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Report of the ICES/IOC/IMO Working Group on Ballast and Other Ship Vectors
(WGBOSV)

12-14 March 2012, Lisbon, Portugal
Report of the ICES/IOC/IMO Working Group on Ballast and Other Ship Vectors (WGBOSV)

12 – 14 March 2012
Lisbon, Portugal
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Executive summary

The ICES/IOC/IMO Working Group on Ballast and Other Ship Vectors (WGBOSV) met from 12th to 14th March, 2012 at the European Maritime Safety Agency (EMSA) in Lisbon, Portugal with Brian Elliott (EMSA) as host and Tracy McCollin (United Kingdom) as chair. In total there were 39 participants representing 19 countries and EMSA over the course of this meeting and the joint meeting on the morning of the 14th March with the Working Group on Introductions and Transfers of Marine Organisms (WGITMO) (Annex 1).

The meeting covered a range of objectives, the group were updated on the status of shipping vector research, discussed methods and procedures used at ballast water treatment test facilities, risk assessment and pathway management methodologies.

Two of the Terms of Reference were completed during a sub-group meeting of WGBOSV in London from 26-27th January, 2012. The sub group met directly before a meeting of the Bulk Liquids and Gases (BLG) subcommittee meeting at the IMO to discuss proposed guidelines on ballast water sampling and analysis. The outcome of the group’s discussions was then provided to the BLG meeting the following week by the chair (Tracy McCollin) representing ICES. A summary of the meeting was given at the meeting in Lisbon and a short meeting report is provided in Annex 3.

The approach taken at the meeting was for each country to provide an update on the status of shipping vector research and other interesting information in the form of a National Report. These are provided in Annex 4 and a short summary is given in the main body of the report. For some Terms of Reference a more detailed presentation was given during the meeting and a short overview of the information and subsequent discussion is provided in the report at the end of each section. The report is structured so that each Term of Reference is dealt with in sequential order apart from ToR c) and e) which are combined. The main body of the report contains summaries of the presentations and discussions with the more detailed documents being contained in the Annexes.

The main outcome of the meeting was a better understanding of the work being carried out in different countries and where there may be opportunities for collaboration, recommendations regarding what information may be needed to carry out risk assessments and how this relates to the current IMO (G7) guidelines and exemptions and a wide ranging discussion regarding the potential improvements that could be made to the IMO guidelines for approval of ballast water management systems (G8).
1 Opening of the meeting

The meeting was opened by Tracy McCollin who welcomed all the participants and introduced Brian Elliott from the European Maritime Safety Agency (EMSA) who had kindly agreed to host the meeting. Brian Elliott welcomed everyone to Lisbon and gave a brief introduction to EMSA and the arrangements for the meeting. As there were some people new to the meeting introductions were made around the table with everyone giving their name, institution and a brief overview of their main work in relation to the group.

2 Adoption of the Agenda

The agenda (Annex 2) was reviewed and there were no major changes, only slight adjustments to allow for people arriving later in the day.

Gemma Quilez Badia (Spain) was appointed as rapporteur.

3 Terms of Reference

WGBOSV – ICES/IOC/IMO Working Group on Ballast and Other Ship Vectors

2011/2/ACOM32 The ICES/IOC/IMO Working Group on Ballast and Other Ship Vectors (WGBOSV), chaired by Tracy McCollin, United Kingdom, will meet 26–27 January 2012 in London and in Lisbon, Portugal from 12–14 March 2012, with a back to back meeting with the Working Group on Introductions and Transfers of Marine Organisms (WGITMO) to:

a) Continue to critically review and report on the status of shipping vector research with an emphasis on new developments in ballast water treatment technology and ballast water sampling and analysis in order to support the ongoing work at IMO. Discuss the methods and procedures used at test facilities and invite participation from operators of such facilities to attend the meeting.

b) Taking into account current risk assessment and pathway management methodologies, recommend principles for risk assessment under IMO Guidelines for risk assessment under Regulation A-4 of the BWM Convention (G7).

c) Further discuss and evaluate the sampling strategies under consideration at IMO and provide comment to relevant IMO committees and their correspondence groups. Solicit experts statistical advice to support this work.

d) Re-establish and elaborate the cooperation with PICES WG 21,

e) Discuss and prepare expert input on the International Maritime Organizations Ballast Water Sampling guidelines that are currently under development (January meeting).

WGBOSV will report by 13 April, 2012 to the attention of ACOM.
Supporting Information

<table>
<thead>
<tr>
<th>PRIORITY:</th>
<th>THE WORKING GROUP REVIEW AND REPORT ON THE SCIENTIFIC AND TECHNICAL DEVELOPMENT IN RELATION TO BALLAST WATER AND SHIPPING VECTORS. AS A JOINT WORKING GROUP IT ALSO FOLLOWS AND SUPPORTS THE WORK WITHIN IMO AND IOC ON THESE TOPICS.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scientific justification and relation to action plan:</td>
<td>e) WGBOSV has a long history of providing scientific support to the development of international measures to reduce the risk of transporting non-native species via shipping vectors. The group has had input into the issue of Ballast Water Sampling guidelines in several ways. The issue has been discussed at the annual meetings of the Working Group. Members of the group have contributed to the correspondence group set up by IMO to develop the guidelines for submission to BLG. The working group has previously submitted documents to meetings at IMO to support the development of these guidelines. This type of input helps ensure that the guidelines are based on accurate scientific information and supports the implementation of the Ballast Water Management Convention.</td>
</tr>
<tr>
<td>Resource requirements:</td>
<td>None</td>
</tr>
<tr>
<td>Participants:</td>
<td>The Group is normally attended by some 25–35 members and guests.</td>
</tr>
<tr>
<td>Secretariat facilities:</td>
<td>None.</td>
</tr>
<tr>
<td>Financial:</td>
<td>No financial implications.</td>
</tr>
<tr>
<td>Linkages to advisory committees:</td>
<td>ACOM</td>
</tr>
<tr>
<td>Linkages to other committees or groups:</td>
<td>There is a very close working relationship with the working Group on Introductions and Transfers of Marine Organisms (WGITMO) and the Working Group on Harmful Algal Bloom Dynamics (WGHABD). There is also a link to PICES Working Group 21.</td>
</tr>
<tr>
<td>Linkages to other organizations:</td>
<td>The work of this group is closely linked to work carried out by the European Maritime Safety Agency (EMSA), the International Maritime Organization (IMO) and the Intergovernmental Oceanographic Commission (IOC).</td>
</tr>
</tbody>
</table>
4 Progress in relation to Terms of Reference

4.1 Term of Reference a)

Continue to critically review and report on the status of shipping vector research with an emphasis on new developments in ballast water treatment technology and ballast water sampling and analysis in order to support the ongoing work at IMO. Discuss the methods and procedures used at test facilities and invite participation from operators of such facilities to attend the meeting.

This Term of Reference was achieved by a representative from each country providing an update via a National Report. The summaries for each country are provided below and the National Reports, where provided, are contained within Annex 4. A short summary of the main points of discussion is given at the end of the section.

4.1.1 Belgium

There is no work currently on ballast water or biofouling issues in Belgium although the Ballast Water Management Convention is in the process of being ratified. However, there has been some work carried out looking at fouling on windmill farms and a range of species has been found, including some non natives.

4.1.2 Canada

Canada continues to conduct extensive research on transport vectors, management strategies and risk assessment. There have been no reports of new ship-mediated invasive species in the last year, although monitoring programs are limited and assessment of taxa present in Canadian Arctic ports has just begun. Current research studies include biological assessments of species transported by commercial and military shipping (hull fouling, ballast water) to the Canadian Arctic as well as examination of sea chests and rate of ballast sediment discharge by vessels in the Atlantic and Pacific regions. In addition, work is on-going to examine the risk associated with recreational vessels in the Atlantic, Pacific and Great Lakes regions. Management studies are being undertaken by the Canadian Aquatic Invasive Species Network (CAISN), which focuses on development of early detection and rapid response strategies. In addition, shipboard trials are being planned to examine a combination strategy for ballast water management, ballast exchange plus ballast water treatment, as a means to protect low salinity waters. Further, mitigation of invasive tunicates by removal of floating docks is being evaluated in an eastern Canada marina. Risk assessments have been initiated for the commercial and recreational shipping pathways.

4.1.3 Croatia

A National Strategy on Invasive Alien Species in Croatia is being prepared by the State Institute for Nature Protection.

Ballast water risk assessments for the main ports in the country are in the process of being established. These are based on a study of environmental zero status in three Croatian ports (Rijeka, Split and Ploče), which was carried out by the Croatian marine institutes under the supervision of the Ministry of Maritime Affairs, Transport and Infrastructure as a part of the GloBallast Partnership Project.

In last two years, three new invasive alien species were recorded in the Eastern Adriatic Sea. Among them, six specimens of the bivalve *Anadara transversa* (Say, 1822)
were found on the muddy bottom in the innermost part of Lim Bay (Northern Adriatic). Dwarf flathead *Elates ransonnetii* (Steindachner, 1876) and Creole fish *Paranthias furcifer* (Valenciennes, 1828) were caught in the Eastern Adriatic Sea as well. The possible introduction vector for the first species was ballast water and an oil platform was the likely introduction vector for the second species.

The blue crab, *Callinectes sapidus*, Rathbun, 1896, due to its remarkable increase in abundance in the Neretva River Delta, will be promoted as a new food source on the local market in terms of reducing eventual potentially negative impacts on the indigenous fauna.

### 4.1.4 Estonia

Two new alien species findings were reported for 2011: the palemonid shrimp *Palaeomon elegans* and the Harris mud crab *Rhithropanopeus harrisii*. Both species have been found earlier in other parts of the Baltic Sea, but not in Estonian waters. However, their invasion vectors are unknown. Monitoring of alien species in marine waters was started since 2010. Field sampling for zooplankton and macrozoobenthos (by using HELCOM methodologies) was carried out in the high-risk area of new invasions of the country – Port of Tallinn and its vicinity, together with continuation of the already existing long-term surveys on selected invasive alien species. One of the tasks for the alien species national monitoring program for 2011 was to compile an overview on any documented ecological impacts of alien species. It was concluded, that perhaps the most impacting alien species in Estonian marine waters is the predatory cladoceran *Cercopagis pengoi*.

### 4.1.5 France

There are a series of projects being undertaken in France, these include sampling ballast water discharges to detect any potentially toxic non native phytoplankton. There have also been studies of whether discharged ballast water would affect oyster beds. Another study is examining the presence of *Alexandrium tamarense* cysts in ballast water samples and another is tracking potential pathogenic bacteria and toxic phytoplankton. A thesis on a ballast water treatment that uses a membrane filtration system has also been completed.

### 4.1.6 Germany

- Since the last reporting period Germany has approved four new Ballast Water Treatment Systems (BWMS). Two systems use active substances and two use UV radiation for treatment.
- An additional guidance regarding ballast water sampling for compliance control is under development. This document was discussed in a correspondence group led by Brian Elliott of EMSA and further discussed in detail at recent BLG meeting.
- A paper regarding minimum data requirements for the non-confidential part of basic and final approval dossiers for BWMS submitted by Germany to MEPC 63 (held in March 2012) and was accepted by the committee. This paper will be circulated by the IMO.
- Germany was actively involved in the development of the IMO hull fouling guideline which was agreed at IMO.
• A “Platform for Information Exchange on Neobiota” has been established in the framework of the “Federal and Federal States Marine Monitoring Programme” in Germany.

• A risk assessment project for intra-Baltic shipping was completed in Nov 2011 as a contract of HELCOM.

• The German Federal Maritime and Hydrographic Agency initiated a research project on risk assessments for ship voyages between harbours in the North Sea and in the Baltic Seas.

• On 2 November 2011, a very dense, well established population of G3-complex-Claviceps purpurea was found on the common cord-grass at two localities on the German North Sea coast in the Wadden Sea.

• Monitoring projects are underway which also include sampling sites in commercial ports. Knowledge on alien species is an essential component of risk assessment based exemptions of ballast water management requirements, which the first shipping lines apply for.

4.1.7 Netherlands

In the Netherlands a lot of work on ballast and other ship vectors are going on. In the field of ballast water research the North Sea Ballast Water Opportunity (NSBW0) project led by the NIOZ delivered workshops, organized ballast water related conferences at Europort, Rotterdam for the Dutch industry, performed background studies on detection of microorganisms present in ballast water, viability and long-term survival of microorganisms in ballast water and the forgotten organisms < 10 micron in the BW discharge standard.

As part of the NSBW0 project IMARES Wageningen UR investigated the ecological risk of treated ballast water using experimental ecosystems, the so-called mesocosms. The first results from this project were presented at the GloBallast conference in Istanbul, November 2011. It was concluded that replacement of water without remaining active substances is not free from effects. However, the level of toxic substances present in the treated water corresponded with the amount of effects. Effects seen in bioassays were not directly copied in mesocosms. Results might be affected by physical characteristics like pH, oxygen, DOC, N/P. However, high risk indicated by the toxicity tests corresponded with high level of disturbances of the ecosystem.

The NIOZ tested several Ballast Water Management System (BWMS) during the last year for certification. IMARES Wageningen UR tested the toxicity for certification for three BWMS in 2011 and was involved in pilot scale efficacy testing for two BWMS. Both institutes took part in the GloBalTestNet meetings and for the next few years Dr. Jan Boon from the NIOZ will take the lead in this group together with a representative of Asia and the USA. NIOZ and IMARES Wageningen UR took part in a TAG team for advising the set up for compliance monitoring in California, USA.

The Dutch government co-ordinates an expert group on hull fouling since 2011. Research on the pathways for hull fouling made by the Team Invasive Exotic Species (TIE) is under development. A methodology for analyzing and sampling hull fouling using DNA 454-sequencing has been prepared for the Maritime Campus Netherlands. Ongoing research on effectiveness testing of (new) antifouling and corrosion paints is being done by TNO Industry and Technique. An innovative technique using short fibres “thorns” as hull fouling has been investigated and tested by Micanti. The non-toxic hull fouling type seems promising.
GIMaRis has made an inventory of the Dutch Wadden Sea on bases of literature study and field monitoring. Here, two new species *Ceramium botryocarpum* and *Ceramium tenuicorne* had been recorded for the first time as settled/attached individuals in 2011. The Netherlands is also involved in a Global method for the rapid detection of alien fouling species, the SETL project. This is an ongoing monitoring project performed by GIMaRis from 2006-2012.

“Pleasure crafts” as a transport vector of invasive species have been investigated by GIMaRis. For this project several of hundreds of boats in various harbours along the Dutch coast were photographed and/or filmed in detail and analysed. Information from the transport routes of the ships was collected using information from harbour masters and boat owners. Preliminary results indicate that pleasure crafts are a very important, if not the most important transport, vector of alien species along the Dutch coast. Clear (significant differences in fouling species diversity and abundance) distinctions can be made between lower and higher risk harbours and boat types could be made.

The University of Groningen studies in enclosed land-locked saline ecosystems the survival of transported species in sediments in relation to ballast water conditions. IMARES Wageningen UR is pioneering with the genetic analysis of flora and fauna from sediment samples.

The Dutch Team Invasive Exotic Species gave special attention to the EU strategy on Invasive Alien Species and the trilateral policy on invasive species for the coastal areas in their workplan for 2011.

IMARES Wageningen UR is more and more using their large databases from multi species monitoring programs and surveys to investigate the development of IAS. Special focus from the research team is innovations using DNA sequencing techniques and early warning for new entries.

### 4.1.8 Norway

Norwegian Institute for Water Research (NIVA) is continuously conducting many internal research projects in parallel to pilotscale, shipboard and land-based testing of BWMS at the NIVA’s test facility for BWMS testing according to IMO requirements. Most of the research studies are still going on to establish and improve sampling and analysis methods according to G8/G9 and further ETV protocol (US coast Guard/EPA, 2010). The last three on going research projects at NIVA are for the first one study on false positive results with staining method for 10–50um organism analysis when the ballast water is treated by UV irradiation. The second one is the disinfection by-products (DBP) formation correlation with toxicity results in ballast water treated by BWMS using active substances. The third one was on validation of a PCR method to analyse ballast water for toxicogenic *V. cholera*, in collaboration with the Norwegian Defence Research Establishment (FFI).

NIVA participated in several harmonization effort as the sampling and analysis methods harmonization working group (Global TestNet) initially organised by IMO/Globallast, for intercalibration of the test water preparation method, sampling and analysis methods for each organism group and insurance quality (QAPP, QMP) between all test facilities in the world (Europe, USA and Asia). The last working group occurred in Istanbul in October 2011 and NIVA was the chairman. NIVA did contribute to the IMO Correspondence Group to finalize the Port State Control Guidelines for sampling and analysis in 2011. NIVA was also active at the Workshop
on 10-50um organism sampling and analysis organised by NIOZ as coordinator of EU Interreg Project in March 2011 at Golden Bear Test facility in California, USA.

A first attempt of mapping/monitoring of marine alien species in a more systematic way in Norwegian marine waters has been conducted. (Rapid Assessment Inventories) This study is cooperation between the University of Bergen and IMR. (Husa et al, 2012, a,b).

The Norwegian Environmental Department has made bylaws effective from july 1, 2010, implementing the first part of the Ballast-water Convention. The bylaws regulates BW exchange (depth/distance from shore) but does not make any treatment (e.g. compliance with a D2 standard) mandatory. The Norwegian “species databank” has initiated work in 2010 on a revision of the alien species list of 2007. Simultaneously the risk assessment has been developed into a more generic tool. Both ecological damage and spreading capacity is evaluated and expressed as a “risk matrix”. A new “alien species list” will be published in 2012. The ”Norwegian species database” is an open access database with several reference- and GIF-tools.


IMR is part of a project group having looked at alien species transported by shipping to Svalbard. The samples are under analysis and will be published during 2012. The project has also been extended and funded to sample (ballast water and hull fouling) in vessel(s) going through the NE passage. No “new species” directly attributable to shipping activities found, but the conformation of earlier findings of Diadumene lineata, and Styela clava have likely had boats/ship/vessels as primary and/or secondary vectors.

4.1.9 Portugal

The national project INSPECT- PTDC/MAR/73579/2006 came to an end in December 2011. Study of the characteristics of the maritime traffic routes including Portuguese ports and comparison with the known native distribution of NIS occurring in Portugal, allowed the identification of shipping as the major introduction vector, both through ballast water and fouling. Evidence supports the introduction of NIS mainly by secondary transfer.

In July 2011, the survival of microorganisms (zooplankton and phytoplankton) inside ballast tanks and the efficiency of oceanic ballast water exchange was investigated during a cruise on a container ship between mainland Portugal and the Azores archipelago. This will be the first data set documenting the risk of ballast water transfer in Portuguese regional traffic routes.

At the end of the project 81 NIS were recorded for mainland Portugal, Azores and Madeira (phytoplankton, macroalgae and macroinvertebrates). In the Tagus estuary, where the port of Lisbon is located, 17 NIS were recorded representing the estuary with the highest number of NIS.

The study of the fossil record on sediment cores from different latitudes along the Portuguese coast confirmed the dinoflagellate species Gymnodinium catenatum as non-indigenous in the north Atlantic. However, evidence suggests its introduction is most probably the result of the northward expansion of the natural biogeographical limit from NW Africa rather than an introduction by ballast water (Ribeiro et al. 2012).
4.1.10 Spain

The skeleton shrimp, Paracaprella pusilla, was recorded for the first time in European waters in summer of 2010 in Cádiz harbor (36° 31’N, 6° 17’W), where it was present on the native bryozoan Zoobotryon verticillatum and the native hydroid Eudendrium racemosum in summer months, probably due to the higher water temperature during that season. Ship fouling is the most probable vector for its introduction.

4.1.11 Sweden

In Sweden two research projects are investigating the effects of the recently introduced ctenophore (comb jelly) Mnemiopsis leidyi. Within the “Baltic Zooplankton Cascades”-project the distribution of M leidyi in the Baltic Sea has been monitored and the possible cascading effects on the marine ecosystems caused by this comb jelly investigated. Some of the main outcomes from the project is that salinity (under 6 psu) limits the reproduction of M leidyi in the Baltic Sea and that M leidyi does not seem to be a direct threat to the cod in the Baltic (as it does not ingest cod egg or larvae to any larger extent). A frequent monitoring of jellyfish and zooplankton is also ongoing in the Gullmar fjord on the west coast of Sweden where high densities (biomass) of M leidyi have been recorded in late summer-autumn from 2007-2010. However in 2011 only a few specimens were found. Concerning the implementation of the BWMC in Sweden, work is ongoing (the Ballast Water Law is under construction). There is also work ongoing with questions about and procedure for seeking exemptions from BW treatment.

4.1.12 United Kingdom

The United Kingdom has a mix of practical and desk top studies being carried out in relation to non native species. A biofouling study to assess the risk of introducing non native species via shipping is coming to an end and two studies of the potential spread of non native species via marine renewable energy structures are underway in Scotland. The desk top studies include a network analysis of the spread of invasive marine non native species, which will develop a tool to identify the high risk pathways and vectors and two studies related to biosecurity. One study will review the evidence underpinning advice on biosecurity in the marine and freshwater environment and the other will review guidance on the recognition and eradication of non native species particularly in relation to those that may impact the aquaculture industry.

There is ongoing work to eradicate the invasive sea squirt Didemnum vexillum from Holyhead marina in North Wales and another project will carry out molecular genetic analysis to assess whether the populations of Didemnum vexillum in the UK are all the same species.

A project bid called “Pathways” is being put together for LIFE+ funding from the EU and the project has the overall aim to reduce the risk posed to native marine biodiversity and marine industries from invasive non native species. The project will aim to reduce the risk of spreading non native species through improved biosecurity and improve communication with key stakeholders to encourage early detection and rapid reporting. The project aims to improve the ability to rapidly respond to new non native species and to deliver innovative demonstration projects relating to biosecurity and rapid response.
4.1.13 United States of America

Two federal agencies have actions pending on ballast water regulations and policies. The U.S. Coast Guard will publish its final rule in the Federal Register shortly (approved in February 2012), but the numbers are not available until published. The US Environmental Protection Agency in meeting a court settlement, convened a committee to evaluate methods for ballast treatment that will meet the US Coast Guard standards. Five treatments were identified as meeting the criteria, although three other options were also an option.

Another study, funded through the National Research Council, looked at the issue from a theoretical perspective. The risk of probability using different types of models suggests that all models have a degree of uncertainty associated with them. The committee concluded that no one proxy was adequate for serving as organism density.

One new species identified in the northwest Atlantic, a subtropical worm *Hydroides elegans* was found in an isolated pond in Massachusetts and is not likely to survive. A second species, a bryozoans *Zoobotryon verticillatum* was found for the past couple of years in Connecticut and in 2011 in Narragansett Bay, Rhode Island. Neither are expected to survive the winter season, but *Z. verticillatum* has reinvaded several times.

4.1.14 European Maritime Safety Agency

The European Maritime Safety Agency (EMSA) has a series of objectives that aim to provide technical and scientific assistance to the European Commission and Member States in the proper development and implementation of EU legislation on maritime safety, pollution by ships and security on board ships. EMSA aims to improve cooperation with, and between, Member States in all key areas and to foster technical cooperation and development and disseminate best practices in the Member States. For the work related to ballast water EMSA will review Ballast Water Risk Assessment Methodologies, review the need for further guidance on a range of topics e.g. data collection on ship’s ballast water exchange and on invasive species in ports and produce a briefing note related to the use of active substances under the Biocides Directive, the proposed Biocides Regulation and the BWM Convention’s Guidelines. Further work, including two large research projects, have been carried out with regard to sampling and analysis of ballast water resulting EMSA submitting a document regarding this issue to IMO. Other EMSA work involves the sharing of information on ballast water management and cooperation and liaison with ongoing projects, DG Environment, the European Environment Agency and the Regional Seas Conventions.

