

14th International Conference on Aquatic Invasive Species Trip Report

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“If meetings could kill invasive species, they would all be dead by now.” – attributed to an unknown tired government biologist

Background

It is our understanding that this conference originally was developed to present information on zebra mussel invasions. It has since evolved into an international conference that looks at a variety of aquatic invasion issues. Dan and Lisa of PWSRCAC and Linda Shaw of NOAA/NMFS were the entire Alaska contingent. Below is a summary of the information presented at the conference during the sessions attended by staff. Some of the information just was not relevant to our interests and will not be covered in this trip report. Lisa and Dan both have copies of the complete abstracts.

Plenary Session

Sue Haseltine with the USCG pulled together some themes she saw emerging from the conference agenda:

- Moving from species to ecological/economic impacts
- Invasion pathways
- Working collaboratively
- Information sharing: she stressed here that we need to focus on the science community to encourage the sharing of research and monitoring results. The science community needs to not only alert us to invasions, but most also forecast and model potential harmful invasions.

Jim Tate, the Science Director to the Secretary of the Interior, briefed the conference on the National Invasive Species Council (NISC) and announced that a five year review was just released. He said that the Invasive Species Advisory Committee (ISAC) also provided a white paper to NISC on what is and what is not an invasive species.

Tim Keeney, the Deputy Assistant Secretary of Commerce for Oceans and Atmosphere, NOAA, said there were knowledge gaps that made management difficult. He said that we have made substantial progress on research, but now needed to make progress on how to use the research to prevent impacts. He said that there has been a lot of progress made in the area of ballast water management including the USCG regulations and that new international regulations were on the

horizon. [It is important to continue to point out that the TAPS trade tankers in the coastwise trade are exempt from USCG ballast water exchange and reporting requirements.]. Keeney went on to say that there needs to be more emphasis on education – non-regulatory avenues to reduce risk. He also said there are very few studies on benefits/costs and we needed more socio-economic research.

Don Schmitz gave a presentation on the idea of a National Center for Biological Invasions in the United States. Schmitz was the speaker that presented the quote at the beginning of this trip report. He went through the numbers of federal and state agencies, organizations, and councils involved in invasive species issues. He found 143 on-line invasive species databases. He said the formation of NISC in 1999 was an important first step, including the development of a national plan, but that NISC lacks resources (for example NISC has a staff of 10). Schmitz promoted the idea that one federal agency should take responsibility. He presented the CDC (Centers for Disease Control and Prevention) as a useful national model. Schmitz said we need to establish a National Center for Biological Controls and set national standards. His example for national standards was the fact that various terms are used for bioinvasions such as invasive species, exotic species, etc.

Ballast Water Policy Progress and Updates: Challenging the World

Rich Everett of the USCG gave the first presentation on the USCG Aquatic Nuisance Species program. Everett reviewed the two major pieces of US legislation to date: NANPCA 1990 which addressed the Great Lakes and NISA 1996 which addressed the whole US. He said we now have a mandatory program for ballast water management in the US [which does not apply to the TAPS trade tankers in the coastwise trade]. Currently the USCG is working on a ballast water discharge standard. They need to evaluate alternatives to ballast water exchange.

Everett mentioned the Ballast Water Technology Test Facility which is a partnership between the USCG and the Naval Research Laboratory. The purpose of the facility is to validate and refine EPA-ETA protocols. Pilot tests were to begin shortly. The facility is located in Key West.

Everett also went over the Shipboard Technology Evaluation Program (STEP). The goals of STEP include:

- Encourage installation of ballast water treatment technology
- Promote credible and rigorous performance tests
- And to grandfather in any alternative systems even if they do not meet the future standards.

The future activities for the Aquatic Nuisance Species program include:

- Publishing a ballast water discharge standard rule
- Approving ballast water management systems

Everett also mentioned pending legislation in Congress which provided various directions for the USCG.

