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Chair

Mr. Rodney Weston

Standing Committee on Fisheries and Oceans

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● (1535)

[*English*]

The Chair (Mr. Rodney Weston (Saint John, CPC)): I call this meeting to order.

Before we begin, I have an item of business I would like to bring to the committee's attention. It's been brought to my attention that today is quite possibly the last official day we will have Claudia with us as our interpreter. Claudia is about to retire, and my understanding is that this could be her last day. However, we could be blessed with Claudia's presence in the future. She tells me she's going to come back on a part-time basis down the road, so we could potentially be seeing Claudia.

On behalf of the committee, Claudia, I want to say thank you very much for the years of service you've given to this committee. Quite frankly, when I came here I was told that you're an institution with the committee. Certainly you make no bones about it, and you let me know that.

Ladies and gentlemen, committee members, let's show Claudia our heartfelt thanks.

Some hon. members: Hear, hear!

The Chair: Now, Claudia, I'll put my earpiece in if you want to say anything.

[*Translation*]

Mr. Bryan Hayes (Sault Ste. Marie, CPC): In French, please.

Voices: Oh, oh!

[*English*]

The Chair: Thank you, Claudia.

Committee members, we have with us today two witnesses: Monsieur Ricciardi and Mr. Johnson.

Thank you very much for taking the time out of your busy schedules to appear before the committee today. Certainly committee members look forward to your presentations and the opportunity to ask questions of you with respect to the study we've undertaken on invasive species.

Dr. Ricciardi, please proceed. I believe the clerks informed you that we generally allow about ten minutes for opening presentations, and then we'll move into questions and answers. If I cut you off, I apologize in advance. Members are constrained by timeframes in the interest of fairness, and certainly I make every attempt not to cut off our witnesses. Sometimes our members will be long-winded, and I appreciate your cooperation in advance.

Professor, if you'd like to proceed at this point, please do.

Dr. Anthony Ricciardi (Associate Professor, McGill University, As an Individual): Thank you.

My name is Anthony Ricciardi. I'm a professor of biology at McGill University. I've studied invasive species for 20 years. My research examines the impacts of invasions in aquatic environments.

There are a few important points I'd like to bring to your attention.

The first point is that there is indisputable evidence that invasions are increasing in frequency worldwide, particularly in large aquatic systems like the Great Lakes. The invasion history of the Great Lakes spans two centuries and shows an increasing number of non-indigenous species being discovered over time.

Since the opening of the St. Lawrence Seaway in 1959, one new invader has been discovered every seven months, on average. This rate is higher than those reported for any other freshwater system for which we have long-term data.

There are at least 187 non-indigenous species that have become established in the Great Lakes since the late 19th century. These include plants, fish, invertebrates, and various kinds of microbes, including pathogens.

One hundred and eighty-seven species is a conservative number because there had to have been invasions that went unnoticed. Furthermore, there are at least 20 additional species in the Great Lakes whose origins are uncertain. We don't know if they're native or non-indigenous.

So we have very likely underestimated the degree to which the system has been invaded, but I can say that it is very likely the most highly invaded freshwater system on the planet.

Another interesting observation is that, as far as we know, every one of those 187 species is still present in the Great Lakes. To my knowledge, not a single non-indigenous species ever established in the Great Lakes has gone extinct or has been eradicated. So what we're seeing in the system is an increasing accumulation of invaders and their impacts over time.

I also want to emphasize that the impacts of the vast majority of these invaders have not been studied. Consequently, we have a poor understanding of how most of them have affected fisheries or water quality. Without this information, we cannot conclude with any certainty that most of these invasions have been benign.

We do know that at least some of these species have had strong impacts on fish communities. In fact, nearly one out of every five invaders that have been discovered over the past 50 years has had significant negative effects on native species populations in the Great Lakes. These include several parasites and disease pathogens that have been found just within the past two decades, such as—you may have heard of some of these—the largemouth bass virus, muskie pox, and VHS, or viral hemorrhagic septicemia. VHS has caused local mass mortalities in fish populations throughout the Great Lakes—except for perhaps Lake Superior—at various times since 2003, when the virus was first detected.

It's not clear whether this recent increase in the discovery of diseases is the result of scientists being better able to detect these organisms, or whether it is a real trend that reflects some increasing vulnerability in the Great Lakes to disease outbreaks.

Several vectors are responsible for delivering non-indigenous species to the Great Lakes. The most important one historically has been ballast water release from overseas shipping. The discharge of ballast water is assumed to be responsible for 60% of the invaders discovered since 1959. These include some of the most disruptive species ever introduced to Canada, such as the spiny water flea, the zebra mussel, the quagga mussel, the round goby, and several others.

In 2006 Canada took an important step in controlling this vector by requiring all ballast water entering the Great Lakes to be at a salinity of 30 parts per thousand—in other words, near the concentration of sea water. This was adopted as a harmonized regulation by the St. Lawrence Seaway Authority—that is, by both countries—in 2008.

Over the past five years since the regulation went into effect, there have been no reported invasions attributable to overseas shipping. I think it is still too early to conclude that the ballast water problem has been solved, because some invasive species can remain hidden for several years before being discovered. However, I believe that the risk of invasion has been greatly reduced, and many of my colleagues share this opinion.

If the risk of ballast water has not been sufficiently reduced, then the Great Lakes remain vulnerable to several immediate invasion threats. There are several potentially harmful species that are currently invading Europe, and they have become abundant at ports from which the Great Lakes receive shipping traffic. One of these is an invertebrate predator known as the killer shrimp. You may have heard of it. It has received a lot of media attention overseas. I've done a risk assessment to identify and rank these species, so I am pretty familiar with what the risks are of the ones that are currently invading Europe.

● (1540)

Even if we have shut the door on invaders arriving in ballast water, a number of other doors remain open. I believe the most important one is commercial trade in live aquatic organisms. I'm referring to the importation and sale of live organisms used for ornamental ponds, as pets, for biological research and teaching in universities, and for human consumption.

A very large number of organisms are transported into Canada every year. I don't think most people appreciate how big that number is. For example, Dr. Nicholas Mandrak, at DFO, has found that over 2,000 species of fish were imported alive into Canada in a single year—in 2005. Most of these are freshwater fish. Very few, if any, of these species are regulated. In the Great Lakes, there are already 30 non-indigenous species that are assumed to have been introduced through the ornamental plant trade, the aquarium trade, or the bait industry. At least half of these species have had significant ecological impacts.

There are several imported species that have not yet invaded, as far as we know, that have been identified as being serious threats to invade and cause undesirable impacts. You have heard of one example, Asian carp, which actually consists of a few species, such as bighead carp, silver carp, and grass carp.

Most of the attention on Asian carp has been focused on the Chicago shipping canal as the potential pathway by which they can enter the Great Lakes from the Mississippi River basin. A more important vector may be live trade. Asian carp are being raised in fish farms in the southern United States and then transported into Canada to supply Asian food markets. Multiple times over the past few months, Canadian border security have stopped trucks from transporting thousands of pounds of live Asian carp across the border at Windsor, Ontario. I should point out that border security does not have a mandate to seize shipments of fish. They are merely cooperating with the Ontario government, which prohibits the possession of live Asian carp in the province.

At the federal level, live trade is completely unregulated as an invasive species problem. The Canadian Food Inspection Agency regulates several hundred aquatic animal species that are reported to carry diseases that pose significant economic or human health risks. Canada has no federal regulation that allows us to ban the importation of species based solely on whether they pose an invasion threat. We do not prohibit the importation of known invasive species. This is in sharp contrast with certain other nations, such as New Zealand and Australia, which have stringent biosecurity regulations based on risk assessments.

This brings me to my final point. The most cost-effective method of dealing with invasions is prevention, which requires early detection and rapid response. Unfortunately, there is no coordinated monitoring system in place to detect new invaders in the Great Lakes. There is no infrastructure for early detection and rapid response to an invasion threat. There is no federal policy to identify and regulate the relatively small percentage of incoming species that would likely be harmful to Canadian ecosystems. Until that situation changes, our natural resources will continue to be degraded by invasions.

That concludes my statement.

● (1545)

The Chair: Thank you, Professor.

We'll go to Professor Johnson.

Dr. Ladd Johnson (Professor, Department of Biology, Laval University, As an Individual): My name is Ladd Johnson. I'm a professor at Laval University, a member of Québec-Océan, and also —and I don't think Dr. Ricciardi mentioned this—a member of the Canadian Aquatic Invasive Species Network.

I'm capable of giving this in French, but I'm a little nervous and I think it would be better for everyone if I continued in English. My apologies to the francophone people here. I would be happy to handle questions in French, but I think for everyone's benefit I'll continue in English. I've also been in Chile for the last four months on sabbatical, so Spanish words are running through my head. I've also been travelling for the past two days to get here, not specifically to get to this meeting, but I'm a little bit fatigued from that as well.

After I learned Dr. Ricciardi was going to be presenting, I knew he would cover the details, the facts, and the trends very well for the Great Lakes, because that is really his speciality. I also have worked on invasive species for the past 20 years, but I would argue that this is my applied nature. I also work on fundamental aspects of ecology, and I work in marine systems on invasive species as well. So I decided, when learning Dr. Ricciardi would be here, that I would orient my presentation more towards conceptual things, particularly the role of uncertainty in our dealing with invasive species.

Dr. Ricciardi tells me I should speak more slowly. I will try to speak more slowly.

If I can go to the first slide, I would say everywhere in the process we have uncertainty. Often invasions are done in three phases. Where there is an introduction, we have a lot of uncertainty about the vectors, the types of vectors that are involved, and their activities. We've made great progress, but we still have a lot unknowns about that.

