves to stop antifouling, stop the fouling on the treads. Okay? Okay, here we go.

So the title is Antifouling on the Chilean Salmon Farming Industry. So just give me the next slide. [Unintelligible] made before I got--it's a combination of things I've got on the mail during the last night and that I made myself, so you can just continue.

Well, the Chilean salmon farming industry started back in the 80s and Chile had for some years been the second largest producer and 387,000 tons of salmon altogether in '96. And only one company had been involved in the organic salmon farming in Chile and I think they have stopped. And one of the main technical problems, as I already said, will be the fouling of the nets. And this will vary with season and temperature, salinity, tide. What's the will of organisms to grow? And one of the big problems is that the fouling will reduce the water flow through the net and also increase the weight of the whole construction, so you have to take this into consideration when you make dimensions. And it will also have direct effect on the fish health, will reduce oxygen, can have jellyfish that will more easily stop in the nets or seaweed. And attached organisms may also act as [unintelligible]. Next one, please.

Copper: Chile is quite rich in copper, and copper is the only metal that's allowed in antifouling for fish farming in Chile. And as we note, copper is defined as an environmental toxin and it can accumulate in algae and a lot of different organisms in the sea. And the effect of the antifouling is that you make a paint with copper and the copper would leak out to the near environment and as long as there is copper, that will prevent the new organisms, at least reduce them, the possibility so they can [unintelligible]. And it's efficient with the quite low levels. So here's a diagram over--if you're used to different meshes and different seasons, we don't even know with antifouling how long a time it takes before you have to change your nets. And for the smelt production, when you have quite small measures, it takes down to 10 to

12 days in the summer without antifouling before you have to change your nets. And if you have antifouling, it takes several weeks, maybe 20 weeks if you are in a good position. So this just shows how important the antifouling today is for Chilean industry. This data collection is the project I've been going on for five years and they've been sent out [unintelligible] to the companies that sell the antifouling and also to the companies that giving the service, washing and painting the nets. So it should be quite consistent.

This shows the different products and I at least see several of the products that I know the products names from Norway that I established down there and we see one of the different things at least from Norway and I guess UK is that there are very few that are water based. If you can just show the next one.

This shows the specifications on the different antifouling. A lot of solvents are used with [unintelligible] and I think it's just 10% of the antifouling in Chile today that is based on water. And the copper content, well I guess it's quite cheap in Chile, so it's quite high compared to what we are used to having in Norway. So the total sales were also quite high in 1999, 1 million 700 liter and with the 20% copper that accounts for 460 tons of copper. And I tried to compare this a little to Norway. The sales have increased quite rapidly in Chile, so it's 2003, 1200 tons of copper and compared with Norway, about the same amount of salmon production, Norway have about 200 tons, about 1/6 of that.

Well this shows a figure of the development of the aquaculture industry on salmon in Chile for the last five years and we see there's a more rapid increase in the use of antifouling based on copper than its increase of the salmon production.

And I think the next slide will give some explanations for that. One of the explanations is that the sizes of the cages have grown much, much bigger, so it's much more difficult to change the nets so often. So they need to have very good antifouling that will last for quite long. And they also moved out into more exposed areas so that gives more problems for changing the nets. And the claim that they have more quicker [unintelligible] by the [unintelligible] and that may be part of this--what shall I say?--more fertilizing in the sea and they have low percentage of water based antifouling compared with what's usually in Europe.

Alternative solutions, that is to use different washers or brushers with high pressure operated by divers or operated from the surface. But they say it's not a good solution because it gives a lot of suspended materials out in the sea that gives problem for the gills of the salmon and also this organic load may accumulate at the bottom.  And also it's difficult to operate this washer out on the more exposed sites.

So in [unintelligible], there are now several farms that try to operate without using antifouling, at least antifouling without copper. You have several possibilities to use net polish or other silicone-based that make a smooth surface and make the treads stay together without using any copper and makes it easier to clean.  But also this frequent handling of the nets and changing nets may cause escape of fish and stress and [unintelligible].  And the copper based paint in Chile, at least [unintelligible], will be banned as soon as there are good possibilities available and they compare with the TBT that this 1000 time more better, and I think that's what's used on big boats traveling on the big seas.  And in Chile, they also have, at least have had a lot of net pens in the lakes for smelt production and they have not been permitted to use copper in those lakes. And when you wash these nets and you take care of the debris and the mussels and seaweeds that are--have a lot of copper, it's usually a problem to recycle it because it's quite expensive.

So this was the first part and the project was financed by the [unintelligible] Investigation Pescera so when I was asked to put down some slides about the situation and antifouling in Norway, so I think they will follow now.

Antifouling in Norwegian aquaculture industry has also been dominated by copper and its use is about 220 a year and the industry goal is to reduce this to 20 tons a year. There's an increased use of paint without toxin as I now test out in Chile and the purpose is to give a smooth surface that's easy to clean and also to pack the treads, giving it more difficult for the organisms to settle. And in Norway there's quite many cleaner equipment in use and we have had no problems with this suspended materials in the gills or gathering organic materials on the bottom. We are operating quite deep areas, deep fjords and a lot of current. And there's also an increased use of so-called environmental nets where you have two nets that are put together that are not painted with copper and when the one is in use, the one is out in the air drying, so you just change them every second week or once a month.

And the next slide will show what I've been working with for the last 20 years, use of cleaner fish; that is fish [unintelligible] that will eat fouling organisms from the nets. So you can have the next one. Quite easily or rapidly during the summer, the net would look like this. So I have had several students working on finding out on what's growing on the net and what's eaten by the cleaner fish. [Inaudible] the next one. Well, giving you some organisms that grows quite rapidly; blue mussels will be quite easily and all the others will establish quite quickly. And for the cleaner fish that we mainly put in to have control of the sea life. This was with just like lunch table all the time. So we have looked into the stomachs of this cleaner fish, so I hope that's the next one, maybe. So here is a summer situation and the number of mussels that we found in each of these cleaner fish. So we see that the--at the most, when the blue mussels settle, 180 blue mussels in the one cleaner fish. So that they really do a vacuum cleaning job.

[END MZ005004]

[START MZ005005]

MR. PER GUNNER KVENSETH: We see also this [Unintelligible] quiet manual then [phonetic]. And very nicely, we have had quite few sea lice [phonetic]. So when there are sea lice, they will raise them down if we operate this in the right way.

And to take, this is a quite abnormal environment for the cleaner [phonetic] fish, so to take care of them in the best possible way. We'll make a micro habitat for them with different arrangements.

I think this is my favorite picture, as you see, so if it's done the right way, they clean the net so you can just continue with the, like a new pressure [phonetic].

This is cleaner fish that's eating the sea lice and the good thing, continuously lower levels of sea lice, if do it in the right way.

So that's it.

[Applause]

MS. ANDREA CAROE: Thank you very much.

Valerie, our next speaker?

MS. VALERIE FRANCES: Our next person is Kenneth Brooks with the Aquatic Environmental Sciences in Washington.

MR. KENNETH BROOKS: Thank you, Valerie. I don't haven any jokes to tell either.

Okay. This is a typical salmon farm, this one is located at Fortune Channel that will [phonetic], in Clakawit [phonetic] Sound, British Columbia. Next.

At a meeting, oh, I'm going to guess it was 15 years ago, a young student in the audience said, "Well, there are no environmental effects associated with my diet, because I eat only bread."

In addition to being a scientist involved in examining the environmental effects associated with aquaculture, I've been actively involved in conservation since I retired from the Navy 30 years ago.

I've worked extensively with USDA soil conservation service, with our local conservation district as the chairman of that district for 12 years, and as chairman of Washington State's Conservation Commission. I'm fully aware as are those of you who are agronomists, of soil losses, one effect of traditional terrestrial agriculture.

The photo on the left is from the Pollus [phonetic] in Washington State. The photo on the right is from a talk given by General Herrel [phonetic] after the first draw downs on the Columbia River. And that's one of the impoundments behind a dam on the Columbia River.

All of the sediment that you see there has been deposited, primarily from agricultural lands into these impoundments. After his talk, I asked General Herrel, I said, "Well, there's a huge amount of sediment there." And his response was, "When we first built the dams, we thought they would have sufficient hydraulic capacity to produce power for 200 years. Because of the soil loss and sedimentation behind the dams, we now believe that's only 75 years."

Soil is lost from the wheat-growing areas where bread is produced in Washington State, at 4–11 tons per acre. Soil losses are over four tons, I think it's 4.2 tons average from airable [phonetic] land throughout the United States, and it's 16-300 times higher in other countries. Topsoil is being lost on average worldwide 17 times faster than it's being produced.

My point is that there are environmental costs associated with a loaf of bread. Next slide.

Categories environmental cost. I'm a member of GSAMP 31, an FAO committee that has been working for several years to develop management recommendations for near-shore and offshore aquaculture for member countries. I've suggested that we can categorize environmental costs associated with aquaculture in these four categories.

Today I want to talk a little bit about category two, what I call inevitable costs, and a little bit about category four, possible effects. Next slide.

The benefits and economic costs. This is for one company, 2005 they produced 38 million kilograms of Atlantic salmon. That's a third of a billion meals for human beings. The production per site was 3,500-4,000 metric tons. They used 45,000 metric tons of feed, with a biological FCR of 1.16. And the water area covered by these 38 net pen complexes to produce a third of a billion meals was 15.2 hectares. Next.

Dissolve nutrients from salmon farms. I'm going to point this out because I notice in your recommendations, in some cases, not all, that you look for broad-ranging prescriptive operating standards to apply to apply to aquaculture. You hard earlier that it's inappropriate to apply feed standards across a broad range of species.

One of the things that we discuss frequently in FAO is that standards are at least regionally specific. The environmental problems that you encounter in the Northeast Pacific are very different from the environmental problems that you might encounter on the east coast of the United States, and they're further different from the problems that you would encounter in the southern hemisphere or in the Northeast Atlantic.

Environmental standards need to be at least regional, and if you try to apply blanket standards across all regions, you will either not be effective, or you will actually have unintended consequences that don't help us achieve sustainability.

As an example, on the West Coast, because of upwelling -- the bringing of nutrient-rich oxygen-poor waters from the deep Pacific to the surface -- we have a lot of nutrient, far more nutrient than the phytoplankton a macro algae can use. In fact, they're light-limited where we are. They are not nutrient-limited.

Back in the '90s, I monitored nearly all of the salmon farms in Washington State, and we were required to look at nutrient levels up current, down current at three meters and down current at 30 meters. And we were required to analyze those water samples within half an hour of slack tide when we anticipated that the concentrations of metabolic waste would be at their highest for ammonia, ammonium, phosphate and silicate.

What we found was, and it's really ammonium that we're most concerned about, that's what's directly evative [phonetic] for the phytoplankton, that's what's given off as a primary excrement from the fish. Nutrient-rich concentrations were infrequently elevated within three meters down current from net pens. We never saw a significant increase 30 meters downstream from the net pens in comparison with upstream values. And there's no evidence from dozens of studies in the Northeast Pacific that salmon farms have any effect on phytoplankton production.

In our region, nutrient additions, water column nutrification [phonetic] is simply not an issue except in a few isolated poorly-flushed embayment's [phonetic] where we don't site salmon farms.

I was asked by NOAH about putting a 300-metric ton striped bass farm in Chesapeake Bay, at a meeting six, seven years ago. I kind of threw up my hands and I said, "you've got to be kidding me." Chesapeake Bay is nutrient-challenged in the extreme, and that's an example that's very different from the Northeast Pacific. Next slide.

Benthic [phonetic] effects. These are inevitable effects with open net pens, they are real effects. Some kind of an effect will occur and those effects can either be positive or they can be negative. In the worst cases, we see a significant reduction within 100-150 meters of the net pens in the macrofaunal [phonetic] production due to the enrichment of the sediments. In other cases, perhaps 10%, 15% of the forms in the Northeast Pacific, we actually see an enhancement, both in the abundance and in the diversity of critters living on and in the sediments under and in the vicinity of the farms. These are generally very well-flushed sites where the currents are in excess of a knot and a half, 75 centimeters per second. But we do see those enhancement effects.

Near-field effects are what we, the way I define near-field effects is that there can be assessed at specific points in time. In other words, we can go out on Tuesday and monitor, and we can see where the physical, chemical, and biological changes have occurred. Far-field effects, which we're not going to discuss today, have not been well documented, in part because they're very difficult to document.

Effects are best managed by proper siting to avoid sensitive areas, we don't put salmon farms over shellfish beds, over eelgrass meadows, over rocky reef habitats, important to rockfish and a number of other species. We put them over the muddy plains or the sandy plains that are not so sensitive to nutrient additions. And macrobenthic [phonetic] environments have always been found to naturally remediate, and I've done numerous studies looking at the long-term response of these environments to fowl.

When you have a farm operating and then you stop operations, how long does it take for the sediments to chemically remediate, for the organic carbon to be catabolized [phonetic] and go back to normal sulfides decrease, redox [phonetic]increased, and for the macrobenthic community to recolonize that area? Next.

Because these effects have been very well studied by many, many researchers over the last 20 years, and because this is essentially an inevitable effect of net pens, we've developed -- we haven't, Chrome E [phonetic] and Kenny Black and others have developed some models that predict the deposition of carbon on the bottom. And here you can see the net pen if you look carefully, and you can see the red area, which is where you get more than about 5 grams of carbon, which is the threshold above which they think they see significant effects. So we can predict what the extent of these effects is going to be. Next.

My own work has focused a great deal on determining the environmental response to what we call physical chemical surrogates, which are sulfides and redox potential and total volatile solvents in the sediment. And here you can see a very real response. The Y axis is the log of the number of taxa [phonetic] that we see; the kinds of animals we see in these sediments. And on the X axis, you see the log base 10 of the free sediment sulfides, and you can see there's a very nice, linear relationship with the reduction in the kinds of critters you find in these sediments as the sulfides increase. Next.