We learned quite a bit about NOBOBs (No Ballast on Board) ships. Although we do not have NOBOBs in our tanker fleet, it is worth knowing the issues surrounding NOBOBs. NOBOBs carry sediments and residual water in ballast tanks and still provide an invasion threat. In the

Great Lakes, they will pick up water and discharge water during their normal transit within the lakes. Bivan Patnaik of the USCG said that currently the NOBOB policy is voluntary and it advises vessels to conduct ballast water exchange prior to entry into the Great Lakes. Salt water flushing when possible is also advised. And vessels are advised to report use of practices to the USCG.

Ballast Water: Advances in Science

Monaca Noble for Portland State University gave a presentation on the transfer of plankton species in coastal ballast water. In the Columbia River, 31 species have been introduced due to ballast water or hull fouling. The concern is that freshwater plankton species are being transferred from one freshwater system to another (i.e. port of Sacramento to the Columbia River.) Ballast water exchange is required by both the States of Washington and Oregon. Ballast water exchange is effective in reducing freshwater plankton.

Linda Farmer of the University of Miami gave a presentation on introductions via cruise ships since they carry ballast water. The vast amount of shipping traffic in Miami is cruise ships and although they do not carry a lot of ballast, introductions occur almost weekly. The cruise ships are making repeated trips along fixed routes.

Stephan Gollasch of Go Consult, gave a presentation on ballast water sampling – options for rapid sampling analysis. He said that currently there is no standardized sampling equipment available. He looked at various sampling techniques – about 40 of them. He asked the question, “how can you compare results when they all use different technology?” Gollasch then went over a new sampling device he said was very efficient. He also gave advice for pump sampling and trap sampling. He said that all our best sampling efforts are an underestimate of the number of the organisms in the tank. Gollasch went over IMO sampling guidelines. The IMO provides guidance for compliance control sampling. What is still unresolved includes the sample access point (discharge line vs. in line sampling) and sample volume. He speculated that these issues and others should be resolved this year by the IMO.

Derik Gray of the University of Windsor discussed open-ocean ballast water exchange used for preventing transfer of invertebrates between freshwater ports. He pointed out that invertebrate eggs in ballast water pose a risk as eggs can hatch in the dark tank conditions. Resting eggs and benthic invertebrates can be present in sediment. Through his research, he found ballast water exchange to be over 95% effective at removing freshwater planktonic invertebrates but not as effective on diapausing eggs.

Meghana Gavand of the University of Alabama went over laboratory experiments that used three treatments:

- Sonication – formation of cavitation microbubbles and release of energy
- Hydrogen peroxide which degrades quickly in water and
- Ozone used in low concentrations.

The experiments used these treatments in various combinations. The results indicated these treatments combined would be effective in combating various life stages (cysts, larvae, adults) of aquatic and marine macroinvertebrates in ballast water. The combination of all three treatments leads to the highest mortality of about 90%.

Monitoring, Detection, and Response

Jemma Martin of the Department of Agriculture, Fisheries, and Forestry in Australia talked about comprehensive baselines (presence/absence) surveys being carried out in high risk ports around Australia and New Zealand. Both countries have recognized the importance of on-going monitoring and have developed a set of standard, quality-assured quality-controlled (QAQC) procedures for marine pest monitoring. Both countries will publish a marine pest monitoring manual that will be e-published in late 2006.

Ballast Water: Advances in Control Technologies

George Smith of the Smithsonian Environmental Research Center, gave a presentation on Venturi Oxygen Stripping (VOS). During this presentation he went over the IMO standards:

- <10 viable organisms/m³ in the 50 micron size class and above
- <10 viable organisms/m³ in between 0 – 50 microns

Smith mentioned the June 2005 workshop that was held in Portland, Oregon to try to set standards for evaluation testing. He said the workshop participants agreed that testing should be tiered as follows:

1. Mason jar tests
2. Mesocoms tests
3. Shipboard tests

Smith then went over VOS and said it creates severe hypoxia in ballast water, asphyxiating biota and reducing corrosion in the tank. After performing the jar and benchtop tests first, they performed their shipboard testing on a bulk carrier. They were able to meet the IMO zooplankton standard with the VOS. They did not observe any chlorophyll grow-out. However, VOS did not knock out e coli.

