PUBLIC HEARING BY THE PIERCE COUNTY HEARING EXAMINER

In Re:	)
	)
Administrative Appeal: AE1-10	)
Appellants: Coalition to Protect Puget Sound Habitat and Case Inlet Shoreline Association	)
	)
Shoreline Substantial Development Permit: SD22-06	)
Applicant: Longbranch Shellfish, LLC	)
	)
	)

Excerpt of Transcript of Proceeding

Before STEPHEN J. CAUSSEAUX, JR.

Tuesday, March 15, 2011

APPEARANCES

For the Appellant Coalition to Protect Puget Sound Habitat:

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Adonais Clark, Environmental Designee, PALS
Dave Risvold, Environmental Biologist, PALS
Jenny Pelesky, Clerk

Reported by: Linda M. Grotefendt, CCR
License No. 3013

(Herein begins the first excerpted portion of the transcript.)

DAN PENTTILA, having been first duly sworn upon oath by the Hearing Examiner, testified as follows:

THE WITNESS: My name is Dan Penttila. That's spelled P-e-n-t-t-i-l-a. I reside at 5108 Kings Way, Anacortes, Washington 98221.

DIRECT EXAMINATION

BY MS. HENDRICKS:

Q Mr. Penttila, can you please tell us how you became the most recognized forage-fish expert for the Washington State Department of Fish and Wildlife for the last several decades?

A My background is University of Washington, 1970, bachelor's in zoology; University of Oregon in 1971, master's in biology. And within months after graduating from the University of Oregon, I was employed with the Department of Fish -- then-Washington Department of Fisheries in the incipient Puget Sound Bait Fish Project.

I was involved in bait-fish research and investigations from March 1972 through July 2010, at which time I retired from the agency. I'm continuing in forage-

fish matters as a private consultant, under the name Salish Sea Biological.

During the course of my career, I was involved in all phases of all life-history stages of most of the forage fishes in Puget Sound: herring, surf smelt, sand lance; the sampling of adults, sampling of larvae in plankton surveys; mapping of spawning habitats for habitat-protection purposes; biological sampling of fish themselves. And details of my work activities are included in my CV submitted for this matter.

Q Have you concluded Washington Department of Fish and Wildlife forage-fish spawning-habitat mapping surveys around the Longbranch site?

A Yes. Yes. During the course of my work activities, a main feature of my work activities in Puget Sound was the mapping of spawning habitats for surf smelt and sand lance.

When we came upon the scene in the early 1970s, virtually very little was actually known about the distribution of surf smelt spawning beaches in Puget Sound, and nothing was known of sand lance spawning beaches in Puget Sound.

Over the course of the years, we formulated several projects where we did, basically, synoptic surveys of all the shorelines in the Puget Sound basin, pursuing evidence of spawning activities--that is, detecting eggs in situ--

in beach gravel samples in various places around and about Puget Sound, including the Longbranch site.

And during the course of our survey activity, we surveyed past and on the Longbranch site three times. They were on November 23rd, 1992 -- that's -- the field report for that survey is our Appellant Exhibit 253 -- January 5th, 1996, Exhibit 254; and January 19th, 2007. That is our Exhibit 255.

During the January 5th, 1996 visit, sand lance eggs were found on the farm site. And subsequently, as is our convention, a thousand-foot polygon of what we call documented spawning habitat was erected based on the observance of the sand lance eggs at that site, and it almost exactly coincides with the boundaries of the Longbranch farm proposal.

Q Now, during your work, did you also spend years reviewing that application of the GMA and the SMA to these type of habitat protections?

A Yes. During the course of our habitat mapping and the routine of observance and acceptance, by other resource agencies in the area, that forage-fish spawning habitats are vulnerable of all of the myriad of human shoreline development practices, language specific to forage-fish spawning habitats was eventually included in the language of the Growth Management Act of the state, the Shoreline

Management Act of the state, the Washington Administrative Code Hydraulic Code rules; and, also, the federal government has come to decide that documented forage-fish spawning habitat sites are critical habitat -- "essential habitat," I believe, is their term. The GSA listed salmonids.

Q Could you give us just a quick overview of different reports that you have written for the State of Washington that are used as reference?

A Starting in 1978, I wrote my first Sound-wide report on surf smelt spawning-habitat studies--or surf smelt studies, not just spawning habitat--in Puget Sound. And we have a number of exhibits submitted of my reports. I'm blanking on the exact titles right now.

There's been a number of conference papers dealing with our survey. We had to invent the survey protocols and also the results for -- initially, the results for sand lance investigations, because the sand lance spawning-habitat context in the upper intertidal zone, that we're involved with in this hearing, was not known before 1989.

They simply escaped the notice of generations of fish biologists in the Puget Sound basin up until the point where we, sort of serendipitously, discovered sand lance eggs in surf smelt spawning context. And then once we knew what we were looking for--we had a second egg up high on

the intertidal beaches--we had to invent a way of detecting those eggs, because they are visually very cryptic and can't be readily seen, or else they would have been discovered before 1989.

Anyway, we -- in terms of the reports, my final report with -- for the Washington Department of Fish and Wildlife was the report on -- summary report on marine forage fishes in Puget Sound, prepared for the Puget Sound Nearshore Partnership. And it's on the pugetsoundnearshore.org website, along with Jim Johannessen's report on bluffs and beaches and a number of other reports that might be relevant to this proceeding.

Q And did you also contribute your efforts on the interim guide that was produced as well?

A Oh, yes. And you will have to prompt me on what exhibit number this was, but yes, October 2007, generated a report called "Protecting Nearshore Habitat and Functions in Puget Sound, An Interim Guide," by EnviroVision, Herrera Environmental, and Aquatic Habitat Guidelines Working Group of the State Agencies.

Q That's A179.

A 179, okay. And I submitted as an exhibit just the forage-fish excerpt, and, basically, it is a review of the WACs and the GMA references and the SMA references with regards to forage-fish habitats. That is supposedly to be used.

Now, I understand -- you just commented that perhaps the aquaculture industry is not -- these guidelines don't apply to them. And I would ask the rhetorical question: If not, why not?

Q That was during our breakfast. In fact -- well, I'll just ask you the question. Do the hydraulic codes apply? Let me ask -- redirect. Are there hydraulic codes in the Fish and Wildlife protocols that are used for protection of nearshore?

A Yes. There's a whole -- I forget the chapter and verse of the Washington Administrative Code. But, yeah, there's Hydraulic Code rules, and within the Hydraulic Code rules, there's saltwater provisions.

Q In your opinion, are those important for the protection of forage fish?

A Yes. Yeah. They are instrumental. Prior to our appearance on the scene in 1972, nobody gave a hoot about forage-fish spawning-habitat protection. Where the fish spawned were virtually unknown, even for herring. And so the existing WACs of today referring to forage fish has evolved from in-house policies in the 1970s to written insertions into the WAC code in the early 1980s. And as sand lances were found to be as vulnerable as surf smelt and herring and ecologically valuable, language pertaining to sand lances was inserted into the hydraulic codes, later

on in the 1980s, when we found and started mapping the sand lance habitats.

So yeah, they're instrumental. They are one of our main tools to try to curtail the habitat degradation that otherwise would occur more widely in Puget Sound, with regard to these fishes' critical habitats.

Q Were you surprised to find out that the aquaculture industry was exempt from getting a hydraulic permit?

A I'm not party to all of the ins and outs of who's -- who's -- what's going on in Olympia with regards to that, so perhaps "surprised" is too strong a word.

Q Is it a concern?

A Yes, it would be a concern. And I think the -- the rules that we have fomented for the protection of forage-fish habitats -- they are -- they are applicable, I think, to any in-water activities, especially one that is covering so much ground as aquaculture. Truth be known, I have informed the aquaculture industry over the years, at various presentations, as to the importance of these habitats and to persuade them to pay them some mind.

Q Could you review the Washington Department of Fish and Wildlife smelt, salmon, and spawning-habitat protocols used on such surveys to map spawning habitat?