This is the number of taxa that we see

adjacent to a salmon farm, typical salmon farm in British Columbia, as a function of distance in meters on the X axis. And you can see, the control, which is about 500 meters away, it's plotted at 300 just for visual aide, you can see that from the control, the log and the taxa is about 1.6, and we're below that when we get inside about 65 or 70 meters from the farm. So near-field, close to the farm, we see a reduction.

I have never collected a sediment sample from a salmon farm or a shellfish farm, and we see similar effects under intensive mussel culture in the Pacific Northwest. I've never collected a sample that did not contain some animals. There is no desert there, but there is a significant reduction at some sites in the numbers of kinds of animals that we see. Next.

Same is not true for the abundance of critters, and very frequently at intermediate levels of sulfide, from about 200-300 micromoles up to around 4,500-5,000 micromoles, we see an absolute proliferation of animals, and there's a few kinds. I've identified eight, call them carbon opportunists, in the Pacific Northwest, and they proliferate and we get huge numbers of them. These are numbers per sample, and we get up to 18-

19,000 critters in a tenth-meter square sample.

If this is all too detailed for you, imagine my poor techs who have to separate all those 19,000 critters from the residue in those sieved samples. Next.

Environmental costs, benthic costs have both spatial and temporal dimensions. In this direction, we have distance from the farm, and in this direction, we have ton. And these red areas here are areas where we have significantly elevated levels of sulfide. And you can see that at this farm, we got significantly elevated levels out to about 25 meters, and they extended through the production period, but then once the fish started to be harvested -- not when the farm went fallow, but as soon as the fish biomass started to be decreased during harvest -- those sediments started to chemically remediate. And within about six months, they went fallow in March of 2002, and sulfide remediation at this site was essentially complete at all stations by July of 2002.

It then takes some period of time when new critters can recruit into those sediments, most of them are planktonic and it can be up to a year. If the farm remediates in October or November, it's going to be the next spring, early-summer before you have a cohort of new recruits to repopulate those sediments.

But in cases like this where we have chemical remediation in the summer, by the fall, those sediments will be well on their way to biological remediation. Not all farms respond this way. In the worst case that I'm aware of in the Northeast Pacific, it took eight years for the sediments to chemically remediate. But with better siting, in today's world, this is more characteristic of what we see. Next, please.

What are the environmental costs? Well, we lose species, biodiversity is decreased, and in some cases, in fact I would say in most cases, the abundance of benthic critters benthic critters is diminished. That results in a loss of wild fish production due to a loss of their prey.

The average footprint of a Northeast Pacific salmon farm is about 1.6 hectares. And the average temporal extent of the adverse effects during production and remediation, is about 44 months. Next.

What do these losses mean? Well, if you just assume one trophic [phonetic] level between the macrofauna in and on the sediments and in edible fish, then we lose about 307 kilos of wild fish due to the lost prey base under the farm. In exchange, the average farm produced, during these year-2000 surveys, produced about a million kilos of salmon. That's 12,624 times more salmon produced than wild fish were lost. It's about 84 kilos of wild fish per year during that 44-month period. Next.

I was fortunate enough, when I was 23, to have bought 17 acres of old-growth forest on Horsefly Lake in the Canadian Rockies. This is some of the old growth timber near our cabin there. Next.

This is my farm where I raise cattle and trees. The wetlands that you see in the bottom there, that was all pasture. I moved 17,000 yards of semiaumal mud [phonetic] to create those wetlands which are now fantastic wildlife habitat. Next.

My cows and your cows can deplete the soils of nutrients. They destroy brush, trees and imperion [phonetic] habitats. They add to greenhouse gasses, they compact the soil, they add excess nutrients to surface waters, etc., etc., but they are a valuable source of meat that helps feed people. Next.

What are the spatial and temporal

footprints? And I'm just talking about the land consumed by these two ways of producing protein. For salmon, to produce 1,250 metric tons of edible salmon flesh, this assumes that 50% of the carcass ends up -- a salmon carcass -- ends up as edible flesh. It takes 1.6 hectares on average.

For beef, at 8 AMUs, which is typical of grass production in my part of the world, it takes 3,174 hectares. The temporal footprint for salmon is two to four years, for beef, for my farm to return back to that old-growth forest would take at least 200 years.

This is just one aspect of the environmental cost, but I think it clearly illustrates from an environmental-use point of view, the efficiency that can be achieved with aquaculture. Next, please.

Some of the costs of commercial fishing. In the Straits of Juan de Fuca, not myself, but a group of recreational fishermen got some side-scanning sonar and identified 2,000, I call them derelict pots and nets, other people call it ghost fishing gear. They were then able to retrieve, these pots and fishing gear are generally in deep water, they've been able to retrieve over 200 of the pots. I have dozens of pictures like the one on the left which is of one of these pots. And all of those fish, prawns and crabs, and other critters in there, are just dying with no benefit to anybody.

The Department of Fish and Wildlife in Washington State has estimated that just in these three embayments, where these 2,000 pots were found, those pots are catching 10% of the allowable Dungeness crab fishery in Washington State. And you look worldwide at the lost fishing gear, at the lost pots, at the lost nets, and all the light areas you see in that pile of nets that these guys were able to get this commercial to haul up for them, that's all fish caught in those nets and dying.

Point being, there are costs associated with the wild harvests of fish. Next slide, please.

And in fact, there are environmental costs with every form of food production. Society needs to understand and accept that there are costs associated with a loaf of bread, a hamburger, or any other food, including the wonderful fried fish filet I saw someone consuming for lunch today. I wished I'd chosen that meal.

We need to prioritize environmental costs and focus our energy on solving problems rather than using the environment as a battlefield upon which to debate social and economic issues. And I deal in a number of environmental areas and I see far too much of that.

At commission meetings when I was chairman of the commission, I used to constantly chide people that we're not going to make any progress towards sustainability until all you folks sitting around the table pointing your finger at the people across the table turn those fingers around and say, "What can I do to solve these problems?" not "What do I want you to do." Next.

Ten years ago, these were some of the challenges put forth by the ENGOs opposed to salmon farming. Today, we're involved in sea lice extirpating pink salmon runs in the Broughton [phonetic], and escaped Atlantic salmon will out-compete displaced native Pacific salmon. Next.

MS. CAROE: Excuse me. Mr. Brooks:

MR. BROOKS: Yes?

MS. CAROE: You did run out of your time, but we want you to continue, briefly, please.

MR. BROOKS: I'll be quick.

MS. CAROE: Thank you.

MR. BROOKS: I'll try to be quick. I’m a retired professor and I tend to think in 50-minute increments. Anything less than that is tough.

This is even-year peak salmon returns to the Broughton, and salmon farming started where the purple line is and you can see that after the initiation of salmon farming in the Broughton, we've actually seen some of the highest sustained levels of pink salmon returns to the Broughton.

In 2000, there was an enormous return: 3.6 million fish, and the next year it crashed, and therein ensued the current debate over the effects of sea lice on those pink salmon returns. Next slide.

I just returned from a meeting of the Pacific Salmon Forum, which is addressing this and Dick Baymish [phonetic], a revered DFO scientist presented some marine survival data for the years 2004 through 2007 for Glendale, the major spawning river in the Broughton. 2004 survival was 23%; 2005, 3.4%; 2006, 1%: and 2007, 2.6%.

Frazer [phonetic] river stock marine survival has historically averaged 1.2%, and coast wide, pink salmon survival averages 2-3%. The bottom line is that marine survival of pink salmon originated in the Broughton Archipelago watersheds has been equal to or better than average. There is no crisis in those stocks. Next slide.

This is the number of escaped cultured salmon, and I noticed in the submission to you that it essentially ignored escapes in British Columbia, Maine, and in Washington. And as you can see, there were a lot of escapes, primarily Chinook in late-80s, early-90s, but today we have very few escapes.

Andy Thompson, with DFO has been running the Salmon Watch program for 15 years now and I talked to him just the other day and he said, "Ken, we're kind of discontinuing the program because we just don't find escaped Atlantic salmon in British Columbia streams, despite extensive looks." Next slide.

MS. CAROE: [Unintelligible].

MALE VOICE: How many more slides do you have, because--

MR. BROOKS: I think I'm done.

MS. CAROE: Yeah. I think.

MR. BROOKS: So organic standards, one, I would encourage you to look at efficiency in our food production. I would encourage you to use performance standards rather then operating standards. A lot of what I read is just fine. I question why you have this passion for reducing or eliminating fish meal.

My recommendation is that you rely on regional laws, because regional governments do attempt to do a good job at managing the environmental costs associated with [Unintelligible - cough] and you should take advantage of all of their work. Next slide.

This is one of the ponds on my farm. There's four- to five-pound trout in there. That's my son trying to catch one. Last slide.

And that's my bit of heaven on Horsefly Lake. I thank you for your indulgence of my exceeding your time.

MS. CAROE: Thank you.

[Applause]

MS. CAROE: Valerie, our next speaker?

MS. FRANCES: Number three is, Neil Sims, Kona Blue, Applicability of Organic Principles to Marine Fish Aquaculture.

MR. NEIL SIMS: Thank you. My name is Neil Anthony Sims, N-E-I-L, A-N-T-H-O-N-Y, S-I-M-S. I'm the President and co-founder of Kona Blue. And I want to speak to you this afternoon, a lot of people have put forward the idea of closed containment systems as an answer, and perhaps the only answer for organic marine fin fish culture and I want to just talk about my perspective on this comparison of open-ocean net pens and closed containment systems for Kona Kampachi.

I'm going to give a brief introduction to some of the overarching questions that we're going to address with it that we're addressing here, and then run through some of the methods that we use in this study, some of the results and then some shameless podium thumping in the discussion.

In the introduction here, I do talk about the McCarthyism of mariculture [phonetic] and I realize that that's a fairly loaded term to use, but I can't think of what else really describes the morally questionable opposition to aquaculture and where farm fish really has become a pejorative in the common lexicon. That strikes me as passingly strange.

We are scaring Americans fishless. They're walking past the seafood counter and going and buying something else. Yet, Moser, Ferry and Rim [phonetic] the most recent meta study on the benefits of seafood has shown that modest consumption of oily fish, once or twice a week, will result in a 30% reduction in coronary death and a 17% overall reduction in mortality. This is right up there with anti-smoking campaigns and seat belts in terms of the public policy issue, and we need to try and begin to turn this around.

Why do I call it McCarthyism? There is, as a good senator from Wisconsin liked to do, there's a lot of distortion of facts here. A lot of the past examples of salmon farms from 20 or 30 years ago are used to deride what organic aquaculture of marine fin fish might be now.

This constant reference to the plumes of sewage that's down current of fish farms, there's talk about net pens as being feed lots, when really what we're talking about here is putting fish in their natural environment and just fencing them so that we can come back and get them when we want to harvest them.

There's also a portrayal of organic principles as some idol or some ideal, where it really is an ideal that we ought to aspire towards for the benefit of the planet, the oceans, and the consumers.

Then I was very reticent to put this up there, but there's no other term to use for the outright lies that have been put forward to this orgast [phonetic] body at the last hearings here. My mother always said, "Don't use the term 'lie' unless you absolutely have to." But when it is more than an order of magnitude, that's not a distortion. People have testified to you that there was a 50-to-1 food conversion ratio for Kona Kampachi, and the truth is, that it is less than 2-to-1 in our net pens, and in controlled feeding trials, we can get it down to under 1-to-1.

Enough of the emotion, let's, well, perhaps a little bit more of emotion, because the emotion stems a lot from the, what I would call the salmo-centricity [phonetic]. A lot of people are very emotionally attached to this beautiful fish, the iconic salmon. I come from Australia where this isn't such an icon, and I'm a marine fishery biologist. There are 20,000 species out there in the ocean and we've only just begun to scratch the surface. We've been doing terrestrial agriculture for 10,000 years, marine fin fish culture for 30 years. We need to get better, but let's develop, let's work towards solutions.

When we're talking about marine fish, we're talking about diversity, because we're not just talking about salmon in the Broughton, for crying out loud.

Right across the Mediterranean or Southeast Asia, or all across Eastern Asia, in

Norway and Scotland, all of these various species in all of these different areas, and yes, in Hawaii, we've grow Kona Kampachi as well as threadfin moy [phonetic]. So this is a much broader debate than just salmon.

Let's think again about the historical arc here. Yes, the earliest net pen systems, they were very primitive, and because of the engineering limitations, they put them in very protective bodies of water. They were feeding them wet fish or moist pellets. They had very little understanding of fish nutrition, they were using prophylactic antibiotics and there was almost no understanding about the ecosystem impacts or how to model that.

Yet now we have, in 30 years, we have vastly improved culture practices much better: net pen design which allows us to into more exposed sites, formulated feeds which are more digestible, reduce the effluent. We have prepared these strategies and vaccines for fish ill [phonetic] and we have very sophisticated ecosystem modeling as Dr. Brooks has shown.

With some shameless chest thumping here about Kona Kampachi, we have, I think we'd like to hold ourselves forward as one of the representatives of how this has moved forward, where we're now using native species, actually reared wherein in exposed sites, sustainable feeds and healthful product.

Our Kona Kampachi, it's name, it's a deep-water fish, there's no commercial fishery there.  We culture them there in the hatchery, we get excellent growth rates, very good feed conversion ratios, and it makes great sashimi and versatile cooked fish.

It's hatchery reared, that's important to us.  Because we can control what goes into that fish all the way from hatch to harvest, from its very first feeding.  But it's also important to us from a sustainability perspective, for our company, that we rear these fish all the way through, and we can scale our operation.  We're not dependent on the wild stocks.

The siting is important to us, and constant monitoring, where, okay, we're only a half mile offshore, but it is open ocean agriculture.  There's nothing between us and China to the west, and there's nothing between us and Antarctica to the south.  We're in waters over 200 feet deep and the technical term for the currents through our farms like that is rip snorting.

Our feeding is always actively monitored, either by in-cage video or by divers. We also have extensive monitoring of water quality there. The basic parameter that we're always concerned with because we're in tropical waters is turbidity --the scientific term for fish poop. And there's no measurable difference between what's up current and what's down current of the farm.