4.1.15 Further updates of interest:

Tracy McCollin (TM) gave an update regarding a meeting of the Ballast Water Expert Group (BWEG) at the Institute of Marine Engineering, Science and Technology (IMarEST) in London. The group had expressed an interest in the work of WGBOSV and invited TM to the meeting to discuss areas of possible collaboration. The work of both groups has similarities although the BWEG has more input from the shipping industry and the developers of treatment technology. WGBOSV has more input into the methods and sampling techniques that would be required to type approve ballast water treatment systems or confirm compliance with the discharges standards in the Ballast Water Management Convention. However there are plenty of areas of interest...
to both groups and the outcome was that the BWEG would keep in contact with WGBOSV with the aim to attend a future meeting.

There were also a range of presentations that gave more detailed information regarding shipping vector research, treatment technologies and legislation and the abstracts of these are given below.

4.1.16 Discharge of ballast sediment residuals during deballasting procedures: A potential vector for the transfer of AIS?

Presented by Nathalie Simard, Fisheries and Oceans Canada, Maurice Lamontagne Institute

Nathalie Simard1, Andrea M. Weise1, Chris W. McKindsey1, 2, André Rochon2, Suzanne Roy2, Elizabeta Briski3, and Claude Rouleau1

1 Fisheries and Oceans Canada, Maurice Lamontagne Institute

2 ISMER, Université du Québec à Rimouski

3 University of Windsor, Great Lakes Institute for Environmental Research

Ship’s ballast water and associated sediment residuals may be an important vector for the introduction of aquatic invasive species (AIS). It is not possible to prevent some entrained sediments and their associated organisms from being pumped with the water into ballast tanks. Ships cannot completely empty their ballast tanks due to structural and pumping limitations and, as a result, some ships may accumulate significant quantities of sediment after several years. To date, propagule pressure associated with ballast water and sediments has been calculated as the product of the quantity of ballast water or sediments discharged x the density of organisms in the ballast water or sediments x the proportion of these that are viable. However, we do not know what proportion of sediments and associated organisms are released during deballasting procedures. To address this question, we sampled a commercial bulk carrier following two consecutive trans-oceanic voyages. The objectives of this study were to 1) measure at regular intervals the concentration of suspended particulate matter (SPM) in the ballast water that was being pumped out to estimate the quantity of sediments released; 2) examine in situ sediment dynamics by mapping the distribution of sediments and organisms; 3) measure the quantity of sediments remaining in the tank to estimate the proportion of sediments released; and 4) assess the depth-dependent viability of diapausing invertebrates and dinoflagellate cysts. Results show increasing SPM concentrations towards the end of deballasting procedures, some interior hull fouling organisms (anemones, hydrozoans, and bryozoans), up to 18 cm to 30 cm of sediment accumulation in some areas of the tank, abundant invertebrate eggs with concentrations varying with sediment depth and spatially, and abundant dinoflagellate cysts with viable cysts even in the deepest sediment strata (16-18 cm). Based on SPM concentrations, we estimated that less than 1% of residual sediments are released during deballasting operations. In terms of propagule pressure (PP) associated with ballast sediments, our estimates were 106 invertebrates and 108 dinocysts. In comparison with a previous study, PP associated with ballast waters was higher with 109 individuals and 1013 cells. Our results will help to better assess propagule pressure associated with ballast sediment release and will be relevant to the management of residual sediments and AIS.
4.1.17 Hydrocyclone Treatment as a Possible Method for Inactivation of Planktonic Organisms in Ballast Water

Presented by: Marijana Pećarević, University of Dubrovnik, Croatia

Removal of unwanted organisms from ballast water was traditionally achieved by means of separation. But that approach was never regarded as the optimal solution, since separation was never complete and its efficiency was very much dependant on the characteristics of organisms (density, size etc). Our study adapts the idea of using hydrocyclones not just for separation, but also for inactivation of the organisms in ballast water. The goal of the research was to prove the existence of lethal conditions in hydrocyclon via experimental results and explain their action using Computation Fluid Dynamics (CFD) techniques.

A specially designed hydrocyclone has been run with sea water at two inlet pressures, 2.4 and 4.8 bars. Samples of sea water with added phytoplankton and zooplankton organisms were analysed under a stereomicroscope before and after the cyclone treatment in order to determine a number and viability of organisms.

By comparing the results from the treatment of the various planktonic species at two different inlet pressures in the hydrocyclone, 2.4 bar (A) and 4.8 bar (B), it was concluded that better results were obtained in experiments with the higher input pressure and from experiments in which organisms with higher mass and density were used. The computational study has demonstrated that the most potential sources of organism damage were: energy transferred by turbulent eddies, decompression and acceleration, but it was impossible to quantify the exact contribution of each damage factor.

This method provides an alternative to the traditional purpose of hydrocyclones, which is exclusively used for separation or reduction of suspended matter and organisms in ballast water. Based on this study, a further development of the cyclonic system, in order to optimise its lethal potential, is now possible.

4.1.18 Environmental zero status in Croatian ports (Eastern Adriatic Sea)

Presented by Josip Mikuš, University of Dubrovnik, Croatia

A study of environmental zero status in three Croatian ports (Rijeka, Split and Ploče) was carried out by three Croatian marine institutes (Institute of Oceanography and Fisheries, Split, Center for Marine Research, Rudar Bošković Institute, Rovinj and Institute for Marine and Coastal Research, University of Dubrovnik) granted by the Ministry of Maritime Affairs, Transport and Infrastructure as a part of GloBallast Partnership Project.

The main goals of the study were: providing data on composition of biological communities, biodiversity, distribution and abundance of organisms in the water column and sediment in ports, determining presence of the invasive alien species (IAS) in ports, creating a data-base of IAS recorded in Croatian ports and providing fundament for possibly early detection of the IAS in ports and in time informing about findings.

Abiotic parameters (temperature, salinity, sea transparency), phytoplankton, microzooplankton, benthos and ichthyofauna were studied using standard chemical and biological methods for seawater analysis.
A total of 186 phytoplankton taxa from seven classes were determined, among which Dinoflagellates were dominant group. Toxic and potential toxic species from genus *Alexandrium, Ceratium, Chaetoceros, Dinophysis, Lingulodinium, Prorocentrum, Protoperidinium* and *Pseudo-nitzschia* were recorded. 16 various dinoflagellate cysts were determined to genus or species level among which three were toxic or potential toxic: *Gonyaulax polygramma, Lingulodinium polyedra* and *Protoperidinium crassipes*.

Influence of non-indigenous microzooplankton species was not recorded in the investigated area of Kaštela Bay (Middle Adriatic) and Northern Adriatic. Innate factors in that areas have primary influence on composition and distribution of microzooplankton.

In benthic communities some of IAS were recorded: limpet snail *Siphonaria pectinata*, australian tubeworm *Ficopomatus enigmaticus*, and blue crab *Calinectes sapidus*: Population of blue crab in area close to harbour of Ploče (Southern Adriatic) was established.

A few invasive fish species were found in the Middle and Southern Adriatic investigated sites (Split and Ploče harbours): dusky spinefoot *Siganus luridus*, atlantic tripletail *Lobotes surinamensis*, creol fish *Paranthias furcifer* and queen angelfish *Holacanthus ciliaris*.

### 4.1.19 Alien Species legislation

Presented by Brian Elliott

The EU are currently in the process of developing a dedicated legislative instrument for Invasive Alien Species (IAS) by 2012. The discussions to date have resulted in five policy issues:

1. Tackling trade, marketing and transport
2. Tackling intentional release in the environment
3. Tackling pathways of unintentional release
4. Early warning rapid eradication of new invasions
5. Managing established IAS as to minimise impacts

These policy issues have resulted in three operational issues of Prevention, Early warning and rapid eradication and Management of established IAS. These policy and operational issues will be examined by having three options of Business as usual (BAU), BAU with non-legislative action and BAU with both non-legislative and legislative action with three levels of legislative action proposed based on consultations that will be low, medium and high ambition.

For each of the five policy issues this leads to a range of choices whereby current legislation will be used or adapted or new mandatory measures would be introduced. These choices are currently under discussion and consultation but any legislative actions to fill policy gaps in combating IAS and develop a dedicated legislative instrument should be completed by 2012.

### 4.1.20 Summary of discussions in relation to ToR a)

The National Reports and the additional presentations given by the participants summarised a lot of useful information and provided an up to date overview of the research being undertaken around the world.
The presentations resulted in discussions amongst the group on a variety of issues, such as the issue of residual toxicity after treatment and an interesting point was raised regarding water that is treated, has no residual toxicity, but has been shown (at an experimental mesocosm scale) to have an effect on the environment when released. Results might be affected by physical characteristics like pH, oxygen, DOC, N/P. This also led onto discussions regarding ballast water exchange zones and the possible impact of discharging large volumes of ballast water in a relatively small area.

Further discussions were around facilities used to test ballast water management systems and information was provided regarding some methodologies that have been tested and developed to assess whether the treatment systems are performing as required. It was highlighted that currently the test facilities around the world all operate in different ways and have different protocols, methods and ways of working. This has led to the development of the Global Ballast Water Test Organizations Network, or GloBal TestNet. The mission of GloBal TestNet is "To generate comparable, accurate test results on the performance of ballast water management systems through transparency, testing standards, mutual recognition, and an open exchange of information". One of the actions that the GloBal TestNet will be undertaking is to review and compile suggestions for modifying the IMO Guidelines for approval of ballast water management systems (G8). Members of the WGBOSV agreed that the G8 guidelines are likely to require modification now that experience has been gained regarding setting up and running test facilities and many participants within the group can contribute to these discussions based on their own experiences of working with and at test facilities.

There were related presentations from Portugal and Canada regarding the transport of species in the sediments in ballast tanks. Both studies found a range of species in the sediments which were viable and the Canadian study provided some estimates of how much of the sediment was released when the ballast water was discharged. The Portuguese study also looked at how the dinoflagellate Gymnodinium catenatum had appeared in sediment cores along the coast of Portugal and how this related to when it was found in the water column. As this is a cyst that has been found in ballast tanks it is a potential vector for the transportation of this species (although is probably not the case in Portugal, which is more likely to be a range extension). The group also discussed the fact that phytoplankton within the ballast tanks seemed to follow a circadian rhythm throughout the day even though the ballast tanks were dark. The impact this could have on sampling and the subsequent results were discussed.

The issue of hull fouling and the initial outputs from some research projects was also dealt with by the group and the chair (TM) pointed the group to the SharePoint site where the IMO Biofouling Guidelines and the associated guidance for recreational craft were available. A new antifouling technique based on using short fibres to prevent fouling on aquaculture nets was described by the Netherlands and there is ongoing testing to see if it can be used for other purposes.

As well as the presentations and discussions members of the group also made several relevant reports and papers available via the SharePoint.

4.2 Term of Reference b)

Taking into account current risk assessment and pathway management methodologies, recommend principles for risk assessment under IMO Guidelines for risk assessment under Regulation A-4 of the BWM Convention (G7).
This Term of Reference was achieved by having a series of presentations and then a
general discussion within the group. The summaries of the presentations are given
below and the outcome of the discussions is given at the end of this section and in-
cludes the issues the group recommended need to be taken into account when carry-
ing out risk assessments.

4.2.1 Vector-Based Risk Assessment for Ship-Mediated Introductions to
Canada
Presenting author: Sarah Bailey

In order to predict and to efficiently manage aquatic invasions, risk assessments must
be conducted to evaluate probabilities of success and potential impact at each stage of
the invasion process. While there have been a number of highly useful species-
specific risk assessments that consider a variety of vectors for a single species of in-
terest, vector-based risk assessments that consider a variety of species moved by a
single vector are urgently needed to manage an overwhelming number of potential
invaders as well as unknown (or unpredicted) species.

Canada is conducting semi-quantitative, risk assessments for two shipping vectors
(hull fouling and ballast water) to Canadian ports by a variety of shipping pathway s
(e.g., transoceanic, coastal and domestic). These assessments evaluate the probability
of introduction (arrival and survival) of an aquatic nonindigenous species and associ-
ated potential consequences (impacts) to determine risk. A comprehensive database
of vessel arrivals and volume of ballast water discharged at Canadian ports was util-
ized to estimate the probability of arrival. Environmental similarity between source
and recipient ports was then used to estimate the probability of survival after arrival.
The number of high impact aquatic nonindigenous species reported from the donor
ecoregion(s) was used to estimate the potential magnitude of consequences. This
methodology enabled identification of ports at highest risk for ship-mediated inva-
sion and will direct future research and management efforts.

Risk assessments for the Arctic and Great Lakes regions are complete, and are avai-
able at www.dfo-mpo.gc.ca/csas. Risk assessments for the Atlantic and Pacific re-
regions are currently undergoing peer review and will be published at the same
website in late 2012.

4.2.2 The Significance of Various Pathways/Vectors for Introduction of Ma-
rine Alien Species in European Seas
Presenting author: Argyro Zenetos

1) The work presented was carried out as an ETC/ICM [European Topic Cen-
tre on Inland, Coastal and Marine waters] activity towards developing
Transitional Coastal and Marine Indicators. It is part of a Sub-assessment
on Marine Environmental aspects to 2012 water report commissioned by
the European Environment Agency (EEA). Trends in primary pathways
per decade should tell us a story when combined with management poli-
cies applied/implemented over the last decades.

2) The classification of primary pathways of introduction was an adaptation
of the frameworks proposed by Hulme et al. (2008) and Molnar et al.
(2008). For simplicity and to be more specific to the marine environment,
we used five broad categories defined on a human activity basis namely:
‘aquaculture’ (subdivided to ‘commodity’ and ‘contaminant’), ‘shipping’
An inventory of marine alien species in Europe was created by critically evaluating related information in scientific and grey literature, and all European, regional, and national online information systems on alien species in Europe. To have full coverage of the Seas surrounding Europe, alien marine species reported from the entire Mediterranean Sea were included, i.e. also from North African and Near East Mediterranean countries. A total of more than 1350 marine species were identified and linked to the most probable pathway of primary introduction across biogeographical barriers. Pathways of secondary introductions, i.e. further spread of marine alien species within a biogeographical region to other localities/countries, were not considered. Trends in the numbers of introduced species were assessed on a decadal basis, from the 1950s to the 2000s.

Almost half of the marine alien species in European Seas (48%) were introduced by shipping. Marine and inland corridors were the second most common pathway of introduction followed by aquaculture and aquarium trade. The trends analysis revealed that:

a) the cumulative trend of ship-mediated aliens is increasing. Species introduced with hull fouling seem to slightly dominate those associated with ballast water. Globalization facilitates the spread of invasive alien species (IAS) as international commerce develops new trade routes, markets, and products.

b) Among canals, the Suez Canal is hold responsible for the great majority of introductions, the rate of new introductions is continually increasing, a fact attributed to the widening/deepening of the Suez Canal. However, of the so called Lessepsian immigrants, only 200 are established, and those mostly limited in the eastern Mediterranean. Twenty-five species have been transferred to new bio-geographic regions via inland canals (mainly from the Ponto-Caspian region to the Baltic and the North Sea).

c) Aquaculture is considered responsible for about 230 marine alien species introductions in European Seas, most of them arriving accidentally (‘aquaculture/contaminant’) being transferred together with species introduced for aquaculture. There is a considerable decrease in rate of aquaculture related introductions over the last decade, attributed to the aquaculture Directive.

d) The rate of aquaria species released in the wild has been tripled over the last decade. They are mostly fish purchased in aquaria but also macroalgae, and mollusca. The most well-known case is that of the «killer algae» Caulerpa taxifolia, one of the 100 top invasive species worldwide, that was released/escaped from the Monaco Aquarium. Despite the existence of strict European legislation of regulation on food Fisheries, the capture and trade of ornamental species in European Seas has never been addressed. This leads to spread of traded species throughout the world in a generally unregulated industry

References


4.2.3 HELCOM Risk Assessment for Intra–Baltic Shipping BWM Exemptions


This risk assessment study focuses on intra Baltic Sea shipping. The HELCOM Guidance to distinguish between unacceptable high risk scenarios and acceptable low risk scenarios – a risk of spreading of alien species by ships on Intra-Baltic voyages (HELCOM Risk Assessment (RA) Guidance) was taken as a starting point to develop the RA concept. In addition the three different risk assessment approaches as outlined in the IMO Guidelines for risk assessment under regulation A-4 of the BWM Convention (IMO G7 Guideline) were evaluated for their applicability in the region. The application of the HELCOM RA Guidance and consistency with the IMO Guideline G7 was studied, and comments are provided.

The biogeographic risk assessment approach of IMO Guideline G7 is not applicable as the ballast water movements considered here are not undertaken between different biogeographical regions. IMO Guideline G7 further states a species-specific risk assessment may be best suited to situations where the assessment can be conducted on a limited number of harmful species within a biogeographic region.

It became clear that essentially needed data (i.e., on already introduced species in the Baltic Sea ports) are missing to undertake a species-specific and target species risk assessment as no port baseline surveys were undertaken yet. However, a target species selection process may be conducted based upon harmonized selection criteria. Target species can thereby be identified, but a risk assessment based upon target species is only possible with the knowledge on their occurrence in ballast water donor areas – highlighting the need to undertake port baseline surveys. Therefore it is of utmost importance to agree upon R&D priorities. The priority should be placed on undertaking port baseline studies and monitoring programmes and only thereafter e.g. physiological and experimental studies of different life stages of species, as proposed under Guidance “6.3 Comparisons of known physiological tolerances...” may be conducted.

The risk assessment based upon an environmental match may also be applied considering water salinity as key feature in this approach. It should be noted that the more environmental parameters are being included the lesser robust and reliable becomes this assessment which is in conflict with the precautionary principle. The salinity is believed to be a relatively solid indicator for species compatibility and survival in a new environment, and on the other side, this information is easily available for ballast water source and discharge areas. A high risk is assessed should the salinity match between ballast water donor and recipient regions, e.g., marine to marine, marine to brackish or freshwater to brackish environments. A mismatch of salinity, i.e.,
waters with high salinity difference, e.g., freshwater (< 0.5 PSU) to marine (> 30 PSU), indicates a lower risk. This generic approach however needs a bit caution in regards to human pathogens, which in general do not survive in marine waters or brackish waters with higher salinities, but may survive in a host animal or debris. In conclusion such a salinity difference does not occur for intra-Baltic shipping and therefore this environmental match approach alone cannot be applied as RA concept.

Temperature was also considered as risk assessment quantifying factor in the environmental match approach, but it was agreed that this is of lesser reliability to identify low risk scenarios. This view is based upon the assumption that organisms are more flexible regarding temperature tolerances compared to salinity. One reason for this assumption is the greater temperature difference compared to salinity difference over the seasons in the Baltic region which the species need to tolerate.

A combination of both, the target species approach together with an environmental match, is to be considered. Should the selected target species occur in the ballast water donor area and both the ballast water donor and recipient ports show matching salinities, a high risk is assessed. However, if a high mismatch of salinity is identified between donor and recipient ports, the ballast water may be identified as low risk. All these low risk scenarios are acceptable only provided the ballast water is in no instance mixed with ballast water from other sources.

It should be noted that low risks can only be identified provided reliable data are available. This at present may be a key limiting factor of the risk assessment in the Baltic Sea as especially no port profiles are available for Baltic ports.

The following shipping routes were selected for a more detailed risk assessment:

- St. Petersburg (RU) – Gothenburg (SE),
- Klaipėda (LT) – Kiel (DE),
- Kiel (DE) – Gothenburg (SE), and
- Terneuzen (NL) – Mönsterås (SE) – Karlshamn (SE).

In the IMO “same location concept” chapter the report also recommends how ferries and other vessels may approach ballast water management exemptions provided they are solely operated on a constant shipping route.

### 4.2.4 Outcome of Discussion

The presentations dealt with different aspects of risk assessment with Sarah Bailey presenting the methods by which Canada has carried out assessments, Argyro Zentos outlining how particular vectors may have increased or decreased in importance and Stephan Gollasch providing the outcome of a Baltic Sea project that used the IMO Guidelines for risk assessment under regulation A-4 (G7) to assess whether it is possible to use these to grant exemptions to vessels in intra-Baltic shipping. An exemption might be granted where a vessel travelled only between the ports considered (two or more ports) and in cases the risk assessment suggested that this would have a low risk of transporting (potentially) harmful species between these ports. The vessels operated between these ports could then be exempted from carrying out ballast water management to meet the D-1 or D-2 standards within the Ballast Water Management Convention provided the ballast water is not mixed with water from other source regions.
The main question that risk assessments set out to answer is “is there a risk of introducing a (potentially) harmful species?” and in order to answer this question a huge amount of biological information is required. There are also a variety of ways in which the risk assessment could be carried out to provide the answer, all of which have advantages and disadvantages.

The discussion within the group resulted in a list of points that should be taken into consideration when carrying out a risk assessment and these are listed below;

- One of the main points that was considered to be of fundamental importance was the quality of the baseline data (port baseline surveys) on which to base the risk assessment. This was particularly the case for the IMO G7 guidelines as good quality, recent baseline biological data would be required from port areas. Although some data exist, it is often out of date and incomplete, possibly not addressing all groups of organisms and originally collected for a different purpose. However, up-to-date and comprehensive knowledge on port biota and abiotic information are required for a risk assessment.

- It was also emphasised that the vessels should only be travelling between the ports for which the risk assessment was conducted in order to qualify for an exemption under G7.

- Current Canadian exemption zones are based on biogeography of native species but these do not account for secondary spread, which is important and needs to be taken into account.

- Shipping may breach natural barriers that have prevented species from spreading and once this has occurred it becomes more difficult to assess the risk for shipping routes connecting such areas.

- As many ship owners are likely to be interested in obtaining an exemption the idea of a collaboration between ship owners or neighbouring countries to undertake port surveys in order to carry out a risk assessment may be a way of obtaining consistent and up to date biological information about the ports.

- Molecular techniques are likely to provide a library of publicly available data soon but currently a combination of taxonomists and molecular techniques is required to ensure there is a match between the different sets of information.

- It was further recommended that monitoring programmes are to be established in the ports for which the risk assessment was undertaken to document whether or not new species introductions occur. Should new harmful species be found the risk assessment based exemptions from ballast water management requirements may be revoked.

4.3 Term of Reference c) and e)

c) Further discuss and evaluate the sampling strategies under consideration at IMO and provide comment to relevant IMO committees and their corresponding groups. Solicit experts statistical advice to support this work.

e) Discuss and prepare expert input on the International Maritime Organization’s Ballast Water Sampling guidelines that are currently under development (January meeting).
As WGBOSV had carried out the majority of this work intersessionally only a brief overview was given at the meeting. Brian Elliott from EMSA gave a presentation regarding the work that has been carried out by a correspondence group under his chairmanship to produce a set of ballast water sampling and analysis guidelines. The presentation gave an overview of the history of the document and the work that had been carried out intersessionally and the outcome at the latest meeting at IMO with regard to the guidelines. Brian Elliott also highlighted where more work is required and where there are still issues with the draft guidelines and how these may be overcome. Members of the WGBOSV have contributed to this process in a variety of ways, there was a discussion at the last meeting and it was agreed the group would contribute to the work of the correspondence group by sending comments to the chair (TM) who would then collate them and send them to the correspondence group via ICES on behalf of the WGBOSV. Comments were sent on two occasions and many of these were incorporated into the document.