A Okay. And these were the protocols used on and near the Longbranch site. Basically, when we realized we had a

second visually cryptic egg type in the beach gravels that needed to be mapped if we were to effectively protect their habitat, we sort of invented a method by which bulk samples of upper intertidal beach material are collected, screened, and processed in a manner to highgrade the lightweight material out of these bulk samples, and subsamples of these bulk samples' light fraction are inspected under a microscope to detect -- to detect surf smelt and sand lance eggs.

Prior to the advent of this technique in 1991, we used only visual inspection of handfuls of beach material in the field to detect what we were then only looking for: surf smelt eggs. So this bulk sampling technique is much more efficient in detecting eggs, especially in small -- in low densities on the beach surface, where they might escape visual notice.

Q Now, you mentioned that they're extremely hard to see. Can the normal person see these eggs of the sand lance or the surf smelt easily when they're walking on the beach?

A Untrained, no.

Q Okay.

A But the whole matter is trainable. The protocols are trainable. A number of NGOs have assisted us in the Puget Sound basin. Over the years of our surveys, they've gotten -- went out and gotten grants to do certain counties. And

I trained them up and did some -- afforded them some lab QA/QC for their tentative results and that sort of thing.

But the average person in -- even a shoreline landowner who thinks they might be fairly intimately familiar with the comings and goings of creatures on their beach, are usually fairly ignorant of the presence of surf smelt and sand lance spawning habitat, and especially sand lance.

We've come to find sand lance eggs on 10 percent of the shoreline of Puget Sound's basin, roughly 200, 250 miles, I think it's up to now. And prior to our discovery of the eggs through an application of our visual techniques, not one single report from a private citizen, of sand lance spawning activity, had ever been forwarded to us. Their spawning-habitat context is unknown.

And also, as far as that goes, the spawning behavior of the fish is just now being documented for the first time. In 2009, 2010, a video -- underwater video team connected with the Puget Sound -- or the Island County Beach Watchers organization has succeeded in videotaping sand lance spawning activity for the first time ever in the world.

So -- so our knowledge is evolving of -- particularly of sand lance is the least known of the three shore-spawners.

Q What is the Washington Department of Fish and Wildlife Salmonscape Database?

A Oh, that's a publicly accessible database on the WDFW habitat program website. It was determined, after 30 years, that: Gee, it would be a good idea to put this all down digitally, GIS-wise. And so that was done. So there is a database that you can get into on the habitat program.

Type in "Salmonscape," click on "Salmonscape." You'll get a map of the state. With the cursor, draw a little square around anywhere in the Puget Sound basin, hit "change map," and then, when that map comes up, there will be a menu on the left side of the new map. It indicates intertidal forage-fish spawning habitat, and there will be "surf smelt," "sand lance," "combined," and "potential" choices there, where anybody can look and see the present-day, current distribution of our documented spawning habitat polygons.

And I think it has been evolving since I left so that some of the survey-by-survey, station-by-station data might also be available to those with the proper computer machinery. So that's Salmonscape, with a capital "S."

Q Would you think it would be important that Pierce County should know the inventory of their spawning sites in their county, as to what they have here as sand lance?

A Yes.

Q Because it's such a small percentage?
A Every political jurisdiction in the Puget Sound should know that, I believe, if they are a jurisdiction that is required to periodically update their Critical Area ordinance or their Shoreline Master Program. I believe the language states that they are to pay attention to where these places are.

Now, they are not the -- maps are -- we've covered everywhere in Puget Sound, just about, several times, but that's not sufficient to have the maps perfect. There is a potential that not all of the documented spawning sites are, in fact, known yet. So there is a need, down the line, for the next generation of field biologists to continue this mapping.

Q Are a great majority of these spawning sites in South Puget Sound, or are they widely dispersed?
A I'm afraid I don't know what proportion. I couldn't give you a proportion of the total that's in Pierce County or south of the Narrows. South of the Narrows, if you look at our spawning-habitat distribution, there's an awful lot of shoreline that's occupied with smelt sites or sand lance sites. Occasionally, both species using the beach. Down here, the surf smelt tend to spawn in the fall/winter, and that's when the sand lances spawn. So both of the species' eggs will be in the same gravel at the same time.

This almost happened at the Longbranch site. If I might refer to this picture here -- well, I won't leave you out. Okay, the sand lance polygon is right about down here (indicating), almost centering on this stream delta. Immediately north of this plot here is a surf smelt polygon that reaches for nearly a mile up the shoreline, up towards Longbranch proper.

There is a sand lance polygon at the tip of the spit going into Felucy Bay. Spit tips are favorite places for sand lance spawning. There's also a sand lance polygon on this spit immediately south of the Longbranch farm site too.

And that's fairly typical, that when you take them in total -- a considerable amount of the total shoreline down in southern Puget Sound here is documented by one species or another of those two.

Q In your opinion, have a lot of the sites that you -- are the prerequisites for geoduck aquaculture coincident with sand lance habitat?

A It may be mere happenstance, but yeah, it would appear to. The fact that -- speaking of cumulative-impact analyses, which I will not do, the statements that were made of 91 percent of the shoreline of Totten Inlet being occupied with farming activities, aquaculture farming activities -- I believe that's the number; 90 percent, something like

that.

There, if that's true, it may be that 90 percent of the shoreline of Totten Inlet has been documented to be smelt and/or sand lance spawning habitat as well. So there's an example of a place where there's quite a bit of overlap between aquaculture activities and forage-fish spawning activities too.

Q Is it a concern for you that the sand lance are spawning in the fall/winter and that the harvesting around Christmas/Thanksgiving is a prime time when they harvest the geoducks?

A Yes, it would be, I think. Because I concur with Jim Johannessen's testimony yesterday, that there's a likelihood of fine material from harvest activities being able to move up-beach into the sand lance spawning-habitat zone from the digging zone or the harvest zone. There's only a couple vertical foot separating those two zones. And -- and the -- I thought perhaps that, during the course of consideration of this matter, that there had been a proposal to curtail or prohibit geoduck harvest during the sand lance spawning period.

I think that might have been just someone's proposal. I don't know if it made it in. I read the County report -- thumbed through the County report here this morning, the 36 points. I don't believe any of those 36 points involved

the curtailment of geoduck harvest during the sand lance spawning season.

Q Would you explain the value of forage fishes to the marine ecosystem?

A Forage fishes are called forage fishes. They used to be called bait fish because, back in the '70s, we were just worried about providing salmon support bait, herring, to the fisheries.

But present-day, they're called forage fishes because they are foraged upon by a whole suite of higher consumers in the food web, what I call the charismatic mega fauna: the birds, the whales, the ling cod, the salmon, the humans. And they are -- just a few species, four or five species, then connect the vast bottom part of the food web. All the planktonic forms that these fishes feed upon, both phyto- and zooplankton.

So they are -- they are the key link in the middle of the food web. And I would state that -- if you want to see a food-web diagram, look at Page 12 in my forage fishes -- "Marine Forage Fishes of Puget Sound" Pisner paper, it has a food web there that illustrates that -- that importance of the middle band of positions in the food web being occupied by what we consider to be the forage fishes, in large part.

Q Have much of the critical forage-fish habitat been damaged

at this point, or been lost?

A The exact percent is unknown. When we showed up in 1972, a considerable proportion -- an unknown proportion, but what I considered to be a considerable proportion of the potential spawning habitat for forage fishes--surf smelt, sand lance, particularly--in Puget Sound had been damaged in some manner by inadvertent human activity.

Inadvertently damaged by human activities. Everything from the massive railroad causeway from the Nisqually to Bellingham down to individual 100-foot single-family residence building lots, built on bulkheads that were too far out from the shoreline.

But I think -- I'm not sure if the number is changed, but I think already, by that time, 30 percent of the shoreline of Puget Sound had been armored in some manner or other. I believe that's a number that Puget Sound Partnership bandies about.