We are working towards more sustainable feed solutions. This is something that we're constantly discussing and striving towards both. With some of the NGOs that are actively involved in these issues, more so with our feed company. Everybody wants to move towards these sorts of solutions.

So our fish actually, the diet that we feed them is 50% vegetarian. The fish meal and fish oil that we use is from sustainable fisheries. We're currently using about 10% of byproduct from the British Columbian eight [phonetic]. We'd like to move towards zero fish meal and fish oil from reduction fisheries, but it becomes very expensive to do this if you're going to go and use byproduct. And the only other alternative, as you're keenly aware, is poultry meal or other terrestrial animal byproducts.

But we do grow, we're very proud of the fact that we grow a very healthful product. We are able to control the diet, we know there's no risk of internal parasites or ciguatera, which are banes of these fish in the wild. And there are undetectable levels of mercury.

There's fat levels of up over 30% in our fish, and these are all the heart-healthy Omega 3s. Well, they're not all the heart-healthy Omega 3s, but it's the fish oils that people really need to be eating more of.

We have higher Omega 3 fatty acid levels than almost anything else in the ocean. We're now harvesting about 18,000 pounds a week, and we're on track, we're hoping to do 30,000 pounds a week by the middle of next year.

We like to think of ourselves as all that ocean culture could be and should be. We would like to be organic, but we're not really sure we're going to be able to fit that model, because of these other various reasons about byproducts and how this all may play out in the end.

But just to come back now to the question of comparing land-based and open-ocean grown, I have done this. We have eight 50-ton tanks there at ESOP [phonetic] and we're going through the pre-commercial stage here. We're growing our Kona Kampachi in these land-based tanks. And now we've reached the stage where we have eight of these 3,000-cubic meter cages offshore there in our farm site in Kona.

So let's first of all look at what this means in terms of the comparison of biological loading and stocking density here. This table is there in my written presentation. I'd like to highlight here the water exchange, this is, we're getting a turnover in the tanks every four hours of a full exchange of those tanks there, which we ran, actually, at 25 tons rather than the capacity of 50 tons. And this here was a very conservative estimate of the water exchange through those cages out offshore about a turnover a minute.

This is the relative flow right here and then what the actual fish feels is not the number of kilos, because these are, our fish are very happy to be schooling very close together. What they feel physiologically is the load in kilograms per liter per hour. And this is the production capacity from our land-based system of 10,000 tons out offshore. If we do it right, we should be doing 720 tons per year.

So in essence, a synopsis of this is

there is a 1,600 times greater load in terms of kilograms per liter per hour in the land-based tanks, and a 67% greater density of the fish.  Out off shore will [phonetic] much lower density, much less exchange rate.  And it's also a lot closer to the natural environment.

In our land-based tanks, we had heavy shading there, drew a juicy amount of algal growth in the tanks.  Out offshore, we have natural lighting and there, the seasonal lighting there.

In the land-based tanks, there's constant centripetal motion, that's what you need to be able to move the particulates out of there.  Yet out offshore, there's natural tides and currents.

In the land-based tanks, the fish are within a couple of feet of the tank bottom, which that's where the fish feces and the other fouling accumulates, yet out in the open ocean, we're over 100 feet away from the substrate where there is our rip-snorting current that pushes along through there.

And in land-based tanks, the fish will pretty much just hold in one position there, relative to their neighbors, oriented into the [Unintelligible].  Out offshore, the fish are able to swim freely throughout the cage there.

The effluent right and the nutrient recycling has always been spoken of very eloquently by Professor Brooks, but what I'd like to point out here is that in the work that we had done, there was no discernable difference, even over 1,600 times more concentrated in the land-based tanks, that was going into the groundwater at the natural energy lab, which is near shore and then goes eventually out to ocean. But there was no measurable impact on the groundwater or the near-shore waters, even at 1,600 times the concentration of what we see out in our offshore cages.

We have extensive water quality data available on our website, I'd like to refer you all to that if you're interested in numbers and graphs at length. But again, the take home message is there is no measurable impact on effluent water quality. And again, this is the measures of turbidity here.

Now what does this mean if we're going to scale, if we're going to build a larger operation? In the land-based tank, you're still going to be putting those into a single point source that goes into the groundwater, where out offshore, if you're going to scale your offshore operation, the sensible farmer would go and put the cages across current and so there will not be any added [Unintelligible] effects on water quality out there.

From land-based tanks of particulates, there's often talk about recycling of the particulates from fish farms, but in a marine fish farm, these are salt laden. They do not make a usable fertilizer and I don't think that there is any use for the particulates from marine fish farming. Yet if you site your farm correctly in the open ocean, the particulates should stay up in the mixed layer of the water column, where they become bio-available.

So the land-based tank, there is some potential, eventually at some scale, for some detrimental impact on the coral reef there. Yet out offshore, the nutrients should become quickly assimilated, particularly in tropical waters where metabolic processes happen a lot faster, and they should become bio available.

So the comparison between the two is that your nutrient enrichment in the land-based tank has the potential to become pollution, where if you site your farm properly out offshore, then it should just become a source of productivity.

I want to just quickly talk about energy usage and the carbon footprint. I know this is not germane to the criteria of organic standards, but I'm starting to lose the clicking here, Valerie, so I might ask you to occasionally step in.

But these were the, in the land-based tanks here, I used in the calculations, in the paper, I used a pump head of 5 meters, about 15 feet, which okay, in most closed containment systems that are going to be floating in the water, they're going to be the same head. However, you are going to have to be pushing water across a filtration system, and filters require a lot of pump heads. So I think that's a fair number to be using.

And without distracting you too much with all of these various numbers, what we end up with here out of this system, the production demand is about 1,700 kilograms of Kona Kampachi that we can produce per ton of $CO_2$, just the electricity for driving the pumps. That's not counting the electricity for production of the oxygen or all of the other considerations.

Out in the open ocean, net pens, the main carbon demand there is the boats to go backwards and forwards. We're eight kilometers away from the farm site. And again, these data and the notes, the explanatory notes are available in the full paper.

For our 720-ton operation, it's about 3,500 kilos per ton of $CO_2$. So the take-home message here is [Unintelligible] in the carbon footprint, it's about twice as efficient in an open ocean net pen as opposed to a land-based system.

Let's look at some of the other considerations: animal welfare and ecosystem impacts, which are perhaps more germane to the organic discussion. We do undertake ongoing monitoring of wild con-specifics [phonetic], so it's still a very healthy population of Kona Kampachi, literally around the net pens there, and so we do catch these fish.

What we find in the wild fish is that they are somewhat late [phonetic] and fairly prevalent with a calogous-like [phonetic] parasite, but we don't find any of these copepod [phonetic] parasites on our fish in the net pens.

What we do find in the net pens is that there is an ectoparasite, a skin fluke that does become prevalent there in the farm fish. Yet in the wild, we only find about 0.2 of a skin fluke per fish there in the wild. So the wild fish are also very heavily laden with internal parasites, as a part of what renders them unsaleable, yet we have no internal parasites in our Kona Kampachi, again, because we have this level of control over their life, all the way through.

We find no evidence from our study of any negative interaction between pests and parasites, between the wild and the farmed fish.

Some of the other questions that are germane here, what we like to hold ourselves up to, as I said, we're not calling ourselves organic, but we do like to call ourselves what we're doing as environmentally sound as practicable. We're using a local species, there are healthy wild stocks, we're not engaging in any selective breeding, we don't go, we choose not to go past, if too we recognize that we don't have all these questions of cage, integrity nailed down with this new engineering out there. So we will not indulge in selective breeding until we actually have a big of control over that.

These cages are very resistant to predators. In the three years that we've been out in the water, we've only had one instance, and that was really a management issue there where there had not been adequate management of the nets, where we'd had a predator problem there. But we think that this is something that the idea of a predator-management plan is very appropriate, because it's something that's progressive, that we will learn as we go along through this.

So what I'd like to do in this general discussion is just talk about some of the, to help you understand that some of the benefits of open-ocean fish farms. It's connected to the fact that these can become a productivity pump, particularly in alogotrophic [phonetic] waters such as in the tropics there. And whilst in other areas where your nutrient laden, in tropical waters, you're really nutrient poor. It's not measurable, but all of the modeling suggests that if you're putting these nutrients into the water, that you have the potential for further productivity down current.

And there really are no detrimental impacts if your farm is sited correctly. I want us all to just consider the hypothetical open-ocean fish farm that's stuck, for argument's sake, in the middle of the mid-Atlantic. And so you could presume there that there are negligible impacts there. The only reason why you might claim that there are significant impacts is if it were farming salmon and that it was emotionally problematic.

But if this fish farm in the middle of the Atlantic has no significant detrimental impact, then why couldn't you consider it organic? At some stage you're going to want to move it closer to shore, and so it then becomes a question of what criteria do you apply to the siting there.

And this, then comes back to these questions that you had posed. I want to run through all of these various questions that you had posed here that you wanted to have addressed here. And the first one is just what do you have to do to be ecologically responsible?

There are three critical factors: the species that you culture, the biomass at which you culture them at, and the site. The overarching aspiration, I think, is that you should always be operating within the ecosystem capacities. So we need to establish some standards there and then you need to monitor. And this is something that we, as a company, and I think we as an industry, would embrace.

The question of sea lice infestations or other parasite infestations, perhaps, Aquaculture Working Group had said that you should take all practicable measures. I would actually suggest that there be something else be added in there. That there should be monitoring. That the onus be put upon the fish farm to monitor, to ensure that there is no proliferation there. Establish them some standards and then monitor.

Aquaculture Working Group's recommendation, again, suggested minimize the release of nutrients. I actually suggested it should be, in the case of open net pen culture, that you should optimize the assimilation of nutrients, and that, again, is a siting question.

The assimilation of wastes, the Aquaculture Working Group talks about using a measure of waste assimilation from one species to another. Just purely from an extractive viewpoint, I think as a marine biologist, I would suggest let's look at this more in an ecosystem impact. But it doesn't necessarily, the additional productivity, the recycling doesn't necessarily have to be something that we take back. We don't always have to take. Some of this productivity we can let it go into the wider ecosystem.

Again, one thing I would like to endorse from the Aquaculture Working Group here with the assimilation of wastes is that they do emphasize that monitoring shall be employed. Establish some standards, and then let's monitor here.

They also talk about multiple species and polyculture as something that must be included. I think, again, siting is important here. It's inappropriate to have polyculture in offshore systems, but instead, you want to encourage fish farmers to move towards more exposed sites, and that's not where you want to go and have macro algae or mussels hanging off there, because that's additional loading on your mooring. Encourage them towards more exposed sites where there is better flow through, better flushing.

And the question about predators, I think the idea of a predator-management plan is something that we would endorse, because it allows for improvement and adaptation, and that really is the fundamental of organic principles.

The question of migratory instincts in cultured fish, perhaps for an adromous [phonetic] fish or for F1s, but certainly not for marine fish, and I would suggest certainly not for domesticated fish. This is like saying that there are migratory instincts in domesticated ducks or domesticated cattle. You do breed these instincts out of the animals that you grow and that you come to know and love.

I think in conclusion, closed containment systems are actually further from the ideals of organic aquaculture, because of the densities, because of the nutrient recycling challenges, because they're more removed from natural systems and because of the additional energy loose there.

The question is not whether net pen culture should be allowable as organic, but rather, how: what the standards should be. We need to establish siting guidelines and then you need to put the onus on us, the farmers to monitor and to validate that which you're charging us to do.

Open-ocean net pen culture should be good for the fish, it should be good for the oceans, and it certainly should be good for the consumers and good for broader humanity. Thank you very much.

[Applause]

MS. CAROE: Thank you very much. It was a good presentation. Now the next presenter, Valerie?

MS. FRANCES: Our next presenter was to be Andrea Kavanagh, Director of Pure Salmon Campaign, and she had a medical emergency, so she is being replaced by another member of her staff who is their Research Director, Thomas Natan, and he can provide more information about himself.

MR. THOMAS NATAN: Thanks very much. My name is Tom Natan, I'm the Research Director at National Environmental Trust. I'm a chemical engineer by training and I have two broad areas of responsibility within National Environmental trust. One is one of my fields of expertise is on environmental inventory data of all kinds. That ranges from greenhouse gas emissions data to data provided on things like escapes which we're going to talk about today. And the other one is human health and environmental toxicology issues.

A little bit about the Pure Salmon Campaign. As you heard, we're a coalition of partners and allies from salmon-producing countries. The campaign rests on the simple premise that salmon can be farmed safely and with minimum ecological damage if there are standards that protect the environment, consumers, and local communities.

That leads to two questions applicable

here today. Can the farming of any fin fish in open-net cages achieve the goal of minimal ecological damage? And can the systems like that be labeled as organic?

We're going to be talking primarily about escapes as the indicator of environmental impact. Next slide, please.

These are the questions that you asked us to address and we're going to take them in reverse order. We're going to talk about escapes first. Next slide, please.

Over the past few years, the Pure Salmon Campaign has been collecting data on escapes in major producing regions via Freedom of Information Act requests in Scotland, Norway, Chile, Maine, and Australia. We've also obtained some data from British Columbia, so I think somebody said that we, one of the speakers said we didn't have those data; we do have data from British Columbia. We also have some data from Washington State as well, and we have some information that also come from conservation organizations.

We've been trying to form an inventory of the reported escapes of salmon and other marine fish from open-net cages, and this is the first agglomeration of these data in one place. And by our calculations, it represents approximately 70% of salmon farming operations. So it's a robust compilation globally. Next slide, please.

Very likely that these data are only a conservative estimate of escapes, and they are reported in general by incident and then agglomerated over time. It does not include leakages and it only includes, basically, salmons for the most part, and we do not have 2007 data for all of the regions yet, so we're not presenting 2007 data.

There are lots of, in general, I think, most inventories of any kind, and that includes pollution emissions, are generally under reported. Next slide, please.