However, there were still some outstanding issues with the document and in order to prepare more detailed expert input for the Bulk Liquids and Gases subcommittee (BLG) at the IMO in January a sub group meeting of the WGBOSV was arranged in London immediately before the meeting. The group met for two days and went through the parts of the document related to sampling and analysis and made a series of suggestions to change the text to try to overcome some of the issues. A report of this meeting is provided in Annex 3 along with a copy of the changes that were suggested by the sub group meeting and raised on behalf of the group by the chair (TM).

During the WGBOSV meeting in Lisbon, an overview was given of the outcome of the sub group meeting and there was a brief discussion regarding how the group could have further input as the document has been sent to the next meeting of BLG for further discussion. The document currently has some tables in the appendix (See SharePoint for the latest version) that have some gaps related to level of confidence and detection limits of the methods and it was suggested that if any members of the group had information that they could provide they should get in touch with their national delegation to IMO to discuss providing this to the next BLG meeting in early 2013. There is currently no correspondence group for this work so this is likely to be the most effective way of providing information.

4.4 Term of Reference d)

Re-establish and elaborate the cooperation with PICES WG 21.

Information was obtained from Tom Therriault and Darlene Smith regarding the work of this group. The work of the group is coming to an end and there will be a final meeting in Japan in October 2012. There has been some discussion regarding future work on non indigenous species and these include adaptive management and dealing with range expansions due to climate change. However, any future work would be undertaken by a newly created working group as PICES groups have a fixed time span. Both Tom and Darlene were keen that there should be collaboration with ICES if possible and an invitation was issued to representatives of WGBOSV and WGITMO to attend the October 2012 meeting. Therefore there is still a connection between ICES and PICES on non indigenous species issues and once it is decided whether PICES will go ahead with a new working group the chairs of the working groups can discuss the best way to link the work of the groups.
4.5 Other matters of joint interest to WGBOSV and WGITMO

An overview of the recent developments within ICES was given by Henn Ojaveer. This included explaining the structure and tasks of the two high-level committees (advisory committee and science committee) and where the two groups (i.e., WGBOSV and WGITMO) sit within these and an overview of the ICES Science Plan for 2009-2013. There was also a discussion regarding the links with other ICES expert groups and strategic initiatives within ICES (incl. biodiversity initiative) and it was agreed that it would be useful to have people attend from several biodiversity-related and aquaculture expert groups. WGBOSV already has links with the Working Group on Harmful Algal Bloom Dynamics and has worked together with them in the past in response to a specific request regarding HABs in ballast water.

It was also discussed and agreed, that as WGBOSV and WGITMO have strong advisory potential within ICES (by incl. related to IMO BWMC, MSFD Descriptor 2 and the forthcoming EU strategy on invasive alien species), the high-level parent committee for these two groups should be ACOM. It was not seen as an obstacle to effectively contribute to the ICES Science Plan.

It was agreed that WGBOSV and WGITMO should continue to meet back to back as in previous years and that it would be good to have presentations and discussions during the joint meeting on topics of interest to both groups. An example of this would be biofouling on artificial marine structures. It was agreed that at least one common Term of Reference would be added for both groups (see Annex 5).

There was also discussion regarding how WGBOSV and WGITMO could have input into the work being carried out for the Marine Strategy Framework Directive (MSFD), particularly in relation to Descriptor 2 on non indigenous species but also related descriptors on e.g. biodiversity, food webs etc. This serves as a potential common interest in coming years with offering a more holistic approach to deal with MSFD Descriptor 2. In addition, it allows incorporation of rich North-American experience and expertise to MSFD-related work within ICES.

4.6 Nomination of chair

As the current chair, Tracy McCollin (United Kingdom) was stepping down as it was the end of the three year election term, a new chair, Sarah Bailey (Canada), was nominated. Tracy thanked Sarah for taking on the role and wished her all the best.

4.7 Closing of the meeting

The meeting came to a close at 12.30 on Wednesday 14th March, 2012 after the joint meeting with WGITMO. Tracy McCollin thanked the group for all their input and participation over the last three years. The group has achieved good outputs and the participants always provide interesting and relevant updates. Brian Elliott and Eleonora Panella of EMSA were also thanked for hosting the meeting and for their participation throughout the week. The chair also thanked Gemma Quilez Badia of Spain for acting as rapporteur and her help during the meeting.
### Annex 1: List of participants

**ICES/IOC/IMO Working Group on Ballast and other Ship Vectors (WGBOSV)**

**12 – 14 March 2012**

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</table>
Annex 2 Agenda

ICES/IOC/IMO Working Group on Ballast and Other Ship Vectors

12-14th March, 2012.

European Maritime Safety Agency (EMSA)

Cais do Sodré, 1249-206 Lisbon, Portugal

SUNDAY 11th MARCH

A table will be booked for anyone who has arrived on Sunday and would like to meet up to have a meal (at your own cost). An arrangement has been made with the café listed below to provide a three course meal and one drink for €20. The café needs to know beforehand what everyone would like and I have provided a list of choices in a separate document. Please fill this in and send it back to me.

I suggest we meet at the restaurant at 20.00.

Café Portas do Sol
Largo das Portas do Sol
Beco de Santa Helena
1100 Lisboa


MONDAY 12TH MARCH

Meet at EMSA @ 08.30 to allow time for security and setting up computers.

09.00 Opening of the meeting

Welcoming remarks Tracy McCollin (Chair) and Brian Elliott (EMSA)

Logistics
Introduction of Participants and Guests.

09.45 Review of Terms of Reference and Agenda

10.00 ToRa) National Reports

Highlights from the National Reports. I have allowed about 15 minutes each but if people only want to give a very brief overview for a few minutes that is fine as others will require more time. Also do not worry too much about the times and sequence of the updates as these are flexible and can be adapted on the day to fit in with when people arrive and so on.

- Belgium Francis Kerckhof
- Canada Sarah Bailey, Nathalie Simard, Cynthia McKenzie
- Croatia Marijana Pecarevic, Joško Mikus
- Estonia Henn Ojaveer

11.00-11.30 Coffee break

- Germany Stephan Gollasch, Stefan Kacan
• Netherlands Andrea Sneekes, Cato Tjabbes, Louis Peperzak
• Norway Stephanie Delacroix, Anders Jelmert
• Portugal Ana Amorim, Paula Chainho, Joao Canning-Clode

13.00-14.00 Lunch break
• Spain Gemma Quilez Badia
• Sweden Lena Granhag
• UK Tracy McCollin, Steve Milligan, Michael Godard
• USA Judy Pederson, Fred Dobbs, Greg Ruiz, Whitman Miller
• EC Brian Elliott

15.00-15.30 Coffee break
15.30 ToR b) Risk assessments and pathway management
• Risk assessment methods for the shipping pathway as a vector of NIS to Canada. Sarah Bailey.
• The significance of various pathways/vectors for introduction of Marine alien Species in European Seas. Argyro Zenetos.
• HELCOM Risk Assessment for intra-Baltic shipping BWM exemptions. Stephan Gollasch, Matej David & Erkki Leppäkoski.

17.00 Close of first day of meeting

TUESDAY 14TH MARCH

09.00 Announcements
Feedback from a meeting of the Ballast Water Expert Group meeting at the Institute of Marine Engineering, Science and Technology (IMarEST) and suggestions for areas of possible collaboration.

09.30 ToR c) and e) Ballast water sampling and analysis
• The work of the IMO Correspondence Group on Ballast Water Sampling and the corresponding discussions at BLG 16. Brian Elliott.
• Overview of sub group meeting
• Contribution to BLG 16
• Outstanding issues

Discussion as to where WGBOSV can have input e.g.
• Validation of analysis methods
• Use of similar methods to provide examples for the tables?
• Ship board sampling design
• Other suggestions ???

11.00-11.30 Coffee break
• Discharge of ballast sediment during deballasting procedures: a potential vector for the transfer of AIS? Nathalie Simard.
• Hydrocyclone treatment as a possible method for inactivation of planktonic organisms in ballast water Marijana Pecarevic.
13.00-14.00 Lunch break
- Environmental zero status in Croatian ports (from the study conducted as part of GloBallast Partnership Project). Joško Mikuš.

15.00-15.30 Coffee break
- Input required for report
- Terms of Reference for 2013 meeting
- Nomination of chair for next three years
- Administration matters

17.00 Close of second day of meeting

WEDNESDAY 14TH MARCH

JOINT MEETING WITH WGITMO

09.00 Opening of the meeting
Welcoming remarks (Tracy McCollin and Henn Ojaveer)

Logistics
Introduction of participants

09.30 WGBOSV ToR d) and other matters of joint interest to groups
- ICES updates
  - Parent committee
  - ICES Science Plan
  - Link between WGITMO and WGBOSV
  - Co-operation with other expert groups within ICES
  - Marine Strategy Framework Directive (MSFD) process and ICES role
  - WGITMO intersessional work
- WGITMO ToR f: Continue efforts to establish effective cooperation with PICES and CIESM

11.00-11.30 Coffee break
- General discussion
- Wrapping up
- Location of next meeting
- AOB

13.00 End of joint meeting

13.00-13.30 Lunch break

Sub Group meeting of the ICES/IOC/IMO Working Group on Ballast and Other Ship Vectors.


Defra, Ergon House, Horseferry Road, London, SW1P 2AL

INTRODUCTION

A sub group of the ICES/IOC/IMO Working Group on Ballast and Other Ship Vectors (WGBOSV) met in London from 26-27th January, 2012. Defra very kindly gave the group use of a meeting room for the two days. The meeting was attended by 14 participants, one of whom (Allegra Cangelosi, USA) joined by telephone conference on the afternoon of the second day. Whitman Millar (USA) was also intending to phone in but technical difficulties prevented him from doing so and he sent his apologies. The meeting was chaired by Tracy McCollin (United Kingdom) with assistance from Brian Elliott of the European Maritime Safety Agency (EMSA).

The main purpose of the meeting was to achieve an output relevant to the following Terms of Reference:

c) Further discuss and evaluate the sampling strategies under consideration at IMO and provide comment to relevant IMO committees and their correspondence groups. Solicit experts statistical advice to support this work.

e) Discuss and prepare expert input on the International Maritime Organizations Ballast Water Sampling guidelines that are currently under development (January meeting).

Tracy McCollin outlined the previous work that had been carried out by the WGBOSV that had resulted in input from ICES to meetings at the International Maritime Organization. The WGBOSV had most recently contributed to a correspondence group (chaired by Brian Elliott representing EMSA) that was developing a set of guidelines on ballast water sampling and analysis. The outcome of the correspondence group was a document (BLG 16/4, provided on SharePoint site) that had been submitted to the International Maritime Organization’s Sub Committee on Bulk Liquids and Gases (BLG) at their 16th meeting which would be held from 30th January to 3rd February, 2012. It was therefore decided to hold the sub group meeting of the WGBOSV in the week immediately prior to BLG 16 so that the group could provide relevant and timely scientific input regarding the document.

OUTCOME

The meeting was split into two broad parts (see agenda also, Appendix 1):

1) The group went through document BLG 16/4 and discussed and provided further input to the comments that had been submitted previously by ICES/IOC/IMO WGBOSV through the correspondence group. This was supplemented by a presentation from Brian Elliott (EMSA) who outlined some of the outstanding issues and problems with the document.

2) Two scientific presentations were given, one by Stephan Gollasch (Germany) with Matej David as co-author on “Sampling to prove compliance...
with the Ballast Water Management Convention” and one by Colin Millar (UK) on a statistical model that was based on some data that had been collected during ship board sampling studies.

The group worked through the BLG 16/4 document and had detailed discussions regarding the definitions contained within the document and how these related to the text and tables. The outcome of this part of the discussion was a document that contained alternative text for some of the definitions. The group also took into account some of the issues that had arisen during the correspondence group and Brian Elliott provided detailed input to explain these. By providing new and alternative text for some definitions the group aimed to provide scientific input that clarified and simplified some of these issues and could be provided to BLG 16 the following week. This input was provided in the form of an “Informal Meeting Room Paper” that was submitted to the Ballast Water and Biofouling Working Group at BLG 16 (see Appendix 2). This was introduced by Tracy McCollin who gave the background to the paper and also spoke on behalf of ICES WGBOSV to explain each change as it came up in the discussion. Many of the changes were incorporated into the text of the document and the input of ICES was acknowledged by the chair of the working group.

The scientific presentations of Stephan Gollasch and Colin Millar provided linked information regarding ship board sampling and the possible ways in which this could be analysed. Both presentations stimulated a lot of discussion and provided the group with the basis for much discussion regarding what further work could be carried out. Some of the main topics were regarding the issue of live and dead counts rather than just live, the method by which the organisms were collected, the variability of the data, how samples should be taken to provide further data for statistical modelling, the relationship of the results to the D-2 standard and suggestions for how further work should be carried out.
APPENDIX 1 AGENDA

Sub Group meeting of the ICES/IOC/IMO Working Group on Ballast and Other Ship Vectors


Room LG01 in Defra, Ergon House, Horseferry Road, London, SW1P 2AL

Attendees:

Tracy McCollin (Chair)
Stephan Gollasch
Brian Elliott
Sarah Bailey
Lisa Drake
Stephanie Delacroix
Richard Everett
Karina Scott
Matthew Gregg
Colin Millar
Whitman Miller (by teleconference if possible)
Stefan Kacan
Allegra Cangelosi (by teleconference)
Klaas Kaag
Leanne Page

Thursday 26th January, 2012

Aim to arrive at 09.00 to start at 09.30 to allow for security requirements

09.30

Introductions and information about meeting room arrangements (Chair)

Background to meeting and the ICES/IOC/IMO Working Group on Ballast and Other Ship Vectors (WGBOSV) (Chair).

Overview of the WGBOSV Terms of Reference c) and e):

  c) Further discuss and evaluate the sampling strategies under consideration at IMO and provide comment to relevant IMO committees and their correspondence groups. Solicit experts statistical advice to support this work.
  
e) Discuss and prepare expert input on the International Maritime Organizations Ballast Water Sampling guidelines that are currently under development (January meeting).

10.30 – 11.00 Break

Input from ICES to date (Chair):

• Ensure group is happy with input
• Any issues that need to be raised at BLG?
12.30 – 13.30 Lunch
Background to the Ballast Water Sampling Correspondence Group document BLG 16/4 (Brian Elliott):

- How it came about
- How it has been put together
- Any outstanding issues

Group discussion regarding any outstanding issues with respect to the Ballast Water Sampling Correspondence Group document BLG 16/4 and how these could be dealt with by ICES at the BLG meeting (Group).

15.30 – 16.00 Break

Group discussion continued.

17.00 End of day 1.

Friday 27th January, 2012

Aim to arrive at 09.00 to start at 09.30 to allow for security requirements

09.30

Overview of previous day’s work (Chair and Brian Elliott)

Decide on what support or scientific opinion the WGBOSV can provide to the BLG meeting (Chair/Group).

10.30 – 11.00 Break

Start to create a list of points that can be raised by the chair of WGBOSV (Group).

12.30 – 13.30 Lunch

Continue this work and ensure the sub group has agreed the input that ICES will make to the BLG meeting.

Allow time for more general discussion regarding the Term of Reference c) for the WGBOSV.

Gollasch & David 2012. Sampling to Prove Compliance with the IMO Ballast Water Management Convention.

Millar 2012. Statistical modelling based on data from ship board sampling.

15.30 – 16.00 Break

More general discussion with respect to Term of Reference c) and wrapping up (Chair).

17.00 End of the meeting.
Suggested text for new definitions and alternatives to current definitions contained in BLG 16/4. ICES comments provided in italics.

A new definition for sample is suggested (see below). This should be located at the start of section 3.1 to provide an overarching definition that can be related to the definitions that follow.

A sample means a small quantity intended to show what the larger volume of interest is like. Representative sampling reflects the relative concentrations and composition of the populations (organisms or chemicals) in the volume of interest. Samples should be taken in accordance with the Annex, part 1 and/or part 2 of the Guidelines on Ballast Water Sampling (G2) to establish whether a ship is potentially [compliant or] non-compliant with the D-1 and/or the D-2 standard of the BWM Convention.

ICES suggests that from a scientific perspective it would be more clear to have an overarching definition of what is meant by analysis and this should be followed by more concise definitions of indicative and detailed analysis.

Analysis means the process of measuring and determining the concentrations and composition of the populations of interest within the sample.

Alternative definition for current 3.1.2 (Indicative analysis). Current bullet points 3.1.2.1 to 3.1.2.3 would remain but 3.1.2.4 and 3.1.2.5 could be deleted

An indicative analysis means a compliance test that is a relatively quick indirect or direct measurement of a representative sample of the ballast water volume of interest.

Alternative definition for current 3.1.3 (Detailed analysis).

A detailed analysis means a compliance test that is likely to be more complex than indicative analysis and is a direct measurement of a representative sample used to determine the viable organism concentration of a ballast water volume of interest.

ICES discussed the issue of small and full scale sampling and having suggested the changes to the definitions listed above feels that the text below would provide more clarity on this issue.

Compliance testing using indicative analysis and detailed analysis can employ a range of general approaches or standard methods. These approaches or methods are divided into those that sample a small proportion of the volume of interest to indicate compliance or a larger proportion of the volume of interest that can be utilized to indicate and confirm compliance. Those that provide a wide confidence interval should only be used for indicative analysis unless the result and confidence limit are demonstrably over the D-2 standard as measured directly or indirectly. Approaches/Standards are highlighted in Sections 5.1, 5.2 and 5.4 for Indicative analysis and Sections 5.3 and 5.4 for detailed analysis.

Alternative definition for 3.1.16

Operational indicator means a parameter used to monitor and control the operation of the BWMS as defined during testing for Type Approval e.g. limit values of physical or chemical parameters such as flow rate, dose etc.
New definition for 3.1.17

**Performance indicator** means a biological parameter (e.g. ATP, chlorophyll a, direct counts) used to estimate or measure the performance of the BWMS in achieving the D-2 standard.

Alternative text for Table 1 following changes to definitions and further discussion by ICES WG.

Table 1. Definition and differences between indicative and detailed analysis.

<table>
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<th>INDICATIVE ANALYSIS</th>
<th>DETAILED ANALYSIS</th>
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<td><strong>Purpose</strong></td>
<td>To provide a quick, rough estimate of the number of viable organisms.</td>
<td>To provide a robust, direct measurement of the number of viable organisms</td>
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<td><strong>Sampling</strong></td>
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<tr>
<td><strong>Volume</strong></td>
<td>Small or large depending on specific analysis</td>
<td>Small or large depending on specific analysis</td>
</tr>
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<td><strong>Representative sampling</strong></td>
<td>Yes, representative of volume of interest</td>
<td>Yes, representative of volume of interest</td>
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<tr>
<td><strong>Analysis method</strong></td>
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<tr>
<td><strong>Analysis parameters</strong></td>
<td>Operational and/or performance indicators (Chemical, physical or biological)</td>
<td>Direct counts (biological).</td>
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<td><strong>Time consuming</strong></td>
<td>Lower</td>
<td>Higher</td>
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<td><strong>Required skill</strong></td>
<td>Lower</td>
<td>Higher</td>
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<td><strong>Detection limit</strong></td>
<td>Higher (poorer)</td>
<td>Lower (better)</td>
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<tr>
<td><strong>Confidence with respect to D-2</strong></td>
<td>Low</td>
<td>High</td>
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Annex 4 National Reports ToR a)

CANADA

National Report Format for Update on Status of Invasive Species Research WGBOSV

Country: Canada

Author(s) and contact details:

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A TRANSPORT VECTORS

- Results of ongoing research project(s) i.e. project title, host institute, contact details, co-ordinator, project duration, key objective(s), website if available
- Planning of new research project(s), website if available
- For each category below include information, where available, on biology, treatment, sampling and legislation/regulations.

1 Ballast

*Examination of ballast water discharged at Canadian Arctic Ports*

Great Lakes Laboratory for Fisheries and Aquatic Sciences, Fisheries and Oceans Canada, Burlington, Ontario

Sarah Bailey: sarah.bailey@dfo-mpo.gc.ca

The introduction of invasive species by ship vectors has been identified as an activity that may negatively impact the Canadian Arctic ecosystem, but there has been no scientific evaluation of the current risk level. In addition, climate change may increase the risk of introductions to the Arctic because melting of the polar ice cap will allow increased vessel access to Arctic waters. Vessels arriving to Churchill and Deception Bay were sampled in 2009 and 2010 in order to quantify propagule pressure. Publication of results are anticipated in 2012.

2 Hull Fouling

*Examination of hull fouling risk at Canadian Arctic Ports*

Great Lakes Laboratory for Fisheries and Aquatic Sciences, Fisheries and Oceans Canada, Burlington, Ontario

Sarah Bailey: sarah.bailey@dfo-mpo.gc.ca

The introduction of invasive species by ship vectors has been identified as an activity that may negatively impact the Canadian Arctic ecosystem, but there has been no scientific evaluation of the current risk level. In addition, climate change may increase the risk of introductions to the Arctic because melting of the polar ice cap will allow increased vessel access to Arctic waters. Hulls of commercial vessels were sampled by scuba diver in 2010 and 2011 at the most active port (Churchill) in order to quantify propagule pressure by hull fouling to the ports. In addition, Canadian military
vessels have been examined before, during and after northern transits. Sampling of military vessels is expected to continue in 2012.

An investigation of the risk posed by recreational boating as a vector in the introduction and spread of aquatic invasive species in Atlantic Canada

Institute Maurice-Lamontagne, Mont-Joli, Quebec; Northwest Atlantic Fisheries Centre, St. John, Newfoundland and Labrador; Gulf Fisheries Centre, Moncton, New Brunswick; St. Andrews Biological Station, St. Andrews, New Brunswick

Nathalie Simard (Quebec Region): Nathalie.simard@dfo-mpo.gc.ca
Cynthia McKenzie (Newfoundland and Labrador Region): Cynthia.mckenzie@dfo-mpo.gc.ca
Andrea Locke (Gulf Region): Andrea.locke@dfo-mpo.gc.ca
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The four eastern Canadian DFO regions are collaborating to determine the risk posed by recreational boating as a vector in the introduction and spread of aquatic invasive species in Atlantic Canada. This multi-year project obtains data through direct contact (by phone and in person) with harbour managers including harbour authorities, small craft harbours, and marina and yacht club managers as well as boat owners. The use of a standard questionnaire allows comparison between regions. Video surveys of docks, wharves and boat hulls will be conducted at high risk harbours. SCUBA diver surveys are also conducted at some locations. The objectives of the project are: to determine risk of introduction and spread of AIS in Atlantic Canadian waters via regional and international recreational boating traffic as vectors; to determine locations of harbours that are particularly at high risk for introduction and spread of AIS; to communicate and inform recreational boaters on the risk of AIS movement and measures that they can take to prevent the spread of AIS.

3 Sediments

Discharge of ballast sediment residuals during deballasting procedures: A potential vector for the transfer of AIS?