For the establishment, often the second phase of an invasion, there are new ideas emerging about propagule pressure, the number of propagules necessary to establish a population. But we are still learning a great deal about that and an effect, known as the Allee effect, requiring a certain critical number.

A long time ago I published a small piece about mussel myths and the “Noah fallacy”, which dealt with the idea that it would only take two zebra mussels to start a new population. I think we all know that's not true. The Noah fallacy was the idea of Noah's collection of pairs of animals. We know now that it takes a substantial number of propagules. We still do not know how many. It varies from species to species. Of course this is part of the science we're doing to investigate this.

Next, we would have ecological and economic impacts. Again, as Dr. Ricciardi mentioned, many of the species have not been well studied. We certainly know the best cases. There are many stories of that. They are very rarely quantified in terms of being able to compare for cost-benefit analyses.

Finally, I will talk about our actions. This is where I'm hoping to inspire you, because you people are the ones who will be taking action on this at a government level. These actions include assessing how good a job we're doing. Many times we do things that one would say are feel-good measures; we think they should do well, but then we never assess whether or not they've actually accomplished our goals. In monitoring, often our monitoring efforts are inadequate. We hope we can detect things, but we do not really have certainty in doing that. Finally, in our response, sometimes I believe we are afraid to make responses or take actions or decisions because we are not certain as to the outcome of those actions. I'll develop those a little later.

I will talk about government actions, because you are in the government, and we are here to help you make decisions. Of course we need to fund more research—that's what any good scientist would say in order to obtain more funds—but I would argue that we need to specialize those in the invasion process itself. Oftentimes we study the impacts, but we're not really looking at how they get here and how they become established. On cost versus benefits, as hard as it is sometimes to quantify ecological and economic impacts, we need to somehow obtain means of comparing things so we know what the costs of our actions are, and the costs of our inactions.

We need to turn our uncertainties into probabilities, because that's really what uncertainty is. It means that something might not happen. Probability is just a way of quantifying that.

● (1550)

Secondly, I mentioned participating in more research. That basically means funding government agencies to work more closely with government scientists. I think the network that Dr. Ricciardi and I are involved in is an excellent example of how cooperation between DFO scientists and university scientists has led to many good outcomes.

We need to also create a regulatory structure to prevent future things, much like the ballast water exchange program that's enforced rigorously, because oftentimes there is not proper enforcement after regulations are on the books. Dr. Ricciardi mentioned more monitoring so we can detect incipient populations and invasive species and react.

We need to have plans in place for responding so we can assess whether we should take actions, and what types of actions we should take—containment or eradication, or perhaps just control.

Finally, of course, we need to cooperate. The obvious one is Canadian versus American interests, but there are other stakeholders that need to be involved, such as the public, commercial enterprises, etc.

Just to give an idea of the costs and benefits, I made a little table here. I don't want to go into too much detail, but we need to start filling in some of these blanks. In proactive management, such as ballast water management, where we take no action there is no cost, but there are negative effects, if you don't mind me saying. We don't know if the probability is 100%, because maybe they'll never come. Maybe we'll be lucky and a species will never appear.

If we do take action it will cost us money, and we can quantify that, but we cannot quantify the benefits. That's again where we need more science in ecological economics. The probability is that we do not know, and perhaps our actions will not help.

On reactive things, once a species has become established, taking no action doesn't cost us anything, but there will be definite negative benefits. The probability of that is 100%. Action will take money, but the benefits will be positive in reducing the impact of invasive species. Again, we are not certain if those actions will actually accomplish what we hope for.

I'll give you one example here where we have made progress. A recent study showed the costs and benefits of doing prevention and control. It found that managers should take the risk of trying to prevent, because that will yield better economic benefits for society in the long term.

Risk assessment is important, and I want to mention a few things we need to give attention to for establishment. We need to identify the species that are likely to come; the regions from which they might come; the things that might bring them and the paths they might take; the places they might show up—often known as hot spots in our business; and the times they might show up—often windows of opportunity when things might become established. These are all part of refining our science.

I want to finish by talking a little about secondary dispersal, because I think it is the biggest problem facing our science. Preventing invasive species from becoming established initially is obviously a good idea. It's the best way to prevent problems, but what do we do after they come here?

The problem is that once secondary spread begins, human-mediated vectors can continue the spread, but natural ones can as well. This leads to a mentality of inevitability—that it's a lost cause and we have lost the war. I think this is a rather defeatist attitude, and the goal has to be slowing the invasion instead of stopping it.

Even if you think it's inevitable, slowing things down will accrue benefits over time. If it didn't accrue benefits over time people wouldn't be worried about the spread. People are always worried about the spread, so if we can slow down the spread we will accrue benefits over time.

I'll give you the case study on invasive tunicates in Prince Edward Island, where I am working. We have invasive tunicates located in just three or four bays in the east end. I'm sure all of the mussel farmers on the rest of the island would like them to stay in the east end. I think that is a manageable goal, and possible to achieve.

Finally, I think our goal is to predict invasions better and respond more rapidly. We need to accept uncertainty in more general terms and try to translate it into probability. We need to seek more data, but prioritize it toward the data that is more essential for decision-making. Taking action is an important element. We can't sit by and wait. We also have to accept that we will make mistakes.

Thank you very much.

● (1555)

The Chair: Thank you, Professor.

We'll move to questions at this point. We'll start with Mrs. Davidson.

Mrs. Patricia Davidson (Sarnia—Lambton, CPC): Thanks very much, Mr. Chair.

Thanks, gentlemen, for appearing before us this afternoon.

I'm sure you are well aware that we started this study because of concerns that were raised in the Great Lakes area and concerns we have about several invasive species, in particular the Asian carp. We are concerned about it coming up through the Mississippi system, through Chicago, and into the Great Lakes system.

We are certainly no strangers to invasive species in the Great Lakes. We have been dealing with them for a long time. But I think the Asian carp became an issue in my riding of Sarnia—Lambton because of the news we were hearing about it on the very drastic impacts that are being felt in the Mississippi basin, with the destruction it's doing there. With our sport fishing and commercial fishing in the Great Lakes, it has certainly brought home the dangers that it poses. That's one of the things we're looking at.

We know there has been a fair amount of collaboration and work on it between the Canadian and U.S. governments. We know that work is ongoing.

Dr. Ricciardi, I would like you to address the statement you made about prevention, early detection, and rapid response being our best defences. What do you see as the main things we need to do? If you would like to address the Asian carp issue to begin with, that would be fine.

Dr. Anthony Ricciardi: There are many facets to that.

As far as Asian carp are concerned, I identified a back door that has largely been ignored by the public—and I suppose maybe by some policy-makers too—in that we're worried about the Chicago shipping canal, and rightly so, because it is abundant in the upper Mississippi River. I say “it”, but we're talking about a couple of species here. They are abundant in the upper Mississippi River and probably have already passed that canal, but not in sufficient numbers to establish a population. Keep in mind that the presence of a couple of individuals in an area does not guarantee that you have a population.

For snakehead fish, which I'll talk about later—if anybody wants to hear about it—at least one has been found in Lake Michigan. This does not mean that it's established there. We have no reason to believe that it's established there.

Piranhas are found every year in the Great Lakes, or nearly so, and we know they're not established, or at least there's good reason to believe that they're not established. We haven't found any juveniles. But there are indications of something. There are indications that people are dumping fish there.

As far as Asian carp is concerned, its live trade, I believe, is equally as important at the present time, or nearly so, as that shipping canal with its electric barrier. The fact is that we have trucks bringing live carp into Canada through Windsor. The fact is that I can go into Montreal, and I know a place where I can go in and buy live bighead carp, Asian carp, and they'll encourage me to leave with it alive.

I did a little operation with my students down there to check out what was going on in a market, which will not be named, but we're watching it. If I'm willing to pay for it, I can buy Asian carp and I can go all the way to the port of Montreal and, if I feel like it, dump them there. So that is an issue.

And it's not just Asian carp. That's the one you hear about the most, but this vector I'm talking about, live trade.... Actually, there's a multitude of vectors that are associated with the commercial importation of live organisms for various reasons. In this case, we're talking about for the food markets. For the snakehead fish, it's not only for the food markets, but also maybe through the illegal pet trade.

If you want to stop these species, you have to start regulating the importation of organisms.

A recent study done in the United States—I talked about numbers of species coming in—said that in terms of actual numbers of individual animals coming in, 1.1 billion freshwater fish enter the United States every year. I'm assuming that we also get numbers that are rather high, maybe not as high as those numbers, but of course if they're in the States they could be moved around as well, into Canada. But we probably receive a huge number too. I'm just not aware of what it is.

That also bothers me—that I'm not aware of what it is for Canada. I'm not really aware of how many species are coming across our borders. I have estimates for certain situations, like the one that was provided to me by Nick Mandrak, who had to cobble together a lot of information to get that estimate. So we're not aware of the degree of the problem.

I'm saying that you have to control the vectors to control not only the current recognized threat, but also the ones that are unrecognized and that could come here in the future or are coming in now.

I had my undergraduate students in one class do a project to look at the effects of the aquarium trade and of the biological supply houses, those companies that send into Canada material for teaching or biological research. They looked at the organisms that would be acclimated to Canada, based on where they come from. They used a climate-matching model to figure out which ones could establish if they escaped in sufficient numbers. We found that 5% not only can establish, but can also cause harm, judging by what they've done elsewhere. Five percent of thousands of species coming in is a rough estimate. It could be off by a few percentage points. I just know that it's not one I like to live with.