Stephan Gollasch presented information on a ballast water treatment system called “The OceanSaver.” He described it as a modular, three step approach that includes 50 micron filtration, nitrogen injection, and a cavitation unit. He said an existing vessel can be retrofitted with the system as it has a small footprint. The system was tested on a RO/RL carrier using only the filtration and nitrogen components of the system. The results showed a reduction in the number of organism: from 3000 per ton to less than 500 on day two of the experiment. Future plans include longer term experiments, using the cavitation unit, and corrosion tests. Overall, Gollasch was optimistic about this system.

The next presenter was Georges Robichon of Fednav Limited, a shipping company out of Canada. He too was presenting on the OceanSaver system but from a shipowner’s point of view. Fednav is the largest ship operator on the Great Lake and charter operator in Canada. Fednav had previously tried a couple of biocides but the results were inconclusive. They decided they did not want to be associated with biocides anymore.

In 2004, they were approached about the OceanSaver system and made a ship available as a platform for testing the system. Then they purchased a prototype. Robichon was pointed out that the “small footprint” comment in Gollasch’s presentation was a slight exaggeration as the equipment is big. It cost Fednav \$1 million to purchase the prototype. Robinchon went over some of the advantages to the system:

- No significant impact on ballasting transit time
- No additional power needed as it is fully automated
- Nitrogen removes the oxygen thus may be impeding corrosion. Having to recoat the ballast tanks is expensive.

Robichon made a point of mentioning that Allegra Cangelosi has participated in the testing of this system. [Allegra is a member of NISC among other things]. He went on to express his frustration with US legislation (specifically Michigan law) in the Great Lakes and said that the shipping industry is facing a complete shut down in the Great Lakes. The Michigan law requires permits to discharge in the Great Lakes by January 2006 and four systems have been endorsed by Michigan (deoxygenation, UV, chlorine and some other system). Robichon was not sure how they came up with this and said it was very easy to attack the shipping industry.

Yves de Lafontaine of Environment Canada gave a presentation on ballast water treatment systems used at very cold water conditions. He said that in St. Lawrence, the water is at 1 degree C for four months a year and this can have an effect on ballast water treatment systems such as chemical treatment which is supposed to degrade in water. In these experiments, two treatments were evaluated: a biological treatment called “Bella Clean” and a chemical treatment called “Peraclean Ocean.” The experiments were conducted in very large tanks at temperatures between 0.6 and 1.9 degrees C. It was concluded that both these treatment options can effectively treat ballast water under a wide range of temperatures and salinities. Lafontaine pointed out that results of treatment efficacy tests at one temperature may not be applicable to all temperatures.

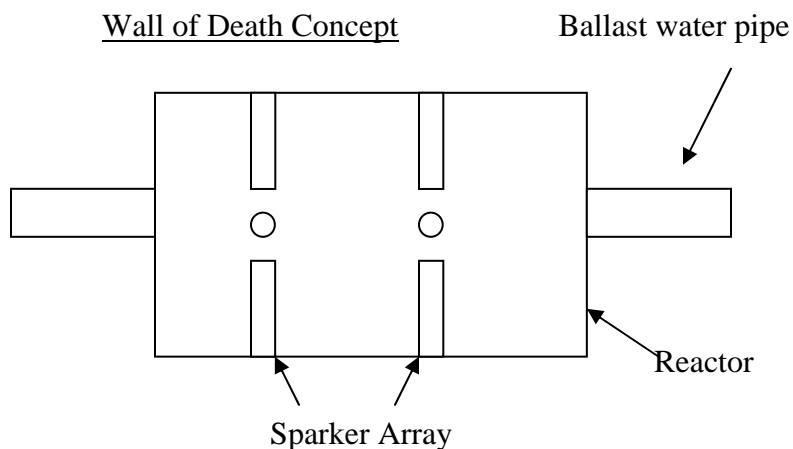
Steve Bollens from Washington State University gave the next presentation regarding the use of carbon dioxide as a treatment. Bollens mentioned that there has been other research and patents on the use of CO₂ including use of other treatments systems. He said it was inexpensive (estimated at about 16 cents per ton of ballast water) and readily available. He also said the chemical biological effects dissipate in sea water. The research he presented showed a very significant reduction in zooplankton. He was not sure about its effects on pathogens and said this needed more research as well as more investigation into corrosion issues and downstream effects.