Maurice Lamontagne Institute, Fisheries and Oceans Canada, Mont-Joli, Quebec, Canada

Nathalie Simard: Nathalie.simard@dfo-mpo.gc.ca

Ships cannot completely empty their ballast tanks due to structural and pumping limitations and, as a result, some ships may accumulate significant quantities of sediment after several years. This ongoing study addresses the existing knowledge gap concerning residual ballast sediments as a vector for the transfer of AIS. To date, propagule pressure associated with ballast water and sediments has been calculated as the product of the quantity of ballast water or sediments discharged x the density of organisms in the ballast water or sediments x the proportion of these that are viable. However, we do not know what proportion of sediments and associated organisms are released during deballasting procedures. To address this question, we sampled a commercial bulk carrier following two consecutive transoceanic voyages. The objectives of this study were to 1) measure at regular intervals the concentration of suspended particulate matter (SPM) in the ballast water that was being pumped out to estimate the quantity of sediments released; 2) measure the quantity of sediments remaining in the tank to estimate the proportion of sediments released; 3) calculate the sediment accumulation rate in the ballast reservoir based on 210Pb
measurements and; 4) assess the depth-dependent viability of diapausing invertebrates and dinoflagellate cysts. A publication is expected in 2012.

4 Sea Chests

Sea chests as a potential vector for aquatic invasive species along Canadian coasts

Maurice Lamontagne Institute, Fisheries and Oceans Canada, Mont-Joli, Quebec, Canada

Nathalie Simard: Nathalie.simard@dfo-mpo.gc.ca

The primary goal of this project is to identify and quantify the communities, including potential AIS, being transported in sea-chests of both trans-oceanic and intra-continental ships entering Pacific and Atlantic ports and to estimate the potential propagule pressure from ships’ sea-chests exerted on ports on both coasts of Canada. Potential vessels “of interest” are being sampled opportunistically based on schedules provided by dry dock facilities. All sampling was conducted in accordance with a national standard developed for sampling sea-chests for AIS. The project was completed in 2010. A publication is expected in 2012.

5 Others

(see Handbook of Invasion Vectors, prepared by WGITMO and published as ICES Cooperative Research Report)

B INVASIVE SPECIES MANAGEMENT

1 Eradication Programmes
2 Management and Control of Invasive Species

NSERC Canadian Aquatic Invasive Species Network II

Great Lakes Institute for Environmental Research, University of Windsor, Windsor, Ontario

Hugh MacIsaac: hughm@uwindsor.ca

The national network consisting of some of the world’s leading researchers, explorers and innovators in the field of aquatic invasive species has received funding for an additional five years (2011-2016). A coordinated set of comprehensive studies are planned, directed at four research themes pertaining to Aquatic Invasive Species (AIS): i) early detection strategies; ii) rapid response strategies; iii) AIS as part of multiple stressors affecting aquatic ecosystems; and iv) reducing uncertainty in prediction and management. Selected projects under each theme are meant to further understanding of the AIS issue, with particular focus on early detection and rapid response. What’s more, CAISN will be conducting its first series of research efforts in the Arctic, where increased shipping, due in part to climate change, has put it at greater risk than ever before for aquatic invasion. It is also worthwhile to note that numerous publications resulting from the shipping vector research conducted during CAISN I are expected in 2012. See www.caisn.ca for more information on CAISN II research projects and links to publications from CAISN I.
Examination of ballast water exchange plus treatment to achieve enhanced protection of low salinity waters

Great Lakes Laboratory for Fisheries and Aquatic Sciences, Fisheries and Oceans Canada, Burlington, Ontario

Sarah Bailey: sarah.bailey@dfo-mpo.gc.ca

Canada is exploring a combination treatment strategy (using both ballast water exchange and a ballast water management system) as a means to provide enhanced protection for low salinity waters, like the Great Lakes. The theory behind the combination strategy is outlined in a document submitted to the IMO (BLG 15/5/7). Three land-based tests were conducted at the Great Ships Initiative Facility in Superior, Wisconsin in 2011 and shipboard testing is planned for 2012. Preliminary results to date are consistent with theory.

Mitigation of an invasive tunicate in an eastern Canadian marina through the removal of floating docks

Northwest Atlantic Fisheries Centre, Fisheries and Oceans Canada, St. John’s, Newfoundland and Labrador

Cynthia McKenzie: Cynthia.mckenzie@dfo-mpo.gc.ca

The invasive golden star tunicate, *Botryllus schlosseri*, was detected on floating docks in a small marina in Conception Bay, Newfoundland and Labrador. The species had been found previously in harbours in a southern bay (Placentia Bay) but this was the first indication that the tunicate had spread to a north-eastern region. To prevent the growth and spread of this invasive species a management decision was made to remove 15 floating docks from the marina over the winter. The docks were removed (winter) to land by crane and will be replaced in the spring. This was accomplished with the assistance of DFO Small Craft Harbours, and the local Harbour Authority. The sight will be monitored for reintroduction of the invasive tunicate.

C RISK ASSESSMENT APPROACHES

National risk assessment for ship-mediated introductions of aquatic nonindigenous species to Canada

Great Lakes Laboratory for Fisheries and Aquatic Sciences, Fisheries and Oceans Canada, Burlington, Ontario

Sarah Bailey: sarah.bailey@dfo-mpo.gc.ca

This ongoing project is conducting a pathway-based (rather than species-specific) risk assessment of the shipping vector to assess the risk of AIS introductions to regions across Canada. These risk assessments are based on analyses of vector activity (shipping traffic patterns), environmental matching between donor and recipient ports, and estimates of potential impacts based on reported AIS in donor ports. Risk Assessments for the Canadian Arctic and Great Lakes have been completed and are available online (Chan et al. (2011) and Bailey et al. (2011)). Documents for the Atlantic and Pacific coasts are expected in 2012, with a national summary document to follow. Canada plans to establish guidelines for vector-based risk assessments through the national Centre of Expertise for Aquatic Risk Assessment.
National risk assessment of recreational boats as vector of aquatic nonindigenous species to Canada

Pacific Biological Station, Fisheries and Oceans Canada, Nanaimo, British Columbia

Thomas Therriault: Thomas.Therriault@dfo-mpo.gc.ca

The goals of this ongoing project are to: a) identify/characterize the invasive species being introduced or redistributed (secondary spread) by this often overlooked vector, b) characterize vector activity in Canadian waters (including international arrivals), and c) conduct a vector-based risk assessment. Data collection includes both dock-side/dive surveys to characterize invasive species on recreational boats (e.g., Atlantic Canada hull fouling project described above) and distributed/online surveys to characterize boater movements and behaviours. This project will contribute to Canada’s plan to establish vector-based risk assessment guidelines (as above).

An ecological and oceanographic assessment of alternate ballast water exchange zones in the eastern Arctic

Freshwater Institute, Fisheries and Oceans Canada, Winnipeg, Manitoba

Kimberly Howland: Kimberly.Howland@dfo-mpo.gc.ca

Scientific information and advice is required to assess the ecological risk of introducing non-indigenous species into Canadian Arctic waters in the event that foreign vessels bound for Arctic ports need to conduct emergency ballast water exchange in designated alternate ballast exchange zones (ABWEZs) within the Canadian Exclusive Economic Zone (EEZ). In 2010-11 an assessment for the Eastern Arctic was initiated; the immediate area surrounding the existing Hudson Strait and Lancaster Sound ABWEZs and the waters to the east that span these two zones but are within the Canadian EEZ were considered. The assessment involves evaluating the relative risks of ballast exchange along major shipping routes based on oceanographic modeling of particle dispersion and the identification of areas with ecological, economic and/or cultural significance. The draft assessment will be completed in 2012. A peer-reviewed publication is expected by 2013.

D OCCURRENCE OF NEW SHIP-MEDIATED INTRODUCED SPECIES

<table>
<thead>
<tr>
<th>TAXON</th>
<th>YEAR OF FIRST RECORD</th>
<th>LOCATION OF FIRST RECORD</th>
<th>POSSIBLE INTRODUCTION VECTOR*</th>
<th>INVASION STATUS**</th>
<th>REFERENCE</th>
</tr>
</thead>
</table>

* Duplication with WGITMO report if the vector is unknown
** When spreading see details in Section E

E IMPACT OF INTRODUCED SPECIES

Economic (quantify if possible)
Ecological

F OTHER RELEVANT INFORMATION
REFERENCES


Canada. 2010. Proposal to utilize ballast water exchange in combination with a ballast water management system to achieve an enhanced level of protection. Submitted to the 15th session of the International Maritime Organization Sub-Committee on Bulk Liquids and Gases: BLG 15/5/7, 5 pp.


CROATIA

National Report Format for Update on Status of Invasive Species Research
WGBOSV
CROATIA
Marijana Pećarević and Josip Mikuš
University of Dubrovnik, Croatia
Contact: marijana.pecarevic@unidu.hr; josip.mikus@unidu.hr

A TRANSPORT VECTORS

- There is no ongoing research projects in the Republic of Croatia.
- New project on ballast water treatment at the University of Dubrovnik is planned. The planned research includes treatment using hydrodynamic forces and magnetic field based on Method and ship’s plant for inactivation of planktonic organisms in ballast water by hydrodynamic forces patented in 2010.

1 Ballast

Study of environmental zero status in three Croatian ports, Rijeka, Split and Ploče, was carried out by Croatian marine institutes under supervising of the Ministry of Maritime Affairs, Transport and Infrastructure as a part of GloBallast Partnership Project. This study was necessary for estimating of the impact of increased shipping traffic on marine communities in Croatian ports in future. Results of the study will be published at the web pages of the Ministry (http://www.mppi.hr).

2 Hull Fouling

No data.

3 Sediments

No data.

4 Sea Chests

No data.

5 Others

No data.

B INVASIVE SPECIES MANAGEMENT

1 Eradication Programmes

Monitoring, control and eradication of the invasive algae of the genus Caulerpa in the Adriatic Sea, Institute of Oceanography and Fisheries, Laboratory for Benthos, Split, 2009-2011 (grant from Croatian Ministry of culture).

Web page of the project: http://jadran.izor.hr/kaulerpa/
2 Management and Control of Invasive Species

The Regulation on Management and Control of the Ballast Water from 2007. enacts the principles and methods in managing and controlling of the ballast water in floating objects during their stay or voyage in Croatian part of the Adriatic Sea.

Preparing of the National Strategy on Invasive Alien Species in Croatia is in progress. Representatives of Ministry of Culture – Nature Protection Directorate and Directorate for Nature Protection Inspection, State Institute for Nature Protection and Croatian Environment Agency have been included in this project in order to help with data input and expertise.

C RISK ASSESSMENT APPROACHES

Ballast water risk assessments for the main ports in the country (Rijeka, Split and Ploče) is in progress of establishing.

D OCCURRENCE OF NEW SHIP-MEDIATED INTRODUCED SPECIES

<table>
<thead>
<tr>
<th>TAXON</th>
<th>YEAR OF FIRST RECORD</th>
<th>LOCATION OF FIRST RECORD</th>
<th>POSSIBLE INTRODUCTION VECTOR*</th>
<th>INVASION STATUS**</th>
<th>REFERENCE</th>
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</thead>
<tbody>
<tr>
<td>Pyrrhophyta (Dinophyceae)</td>
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<tr>
<td>Ceratoperidinium yeye Margalef</td>
<td>2003</td>
<td>Northern Adriatic (45°15'N, 13°34'E and 45°17'N, 13°32'E)</td>
<td>unknown spreading</td>
<td>Ninčević et al., 2006</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Southern Adriatic (43°45'N, 15°51'E)</td>
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<tr>
<td>Chlorophyta</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Caulerpa racemosa (Forskál)</td>
<td>2000</td>
<td>Pakleni otoci (Marinkovac islet)</td>
<td>ship anchor established</td>
<td>Žuljević et al., 2003</td>
<td></td>
</tr>
<tr>
<td>J.Agardh 1873</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Caulerpa taxifolia (M.Vahl)</td>
<td>1994</td>
<td>Stari Grad (isl. Hvar) (43°11’N, 16°34’E)</td>
<td>ship anchor established</td>
<td>Žuljević et al., 1998</td>
<td></td>
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<tr>
<td>C.Agardh 1817</td>
<td></td>
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<tr>
<td>Cnidaria</td>
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<tr>
<td>Anthozoa</td>
<td></td>
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</tr>
<tr>
<td>Cladocora debilis</td>
<td>2002</td>
<td>Lastovo Island, Southern Adriatic (42°43’N, 16°53’E)</td>
<td>unknown spreading</td>
<td>Kružić et al., 2005</td>
<td></td>
</tr>
<tr>
<td>Milne Edwards &amp; Haime, thin tube coral</td>
<td></td>
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<tr>
<td>Mollusca</td>
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<tr>
<td>Gastropoda</td>
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<tr>
<td>Melibe viridis (Kelaart, 1858)</td>
<td>2001</td>
<td>Stari Grad (isl. Hvar) (43°11’N, 16°34’E)</td>
<td>unknown alien</td>
<td>Despalatović et al., 2002</td>
<td></td>
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<tr>
<td>(syn. Melibe fimbriata Alder &amp; Hancock, 1864)</td>
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<tr>
<td>Kingdom</td>
<td>Phylum</td>
<td>Class</td>
<td>Species</td>
<td>Year</td>
<td>Location</td>
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<tr>
<td><strong>Siphonaria</strong></td>
<td><strong>Bivalvia</strong></td>
<td></td>
<td><em>Siphonaria pectinata</em> (Linnaeus, 1758), striped falselimpet</td>
<td>2003</td>
<td>Split (43°30’N, 16°24’E)</td>
</tr>
<tr>
<td><strong>Anadara transversa</strong></td>
<td></td>
<td></td>
<td><em>Anadara transversa</em> (Say, 1822)</td>
<td>2011</td>
<td>Lim Bay, Northern Adriatic (45°07’N, 13°39’E)</td>
</tr>
<tr>
<td><strong>Annelida</strong></td>
<td><strong>Polychaeta</strong></td>
<td></td>
<td><em>Ficopomatus enigmaticus</em> (Fauvel, 1923), australian tubeworm</td>
<td>2009</td>
<td>Krka River Estuary (43°44’N, 15°52’E) and Neretva River Delta (43°02’N, 17°25’E)</td>
</tr>
<tr>
<td><strong>Crustacea</strong></td>
<td><strong>Arthropoda</strong></td>
<td></td>
<td><em>Peniculus fistula</em> von Nordmann, parasitic copepod</td>
<td>2008</td>
<td>Eastern Adriatic Sea</td>
</tr>
<tr>
<td><strong>Hippolyte prideauxiana</strong></td>
<td></td>
<td></td>
<td><em>Hippolyte prideauxiana</em> Leach, 1817</td>
<td>2002</td>
<td>Kostrena, Northern Adriatic (45°18’N, 14°30’E)</td>
</tr>
<tr>
<td><strong>Callinectes sapidus</strong></td>
<td></td>
<td></td>
<td><em>Callinectes sapidus</em> Rathbun, 1896, blue crab</td>
<td>2004</td>
<td>Ston (42°49’N, 17°41’E)</td>
</tr>
<tr>
<td><strong>Chordata</strong></td>
<td><strong>Pisces</strong></td>
<td></td>
<td><em>Elates ransonnetii</em> (Steindachner, 1876)</td>
<td>2010</td>
<td>Eastern Adriatic</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><em>Paranthias furcifer</em> (Valenciennes, 1828), creole fish</td>
<td>2011</td>
<td>Zaljev Marina (Marina Bay) (43°30’N, 16°09’E)</td>
</tr>
</tbody>
</table>

* Duplication with WGITMO report if the vector is unknown
** When spreading see details in Section E
E IMPACT OF INTRODUCED SPECIES

Economic

Blue crab, *Callinectes sapidus*, due to its remarkable increase in abundance in the Neretva River Delta, should be promoted as a new food source on the local market in terms of reducing eventual potentially negative impacts on the indigenous fauna (Dulčić et al., 2011).

The bluefish, *Pomatomus saltator*, is a typical predator, preying mainly on flathead grey mullet, *Mugil cephalus* L., 1758, which comprises the most important catch of the local fishery. This increase has a consequence, a decreased catch of the flathead grey mullet. Bluefish often also destroy the nets adapted to the traditional hunting of flathead grey mullet, and, moreover, damage the rest of the catch in the nets (Glamuzina & Dulčić, 2008). Therefore the significant increase in the number of bluefish make big damages to the local fishery and shellfish culture in the Neretva River Delta (Glamuzina, 2012).

Ecological

A remarkable impact of the invasive green alga *Caulerpa racemosa* var. *cylindracea* on the epiphytic macroalgal assemblage of *Posidonia oceanica* seagrass rhizomes were observed at Marinkovac Island (central Adriatic Sea) in autumn 2002. Changes of both macroalgal diversity and vegetational characteristics of the epiphytic macroalgal assemblage on *Posidonia oceanica* rhizomes of a meadow occurring was evident. A significant reduction in both the number of epiphytic algal taxa and their cover was recorded. A total of 71 epiphytic macroalgal taxa were found on the *P. oceanica* rhizomes within the reference area unaffected by *C. racemosa* var. *cylindracea* (Rhodophyta 55, Ochrophyta 5, Chlorophyta 11), compared with 20 taxa on rhizomes in the invaded area (Rhodophyta 18, Ochrophyta 1, Chlorophyta 1) (Antolić et al., 2008).

F OTHER RELEVANT INFORMATION

The known geographical distribution of the colonial scleractinian coral *Cladocora debilis* Milne Edwards & Haime, 1849 has been extended with new record from the eastern Adriatic Sea. This scleractinian coral was found in spring 2002 on the cliff at the south of Lastovo Island (South Adriatic). The new record reported here is the first confirmation of *C. debilis* presently living in the Adriatic Sea (Kružić et al., 2005).

Six specimens of the alien bivalve *Anadara transversa* (Say, 1822) were found on the muddy bottom at a depth of 4.4 m in the innermost part of Lim Bay in June 2011. This species is being newly reported from the Croatian part of the Adriatic Sea (Nerlović et al., 2012).

The specimens of *Melibe fimbriata* were found during October 2001 in Stari Grad Bay (Island of Hvar, Croatia) in *Cymodocea nodosa* and *Posidonia oceanica* beds on sandy and sandy–muddy bottoms at depths of 2 to 15 m. Presently, this is the northernmost record of this lessepsian immigrant in the Mediterranean basin (Despalatović et al., 2002).

An abundant population of limpet snail *Siphonaria pectinata* (Linnaeus, 1758) (Mollusca, Gastropoda, Pulmonata) was recorded for the first time in the Adriatic Sea near Split in spring 2003. It is probably introduced by ballast water. In 2009 populations of this species were found in the coastal area from Rogoznica to Omiš spreading to island of Brač. *S. pectinata* population took over the indigenous species of genus *Patella* (Despalatović et al., 2009).
Alien species *Ficopomatus enigmaticus*, australian tubeworm, was recorded on two locations along the eastern Adriatic coast, Krka River Estuary and Neretva River Delta in 2009. It is probably introduced as ship fouling (Cukrov *et al*., 2010).

During the investigation of garfish biology in the eastern Adriatic Sea in 2008, a number of fish infested with the pennellid copepod *Peniculus fistula* von Nordmann, 1832 was recorded. This is the first record of *P. fistula* in the Adriatic Sea and the first record of garfish as a host of this parasite (Vidjak *et al*., 2008).

In 2002, during the routine Natural History Museum of Rijeka SCUBA fieldwork, the caridean shrimp, *Hippolyte prideauxiana* Leach, 1817, was collected at Kostrena near the city of Rijeka in the northern Adriatic. This was first record for the Adriatic Sea (Kirinčić, 2006).

On 15 October 2004, four specimens of the blue crab, *Callinectes sapidus* were caught near Ston (Pelješac peninsula, south-eastern Adriatic) in a hypersaline lagoon (salt ponds) at a depth of 0.50 m. One other specimen was caught in the Neretva River estuary on 1 October 2004 at a depth of 7 m, and a second one on 6 December 2006 at a depth of 5 m. This records were the first records of this species from the eastern Adriatic coast and confirm the spreading of this species throughout the Adriatic Sea. The present records of the blue crab in the eastern Adriatic constitute evidence of an established population of this species in the region investigated (Delta of the river Neretva) (Onofri *et al*., 2008; Dulčić *et al*., 2011).

A specimen of *Elates ransonnetii* (Steindachner, 1876) was caught on 6 March 2010 in the eastern Adriatic Sea. The specimen was caught at the depth of 15 meters on muddy bottom and measured 163 mm in total length. This is the first record of this species in the Adriatic, and second in the Mediterranean (Dučić *et al*., 2010).

**REFERENCES**


ESTONIA

National Report Format for Update on Status of Invasive Species Research
WGBOSV

Country: ESTONIA

Author(s) and contact details: Henn Ojaveer. Estonian Marine Institute, University of Tartu. Lootsi 2a, 80012 Pärnu. Estonia

A Transport Vectors.
No research projects neither carried out nor planned.

B Invasive Species Management.
No relevant activities in marine waters neither ongoing nor planned.

C Risk Assessment Approaches.
No risk assessment approaches applied

D Occurrence of New Ship-mediated Introduced Species.
Two new alien species findings were reported for 2011: the palemonid shrimp *Palaeomon elegans* (Kotta and Kuprijanov 2012) and the Harris mud crab *Rhithropanopeus harrisii*. Both species have been found earlier in other parts of the Baltic Sea, but not in Estonian waters. However, their invasion vectors are unknown. For details, please consult Estonian national report to WGITMO.

E Impact of Introduced Species.
No economic evaluations performed. New evidences of ecological impacts are reported in the WGITMO report for 2012. One of the tasks for the alien species national monitoring program for 2011 was to compile an overview on any documented ecological impacts of alien species. As a result, it was concluded, that perhaps the most impacting alien species in Estonian marine waters is the predatory cladoceran *Cercopagis pengoi*, mostly because of its wide distribution and substantial trophic role in the pelagic ecosystem (Anon. 2012; Lankov et al. 2010, Põllupüü et al. submitted, Ojaveer et al. submitted).

F Other Relevant Information
According to the HELCOM Baltic Sea Action Plan, Baltic Sea countries should ratify the IMO BWC preferably in 2010 but no later than 2013. For this purpose, HELCOM Correspondence Working Group on the Implementation of the HELCOM Ballast Water Road Map was established and is currently active. According to the current information, Estonia is planning to ratify the IMO BWC in 2013.

Monitoring of alien species in marine waters was started since 2010. Field sampling for zooplankton and macrozoobenthos (by using HELCOM methodologies) was carried out in the high-risk area of new invasions of the country – Port of Tallinn and its vicinity areas, together with continuation of the already existing long-term surveys on selected invasive alien species (Anon 2012, Ojaveer et al. 2011a).

Handbook of aquatic alien species in Estonia was published in 2011 (in Estonian). Amongst others, it also contains overview on invasion pathways and associated vectors (Ojaveer et al. 2011b).
References


FRANCE

National Report Format for Update on Status of Invasive Species Research WGBOSV

Country: FRANCE

Author(s) and contact details: Daniel MASSON ; Daniel.Masson@ifremer.fr

A TRANSPORT VECTORS

Results of ongoing research project(s) i.e. project title, host institute, contact details, co-ordinator, project duration, key objective(s), website if available

-PHYCOPORT (regional research action, in CPER project, contract between State and Region Poitou-Charentes); IFREMER; Project coordinator: Christian Bechemin (Christian.Bechemin@ifremer.fr); action duration: 2010-2013; key objectives: collect data on discharged ballast waters in La Rochelle port, for regional decision makers and port authorities awareness.