So there's a lack of information of the degree of the threat, but we have enough to know that live trade in all its forms is one that we've ignored for far too long. It includes the species you're interested in, or the group of species called Asian carp, which includes the bighead carp, the one that's probably the most dangerous, and silver carp and a couple of others. Bighead carp was the one that I could buy in Montreal. I also know that in previous years you could buy it in Toronto and in Ottawa and in various other places.

Mrs. Patricia Davidson: Thank you.

Dr. Ladd Johnson: May I...?

Mrs. Patricia Davidson: Yes, absolutely.

● (1600)

Dr. Ladd Johnson: Just from a first principles point of view, that has to be the easiest thing to control. If you put in priorities, intentional releases for bio-control would be the easiest, because that often requires approval by the organizations involved.

The live trade where people are intentionally trying to bring them in would be the next step, and it's also a very easy thing to regulate.

Natural means, where they're actually swimming in through the Chicago sanitary and shipping canal, would be harder, and it gets harder.

You could make a list. I remember receiving in my first position with exotic species a list of potential vectors in terms of zebra mussels. There was a list of 25. That was rather daunting to see 25 possible means, but if you put them in order, you could see that there are probably a handful that were important for the secondary dispersal of zebra mussels.

Likewise, you can put these in order. I think Dr. Ricciardi is correct in identifying the live trade as a low-hanging fruit. It is a very easy one to stop very quickly.

● (1605)

The Chair: Thank you very much. Your time is up, Ms. Davidson.

Mr. Toone.

Mr. Philip Toone (Gaspésie—Îles-de-la-Madeleine, NDP): Thank you, Mr. Chair. Once again, I want to applaud your chairing capabilities.

The Chair: Thank you. Flattery will get you an extra thirty seconds.

Mr. Philip Toone: Thank you for coming. I find what you had to present just now truly quite interesting.

The study that we're having in the Great Lakes, and with your expertise as well in the St. Lawrence.... Considering where you're located, you probably have some experience on the St. Lawrence River Valley as well.

You've said, Mr. Ricciardi, that we have a difficult time with getting a grasp on just how many invasive species have entered into Canadian waters at this point. And you said we might be getting better at detecting them and that might be one of the reasons why we're detecting more. But I'm wondering to what extent the DFO is taking this seriously and actually actively seeking out invasive species. With all the cutbacks recently at the DFO, scientists are getting laid off at

[*Translation*]

at the Institut Maurice-Lamontagne in Mont-Joli,

[*English*]

and other scientists as well have received their pink slips or notices of dismissal. My concern is that we're going to become much worse at detecting invasive species because the scientists are simply not there to do the science.

So you're doing some of this work now. Your funding, I'm taking it, is largely provincial—

Dr. Anthony Ricciardi: My funding is NSERC. It's federal, largely, and other places as well.

Mr. Philip Toone: How much are you working in collaboration with DFO? How much information is coming from DFO, or had been coming from DFO in the past, and how much do you expect will be coming in the future?

Dr. Anthony Ricciardi: As Dr. Johnson has indicated, we happen to be part of an NSERC-funded research network called CAISN, the Canadian Aquatic Invasive Species Network, which consists of people from over 20 universities as well as government scientists at the provincial level, such as Ontario, and the federal level, DFO.

I've always been in close collaboration with at least a couple of DFO scientists. Nick Mandrak, in Burlington, and his colleague Becky Cudmore are probably the two most knowledgeable freshwater fisheries biologists in the country. The amount of work they're managing to do is incredible. They're the ones who got this diffuse data and put it together, through a very fatiguing process, and came up with this first-order estimate of how many fish are crossing our borders. They're the ones who have—I wonder if I'm allowed to say this—suggested to border security that they contact OMNR, Ontario Ministry of Natural Resources, when they see fish being shipped in. I don't think the level of commitment they have to this problem and the amount of work they're doing has been well appreciated.

They're the scientists I do know. I would like to have more Nick Mandraks and Becky Cudmores in the country, on the front lines, monitoring this. They run a risk assessment centre, which basically consists of them and some students, to provide risk assessment reports on what the threats are and how we should prioritize them. They and their colleagues have put together a model, for example, to show that the northern snakehead could adapt very well to the Canadian climate and could colonize it, given the opportunity, not only in the Great Lakes but all the way to the territories. We need this kind of work. We need this information.

I study impacts, and I use the St. Lawrence as my laboratory, so I'm very familiar with the St. Lawrence River. I also examine long-term trends, and I need the data they provide to do that. I put together a couple of papers that showed the rate of accumulation in the Great Lakes and related it to changes in dominant vectors over time. I also compared it to other parts of the world. I couldn't have done that without information from other scientists on the ground, which is in either unpublished reports, technical reports, such as the ones DFO does, or the literature. We can't synthesize unless we get the big picture, and thus complete an accurate risk assessment, without this information, without these people.

I think that's what you're alluding to. So yes, I do work with them very closely.

● (1610)

Mr. Philip Toone: Certainly one of the vectors, and I think probably the most important vector, is the shipping that's coming in from the St. Lawrence River Valley and coming in from the gulf and coming in from overseas.

We've already alluded to the fact that in 2007 Transport Canada changed the regulations regarding shipping and salinity requirements and that. How much monitoring is there of that? I'm especially interested in a comparison between the U.S. and Canada. Are we more vigilant, or are we less vigilant? Are we able to be as vigilant? Are there any differences between the enforcement of regulations in Canada and the U.S., or is there an absence of regulation in Canada versus the U.S.?

Dr. Anthony Ricciardi: I can't comment on that. I'm not aware of how much Transport Canada is monitoring. My impression is that they're taking this very seriously and are boarding many ships to test the ballast tanks for salinity.

Mr. Philip Toone: We have difficulty comparing American responses and Canadian responses, so right now we wouldn't be able to discuss that—is that right?

Dr. Anthony Ricciardi: My understanding is that they're working closely together through the St. Lawrence Seaway Authority. I can't comment on how efficient they are.

Mr. Philip Toone: Mr. Johnson, I know that in your presentation you said that increased cooperation was one of the things we should probably be looking at. Would you be able to comment on what's lacking? What cooperation would we be looking at here?

Dr. Ladd Johnson: The cooperation I think would be a model, and my knowledge of that is incomplete as well, as I have not worked on ballast water.

I do know there was some disjunct in the early days when some was optional and some was required and there were different standards, but I think it's been converged very well. I would look to that as a model for cooperation in this area.

I would argue that perhaps there has not been enough assessment. Again, we can say that we're doing the right thing, but unless we rigorously apply scientific standards to assess whether the result has been efficacious, do we have the result we're looking for? It's hard to judge that.

My bigger concern.... And it's a bit hard, because I've mostly been studying Great Lakes species that have been dispersing away from the Great Lakes into interior waters. What we have here as your principal concern at this moment is the opposite when they are coming from other watersheds into the Great Lakes. There you have many different points of entry, many state, provincial, and national jurisdictions. I'll use as a small case Lake Memphremagog in Quebec, which was very concerned about zebra mussels at one time. I believe the Vermont side wanted to install boat washing stations, a really rigorous approach to making sure there would be no chance they would come in that way. But then the Quebec side had nothing going on. So it seemed pretty futile. If you don't have that kind of coordination, it makes it a pretty futile effort.

Dr. Anthony Ricciardi: Starting with the effectiveness of ballast water exchange, the current guidelines applying to ships that we call NOBOB ships, those reporting no ballast on board, that regulation went into effect in 2006.

Those are the ones that were not subject to any previous regulation that was put into effect in the early 1990s. That was corrected by the amendment to the regulation in 2006, which became harmonized by both countries in the St. Lawrence Seaway Authority in 2008.

There have been a series of studies by DFO and members of my research network, CAISN, that have tested the effectiveness of that procedure and have found it very promising. That coupled with data that suggest there haven't been any reported invasions attributable to ballast water since that time give us reason to be optimistic.

● (1615)

The Chair: Thank you very much.

Mr. Sopuck, I don't believe he was talking to you when he said No Bob.

Mr. Robert Sopuck (Dauphin—Swan River—Marquette, CPC): I caught that. Those are ships I can't go on.

Dr. Ricciardi, you made the point that there are no federal regulations regulating the live trade in these species. Has anybody developed recommendations our committee could look at, the ideal recommendations that you would like to see in place that are both effective and within the jurisdiction of the federal government?

Dr. Anthony Ricciardi: The regulation would have to be based on solid risk assessment, as it is in the countries I named, which are well advanced in this, both in the science of risk assessment and the application and regulation. They are Australia and New Zealand, which have ministries or departments of biosecurity. They take this issue very seriously because they recognize it as a national security issue.

When you consider how much invasions cost the world, something like 5% of the GNP, that's a large tax on global economies. But they are aware of this, and they have strong political will among their public to do something about it, regardless of which government is in power.

I would look to them as a model. It has to be based on risk assessment. The regulation has to be coupled with a scientific assessment of the threat, which changes over time.

The people to talk to about this are the people I mentioned, Nick Mandrak and Becky Cudmore, in the Department of Fisheries and Oceans.

Mr. Robert Sopuck: So what you're telling us is that a template exists that would have to be modified for the Canadian situation, and Australia and New Zealand would be the first place for us to look in terms of a template.

Dr. Anthony Ricciardi: Potentially those would be the countries I'd look to for guidance.

Mr. Robert Sopuck: Thanks. I really appreciate that.

I have just a gratuitous comment here. Too often members of the scientific community who appear before our committee are very loath to give specific recommendations, so yours is greatly appreciated, and I mean that.

Dr. Johnson, I'm interested in the tunicate example from P.E.I. It seems to be a success story. What lessons can we learn from the successful containment of that species so far that could be applied elsewhere?