And although we do have hydraulic rules in place to try to ameliorate the continued degradation of such activities, the WAC Hydraulic Code does not preclude those activities. Single-family-residence bulkheads get a bye. We cannot deny them even if we don't think they're a good idea. All we can do is design them so that their impact is minimal.

Meanwhile, the other thing that armoring does that

cuts off the normal erosional inputs of sediment down onto the beaches, which is how the beaches are made -- the gravel doesn't come down the streams, it comes off the bluffs.

Q Is it important that those beaches, once they are suitable substrate, in your opinion, are protected?

A Yes.

Q Okay.

A Yeah. That's keystone to our -- it's the one thing we thought we could do, with a minimal staff that got deprioritized about every five years. That's the one thing we thought we could do to protect the species, is to protect their critical habitats, and in the absence of any other more-expensive way to try to assess their numbers or otherwise protect them.

Q Now, is the forage-fish species sand lance your most closely occurring farm site -- would you review the sand lance spawning ecology pertinent to this case?

A Okay. Very briefly, like I say, just a year and a half ago, we found out what sand lances do when they spawn. And still, there's not -- there's not all the answers. The videos need to be analyzed to glean more information out of them and, also, for the videos to be done in more places than just the north shore of Penn Cove.

But it appears that the sand lances -- first of all,

for those of you that are unfamiliar, sand lances have a peculiar diurnal habit of burrowing into sandy substrates during those times of the day when they are not up in the plankton, feeding on things. We think that's a predator-avoidance mechanism.

It generally happens at night, but not always. They can be found burrowed into the substrate during the day. And the details of what they do in the vicinity of their spawning areas, out in 10 or 20 feet of water, are still unknown. Those haven't been videotaped.

But the pre-spawning fishes rove to and fro along -- it happens at high tide. They rove to and fro along the shoreline and ripen in schools. And at some triggering moment--and we don't know what triggers them at this point yet--schools of a few dozen to several hundred will suddenly split off of these roving schools, and they will press themselves onto the bottom; the whole school will writhe violently on the bottom of the substrate. This is in waters of 1 or 2 feet deep. There will be a burst of milt, and we presume that, at that milt burst, eggs are also being extruded; fertilization is occurring in the few moments that the eggs take to settle down out of the vents of the females, down onto the sandy bottom.

And the fertilized eggs are adhesive for a moment when they touch the sandy bottom, and they acquire a coat of --

sometimes complete coats, sometimes just a few sand grains. Anyway, their egg shells are adhesive for a moment, and they acquire sand grains that adhere to them. They rest on the sandy bottom, once again, up in the upper third of the intertidal zone, as near as we can tell, and they incubate there.

There will be several spawnings on a beach during the course of the two- to three-month spawning season. And they take -- each brood takes one month to hatch.

Q So you're saying that that part of the beach is a very important part of the beach?

A Yes.

Q I hate to bring up -- we're going to have to start to get down to the specifics of the Longbranch, because I'm on a time frame here of our six hours.

I would like to introduce Exhibits 248 -- A248, A249, and A252, which is on the spawning behavior and life history that Mr. Penttila furnished; as well as Exhibit 256.

Would you review your concerns about the potential impacts of the geoduck-farm operations on spawning -- on the sand lance spawning?

A Okay. It is acknowledged that the design of the farm and the apparent policy of aquaculture, in terms of where they want to plant geoducks -- that there will be a physical

lateral separation between the innermost geoduck tube arrays and the spawning substrate itself.

I would, once again, just refer to Jim Johannessen's testimony, that he suggested there's a likelihood of fine material being able to move up-beach on flood tides into the spawning zone. That's one thing.

And let's see. I have the grain-size analysis. What exhibit number is that amongst the 250s, my group?

Q It's in the exhibits.

A Yeah. It would be 258 or so, amongst those that I submitted.

Q Oh, I see. Is it "Known Spawning Beaches"? No, let's see. Grain-size, A256.

A 256, okay.

Q That's the one I introduced.

A This is a summary of data collected from throughout the Puget Sound basin of surf smelt and sand lance spawn-bearing-substrate grain-size analyses, where we collected bulk samples. We screened the samples down through a set of Tyler screens to get an idea of just what the substrate is comprised of. And for sand lances, this is the graph (indicating). Down here is the tiny little representation of silt-sized particles in the spawning substrate. Most of the spawning substrate is made up of medium sand. And so that's -- this is from 70 samples collected throughout the

Puget Sound basin.

So that's an example of the fact that sand lance spawning substrates are silt-free, for the most part, in a natural condition.

Q Now, would you please review your concerns about the impacts of ingestion of forage-fish larva by the cultured animals in a geoduck farm. Basically, the planted geoducks.

A Yeah. It came -- actually, our knowledge and our concerns are evolving. When I first was called upon to contribute forage-fish information to this matter, I was not really aware of the fact that geoducks can ingest -- apparently can ingest zooplankton as well as phytoplankton. And I would posit that there is a likelihood that hatched sand lance larvae off this site or surf smelt's larvae from the area to the north or sand lance larvae from the areas to the south of the farm site would be exposed to ingestion by culturing geoducks during the course of the farm operation.

There's -- much about this is unknown. There's much about this that I would propose that should be included in an EIS. I would propose that -- and we have a set of exhibits, that perhaps weren't originally submitted, on the ingestion of zooplankton by -- by bivalves. We have it here somewhere.

Q Okay.

A That basically forms the basis of my concerns. Where it's possible, when sand lance eggs hatch out, the larva is 4 or 5 millimeters long. It is encumbered by a yolk sac. It has virtually no swimming ability, and it is basically drifting in the plankton.

Tide's in, the eggs hatch. There's been some suggestion that the larvae will go along the beach or somewhere besides where the geoducks are. It's my contention that, all other things being equal, the larvae will follow the ebb tide down-beach in the surface waters at first, and they will be in direct contact with the geoduck farms. Not just here, but every place in Puget Sound where spawning beaches are coincident with geoduck farms.

There's the matter of -- okay, larva ingests, so it can't buck the inbound current of a feeding geoduck, so it winds up down in the filtration system. Is it eaten? Is it digested by the clam, or is it somehow rejected alive?

The literature suggests that anything that's ingested that's not eaten, digested, is ejected by the bivalve in what they call pseudo feces, which is mucus-wrapped stuff that the clam, for some reason, rejected from ingesting into its alimentary canal.

I would submit that mucus-wrapped forage-fish larvae are dead. And so that's the -- that's the gist of my

concern, however new it might be.

I also had conceived of a lab experiment where you could get at this. There are geoduck hatcheries. There are domesticated geoducks in tanks that could be presented in some way with quasi-normal tank conditions. Larvae could be pipetted at them with circumstances whereby you could videograph the behavior of the larvae in the vicinity of the feeding geoduck, whether the -- larvae at various sizes even -- see whether it can get away, or if it's helpless.

And so it's not an insurmountable problem to answer these questions, but they are not -- they are not answered now.

Q So would you say -- we have to get two short questions.

A Okay.

Q One, would you say this is a probable and significant issue?

A Yes, I think it would be. Especially in the light of, once again, cumulative-impactwise, of the consistent -- or persistent rather, not consistent -- persistent report of the disappearance of forage fish in Totten Inlet.

I used to not give it much credence. I don't have data recently to know whether or not it's actually true. The last time I was in Totten Inlet was in 2009, searching for smelt eggs for a genetic study. The spawning

habitat -- the upper intertidal spawning habitat that the fishes have been know to use since the 1970s appears to be intact. So I don't know why else the surf smelt might be gone for so many years.

They're short-lived. They're -- they will have fluctuations in their relative abundance because they are short-lived fish. But to have them gone now where people have been saying they've been gone for 10 or 12 years, that's unusual, and so that should be studied.

Q Thank you.

A Okay.

Q Oh, I have this exhibit, "Ingestion of mezzo-zoic plankton by three species of bivalve," that you wanted to submit.

A There's actually three papers attached to it.

Q There's three papers to it?

A Yes.

Q Okay.