What do we know about escapes in general? These are the agglomerations of the data that we have for these various countries or provinces for the years that are indicated there. As you can see, if you total it up, there have been at least 10.2 million reported farm salmonid escapes and there were 262 reported escape incidents from the open-net cages between 2000 and 2006.

And even though regions or countries such as Norway and Scotland have regulations aimed at controlling those escapes, we're talking about hundreds of thousands and millions of escapes from those countries.

The British Columbia data vary significantly from year to year, so when you take an average, it looks like it's lower. I'm not sure how, if we had more data over a longer time, if that wouldn't come closer to what we see from the other countries. On the other hand, if they're doing something right, we'd really love to hear them tell us what that might be. Next slide, please.

Norway has provided some data on escapes from other species and so we wanted to see if we could do a little comparison, and this is 2006. The escape ratio for cod was much higher than it was for farmed salmon, and if you look at the other marine species, such as Arctic char [phonetic], halibut, turbot, etc, it's three times greater than Atlantic salmon.

So if we can take these as representative, and of course, it's only one year, so it's difficult to say whether they are representative of or not, but if we assume they are, it does raise concern that escapes are going to significantly increase rather than decrease, if you see the expansion of aquaculture to other species worldwide. And I think these are, this is relevant to your considerations, whether to include open net pens for other species as well. Next slide, please.

We were asked to determine the rate of escapes from organic fish farms, and it's really actually impossible for us to do, because we don't know which farms are organic. Some certifying bodies, such as the Organic Food Federation, which certifies U.K. salmon as organic, they've refused to provide a list of organic salmon farms. So we don't have any way of comparing this to other escapes in Scotland on and off of organic farms.

We don't know the level of production for organic salmon farms, and company-specific information isn't actually shared with the Scottish executive, because it's considered to be commercially sensitive.

So we would need to get each of these farms to provide us data on escapes and then on production. This is what we do know, though, from the soil association of organic salmon farm sites to seek data in 2002 to 2006, there were 12 escape incidents, 132,000 reported escapes, only about 1% were recaptured. And as I said, we don't have production data so we can't calculate the escape rates. Next slide, please.

It's difficult to summarize globally what might cause escapes, because it does appear to have a high amount of regional factors. Failure of equipment was the number-one cause in Norway, Scotland, Chile, and Australia. In those regions, equipment failure was responsible for between 32 and 58% of the escapes in the reporting period.

In Scotland, Chile, and Australia, it was weather: storms, ice, etc., that was the number two cause of escapes during the reported period. Human error factored somewhat further down the list except for Norway, where it was the number-two cause of escapes.

In all regions though, human error played a significant role and predators -- sea lions and seals -- were reported as number three cause of escape in Norway, Chile, and Australia, and number four in Chile [*sic?*]. Next slide, please.

One of the concerning trends in escapes is that successful recapture is virtually impossible and as you can see here, this is Scottish data from 2001 to 2006. Out of 1.9 million escapes, about 1,900 were recovered. So we're talking about a very, very small percentage: one out of every thousand escaped fish was recaptured.

Now this does not include some 130,000 escapes that were reported dead in 2006, and 125, I'm sorry. It doesn't include 30,000 escapes that were reported dead in 2006. So we didn't include dead fish within the calculations since they were likely still in the farm area, and they wouldn't accurately represent the ability to recover them once they've escaped into the wild. Next slide, please.

Some more Scottish data, and this is on escapes from IPN-infected sites. Sixty-percent of the Scottish escapees are from IPN, in fact, its sites between 2000 and 2005 we're talking about close to 1.2 million salmon escaping from IPN-infected sites. And in 2004, all of the reported farm salmon escapes in Scotland were from IPN-infected sites. Next slide, please.

Some more data on chemically-treated salmon escapes. These are also from the Scottish executive, and this is with, these are salmon sites treated with sea-lice chemical slice, access and oxytetracycline at the time of the reported escape.

So since 2002, over 115,000 escapes came from sites that were treated with slice. Next slide, please.

Another consideration that we'd like to bring to your attention is escape of farm fish into special areas of conservation, protected areas, or areas deemed critical for wild salmon. So from this map, you can see that -- it's difficult to see, even for me standing here, sorry about that. But you can see that there are the special areas of con…

[END MZ005005]

[START MZ005006]

…servation, and then you have the overlays of some of the farms.

There were approximately 400,000 escapees in the Shatlands [phonetic], which is in the upper right of your map, and close to 800,000 in the western islands, and the paper provides a better breakdown for some of these so that you can take a look at that.

The reason these are concerns, wild salmon and other species are supposed to be, in theory, protected by international and national laws in those areas. Next slide, please.

So the observations that based on this inventory that the Pure Salmon Campaign created, that escapes continue to occur all over, and despite having a zero-tolerance policy for escapes in Norway, they reported 1.2 million escapes of farmed fish in 2006.

Various causes for it, including failure of equipment and also weather. Less than 2% of escapes are recaptured on average, and certainly when you consider the total number over the years, it's much, much less than that. Escapes do occur from chemical-treated and diseased sites. New species, new to fish farming, anyway, are escaping at a higher rate than salmon are, at least according to the Norwegian data.

And we do know from the Scottish data, that there are escapes from organic sites as well. Next slide. I forgot we had the rolling pointer here. Thanks. Next one. There we go.

The paper does provide a literature review on over 30 scientific papers from authors across the globe. These start from the early 1990s, so they're not quite 30-years old, more like 20-years old. And two recent scientific reviews are a particular useful frame of reference. There's a 2005 review paper by Neeler [phonetic] et. al, and a 2007 review by Ferguson, and they're both attached to our submission. So I wanted to point those out to you.

These are the effects that are noted in these papers, significant and ecological genetic impacts on native wild fish populations, increased disease risk, sea-lice infestations, and then escapes from other species are an emerging international issue as well. Next slide, please.

The question that we have here is the only, is it true that the only solution to ensuring that escaped farm fish have little to no impact on wild fish and marine biodiversity is to prevent the escapes in the first place. That is what the Principle 15 of the Rio Declaration [phonetic] would support, and certainly it is the basis of the precautionary principle. Next slide, please.

You did ask us a bunch of other questions and we do not have the expertise to deal with those specifically. And so we, instead of trying to just end at that, it seemed appropriate to try and pose what sort of questions have to be answered in order to answer the questions that you had asked us.

So first, it's evident to us that the burden of proof that these systems do contain escapes and that they won't have the impacts that are described, really falls on the proponents of the organic open-net cage aquaculture. And so that's why we wanted to pose it in this way.

You asked how, the first question would be how many escapes are too many? What number would be too high? At what level are escapes a threat to the wild fish populations? If one of the solutions to this is farming native species only, then this leads to the question of are the potential increase in genetic disease risks inherent with the culture of native species preferable to the conventional genetic and ecological impacts associated with the culture of exotic species?

So we don’t know if there's actually any science to answer those questions, or if it's in the pipeline. Next slide, please.

So the other, if it's impossible to ensure that the open-net cage fish are not going to contract disease, so what we would want to ask in that case, is there certainty that diseases and parasites will be effectively treated and fully contained? Can we guarantee that these diseases, including sea lice, are not going to spread? And what kind of data are available showing that organic pollution from the farms are not and will not drive additional disease or parasite burdens on wild fish?

That's all I have, so thank you very much. I appreciate the opportunity to come and present to you, and I apologize for not being Andrea. She sounded a little frantic when I talked to her this morning. But thanks again, and obviously if you have any questions--

MS. CAROE: Before you leave the podium, can you give your name and affiliation and spell it for the court recorder? I don't think you did that in the beginning.

MR. NATAN: Sure. My name is Tom Natan, N-A-T-A-N. I'm the Research Director with National Environmental Trust in Washington, DC.

MS. CAROE: Thank you.

[Applause]

MS. CAROE: We are now scheduled for a little break, and I guess we'll take 15 minutes. I have, that it is 25 after, so 20 of we'll come back, we'll reconvene. Thank you.

MS. CAROE: Valerie? Are we ready with the next presenter?

MS. FRANCES: Next on deck is Martin Krkosek, with the Centre for Mathematical Biology, Department of Biological Sciences, University of Alberta.

MR. MARTIN KRKOSEK: Hi. I'm Marty Krkosek, it's spelled K-R-K-O-S-E-K. I'm a Ph.D. candidate at the University of Alberta. I've been studying sea lice in salmon in the Broughton Archipelago for the last five years. That's mostly what I'm going to talk about today, but I'm also going to talk about some other observations we've made on disease interactions between wild and farmed salmon in the area over the years.

The term "emerging infectious disease" is probably something most people in this room have heard of. When we think about Avian Flu or West Nile Virus, those are examples of emerging infectious diseases. These diseases are emerging through interactions between humans and wildlife and domesticated animals.

When we're thinking about disease interactions between wild salmon and farmed salmon, we're dealing with this area here, which is an interaction between domesticated fish and wild fish.

Usually when we think about these kind of disease interactions, the conceptual framework is something like this: you start with a natural wildlife population, some domesticated animal is introduced, and it might have some novel pathogen, and then that pathogen can spread between the wild population and the farmed population.

And there's many examples of this, a lot of them from Africa. The most contemporary example is the critically endangered Ethiopian wolf, and its primary conservation threat is the spread of rabies from domestic dogs.

When we're thinking about wild and farmed salmon interactions, this is the scenario that we're looking at. This is the migration routes, the migration pattern of wild pink salmon in the Pacific Ocean. They leave their rivers, go out to the open ocean and come back.

Here's Vancouver Island, which is located right here, and each of those dots is a salmon farm -- an open-net salmon farm. They're situated on the migration routes of the wild fish, so there's an opportunity for pathogens and parasites to get transmitted between the wild and the farmed populations.

The first example we have of pathogen interactions in the Broughton occurred in 1991, and it was repeated in 1993 where there were outbreaks of furonculosis [phonetic] on the Atlantic salmon farms in the Broughton, which subsequently spread to the wild salmon populations and into a hatchery located in Echo Bay.

This picture here is an escaped Atlantic Salmon caught in Scott Cove Creek amongst a school of wild Koho salmon and it is diseased with furonculosis.

The next example is IHN, this is a viral pathogen. It is highly transmissible in the water and it's highly pathogenic to Atlantic salmon and some Pacific salmon species.

In 2003, there was an outbreak that occurred on a salmon farm located right here, which is near Campbell River.

After that, a boat left Campbell River and traveled up the coast delivering smolts [phonetic] to salmon farms. And all those red dots are the subsequent locations of the salmon farms where the virus spread.

So it can spread rapidly, and that happened in one year. It can spread rapidly among the salmon farms, but one question from a conservation perspective is what was the impact on the wild fish stocks?

This is the Broughton Archipelago here, where we've been working. And that's the origin, the nadal [phonetic] river of all tagged wild salmon that have been recovered in the Broughton.

We're dealing with a highly-migratory wild fish species. The opportunity to spread these pathogens throughout the coast is vast.

I've been studying sea lice for the last five years. Sea lice are a crustacean, they're related to crabs and shrimp, and they're a natural parasite. They're native. They occur naturally on wild salmon. They're common also on farmed salmon, they're common in wild adult salmon, but they are rare on wild juvenile Pacific salmon.

Wherever you look in places where there are no salmon farms, the prevalence of sea lice on wild juvenile salmon is less than 5%.

Sea lice have a lifecycle that has two stages and it's important to understand this lifecycle. There's a definitive parasitic stage where the parasite makes its living on the host, feeding on surface tissues. It goes through a developmental progression from a baby copapoda louse [phonetic] freshly attached. They're only about a millimeter in size. They progress then through calamous [phonetic] stages, which are like middle-aged lice, and finally into motile lice, when they're sexually reproductive. They reproduce and they release their progeny into the water column where they can persist for up to a week before infecting another fish. So you have this dispersing planktonic stage that can move through the environment, and a definitive stage that it's attached to its host.

This picture here is a juvenile pink salmon. It's about this big, it weighs about one gram, it's about four centimeters in length. These are female salmon lice infecting the juvenile pink salmon. You can see the extensive tissue damage to, you can see the extensive damage to the surface tissues of the fish, puncture wounds, scaring. The feeding of the lice on the surface of the fish causes stress to the fish, it makes it hard for the fish to maintain its osmotic balance, and can ultimately kill the fish.

Wherever you look in British Columbia, also in Norway, Scotland, and Ireland, there are more sea lice on juvenile wild salmon in areas where there are salmon farms.

What this means is when we're thinking about, conceptually, about the interaction between wild and farmed fish, we need to revise that a little bit. Wild fish generally have the structure where the adults occupy different habitats than the juveniles. Juvenile fish are small, they have different prey, they have different predators and they have different habitat requirements. What that means is if you have a pathogen that's associated with the adult fish, the juvenile fish do not encounter that pathogen until they're recruited into the adult population.

When you introduce domesticated fish into the environment, you have the opportunity for new transmission chains to open up and the juvenile fish can become exposed to these parasites when they are very small and not well equipped to handle the parasite.

So we've been looking at three questions when we're looking at sea-lice impacts on wild fish, wild salmon in the Broughton. Do sea lice spread from farmed to wild salmon? Do they kill the juvenile salmon? And is that mortality sufficient to threaten the wild salmon populations?

This is how we do it. So to look at the first question, we sample the juvenile salmon as they're leaving the rivers and migrating out to sea. Each one of these stars is a sample site. We collect the fish by beach scene [phonetic] and count the lice on them.

In 2003, there was one isolated salmon

farm located right there. So we were able to study the fish as they're approaching and passing that salmon farm. We can see where the infection begins, and how it progresses.

Here's a look at the data. Again, here's the migration route, there's the salmon farm. On this plot here, are the three developmental stages of lice on those fish. The copapodas, which are the baby lice, the calamous lice, which are the middle-aged lice, and the motiles, which are the adult lice.

The fish are traveling from left to right, which corresponds to their migration down this migration route. The farm is located at X equals zero.