Methods:

Seawater samples are collected by pumping and filtration (20µ) along the hull or directly (photo) when ship deballasts; then subsamples are examined on inverted microscope to detect the foreign phytoplankton species, particularly those known to produce toxins.
Last interesting result:

A ballast water discharge has been tracked on ship’s waiting area (yellow line), 6 miles from La Rochelle port entrance, using MARS 2D model.

With 10 000 m$^3$ simulated discharge, the waters (orange then green) reach (and spread on) oyster beds (in pink) within 4 or 5 days:
If discharged in front of port entrance, this water reach the mussel poles area or mussel long lines in the same delay. Work continues, with also *Vibrio* research in focus.

Planning of new research project(s)

5 Ballast

1.1 Biology of Ballast Water

-Project MEDINA: submitted to French Ministry call LITEAU; study of *Alexandrium tamarense* cysts dynamics in Mediterranean waters using ship’s ballast water samples taken in French, Tunisian, Algerian and perhaps Moroccan ports; extensive use of genetic probes to determine the strains and origins. Consortium: IFREMER-Montpellier 2 University. Duration: 2 years. Presently in evaluation.

-Ballast water impacts in the Gulf of Gascony: sampling campaign in the ports of Bordeaux and Bayonne to track the pathogenic bacteria, particularly those responsible of nosocomial diseases in hospitals. Accessorily, potentially toxic phytoplankton will be tracked too. Consortium: IFREMER-Bordeaux 2 University-GEFMA. Duration: 2 years. Project at early building stage.

1.2 Ballast Water Treatment:

-In Saint Nazaire University, a thesis is on its way about ballast water treatment by filtration with membranes. End of the work: in 2012.

-One of the two French companies intending to submit BWT (UV) to IMO approval is still on its way, apparently carrying real scale tests.
Hull Fouling

Sediments

Sea Chests

Others

(see Handbook of Invasion Vectors, prepared by WGITMO and published as ICES Cooperative Research Report)

B INVASIVE SPECIES MANAGEMENT

1 Eradication Programmes
2 Management and Control of Invasive Species

C RISK ASSESSMENT APPROACHES

- Thesis project (co-direction) in World Maritime University (Göteborg): Assessing and mitigating environment impacts of Shipping in the Arctic. Building stage.

D OCCURRENCE OF NEW SHIP-MEDIATED INTRODUCED SPECIES

<table>
<thead>
<tr>
<th>Taxon</th>
<th>Year of first record</th>
<th>Location of first record</th>
<th>Possible introduction vector*</th>
<th>Invasion Status**</th>
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* Duplication with WGITMO report if the vector is unknown
** When spreading see details in Section E

E IMPACT OF INTRODUCED SPECIES

Economic (quantify if possible)
Ecological

F OTHER RELEVANT INFORMATION

G REFERENCES
GERMANY

National Report for Update on Status of Invasive Species Research WGBOSV

Country: Germany

Author(s) and contact details:
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Stefan Kacan stefan.kacan@bsh.de

Highlights

- Since the last reporting period Germany has been approved four new Ballast Water Treatment Systems (BWMS). Two systems use active substances and two use UV radiation for treatment.
- An additional guidance regarding ballast water sampling for compliance control is under development. This document was discussed in a correspondence group led by Brian Elliot of EMSA and further discussed in detail at recent BLG meeting.
- A paper regarding minimum data requirements for the non-confidential part of basic and final approval dossiers for BWMS submitted by Germany to MEPC 63 (held in March 2012) and was accepted by the committee. This paper is going to be circulated by the IMO.
- Germany was actively involved in the development of the IMO hull fouling guideline which was agreed at IMO.
- A “Platform for Information Exchange on Neobiota” has been established in the framework of the “Federal and Federal States Marine Monitoring Programme” in Germany.
- A risk assessment project for intra-Baltic shipping was completed in Nov 2011 as a contract of HELCOM.
- The German Federal Maritime and Hydrographic Agency initiated a research project on risk assessments for ship voyages between harbours in the North Sea and in the Baltic Seas.
- On 2 November 2011, a very dense, well established population of G3-comlex-Claviceps purpurea was found on the common cord-grass at two localities on the German North Sea coast in the Wadden Sea.
- Monitoring projects are underway which also include sampling sites in commercial ports. Knowledge on alien species is an essential component of risk assessment based exemptions of ballast water management requirements, which the first shipping lines apply for.

A Transport Vectors

1. Ballast

1.1 Biology of Ballast Water

As mentioned in last year’s report a project is planned in cooperation with Canadian experts to test the efficacy of ballast water exchange in combination with and without ballast water treatment. The planned project start is in summer 2012. During this project it is planned to uptake the ballast water in a freshwater port.
1.2 Ballast Water Treatment

The Federal Maritime and Hydrographic Agency (BSH) is responsible for the type approval of ballast water treatment systems in Germany and has since the last reporting period approved four treatment systems (Mahle, Severn Trent de Nora, Ecoclor and Aquaworx). Various others are at different stages of the approval process.

Gollasch is involved in onboard performance tests of several ballast water treatment systems.

Federal Institute of Risk Assessment (BfR, Berlin) risk assessment workshop for ballast water treatment systems using active substances (Oct. 2011). The proceedings of this meeting will be published soon.

A workshop to address ballast water treatment systems using UV-Radiation was held in November 2011. For a copy of the presentations please contact Stefan Kacan.

1.3 Ballast Water Sampling

IMO

Additional guidance regarding ballast water sampling for compliance control with the standards as set forth in Regulation D-2 of the IMO Ballast Water Management Convention are under development. The result of a correspondence group, led by Brian Elliott of EMSA, were communicated and discussed in great detail at the recent IMO Bulk Liquid and Gases (BLG) Sub-committee meeting (Jan. 2012).

The new methodology of the GESAMP group to evaluate active substances was discussed and agreed at the MEPC meeting in (March 2012). Germany contributed in this regard by submitting a document. Further, with the interest to harmonize dossier submissions, Germany made a paper available outlining the minimum requirements for such dossiers.

1.4 Ballast Water Management

Ballast Water Opportunity

This Interreg IVB funded study will run another 1.5 years. Within the different work packages the project deals with regional cohesion (coherence, harmonization and transparency), ballast water treatment systems (knowledge transfer, innovation, test bed, demonstration and certification of ballast water treatment systems), detection for monitoring and compliance control, strategies and dissemination.

Germany is responsible for WP2 (BSH) and WP4 (GoConsult). One major outcome of WP4 was a summary of organism detection technologies addressing a wealth of different methods which may be applied for an indicative and/or an in-depth analysis of ballast water samples.

More details regarding this project and an activity update are available at http://projects.nioz.nl/northseaballast/.

Status of IMO Ballast Water Management Convention

As per the IMO homepage, the Ballast Water Management Convention was now ratified by 33 countries representing 26.46% of the world fleet tonnage. For its entry into force 30 countries with 35% tonnage need to ratify this instrument.
2 Hull Fouling

Germany was actively involved in the development of the IMO hull fouling guideline which was agreed at IMO BLG Sub-Committee meeting in February 2010. Vessels below 24 m in length were addressed by a separate document which was agreed IMO BLG Sub-Committee meeting in February 2012.

3 Sediments

4 Sea Chests

5 Others

B Invasive Species Management

Eradication Programmes

Management and Control of Invasive Species

Platform for Information Exchange on Neobiota

The issue of neobiota in the marine environment including the coastal areas and the harbours attracts growing interest world wide. In the meantime it is taken on by international fora like IMO, OSPAR, HELCOM. European regulations like the EU Water Framework Directive and the EU Marine Strategy Framework Directive include provisions for neobiota and since the Wadden Sea has been placed on the list of UNESCO’s World Heritage Sites neobiota receive growing attention. Recognizing that against the background of the varied fora and regulations in Germany different official bodies are busy with the subject and that the information exchange between these bodies could be enhanced a “Platform for Information Exchange on Neobiota” has been established in the framework of the “Federal and Federal States Marine Monitoring Programme” the national body that takes care of the duties arising from national and international obligations. Involved in the group are representatives from different federal agencies, federal state agencies and research facilities.

Inventory study to provide an overview of the state of the art regarding neobiota in the Wadden Sea

At the 11th trilateral governmental Wadden Sea Conference (Sylt, Germany March 2011), the three Wadden Sea states decided to develop a common strategy for dealing with alien species introductions in the Wadden Sea, taking account of the request of the UNESCO World Heritage Committee and the Ballast Water Management Convention (BMW Convention).

An inventory study to provide an overview of the state of the art regarding neobiota, as a basis for the development of a trilateral strategy on neobiota for the trilateral Wadden Sea Cooperation Area was completed. The report provides recommendations for the main elements of a trilateral strategy. The study consist of an inventory part and an analysis part (Bouma et al 2011).

EU Strategy on Neobiota

This EU Strategy is developing is and is now open for Member States to comment. The basic components of the instrument include avoidance of new alien species introductions, early recognition of new aliens and management of established (widespread) aliens.
EU - CITES

An instrument in the EU is available to regulate imports of species. This addresses also alien species in a similar fashion as the CITES instrument.

C Risk Assessment Approaches

Ballast Water Opportunity

In the framework of this project (see above) a risk assessment study for the North Sea shipping was jointly prepared by Matej David (University of Ljubljana, Faculty of Maritime Studies and Transport, Portoroz, Slovenia) and Stephan Gollasch and was presented in last years National Report.

German Federal Maritime and Hydrographic Agency

The German Federal Maritime and Hydrographic Agency initiated a research project on risk assessments for ship voyages between harbours in the North Sea and in the Baltic Seas. Based on a compilation of available risk assessment approaches and the availability of the information about environmental conditions and the prevailing species composition risk assessment should be carried out for selected harbours in the North Sea and in the Baltic. The project is nearly finished.

Helsinki Commission – Baltic Marine Environment Protection Commission (hereafter referred to as HELCOM)

The 2010 HELCOM Moscow Ministerial Meeting adopted the HELCOM Guidance on how to distinguish between high and low risk – a risk of secondary spreading of alien species through ballast water and sediments – by ships engaged in intra-Baltic voyages. The Guidance has been developed to support transparent and consistent risk assessments for regional ship voyages and to allow a unified Baltic Sea system on exemptions from applying ballast water management in accordance with the Ballast Water Management Convention Regulation A-4.

The Guidance, however, has not been tested yet on real cases, and there is a growing need to gain the knowledge among national administrations and provide best practices on how to conduct and/or evaluate and consult risk assessments as set in the Ballast Water Management Convention.

To test the Guidance, HELCOM MARITIME 9/2010 and HELCOM HOD 34/2010 agreed on conducting the project “Pilot risk assessments of alien species transfer on intra-Baltic ship voyages”.

Stephan Gollasch is involved in this project and the work was jointly undertaken with Matej David (University of Ljubljana, Faculty of Maritime Studies and Transport, Portoroz, Slovenia) and Erkki Leppäkoski (emeritus, Abo Akademi, Turku, Finland). The project was completed in November 2011 with a presentation and discussions at HELCOM MARITIME. The summary of this report is attached as Annex 1 (Gollasch et al. 2011).

D Occurrence of new ship-mediated Introduced Species

The most up-to-date list of alien species in German coastal waters can be found at www.aquatic-aliens.de/species-directory.htm.

On 2 November 2011, a very dense, well established population of G3 *Claviceps purpurea* was found on the common cord-grass *Spartina anglica* C.E. Hubbard at two localities on the German North Sea coast in the Wadden Sea (Cäciliengroden and Hooksiel). It is most likely that G3 *C. purpurea* has a North American origin and en-
tered German coastal waters by floating sclerotia from Irish, British, or Benelux waters, where it was previously found. However, introduction via ships’ ballast water coming from their native or introduced ranges is also plausible. Furthermore imports of G3 sclerotia via seed mussels collected from wild subtidal banks in Irish, British and Dutch coastal waters and released into the German Wadden Sea can currently not be excluded. Risks from this highly toxic fungus for human, grazing animals and the marine environment have been identified but not yet quantified in terms of impact (Nehring et al., 2012).

<table>
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<tr>
<th>Taxon</th>
<th>Year first record</th>
<th>Location of first record</th>
<th>Possible introduction vector*</th>
<th>Invasion Status**</th>
<th>Reference</th>
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</thead>
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<td><em>Claviceps purpurea</em></td>
<td>2011</td>
<td>Wadden Sea</td>
<td>ballast</td>
<td>invasive</td>
<td>Nehring et al. in press.</td>
</tr>
</tbody>
</table>

* Duplication with WGITMO report if the vector is unknown
** When spreading see details in Section E

E Impact of Introduced Species

Economic (quantify if possible)
Ecological

F Other Relevant Information

Good Environmental Status (GES)

As reported last year, one of the 12 identifiers of Good Environmental Status (GES) are alien species. There are discussions at national and HELCOM as well as OSPAR level how to use alien species to qualify the status. A trend indicator (rate of new invasions) and an impact indicator (invasiveness) are discussed. One of the key issues is to identify where to draw the “bottom line”, i.e. what is currently the number of alien species so that future newly found aliens are new introductions and not overlooked already earlier introduced species.

Alien species monitoring programmes

German coastal waters are monitored quite well in comparison to other Baltic Sea countries including studies targeting alien species in ports and the taxonomic expertise to process these samples is well available. Almost all regular monitoring activities are also made aware to report on the occurrence of alien species. Comparing all known Baltic Sea alien species records, the German coastal waters have the highest numbers (Fig. 1). It is questionable if this reflects the real situation or if this may be a result of “the more you look, the more you find”. This gives an interesting perspective regarding the EU qualifiers for Good Environmental Status (GES). Does Germany have a worse status when looking at alien species due to the higher number of these species, or are simply more species found due to targeted monitoring and awareness raising in regular monitoring studies?
The German alien species targeted monitoring programmes include sampling stations in ports (8 Baltic and 8 North Sea ports). The samplings are conducted annually between August and October (Buschbaum pers. comm.). However, not all habitats and all species groups are monitored in the same level of detail. Most efforts focus on benthos and to a lesser degree on zooplankton. Fouling communities on artificial surfaces and natural habitats and phytoplankton are poorly studied groups.

Lack of taxonomic expertise

A general problem is the lack of taxonomic expertise. It may well be possible that incomplete taxonomic knowledge will result in confusion in the area of biogeography and biological invasion science. Taxonomic skills are needed as the invasion status of an organism can usually only be assessed when the species level is identified. The lack of taxonomic expertise may also lead to overlooking introduced species, as had happened with *Mnemiopsis leidii* in the North Sea. The presence of this species was most likely overlooked for a decade as the comb jellies-found were confused with native species. Which also may have been caused by the (rapid) disintegration of comb jellies in preserved samples.
Germany noted the importance of taxonomic organism identification and two workshops (July 2011 – North Sea, March 2012 – Baltic Sea) were held to familiarize researchers involved in regular monitoring programmes with alien species.

**Black listed species**

An ongoing project will result in a list of black, grey and white listed alien species which do not yet occur in German waters, but are known from neighbouring countries or nearby areas (Rabitsch et al. in prep.). The species of greatest concern are included in the black lists.

**References**

A book contract on ballast water management was signed with Springer (David, Gollasch, Hewitt (eds.). The tentative title is GLOBAL MARITIME TRANSPORT AND BALLAST WATER MANAGEMENT – ISSUES AND SOLUTIONS. It is planned to publish this book in 2012.

This book will provide an overview of the possible solutions to the complex issue of ballast water management and will further outline consequences and implications to address the ballast water "problem" following the provisions of the Convention. There is a need to have a good insight to the ship-ballast operations, environmental and other aspects of the issue, international requirements, as well as in depth insights in possibilities how to approach or manage it in a most effective way, specifically considering specifics on a case-by-case basis. The editor and main authors are scientists of different disciplines including professors of universities in the maritime sphere and biological arena (biosecurity) who have been involved or are leading researchers in this field in different parts of the world (Australia, New Zealand, Europe), as well as have been involved in the policy making processes at the highest international (IMO), national and regional levels. Experience of this group has been gained through years of committed work in scientific research in this field, close work with the shipping industry, as well as at national and global regulatory levels with IMO, gave a unique opportunity to gain specific knowledge and experience of the authors to offer solutions to the related issues. On the other side, the book contributions will reflect the industry, administrations and academic views regarding ballast water management. In essence the book contributions will describe the ballast water problem and will show possible solutions to tackle this problem also including recommendations and guidance for countries to take the next steps to implement measures to avoid future species introductions with ballast water.


David and Gollasch (in press). Ballast water treatment systems – A summary, Conference on Emerging Risks from Ballast Water Treatment, Berlin, Germany


David M, Gollasch S and Leppäkoski E (in press). Risk assessment for exemptions from ballast water management – The intra-Baltic HELCOM study. IMO GloBallast and Republic of
Turkey Global R&D Forum and Exhibition on Ballast Water Management, Conference Proceedings, Istanbul, Turkey

David M, Gollasch S and Pavliha M (submitted). The same location concept in ballast water management – A clear term or a clear issue?


Eschweiler, N.and Buschbaum, C. 2011. Alien epibiont (Crassostrea gigas) impacts on native periwinkles (Littorina littorea). Aquatic invasions. 6(3), 381-390


Annex 1

Executive Summary

This risk assessment study focuses on intra Baltic Sea shipping. The HELCOM Guidance to distinguish between unacceptable high risk scenarios and acceptable low risk scenarios – a risk of spreading of alien species by ships on Intra-Baltic voyages (HELCOM Risk Assessment (RA) Guidance) was taken as a starting point to develop the RA concept. In addition the three different risk assessment approaches as outlined in the IMO Guidelines for risk assessment under regulation A-4 of the BWM Convention (IMO G7 Guideline) were evaluated for their applicability in the region. The application of the HELCOM RA Guidance and consistency with the IMO Guideline G7 was studied, and comments are provided.

The biogeographic risk assessment approach of IMO Guideline G7 is not applicable as the ballast water movements considered here are not undertaken between different biogeographical regions. IMO Guideline G7 further states a species-specific risk assessment may be best suited to situations where the assessment can be conducted on a limited number of harmful species within a biogeographic region.

It became clear that essentially needed data (i.e., on already introduced species in the Baltic Sea ports) are missing to undertake a species-specific and target species risk assessment as no port baseline surveys were undertaken yet. However, a target species selection process may be conducted based upon harmonized selection criteria. Target species can thereby be identified, but a risk assessment based upon target species is only possible with the knowledge on their occurrence in ballast water donor areas – highlighting the need to undertake port baseline surveys. Therefore it is of utmost importance to agree upon R&D priorities. The priority should be placed on undertaking port baseline studies and monitoring programmes and only thereafter e.g. physiological and experimental studies of different life stages of species, as proposed under Guidance “6.3 Comparisons of known physiological tolerances…” may be conducted.

The risk assessment based upon an environmental match may also be applied considering water salinity as key feature in this approach. It should be noted that the more environmental parameters are being included the lesser robust and reliable becomes this assessment which is in conflict with the precautionary principle. The salinity is believed to be a relatively solid indicator for species compatibility and survival in a new environment, and on the other side, this information is easily available for ballast water source and discharge areas. A high risk is assessed should the salinity match between ballast water donor and recipient regions, e.g., marine to marine, marine to brackish or freshwater to brackish environments. A mismatch of salinity, i.e., waters with high salinity difference, e.g., freshwater (< 0.5 PSU) to marine (> 30 PSU), indicates a lower risk. This generic approach however needs a bit caution in regards to human pathogens, which in general do not survive in marine waters or brackish waters with higher salinities, but may survive in a host animal or debris. In conclusion such a salinity difference does not occur for intra-Baltic shipping and therefore this environmental match approach alone cannot be applied as RA concept.
Temperature was also considered as risk assessment quantifying factor in the environmental match approach, but it was agreed that this is of lesser reliability to identify low risk scenarios. This view is based upon the assumption that organisms are more flexible regarding temperature tolerances compared to salinity. One reason for this assumption is the greater temperature difference compared to salinity difference over the seasons in the Baltic region which the species need to tolerate.

A combination of both, the target species approach together with an environmental match, is to be considered. Should the selected target species occur in the ballast water donor area and both the ballast water donor and recipient ports show matching salinities, a high risk is assessed. However, if a high mismatch of salinity is identified between donor and recipient ports, the ballast water may be identified as low risk. All these low risk scenarios are acceptable only provided the ballast water is in no instance mixed with ballast water from other sources.

It should be noted that low risks can only be identified provided reliable data are available. This at present may be a key limiting factor of the risk assessment in the Baltic Sea as especially no port profiles are available for Baltic ports.

The following shipping routes were selected for a more detailed risk assessment:

- St. Petersburg (RU) – Gothenburg (SE),
- Klaipėda (LT) – Kiel (DE),
- Kiel (DE) – Gothenburg (SE), and
- Terneuzen (NL) – Mönsterås (SE) – Karlshamn (SE).

In the IMO “same location concept” chapter the report also recommends how ferries and other vessels may approach ballast water management exemptions provided they are solely operated on a constant shipping route.
THE NETHERLANDS

National Report Format for Update on Status of Invasive Species Research
WGBOSV

Country: The Netherlands

Authors and contact details:

Andrea Sneekes (IMARES Wageningen UR)  email: andrea.sneekes@wur.nl
Cato ten Hallers-Tjabbes (CATO Marine)  email: cato@catomarine.eu

A TRANSPORT VECTORS

- Results of ongoing research project(s) i.e. project title, host institute, contact details, co-ordinator, project duration, key objective(s), website if available
- Planning of new research project(s), website if available
- For each category below include information, where available, on biology, treatment, sampling and legislation/regulations.

1 Ballast water

1.1 Biology of ballast water

Project (www.NorthSeaBallast.eu)

NIOZ

- Background studies on detection of microorganisms present in ballast water, viability and long-term survival of microorganisms in ballast water and the forgotten organisms < 10 micron I the BW discharge standard.
- Conference for dissemination of the ballast water convention was organised during Europort 2011 in Rotterdam. This was part of the NSBWO project and speakers from governments, researchers and shipowners were invited.

IMARES Wageningen UR

- Interreg NSBWO. Mesocosm Ballast Water study:

Ecological risk of treated ballast water: a mesocosm experiment


As a consequence of the IMO Ballast Water Convention, in the near future large amounts of water treated with an active substance will be discharged in harbours and coastal areas. With regard to the ecological risk assessment of active substances used in ballast water treatment systems, mesocosms may be applied. Routinely, mesocosms are applied as ‘higher tier tests’ in the ecological risk assessment of pesticides. For ballast water testing, adaptation of the test set-up is necessary, as not a small amount of a toxic substance is added, but a significant volume of water is replaced instead.

During spring 2011, such an experiment was conducted in 4-m3 outdoor marine mesocosms with PERACLEAN Ocean® as the active substance. Three different treatment levels were created by replacing 10% of the volume of test systems with
treated ballast water aged for 1 hour (BW-d0), 24 hours (BW-d1) or 5 days (BW-d5). Two control systems did not receive any treatment. At the same time, the toxicity of the ballast water was tested with standard laboratory bioassays confirming earlier test results. During the 69 day exposure period, the water compartment was sampled weekly. At the end, the test systems were drained and the bottom compartment was sampled.