A I had them separate here, and I --

THE HEARING EXAMINER: Has the Applicant seen these, or is this part of your --

MR. PLAUCHÉ: Are those part of your exhibits?

MS. STOCK: Those are not part of the exhibit.

MS. HENDRICKS: No. These are not.

THE WITNESS: No.

MR. PLAUCHÉ: Do you have a copy?

THE WITNESS: So how to best handle --

Q Do you have a set?

A I have a set. Why it's not here, I don't know.

MS. HENDRICKS: You can have this one.

MR. PLAUCHÉ: Oh, good. It has your highlighting.

MS. HENDRICKS: That's right.

THE HEARING EXAMINER: Would you like to take a look at that and then make a determination later on whether you want to object to it?

MR. PLAUCHÉ: Yeah. That would be great. Thank you. I'm sorry. Yes, I'd like that opportunity.

THE HEARING EXAMINER: Okay. Do you have any further questions?

MS. HENDRICKS: No, I don't.

THE HEARING EXAMINER: Okay.

MR. PLAUCHÉ: I do.

THE HEARING EXAMINER: Well, I'll ask Ms. Guernsey first, though.

MS. GUERNSEY: No.

CROSS-EXAMINATION

BY MR. PLAUCHÉ:

Q Thank you for your time, Mr. Penttila. I certainly recognize your expertise on forage fish.

A Thank you.

Q Do you have your report that was submitted end of January up there with you?
A I do.
Q So if you can just pull that out. As I look through your report, you've listed a number of references that you looked at. And down on Page 4 -- I'll let you get there.
A Okay.
Q -- third from the bottom, you reference the U.S. Fish and Wildlife Service biological opinion for Nationwide Permit 48?
A Yes.
Q Did you also consider the National Marine Fisheries Service biological opinion for Nationwide 48?
A Yes. I was able to get ahold of both of those, and I read quickly through the other one and didn't see where it had many forage-fish references compared to this U.S. Fish and Wildlife bio-pinion.
Q The National Marine Fisheries Service biological opinion has two sections. One was an Endangered Species Act consultation. One was an Essential Fish Habitat consultation. Did you review both pieces of that?
A I'm afraid I can't recall.
Q Okay. Let me just go through just a couple of questions on your report and testimony now, specific to forage fish again. Given the distance of this site from documented

herring spawning areas, direct impact to herring spawning habitat can't be an issue for this project; is that correct?

A Correct.

Q Okay.

A Yeah. I believe there is a stipulation -- well, no. It's part of the Growers Code of Practice perhaps, that herring eggs will be left undisturbed until hatching on aquaculture structures if they are observed. But that is also a voluntary -- that is a voluntary Code of Practice.

Q Understood. And you've given some -- I'm sorry. I didn't mean to interrupt.

A No. But in terms of herring here, it is some distance from the -- from the nearest documented herring spawning ground, which I think is -- well, there's a tiny one in Lake Bay, up through Pitt Pass and north, on the west shore of Carr Inlet. There's a relatively new spawning ground known now in the Purdy Burley Lagoon area. And then there is a spawning -- a relatively new herring spawning ground known in Wollochet Bay. And I note those last two because it does illustrate that, although we are fairly certain we know where all the major herring spawning sites are in Puget Sound, it is not absolutely and for sure that the fish can't spawn here. But that would be hypothetical or speculative, to say that they spawn here.

During the course of acoustical trawl surveys in South Sound in the '70s and '80s, it was not unusual to find a body of ripening herring positioning themselves in Drayton Pass within a mile or two of this site. But we think that those fish eventually wound their way up through Dana Pass and Squaxin Pass and spawned in the Totten Inlet/Hammer's Inlet area.

Q Understood. So it's unlikely that they would spawn here, but, if they did, you reference this industry Code of Practice that requires identification of spawn and sort of avoidance of any disturbance of spawning herring?

A I guess that's the Code of Practice. I don't know of any instances where it has been followed.

Q But as I recall, you've given presentations--I think you testified to this--to shellfish growers--

A Yes.

Q --regarding identification of herring spawn and how to implement that avoidance practice; is that correct?

A Right. And the last -- the most specific one would be to Taylor Shellfish farm managers in about 2007 or so, where all of this -- the general forage-fish information was presented.

Q Okay. Thank you. And again, in light of the distance from herring hatching areas, you would not anticipate the young-of-year herring to be common at the farming site

either; is that correct?
A I stated that, I believe, in my report, but they are not absent, because the Dorn beach seines detected them.
Q Okay.
A And we don't know where those came from, but they are present in some small numbers, if I may.
Q But your report indicated that you would not anticipate those?
A No. It's strictly due to the physical number of water miles from the closest hatching ground.
Q Understood. And post young-of-year, the older herring -- they typically dwell primarily in deeper water?
A Yes. They are not the one-pluses. One-and-a-half-year-olds and larger are not -- are not nearshore-dwelling animals particularly. They do occur in the general area, but they are out where -- in the daytime, they are most likely to be found, say, in the 30 or 40 fathoms of water.
Q Much deeper than the --
A And then, at night, they rise up to 10 or 15 fathoms of water. They do a diurnal migration too. But they are probably not -- because of the shallow slope of the shoreline, are probably not going to be encountered.
Q Okay. Now, you've also noted that the macro algae that may form on the aquaculture gear here at the site could possibly provide suitable herring habitat for them --

spawning habitat?

A Well, potential, in that, probably, the species of algaes that the herring do use in their local spawning grounds, in the absence of eelgrass, would become established on the aquaculture structures.

But the herring use certain areas of Puget Sound. Once again, about 10 percent of the shoreline. I don't know why they have selected to spawn where they spawn, but they don't spawn everywhere that there's seaweed.

Q Understood. And if they spawned on macro algae at this site and the condition that we talked about, of identifying and avoiding any impact to herring spawn, would that spawning ultimately be a positive for herring, a negative, a wash, in your opinion?

A To find spawn deposition there, if it was regular, if it was every year, if it just so happened that the farm site was a previously undocumented herring spawning site that was used every year, like we have found up in Purdy and Wollochet, that would be important. Yes, it would be.

We endeavor -- we've talked mostly about surf smelt and sand lance through all this, but we also endeavor to protect every algae bed, every eelgrass bed in Puget Sound where herring eggs have ever been found. And so this would suddenly become a polygon on our habitat-protection charts.

And it's unlikely that just the farm would be used.

They would probably -- if there was -- hypothetically, if there was spawning there at all, they would be using a mile of shoreline in both directions. They would be using the shorelines over on Anderson Island. They would -- there's no herring spawning habitat that I know of, no herring spawning ground that I know of that is only five acres big.

Q Got it.

A They're bigger than that.

Q Understood. So let's move on to surf smelt. Now, you expressed concern about the potential ATV use impacting surf smelt habitat. That's only a concern if ATVs are actually used, right?

A Yeah. It turns out apparently, it's going to be a nonissue.

Q Okay. Thank you. Now, you've also expressed a concern about fish-gilling, I think you referred to, in anti-predator nets?

A And, apparently, wide-cast nets are a nonissue.

Q Okay. So again, nonissue?

A Yeah.

Q Now, sand lance. Moving on to sand lance. You talked a little bit about, I think it was 150 feet of vertical separation between --

A Not vertical, lateral.

Q Lateral. Thank you. Lateral separation between the farm

location and the sand lance spawning area. You would not argue that that buffering is not sufficient to protect the sand lance spawning areas, would you?

A No, if all of the things were equal. Unfortunately, the seaward edge of that particular buffer in this case is a silt-generating operation.

Q So the concern there is what you talked about in your direct testimony--

A Yeah.

Q --which was silt moving up the beach to spawning areas.

A Right. Right.

Q Generally, on forage fish or bait fish, is there a commercial fishery for those fish?

A The last commercial herring fishery in Puget Sound is for salmon support bait, a few hundred tons a year.

Q Okay.

A Surf smelt is targeted by a number of artisanal beach-seine fisheries for commercial purposes and active sport-dipping fisheries on spawning beaches scattered throughout Puget Sound, not here, that I know of. And sand lance fisheries were legislated out of existence in 1997.