Before they reach the salmon farm, there's few lice on those fish, but there are some lice there. As they pass the salmon farm, you see a rise in the baby lice, indicating transmission is happening and those fish are picking up lice as they're passing the salmon farm. As they continue to migrate out to see, you can see those lice maturing through the middle-age stage, the calamous lice. Finally, by the time the fish reach the end of the migration route, the lice have matured. They're sexually reproductive, and we see a second generation of lice appearing down here.

When we analyze these data, we can reconstruct where all those lice are coming from, and that's what's shown in this plot here. Fish are migrating from left to right, and this is the spatial distribution of the infective larvae in the environment. This is like the cloud of parasites that the fish have to migrate through on their way to the ocean.

This thick curve here is the overall distribution. This first curve here are the lice coming from the salmon farm. The second curve here, is the second-generation of lice. Once these lice have matured and reproduced and re-infected the fish, and there's another line near zero here which is the natural abundance of lice in the environment.

These lice here correspond to the 2-3% of the lice that we see in areas where there aren't any salmon farms. Next slide.

These are the models that we use to analyze the data. I'm not going to explain it. Next slide.

This is how we fit the models to the data, and if anyone's interested, I'd be happy to talk afterwards. Next slide.

And this is how many times we've done it. We've looked at different species of salmon, migrating down different migration routes in different years. Every time we look, we get the same answers. Sometimes there's three salmon farms on the migration route, sometimes there's two, sometimes there's one. Every time, the answers are the same. There are natural sea lice in the environment, but there's also a lot of sea lice coming from the salmon farms and infecting those wild juvenile salmon. Next slide.

So to answer the first question, do sea lice spread from farm salmon to wild juvenile salmon, the answer is yes. And this occurs on the scale of about 30 to 80 kilometers. So you don't have to go right past the salmon farm, you can be 50 kilometers away and still feel that impact.

But so what? We really need to know what those lice are doing to those fish, and so that's what we looked at next.

We did some experiments where we collected these infected fish from the environment, sorted them by the number of lice they had, and held them in these ocean enclosures, protected them from predators, fed them salmon feed, and monitored their survival over the course of a month.

Each one of these panels here corresponds to one of these enclosures, and this is the number of lice the fish had on them at the beginning of the experiment. The fish with no lice survived very well. There were two mortalities in this one and two mortalities in this one.

The black line here in each of these panels is the real number of fish surviving through time. As the number of lice increases, the survival of the fish declines. Next slide.

You can take that information and combine it with the information we have on sea lice infecting the juvenile salmon as they're migrating out to sea --next slide -- and estimate the proportion of the wild salmon populations that are dying from the sea lice as they're passing the salmon farms. And that's what's shown here.

Along the migration route as the fish are traveling from their rivers out to sea, the grey area here is the proportion of the juvenile salmon population that is surviving the sea-lice infestations. Sometimes the mortality is not too bad, about 9%, and other times, the mortality is up to 95%.

Ninety-five percent of the juvenile salmon leaving the Broughton are dying from the sea lice from the salmon farms. Next slide.

So clearly, if 95% of the juvenile salmon are dying every year from sea lice, we have a problem. We have a very serious problem. But the mortality of these juvenile fish, from when they enter the sea to when they return to spawn is very high anyways. About 85% of those juvenile salmon are going to die before they return to spawn, and so what if 50% of these fish are infected with lice?

This is a really challenging question to evaluate whether or not this is actually a threat to the wild salmon populations. Next slide.

Well, you can look at it mathematically. If we write down what we know about salmon population dynamics and how pathogenic the sea lice are to the juvenile salmon, you can estimate that an average abundance of about 2 to 3 motile-stage sea lice, the wild salmon populations are going to collapse.

We've seen sea-lice infestations in that range, and we've seen collapses of those populations. Now a few moments ago, Dr. Brooks presented some data from one population in the

Broughton suggesting that the wild pink salmon are doing just fine. That was from one population. There's at least 16 populations in the Broughton of pink salmon, there's also chum salmon and Coho salmon.

You can't conclude based on one population that everything is okay. No one's done that comprehensive analysis yet. Next slide.

Here's one example of a population from the Broughton that's doing really poorly. These are the Viner [phonetic] chum salmon. From 1953 to 2005, the number of chum salmon returning to Viner Creek. The first thing to take note is that it's incredibly variable. There's good years and there's bad years. Over this time period, there was a commercial fishery right in Viner Sound, fishing this population.

This is when the salmon farm came in about a kilometer and a half from the mouth of the river.

We used to have returns of 10,000-60,000 fish to this river. Over the last few years, the number of chum salmon returning to Viner Creek has been less than 100 individual fish. Next slide.

So do sea lice threaten wild salmon populations? You can be shown examples that say yes, you can be shown examples that say no. The answer really is we don't know yet. I would say probably, but the comprehensive analysis hasn't been done. Next slide.

But I want to impress upon you that we are not dealing with just a few missing fish. This is one of the 89 chum salmon that returned to Viner Creek this year, 89 individuals. Next slide.

The whole ecosystem depends on these fish. Marine birds feed on the juvenile fish. Next slide. Eagles feed on the adult fish. Next slide. Sea lions, marine mammals feed on the adult salmon. Next slide. Orcas congregate in the summer to mate and gorge on the wild salmon. Next slide. Grizzly bears, coastal bears, three-quarters of their annual energy and nutrient intake comes from salmon. Next slide.

And humans come to British Columbia to fish the salmon for fun. Commercial fishermen depend on wild salmon and aboriginal cultures have evolved with the wild salmon for thousands of years. These are the linkages that are being threatened. Next slide.

But the story isn't limited to salmon. Over the last couple of years, we've been getting reports of other fish species that are being brought up in the shrimp dragger nets. These are flat-head sole infected with some kind of bacteria that we haven't identified yet. Near the salmon farms, almost all of them have it, distant from the salmon farms, it's almost absent. Next slide.

This is a rock sole infested with a copepod, same story. Next slide. This is a juvenile skate infested with parasitic worms. Same story: near the salmon farms, they're infested; distant from the salmon farms, they're not. Next slide.

These are turbot infected with a copepod that infects their eyeballs. Near the salmon farms, almost 95% of the turbot have this parasite; distant, they don't. These observations so far are preliminary. We're only beginning to analyze these kinds of questions. Next slide.

There are a myriad of ways that diseases can interact between wild and farmed salmon. Not just wild and farmed salmon, but also farmed salmon and other wild fish species such as those bottom-fish I just showed you.

These impacts are inherently unpredictable and they are poorly understood. Scientifically, we're just beginning to develop the capacity to study sea lice, which you can go out and see and count, but there's all kinds of other viral and bacterial diseases that are much more difficult to study and we don't have any information on what's happening to those fish. Next slide.

The reason that disease interactions between wild and farmed salmon are so rich and so damaging is because the ocean is an open system. Pathogens can persist for long periods of time in the ocean. They are widely dispersed, there are abundant fish populations that are highly migratory, the system is well mixed. The salmon in the net pens are always going to be exposed to the pathogens that the wild fish carry, and then there's always the threat to the natural ecosystem of those pathogens being returned. Next slide.

I just put this slide together to address the points made earlier today, just to clarify where our funding comes from. Three-quarters of it comes from peer-reviewed scientific grants, the remaining funding comes as matching funds through a peer-reviewed system.

And that's all I have for you.

[Applause]

MS. CAROE: Thank you. Thank you very

much. Before we go to the last presenter, I would like all attendees who have not signed in to please do so. We really need a record of how many people attended this symposium, so if you have not signed in, I ask that you please go to the book. And Valerie, the book is located?

MS. FRANCES: Right here.

MS. CAROE: Right there. So please go and sign the book before we leave today. It's very important that we have an accurate number.

MS. FRANCES: Behind the screen.

MS. CAROE: Behind the screen. The lady with the red shirt. All right. Valerie, our last presenter for today?

MS. FRANCES: George Leonard is formally with the Monterey Bay Aquarium, Center for Future of Oceans, and is now currently the Director of Aquaculture program for the Ocean Conservancy.

DR. GEORGE LEONARD: Thank you, Valerie. I want to thank all of you for toughing it out. I picked number six out of the bag, out of the hat, and it was totally unintentional, but I actually think it's great because I get an opportunity to do a little bit of cleanup here at the end of the day. And I think I will touch, ever so briefly, on all the issues brought up by the other speakers.

My name is George Leonard, spelled G-E-O-R-G-E, L-E-O-N-A-R-D, and I am now currently with the Ocean Conservancy. Up until two weeks ago, I spent the last five years as the Science Manager at the Seafood Watch Program. And for those of you who don't know, the Seafood Watch Program at the Monterey Bay Aquarium, we have largely been the guys that have put out those seafood cards with the red, yellow, and green lists that you either love or hate, depending on where you fall on the rankings.

We are presenting, this is a joint presentation today with myself and Cory Pete [phonetic] who is in the back over here. This is work that we did at the Monterey Bay Aquarium. And what we want to do is talk a little bit about performance metrics as a potential solution to this quagmire about open net-pen systems and carnivorous or highly fish-meal- and fish-oil-dependent species as perhaps a third path, a way to think through some of these issues with respect to organics.

I'd like to thank the NOSB for all their hard work on this, the Aquaculture Working Group for the same, and in particular, George for his leadership on this issue. We want to take where that work went and see if we can move it a little farther down the line.

I also want to admit that I think this stuff is really, really hard. Okay? I spent five years thinking about what is a sustainable fishery or a sustainable aquaculture operation. You now take that issue and you have to overlay it with the concept known as organic, and I think it's really hard.

So what we're trying to talk about here, I don't think is perfect, but I think it's an interesting concept. And for those of us like myself who sometimes has some difficulty with this concept, I think it's because we're trying to explicitly merge two concepts. Second slide.

So none of us need to be told this issue is controversial, there's a whole bunch of reasons for that. As I've mentioned, we think performance metrics may work as a potential solution instead of production or performance-based metrics. It is this intersection of sustainability and organic production. And this is really designed to be a thought experiment as a proposal for discussion rather than some certification regime that we should go off and start implementing tomorrow afternoon. Next slide.

So first, starting with organic principles, I'm certainly no expert in organic principles, but my sense of this is that if you look back half a century into the 1940s and look at Sir Albert Howard's *Agricultural Testament*, it's a very nice sort of summary of this whole issue and where the concept started.

And what's really key about this is that the principles of ecology, the principles of recycling wastes, and in particular of natural defenses as part of an agricultural system is at the heart of what he's talking about 60 or so years ago.

Of course in 1990, the Organic Food Production Act kind of codified this whole issue, and really, in very much the same spirit as Howard was talking about. So we're talking about an ecological management system that looks toward the preservation of biodiversity, the maintenance of biological cycles within a farming system, and in the case of terrestrial where this all starts, really the maintenance of soil biological activity. Next slide.

Now the issue becomes difficult when we try to then think about the concept of organic as it relates to aquaculture, and in particular, open net-pen systems precisely because of some of the sustainability issues that we've talked about this afternoon.

And there really are five issues. I'm really only going to talk about four of those today, and none of this should be new to anybody, right? But just for the sake of completeness, the five issues are: the risk of escaped fish to wild fish and natural ecosystems; the risk of pollution or nutrient inputs and habitat impacts from farming operations; the third issue is the impact on predator populations; the fourth is the risk of disease and parasite transfer, much like Marty just talked about in advance of me; and the fifth is the use of marine resources for feed. This is the fish-in, fish-out kinds of discussions from this morning.

We don't really think it's all that useful to debate whether these are real issues or not. I think much of the science -- it was presented both in testimony and in writing -- suggests that many of these, if not all of these, are very well documented in the scientific literature. So the more important question is what are we going to do about these potential risks in the context of organic certification of fish grown in these types of systems? Next slide.

So our approach here was to have sort of two goals: one was to think about whether there are performance rather than production-based standards or metrics that could actually reduce these environmental risks to something that we think is tolerable, and at the same time the goal is that each of those metrics should be as consistent as possible with the existing organic principles, both as laid out by Howard in the 40s, as well as codified within U.S. regulation.

The goal here is to strive to achieve this balance, this overlay, without thinking about certain species or certain kinds of different methods of production. So much like Neil talked, this is much more than salmon, we would agree that this is not a discussion simply about salmon. Salmon can inform the debate, but this is much more about that broad sweep, I'm not sure it's 20,000 different fish, but certainly there's going to be a range of fish coming into production in the next 10-20 years, and the question is how do these principles apply to those as well as salmon?

Now the way we did this is we hosted a workshop last summer in July of 2007, and we brought together a small group of constructive folks from both the aquaculture production community, from the organic certification community, from the scientific community, and from the conservation community. And we asked these folks, who have various opinions and perspectives, to come together and help us think through this explicitly with the idea of being constructive. Constructive engagement was the only criteria. And because this wasn't necessarily something that they were required to sign onto or some sort of consensus-based approach, the idea was what would come out of this, we will have to own this so nobody is responsible for what's on the paper other than ourselves. But we didn't create this in a black box. Next slide.

So what I want to do is I want to walk through each of the four issues, talk about what this performance metric might be, and then discuss how they either help or don't help solve some of the sustainability concerns in the context of organic.

So the first is the risk of escapes, and like the Aquaculture Working Group, we think that open net-pen systems must be designed and implemented to eliminate escapes. But we also know from Andrea's work and the Pure Salmon Campaign, that in fact, even if you work to eliminate escapes, you still get escapes. So we have to go beyond that.

So our feeling is that as a consequence, if we're going to have escapes, we need to reduce those impacts in the wild, and that the only way to do that is really to farm native species of local genotype, which we've heard about today as well.

What that means is that non-native species, or native species with substantial genetic divergence from wild stocks, would simply not be able to be declared as organic farmed fish. And that also includes fish that would be heavily selected upon, even if they were natives. So we are suggesting here then that organic farm fish must essentially be the farming of wild fish. And that's a point that probably needs some discussion.