Tom Perlich of Echochlor Inc. spoke about chlorine dioxide, which is an approved treatment for drinking water. He said it was highly effective on all organisms and environmentally acceptable. He has submitted two applications for this treatment system to the USCG STEP program and an application to Washington State. He described a fully automated system with a small footprint (9m² or 80ft²). He said that the operation of this system did not effect ballasting operations at all. The treatment was shown to have a high effect on zooplankton, vibrios, and e coli colonies. Re-growth will need to be addressed with subsequent testing.

Another treatment option described by a speaker in this session included ferrate which is a powerful oxidant. The speaker said it had good potential for ballast water treatment. Another speaker described using ground-up waste tires for filtration systems. In the end, the removal efficiencies found in his study did not meet IMO standards.

Dan McClary gave an interesting presentation on some alternative options for dealing with invasives in coastal waters. He talked about biocides, smothering and manual removal. He showed a project where they used hot water to sterilize a substrate where invasive seaweed grew in New Zealand.

The last presentation in this session was actually the most interesting, partly because the speaker had a great sense of humor and spoke well. The presentation was on the use of a sparker-based ballast water treatment methodology given by Renata Claudi of RNT Consulting, Inc. A “sparker” involves the use of a high voltage spark passed between two electrodes submerged in water. The sparker vaporizes the water producing a plasma bubble. There are multiple effects. Sparkers have been previously used to control zebra mussels, and slime and algae and also to disinfect water. The sparker described in this study is 25 times more efficient than the previous sparker. Claudi described her “wall of death” concept (diagram below). The studies she described were small scale (sparker in a rubber maid type tub). She thinks the technology is promising but they need to evaluate how many pulses cause death, does temperature have an effect and is it repeatable.



Monitoring, Detection and Response

Paul Heimowitz of the USF&WS gave a presentation on applying spill response lessons to aquatic invader response planning. He described the introduction of aquatic invaders as an oil spill in slow motion. Heimowitz went over a number of oil spill lessons learned (that keep popping up with each spill – thus not learned well) that he said applied to invader response planning:

- “Create an adequate National Response fund.” Such a fund is also needed on the invasion side, especially since there is not typically a “responsible party” for the invasion vs. an oil spill.
- “Plan for a worst case scenario.” Heimowitz said that the tendency is to assume a worst case scenario could never happen, but experience has told us otherwise in both oil spills and aquatic invasions.
- “Integrate response plans at local/regional/national scale.”

- “Know (and agree) who is in charge.” He went over the Unified Command system briefly.
- “Establish roles and responsibilities before the incident.”
- “Notify everyone who cares.”
- “Define specific objectives; review and update constantly.”
- “Be aggressive in minimizing spread.” For example, requiring boat cleaning or prohibiting boat movement to minimize the spread of invasive species.
- “Maintain adequate caches of equipment” or expertise.
- “Establish an effective communications system.”
- “Hold frequent coordination meetings.”
- “Regularly broadcast accurate news via Joint Information Centers.”
- “Test the notification and response system periodically.”
- Evaluate the response; document lessons learned.”

Ship Fouling: Another Vector

Martin Davis of Fawley Biofouling in the UK gave the first talk. Hull fouling is a more important vector for sessile species with a brief larval phase (vs. ballast water). The antifouling coating used in the past was very effective, but also very toxic. Self polishing coatings require substantial flow to be effective. They are ineffective in low flow areas. One alternative suggested by Davis was to use a floating curtain and soak the hull of the ship in treated water. The treatments must be rapid, easily contained and have minimal effect on the surrounding environment. Options include heat, osmotic shock, deoxygenation, oxidizing biocides and a combination of treatments. Davis went back to his curtain idea and described the process of booming the ship with a curtain, using warm, low oxygen water, and using the ship’s engine to heat the water. The boom could be stored and deployed at a shoreside facility and solar panels could be used for the heating. He estimated the cost to be \$25,000 for the boom but posed the question about who pays for it?