The results show that replacement of water without remaining active substances is not free from effects. However, the level of toxic substances present in the treated water corresponded with the amount of effects. Effects seen in bioassays are not directly copied in mesocosms. Results might be affected by physical characteristics like pH, oxygen, DOC, N/P. However, high risk indicated by the toxicity tests corresponded with high level of disturbances of the ecosystem. Mesocosms can be used in higher tier assessment of whole effluents, such as ballast water. Even when as much as 10% of the water volume is replaced by treated water, treatment effects are obvious. Moreover, clear recovery of some systems was observed within the test period enabling to assess the No Observed Ecological Adverse Effects Concentration (NOEAE) conform De Jong et al. (2008). The mesocosms are a useful tool for assessment of treatments including the side effects in discharge ballast water, by integrating effects as well as recovery of multiple interacting species.

1.2 Ballast water treatment

NIOZ

- BWM certification testing ongoing
  - G8 testing for 1 BWMS using inert gas
  - G8 testing for 1 BWMS using filtration and UV
  - G8 testing for 1 BWMS using filtration and active substances

Publications:

IMARES Wageningen UR

http://www.imares.wur.nl/UK/research/environment/facilities/ballastwater/

- BWM certification testing toxicity
  - G9 testing of active substances for 2 BWMS
  - G8 testing for 1 BWMS using inert gas and 1 BWMS using UV
- Pilot scale efficacy testing for 2 BWMS

NIOZ and IMARES Wageningen UR both are member of the international harmonisation group for ballast water test facilities: Global TestNet and have been taking part of the discussions in Istanbul (2011), Singapore (2010) and Malmo (2009). Both parties are also actively involved in discussions as part of a technical advisory group (TAG) initiated by California to advice on port state control sampling.

A first meeting on Neobiota in the trilateral Wadden Sea area has been taken place in Groningen. Here several Dutch parties were involved in the discussions and four
items in relation to IAS were addressed: hull fouling, ballast water, shellfish transports and monitoring.

2 Hull Fouling

NL Government
- Hull fouling expert group since 2011 (co-ordinated by NL Government)

Team Invasive Exotic species (TIE) (Nieuwe Voedsel en waren autoriteit)
- Pathway analyses for hull fouling under development

Maritime Campus Netherlands (IMARES Wageningen UR and TNO Industry and Technique)
- Bio-invasion from hull fouling project
  B. Bolman, N.H.B.M. Kaag, H. van Pelt, A.C. Sneekes
The Bio-Invasion project aims to build a knowledge base on bio-invasion risks, mechanisms, legislation and management measures. To achieve this aim technological innovations using DNA 454-sequencing techniques and sampling have been developed. The next step within the project is sampling hull fouling and comparing it to the local situation.

TNO Industry and Technique
- Hull fouling research ongoing. Testing effectiveness of (new) antifouling and corrosion paints and techniques.

Micanti
- A new innovative type of non-toxic hull fouling is developed during the last years. The fouling uses short fibers “thorns” which makes the surface prickly and unattractive for fouling organisms to settle. www.micanti.com

GIMaRis
- Total alien species inventory of the Dutch Wadden Sea
  Dr. Adriaan Gittenberger / www.GiMaRIS.com
Goal of this project is to give a complete overview of all alien species (ever recorded) in the Dutch Wadden Sea. Therefore, extensive fieldwork in which various monitoring methods were combined and as many different habitats as possible were searched; Literature study. The fieldwork period was from June-August 2011.

During the alien species inventories in 2009 and 2011 in total 19 new species (resp. 11 and 8) were found, raising the number of known alien species in the Dutch Wadden Sea from 54 to 72 in three years time. Many of these species have probably been overlooked in previous years as the inventories of 2009 and 2011 were the first to specifically focus on finding all alien species in the Dutch Wadden Sea. In 2001 two of the eight ‘new’ alien species for The Wadden Sea, also concern ‘new’ alien species to The Netherlands: Ceramium botryocarpum and Ceramium tenuicorne. Although they had been found “washed ashore” in previous years, they were first recorded as settled/attached individuals in 2011.

Project issued by: Producentenorganisatie van de mosselcultuur (inventory in 2011) & Team Invasive Exotic species of the Dutch Ministry of LNV (inventory in 2009)
- SETL-project: Fouling community study
  Dr. Adriaan Gittenberger / www.GiMaRIS.com
Goal is to use a rapid detection method of alien fouling species:

- Continuous monitoring project (since 2006) focussing on monitoring the settlement of fouling species all along the Dutch coast from the Wadden Sea to Zeeland with the focus on harbours
- The chosen method must enable comparisons with fouling community dynamics in other temperate waters worldwide
- Fundamental research: Publishing results in SCI-journals / Data is made freely available for non-commercial publication purposes for outside parties (for e.g. co-authorship).

About 200 14x14 cm grey PVC plates, hanging on a depth of 1 meter in 16 harbours along the Dutch coast, are checked for species, renewed and analysed every three months. When starting in 2006, the methodology was copied from (developed in cooperation with) the Smithsonian Marine Invasions Laboratory. It was furthermore incorporated in the MarBEF EU Network of Excellence. Therefor exactly the same plates (same material, dimensions, depth, etc.) have been deployed over the years all along the European coasts, on both sides of North America (USA, Canada), and from Hawaii to New Zealand, enabling comparisons in fouling community dynamics to be made worldwide. Many of the more well-known temperate water alien species (e.g. sea-squirt species) occur at virtually all of these locations worldwide! Fieldwork period is from 2006 till 2012. A continuous monitoring project.

During the 2011 monitoring of the SETL-project, no new alien species for The Netherlands were found (in previous years several new species were discovered). In 2011 one alien species new to the Dutch Wadden Sea was discovered: Telmatogeton japonicas.

Project issued by: GiMaRIS / no external funding in 2011

- “Pleasure crafts” as a transport vector of invasive species
  Dr. Adriaan Gittenberger / www.GiMaRIS.com

Aims/Goals

- Risk analysis of hull fouling on small to medium sized boats as an import vector of exotic species in the Wadden Sea.
- What percentage of the pleasure crafts along the Dutch coast is fouled and what species (native/non-native) can be found on these boats?
- Can a distinction be made between high/medium/low risk harbors, concerning the spread of invasive species?
- Can a distinction be made between high/medium/low risk boat types, i.e. sailing boats, motorboats, etc., concerning the spread of invasive species?
- Can a distinction be made between boat owners and their behaviour (how often do they clean their boats, etc.), concerning the spread of invasive species?

The hulls of several hundreds of boats in various harbours along the Dutch coast were photographed and/or filmed in detail after which these photos and films were analysed: fouling percentages were calculated and species (as far as possible) were identified. Harbour masters and boat owners were asked to fill in a questionnaire focusing on where boats have been, how they are cleaned/maintained and what were the extra costs they encountered, which could be related to the presence of alien species. Fieldwork period in 2011. Most monitoring was done in the summer months.
Preliminary results indicate that pleasure crafts concern a very important if not the most important transport vector of alien species along the Dutch coast. Clear (significant differences in fouling species diversity and abundance) distinctions can be made between lower and higher risk harbours and boat types could be made. Partly based on the results of the project a risk analysis was made:


3 Sediments

University of Groningen

Comparative studies in enclosed land-locked saline ecosystem: survival of transported species in sediments in relation to ballast water conditions.

IMARES, Wageningen UR

- IMARES is pioneering with the genetic analysis of flora and fauna samples. The challenge is to isolate high quality DNA from mixed samples such as total plankton samples or sediment cores. The DNA is analysed and results are compared with DNA-Barcoding databases on the internet to check which species were present. This technique is particularly suitable for the early identification of invasive species in our samples. Species identification based on genetic analysis is efficient for the small fractions of the marine ecosystem, such as plankton, meiofauna and the microbial community. Several papers are in preparation and are expected to be published this year.

4 Sea chests

- Others

(see Handbook of Invasion Vectors, prepared by WGITMO and published as ICES Cooperative Research Report)


B INVASIVE SPECIES MANAGEMENT

Eradication Programmes
Management and Control of Invasive Species

Team Invasive Exotic species (TIE)
- Workplan 2011
  Wiebe Lammers

The team on invasive species created a workplan. Here the actions for 2011 had been set out for all invasive species related work in the Netherlands. Specific attention in 2011 was for the EU strategy on Invasive Alien Species and the trilateral policy on invasive species for the coastal areas.

IMARES, Wageningen UR
- Invasive species monitoring and risk assessments
  J.M. Jansen (jeroenM.jansen@wur.nl)

Surveys

IMARES has a rich history conducting stock assessments for commercial fish and shellfish species. In recent years, these surveys changed from single species monitoring to multi species monitoring programs. Doing so, the results of these surveys are an important source of information when assessing the quality status of the marine environment. During these extensive surveys special attention is paid to presence of exotic and invasive species in the samples.

Research vessel “Tridens” coordinates a 5 week bottom trawl survey (IBTS) in the North Sea to which vessels from Denmark, Germany, France, Norway, Scotland and Sweden are contributing. Sampling during this survey is conducted using a “bottom-trawl”, the so called GOV (Grand Ouverture Verticale), which is especially useful to capture large bottom-dwelling exotic and invasive species. During the night, they survey with a plankton sampler (MIK-net, Method Isaac Kidd). The purpose is to identify and count the larvae of commercial fish. Potentially, these plankton samples form an important source of information on invasive species. IMARES laboratories work hard to start analysing these samples using a metagenomic approach (see below).

IMARES carries out three separate flatfish surveys. This “Beam Trawl Survey” (BTS) spends five weeks in the south eastern North Sea using research vessel “Isis”, and four weeks in the central North Sea using research vessel Tridens. During these weeks both vessels are equipped with an eight meter wide beam trawl. Besides different target species focusses this survey on the diversity and distribution of mega-epifauna and invasive species.

The “Demersal young fish survey” (DYFS) is another international stock assessment for 0- and 1-year old flatfishes. The survey is conducted in the North Sea coastal zone, adjacent estuaries and the Wadden Sea. Different research vessels collaborate to fulfil this survey that is carried out with regular shrimping gear. This annual investigation provides a lot of information on the development of macro- and mega- epifauna in the coastal zone.

In addition to surveys with fishing gear and plankton nets, IMARES carries out surveys with benthos dredges at a large scale (fig. 1). Dredges have a 5mm mesh size, providing information on shell fish, crustaceans and echinoderms. Occasionally, tube worms, hydrozoan, anthozoa and bryozoan are collected as well. Over the past 15
years, these survey allowed us to follow the development of important invasive shellfish species, such as the Pacific Oyster (*Crassostrea gigas*), the Razorshell clam (*Ensis directus*) and the Ottershell (*Lutraria lutraria*); (fig.2).

**Figure 1**: Sampling stations visited for benthos sampling by IMARES at an annual basis.

**Figure 2**: Development of the stock of Ottershells (*Lutraria lutraria*) in Dutch coastal waters.
Surveys on macrofauna are carried out using corer samples. IMARES follows the development of macrofauna in the vicinity of several oil-drilling plants in the central North Sea and near-shore locations. These surveys allowed us to identify several macrofauna species that had not been reported for the North Sea before. During all these benthos surveys species lists are checked for exotic invaders. Whenever exotic species are identified, results are communicated by collaborating labs from GiMaRes and NMBACQ and specialists all over the world.

Most macrofauna research is carried out in the Wadden Sea. Within PRODUS framework (Project Sustainable shellfish Culture) IMARES carries out comprehensive sampling campaigns in the sublittoral Wadden Sea. Last year, IMARES started to investigate the species composition in oyster reefs. This year IMARES will start a new program on the development of macrofauna (including invasive species) in undisturbed parts of the Wadden Sea and coastal zone.

A final series of surveys that provide relevant information for invasive species monitoring are discard studies for bottom trawling and shrimp fisheries. Discards are landed and transported to IMARES laboratories where they are analysed for species composition. Additionally, tissue sampling from discards has started for genetic analysis. These molecular techniques provide information on cryptic species or sibling species that are often found to be invasive as well; replacing endemic species from the same family. Clear examples are invasive mussels (Mytilidae) all over the world. Or, close to home, the shrimp *Palaemon macrodactilus* that completely replaced *P. serratus* in Dutch estuaries.

**Early warning**

Altogether, IMARES surveys cover an important part of the North Sea and its adjacent waters. Annual updates on fish-, larval- and benthic communities provide a system to monitor exotic species and possible invasions entering these waters.

**C RISK ASSESSMENT APPROACHES**

NSBWO Risk assessment for ballast water management exemptions strategy

University of Groningen/NIOZ

Study shipping needs for targeted risk assessment.

**Publications**

**D  OCCURRENCE OF NEW SHIP-MEDIATED INTRODUCED SPECIES**

<table>
<thead>
<tr>
<th>Taxon</th>
<th>Year of first record</th>
<th>Location of first record</th>
<th>Possible introduction vector</th>
<th>Invasion status**</th>
<th>Reference</th>
</tr>
</thead>
</table>

* Duplication with WGITMO report if the vector is unknown
** When spreading see details in Section E

**E  IMPACT OF INTRODUCED SPECIES**

- Economic (quantify if possible)
- Ecological

**F  OTHER RELEVANT INFORMATION**

**Publications**


**G  REFERENCES**

- Websites:
  - www.werkgroepexoten.nl
  - www.vwa.nl/invasieve-exoten

NORWAY

National Report Format for Update on Status of Invasive Species Research
WGBOSV

Country: Norway

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Gaudstadalleen 21
NO-0349 Oslo- Norway
Email: sde@niva.no

A TRANSPORT VECTORS

• Results of ongoing research project(s) i.e. project title, host institute, contact details, co-ordinator, project duration, key objective(s), website if available
• Planning of new research project(s), web site if available
• For each category below include information, where available, on biology, treatment, sampling and legislation/regulations.

1 Ballast
Some research/learned experiences related to fullscale, pilotscale and labscale land based and shipboard project for testing of different Ballast Water Management Systems (BWMS), NIVA, Stephanie Delacroix, several months each project, type approval final report for approval. (Customer’s property results)

2 Biology of Ballast Water
NIVA’s on-going research projects:
DBP formation and toxicity by BWMS using active substances, NIVA
http://www.ballast2011.com/?page=presentations (Stephanie Delacroix)
Validation of a PCR method to analyse ballast water for V. cholera, NIVA
Alternative rapid analysis method for the 10-50µm organism group, NIVA
Study on <10µm organism in ballast water before and after treatment, NIVA
Study on effect of treatment technologies on ≥50µm organism reproducibility, NIVA
False positive results with staining methods in water treated by UV irradiation, NIVA
http://www.ballast2011.com/?page=presentations (Anne-Marie Bomo)
NIVA’s new projects starting in 2012:

Temperature and salinity effect on treatment system biological efficiency and toxicity of effluents, NIVA

Evaluation of the robustness of the fjord’s species to different water treatment, NIVA

Realtime monitoring ballastwater with flowcytometry, HSH-NIVA (3 years) (http://www.ballastflow.com/)

Risk assessment of ballast water onboard of vessels under construction transported from port to port without any treatment system/power supply onboard, NIVA

Application for a project on alien species with shipping activities in the Arctic (N.E. Passage) has been proposed through the “Fram-Centre (Tromsø) This proposal has been merged with an on-going project on alien species to the Svalbard archipelago. P.I.: PhD. Ingrid G. Alsos, (University of Tromsø), and have received partial funding for 2012. (Funding Source: Environmental Dep.). If suitable vessels are found, researchers will embark a vessel in the Pacific (or the Atlantic) and measure/monitor survival in ballast tanks en route.

Some results from the Svalbard study have already been published (Alsos et al. 2012).

3 Ballast Water Treatment

BWMS testing at NIVA’s test facility: 11 fullscale land-based testing projects, in addition to several pilot scale testing and shipboard testing projects, NIVA

http://www.ballasttech-niva.no/

4 Ballast Water Sampling

Sampling methods experiences from both land based and shipboard testing projects according to IMO guidelines, NIVA

Study on sampling methods for ETV protocol compliance, NIVA

5 Ballast Water Legislation/Regulations

GloBallast/IMO Sampling and analysis method harmonisation workshop: intercalibration workshop between worldwide test facilities.

NIVA participated to the IMO Correspondence Group to finalize the development of a BWM circular on ballast water sampling and analysis for Port State Control.

6 Hull Fouling

2.1 The above specified project (see1.1) has samples vessels to Svalbard (Alsos et al., 2012) and have planned sampling of hull fouling on vessels having travelled the polar sea routes. Sampling will be carried out opportunistically on relevant vessels in port (scuba/photo/video) or if vessels become available in drydocking.

7 Sediments

8 Sea Chests

See 1.1 and 2.1

9 Others

(see Handbook of Invasion Vectors, prepared by WGITMO and published as ICES Cooperative Research Report)
B  INVASIVE SPECIES MANAGEMENT

Eradication Programmes

Eradication efforts on the Pacific oyster (*Crassostrea gigas*) and the American lobster, (*Homarus americanus*) but not relevant for BOSV.

Management and Control of Invasive Species

One municipality (Oslo and Akershus) have finalised an action plan for the control of alien species, another municipality (Aust Agder) are developing a similar plan. Other municipalities along the coast are expected to follow suit.

C  RISK ASSESSMENT APPROACHES

The Norwegian Species Databank (Artsdtabanken) have completed a review of the 2007 alien species list, including a new risk assessment approach for the majority of alien species in Norway (including the marine/brackish) The new list will become public in June, 2012 http://www.biodiversity.no/frontpage.aspx?m=23

Risk assessment of discharge of ballast water onboard of vessels under construction transported from Turkey to Norway without any treatment system/power supply onboard, NIVA

D  OCCURRENCE OF NEW SHIP-MEDIATED INTRODUCED SPECIES

<table>
<thead>
<tr>
<th>TAXON</th>
<th>YEAR FIRST RECORD</th>
<th>LOCATION OF FIRST RECORD</th>
<th>POSSIBLE INTRODUCTION VECTOR*</th>
<th>INVASION STATUS**</th>
<th>REFERENCE</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Styela clava</em></td>
<td>2012</td>
<td>Stavanger, 58 55.912N, 05 51.007E</td>
<td>Hull fouling/recreational boats</td>
<td>Established, spreading</td>
<td>Husa et al. 2012</td>
</tr>
<tr>
<td><em>Diadumene lineata</em></td>
<td>2012</td>
<td>Eigersund, 58 28.03 05 58.04</td>
<td>Hull fouling/recreational boats</td>
<td>Established, low numbers</td>
<td>Husa et al. 2012</td>
</tr>
</tbody>
</table>

* Duplication with WGITMO report if the vector is unknown
** When spreading see details in Section E
§ Not necessary first observations, but local spread detected by Rapid Coastal surveys (Husa et al, 2012, a,b.)

E  IMPACT OF INTRODUCED SPECIES

F  OTHER RELEVANT INFORMATION

G  REFERENCES

Kartlegging av fremmede marine arter i Hordaland. Utredning for DN 2-2012.
Direktoratet for naturforvaltning (in Norwegian).


Arctic Stowaways; the potential for species introduction to occur in Svalbard associated with shipping. Preliminary project report.

http://www.sysselmannen.no/hoved.aspx?m=45704&amid=3182343
PORTUGAL

National Report for Update on Status of Invasive Species Research WGBOSV 2012

Country: Portugal

Author(s) and contact details:
Compiled by Ana Amorim & Paula Chainho
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Oceanography Centre, 1749-016 Lisboa, Portugal
Email: ajamorim@fc.ul.pt

Highlights:
The national project INSPECT- PTDC/MAR/73579/2006 came to an end in December 2011. Study of the characteristics of the maritime traffic routes including Portuguese ports and comparison with the known native distribution of NIS occurring in Portugal, allowed the identification of shipping as the major introduction vector, both through ballast water and fouling. Evidence supports the introduction of NIS mainly by secondary transfer.

In July 2011, the survival of microorganisms (zooplankton and phytoplankton) inside ballast tanks and the efficiency of oceanic ballast water exchange was investigated during a cruise on a container ship between mainland Portugal and the Azores archipelago. This will be the first data set documenting the risk of ballast water transfer in Portuguese regional traffic routes.

At the end of the project 81 NIS were recorded for mainland Portugal, Azores and Madeira (phytoplankton, macroalgae and macroinvertebrates). In the Tagus estuary, where the port of Lisbon is located, 17 NIS were recorded representing the estuary with the highest number of NIS.

The study of the fossil record on sediment cores from different latitudes along the Portuguese coast confirmed the dinoflagellate species Gymnodinium catenatum as non-indigenous in the north Atlantic. However, evidence suggests its introduction is most probably the result of the northward expansion of the natural biogeographical limit from NW Africa rather than an introduction by ballast water (Ribeiro et al. 2012).

A TRANSPORT VECTORS

Research under the national project INSPECT- PTDC/MAR/73579/2006 (objectives already presented in the 2010 report) continued in 2011. Study of shipping characteristics to Portuguese ports and comparison with the known native distribution of NIS occurring in Portugal, allowed the identification of shipping as the major introduction vector, both through ballast water and fouling. Most recorded NIS have a known native distribution in the Asian-Pacific region, Australia, NW Atlantic and the Mediterranean. The shipping traffic by contrast is dominated by European routes suggesting NIS are introduced mainly by secondary transfer.
At the end of the project 81 NIS were recorded for mainland Portugal, Azores and Madeira (phytoplankton, macroalgae and macroinvertebrates). In the Tagus estuary, where the port of Lisbon is located, 17 NIS were recorded representing the estuary with the highest number of NIS.

1 Ballast

Several sampling campaigns aiming at ballast water in ships calling at Lisbon port were carried out and the data is now being processed. Samples are being analyzed for phytoplankton and zooplankton.

The survival of microorganisms (zooplankton and phytoplankton) inside ballast tanks and the efficiency of oceanic ballast water exchange was investigated during a cruise on a container ship between mainland Portugal and the Azores archipelago in July 2011. Phytoplankton viability was monitored by PAM fluorescence and through incubation of water samples under controlled laboratory conditions, and checked regularly for viable cells. Zooplankton viability was checked immediately after collection. Samples were also preserved for quantitative analysis. Samples are currently under analysis.

2 Hull Fouling

A post-doctoral project for 2012-2015 has been approved to investigate the importance of fouling for marine invasions in Portuguese coastal waters (J. Canning-Clode, “Exploring fouling invasions in Portuguese waters: roles of artificial substrates and metal pollution”. Postdoctoral FCT grant. 2012-2015).

3 Sediments

Further studies on sediment cores from different latitudes along the Portuguese coast confirmed the dinoflagellate species Gymnodinium catenatum as non-indigenous in the north Atlantic. However, a northward delay in the time of the first record together with recent evidence for a millennial presence in NW Africa suggest that the introduction of G. catenatum is most probably the result of the northward expansion of the natural biogeographical limit in NW Africa rather than an introduction by ballast water (Ribeiro et al. 2012). The record of other dinoflagellate species producing microreticulate resting cysts (G. microreticulatum and G. cf. nolleri) suggest that there presence in NW Iberia may also be related to the expansion of biogeographical limits.

4 Sea Chests

No known research

5 Others

No known research

B INVASIVE SPECIES MANAGEMENT

No known research

C RISK ASSESSMENT APPROACHES

No known research. Implementation of the MSFD is expected to stimulate development of risk assessment approaches.
### OCCURRENCE OF NEW SHIP-MEDIATED INTRODUCED SPECIES

New additions to the 2011 list are listed below. New additions for Portuguese mainland and Azores and Madeira islands were considered separately. Species for which there are corrections/changes on the possible introduction vectors, year of first record, population status and references were included. The inventory of NIS did not include fish species and freshwater species.