Dr. Ladd Johnson: I think the most important one, and the one I alluded to earlier, was trying to work with—even though I don't like the word very much, it's very useful—"stakeholders", with all the parties that are involved. I think P.E.I. was probably exceptional in involving the provincial government and the mussel-farming industry very quickly in the problem. There are a multitude of ways in which species can get moved around, and if you don't have the cooperation of everyone involved, and explain to them how important it is—and I think that's one of the advantages....

The economic consequences of those invasions have been very clear to the farmers there. So they were immediately attentive to that, although I think there's still sloppiness and perhaps a lack of enforcement there. The invasive tunicates still spread. There's still some movement going on there. For some of it, because we can't be there, we're not sure, but perhaps there could be movement of aquaculture equipment from one bay to another. People do take shortcuts. I think only if you include them ahead of time.... When it's a crisis situation, it becomes very hard to bring everyone to consensus. So exploring these possibilities ahead of time is the key issue for a rapid response.

Mr. Robert Sopuck: Does DFO or any other agency have any species-specific contingency plans in place, should invasive species such as Asian carp, for example, become established in the Great Lakes? Is somebody war-gaming this and asking what if and coming up with contingency plans?

Dr. Anthony Ricciardi: I feel uncomfortable speaking for DFO. I really think you should talk to them.

I don't know. That seems to be an interesting idea, but it would become a bit problematic to apply this on a species-by-species basis, because there are so many potential threats.

Can I get back to what you were saying about what we've learned?

● (1620)

Mr. Robert Sopuck: Sure.

Dr. Anthony Ricciardi: One of the things we've learned about successful eradication of invasive species in general, not just aquatic ones, is that there are some patterns that differentiate successful eradication from the more dominant, more common, unsuccessful ones.

One of the things we've learned is that it depends greatly on early detection. The more area a species occupies before you start trying to attack it, the more man-hours and money you will have to put forward to attempt to control it, and you may not be successful. That is all dependent on time. When a species comes in, if it is successful, it will start building a population that's self-sustaining. As it builds, it will grow faster and faster through what Dr. Johnson called an Allee effect. That's just a technical term meaning there's density-dependent growth. It will also start to spread, and its rate of spread is dependent on how many there are. So the rate of spread increases with population growth.

So two things happen. There will be more of them, and they'll start to move. And as they move, they'll interface with other human vectors, all kinds of crazy ones that we may not anticipate, and they'll get spread even further in some cases. So that means that time is critical. You have to recognize the species, identify it, prioritize it —which requires careful risk assessment that has to be done rapidly and effectively—and then you can decide whether you can eradicate or contain it. If you can't, then you're going to be paying the chronic cost, because it won't go away.

Mr. Robert Sopuck: Right.

Sure, go ahead.

Dr. Ladd Johnson: Because you were looking for specific examples, again, Australia has our star example. I don't know exactly the authority that allowed it, but they shut down a marina within 24 hours of detecting a new species, and they bleached it. They went in there....

Dr. Anthony Ricciardi: That's a famous example. It's not the only one, but it's one that's well known.

There was a mussel that's similar to the zebra mussel, except it's marine, and it was brought into Darwin Harbour, in Australia. It was brought in by yachts from the Caribbean. It invaded three marinas within Darwin Harbour. The reason we know that is because these marinas are monitored for just this purpose. So it was found early. Once they recognized what it was, whatever Australian government authority that's responsible for this put a plan in place where they cordoned off the harbours, pumped in whatever chemicals are necessary to kill everything in there, and as a result of that it was successfully eradicated.

It's rather a scorched-earth policy, isn't it, but the fact is those marinas are not natural. They're not a natural habitat. In fact, if they were, and the natural tidal regime was established, that species would never have gotten in in the first place. They got in because the marinas were welcoming yachts, and they were attached to the yachts.

Now, of course, that raises a couple of issues. One, the Australian government took about a month to identify it, put a plan in place to control it and carry it out. I'm not sure we would have had a meeting set up in a month over here if there was something similar. I'm only half joking about that.

Another thing is that they also continued monitoring afterwards, because the vector still applies. The thing could still come back. That's something else about eradication: you can't assume the mission's accomplished and go home; you have to be constantly vigilant.

But they have public support, whatever government's in power, to do this, to react this way, which other people might see as rather extreme. They do that. If you visit their national museums, even though they have nothing to do with biology, you would think, they have whole wings devoted to exotic species because they recognize that it's ingrained in their history. There's a great public awareness and thus public support for the government to react this way.

Mr. Robert Sopuck: Thank you very much.

Dr. Ladd Johnson: Could I just add one comment?

The Chair: Certainly. Go ahead, Dr. Johnson.

Dr. Ladd Johnson: I would argue that in the early nineties we could have eliminated the Eurasian ruffe from the Great Lakes if we had taken the same sort of action. I don't want to go into the details of that, and don't want to say “dithering”, but that's the word that came to mind. By the time they finally decided it was a problem and should be stopped, it was too late.

The Chair: Thank you very much.

Mr. MacAulay.

Hon. Lawrence MacAulay (Cardigan, Lib.): Thank you very much, Mr. Chairman.

Doctors, thank you for being here. It's a pretty important issue.

I am fully aware of the invasive tunicates issue on P.E.I., and you say it's still there. I wasn't sure just what the situation was. But again, it's an example of what can happen anywhere in the world. I do not know if you're aware of how it happened or if they have established how it came. They thought it came in because boats were not washed properly. I don't know if you have any detail on that. That's another thing that can happen.

You also indicated that there's a bit of sloppiness. The blue mussel industry is pretty valuable to us. I would just like you to expand further on this. First of all, you've said there were three or four cases of it. It seems, then, that they have cleaned up a fair bit of it, if that's correct. On the sloppiness, what needs to be done? Should there be regulation put in place? There are a lot of dollars involved here. It's a big industry. They're shipped all over the world.

● (1625)

Dr. Ladd Johnson: You're asking specifically about the P.E.I. mussel situation?

Hon. Lawrence MacAulay: Yes.

Dr. Ladd Johnson: When I said there were three or four cases, I should have said there have been three or four of the bays that have been invaded on the east side.

Our current study suggests that the natural spread of the larvae is insufficient to explain the movement, bay to bay. It has probably been the movement of perhaps boats that have not been cleaned, because there is very little opportunity to clean marine boats, unlike boats that are in use in fresh water and are taken out periodically. More likely it would be the movement of aquaculture equipment. I'm not an expert in the way things move around, but it's a business and there is a lot of material being moved from place to place. Just in the processing, the harvesting, the movement, one needs equipment. To be honest, I would not blame.... Even scientists now have realized that our activities might lead to the spread of a species as well, and we take our own precautions now to sterilize our equipment and in the use of our boats.

Again, I can't overemphasize the importance of working with the people who are out there in the field, the mussel growers, emphasizing the importance to them.

When I say “sloppy”, I don't mean that the industry is sloppy. I'm just saying that in every business there are people who will take shortcuts. As I said before, there is no way you're ever going to have a 100% solution.

When I first started working with zebra mussels I proposed something to people, because they had a wonderful list of things to do to prevent the spread of zebra mussels between lakes, and I said that was all very silly. I had the perfect idea: burn every boat that leaves the water. They said, “But how could we ever do that?” I said, “Well, there have been governments in this world where, if the dictator said that every boat gets burned, it could happen”.

I don't use the example lightly. If it was a human disease that was being spread from water to water, you bet we could stop boats from being moved from water to water. We could do things if we really wanted to, but that takes the planning, the preparation, and the explanation so you do not make people angry.

You speak of biosecurity. We can talk about bioterrorism in terms of invasive species as well, and I worry about the live trade thing. If you ban live trade fish, certain communities might think they can introduce their own populations. The Chinese mitten crab, which invaded the bay area some 30 or 40 years ago—no, longer, in the 1930s—was probably introduced as a food source for people. So if you block something, they might want to introduce it themselves to start their own populations. It can be very delicate and it requires foresight and thinking ahead.

Hon. Lawrence MacAulay: Doctor, you indicated when you spoke that their monitoring was inadequate. But I would—

Dr. Ladd Johnson: I'm sorry, do you mean specifically P.E.I.?

Hon. Lawrence MacAulay: No, overall. Well, I don't think you were speaking about P.E.I. at all, but anywhere.

The point I'm getting to is this. Are you telling us that these invasive species are something we have to live with? When I heard you address it, I felt you thought that there should be more done before the species arrives, rather than when it arrives in the Great Lakes, and that the monitoring process before the species comes is not as good as it could be. Is that correct? Did I hear you properly?

Dr. Ladd Johnson: You heard me correctly. I'd like to maybe clarify that.

Hon. Lawrence MacAulay: Yes, clarify it a bit, probably. It would be a good place to do it.

Dr. Ladd Johnson: I'll try to do it quickly.

I think that the monitoring efforts globally are inadequate, and I stand by that. I would think P.E.I. would be a model place to look for it, particularly because of the provincial government's implication in that. They do rigorous monitoring there.

Something we haven't mentioned, perhaps just out of forgetfulness, is that our research network actually is focusing on early detection and rapid responses. So these are what we have considered to be the most important things on which we need scientific information. The director of that network, Dr. Hugh MacIsaac, will be here in a couple of weeks, so I'm not going to try to describe what the network is doing. I think he will do a very good job of that.

I can say there are promising new techniques, especially molecular techniques, that will allow us to be much better at monitoring. But again, Dr. MacIsaac will explain that in a few weeks.

I think we always have to try to prevent. I think that's the first thing to do. But once it happens, we can't just give up.

● (1630)

Hon. Lawrence MacAulay: What about education of everybody who is involved? That has been presented to us here as something that really needs to be done. A lot of people do not realize that possibly if they take a species and dump it....