Q Okay. So just surf smelt and herring still have a commercial fishery?

A Right.

Q In your opinion, do those commercial fisheries impact the

continued viability of those forage-fish species?
A No, probably not.
Q Why is that?
A The sport fisheries and commercial fisheries for surf smelt are taking place on the spawning beaches on a tiny, tiny percent of the 250 miles of spawning beaches in Puget Sound. So there's a vast de facto refuge of spawning habitat when the fisheries are not undertaken.

And the herring -- it is the opinion of the herring managers, which doesn't count me, that extraction of a few tons of pre-spawning herring from the tens and tens of thousands of tons of herring that occur in Puget Sound every year is not -- is not a burden to maintenance of herring stocks.

Q Thank you. Just a couple of questions about the site here in particular. What type of beach substrate is present here at the site?
A It varies. I know people refer to the beach as cobble here, and I wish I had a good picture amongst the exhibits that illustrates the zone of beach specifically used by spawning forage fish.

Because you can have a beach that is -- looks, to the layman, like a cobble beach; that is fist-sized rocks, you know. But if you have a band up at the top, up by the high-water mark, the uppermost few vertical feet of the

shoreline, like here, where the beach grades into coarse sand/fine gravel, even if it's just in patches along the shoreline, that is the sort of habitat that the forage fish -- or the smelt, sand lance seek out for spawn deposition.

So you can have most of the beach unsuitably coarse, but if you have, like this shoreline does -- and I looked on this, and it's too hard to see and try to describe. But there is a band of suitable substrate up at the high-water mark that, areawise, is probably a small minority of the total beach surface, up-beach of zero, say. But it is enough to attract these spawning fish.

Q And on this site, what would be the elevation that you'd see that spawning activity?

A It would be roughly from mean high water, whatever that is here -- it's probably, like, +12 or +13 or something like that, I suppose, down this far, compared to Seattle district, +11 1/2. And that would reach down to +6, +5, something like that.

It would depend on the conditions of the beach at the time of observation, but the upper third of the intertidal zone is -- for spawning habitat, is what we're interested in conserving.

Q And is that generally for Puget Sound, that sort of +6 to +12 or +13?

A Yeah. Well, out in the Straits of Juan De Fuca, of course,

the mean high water is about +8. So it would be, out in the Straits, a smaller tidal amplitude. You've got a thinner band. It's still the upper third.

Q Okay.

A And then, in Seattle, it's +11 or plus -- down about +6 or +5 for sand lance. The sand lances spawn a little lower on the beach than surf smelt do.

And then, if you get down to Olympia, you've got +13 to +7 or something like that. Very, very nicely nourished beaches down in the South Sound. But it's that upper third.

But in terms of tidal elevation, you'd have to take site-specific data, because it varies.

Q Now, you talked a bit about the impacts of shoreline armoring on forage-fish habitat.

A Yes.

Q To your understanding, does aquaculture activities, or shellfish farming activities, require any sort of shoreline armoring?

A Generally, I wouldn't think they would, unless they were building docks and things for -- for handling barges at high tide and stuff. There are some aquaculture sites down in South Sound that are heavily armored. But it was for erosion prevention and housing and that sort of thing.

Q So the armoring is not necessarily related to the shellfish

farming?
A No. Their activities extend landward only as far as they're able to grow their animals. And so they don't -- can't grow their animals all the way up under the trees.
Q Now, you expressed a concern about geoduck ingestion--
A Yes.
Q --of forage-fish larvae. The forage-fish larvae -- where in the water column would that larvae be? Is it sort of spread -- would it be spread uniformly throughout the water column? The upper part? The lower part?
A On a micro scale, that's not known. But the concern for aquaculture impacts would be that the hatching larvae at high tide are in a relatively thin layer, surface layer, of the water column that moves down-beach, across and through and amongst the tubes or the beds or the racks or whatever you've got. And if there isn't enough wind to stir things up, the larvae might be subjected to this ingestion potential through several tidal cycles before they get dispersed out away from the animals.
Q So the two concerns that you've really highlighted, I think, in your testimony were that -- were the ingestion of larva, and then the potential impacts of turbidity or sedimentation from the harvest getting up to the spawning habitat. Is that --
A Let's see. That, and the -- probably ancillary to those is

the modification or the impact of the farm arrays, structure arrays, on the behavior of the fish, pre-spawning and post-spawning.

Q The burrowing activity they do?

A The burrowing activity for sand lances, the roving activity for surf smelt, that sort of thing.

These are all things that are unknown right now, but they are knowable by doing better, more-detailed observations of the behavior of the fish in various degrees of farmed shoreline, I think.

MR. PLAUCHÉ: I have nothing further. Thank you, Mr. Penttila.

THE HEARING EXAMINER: Ms. Guernsey, do you have anything?

MS. GUERNSEY: No.

THE HEARING EXAMINER: Ms. Hendricks, do you have anything further?

MS. HENDRICKS: No.

THE HEARING EXAMINER: I just had one question.

THE WITNESS: Oh, okay.

THE HEARING EXAMINER: Just more of a curiosity.

VOIR DIRE EXAMINATION

BY THE HEARING EXAMINER:

Q As I understood your testimony, then, the larvae, once

they're, I guess you would say, hatched.

A Yes.

Q And you said they moved back and forth among the tubes and that they are subject to being ingested for two to three tidal cycles.

A Unless the -- unless the tide currents disperse them.

Q Earlier?

A Earlier than that. They eventually do wind up away from the arrays of animals. But they have to run that gauntlet for -- for some amount of time at a very helpless stage. They also get big enough, one would presume, that, in a couple, three weeks, the yoke sac is absorbed. They get to be an inch long or so, and perhaps they have -- perhaps they have enough swimming ability to escape such impacts.

Q Do you have any idea what percentage of the larvae that geoducks might ingest --

A No, I don't. This is a matter of field observations and lab study and stuff perspective.

THE HEARING EXAMINER: Thank you, sir.

(Herein concludes the first excerpted portion of the transcript and begins the second excerpted portion of the transcript.)

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CAPT. CHARLES MOORE, having been first duly sworn upon oath by the Hearing Examiner, testified as follows:

THE HEARING EXAMINER: I need you to pick up the microphone there. It has a battery pack, and there's a little clip on there. If you could clip that onto your tie or your jacket there, up close.

And then if you could state your name and address and spell your last name for us, please.

THE WITNESS: Charles Moore, M-o-o-r-e; 345 Bay Shore, two words, Avenue, Long Beach, California 90803.

THE HEARING EXAMINER: Ms. Hendricks.

MS. HENDRICKS: Captain Moore, because of not much time left for our side to present our case, I'm not going to go through your long list of accomplishments, but we do want to introduce you as a witness, that he is a world-renowned plastic-debris expert. His resumé shows that, and it's in the exhibits. And we're asking him to comment specifically on the debris that he sees that comes off a geoduck farm. And then he also has general comments.

THE WITNESS: Okay. So I guess it's ad lib, is it?

MS. HENDRICKS: It's ad lib.

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NARRATIVE TESTIMONY

THE WITNESS: Okay. Well, this is my first time seeing the -- I guess, the collected debris that is supposed to have come from one of the geoduck aquaculture installations. Is that what I'm looking at here?

THE HEARING EXAMINER: You should have been here yesterday.

MS. HENDRICKS: Yeah. We had quite a pile.

THE WITNESS: Yeah. Well, the future looked bright at the dawn of the plastic age, and one of the principal reasons was that people thought the world would be a cleaner place with plastic.

In the early 1950s and late 1940s, the introduction of plastics was heralded as the dawn of a new age, and that certainly was the case. But the wished-for cleanliness has not come along with the use of plastics. Principally because of their low cost and ease of disposal, and, many times, improper disposal.