<table>
<thead>
<tr>
<th>TAXON</th>
<th>YEAR OF FIRST RECORD</th>
<th>LOCATION OF FIRST RECORD</th>
<th>POSSIBLE INTRODUCTION VECTOR*</th>
<th>INVASION STATUS**</th>
<th>REFERENCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ostreopsis cf. ovata</td>
<td>2011</td>
<td>South Coast of Portugal</td>
<td>Unknown</td>
<td>Unknown</td>
<td>David et al., 2012</td>
</tr>
<tr>
<td>G. microreticulatum</td>
<td>1999</td>
<td>Coast of Portugal</td>
<td>unknown</td>
<td>Established</td>
<td>Ribeiro et al, 2012</td>
</tr>
<tr>
<td>Anotrichium furcellatum (J. Agardh) Baldock</td>
<td>1970</td>
<td>Madeira</td>
<td>Ballast water; Fouling</td>
<td>Unknown</td>
<td>Levring, 1974</td>
</tr>
<tr>
<td>Antithamnion diminuatum Wollaston</td>
<td>1994</td>
<td>Azores</td>
<td>Unknown</td>
<td>Established</td>
<td>Athanasiadis &amp; Tittley, 1994</td>
</tr>
<tr>
<td>Antithamnion pectinatum (Montagne) J.Brauner</td>
<td>1994</td>
<td>Southern Portuguese coast</td>
<td>Unknown</td>
<td>Not established</td>
<td>Berecibar 2011</td>
</tr>
<tr>
<td>Antithamnionella spirographidis (Schiffner) E.M. Wollaston</td>
<td>1987</td>
<td>Azores</td>
<td>Ballast water; Fouling</td>
<td>Unknown</td>
<td>Castro &amp; Viegas, 1987</td>
</tr>
<tr>
<td>Asparagopsis ar- mata Harvey (+ estadio Falkenbergia rufolana)</td>
<td>1989</td>
<td>Azores</td>
<td>Unknown</td>
<td>Established</td>
<td>Neto, 1989</td>
</tr>
<tr>
<td>Asparagopsis taxiformis (Delile) Trevisan de Saint-Léon</td>
<td>1929</td>
<td>Azores (S. Miguel, Santa Maria, Flores)</td>
<td>Unknown</td>
<td>Established</td>
<td>Schmidt, 1929</td>
</tr>
<tr>
<td>Taxon</td>
<td>Year</td>
<td>Location</td>
<td>Establishment</td>
<td>Reference</td>
<td></td>
</tr>
<tr>
<td>-------------------------------------------------------------</td>
<td>------</td>
<td>--------------------------------------------------------------------------</td>
<td>---------------</td>
<td>-------------------------------</td>
<td></td>
</tr>
<tr>
<td><em>Bouemaisonia hamifera</em> Harriot</td>
<td>1989</td>
<td>Azores (Faial, Graciosa and Flores)</td>
<td>Fouling</td>
<td>Neto, 1989</td>
<td></td>
</tr>
<tr>
<td><em>Lomentaria hako-datensis</em> Yendo</td>
<td>2003</td>
<td>Southern Portuguese coast</td>
<td>Unknown</td>
<td>Established</td>
<td></td>
</tr>
<tr>
<td><em>Scageliopsis patens</em> Wollaston</td>
<td>2003</td>
<td>Southern Portuguese coast</td>
<td>Unknown</td>
<td>Unknown</td>
<td></td>
</tr>
<tr>
<td><em>Symphyocladia marchantioides</em> (Harvey) Falkenberg</td>
<td>2010</td>
<td>Tagus estuary coastal area</td>
<td>Unknown</td>
<td>Unknown</td>
<td></td>
</tr>
<tr>
<td><em>Codium fragile</em> spp. <em>fragile</em> (Suringar) Harriot</td>
<td>1993</td>
<td>Azores (Sao Miguel, Corvo, Flores, Sao Maria)</td>
<td>Fouling</td>
<td>Established</td>
<td></td>
</tr>
<tr>
<td><em>Ulva pertusa</em> Kjellman</td>
<td>2003</td>
<td>Southern Portuguese coast</td>
<td>Unknown</td>
<td>Unknown</td>
<td></td>
</tr>
<tr>
<td><em>Endarachne binghamiae</em> J. Agardh</td>
<td>1994</td>
<td>Azores (Faial, Pico, Sao Miguel and Terceira)</td>
<td>Fouling</td>
<td>Established</td>
<td></td>
</tr>
<tr>
<td><em>Lomentaria hako-datensis</em> Yendo</td>
<td>2003</td>
<td>Southern Portuguese coast</td>
<td>Unknown</td>
<td>Established</td>
<td></td>
</tr>
<tr>
<td><em>Scageliopsis patens</em> Wollaston</td>
<td>1994</td>
<td>Azores (Faial, Sao Miguel)</td>
<td>Unknown</td>
<td>Tittley &amp; Neto, 1994</td>
<td></td>
</tr>
<tr>
<td><em>Scageliopsis patens</em> Wollaston</td>
<td>2003</td>
<td>Southern Portuguese coast</td>
<td>Unknown</td>
<td>Unknown</td>
<td></td>
</tr>
<tr>
<td><em>Desdemona ornata</em> Banse, 1957</td>
<td>1993</td>
<td>Mainland Portugal (Ria Formosa)</td>
<td>Ballast water</td>
<td>Established</td>
<td></td>
</tr>
<tr>
<td><em>Bugula neritina</em> (Linnaeus, 1758)</td>
<td>2004</td>
<td>Mainland Portugal (Ria de Aveiro)</td>
<td>Fouling</td>
<td>Established</td>
<td></td>
</tr>
<tr>
<td><em>Watersipora subtorquata</em> (d'Orbigny, 1852)</td>
<td>2010</td>
<td>Mainland Portugal (Tagus estuary)</td>
<td>Fouling</td>
<td>Established</td>
<td></td>
</tr>
</tbody>
</table>

### References

- Berecibar, 2011
- Tittley & Neto, 2005
- Machado & Cancela da Fonseca, 1997
- Marchini et al., 2007
- Neto, 1989
- Secilla et al., 2008
- Tittley & Neto, 1994
- Tittley & Neto, 2011
- Tittley & Neto, 1994
- Inspect
Zoobotryon verticillatum Della Chiaje, 1828

2008 Madeira Fouling Unknown Wirtz & Canning-Clode, 2009

Amphibalanus amphitrite (Darwin, 1854)
1920 Azores (S. Miguel and Faial) Ballast water; Fouling Established Gruvel, 1920

Amphibalanus eburneus Gould, 1841
1998 Azores (Faial) Fouling Unknown Southward, 1998

Perforatus perforatus Bruguière, 1789
2011 Azores (S. Miguel) Ballast water; Fouling Established Inspect

* Duplication with WGITMO report if the vector is unknown
** When spreading see details in Section E

E IMPACT OF INTRODUCED SPECIES

F OTHER RELEVANT INFORMATION

The Regional Parliament of the Azores recently approved a Regional law on Nature Conservation and Biodiversity protection where the issue on exotic species is attended.

Regarding the Marine Strategy Framework Directive, in order for Portugal to achieve its obligations by 15 July 2012 a working group has been created according to the Diário da República, 2.ª série — N.º 44 — 1 de março de 2012, Despacho n.º 3068/2012.

G REFERENCES

Athanasiadis, A. & I. Tittley 1994. Antithamnioid algae (Rhodophyta, Ceramiaceae) newly recorded from the Azores. Phycologia 33: 77-80


Schmidt, O. C. 1929 Beitrage zur Kenntnis der Meeresalgen der Azoren II. Hedwingia 69: 165-172.


National Report Format for Update on Status of Invasive Species Research
WGBOSV

Country: SPAIN

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www.panda.org/mediterranean
e-mail: gquilez@atw-wwf.org

A TRANSPORT VECTORS

- Results of ongoing research project(s) i.e. project title, host institute, contact details, co-ordinator, project duration, key objective(s), website if available
- Planning of new research project(s), website if available
- For each category below include information, where available, on biology, treatment, sampling and legislation/regulations.

1 Ballast
2 Hull Fouling
3 Sediments
4 Sea Chests
5 Others

(see Handbook of Invasion Vectors, prepared by WGITMO and published as ICES Cooperative Research Report)

Nothing is being done regarding ballast water or hull fouling, but it seems research groups from Galicia and Andalucía are beginning to consider working with cysts of harmful species in ports.
B INVASIVE SPECIES MANAGEMENT

Eradication Programmes

Management and Control of Invasive Species

C RISK ASSESSMENT APPROACHES

D OCCURRENCE OF NEW SHIP-MEDIATED INTRODUCED SPECIES

<table>
<thead>
<tr>
<th>TAXON</th>
<th>YEAR OF FIRST RECORD</th>
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<th>POSSIBLE INTRODUCTION VECTOR*</th>
<th>Invasion Status**</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paracaprella pusilla</td>
<td>2010</td>
<td>Harbour of Cádiz (South Atlantic coast) (36°31'N 6°17'W)</td>
<td>Shipping</td>
<td>rare</td>
<td>Ros and Guerra-García, 2011</td>
</tr>
</tbody>
</table>

* Duplication with WGITMO report if the vector is unknown

** When spreading see details in Section E

E IMPACT OF INTRODUCED SPECIES

The tropical species *P. pusilla*, which is recorded for the first time in European waters in the referenced study (Ros and Guerra-García, 2011), was only present on the bryozoan *Zoobotryon verticillatum* and the hydroid *Eudendrium racemosum* in summer months, probably due to a higher water temperature during that period.

No deleterious impact has been found regarding this species.

F OTHER RELEVANT INFORMATION

G REFERENCES

SWEDEN

National Report Format for Update on Status of Invasive Species Research
WGBOSV

Country: Sweden

Author(s) and contact details:

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Phone: +46 31 7721461

A TRANSPORT VECTORS

- Results of ongoing research project(s) i.e. project title, host institute, contact details, co-ordinator, project duration, key objective(s), website if available
- Planning of new research project(s), web site if available
- For each category below include information, where available, on biology, treatment, sampling and legislation/regulations.

1 Ballast

TITLE: Baltic Zooplankton Cascades
co-ordinated by Gothenburg University, Sweden
Peter Tiselius (peter.tiselius@bioenv.gu.se)
Department of Marine Ecology- Kristineberg, University of Gothenburg
Kristineberg 566, S-451 78 Fiskebäckskil, Sweden. Duration 2008-2011

Key objectives: Monitoring and ecological impact of Mnemiopsis leidyi

TITLE: Population dynamics and predation impact by the introduced ctenophore Mnemiopsis leidyi in the Gullmar fjord, west coast of Sweden.
Gothenburg University, Sweden
Lene Friis Møller and Peter Tiselius (lene.friis.moller@bioenv.gu.se)
Department of Marine Ecology- Kristineberg, University of Gothenburg
Kristineberg 566, S-451 78 Fiskebäckskil, Sweden. Project runs since 2007

Key objectives: Monitoring of jellyfish and zooplankton
The two research projects are investigating the effects of the ctenophore *Mnemiopsis leidyi* which 2006 was introduced to Swedish waters. Within the “Baltic Zooplankton Cascades”-project the distribution of *M leidyi* in the Baltic Sea has been monitored and the possible cascading effects on the marine ecosystems caused by this comb jelly investigated. Some of the main outcomes from the project is that salinity (under 6 psu) limits the reproduction of *M leidyi* in the Baltic Sea and that *M leidyi* does not seem to be a direct threat to the cod in the Baltic (as it does not ingest cod egg or larvæ to any larger extent). A frequent monitoring of jellyfish and zooplankton is also ongoing in the Gullmar fjord on the west coast of Sweden where high densities (biomass) of *M leidyi* have been recorded in late summer-autumn from 2007-2010. However in 2011 only a few specimens were found.

2 Hull Fouling
3 Sediments
4 Sea Chests
5 Others

(see Handbook of Invasion Vectors, prepared by WGITMO and published as ICES Cooperative Research Report)

**B** INVASIVE SPECIES MANAGEMENT

Eradication Programmes

Management and Control of Invasive Species

**C** RISK ASSESSMENT APPROACHES

**D** OCCURRENCE OF NEW SHIP-MEDIATED INTRODUCED SPECIES

<table>
<thead>
<tr>
<th>TAXON</th>
<th>YEAR OF FIRST RECORD</th>
<th>LOCATION OF FIRST RECORD</th>
<th>POSSIBLE INTRODUCTION VECTOR</th>
<th>INVASION STATUS</th>
<th>REFERENCE</th>
</tr>
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</table>

* Duplication with WGITMO report if the vector is unknown

** When spreading see details in Section E

**E** IMPACT OF INTRODUCED SPECIES

Economic (quantify if possible)

Ecological

**F** OTHER RELEVANT INFORMATION

Concerning the implementation of the BWMC in Sweden, work is ongoing and the Ballast Water Law under construction. There is also work ongoing with questions about and procedure for seeking exemptions from BW treatment. The preliminary suggested procedure is that The Swedish Transport Agency will grant the exemptions with opinion from Swedish Agency for Marine and Water Management.

The research programme “Marine Paint” will hold its final conference 14-15th of May 2012 and present its findings with invited speakers from academia, industry, authorities and regulatory agencies. Marine Paint has been running since 2004 with research
on development of new, effective and environmentally friendly marine antifouling paints. More information about the Marine Paint programme is available in WGBOSV National Report Sweden from 2009 and at the web-site: www.marinepaint.se

Test facilities for ballast water treatment systems are available at N-research, Lysekil, Swedish west coast, conducting tests in pilotscale, land-based tests (0-34 PSU) and on-board test (IMO-standard). At N-research also material testing (ie corrosion) is conducted (in cooperation with Swedish Corrosion Institute)

G REFERENCES


UNIVERSITI KINSTON

National Report Format for Update on Status of Invasive Species Research
WGBOSV

Country: United Kingdom
Author(s) and contact details:
Tracy McCollin  Tracy.McCollin@scotland.gsi.gov.uk

A Transport Vectors

• Results of ongoing research project(s) i.e. project title, host institute, contact details, co-ordinator, project duration, key objective(s), website if available
• Planning of new research project(s), web site if available

1 Ballast

No current research projects

2 Hull Fouling

TITLE: Assessing the risk of transporting non native species to Scotland via biofouling on vessels.

Tracy McCollin Tracy.McCollin@scotland.gsi.gov.uk or
Lyndsay Brown Lyndsay.Brown@scotland.gsi.gov.uk
Marine Scotland Science, 375 Victoria Road, Aberdeen, AB11 9DB.

This is a three year project funded by the Scottish Government and it will finish in 2012. The aim of this work is to obtain information regarding which species are being transported via biofouling and whether particular vessels e.g. recreational or commercial, or voyages e.g. UK based or international, pose a higher risk of introducing non native species.

The Scottish Government funded project has two main aspects:

Dry docks

The dry docks are visited immediately the dock has been drained i.e. prior to the vessel being washed down. Areas such as the hull, sea chests, propellers, rudders are photographed, ranked in terms of the level of fouling and samples collected using a paint scraper. To date 25 vessels have been visited in two dry docks.

Dive surveys

The Marine Scotland - Science dive team take samples from vessels that trade in Scottish ports but would be too large to use the local dry docks. In water methods (e.g. video cameras, small suction devices and scrapers) are used to record and sample biofouling on vessels. To date 6 vessels have been sampled using a dive team but it is unlikely that any further dive team work will occur owing to changes in staffing within Marine Scotland Science.
The sample analysis is ongoing and no new non native species have been detected. The biological analysis will be combined with information on vessel type and voyage pattern to assess whether it is possible to assign levels of risk for introducing non native species.

3  Sediments

No current research projects

4  Sea Chests

No current research projects

5  Others

(see Handbook of Invasion Vectors, prepared by WGITMO and published as ICES Cooperative Research Report)

TITLE: Protecting marine biodiversity and industries by managing non-native species pathways (“The Pathways Project”).

Gabe Wyn g.wyn@ccw.gov.uk
Countryside Council for Wales (CCW), Maes y Ffynnon, Ffordd Penrhos, Bangor Gwynedd, LL57 2BQ

This project is currently being put together in order to bid for LIFE+ funding from the EU. There will be several organisations involved and the project will be led by the Countryside Council for Wales.

The project aims to reduce the risk posed to native marine biodiversity and marine industries from invasive non-native species by:

- Reducing the introduction and spread of INNS in ecologically sensitive areas through improved biosecurity.
- Improving communication with key stakeholders in priority areas to raise awareness, achieve behaviour change and encourage early detection and rapid reporting.
- Improving our ability and capacity to rapidly respond to new non-native species threats in the marine environment.
- Delivering innovative demonstration projects relating to improved biosecurity and rapid response.

Stakeholders expected to be included within this project are: recreational boating sector, marina and port operators, aquaculture and fishing sectors, shipping sector, those undertaking ship recycling and marine relevant NGOs.

TITLE: A Network Analysis of the Introduction and Spread of Non-native Invasive Marine Species in GB

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Cefas, Barrack Road, The Nothe, Weymouth, Dorset, DT4 8UB, UK
Tracy McCollin Tracy.McCollin@scotland.gsi.gov.uk
Marine Scotland Science, 375 Victoria Road, Aberdeen, AB11 9DB.

A collaboration between Cefas, Defra, Marine Scotland Science, Invasive Species Ireland and the Non Native Species Secretariat has been put together to carry out the work outlined below. The project will finish at the end of March 2012.
The aim of the project is to develop a tool that will:

- identify the highest risk vectors/pathways for the introduction and subsequent spread of marine invasive species in GB
  - this should include a ranking of all potential routes of introduction, including routes responsible for initial introductions and routes facilitating subsequent spread
  - If possible these pathways should be categorised by use and by taxa most likely to enter by the pathway
- recognise ‘hot spot’ areas or nodes that are at most risk of invasion
  - coastal areas should be divided depending on use and/or habitat
  - those that are most at risk of invasion (most invaded) identified
  - compare invasion by internal movements or initial introductions
  - If possible these nodes should be categorised by use and by taxa most likely to invade

The study will also include:

- A case study of the invasive tunicate *Didemnum vexillum* to validate the tool and to aid in the management of this species.

**TITLE: Colonisation of offshore marine renewable energy structures: the effects of deployment time, tidal flow and geographical region on the establishment on non-native species**

Adrian K. Macleod: Adrian.Macleod@sams.ac.uk
Elizabeth Cook: Elizabeth.Cook@sams.ac.uk
Scottish Marine Institute, Oban, Argyll PA37 1QA, UK

The large scale addition of artificial structures associated with the marine renewable energy industry has the potential to promote the spread of marine non-native species and change the recipient habitats greatly. Novel habitat types and surfaces such as marine renewable energy devices (MREDS) create opportunities for non-native species, which as rapid space-occupiers may be better able to colonise a wide variety of substrates than native counterparts (Glasby et al. 2007, Brodin and Andersson 2009). Once an artificial structure has been colonised by a non-native species, it can act as a source population providing propagules to surrounding habitats (Glasby et al. 2007), both by natural dispersal processes and transport by construction and/or maintenance vessels, or as hitchhikers on MREDS towed from one location to another.

Little is known about how high flow environments, suitable for many types of energy generation, shape the typical fouling communities and the resulting presence of non-native species. In collaboration with the Northern Lighthouse Board a network of 43 navigation buoys throughout Scotland were used to study epibenthic communities typical of artificial structures in tidal and wave exposed areas proposed for marine renewable energy generation. The presence and abundance of non-native species were assessed to determine the importance of these off-shore artificial habitats for the maintenance of marine non-native populations.

These communities were found to be complex across a wide range of hydrodynamic conditions. Geographical region, rather than tidal flow or submersion time explained most of the variation in community composition. Many non-native species were identified in different geographical regions. Most notably large numbers of *Caprella mu-
tica, a non-native amphipod, were found on many navigation buoys. This identifies a non-native species of particular importance to the marine renewable energy industry.

A purpose built biological flume (speeds up to 120 cms$^{-1}$) found typical behaviours recorded for the native amphipod, *Jassa marmorata*, were less sensitive to elevated flow (typical of tidal areas) than the wide spread non-native amphipod, *Caprella mutica*. Work is ongoing to investigate how ambient flow rates, habitat complexity, and species interactions combine to moderate the outcome of non-native species introductions.

**ADDITIONAL INFORMATION:**

Elizabeth Cook: Elizabeth.Cook@sams.ac.uk
Scottish Marine Institute, Oban, Argyll PA37 1QA, UK

PhD has started recently with joint supervision by the Scottish Association for Marine Science (SAMS) and the Environmental Research Institute in Thurso (Northern Scotland), and working closely with Pelamis (Wave renewables company). The PhD will be studying the non-native and native species associated with the Pelamis structure and with vessels and service hubs associated with the offshore renewables industry. It is also intended to carry out some survey work this summer (2012) and to place some Correx panels in the water in Northern Scotland.

**CAMPAIGN FOR RECREATIONAL CRAFT**

A campaign entitled “Check, Clean, Dry”, to stop the spread of aquatic invasive non-native species, was launched in March. The campaign is aimed at all those that use the water for recreation and sport who can unwittingly spread non-native invasive species as they move between different bodies of water like rowing lakes. Individual organisms, eggs, larvae and plant fragments can be carried on equipment, clothing and footwear. The campaign has the support of major bodies, water user groups and conservation organisations including: Anglian Water, Angling Trust, Association of Rivers Trusts, British Canoe Union, British Marine Federation, British Rowing, Environment Agency, Freshwater Biological Association, Natural England, Royal Yachting Association, and Salmon & Trout association. Further information is available at: https://secure.fera.defra.gov.uk/nonnativespecies/index.cfm?pageid=337

In addition, the RYA has issued general guidance to prevent spread of alien species on their website. See http://www.rya.org.uk/cruising/current-issues/Pages/Preventthespreadofinvasivespecies.aspx

**B Invasive Species Management**

**Eradication Programmes**

**TITLE: Eradication of Carpet seasquirt Didemnum vexillum in Holyhead marina, Wales UK.**

Rohan Holt  R.Holt@ccw.gov.uk  
Countryside Council for Wales (CCW), Maes y Ffynnon, Ffordd Penrhos, Bangor Gwynedd, LL57 2BQ

The Welsh Government is funding the next phase of an eradication attempt of the carpet sea squirt *Didemnum vexillum*, in Holyhead marina, North Wales, UK (Holt 2011). The Countryside Council for Wales and the operator of the marina at Holyhead and the local mussel industry are working together to eradicate the seasquirt from the marina structures starting in January 2012. This is being done by volunteers.
and diving contractors using a variety of methods including wrapping the chains and floating pontoons and removing and cleaning some of the swinging moorings and buoys. The marina structures will then be monitored to check for any re-growth of the ascidian.

Management and Control of Invasive Species

**TITLE: Biosecurity in the freshwater and marine environment**

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Cefas, Barrack Road, The Nothe, Weymouth, Dorset, DT4 8UB, UK  
Alastair Ward Alastair.Ward@fera.gsi.gov.uk  
The Food and Environment Research Agency, Sand Hutton, York, YO41 1LZ, UK

The scoping study will review the evidence underpinning national and international advice on biosecurity in the marine and freshwater aquatic environment and provide evidence based advice on what biosecurity measures should be employed to minimise the risk posed by non-native species and diseases, such as crayfish plague, which are transmitted by non-native species. The project will:

- Carry out a comprehensive review of scientific evidence (published and grey literature) underpinning biosecurity advice in the aquatic environment. The review will consider:
  - the efficacy of different approaches to biosecurity;
  - the ease at which different biosecurity approaches can be implemented, the impact on uptake and the subsequent implications for effectiveness of approach;
  - where there are differences in the marine and freshwater environments and explore these accordingly; and
  - the behaviours and impacts of different relevant sectors e.g. aquaculture, fish farming, angling, boating etc.