What do we do in order to have people understand exactly what massive harm they're doing when they do this? We have to have an education program put in place in order to tell the people involved, around the Great Lakes or in Prince Edward Island or wherever it might be, that if they flush something down the toilet, if they dump something over the wharf....

Do you believe that one of the biggest areas to fight it, or one of the biggest weapons, would be to educate society as to the great damage it's doing?

Dr. Ladd Johnson: I agree entirely, and I could direct you to some programs that I think are doing very good jobs of that.

Hon. Lawrence MacAulay: Well, I believe we're going to receive a program.

Dr. Ricciardi, from what you're telling me, I can bring the bighead carp, the northern snakehead, the Asian carp—any of these species—into this country.

Dr. Anthony Ricciardi: You can't hold them in Ontario. And I'm not sure, but I think there are other provincial.... In terms of other provinces, I'm not sure if B.C. has a regulation against them also.

But clearly there's great heterogeneity in legislation at the provincial level. There is nothing that I know of in the federal regulations that prohibit you from doing that.

Hon. Lawrence MacAulay: Should there be?

Dr. Anthony Ricciardi: Of course there should be.

Hon. Lawrence MacAulay: It would help prevent, but then would you suggest that the regulation should be that we do not take them in alive? What—

The Chair: Thank you, Mr. MacAulay.

Hon. Lawrence MacAulay: Oh, I'm sorry.

The Chair: Your time has expired. I know you were waiting for me to—

Hon. Lawrence MacAulay: I went beyond my time.

The Chair: Yes. Thank you.

We will now move to our five-minute round, and we'll begin with Mr. Donnelly.

Mr. Fin Donnelly (New Westminster—Coquitlam, NDP): Thank you, Mr. Chair.

I'd like to thank Dr. Ricciardi and Dr. Johnson for coming before the committee and providing their testimony to us. I have a couple of questions for both.

First of all, Dr. Ricciardi, federal departments, including DFO, are receiving cuts to staff and resources and funding. According to you, biological invasions are comparable to economic disasters—

Dr. Anthony Ricciardi: Natural disasters.

Mr. Fin Donnelly: —natural disasters—and your study estimated that the annual economic impact of biological invasions is nearly greater, in order of magnitude, than the annual global cost of natural disasters.

Dr. Anthony Ricciardi: Yes.

Mr. Fin Donnelly: As well, contrary to most impacts of natural disasters, the impacts of biological invasions are typically more persistent and sometimes irreversible.

Dr. Anthony Ricciardi: It sounds like you've been reading some of the stuff I've written.

Mr. Fin Donnelly: There you go.

In your opinion, is the Government of Canada providing adequate resources to deal with this threat?

As well, do you believe this is the right time to be cutting monitoring and funding in science?

Dr. Anthony Ricciardi: Most governments, including ours, aren't. We're not alone in that.

Just to elaborate on what I proposed, a colleague of mine, Norm Yan, a professor at York University, suggests that we should treat invasive species with the same kind of serious attitude that we treat natural disasters. Most invasive species probably will not have undesirable negative impacts.

Most natural disasters, or at least the phenomena that generate them, most of the time are negligible. We prepare for extreme hazards that may never happen, because if they did happen it would be unacceptable. So we have building codes. We have safety regulations. Various countries in the world have detection and monitoring and infrastructure in place to prevent something that may never happen, because it would be unacceptable if it did.

We don't do that with invasive species, even though the country is under siege, as I indicated, with billions of animals moving into North America, tens of thousands of species, mostly unregulated. Once they are here, when they become established they are very difficult to eradicate. So we're talking about a cumulative problem.

When I speak to policy-makers, I often liken invasive species to hidden taxes—that usually gets their attention—because they appear out of nowhere, like a hidden tax. Once they're established, they don't go away, like a hidden tax. Usually the cost increases over time, like a hidden tax. And yet this is happening all the time.

I think the reason we don't treat it with the same kind of seriousness and coordinated effort that we do for natural disasters is that they're usually reported in the media as isolated monster stories. You might hear about a mussel over there, a sea squirt or tunicate over here, a fish over there. Yet they're all symptomatic of the same phenomenon: a form of global change that I call, because it's catchy, “global swarming”.

Every country on the planet is susceptible to it. There is no doubt that this form of global change, which interacts with all other forms of global change, is a stress on regional economies, on our natural resources. It poses a threat to human health. It affects all aspects of society. Those nations best able, best equipped, best capable of dealing with it will have a huge advantage as globalization proceeds.

Now, we're far behind in that, in my opinion. We don't have to be. We have great scientific expertise here.

● (1635)

Mr. Fin Donnelly: Thank you, Dr. Ricciardi.

Dr. Johnson, according to the 2008 report from the Commissioner of Environment and Sustainable Development, the Department of Fisheries and Oceans failed to assess the socio-economic risks posed by aquatic invasive species in order to estimate the overall risks. The report stated that without further analysis, the department lacked key information necessary to set priorities or establish risk-based objectives to reducing the harm caused by aquatic invasive species.

I have a two-part question, in the thirty seconds that we have left. In your opinion, has DFO provided adequate socio-economic risk assessment of aquatic invasive species in the Great Lakes and St. Lawrence River basin? And how important is such an assessment to your work and to Canada's ability to reduce harm by invasive aquatic species? And perhaps you could add how this could best be remedied.

Dr. Ladd Johnson: I'd like not to answer the first question because I don't work in the Great Lakes, per se. I have not worked with Great Lakes DFO personnel, so it is hard for me to tell.

I can say that on the east coast there are individuals who are making exceptional efforts in trying to get the information together, both at EML and at the Moncton lab.

The second question was....

Mr. Fin Donnelly: Remedy. Certainly there are exceptional individuals working diligently, but what's the solution?

Dr. Ladd Johnson: I'd like to take the chance of saying.... And I don't want to put monitoring on to government; I think monitoring has a terrible reputation, unjustly deserved, because without that baseline it's very hard to work. I'm not saying that the university scientists should get to do the fun stuff and government scientists should do the drudgery year after year, but the government is there year after year. Scientists sometimes go with their interests. That's a critical role that has to be evaluated. Some core funding needs to be put into that, in all aspects. I think we can monitor things for both invasive species and for other environmental parameters. That would be very good.

The remedy.... Well, obviously more money. I don't know how.... It's a big country. It's unfortunately a big country and it's spread pretty thin. I'm sorry that I can't give you a better answer.

The Chair: Thank you very much, Dr. Johnson.

Mr. Hayes.

Mr. Bryan Hayes: Thank you, Mr. Chair.

I'm going to avoid talking about money, because more money doesn't necessarily solve the problems. And I'm going to avoid talking about Prince Edward Island, because this study is on the Great Lakes.

My first question is to Mr. Johnson. I have two questions, one to each presenter.

Mr. Johnson, I want to get a clear understanding of how the Canadian Aquatic Invasive Species Network is prioritized in terms of what is at the top of the list. You indicated that you're not an expert on the Great Lakes, so I'm assuming that this Canadian Aquatic Invasive Species Network is not all about the Great Lakes either. How do you prioritize what you're going to do next as a committee?

● (1640)

Dr. Ladd Johnson: There are two phases of CAISN. We're in our second phase now. If I could speak to the second phase, because I think that better answers your question, the scientists involved in the first phase sat down at one of our annual general meetings and discussed what we thought were deficits in our knowledge and what we thought were promising avenues for research that could be done at a national level in Canada.

We identified themes, we vetted those themes with all members, we asked for proposals, and then we screened those to come down to what we considered was a related set of four themes. Those were early detection, rapid response, multiple stressors, and dealing with uncertainty. Dr. MacIsaac can tell you much more about it. I don't want to take away from him.

I think it was an excellent process of working with government scientists. The opportunity to work with government scientists was exceptional, as was working with other invasion biologists across the country. I'm delighted by the people. The intellectual stimulation and the satisfaction I get from contributing has been something I don't achieve often as an individual scientist.

Mr. Bryan Hayes: So any four of those themes could be applied to the Great Lakes, or all of those.

Dr. Ladd Johnson: All of those. In fact, I say I don't work on the Great Lakes, but I have projects in the central region, which includes the Great Lakes. I'm involved in a project with Dr. Ricciardi. I'm involved in a project with a DFO scientist in Burlington.

We're taking conceptual.... We've networked in a true sense by taking people with different expertise. So I'm not identifying the zooplankton, my DFO colleague is, but we're bringing in my ideas and combining them with her ideas to move it forward.

Mr. Bryan Hayes: Thank you.

Mr. Ricciardi, here's my big concern from some of your statements. There may be and very likely are invasive species in the Great Lakes that we're not even aware of and that are causing damage we're not even aware of.

Dr. Ladd Johnson: Almost certainly.

Mr. Bryan Hayes: Then you mentioned that there are 20 species that we're not even sure are invasive, and we haven't even studied them.

How would it be determined what should be studied next? In your opinion, what should be studied next of those species? Who makes that decision?

Dr. Anthony Ricciardi: Do you mean which species should be studied?

Mr. Bryan Hayes: Absolutely.

Dr. Anthony Ricciardi: We are developing models to identify, by creating a kind of criminal profile, if you like, of a species that could cause harm or undesirable impacts. We're not the only ones doing this. This is something that's going on around the world.

Even if we're not aware of what species might show up next, ultimately we might have a screen that allows us to identify which species coming in poses the biggest risk, based on this profile. This is an essential form of risk assessment, so it's through risk assessment when properly applied that you can identify threats, even before they've shown themselves to be a threat, in which case it's easier to prioritize to keep them out, or once established, easier to decide if we're going to invest resources to have to eradicate them.