Oliver Floerl of the National Institute of Water and Atmospheric Research in New Zealand talked about hull fouling issues in New Zealand as it relates to recreational yachts. He said ship hull fouling, sea chests and ballast water were the principle vectors, but that hull fouling may be the most important vector. New Zealand is a commercial and recreational shipping hub. They have mandatory ballast water management but no hull fouling regulations. Floerl described a standardized sampling design that they can use on many types of vessels including oil rigs. They divide the board into three quadrants for sampling and take opportunistic samples from places such as the bow thruster tubes and keel. The preliminary results (from the yachts only) indicate that 80% of the yachts arriving in New Zealand have fouling on their hulls. The IDs are still in progress but invasive species were encountered. They found more incidence of fouling in cryptic spaces than on the general hull surfaces.

Ashley Coutts, also from New Zealand, gave the next talk on hull fouling. He described a study where settling plates were attached to the vessels. They used powerful magnets to attach a stainless steel plate (275 x 200 x 10.4 mm); the settling plates were on top of the steel and were made of black acrylic. They used different vessel types and speeds ranging from three to 22 knots. The plates survived the voyages but I (Lisa) did not record the results in my notes, nor are

they in the meeting abstracts. I think that the author and his team were still evaluating the results.

Coutts gave the next presentation as well on species transfer in ship's sea chests. Sea chests are recesses built into a ship's hull below the water-line and covered with a grill. This is the intake for ballast water, exchange cooling, etc. The size and number of sea chests depend upon the size of vessel and need for ballast water. The researchers looked at vessels in dry dock – lots of fishing vessels, one tanker, one tug, one cruise ship, etc. They encountered 150 taxa. Mollusks and crustaceans were quite high. There was the potential for associated pathogens and parasites to be dispersed by adults trapped in the sea chests. Factors that influence colonization of sea chests include:

- Age of anti-fouling paint
- Sea chest treatment system – what are they?
- They were unable to determine other factors including ship speed.

He said adults are able to spawn in the sea chests and could inoculate a harbor that way. Coutts finished by saying that sea chests may be of greater importance than ballast water and hull fouling for certain species.

Ian Davidson of Portland State University gave the next talk on patterns of and invasion risk of hull fouling on the US pacific coast. This work was in collaboration with Mark Sytsma also of PSU and Greg Ruiz of the Smithsonian. Davidson said that on the Pacific Coast, ballast water transfer has been studied and legislation has been implemented to address the problems, but less has occurred in the area of hull fouling. This research involved collecting data on shipping patterns and estimating the flux of wetted surface area (WSA) between ports. The results of their study indicate that ship type is a good predictor of hull fouling due to several factors such as vessel speed and port duration.

Stephan Gollasch spoke next on a German study regarding hull fouling. In the study, they looked at ballast water, tank sediment and hull fouling and found the highest number of non-natives in the hull fouling samples. 98% of the hull fouling samples contained at least one non-native species. They did not look at sea chests. Gollasch pointed out that even on cleaned, anti-fouling painted ships, fouling occurs at the dock support straps – where the boat rests during dry dock. Gollasch also informed the audience of a new European aquatic invasions online journal – <http://www.aquaticinvasions.eu>.

Carolyn Junemann described the US's Maritime Administration's obsolete ships and hull fouling. The Maritime Administration is responsible for disposal of large government and private ships – mostly non-combatant ships. They have an open offer for using the ships for ballast water testing as the ships are not really obsolete. They also need to look at hull fouling issues before the ships are moved from place to place. They had a ship that had two inches thick fouling that they wanted to move from the San Francisco Bay area to Brownsville Texas.