Our definitions are native is really endemic to the local area of culture, and that by local genotype, we do mean fish not beyond the, I think that actually should say F2, but the F2 or F1 generation. The idea being that you will bring in wild genotypes into the husbandry to essentially maintain wild fish. And this is something that Neil, I believe, is doing in Kona right now. Next slide.

So what are the consequences of a native fish kind of performance standard with respect to organic? Well, the first is that I suggested, and as we've heard today, escapes are inevitable. We can make our nets stronger, we can do all the right things with respect to our management plans, but we will get escapes. And that a native species requirement essentially reduces those impacts as much as we possibly can, give it's an open-net system.

Now to us, that strikes that that's essentially on par with stock-enhancement programs and procedures that are currently being used to revive over-fished or threatened species. And so we think that a native species husbandry-type approach as identified here would at least be on par with that approach, but it is important to recognize that hatchery programs themselves are not without their critics. And in fact, there was just a paper published in *Science* a couple of months ago, identifying some pretty big impacts of hatchery programs.

However, it strikes us that the only next step, if those risks are too large, the only next step is then to go to a fully-closed system to actually reduce those levels, in this case, essentially to zero. So again, this is probably a point that deserves some discussion about which way you would want to go on that.

Now there's also another big consequence of this kind of metric, of non-, of native species, and that is that that Atlantic salmon would essentially not be viable candidates for organic certification, because Atlantic salmon in the Atlantic, are essentially, have been heavily bred upon and selected from the wild fish. So there's genetic divergence there. And Atlantic salmon farmed in the Pacific are non-native.

So we recognize that such a metric would drastically impact the ability of Atlantic salmon to be declared certifiable under the NOSB standards. However, we would suggest that farming natives is likely better than the status-quo approach, in which you would allow the farming of non-natives to be considered organic. So that's issue number one.

Issue number two is the question of pollution or nutrient inputs, and I think for those of you who have not read Ken Brook's paper in detail, it's a great summary of these issues. Thank you for putting that together.

Our approach, again, builds on the AWG work. We do believe that polyculture is a good solution to the issue of nutrient enrichment, and we suggest that you might use a performance metric or a performance goal of 50% of the dissolved nutrients in organic material be recycled through polyculture within the farm tenure.

We would also suggest, however, that the cumulative impacts of organic farms and non-organic farms within the surrounding ecosystem needs to be taken into consideration, and that those must not exceed the assimilative capacity of the surrounding ecosystem. I think this is also ultimately a point that's going to need some discussion, is the extent to which individual farms can be thought of as organic when they are embedded in the open system that Marty just touched on.

We would also suggest that benthic habitats should show no measurable impact on chemistry or biodiversity. And we heard from Ken with respect to salmon farms, that in fact, there is an inevitable consequence, at least a near-field effect, for salmon farming. But we also know that with respect to a lot of the other species that are coming online, and Neil's Kona Kampachi is a good example, is that for many of these metrics, there are no measurable impacts. And perhaps having no measurable impacts is the acceptable metric for organic fish, not necessarily sustainable, but for organic fish.

We recognize that polyculture may be a difficult thing to do technologically and otherwise, and would suggest that a transition period of eight years be implemented. And we would suggest that that be incremental: building from an initial entry point of 10%, which is a pretty small number, up to 50% over an eight-year period, and we would like to see that incremental so that it's not a sunset clause where it goes to 50 on the end of year eight. Next slide.

So what are the consequences of this metric with respect to pollution? The first is that polyculture or integrated aquaculture, we do believe, meets the spirit of the definition of organic aquaculture. It's certainly been embraced by the Aquaculture Working Group.

We also think that a performance metric of 50% is actually a feasible number. This is based largely on Terry Chopin's [phonetic] work with seaweeds and salmon farms on the East Coast. And we think that a transition period may actually provide some incentives to scale this thing up over time.

What are some of the other consequences? Well, one of the big consequences is if in fact we stick to a no-demonstrable impact within the farm tenure, that suggests that near-shore producers are likely not going to be able to be considered to be organic under this performance metric, and that would, obviously, include much of the near-shore farmed salmon.

So that likely, like the non-native metric, would perhaps include farmed salmon.

We would suggest, however, that the offshore fish farms may in fact be able to meet this metric, but that at the same time, we should be cautious about that because there's at least one published paper in the peer-reviewed *Science* now that does show that at least at one farm, you can begin to show some nutrification problems even in offshore fish farms. So we don't believe that the nutrient issue can be dismissed entirely in open net-pen systems.

We certainly recognize that polyculture would be difficult in the offshore waters that

Neil Sims and Kona Kampachi is being farmed in, but at the same time, my sense is that 10 or 15 years ago, people didn't think we could farm fish out there at all. And so I suspect that incentives would result in some really new and creative ways of farming fish, even in those offshore waters.

Third issue is the impact on predators, which we think is the third important issue. And like the Aquaculture Working Group, we would suggest that an integrated predator management plan is critical. We must have one. But at the same time, much like the escape plan, we need some metrics around what's a tolerable impact.

We would suggest that non-lethal deterrents are always the first course of action. We would suggest that no underwater acoustic deterrent devices or similar methods can be used at all, ever. And we would also suggest that there is no intentional killing of predators, except for immediate human safety.

The key here is, the keyword is no "intentional" killing of predators, and the key is immediate human safety, which we would hope, obviously, is a rare occurrence.

And the final issue here is that what do we mean by rare? We would also suggest that more than a rare mortality event would essentially result in loss of certification.

Now, what's the definition of rare? Obviously, this is sort of arbitrary, but we would suggest that one mortality event per certification period would perhaps be allowed under these circumstances, but certainly not more than rare.

The key here is this is a performance metric around predator mortalities because in open systems you can't necessarily guarantee you're not going to have a predator problem. Next slide.

So just to touch on that again, with respect to what are the consequences of this, it seems pretty clear that predator impacts must be addressed to meet the consumer expectations of the concept of organic. You just can't have mortality events in organic farms, and that site selection, low stocking densities within open systems and production management, some vigilance to that may -- and you'll notice that that's in italics -- *may* key predator impacts at bay.

But there are no guarantees on this and therefore we would suggest that three years of data that would support sort of a competitor, that would support no predator impacts should be part of the system here. And we think that swift revocation of organic certification would have to go hand in hand with this kind of metric.

You'll notice that this is the third one and it's starting to get squishy in terms of how comfortable we are with these issues. And now let's go to the difficult one, which is this issue of the risk of disease transfer and parasite transfer.

I think Marty's data speaks for itself. It's strong, it's powerful, he's a very smart mathematician and I can't follow the first one of those equations. But it seems clear that there are some major issues in terms of general issues of disease transfer in open systems. Salmon is one issue, my sense is that the general mathematical dynamics that have been identified probably apply to other systems. We just don't know it yet.

So what do we do about that? Well, the only think we could come up with, and this is something we probably should talk about, but the only thing we could come up with was a performance metric that did two things: that said on an organic farm, there simply can't be clinical signs of disease or parasites; and at the same time, there can't be any treatment with synthetic drugs except those that are permitted under the national list.

Now of course, we would allow treatment of sick fish for animal welfare issues, just as you would in terrestrial production. But those certainly couldn't be sold as organic. That seems relatively straightforward. But this metric then, is essentially a no-disease, no-treatment metric. Next Slide.

The consequences is, this is clearly the most daunting issue for organic open net-pen systems, and it's the most daunting performance metric. We believe and I think the data suggests that disease transfer and the chemical treatments themselves negatively impact the environment. We're sort of caught in a Catch-22 here where you can't have either of those issues to be organic, but that there is a strong financial incentive to maintain low disease incidents on a farm, simply because of the positive financial reward of the organic label.

Consequences are salmon are likely going to be excluded because of the data we've heard today. It's not clear, it's likely maybe that other species are capable of meeting this metric, particularly the new and upcoming species. How much of that is because it's at small scale? And at what scale disease issues become a major kind of ecosystem-wide issue is really, I think, where the rubber is going to meet the road on this. And that was actually a question I was going to ask you, Marty, is how we deal with the scale issue and the concept of organic.

Finally, I think we would say that although producers obviously have the right to petition the NOSB for things like parasiticides to be listed on the national list, we don't think that organic consumers would be tolerant of that proposal. Next slide. Next slide again.

The next two is this issue of feed. We did some work on feed, but that's obviously not part of this panel. Happy to talk about it or its in the paper we presented as well. So just go to the next one. Next one. See, I'm close. I've got one final slide in here.

Because these are performance metrics as opposed to production-based standards, it's really about sort of data of no impacts. So we would suggest that because of that, we really need three years of compliance data before certification would happen at all. That is, we'd need to, you basically have to have a clean record before you could be certified, and that that should be obviously continual strong performance on each of those four or five metrics would be part of continuing certification. Final slide.

So the question then becomes, is this a way forward? Is this a way to get us out of this problem we're in? We have a yes camp and a no camp. We, as the Monterey Bay Aquarium have been on the record as closely aligned with the no camp. We think there are legitimate sustainability concerns. The no camp in general thinks that the concept of open net-pens and the fish-meal issue are sort of fundamentally inconsistent with the concept of organic, and are therefore, not certifiable, end of story.

The yes camp, of course, thinks that these issues are compatible and that these kinds of systems and fish should be certified as organic.

It may be that this kind of performance-based approach would help us to actually meld these two concepts in a way that makes people more comfortable, and builds on the very good work that's been done so far. The big implication for this though, as I've sort of hinted at, is that only a very small part of the existing industry, if at all, would actually be certifiable today.

So the question is, does that create enough incentive to get this airplane off the ground? And I would suggest that if two things can't happen, the first being that if this is not deemed to allow enough of an incentive for organic aquaculture to really get a running start at this, or if there's a consensus or some growing understanding that these kinds of performance metrics don't reduce the environmental impacts to a level that people can live with, that the National Organic Standards Board should joint the no camp, and should not certify open net-pen systems as organic under U.S. law. So thank you.

[Applause]

MS. CAROE: Thank you very much, and that is our final presentation for this portion of the symposium. And with that, I'm going to, we're about a half an hour behind, but that's pretty good. I'm going to turn it over to Hue Karreman, Chair of the Livestock Committee to facilitate the board's question and answer, and hopefully, we can get to questions from the audience as well. But again, the board questions will take priority. Go ahead, Hue.

MR. HUE KARREMAN: All right. Thank you, Andrea. I'll just open it up to questions from us. Steve?

MR. STEVEN CRAIG: I only heard one presenter talk about the fouling problem on net pens, and I was wondering, is that a common problem throughout the industry? And if so, is copper the common solution to that problem?

MR. KVENSETH: So far the copper has been a usual solution, but as I told you, there are new solutions coming up so you can treat the pens without copper. Just to get a smoother surface or to bind the treads closer to, you can use mechanical devices to clean them. So I would say that the copper is on its way out, and there is, you can at least operate the organic production without using copper.

MR. KARREMAN: Please, Andrea.

MS. CAROE: Just really quickly, is TBT tributyl tin [phonetic]? It is. Okay.

MR. KAREMAN: Wow. Big word there, Andrea. That's Ken, isn't it? Yeah.

MR. BROOKS: I'd like to just add to that, I left 10 CDs for the members of the Livestock Committee, and on that are several papers dealing with copper zinc, a computer model for predicting water column concentrations of copper.

I'm going to agree that copper is identified by the U.S. EPA as a major marine pollutant in the United States. The Navy in San Diego is spending in excess of $10 million dollars per year looking for alternatives to copper for antifouling paints. And I think this is a technology that will proceed.

However, having said that, copper and zinc from feeds are two metals that are released from salmon farms and they're two metals that we have shown can be managed. But again, I do agree that I think five years from now, 10 years from now, you won't see copper used as an anti-foulant on any marine structures.

MR. KARREMAN: Jerry?

JERRY: Follow-up question to that on antifouling. Neil, didn't you mention something about the effects of the further offshore net pens in relation to antifouling?

MR. SIMS: Neil Sims. No, but just for the record, we have half of the net pens that we have are treated with copper, the other half are not. It's a huge burden to be keeping the non-treated nets clean because it requires divers in the water because of the cage structure. We are working towards some other solutions there such as an invertible cage. We have half of our cages are invertible there where you can air dry the top half and then turn them over and air dry the bottom half there.

But the copper nets do reduce the amount of fouling there, which does increase the water flows through there, which presumably makes for happier fish. There's less restriction on the water movement through the net pens. So there are some benefits to having some sort of antifouling on the system.

JERRY: So the increased current out there further offshore doesn't have any impact on the type of species that want to foul that net? Does it cut down on some of them, or is it no different?

MR. SIMS: Because we are in open ocean and we are in, actually alogotrophic waters, they're very nutrient poor, we don't get the sort of fouling in our net-pen systems that they get, say, in the temperate waters closer to a coastal shelf.

JERRY: All right. Thank you.

MR. SIMS: So it is distinctly different

sorts of fouling.

MR. KAREMAN: Kevin?

KEVIN: I have a question for Mr. Sims very quickly, I thought it very interesting that your efforts to build up your net-pen system almost took an approach of telling us how poorly the land system was. But I was confused about the rip-roaring current and how the fish in that net pen are still able to swim about as their natural behavior, because of the centripetal forces in the closed system, they were not.

MR. SIMS: The currents offshore are highly variable. When there is a very strong current through there, it's periodic, it doesn't seem to be tidally driven, it's more the offshore gyres [phonetic]. When there is a strong current there, the fish will orient into the current.

Most of the time, however, they're able to just swim around inside the cage fairly freely.

In the centripetal current in the land-based tank, the fish can move from one side of the cage to the other, but that means going through the vortex close to the central stand pipe. And so they choose not to, and so you just tend to have the fish holding position in the tank.

KEVIN: So that centripetal force is

constant? There's never a break where there's no current in that water? That's a 24x7 situation?

MR. SIMS: Yes. You have to do that with the land-based tank systems so that you have the feces and other particulates move towards the central drain and then they move out of the tank. If you don't have that, you just have feces and particulates building up on the bottom.