We can't keep everything out. We can't stop everything, nor do we have to. What we have to do is identify where the biggest risks are. What is likely to cause the most damage? Through risk assessment—and the leaders of that are in Australia and New Zealand—which is part of the priority of CAISN, we can develop methods that when applied on the ground can allow us to foresee not only the next threat, but maybe even the next vector that's going to bring it in, or what emerging vectors also will bring in multiple threats.

One way I did this years ago—it was a simple method actually, at the time; now we're becoming more sophisticated—was to identify trends, based on invasion history, and then extrapolate from them.

Most of the species that are introduced in the Great Lakes come from Europe. That reflects opportunities created by trade traffic, primarily. We can see what's invading Europe now. We know that ballast water released from overseas shipping has been historically the most important vector for invasion in the Great Lakes, at least until 2008, and we can assume it will continue to act as such. Therefore what species are colonizing ports, like Rotterdam, Hamburg, and so on, from which we receive shipping traffic and thus pose a risk of coming here?

We have done this. When I did this, I identified about two dozen species that are considered to be high impact where they're invading across Europe, that will likely survive transport in ballast water, and that are in those ports and therefore likely interfacing with ballast water traffic.

This is a big roulette wheel spin. Just because they're there and just because they may be taken up by ships doesn't mean that they're actually going to establish. They may need multiple tries. It's a roll of the dice, but we're loading the dice in their favour in many cases.

I did that years ago, and one of those species has actually arrived, and that is the last species we know of that arrived through ballast water shipping. That was the bloody red mysid shrimp, which you'll hear more about in the future. That one was identified in 2006.

● (1645)

The Chair: Thank you very much.

Go ahead, Monsieur Tremblay.

[*Translation*]

Mr. Jonathan Tremblay (Montmorency—Charlevoix—Haute-Côte-Nord, NDP): Professor Ricciardi, although we talked about this earlier, I would like to explore the issue further.

In order to prevent invasive species from becoming established, the recommendation in the 2008 report of the Commissioner of the Environment and Sustainable Development was to take an approach that allows for early detection and to develop the ability to react quickly. But, based on your document, the legal capacity needed to support this type of management is lacking at the moment.

I will start with this question before going into more detail. What can be done to rectify the situation?

[*English*]

Dr. Anthony Ricciardi: We have no system that coordinates expertise, taxonomic expertise for example, that would allow us to rapidly identify species, which is the first stage towards assessing a threat. The next stage after that is once you know what you have coming in through ballast water or whatever vector, or that has already been found in the Great Lakes, you have to decide, is it a threat? Then you apply the risk assessment models I talked about.

There is no regulation to do this. There is no coordinated monitoring system in place. There is no system that synergizes the activities of large numbers of people who are scattered throughout the country. Actually, the closest thing we have to that is CAISN, the Canadian Aquatic Invasive Species Network, which is NSERC-funded. The point of that was to harness the expertise of people, including people of taxonomic expertise, people of risk assessment expertise, people who understand the ecology of various kinds of organisms—and we mentioned a few of them here, ranging from fish to mussels to tunicates, and all kinds of things—-who are scattered across the country, and give them an opportunity to work together and inform government. We need to do more than that, but that's what we have so far.

Did I answer your question?

[*Translation*]

Mr. Jonathan Tremblay: What steps need to be taken to set up a system for early detection? For you, as someone from a Quebec university, do the steps start in the gulf, the estuary, in Chicago, in the various tributaries? What are the steps needed to develop an effective system for early detection?

[*English*]

Dr. Anthony Ricciardi: I'm not a manager, but you'd have to have someone find the organism, so that requires monitoring. You'd have to be able to identify using, let's say, an expert database, who is capable of identifying species of that group of organisms, whether it's fish or molluscs or other kinds of invertebrates, or plants, get it to them rapidly, have them identify it perhaps using molecular techniques like DNA sequencing, and then once we know what it is, it has to go through risk assessment.

We already have this in place, I think, with respect to human pathogens, I would imagine, with the centres of disease control. I would imagine we could combine that kind of approach that's already being used for screening pathogens, for identifying them, and coordinating expertise and rapid response. We would do that for non-pathogenic species or exotic species that don't affect humans.

● (1650)

[*Translation*]

Mr. Jonathan Tremblay: So basically, you have to act quickly. It is all about rapid detection. Everything needs to be done.

[*English*]

Dr. Anthony Ricciardi: We need rapid identification, then risk assessment to decide what threat it poses, once we know what it is. The difficulty is in knowing what it is. I'm assuming your question was partly prompted by the fact that I said there are species in the Great Lakes and we're not even sure whether they're invasive or not. We have expertise in this country, not as much as I'd like to see, but expertise to identify various kinds of species of organisms, whether it's fish or invertebrates, and so on. We have no coordinated way of accessing this expertise quickly when a new threat is found. Usually what happens is that someone will make a phone call saying they found something strange, so it's very haphazard. Then somebody says maybe you should send it to Dr. Whoever in this university, and it may get to them. Then they'll identify it, saying this is a potential problem, maybe we should talk to somebody about this.

It's very haphazard, as opposed to let's say the situation in Australia, where there is monitoring and more of a coordinated system for rapid identification, rapid assessment, and then rapid response.

The Chair: Dr. Johnson.

[*Translation*]

Dr. Ladd Johnson: I just want to add something.

In my view, the practicality of the process is fine. But what is crucial is to take steps at a political level. No one will do what they are supposed to do if there is no coordination between the federal and provincial governments, including municipalities and the people who live there. It is very important to have everything planned, even if you miss the arrival of some species that might have not been identified properly, for example. I think it is important to have everything ready and to be able to react. A good identification system is not worth much if you are not able to react.

Thank you.

[*English*]

The Chair: Thank you.

Mr. Leef.

Mr. Ryan Leef (Yukon, CPC): Thank you, Mr. Chair.

Mr. Johnson, I didn't hear any Spanish creep in there. That was well done.

Dr. Ladd Johnson: *Muy, muy importante*.

Mr. Ryan Leef: I can't do either. You're way ahead of me.

I was going to ask either one of you gentlemen if you're aware of the federal legislation called WAPPRIITA, the Wild Animal and Plant Protection and Regulation of International and Interprovincial Trade Act.

Dr. Ladd Johnson: No.

Mr. Ryan Leef: History is dragging me back.

I looked it up, and we have a federal body of legislation right now that, among other things, is designed to protect Canadian species whose capture, possession, and transportation are regulated by provincial or territorial laws, whose introduction into Canadian ecosystems could endanger species. The act forbids the import, export, and interprovincial transportation of these species unless the specimens are accompanied by appropriate documents and applies to plants, animals, alive or dead, as well as to their parts and any derived products. Then you go to the act itself, and the definition of animal includes fish.

I asked DFO the same question, and they didn't seem to know what pre-existed, so obviously there's some work we need to do in building that body of the legislation.

Dr. Ladd Johnson: What date is that?

Mr. Ryan Leef: It was enacted several years ago.

I can tell you that when I was a conservation officer in the Yukon Territory we were enforcing that legislation in 1998 or 1999.

Both of you went “huh”, so I guess that tells us we probably should look at that body of legislation again to rehash that, maybe even as a committee to see how it lines up in provincial and international trade.

I hear you. It was the same message we got from DFO, which was customs was largely acting on behalf of the Ontario Ministry of Natural Resources and provincial legislation to prevent carp from coming in, but it would seem to me that they'd be well within their jurisdiction, binding on Her Majesty. This body of legislation would require them to do that at customs under that federal body of legislation.

I guess we have to dig into it and see what we can do or see what it says.

● (1655)

Dr. Ladd Johnson: If I could add, I think that's the enforcement aspect I was referring to. I think the regulation structure is fine, but I know there has to be a mechanism of enforcement, so I'm not sure. Obviously, diffusing that information to the appropriate.... But you said you applied that yourself in certain cases?

Mr. Ryan Leef: Yes.

When I was a conservation officer in the Yukon we used WAPPRIITA more for terrestrial stuff, of course. We're dealing with CITES animals and those sorts of things where they cross provincial boundaries or where they come in and out of the territory from Alaska, which we border on four points of entry. So we didn't have a lot of people trying to live-release fish or aquatic invasive species, necessarily, in the Yukon. You've got to be pretty hardy to live in the Yukon. P.E.I. is easy enough.

I was interested to hear if you'd heard of that and if you had comments on its effectiveness or not, but we don't need to worry about that.

The question I have now is fairly scientific and maybe out of curiosity.

I appreciate your point on early detection and timing, but do we know enough about some of the aquatic invasive species to find periods of vulnerability in their life cycle where it would be most appropriate or timely to target an eradication strategy, and has that been deployed?

Dr. Anthony Ricciardi: You've already heard a lot about the sea lamprey, I imagine.

Mr. Ryan Leef: Yes.

Dr. Anthony Ricciardi: If I recall correctly, it's targeting the larval stages that live in the sediments. So there's an example where the lampricide is applied with that specific life stage in mind.

Normally, we don't look at it that way. Where eradication has been applied in other parts of the world, there's been an attempt to do it before the species has time to disperse rapidly. If it does disperse rapidly, then you're always going to be putting out fires. Also, you have to consider prioritization of species for eradication—in other words, those species most likely to be eradicated—rather than wasting your effort. Species have been identified as priorities for eradication when it's been understood that they can't disperse very quickly, such as certain snails or parasites of these snails. There have been examples on abalone farms of successful eradication of a parasite because it was understood that this thing was a crawling invertebrate, and that therefore it couldn't get very far. So they had time and were likely to be successful if they invested the effort in doing it.