And sometimes this disposal is accidental. As a matter of fact, the law prohibiting dumping plastics at sea has an exclusion for accidental loss so that fishermen or container-ship operators who accidentally, in a storm or through an accident in their business, lose plastics are not penalized, so that we have a tremendous load of plastics

spilled accidentally at sea, and it doesn't even have to be reported.

And I'm sure that the aquaculture operators don't intend to lose this material to the marine environment in their operations. It's a cost to them. And we've documented losses from the plastic industry of the basic plastic resin feedstock, the plastic pellets, of, in the case of PVC, the plastic resin powder that is lost accidentally in very large quantities; surprisingly, about 10 percent of the plastics we find in the ocean, no previous use by a consumer. They were simply accidentally discharged at plastic converters' and processors' plants by careless unloading of railcars and trucks.

So what we're seeing here, I don't believe is an intentional problem for the marine environment, created on purpose by the operators of these farms. Nevertheless, the consequences of accidental loss are extremely large and need to be addressed by the plastics industry and by those who use plastics, because plastics in the marine environment have been found to cause a myriad of problems, principally in terms of large pieces of plastic.

We're looking at what we call entanglement and ingestion. Entanglement and ingestion are the two major deleterious consequences of the loss of plastics to the marine environment. And the trophic level, meaning the

place in the marine food web, in which plastics affect the marine creatures appears to have no lower limit or upper limit. There's no particular niche in which plastics only affect a certain biota.

The first generation of plastics in the marine environment in the 1950s has gone nano and has now degraded to the point where there are individual molecules of plastic. But because the plastic polymer is so large--many thousands of monomer plastic parts link together to make the polymer--the individual plastic molecule has to undergo further degradation in the marine environment before it can return to its basic constituents of carbon dioxide and hydrogen and oxygen and a few minerals.

So the persistence of plastics in the environment is a big issue, and the fact that it can start at the nano scale and go all the way to the great whales, causing death through entanglement and, now, increasingly death through ingestion.

As we saw in the gray whale, which is a mysticeti whale, meaning that it feeds by filtering seawater and sediments through its baleen, we really didn't expect to see this kind of problem. Yet, the whale that washed up on a West Seattle beach last year had golf balls; heavier-than-water plastics; clothing, which is PET, polyethylene theraphthalic, which is heavier than water. It had jogging trousers in its stomach.

It had surgical gloves. These kinds of plastics that are heavier than water are both in these bags and there are floating plastics in these bags.

The zip ties are polyethylene and, many times, they can float. The nets -- they look to be possibly polyethylene. They can float. I don't know if they're nylon. Nylon would sink. Polyvinyl chloride would sink. The PCV would sink. I'm not sure about other plastics that might be used that are biopolymers.

We haven't done a lot of work with those. We're currently working with the marine degradables. But no matter whether the plastic is designed to degrade in the marine environment or persist in the marine environment, it goes through a stage in which it becomes an entanglement or an ingestion hazard.

So those are the two key points, that it persists, it can entangle creatures and kill them in that way. And the figures are in dispute as to how many thousands are dying each year because of it. But I make the case that the plastic footprint, quote, unquote, is killing more marine creatures right now than the so-called carbon footprint.

When we look at, say for instance, polar bears dying from a lack of habitat, I believe that the deleterious consequences of plastic in the marine environment are greater, killing more marine animals, than habitat loss and

climate change. So it's a serious issue.

And in addition to entanglement and ingestion, there is the further hazard of transport of toxic chemicals. And perhaps this is one of the more-serious ones in the current situation, because of the tidal flux and the fact that many pollutants are located at what's known as the sea-surface microlayer, which is the very thin layer on the surface of the ocean where atmospheric pollutants condense and where the lighter-than-water contaminants, oily contaminants, things like pesticides and herbicides float.

Those are preferentially attracted to plastics. Plastics have two mechanisms by which they take in pollutants from the marine environment. One is known as absorption, with a "B," and the other is adsorption, with a "D."

And those two mechanisms -- one -- the polymer, being such a long chain, is organized in a kind of a crystalline structure which has spaces between it. So to absorb into the crystalline structure, a good deal of pollutants get into it that way. But also because it has these holes in its surface, because the polymer chains are open and porous -- they have kind of holes where pollutants, at the microscopic level, adhere, so they absorb to the surface very readily.

So as the tide rises and falls and exposes the plastic,

especially even more so than the tubes themselves, the nets and the zip ties will absorb even greater amounts of these pollutants from the sea-surface microlayer and then are capable, when they get away, as they have here, and begin to break down, desorbing into whatever eats them.

And the examples, as I say, of plastics being ingested by sea creatures mount. Every week, new papers come out. I just read a paper on marine catfish, who live on the bottom, being consumers of the nylon nets that the fishermen use to try to catch them. The particles of nylon that break off the nets were consumed by the marine catfish.

So it's not simply that it blocks their intestines and doesn't provide nutrients and it's not digestible. It's also this transport mechanism for pollutants.

Now, some might say that we don't need to worry about your gray whales or your dolphins, because they could pass pieces of plastic. But you see this hag's hair of debris here. It -- it's mixed together. It's got a lot of different components. So what you end up getting--and we see this in the marine environment constantly--is knitting that the ocean is capable of doing. The currents, the roiling.

I mean, you all experienced the tsunami recently, and you certainly saw pictures of that roiling, churning water. That's just a macroscale of something that's happening all

the time, and these plastics are being woven together into these boluses.

And the sperm whales that recently washed up dead along the North Pacific coast had these boluses of varieties of debris working inside the stomach, and it pierced the paritoneum into -- through the stomach wall, and the whale died as a result of that.

So we can't simply say that the individual particle of plastic or the individual tube or the individual piece of plastic could pass through the digestive tract, because it's more than likely going to be enmeshed in a mass of debris that has been collecting on the bottom or in the mid water or on the surface, depending on the creature and the situation in which they feed.

So let's see. Was there anything else I wanted to touch on?

The PCV itself has organotins. 90 percent of tin stabilizers are used in rigid PVC. And these organotins in PVC affect the immune function in the endocrine system. So what's going on is a kind of a sandblasting at a snail's pace, is what's going on with this material.

And I'm sure it's a pain for the folks that are trying to raise the clams, because it erodes the pipes, and they have to be replaced. And if they go to a marine degradable pipe, that will happen even faster.

And this erosion, this slow sandblasting that's being carried on in this marine environment is creating these nano particles right away. It's bringing nano particles into the marine environment, into the sediments, into the benthos, into the habitat of the creatures that live in the mud. So I would be very interested to see if some organotins perhaps aren't being ingested by the aquacultured species. That may be a problem.

But in any case, even if these nano particles are carried away by the currents, they're still going to be affecting animals living upstream or downstream.

I'm not an expert on littoral processes and coastal sediments. I'm sure that's been addressed by others. But when you're setting up these arrays, you're going to change the habitat. And plastic is certainly a problem, and the fact that, you know, unintentionally -- you certainly don't want to ascribe any mal intent to the operators. It's not in their economic interest or their political interest to have that happen.

But as a sea captain, I can just tell you, it's so hard. The marine environment is so difficult to preserve any particular static structure that you're going to have these losses. It's just not possible to create bridges -- I mean, look at what just happened. Look at the tsunami. I mean, people build to last. And certainly, Japanese are excellent

carpenters and excellent builders, and it was as if they were just seaweed on the beach. It just lifted everything and moved it around in an incredible way.

So certainly, we're going to have these losses. I know that a yeoman's effort will probably be produced to try to stop them. But it's just too hard to stop the contamination of the marine environment with plastic. And it's happening on such a large scale that the problem has exploded in the introduction of a globalized economy; which, I actually have called plastic "the lubricant of globalization," since you can have the cheap labor market in a faraway country wrap its product and have it arrive in a pristine condition in the citadel of consumption. And then it instantly becomes fast-track trash. Once you unwrap it, then it becomes waste and it becomes useless.

So that's not the point here. But the point is, we don't need to add to this burgeoning burden of plastics on the marine environment. That's why, every week, we're seeing two new papers written on this. When I first got into this field 15 years ago, there were virtually no papers being written on this issue. And now we're seeing them exploding because of the deleterious consequences of plastics in the marine environment.