MR. KARREMAN: Actually, I have a question. Let's see, one of you just mentioned, I think it was Dr. Leonard, about using only native species. And I just couldn't help but think about terrestrial agriculture and how we have a lot of Holstein cattle in the U.S. that are actually native to Northern Europe.

So just in case we were to adopt that, philosophically speaking, what would we do with the cattle that are in the U.S. that actually shouldn't be?

DR. LEONARD: I guess send them back is not a good answer? There are lots of non-native species now all over the world. I think the general principle here with respect to non-natives is to be concerned about it.

When I was doing my graduate work, I was impressed by the work being done by Jim Carlton in marine systems in which he sort of became known for demonstrating that ballast water was responsible for moving a lot of non-native species around the world. And the story he told me once, was really eye opening, which was, there was a particular invertebrate that they'd watched for years and it had never come into the East Coast…

[END MZ005006]

[START MZ005007]

GEORGE LEONARD: Even though they knew it was in ballast water for ten or fifteen years. They figured there was something special about this thing. And just when they were getting ready to reach that conclusion it took hold in one of the bays and estuaries in Massachusetts and they have no idea why. And so you know his was to be worried about non native species generally because they are very difficult to predict.

I don't know what you do about terrestrial systems other than to say that cows don't probably move as much as fish do and we can go find them. You know I think it's really interesting that something like less than one percent of the escaped Atlantic salmon can be recovered. I just - that's just not a viable you know strategy.

You know this issue of domestication I think is an important one because this is another one of these kind of catch 22 problems. We either need, in my opinion we either need to farm, basically farm native species of local genotype as we suggested wild fish, so when they get out they minimize the impact because we know they are going to get out.

The other alternative is to really domesticate them hard to the point where if they get out they are kind of like cows walking down the street, you know by the Safeway. They are not going to last very long. Okay. Some folks have said well what if you can put a suicide gene in a fish, right, and if it got out it couldn't - it literally had a survival rate of 0.0. So the difficulty is when we are in the middle, between either full domestication or wild fish where if they do get out there has been enough selection on them that those maladapted genes will persist in the population. And there is enough empirical and modeling data with salmon to suggest there's - there's some problems there. So you know it feels to me like you've got to go one way or the other but being in the middle is difficult.

HUE KARREMAN: Just a quick follow up on

that. At least in my little world I see that actually mixed breed cattle do a whole lot better than - than the pure breds. They are just genetically stronger, I guess the hybrid affect. Can that happen with - in agriculture? You guys, you were just saying you've got to highly domesticate them or have the native stock. Why can't you have some kind of mix? Is that just not possible? Because in cattle they don't make as much milk, but they are really healthy.

GEORGE LEONARD: I am far from an expert on genetics, but there are a number of folks like Ian Fleming and Phil McGinnety who are and it would be really interesting to put that question to. You know I think you first have to recognize that wild fish are not, you know pure breds right? There's a whole diversity of genes in those populations that are breeding as a function of natural genomics. I think the real worry with - with genes from farmed fish is if they - you could make the argument if they get into the population they'll just, they'll have less fitness right, so they are going to be eliminated by natural selection. Which I think applies if escapes happen once. If it's a pulse experiment where you throw some genes into a wild population it will be weeded out over - very quickly over a generation or two.

But the problem is as we now know; escapes are a pretty ongoing event. And in that case when you continually put maladapted genes into a population you can reduce the fitness of the wild population pretty dramatically because of that continual input. And I think that's where the worry comes from.

HUE KARREMAN: Actually what if you looked at it the other way around that you breed in native genetics into your farmed species? Or - is that possible?

MALE VOICE: Yes I think - and that solves it. But right--

GEORGE LEONARD: And maybe Ken or a producer can talk about this more specifically. My understanding is that there is often these like pleotropic [phonetic] effects where when you select for faster growth or larger fish or disease resistance, sometimes those run counter to the genes that would result in high fitness under the wild population. So you can't kind of have your cake and eat it too. But somebody else may be able to comment on that.

HUE KARREMAN: No I realize that but in -

I guess in organics I don't think of maximal production and maximal everything as part of the organic paradigm.

GEORGE LEONARD: Well I think that's exactly a really important point. And that came up this morning with respect to the much of the production data. Where the implication was if your growth rates were twenty percent or thirty percent reduced, that was a problem. But I think - I think it was Andrea over here - identified that perhaps maximum growth is not necessarily a metric on which you can measure successes of organic production.

HUE KARREMAN: Right.

GEORGE LEONARD: Right? I mean that's the whole point right? Is that it's organic but you don't get the fastest growth rates as you could at conventional. And maybe that's a consequence of trying to solve some of these issues, particularly on the feed side as well.

HUE KARREMAN: Julie.

JULIE WEISMAN: Yeah, I was also struggling myself with this issue of the arguments for native species only and things that I had heard from - in some of this morning's presentations, and I know that - that this is not officially a time when any of those people are on the panel, but I - I felt like there were some interaction because I pretty distinctly remember someone this morning talking about how F2 would not be an acceptable parameter for - for farm raised and fed fish. And there had already been hard experience demonstrating how disastrous it was when you tried to bring any - you know when - until domestication had been achieved. And I was wondering if it - if I'm allowed to ask anybody from this morning's panel to address that piece of it.

HUE KARREMAN: Do you know exactly who it is?

ANDREA CAROE: -the post reception [unintelligible].

JULIE WEISMAN: Okay.

HUE KARREMAN: Okay, Dr. Osgard [phonetic]. Does any current panel member have an answer for that? Okay Neal.

NEAL SIMMS: Neal Simms. I think this morning's discussion was focusing on some of the abilities of some species to metabolize some of the anti nutritional factors or some of the other factors that are included in soybean meal. And that is, I think, very specific to that issue.

For all of the other species, of which I'm aware, people are using - starting obviously with wild stock and very few generations. There has not been a lot of work done with selective breeding of marine fish. The research shows that you can get some tremendous improvements in performance in growth particularly. But then when you take that selective pressure away it very quickly reverts back to - there is Charlie Darwin has his own barometer there. It very quickly reverts back to the wild type.

HUE KARREMAN: Okay. Andrea actually--

ANDREA CAROE: This may seem a little bit simplistic but bear with me. With all the discussion about the threat of the escaped domesticated or - or farmed fish in these - in these net pens, is there any consideration or any work being done on secondary containment systems or other mechanical methods in order to decrease the risk associated with - with escapes?

HUE KARREMAN: Ken. Please state your name also.

KENNETH BROOKS: Yeah Kenneth Brooks. I'd like to make a couple of points. One, this issue of escapes and their potential for genetic and - and ecological interaction with wild fish is one of those issues I mentioned this morning which has to be addressed on a regional basis. If you read Ron Jeanette's 2002 report evaluating the potential for escaped Atlantic salmon to interbreed with and/or compete with Pacific salmon, or if you read Lee Alverson's [phonetic] discussion in the Pacific salmon forum, or the *Salmon Aquaculture Review*, you will find that both of these people concluded that there was very little or - I won’t say no - very little, minute potential for genetic interactions or for competition between escaped Atlantic salmon on the Pacific coast and Pacific salmon on the Pacific coast. And I think that's a perfect example of a situation in which farming an exotic species, if you will, significantly reduces the environmental risks associated with the production of that food.

Now if you are farming Atlantic salmon in an area where you have threatened or endangered wild Atlantic salmon, then other considerations need to be made. And so that is an example of these regional issues.

British Columbia, about three years ago I think it was, initiated a very strict net pen integrity program - escape prevention program I guess you would say. It has not reduced the escapes to zero. But unlike the situation in Norway and in Scotland, it has significantly reduced those escapes to the point that in Ms. Cavanaugh's paper she said British Columbia was an outlier. And then went on to state that the escapes from Scotland then and Norway represented the lowest feasible and practicable levels of escapes that could be anticipated from open net pen systems.

My response in part is why didn't that paper look at escapes from British Columbia salmon farms and conclude that with that very aggressive escape prevention program, that represented the lowest level achievable and practicable? It's not going to get to zero. Just like I try to keep my cows in but unfortunately they do escape every once in a while. And - but again that's got to be one of those regional issues and the risks associated with escapes are very much a regional management problem.

HUE KARREMAN: Okay. Julie is up. Wait, okay Jeff. And then Jennifer and then Dan and then Katrina.

JEFFREY MOYER: Thank you Hue. In the discussions that we heard about net pens, I believe Ken brought it up; you were talking about the fact that under - under the net pen scenario you often have reduced biodiversity right, in the region of the net pen. Yet in conventional organic systems we are encouraged to increase biodiversity wherever possible.

Then later George was talking about poly cultures. And I'm just wondering if we could get some kind of reaction from the panel on - on how we can farm with net pens but still maintain or improve the biodiversity of the waters surrounding the net pens and whether poly cultures would help do that.

MALE VOICE: Let me come back to the uh there are risks associated with everything. Now I don't raise chickens. But I've seen a number of chicken farms where the chickens are produced in houses. And the chickens may have access to a yard. What is the biodiversity underneath that house? In almost every form of agriculture there is some loss of biodiversity associated with the production. I like actually the provisions you have in the current recommendations before you, which are consistent with the BC recommendations, that you establish an allowable zone of impact, the site tenure, the site in your - in your example, and that you do not allow effects outside that site. That’s a very reasonable performance standard, and one that is probably achievable with - with the initiation of management practices.

But guys you're not going to find zero risk. If you do we're all going to be eating soil and green.

MALE VOICE: So can I just follow on that real quick? I think the question that has to be asked in the context of - of the impacts around farms is are we talking about well managed conventional farming, or are we talking about organic and what make organic different? Because I would argue that having an allowable impact and minimizing that impact isn't organic, that's simply good management of whatever the traditional model is.

The question is how do you go beyond that in the spirit of organic? And I do think the concept of enhanced biodiversity and poly culture are the two key issues there. It strikes me that those are two separate but related issues. You can do poly culture but the issue of enhancing biodiversity or at least of reducing the negative impacts in the farm tenure, is simply a matter of stocking density. And you can get that by reducing stocking density, which you know obviously there's a - there is an economic consequence of that. But you could perhaps have reduced stocking densities and maintain profitability because of the enhanced income from - from the organic label.

HUE KARREMAN: Neal go ahead.

NEAL SIMMS: If I may add to that as well. As you move into deeper water, into more exposed sites, then you do add to the biodiversity there. Our farm site for example, it was bare open ocean there before our farm site was there. And now we start with small bait fish and then larger decaptorers [phonetic] and then larger tunas and Wahoo, there's an entire ecosystem in there that's built up around our cages. And that's even separate from the nutrient input which is model - you can model that and you can see yes there will be some increased productivity and therefore some increased biodiversity somewhere further downstream. We can't measure it but we know that that effluent is going to have an effect there. So there are two levels for that increase in biodiversity that we see in Kahona [phonetic].

HUE KARREMAN: Jennifer.

JENNIFER HALL: This is really for anyone. A couple of you touched on predator defenses but nobody really talked about them specifically, and I'm wondering what - what practices are common and what the repercussions of those are?

NEAL SIMMS: Neal Simms. In the open ocean systems you have to use your cage as the defense. You can't have any other deterrent there. We are dealing primarily with sharks and there are endangered Hawaiian Monk Seals in the area as well. We very infrequently have them come around the farm because there's nothing there for them. And it's just the integrity of the net is adequate there for us. We do have a seasonal migration of Tiger Sharks that comes through the farm site there. And we don't deter them anymore. We have learned to live with them. This has been part of - I said there's an evolving predator management plan. We've gotten a lot smarter. And something about having a fifteen foot Tiger Shark around your cages makes you get pretty smart pretty fast.

HUE KARREMAN: Dan.

DANIEL GIACOMINI: I'm not really sure how to address this question but I’m - I have some concern on the one hand in the process of - and I think it was brought out in George's paper - in the fact that most of this is in public waterways, working with states, foreign governments, all sorts of different agencies. In looking to move the possibility of - as Neal is suggesting - of deeper waters, in the salmon it sounded like - seems like most of them are in fairly somewhat inland. Is moving the salmon to deeper waters, is that feasible? Is it something that would have regulatory problems with - from the people you have worked with in dealing with getting approvals for that? And then specifically as that question develops, with Martin is the numbers that you used of thirty to eighty kilometers, I'm assuming that's in fairly confined environments. If you went to open, more open sea, deeper water type of environments, what kind of numbers do you think - where do you - it seems like that number would be reduced fairly tremendously. How - what kind of an impact do you think you would see there?

HUE KARREMAN: Please give your name first again.

MARTY KURKOWZIC: Marty Kurkowzic, University of Alberta. Certainly if you move offshore into more flushed environments you are going to reduce that risk. The dispersal of the parasites is going to increase so it will spread much further. But the density is also going to go down. So moving to the more flushed environments would certainly help. And I can't - and in terms of siting obviously it would be better for the juvenile salmon if they moved the salmon farms off the migration routes and offshore is a good place for that, but I can't comment on the regulatory aspects of how that would happen and those kinds of complications.

HUE KARREMAN: Okay, Katrina?

KATRINA HEINZE: My question is for George. And I can't remember what slide it was on but you talked about the - your performance metrics that it would be difficult for organic to maybe meet this particular one - and again I can't remember. But that perhaps a sustainable system could. And I'm a little bit intrigued. What would - maybe two questions. What's the difference between sustainable and organic in your mind? And how would the performance metrics be different?

GEORGE: Yeah I'm not sure I have a great - well this is a question that we have spent a lot of time thinking about. From our perspective at the aquarium, where I was for five years, in talking to consumers I think many consumers think of organic as kind of good for you, good for the environment. And if you can say good for the environment it's sustainable. Right? Then they think of organic as sustainable.