So in that sense, once the invasion has proceeded, once you have a population there, you can make decisions based on its life history, perhaps even specific to certain life stages. You can decide whether it is worth the effort to attempt an eradication, with some potential collateral damage to the rest of the community, or whether it is just going to be a completely controlled operation from now on. These stages where you make the judgments as to prevention, eradication, or chronic control usually depend on how far the species has progressed in its population buildup, which is a function of time.

Dr. Ladd Johnson: I would just like to add briefly that I think the lamprey example is sort of a false hope, in some sense. I don't want people to always think there will be that kind of solution. It's a wonderful case story, where the biology really mattered and we were able to sleuth it out.

On the other hand, I'd like to say there are promising things, especially with certain molecular approaches, and I think in the future we'll be able to use instruments that are less blunt, in terms of doing this. I think of the blackfly control program using Bti, a type of bacterial pathogen for the fly, and targeting the larval stage in the water rather than the adult. So that's an example of how you can target certain things with not exactly a magic bullet, but something much more precise than the chemical treatments that would often be used in normal cases.

The Chair: Thank you very much.

Mr. MacAulay.

Hon. Lawrence MacAulay: Thank you very much, Mr. Chair.

What European countries are fighting invasive species most effectively, and what are they doing?

Also, is the Government of Canada or are any universities in the country—and if there are any, I'd like to hear—dealing government to government or university to university, for example, with European countries or Australia and New Zealand, which you've mentioned here as being quite successful in fighting invasive species? I'd just like you to comment on that.

● (1700)

Dr. Anthony Ricciardi: I'm not familiar with how efficient European countries are in dealing with this problem. I mentioned Australia and New Zealand. I can mention South Africa and to some extent the United States—the United States I'm not certain of, but certainly the other three countries—as being ahead of us and talk about how seriously they take this issue, in terms of risk assessment, and a—I don't like using this word, because it's overused—proactive approach to dealing with the problem. If you talk to them, they'll probably say they're nowhere near as successful as they want to be. I'm just talking about our position relative to where they are. I can't talk about European countries, because I haven't spoken to anybody in their governments.

Hon. Lawrence MacAulay: Well, Doctor, are you telling me, then, that we're working by ourselves and we're not dealing with other countries in fighting invasive species? Generally, we like to deal with other countries, and universities deal with other countries. But basically we're doing it ourselves here?

Dr. Anthony Ricciardi: The sea lamprey example, which was the reason for the Great Lakes Fishery Commission being born, is an example of the great cooperation between the United States and Canada. We recognize that invasive species is yet another transboundary issue, because they don't recognize boundaries, so we're not working just with ourselves. There are differences between the two nations. They have an invasive species act, and we don't. There's probably a difference in commitment of funds as well.

But as far as us working with Europe, I don't know of a situation in which we're working with Europe on a federal level, or even a provincial level. Through universities, we do. We have collaborations with colleagues from overseas who are dealing with invaders before we get them, or sometimes the same ones that have happened to invade both sides of the Atlantic. We share information for the purpose of combining our efforts to understand what these species are doing. So at the university level—that is, at the scientific level—definitely there is an attempt to embrace collaboration with people from other parts of the planet who have different expertise or where they're seeing invasions that we haven't yet.

Hon. Lawrence MacAulay: So we are in fact dealing with other universities around the world. Of course, I am aware that fish do not know where borders are, but I think it's so important that we do not reinvent the wheel, no matter what we're doing. You're telling me that we do deal with other universities around the world and with other governments.

Dr. Anthony Ricciardi: Scientific researchers deal with other universities—absolutely.

Hon. Lawrence MacAulay: Thank you very much.

The Chair: Thank you, Mr. MacAulay.

Dr. Johnson.

Dr. Ladd Johnson: Could I add a final word on that?

When you ask a question like that, I immediately start thinking of economics, and I think of the World Trade Organization.

First, I'd like to mention that ecology in general—and biological invasion, which is somewhat of a sub-discipline of ecology in general—is still not a mature science. We're still in the early stages of learning many, many things. Economics is as well, I think, but....

I think there are models on the economic system that could be applied, and I think the one for ballast water has been developed.

Tony, help me with the acronym. Is it the IMO?

Dr. Anthony Ricciardi: Yes—the International Maritime Organization.

Dr. Ladd Johnson: They've developed regulations that are applied internationally in terms of that, because I believe they see the economics. They've seen the numbers. They understand that if they're regulated and if they're going to have to put in new systems for filtering water, etc., that will affect them in one country or another, it's better to be proactive, to be ahead of the game, to coordinate, and to show that good effort.

I think that would be where I would look. I think I'd look to Germany if I had to pick a European country that's leading in this area.

Hon. Lawrence MacAulay: Thank you very much, Dr. Johnson.

The Chair: Thank you.

Mr. Donnelly.

Mr. Fin Donnelly: Thank you, Mr. Chair.

I just wanted to ask about Australia and their program. Is it federally mandated or funded? How does that work?

Dr. Anthony Ricciardi: Australia and New Zealand have either ministries or departments—I get confused as to which one is which—of biosecurity that serve to coordinate efforts to deal with species that are crossing their borders, whether we're talking about pathogens, species that affect threshold ecosystems, or aquatic invasive species, whether freshwater or marine. They coordinate these activities.

I can't say much more about it than that, except that their decisions are based largely on risk assessment. Their scientists probably lead the field as far as risk assessment methods go—that is, in abilities to identify which species or vectors pose the greatest risk, which ones will likely cause the greatest damage and so on.

● (1705)

Dr. Ladd Johnson: May I add to that?

Mr. Fin Donnelly: Sure.

Dr. Ladd Johnson: I'm always the second at bat. Sometimes I hope I can hit not a home run, but....

I think the thing you have to realize with Australia and New Zealand—because they come up—is that it's not an accident that those are the countries that are ahead of us.

Number one, as isolated islands that have been isolated for hundreds of millions of years, they are susceptible to invasions like no other place. When invasions occur, they're sometimes catastrophic.

Also, they're also better able to control their borders. So they have a mentality—and I think Dr. Ricciardi mentioned that before—of thinking about invasions there, because they've had them, and they're actually able to see that, yes, if they can control the entryways, they can actually do something with much more confidence in their actions.

Mr. Fin Donnelly: Thank you.

We've talked about the biggest sources of this problem. You've mentioned ballast water from foreign ships and the international live trade. Are there any other main sources we should be aware of? What I was thinking when you were describing this is some kind of a hot-spots map that we should have. I know that in my time as city councillor—and I'm thinking of the police—we had the hot-spot areas identified. Is there anything like this that exists? Also, are there any other sources that need to be identified?

Dr. Anthony Ricciardi: I've heard of a study being done in Britain—I can't remember the details—that is applying exactly what you just talked about. It's recent. It applies the hot spots of crime approach, or the statistical approach toward establishing that, to exotic species, or to species outbreaks, if you like.

What was the other part of your question?

Mr. Fin Donnelly: It was about any other sources we can look to.

Dr. Anthony Ricciardi: Well, from sources like canals, for example.... The Welland Canal still can function as a source for allowing species, once they get into the St. Lawrence River, to bypass Niagara Falls and get in, just like the sea lamprey, the alewife, and a few other things did. Canals breach barriers that would otherwise contain species, unless we've found other ways to help them get out.

Dr. Ladd Johnson: There are intentional introductions. I raised this earlier. I definitely remember a time when someone was going to block boat transport to a lake, and someone made an anonymous call. It was a washing station where they were going to require people to wash their boats, and someone said, “If you do that, I'm just going to dump zebra mussels in the lake and get it over with”.

I'm not sure how to provide live fish without that risk. Maybe they can't take them out live, but I could see somebody saying, “Well, we'll put a few in the bay, and we'll have our own population forever”.

Dr. Anthony Ricciardi: Remember that live trade includes lots of sub-vectors. We're talking about moving species for commercial purposes. We're talking about aquarium dumping after the aquarium industry has distributed species. There is bait-bucket dumping. After the bait trade has distributed species, people on the ground will start dumping them. That's how rusty crayfish and a variety of other things have been moved around and continue to be moved around.

Ultimately, human behaviour at the small scale will continue to distribute things after the larger-scale operations of industries have introduced them to a region.

Mr. Fin Donnelly: My final question is sort of the reverse of my initial question.

How can we better address this problem without spending any further resources? Are there steps we can take, for instance? My initial question was whether we can address this problem with limited resources and the cuts the department is facing. How about the reverse? We're not getting any more funds. What's the best thing we can do?

Dr. Ladd Johnson: Yes, it's the tough question.

Dr. Anthony Ricciardi: It's your chance up at bat, Ladd. Hit it out of the park.

Dr. Ladd Johnson: I would go towards targeted public education, because I think that will affect some of these difficult vectors to target. Sowing seeds for the future will not have a big turnaround in the near term, but sensitizing school kids.... It could be included in curricula.

● (1710)

Mr. Fin Donnelly: Sorry, just to clarify, are you talking about government doing that, or non-profit groups or volunteers? Who's doing this without being paid?

Dr. Ladd Johnson: Well, without being paid, you're going to get nothing for nothing. But with your smallest investment, your biggest bang for your buck in the long term I think might very well be public education, with the caveat that you have to assess how effective it is.

The Chair: Thank you very much.

Mr. Kamp.

Mr. Randy Kamp (Pitt Meadows—Maple Ridge—Mission, CPC): Thank you, Mr. Chair.

Thank you, gentlemen, for appearing here. I appreciate your testimony. It has been very helpful. I will try not to repeat many of the topics that have already been discussed, because I think this has already been really helpful.