So I guess I can stop there.

THE HEARING EXAMINER: Do you have any questions

for Captain Moore?

DIRECT EXAMINATION

BY MS. HENDRICKS:

Q First question is: As you're aware, in this case, we -- in order to get an EIS, we need to show proof of probable significant impact on different issues.

Do you feel there's a probable significant impact to aquatic life of -- probably significant impacts to aquatic life by this operation -- or these operations?

A Well, it's not as if nature has evolved in the presence of plastics or plastic-like objects to be able to discriminate between plastic and natural food. In our study, we found 35 percent of the fish we caught to have ingested plastic. It just mimics the texture and the color and the behavior of natural food.

And then, on top of that, it is a host for epibions, for organisms that settle onto the plastic and begin to grow. So it does begin to have a coating of food. And that is a strategy that some birds and fish and mammals use to get food, is to eat things that are coated with life. And so plastic becomes one of those things.

So not only is it significant, it's adding to a burden that is so excessive that it's become a worldwide problem. We just sponsored an international youth summit. In fact,

just yesterday, I sailed the Guam team from our hotel in front of the Queen Mary at the mouth of the L.A. river over to my dock. And we had kids from Kenya that were complaining about the plastics getting into the wildlife preserves; were going to build hedges around it because it's getting in there.

It's just become this plague on the planet, and kids around the world are now having to deal with it. They're concerned. They're concerned. We had 100 kids from 12 countries come to brainstorm ways to deal with plastic pollution. This is plastic pollution (indicating).

And it is significant, and it is harming wildlife. And if we're going to wait till we see species crash and go into a decline which we can't arrest, we'll have waited too long.

Q Do you feel like this project will add to that plastic burden?

A There is no question in my mind, when I see this (indicating), that it will. And as I mentioned, it goes from the nano scale to the stuff that you can see. None of these samples, I imagine, you're bringing here show the thinner wall of this tube. What happened to that material? The wall of the tube becomes thinner with time. Where does that material go? Who is sampling that?

MS. HENDRICKS: We don't have any other questions

at this point.

THE HEARING EXAMINER: Ms. Guernsey?

MS. GUERNSEY: Nothing.

THE HEARING EXAMINER: Mr. Plauché, Ms. Kisielius?

CROSS-EXAMINATION

BY MS. KISIELIUS:

Q Good afternoon, Captain Moore.

A Good afternoon.

Q My name is Laura Kisielius and -- is this on?

A I can hear you great.

MS. KISIELIUS: Can they hear? Unfortunately, they have to hear me.

THE WITNESS: Okay.

THE CLERK: I think I do.

Q Okay. My name is Laura Kisielius.

THE CLERK: Is it on?

THE HEARING EXAMINER: It doesn't sound like it's on.

(Pause in proceeding to address sound system.)

Q Good afternoon again, Captain Moore. My name is Laura Kisielius. I'm one of the attorneys representing Longbranch Shellfish, who is the project proponent in this hearing. I just have a few questions for you.

A Sure.
Q Can you tell us briefly about your experience in the field of toxicology?
A Experience in the field of toxicology. Well, I'm the coauthor of a paper on the accumulation of persistent organic pollutants in plastics found in the North Pacific central gyre, along the Southern California coast, and, actually, in rail yards where the plastic pellets are discharged into the factories that process them.

So I worked with the University of the Pacific, in Stockton, at their Chemistry Department, with the head of the Chemistry Department, Patrick Jones, and his Ph.D. post-doc. Her name is Lorraina Vios Del Rio. She was a student that came on my boat out of the autonomous University of Baja California. That's another one. We were doing studies on the whale lagoons in Baja California. And with her, we have produced a couple of papers on the persistent organic pollutants in plastics.

Now, that is not, per se, toxicology. I'm not an expert in the human or animal effects of pollutants in plastic. But I do read, extensively, the literature on it, and there is mounting evidence -- for instance, there's a study in shearwaters that looked at feeding them plastic pellets from Tokyo Bay, and it was found that the specific conjoiners of the PCBs that are coming from the plastic

were transferred from those pellets to the birds.

So there's mounting evidence that we can link the desorption -- I mentioned absorption and adsorption. We can also link the desorption of these contaminants to the eating of them by sea birds. So that is a paper I'm familiar with.

But in terms of being a toxicologist, certainly, no, I'm not, in any sense, a toxicologist.

THE CLERK: Okay. Now your battery is out.

THE HEARING EXAMINER: Yeah, I think we're going to have to take a break here to change batteries here.

(Recess taken from 3:36 p.m. to 3:42 p.m.)

THE HEARING EXAMINER: We will go ahead and reconvene the hearing, then. Ms. Kisielius, do you want to go ahead?

MS. KISIELIUS: Okay. This is on now, right?

CROSS-EXAMINATION - (continuing)

BY MS. KISIELIUS:

Q Okay. Captain Moore, is it fair to say that your primary research focus is on ocean surface debris?

A It's fair to say that that's what I publish most on. However, we have done some work on the benthos. And our interest lies in heavier-than-water plastics, since, based on resin production in the United States, only 46 percent

of plastic resins will float. So it's just that they will probably be closer to shore and coming out the river mouths, get mixed into the sediment.

But in this case here, where you have a significantly heavier-than-water plastic in the polyvinyl chloride, and in the fact that, in our research, we found rail yards of factories that make the PVC pipe that were losing a lot of PVC pellets to the environment, we'd really like -- one of our research goals is to survey marine canyons in the nearshore environment for heavier-than-water plastics.

But yes, I'm certainly published more on buoyant plastics than on heavier-than-water plastics.

Q Okay. And you referenced a study that you performed regarding fish ingestion.

A Yes, ma'am.

Q Where did you collect those fish specimens?

A Those fish were all from what we call the North Pacific central gyre. They were myctophids, principally lantern fish, although one of the major species was a californicus, which is very common in California waters. So these myctophids are -- wherever there's deep water, there is these myctophids. And one of the species does live in California. But we did not collect California myctophids for the study.

Q And the North Pacific gyre you mentioned -- how many miles

offshore is that, approximately?
A Just -- you know, it kind of depends. Since our coast runs not directly north and south, but really southeast. So it's really closer to you guys than it is to me, you know. But it's about half -- just to give you an idea, it's about halfway between San Francisco and Hawaii.
Q Okay. Can you tell us what issue the Appellant asked you to analyze with regards to this case?
A Well, I was given the documentation of the proposal and the appeal -- you know, was to focus on that proposal. So I read through the proposal to put in the aquaculture operation, learned a lot about the clams; fascinated by the clams because, actually, I found a pirate fishing operation doing geoduck clams in Baja California, Mexico, halfway down the peninsula, in deep water, with scuba gear.

So they are a widely distributed clam along the Pacific Coast, and it's quite interesting to learn about the aquaculture operation. So I had been interested in the clams before, but I don't purport to be an expert in that industry or the aquaculture industry. I just have just a smattering of experience with it.
Q Okay. And your conclusion regarding the significance of the marine debris -- is that related to a cumulative effect of marine debris from all aquaculture fisheries?
A Well, I think we can be both very microscopic in our

analysis and very big-picture on our analysis, because the two are intertwined. Plastic is very, quote, unquote, pelagic, you know; especially the lighter plastics.

But even the benthos -- I was in a conference at the European Commission in Brussels, a workshop on plastic marine debris, and I was with the equivalent of our NOAA -- the French equivalent of our NOAA scientists, who showed a video of the Mediterranean. And the heavier-than-water plastics and PET water bottles had migrated and clumped in kind of a pile in the middle of the Mediterranean.

So these roly-poly things, like these tubes and the water bottles, are capable of enormous migration on the bottom, even though they're heavier than water.

Q Okay. And have you had an opportunity, or have you quantified the amount of marine debris that may possibly escape from the proposed farm?

A No. I don't even know how many actual tubes will be used. I think -- is it one per square foot, approximately?