But as I began to come up to speed with - with the rules and regulations of how organic came about and - and what it really means, there then is this question. Is, you know, is organic equal to sustainable? Right? And that becomes a much bigger discussion, you know probably over beers late at night and this kind of stuff. There's a lot of philosophy involved in that right. But I think in the - and the reason I'm really interested in this with farmed fish is because if the U.S. develops organic standards, that basically by definition are sustainable, then that's where we want to be. Because as a - as a conservation person I am much more interested in sustainability, broad kind of ecosystem sustainability, than I am about a particular label that plays out in the marketplace.

But if that label supports that concept then that's great. But, and that's why I think this so hard because there are the rules and requirements of how organic works and how the AWG did all it's work. But those aren't necessarily the standards you might come up with in terms of sustainability. So you know the good example is the feed issue, right? Where we might say god, from a sustainability point it's really great to be able to recycle and use say poultry byproducts. But if that's not going to fly from the organic eater consumer or regulatory framework, then we're dead in the water on that issue. But that's not - sustainability would have taken you a different place with respect to feed. So that's kind of what we--

KATRINA HEINZE: So how would--

GEORGE: And I can't remember the specific example you were talking about to be honest with you. But I'll - if I go back and look at my slides maybe I can figure it out.

KATRINA HEINZE: So are there places where the performance metrics that you suggested would be different between a sustainable system and an organic system?

GEORGE: Uh--

KATRINA HEINZE: The ones he suggested.

FEMALE VOICE: I think it's relative to disease.

GEORGE: Relative to disease?

KATRINA HEINZE: I think so as well.

GEORGE: You know I'm sorry. Maybe it's because it's late in the afternoon. I was batting cleanup. I need some more coffee. Let me think about that a little bit and let me get back to you. I apologize for that.

KATRINA HEINZE: That's okay. Then I have a follow up question for you.

GEORGE: Okay.

KATRINA HEINZE: To give you a break on that one.

GEORGE: Maybe I could try on that one.

KATRINA HEINZE: You know I am an organic consumer. I have two young children. And frankly I like buying organic because it gives me confidence that my purchasing dollars are driving industry in a direction I want them to go. If we have an organic standard for aquaculture that is so stiff that few if any, I think are the words you used, fish meet that, that really denies me the opportunity to use my consumer dollars to drive industry behavior. Have you considered that? I mean what - how do we find that balance between providing an economic incentive?

GEORGE: Yeah. No you're exactly right. I mean and that's sort of what was at this - at the genesis of this concept, which was if we just say no to organic under these conditions, then we have lost the power of the consumer dollar to actually achieve sustainability under the guise of this thing called organic.

But so how do you go there? How do you develop metrics that might support that? And what we came up with was what we came up with. I think the difficulty here is that - I think our philosophy is that we need - we need to follow the organic principles and the concept of sustainability to where it leads us with respect to standards. And then ask the industry to change to meet those standards if they want to be organic. Rather than trying to figure out a way to shoehorn existing processes into the concept of organic and/or sustainable.

And so you know I think that's the fundamental challenge to this is can we develop standards that aren't so unrealistic or somehow fundamentally flawed that nobody can ever meet it. But let's go through the thought process first and then say well, does this work for anybody? Yes or no. And then move from there.

KATRINA HEINZE: Thank you.

NEAL SIMMS: If I may just add to that?

HUE KARREMAN: Go ahead, yeah sure, go

ahead.

NEAL SIMMS: The other area or the other side of fishery is biology so I can't help but throw into the discussion here the idea of the reuse of edible fishery byproducts. That's an example where clearly these sustainable solutions, something which we all should embrace, is the idea of these Pollock trimmings, which are getting dumped over the back of the boat in the Bering Sea. We should - that's a resource that we should be reusing. And whether you're going to call that sustainable or whether you're going to call that organic, it's a matter of semantics. But we need to encourage that reuse at every level.

I would like to see the opportunity for an industry to build up around that supply, that we create an incentive here in organic standards and with this window of opportunity that the aquaculture working group has provided, that we make it available for these byproducts for an industry to build up around there so that then it becomes more economically viable. At the moment for us to use the BC - British Columbian Hake byproducts, it's more expensive than for us to bring up Peruvian anchovies, and that's when our feed company is in British Columbia. This makes no sense. But that's the way the economics work because it's a matter of scale, because they are working in tens of containers a week for British Columbian Hake it's a smaller fishery and it's more difficult for them to manage it.

HUE KARREMAN: Bea is up and then Rego [phonetic] after that.

BEA JAMES: First of all thank you again to all of the panelists. I enjoyed all of your presentations. My question is for Mr. Simms and anybody else who might be able to answer this. I am trying to understand the space in which you have an open net pen system. And I'm - I'm trying to imagine how you control that and how you determine to shrink and expand it as you grow your business. And you mentioned that - that at this point that you have a level of control and I'm curious to understand at what point would your net pen system be too big for you to have a level of control? And also, this is probably a very elementary question, but how - how do you keep your space protected? What if someone else wants to come into the area and also open up a net pen system?

NEAL SIMMS: Neal Simms. The primary determined over the area that we requested from the state was the scope that we needed on the anchors. We needed the holding power. And so because we are in water 200 feet deep, we needed to go almost 1,000 feet in each direction to get the five to one scope to make sure that our cages stayed where we - we put them. We would like to move into deeper water but there's an interesting trade off there. As we move into deeper water the area that we need becomes greater because the spread of the anchors becomes further.

And so we have been, for the last couple of years we have been in discussions with our community about where and how we might expand, just because we have got overwhelming demand for our fish. And so we want to look at this. And there's still - I think because of, as I said, the pejorative about farmed fish, there's still some disquiet there in the community. People were perfectly open to the idea of us putting larger net pens in there and so what we - the proposal that we have with the state at the moment is instead of the 3,000 cubic meter net pens what we have there, that we'll go and replace those 3,000 cubic meters with 6,000 cubic meter cages. So that's what we have to the state.

I'm comfortable with that given the level of water that we have - the amount of water we have moving through our net pen and the fact that we are not detecting any effluent - any impact on the water quality and the effluent there.

Your second question about control of other farms that may want to come into the area, we would - the general rule of thumb that I think it's the Mediterranean Industry - this is something - it has become a conventional wisdom that has been kicked around and I'm not sure of it's origin, but the conventional wisdom is you don't want to have your fish farms closer than about five miles to each other.  So at some point this industry can be self regulating.  Anybody comes and requests another lease from the state within five miles of ours then we will vigorously oppose it just because peace of mind is a very valuable thing.

We also - it is not an exclusive lease. We do allow fishermen to come through - these tuna and Wahoo and other fish that are attracted to our fish farm, we allow fishermen to come through and troll through our site.  People can bottom fish in the site.  And people also catch some of the bait fish that aggregate around our net pens there. But we do restrict of course scuba diving and spear fishing around the farm site for obvious reasons.

HUE KARREMEN: Rigo.

RIGOBERTO DELGADO: Yes, talking about risks, what would be the risk of using the byproducts from Alaska fro example in your farm, first of all. And second what are the risks of using copper antifouling materials for the fish inside of your nets?

NEAL SIMMS: Neal Simms. Copper is pretty toxic to most marine animals and so the idea of using copper as a feed additive is that perhaps your suggestion?

RIGOBERTO DELGADO: No you are using it as an antifouling. Is there any risk of using those products to the fish inside of your nets?

NEAL SIMMS: The level of ambient copper that the fish are exposed to or that the environment is exposed to is absolutely minimal given the amount of water that moves through there and the limited amount of copper that is on there. Remember eight kilometers away is a small boat harbor that has 200 boats in there who all have copper antifouling. There is no other antifouling that people use on their boats with any regularity and with any effectiveness. And so it's not like we don't use copper in the marine system. It becomes a problem when you get it concentrated or when people are using other forms of antifouling, such as tributal tin is now I think universally prescribed. I don’t think anybody anywhere in the planet is still using TBT.

And I'm sorry your second - I answered your second question first. Your first question was?

RIGOBERTO DELGADO: The first one is risk related to the use of byproducts.

NEAL SIMMS: Right, the salmon byproducts. My understanding is that there is minimal risk of transfer of pathogens from between families. You wouldn't want to use salmon byproducts for salmon feed. And in fact that's actually one of the problems. We would love to be able to be using salmon byproducts in our Kahona Compache Feed. But our feed company will not allow salmon byproducts into their site because the risk of some potential down - down stream of some unknown prion [phonetic] or something to that effect. What - the reason why I would like to see us working towards some incentives is that we need to encourage the feed company to perhaps have different dedicated lines of extruders so that the salmon meal and salmon oil can get fed - can - byproducts can become Kahona Compache feed. The Kahona Compache and the Cobia byproducts can become Barramundi feed. And then the Barramundi byproducts can become salmon feed. That's a beautiful reuse of resources and it's something that we should, I think, encourage and provide economic incentives for. I don’t think that that is diluting the value of the organic brand to start to lead on that rather than just letting consumers tell us what they think. I would say the same would hold true with the question of poultry byproducts.

HUE KARREMAN: All right, Joe and then I'm going to have one question at the end and read some cards yet.

JOSEPH SMILLIE: Well this is for Martin and Ken especially. What parts of the AWG recommendation do you think would move the salmon, the conventional salmon aquaculture industry to a better ecological perspective? And what additions do you think, sort of like George mentioned, performance metrics, should we look at in trying to create an organic and I'll, you know tackle the tough issue, the salmon - it's been - it has been pointed out that the salmon is a problem, it's salmon-centric, and so I'd like to get some direct opinion from you two on exactly which - do you think the AWG standards will help the problems that we have noted with the conventional salmon aquaculture industry? And are there some things that we should go beyond the AWG recommendation to try and create an organic salmon industry? And again your perspective on whether that will help the problem rather than just saying no to organic salmon aquaculture.

MARTIN KURKOWZIC: Marty Kurkowzic. From the perspective of my background, sea lice and salmon, it's really clear that you need to separate the salmon that are inside the farm from the wild juvenile salmon that are migrating past it. And there are some options. One is to move the farms. Coastal waters - in British Columbia there are very few places on the coast where wild juvenile salmon don't go. It would be really hard to find a site that would - that you could move an open net cage farm to - to eliminate that problem. So maybe moving offshore is an option. And the other obvious alternative is a closed containment system where the waste materials from the farm are treated before they are released into the environment.

KENNETH BROOKS: There are so many questions that can be answered in that one question that you asked. One - I deal internationally - U.S., Canada, FAO, on the development of environmental management standards - not standards for organic consumers. And so I have no expertise there. But I will tell you this, that the countries that I deal in and work with spend a huge amount of effort developing management programs to address environmental issues. And as I said earlier, those management programs differ by region, differ by the social and economic structure of the country, their priorities, their environmental characteristics, etcetera, etcetera.

From an environmental point of view I strongly recommend that you follow the trend that I see in - in numerous of your recommendations to rely on those local jurisdictions by requiring that organic consumers be in compliance with those governmental regulatory programs, which are regionally specific. The development of these programs takes tens of thousands of hours and years and years of study. And to think that the National Organic Standards Board, no matter how bright you guys are, are going to sit down and in some reasonable period of time duplicate those standards is I think unrealistic - or improve on those standards is somewhat realistic. Because you would have to look at a broad range of jurisdictions and environmental conditions and it would very quickly go beyond your - your time and resources to do that.

I can't close without saying that I strongly disagree with Marty's presentation - with many elements in Marty's presentation. I just came from a Pacific salmon forum meeting where there are - were a dozen or more researchers who have been doing specific research in this field. And they would not reach the same consensus that Marty has given to you. And I can only suggest that I have included in the CD I sent to you, a list of conclusions from that latest Pacific salmon forum meeting that were reached by one other academic and myself based on the presentations. And I would suggest that you want to read that to gain a different perspective of the BC sea lice issue.

HUE KARREMAN: Okay, it's 4:15. We are well beyond our cutoff. I mean we could keep going but we do have a poster session and we can keep talking about things and I will forgo actually reading these cards at this time unless you all really want me to? No. Okay. They are going to be scanned in.

But I do want to say one thing about the regionality issue. You know that - that's a major deal in other aspects of organic agriculture. And you know, what can we say except this is a national program. And Andrea is going to touch on that more I know. But you know in another symposium we had, the same idea you know, there's regionality to that whole topic of pasture for cattle. So we understand that but this is a national program.

ANDREA CAROE: And just - I'm going to back you on this Hue. We agree that a regional - and even a species specific standards are really more appropriate. However we need to deliver a consistent platform for the organic label. That is our charge. If we are to recognize regional variance, we need to be able to codify that in our regulation with our recommendations stating what that - that level of authority is. Where - where that jurisdiction will go, which is not always easy because although this is a U.S. standard for U.S. products, these products are produced around the world. So we understand what you're saying but the logistical challenges to that are - are pretty - pretty vast in themselves. So at this point we are looking at trying to create a standard that may be at the 30,000 foot view in some areas and not to the detail that we would hope. However that is the best way we can do our job to provide the consumers with - with an assurance to the - to the standard of that - that label on fish. So I think that again backs what - what Hugh said and you want Kevin - Kevin do you have something?

KEVIN ENGELBERT: Yeah I was going to speak about the same thing. But I also want to make a comment. I'm troubled by the implication that - that organic is going to lead down a different path than a sustainable approach. Because one of the tenets of organic agriculture has always been sustainability. And that is one of the things that those of us on the AWG, the NOSB members, have always considered when - in our debates, is this sustainable? We look at everything and every possible angle. We want a system in place that's going to be sustainable for the generations. So there may be Pollack being dumped out the back of fishing boats, but it's not organic Pollack. So if it was, then that would come into play. But I really think that to say that organic and sustainable will diverge - I'm not, I'm not convinced of that yet. I just - I just wanted to make that point. I don't really need a response.

HUE KARREMAN: Okay. With that we're going to take a fifteen-minute break. And I want to thank all the panel members again this afternoon for coming in from all the different areas of the world and providing us with invaluable information as we go through our deliberations. Everyone please stick around and mill around by the posters and ask the panelists from today questions. That's what this next hour is for. We'll start up again in about 4:30 - 4:35. And it goes for one hour until 5:30.

[END TRANSCRIPT]

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