Yesterday the Minister of Fisheries and Oceans made an announcement here in the Ottawa area about responsible protection and conservation of Canada's fisheries. I don't know if you caught that. Partway through, he made this statement:

> You will also be happy to know that regulations will be developed prohibiting the import, transport, and possession of live aquatic invasive species, such as Asian carp, which are threatening the Great Lakes.

If the Fisheries Act were to be amended to refer specifically to the regulation-making power, or include regulation-making power that specifically addressed issues such as the possession of live aquatic invasive species, I'm assuming that you'd think that was progress. That may not be public education, but it has to be kind of close on that list of things we could do that would be helpful without costing a lot of money, at least at the outset.

Dr. Ladd Johnson: Agreed. And perhaps it could even correct it by obviously putting a law on the books that says that it's illegal to do it. I don't know what that costs. I'm sure it doesn't come free, but I'm sure it's pretty inexpensive in comparison. I would follow it up again with enforcement, because without enforcement it's hard to attain the goal.

Mr. Randy Kamp: Yes, and I think that is the direction the minister is going in. The statement was longer than that, and it covered other areas with respect to habitat and protection and so on.

This is a pretty important priority for our government. In fact, some members were here in 2006 and 2007, when we introduced a whole new Fisheries Act. Both times we didn't get through the process, but both of them had a section on aquatic invasive species.

We're aware that there is kind of a gap there in terms of policy and legislation, and in the very near future we may see that gap filled.

Dr. Ladd Johnson: Could I follow with a question on that to help perhaps clarify something for me?

Mr. Randy Kamp: Sure.

Dr. Ladd Johnson: I know that in the province of Quebec authority over fish, especially freshwater fish, is pretty much a provincial concern. How does the new law apply to cooperation between federal and provincial authorities?

Mr. Randy Kamp: Well, in some cases the management of fisheries has been under agreement to the inland provinces, but the protection of habitat is not. It's completely under federal jurisdiction at this point. What the future is, I don't know. I think there's some promise there. The problem at least has been recognized and the minister has referred to it.

My question is more of a theoretical one. Can a biological invasion also be a natural phenomenon? Is it accurate to say that there would be non-native invasions of even harmful species if there were no human interaction with the ecosystem? In other words, does it happen naturally as well?

Dr. Anthony Ricciardi: Yes. The process of invasion is just as natural as the process of extinction. And like extinction, under human influence it has been altered; it has been accelerated.

In fact I have compared rates of invasion from the prehistoric record and modern record, and the differences are many orders of magnitude. If you take as an extreme case Hawaii, which has been invaded at a rate of—let's say before humans arrived, before Polynesians arrived—one every 30,000 years, now you will get 20 new invaders per year. That's an 800,000-fold acceleration.

We've accelerated the rate to levels that have no historical precedent. Unlike extinction, which, pointing to the past when an asteroid hit the planet, let's say, you could find a mass extinction event similar to what's going on now—it's not much consolation, but you can find that—you cannot find any analogy in the fossil record of the mass invasion event that's occurring now.

You can take New Zealand as an example, which we brought up before. It has 35 European mammals on it. There is no way any of them could have arrived in New Zealand on their own. There are 12 birds that normally occur in Britain. There's not a single chance that any one of them could have arrived and established a population in New Zealand on its own.

These big jumps that we're seeing, like zebra mussels coming out of the Great Lakes, could not have happened without human vectors.

So it can happen naturally. It is happening naturally, on very small scales and at far slower rates than it is without our influence.

● (1715)

Mr. Randy Kamp: Dr. Johnson.

Dr. Ladd Johnson: Just to follow up, the invasion of South America with the formation of the Isthmus of Panama was actually a natural catastrophic invasion.

Dr. Anthony Ricciardi: You would have to move all the continents together at the same time and still you wouldn't approach what's happening now. Mass invasions have occurred in the past when continents collided together.

What we're seeing now is something that still does not compare to what's happened in the past that may have happened regionally. What we're talking about is global. It has no precedent.

Mr. Randy Kamp: Thank you very much.

The Chair: Thank you.

Mr. Allen.

Mr. Mike Allen (Tobique—Mactaquac, CPC): Thank you very much, Mr. Chair.

Thank you to our folks for being here.

Any Canadian who thinks that dumping a fish into a body of water is a good idea would just have had to listen to this testimony over the last couple of meetings to understand that is not such a good thing.

You also talked about piranhas in the Great Lakes.

Dr. Anthony Ricciardi: Piranhas are found almost every year in the Great Lakes. They are red-bellied piranhas that are found, which are sold in pet stores. It's easy to guess how they got into the Great Lakes. Somebody decides it's getting too big and it's eating everything else in the tank so let's get rid of it.

I call this the “free Willy syndrome”, because people like dumping their fish—their goldfish and so on—into the wild. I think maybe it eases their conscience.

Every pond, natural or otherwise, on the Island of Montreal has had or now has goldfish in it. Tens of thousands of fish are estimated to have been dumped into the St. Lawrence River every year through this particular vector.

This is the reason we emphasize public education. This is an example of something involving individuals, which when multiplied by large populations creates this huge opportunity for many species to get in.

Piranhas will probably never become established in the Great Lakes, unless winter becomes far less severe than it is now. That is possible, but not in the immediate horizon.

There are other species that have been established that way. The piranhas are a signal that it's happening when we see them every year. I like bringing them up because people are surprised to hear about it.

Mr. Mike Allen: I think I'm going to put on a thicker set of waders when I go fishing now.

I'm a little bit concerned about this.

A number of years ago in New Brunswick, in a lake in my riding, we had a lot of goldfish, and we had to go through a major exercise to get rid of them.

One of the things I'd like to understand is how we can speed up the identification in this process. You talk about identifying them quickly.

I guess the other side is when you talked about bleaching that area in Australia. It was interesting to me, because we've had some suggest that the smallmouth bass invasive species in New Brunswick should have been taken care of by putting rotenone in the lake. There were some serious concerns about doing that.

I can't see our responding that quickly or that dramatically to an invasion of a species in the lakes.

I'd like your thoughts on how we can more quickly jump on these things, to assess and ID them quickly and then take other actions.

Dr. Ladd Johnson: The problem of identifying quickly is just thorny because it's often done pro bono and it's diffuse. It's getting worse at an international level. That type of expertise is no longer really well rewarded.

The bright side is...especially with the DNA bar-coding program in Windsor; it's another network where they're basically trying to get the bar code of life.

● (1720)

Dr. Anthony Ricciardi: It's in Guelph.

Dr. Ladd Johnson: It's Guelph. Basically, you send a piece of tissue in and they'll tell you right away.

As part of the first CAISN network, there was an invasive tunicate bank developed in P.E.I. where people could send.... I'm not sure if they could send samples to get them identified, but they could get voucher collections for different.... I don't want to get into the molecular biology, but they could get tools for identifying species quickly, if not identifying them themselves.

It would be my greatest hope that there would be some centralized area that might be able to do that. It might not be just for invasive species. Again, it might be just for identifying, but it would have to be centralized, I'm pretty sure.

Mr. Mike Allen: Right now we're relying on fishermen and others who catch these or—

Dr. Ladd Johnson: Oh, that's the detection, yes.

Mr. Mike Allen: Yes, that's the detection piece, but the other side of it is, what other proactive things could we do to get on the front end? As you indicated before, some of these things are not dormant, but they're there for a long time before we even understand they're there. I'm just wondering, how do we get onto that stuff quicker?

Dr. Ladd Johnson: In a couple of weeks Dr. MacIsaac can tell you a lot more about a technique called pyrosequencing, which is a very expensive technique, but as with many of these molecular techniques, we see the price coming down. You all know about all the DNA things that can be done for forensics. Well, that's happening as well for invasive species, where you can take environmental DNA and sample it. Again, you need strategies for where and when to sample, but it can probably speed up the process, although in that case it might just identify where follow-up work needs to be done.

I really think there needs to be both a mentality and an authority to react quickly, even after the identification. As I said, the European ruffe was well identified as an invasive species, and it took over a year to have any type of movement on it. By that time it was decided it was in too many rivers. It needed to be decided on within a month or two.

Mr. Mike Allen: Based on your experience, when we've had these infestations and an action plan to get rid of them, do you ever see a situation where there would be an appetite to use something rough like a rotenone?

Dr. Ladd Johnson: As I said, I think we only have blunt tools right now. For me, and I think Dr. Ricciardi would agree with me, I would suffer a lot of collateral damage to put out an invasive species. It's a hard one for the public to swallow, but I think that's where the education comes in again.

Dr. Anthony Ricciardi: Let's take an example. Again, it's public education. Most people figure that goldfish are benign. There was a study at McGill many years ago—I wasn't involved with it—that showed goldfish act like little carp, little aquatic pigs, basically, rooting around in the sediment, and they can increase turbidity, reduce light transmission, and uproot plants. Visual predators like newts and salamanders and so on find their habitat inhospitable, so they leave. The goldfish do this because they're ecologically rewarded by it, because they're shiny, and when you decrease light transmission by creating turbidity, predators can't see you. They're basically engineers, and they re-engineer habitats.

I wouldn't imagine anyone who dumps their fish into a pond imagines that's going to happen. They don't have to know that that particular thing is going to happen, but they have to know that there's a cost to doing something like that.

I think the point is that most people who use the outdoors are not interested in damaging it, but I think most of them aren't aware of what they're doing.

The Chair: Thank you very much, Dr. Ricciardi and Dr. Johnson.

I want to say thank you on behalf of the committee for taking the time today to meet with us and answering our questions. It's been very helpful and we really do appreciate it. Thank you, once again.

There being no further business, this meeting is adjourned.

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