Q That's approximately correct.

A Yeah. One per square foot, so -- and then, I mean, it's a simple multiplication factor, but I'm sure it's in the thousands. So I mean, there's quite a few. And then -- well, I believe -- let's see. There was 3,000 rubber bands collected from an area near two of the operations that had maybe 10 times that many tubes, was it? Something like 10

percent of the tubes had lost a rubber band, if you accept that the rubber bands were from the closest operation and didn't come from far away.

So a 10-percent loss. And even though -- now, you know, you may think: Well, rubber, at least being a natural polymer, will degrade faster and not have as many deleterious consequences. But really, with balloons, we're finding a lot of problems. And I would assume that rubber bands would have some of the same problems as balloons. Just -- they just don't digest, you know, when they're taken in. So they become part of this bolus that becomes something that can catch other things and impact the species.

But yeah. I'm certain -- don't purport -- I'm responding to the material that I read, but I have no background in the industry itself and don't purport to be an expert in how it's run and, you know, the way it's managed.

Q Okay. And I guess, by the same token, have you thought about, or have you quantified, the amount of micro plastics that might escape the farm from the use of PVC?

A I'd be very -- well, to do that, I'd need to get the weight of the tube when it was installed and the weight of the tube when it was removed, and then we could get an idea of how much. But I don't know -- I didn't see any studies, in

the literature, of that figure, that would give me what I would need. Because, first of all, we'd have to remove the epibions to know -- the sessile organisms that had recruited to the plastic would have to be removed to get a good weight on how much plastic had eroded away. So you'd have to clean the plastic.

I mean, you know, it's not something someone is going to do as part of the disposal process unless it's actually being recycled. And I just read a paper on PVC in "The Philosophical Transactions of the Royal Society" that stated that zero PVC was recycled in the United States.

Q And my last question. You weren't able to be here for other testimony, but there was a Proposed Condition of Approval on this project that would require the project proponent to patrol the beach for a half a mile in either direction of the farm once a week and then the day after a severe storm event.

A Hmm.

Q Would that help, in your mind, mitigate any potential impact that escaped marine debris might have?

A Yeah. But helping mitigate an impact is not the same as preventing an impact. You know, I don't impugn the motives of the farmers and the aquaculturists, you know. We've got to find good ways to do aquaculture to feed -- if we're going to have seafood in the future, because we're

decimating wild stocks. Sylvia Earle says, you know, "No one" -- you know, there's no naturalist to propose that we get our meat by hunting anymore. You know, this is not the way we get our meat. And we're not going to be getting our fish by fishing, in the not-too-distant future.

So we've got to find clean, safe ways to do these operations. And we've got to develop better methods. But the fact that you go and retrieve as many as you can of those lost items after they've been lost to the ocean -- really, the percentages are not going to be high, of what you're able to recover, unfortunately.

I just don't see it being the answer to the problem. I agree that it shows goodwill and that the operators are making a valiant effort, but they're just not going to be able to get enough of it to prevent an impact to the marine biota that are going to be exposed to the ones they miss.

MS. KISIELIUS: Thank you very much.

THE HEARING EXAMINER: Ms. Guernsey, do you have anything?

MS. GUERNSEY: Nothing.

THE HEARING EXAMINER: Ms. Hendricks?

MS. HENDRICKS: No.

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VOIR DIRE EXAMINATION

BY THE HEARING EXAMINER:

Q I just had one question, Captain Moore, and that is: How long does it take some of the plastics here to, I guess I would say, decompose in the ocean, that type of thing?

A Well, it depends on the depth at which the decomposition takes place. There is a scientist from Woods Hole that put bread and paper down on the bottom of the deep ocean, and no decomposition. So at the bottom of the deep ocean, it's a forever material, okay?

Then there are kids that do science-fair experiments that find bacteria that live to eat polyethylene, and maybe they get 2 percent a year in soil, you know, going away.

Now, the ocean environment is a lot colder than an active soil or a compost pile and, typically, it takes a lot longer in the marine environment to degrade. Now, the PVC, the zip ties, and the nets are -- if they're submerged or floating near the surface, are probably at least a century, if not more, to fully degrade.

We had an albatross that was found with a stomach with a fragment of a jet -- or not -- I guess it would have been a jet. But anyway, an airplane from World War II, a 60-year-old piece of plastic it had picked up, floating in the ocean. And that's the oldest recorded piece of plastic floating in the ocean that has been documented, was about

60 years old. And it still had the numbers on it so that it could be traced to the actual airplane that it came from.

So it's a cold environment. It's not full of insects. Only one insect, and that's a water strider that we see out in the ocean. Very little fungi. So it's just kind of a dispersed bacterial environment.

And to get the kind of degradation you see on land, to where it will meet a standard -- there is a proposed marine degradability standard, and we're working with the Army to test the plastics that claim to be marine degradable now. In fact, just yesterday, in our lab, I got a call from our lab tech, frantically trying to get ahold of the head laboratory scientist, because it was her turn to measure the degradation of the plastic, and she wanted to make sure she was doing it right.

So we're, right now, involved in trying to find plastics that will degrade. But for all practical purposes, when you've got this cold environment with sparse microbial life, you're not going to get degradation comparable to that on land. And in the case of plastic polymers, as I said, even once you get it down to the individual plastic polymer, you've still got to degrade that further to get it gone.

So even that stuff that's mixing in with the sand --

we're getting plastic sand now on the beaches, and the plastic in the water column that we pull out in our nets likely has -- some of it has likely been there since the dawn of the plastic age.

And the stuff that's gone nano -- we haven't even gotten the papers written on that yet. People are starting -- Dr. Androtti, an expert on the breakdown of plastics in the marine environment, is starting to try to find nano plastics in the marine environment. But it's not a piece of cake to find these tiny, tiny, little pieces of plastic out in the big ocean.

But yeah. You can have all kind of guesses, but they're all guesses. I've seen environmental groups bringing placards to Earth Day events, where they give the number of years for each kind of plastic to break down. That has absolutely no scientific basis. It's all guesswork.

And it can -- we have documented 60 years, but, you know, to fully degrade and, after it goes nano, to break down into the molecules that made it in the first place could take centuries and, in the deep oceans, certainly, millennia.

Q As part of your research, do you investigate alternatives to plastics that are going to be used in either the ocean or close to it or wherever?

A Not -- we are not investigating alternatives to plastics; we're investigating alternative plastics. We're investigating new biopolymers that are made by fermentation of corn sugars that are created as the batch, you might say, is brought up to a large number of organisms. It's then put under stress by withdrawing certain nutrients, and the organisms sequester this plastic as a response to stress.

And plants do it, and bacteria do it. And then they harvest this stress-created compound. In the case of a marine degradable, it's called polyhydroxyalkonoate, and PHA is what we're testing now, that may have a marine application.

So we're testing alternative plastics. You know, whether they could do this, whether it would be economical, with stainless steel tubes or aluminum tubes, or whether it would be economical with glass tubes, you know, I have no idea. I think it would be an economic decision, though. It would certainly mitigate some of the environmental effects.

THE HEARING EXAMINER: Thank you, sir. Anyone else have anything further?

MR. PUDDICOMBE: No questions.

THE HEARING EXAMINER: Thank you very much, Captain Moore.

(Herein concludes the excerpted portions of the transcript.)

CERTIFICATE

STATE OF WASHINGTON)
)
COUNTY OF KING)

I, LINDA M. GROTEFENDT, a Certified Shorthand Reporter and Notary Public in and for King County, Washington, do hereby certify that I reported in machine shorthand the above hearing; that the foregoing transcript was prepared under my personal supervision and constitutes a true record of the above hearing.

I further certify that I am not an attorney or counsel of any parties, nor a relative or employee of any attorney or counsel connected with the action, nor financially interested in the action.

WITNESS my hand and seal in Renton, County of King, State of Washington, this 30th day of March, 2011.

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Notary public in and for the State of Washington, residing at Renton.

My commission expires 1-2-2012.