Ecosystem Management and Restoration: Pushing Back

Linda Dress gave an overview of the comprehensive response used by the National Park Service in dealing with invasives. The National Park Service was created in 1916 to protect natural and cultural history. There are now 2.6 million acres infected with invasive species. There are 3,576

non-native plants, 414 non-native animals, and 118 non-native fish recorded in the park service area. As more people visit the parks, more non-natives arrive. She described the African Oryx at the White Sands National Monument. It is as big as an elk and caused degradation to the monument. The animals were relocated. Within the park service there are 16 exotic plant management teams. Looking ahead, the park service has to work smarter and with fewer funds. They plan to focus more on education and partnerships. She mentioned that they have a DVD entitled “Invaders in the National Park.”

Sara Pelleteri talked about aquatic invasive species response in Hawaii. Hawaii published its Aquatic Invasive Species Plan in 2003 and Pelleteri is the coordinator. The plan calls for an AIS Advisory Group, as well as an AIS Response Team. The team was set up in 2005 and has four people. She talked about the “Supersucker” which looks like a giant vacuum cleaner used for aquatic response. The machine was the result of collaboration between the state, the University of Hawaii and the Nature Conservancy. It is a large pump that sits on a barge and is used to suck up invasive algae. Invasive algae form large dense mats that can completely kill corals. It is capable of sucking 750 pounds of algae an hour or 3000 pounds per day. They are developing another smaller, more mobile machine. The state has also brought an outreach coordinator on board to help with the education and volunteer efforts.

The next talk by Wei Ying Wong of Brown University was about culture and invasive species management. It was very interesting as I had not heard anyone talk about cultural issues associated with invasive species management before. Wong posted the question, how do different stakeholder groups understand and represent the issue of invasive species. She focused on the Chinese Mitten Crab which is native in China and North Korea. She interviewed scientists and the general public on the crab. It is considered a delicacy in many Asian communities. It is said to fetch \$40 per pound on the black market. There is a high local (California) and international demand for the crab. California has one of the largest Asian communities. She spent many days interviewing the public in San Francisco’s China Town. 69% of the public knew where the crabs were originally from and they also said it was an important food source. 45% of the public knew that the crabs can be found in California. 37% had heard that this was a problem. 67% thought the government should allow a harvest while 12% did not agree with a harvest. Her key findings were:

1. Food. The crab is an important food source. One person in her study said “The most important thing is that it’s good to eat” for example.
2. Sense of waste.
3. Issue of racism, disenfranchise, telling people what to do
4. Concept of belonging
5. Cultures in conflict

Wong concluded by saying we need to think beyond science and economics.

Predictive Risk Assessment

Dianna Padilla of Stony Brook gave a detailed presentation on predicting the characteristics of aquatic invertebrate invaders. In the end she said that based upon the current state of knowledge, the best predictor of successful invaders is a successful invasion elsewhere.

Later in the session, Duane Chapman of the USGS spoke about “niche plasticity.” He spoke about the unknown capabilities of a species. The unknown capabilities may be unknown to begin with or the species may evolve to develop new capabilities. The example he presented was the round goby. These animals change to adapt to a new environment, which is different than the natural life history that can be found in the literature. He also spoke about the Asian Carp – the literature did not accurately describe range and tolerance of the carp. Animals change and we need to find new ways to address this in risk assessment.

Summary – Lisa

I was very impressed with this conference overall. It was very well-organized, speakers stayed on topic and within their time allotments. The participation was excellent as countries all over the world were represented. We met a lot of knowledgeable people and had the opportunity to share some of the invasive species issues we face here in Alaska.

There did not seem to be anything really new and exciting regarding ballast water treatment. What impressed me more was that hull fouling is emerging as a vector of the same, if not more, concern as ballast water. This may be an area of interest for PWSRCAC in the future.

On the regulatory side of things, there is still not much movement in the US legislative body on management standards or what those standards might end up being. This seems to be a frustrating situation for anyone in the aquatic invasives field.

The next conference will be held in the Nijmegen, the Netherlands in October 2007.