It will also:

- Carry out the analysis according to broad taxonomic groups with similar biological characteristics
- Taking a risk based approach, based on the findings of the literature review, recommended biosecurity measures that should be implemented in the aquatic environment to minimise the entry and spread of non-native species and key diseases, such as chytrid or crayfish plague, which they transmit.
- Provide advice on key priority areas for further applied research where this will enable biosecurity advice to be enhanced.
- Provide biosecurity plans as examples of how such advice can be conveyed. These will be concise and tailored to the key audience(s) and will compliment the overarching biosecurity advice.

**TITLE: Monitoring and eradication of invasive and non-native species in aquaculture units.**

Elizabeth Cook: Elizabeth.Cook@sams.ac.uk  
Scottish Marine Institute, Oban, Argyll PA37 1QA, UK
A Scottish Aquaculture Research Forum (SARF) funded project that will run from Feb - July 2012 with the following aims:

1) To review existing published guidance on the recognition and eradication of marine invasive and non-native species, with particular relevance to species that could potentially negatively impact the Scottish aquaculture industry.

2) To make recommendations for the production of new identification material, if deemed necessary by Objective 1.

3) To recommend how such guidance could be better disseminated throughout the industry.

C Risk Assessment Approaches

D Occurrence of New Ship-mediated Introduced Species

<table>
<thead>
<tr>
<th>TAXON</th>
<th>YEAR OF RE-CORD</th>
<th>LOCATION OF RE-CORD</th>
<th>POSSIBLE INTRODUCTION VECTOR*</th>
<th>INVASION STATUS**</th>
<th>REFERENCE</th>
</tr>
</thead>
</table>

* Duplication with WGITMO report if the vector is unknown
** When spreading see details in Section E

E Impact of Introduced Species

Economic (quantify if possible)

Ecological

F Other Relevant Information

TITLE: Genetic analysis of the Didemnum populations in the United Kingdom.

Tracy McCollin Tracy.McCollin@scotland.gsi.gov.uk
Marine Scotland Science, 375 Victoria Road, Aberdeen, AB11 9DB.

This project will run for about two months from April 2012 and will aim to obtain samples from as many populations of Didemnum vexillum around the UK as possible and use genetic techniques to confirm that they are all the same species. If time allows a corresponding morphological analysis will be carried out to ascertain whether there are any differences within the populations.

G References


UNITED STATES OF AMERICA

National Report Format for Update on Status of Invasive Species Research
WGBOSV

March 6, 2012
Country: United States

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Abstract and Highlights of US Annual Report

Two federal agencies have actions pending on ballast water regulations and policies. The U.S. Coast Guard will publish its final rule in the Federal Register shortly (approved in February 2012), but the numbers are not available until published. The US Environmental Protection Agency in meeting a court settlement, convened a committee to evaluate methods for ballast treatment that will meet the US Coast Guard standards. Five treatments were identified as meeting the criteria, although three other options were also an option.

Another study, funded through the National Research Council, looked at the issue from a theoretical perspective. The risk of probability using different types of models suggests that all models have a degree of uncertainty associated with them. The committee concluded that no one proxy was adequate for serving as organism density.

One new species identified in the northwest Atlantic, a subtropical worm *Hydroides elegans* was found in an isolated pond in Massachusetts and is not likely to survive.

A second species, a bryozoans *Zoobotryon verticillatum* was found for the past couple of years in Connecticut and in 2011 in Narragansett Bay, Rhode Island. Neither are expected to survive the winter season, but *Z. verticillatum* has reinvaded several times.

A TRANSPORT VECTORS

- Results of ongoing research project(s) i.e. project title, host institute, contact details, co-ordinator, project duration, key objective(s), website if available
- Planning of new research project(s), website if available
- For each category below include information, where available, on biology, treatment, sampling and legislation/regulations.

1 Ballast

There have been two major efforts with respect to ballast water management in the United States, the US Coast Guard and the US Environmental Protection Agency.

A. US Coast Guard Responsibilities

The U.S. Coast Guard is responsible for managing ballast water discharge under the National Invasive Species Act of 1996 (NISA). Initially, guidelines were established, but when deemed inadequate, under NISA, the Coast Guard can establish a mandatory national program. See (US Coast Guard Summary Ballast Water Management (http://www.uscg.mil/hq/cg5/cg522/cg5224/bwm.asp).

Initially, in 1998 a self-policing nationwide program was established where ballast water management (BWM) was voluntary for 24-30 months. However, mandatory ballast reports were not submitted by many vessel operators and the rate of compliance was deemed inadequate by the US Coast Guard. In 2004, the voluntary program became mandatory and current regulations are at 33 CFR 151 subparts C and D.

2 Ballast Water Discharge Standard: Compliance Guidance

On October 29, 2004, the US Coast Guard (USCG) issued Change-1 to the Navigation and Vessel Inspection Circular (NVIC) 07-04, titled “Ballast Water Management for the Control of Aquatic Nuisance Species in the Waters of the United States.” The NVIC provides guidance for USCG personnel, vessel owners and operators, masters,
shipping agents, and persons-in-charge concerning compliance with and enforcement of the USCG’s Ballast Water Management (BWM) Program.

**Penalties for Non-submittal of Ballast Water Reports**

On June 14, 2004, the USCG published regulations establishing penalties for ships headed to the US, Great Lakes, and Hudson River that fail to submit a BMW reporting form. In order to determine patterns of Ballast water movement, the USCG increased the number of vessels that have to report and expanded the record keeping and reporting on the ships. Failure to comply may result in a penalty.

In 2009, the USCG proposed to set a discharge standard to promote development of technologies to treat ballast water, to use the standards in enforcement of regulations and to evaluate the effectiveness of ballast water management. (Documents and public comments are located in the official rulemaking docket USCG-2001-10486. The following relevant documents are also available as follows:

1) Notice of Proposed Rulemaking, 74 FR 44632 (28 Aug 2009)
2) White Paper - Ballast Water Discharge Standard
3) Phase 1 and Phase 2 Standards Implementation Schedule

The Ballast Water Discharge Standard Notice of Proposed Rulemaking (NPRM) was published in the Federal Register on August 28, 2009 for public review and comment. The comment period for this proposed rule was extended from November 27 to December 4, 2009.

On November 11, 2011, the Office of Management and Budget began an inter-agency review of the Coast Guard’s proposed Ballast Water Discharge Standard rulemaking.

As part of the rulemaking process, an Environmental Technical Verification Program was established in conjunction with the US Environmental Protection Agency (USEPA). Final protocols for water treatment system verification were agreed upon by the USEPA and USCG.

Generic Protocol for the Verification of Ballast Water Treatment Technology (September 2010) http://www.epa.gov/nrmrl/pubs/600r10146/600r10146.pdf

2012 Information from John Morris, US Coast Guard:

“The Office of Management and Budget (OMB) completed its review of the Coast Guard’s Ballast Water Discharge Standard regulations in accordance with Executive Order 12866, and changed its designation from an Interim Final Rule to a Final Rule on February 24, 2012. The Coast Guard is preparing it for publication in the Federal Register, and expects to complete the administrative process within 30 days.

We are not at liberty to discuss details of the rule until it is actually published, but wanted to clear up confusion about its status. A copy of OMB’s summary is attached, with the second entry at top, and is also available on its website at <http://www.reginfo.gov/public/do/eopackageMain> http://www.reginfo.gov/public/do/eopackageMain

In other news, the Coast Guard published a Final Rule amending its vessel inspection regulations to add the International Anti-fouling System (IAFS) Certificate to the list of certificates a recognized classification society may issue on behalf of the Coast Guard. This action carries out recently enacted legislation implementing the International Convention on the Control of Harmful Anti-fouling Systems on Ships, 2001.

Mandatory reports are sent to the National Ballast Information Clearinghouse (NBIC) for vessels operating exclusively in the U.S. Exclusive Economic Zone (EEZ). Port Appropriate personnel can submit a Ballast Water Management report as a single batch on a monthly basis instead of port-to-port, pre-arrival as previously required.

Requirements for acceptance into the program include:

- vessel must operate exclusively within the EEZ or Canadian equivalent
- must have a record of compliance and complete, accurate reporting
- must be able to email form
- must make 10 or more BWM reports

Application and submission information are available at: http://invasions.si.edu/nbic/ equivalentprogram.html

Recent Activities

B. The US Environmental Protection Agency’s Responsibilities

The US Environmental Protection Agency is required under the Clean Water Act to permit discharges of pollutants from a point source, including vessels or floating craft in US navigable waters. Initially the USEPA excluded discharges from vessels, but they were sued by five states and environmental petitioners to revoke the exclusion. The court vacated the exemption and allowed the USEPA time to implement permits for vessel discharges. Two general permits are being proposed, one for vessels larger than 79 feet and one for smaller vessels. As noted above the USEPA is coordinating with the USCG.

There will be numeric effluent limits for ballast water discharged by larger vessels (as recommended by an expert committee) and best management practices for other discharges for large and small vessels. The limits may be met in four ways:

- discharge meeting numerical standards
- transfer to a 3rd party that meets the National Pollution Discharge Elimination System as a permitted facility
- use treated, potable water as ballast
- not discharge ballast.

Other types of discharges, e.g., oil to sea interfaces, gray water fish hold effluent, and gas scrubber effluent, will set effluents through best management practices.

One of the more unusual findings by the court is to have vessel owners and operators meet tribal and state-specific requirements under the Clean Water Act’s certification process. The vessels operating in multiple jurisdictions could face potentially conflicting conditions.

The U.S. Environmental Protection Agency’s (EPA) Office of Water requested the EPA’s Science Advisory Board (SAB) to review available data and advise the EPA regarding whether existing shipboard treatment technologies can reach specified concentrations of organisms in vessel ballast water, how these technologies might be improved in the future, and how to overcome limitations in existing data*. To conduct the assessment, the SAB was augmented with additional Panel members having expertise in ballast water issues, marine engineering, and engineering treatment technologies. The panel was convened in 2010 and met in person and by teleconference to consider the charge questions, review data packages on ballast water man-
agement systems (BWMS), and prepare its report (EPA, 2011). Several major findings are presented below.

The Panel concluded the International Maritime Organization (IMO) D-2/U.S. Coast Guard (USCG) Phase 1 performance standards for living organisms in ballast water are currently measurable, based on data from land-based and shipboard testing. However, current methods (and associated detection limits) prevent testing of BWMS to any standard more stringent than D-2/Phase 1 and make it impracticable to verify a standard 100 or 1000 times more stringent. New or improved methods will be required to increase detection limits sufficiently to statistically evaluate a standard 10x more stringent than IMO D-2/Phase 1; such methods may be available in the near future. These conclusions pertain to evaluating data from land-based and shipboard testing, although the same statistical theory and practice applies to compliance testing.

The Panel was provided information on 51 individual BWMS, which were grouped into 34 categories of treatment technologies. Of the 51 BWMS identified, and after reviewing the available data packages, the Panel concluded that test data and other information for 15 individual BWMS were credible and sufficient to permit an assessment of performance capabilities. Of these 15 BWMS, nine systems (representing individual configurations of five different categories of BWMS) have been demonstrated to meet the IMO D-2 discharge standard, when tested under the IMO guidelines, and will likely meet USCG Phase 1 standards, if tested under EPA’s more detailed Environmental Technology Verification (ETV) Protocol (EPA, 2010). The five categories of BWMS technologies are:

1. Deoxygenation + cavitation;
2. Filtration + chlorine dioxide;
3. Filtration + UV;
4. Filtration + UV + TiO2; and
5. Filtration + electro-chlorination.

However, based on the available testing data, it was clear that while five types of BWMS are able to reach the IMO D-2/Phase 1 discharge standard, none of the systems evaluated by the Panel performed at 100 times or 1000 times the Phase 1 standard. The Panel acknowledged the significant achievement of several existing BWMS to effectively and reliably remove living organisms from ballast water under the challenging conditions found on active vessels.

The Panel concluded that moderate adjustments or changes to existing combination technologies are expected to result in only incremental improvements. Reaching the Phase 2 standard, or even 100x IMO D-2/Phase1, would require wholly new treatment systems.

The Panel concluded data are not sufficiently compatible to compare rigorously across BWMS because standard test protocols have been lacking. Furthermore, they determined existing information about ballast water treatment is limited in many respects, including significant limitations in data quality, shortcomings in current methods for testing BWMS and reporting results, issues related to setting standards and compliance monitoring, and issues related to test protocols, including the use of surrogate indicators.

The Panel recommended that any ballast water management strategy to decrease the rate of successful invasions by nonindigenous species or introduction of pathogens be part of an overall risk-based management plan that includes methods to reduce invasion events, process and environmental monitoring, containment, and eradication.
*Note that much of the text in this section was taken verbatim from the US Environmental Protection Agency Science Advisory Board report (USEPA 2011).

C. State Ballast Water Activities

Several states have or have proposed ballast water regulations and standards. California, Washington, Oregon, Alaska, and Hawaii have mandatory ballast water control and management regulations and are successful in enforcing standards consistent with the Guidance proposed by International Maritime Organization (IMO) and the USCG. The regulations also apply to coastwise traffic. Michigan, Minnesota, New York and Wisconsin are Great Lakes states that also have permitting requirements for ballast water discharge. Some Great Lake states, e.g., Illinois, Indiana, Ohio, and Pennsylvania have a less specific permitting and management of ballast water.

Several states have laws requiring ballast water reporting (Maryland and Virginia) and the Rhode Island State Legislature requires collection of data prior to developing a program. New York State had proposed regulations to force vessels travelling to the Great Lakes and Hudson River to standards that were 100 times more restrictive than international standards and were to be in effect in 2013. The maritime industry maintained the regulations would cost 72,000 jobs and a loss of $11.5 billion in annual business and tax revenues; conservation groups push for more stringent standards. As noted above the USEPA is expecting to decide if it will adopt the IMO regulations. Because of the anticipated USEPA regulations, New York state abandoned its regulations.

D. Test Facilities

Great Ships Initiative

2011 Accomplishments

1) BWTS Validation Tests (see reports on GSI website: greatshipsinitiative.org)
   a) One land-based performance evaluation of NaOCl and sodium bisulfite,
   b) One preliminary ship board demonstration of NaOH/Co2,
   c) An US EPA ETV protocol audit of the GSI facility using a government furnished ballast water treatment system; and
   d) Bench tests of several treatment processes still in the early research and development stages.
2) Methods Research and Demonstration:
   a) GSI developed, installed (on 5 ships), and trialed an effective, efficient and practicable method for retrieving representative samples from ships.
   b) A Guidebook describing the ship discharge monitoring method is available to the public at www.greatshipsinitiative.org.

2012 Scope of Work

1) BWTS Validation Tests
   a) Land-based BWTS Performance Verifications of 2-3 BWTS
   b) Several bench-scale tests

2) Methods Research and Development
   a) Validation of draft ETV Shipboard Protocol on a Great Lakes ship
   b) Continued validation of the GSI Ship Discharge Monitoring Protocol on additional five ships.

3) Mesocosm and Ship Survey Research to Determine the Risk-Release Relationship for the Great Lakes
   a) Mesocosm studies with varying inoculation densities to determine influence on rate of establishment
   b) Ship surveys to demonstrate a means for generating field data on risk-release relationship in the real world.

Maritime Environmental Resource Center (MERC, www.maritime-enviro.org)

2011 Accomplishments

1) Evaluated one ballast water treatment system and three ballast water filters onboard the Cape Washington. Final report available on Maritime Environmental Resource Center (MERC) website.

2) Completed construction, setup and initial validations of the new MERC Mobile Test Platform (barge).


4) Continued evaluations of ship biofouling as a source of invasive species. In particular, developing methods (diver and ROV) for vessel fouling surveys.

5) Continued investigations into methods for compliance monitoring of ballast water discharge regulations. In particular, completed evaluation of various methods to measure total residual oxidants for ballast water application (results presented as student Masters Thesis).

6) Continued investigations of discharge toxicity associated with the neutralization of chlorine treated ballast water.

7) Economic assessments of ballast water regulations and treatment technologies. The following references can be accessed at: www.maritime-enviro.org/Reports.php.
   • “The question industry should ask IMO about ballast water”, Sustainable Shipping April 20, 2011, (King and Hagan)
• “Preview of Global Ballast Water Treatment Markets” to appear in Journal of Marine Engineering & Technology early 2012 (King, Hagan, Riggio, Wright)
• “Who will pay for IMO ballast water regulations?” UMCES Discussion Paper (King)
• “Economic Costs and Impacts of Ballast Water Regulations” Draft UMCES Paper (King)
• “MEPC 62 special: The world can afford sustainable shipping”, Sustainable Shipping July 8, 2011 (King)
• “Market impacts of a levy on bunker fuel” (UMCES Draft, King)
• “Economic Impacts of Environmental Regulations on Shipping” (UMCES Draft, King)

2012 Scope of Work

8 ) Conduct Evaluation of three BWTSs onboard the MERC Mobile Test Platform.
9 ) Completed validation trials of new test facility in multiple locations and seasons.
10 ) Continue evaluations of ship biofouling as source of invasive species with efforts will quantify the risk of invasive species from different vessel types and different vessel routes.
11 ) Continue studies compliance monitoring using water quality sensors, with detailed assessments of various fluorometric sensors (Chlorophyll, PAM and FRR) for their application as treatment operations and shipboard compliance monitoring tools.
12 ) Initiate analysis of “Enforcement Economics” related to ballast water regulations.
13 ) Examine the economics of a barge-based, “backup” or “emergency” ballast water treatment operation in Baltimore Harbor.

2 Hull Fouling

Although hull fouling is a concern, the issue has not been addressed at a national level with regulations. The best management practice is to use antifouling paint, but over the years effective chemicals, e.g., mercury and tributyl tin, have been banned. Currently copper is used as the chemical in most antifouling paints, but it has the potential to impair water quality and may be toxic to animals other than the target fouling organisms. Both native and non-native fouling organisms develop copper tolerances that may have implications for what species are transported and which species have competitive advantages.

3 Sediments

No ballast on board (NOBOB) status does not eliminate sediments from ballast tanks. These sediments often support viable benthic organisms and dormant cysts from microalgae, some of which are harmful dinoflagellates. Garrett et al. (2011) developed sampling methods to detect cysts in sediments and used the methods to sample ballast and sediments of ship docked in Tampa Bay, Florida. They found 1,633 dinoflagellate cysts from 63 samples and the persistence of one, *Alexandrium balechii*, a species that can form harmful algal blooms.
4 Sea Chests

There does not appear to be any new sea chest research in the states. Several Sea Grant College Programs have produced outreach materials to raise awareness of sea chests as a vector for non-native species. For more information on sea chests and ballast water see http://nemis.mit.edu/intro_pathways.php.

5 Others

(see Handbook of Invasion Vectors, prepared by WGITMO and published as ICES Cooperative Research Report)

B INVASIVE SPECIES MANAGEMENT

Eradication Programmes

Recent attempts at eradication programs in the US have not generally been successful, specifically Undaria pinnatifida in California and Didemnum vexillum in Washington.

Management and Control of Invasive Species

Efforts for management and control are discussed in the US WGITMO Annual Report. Efforts are focused on control of the zebra and quagga mussels invading the western part of the country and lionfish management in the Southeast and Gulf of Mexico.

C RISK ASSESSMENT APPROACHES

A study by the Committee on Assessing Numeric Limits for Living Organisms in Ballast Water (hereafter Committee) convened by the National Research Council (NRC) prepared a report entitled, Assessing the Relationship Between Propagule Pressure and Invasion Risk in Ballast Water. The committee chair was James Carlton.

(Committee 2011). Specifically the questions posed were:

1) “Evaluate the state of the science of various approaches that assess the risk of establishment of aquatic nonindigenous species given certain concentrations of living organisms in ballast water discharges.
   • What are the advantages and disadvantages of the available approaches?
   • Identify and discuss the merits and practical utility of other additional approaches of which the National Academy of Sciences is aware.
   • How can the various approaches be combined or synthesized to form a model or otherwise more powerful approach?
   • What are the data gaps or other shortcomings of the various approaches and how can they be addressed within the near and long term?
   • Can a “natural invasion rate” (invasion rates based on historic invasion rates), or other “natural” baselines, be reliably established, and if so, how? What utility might such baselines have in informing EPA’s derivation of allowable numeric limits for living organisms in ballast water discharges? Can such baselines be established on a national basis, or would this need to be done on a regional or ecosystem basis?

2) Recommend how these approaches can be used by regulatory agencies to best inform risk management decisions on the allowable concentrations of living organisms in discharged ballast water in order to safeguard against the establishment of new aquatic nonindigenous species and to protect and
preserve existing indigenous populations of fish, shellfish, and wildlife and other beneficial uses of the nation’s waters.

3) Evaluate the risk of successful establishment of new aquatic nonindigenous species associated with a variety of ballast water discharge limits that have been used or suggested by the international community and/or domestic regulatory agencies.” (Committee 2011)

The Committee was not asked to comment on the ballast-water discharge standards. Below is a synopsis of its conclusions and recommendations.

The committee noted the value of models in developing frameworks, stating assumptions, and testing predictions under different scenarios. Theoretically, models can predict risk (invasion and/or target release level) for a given discharge standard and/or target invasion. A variety of models exist as mechanistic single species or multi species models and descriptive models. The major limitation in applying the models is insufficient data; i.e. uncertainty is high and rarely quantified.

1) The recommendations included develop standards based on models within an adaptive framework and that the models should quantify uncertainty.

2) It is assumed that the predicted shape of risk-release is non-linear therefore analysis of the data will depend on the biology of the species as well as other relevant data.

3) Because of the lack of data and higher uncertainty levels with multi-species models, mechanistic single-species models are more likely to provide maximum assurance that high impact will not become established; i.e. provide best case scenarios for preventing invasions. Multiple factors need to be taken into account.

4) In developing a robust statistical model of risk-release, a much more detailed collected of data (e.g. shipping patterns, temporal considerations, environmental variables, among others) need to be collected to assist with develop appropriate models.

5) There is no evidence that any proxy variable used thus far is a reliable stand-in for organism density. (Committee 2011)
## D  OCCURRENCE OF NEW SHIP-MEDIATED INTRODUCED SPECIES

<table>
<thead>
<tr>
<th>Taxon</th>
<th>Year of first record</th>
<th>Location of first record</th>
<th>Possible introduction vector</th>
<th>Invasion status**</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Hydroides elegans</em></td>
<td>2011</td>
<td>Woods Hole, MA</td>
<td>Recreational vessels</td>
<td>Unlikely to survive winter</td>
<td>Enos, Carlton, Pederson, pers. obs.</td>
</tr>
<tr>
<td><em>Zoobotryon verticillatum</em></td>
<td>2011</td>
<td>Narragansett Bay</td>
<td>Recreational vessels, ship fouling</td>
<td>Unlikely to survive winter</td>
<td>Pappal, Carlton, pers. obs.</td>
</tr>
<tr>
<td><em>Palaemon elegans</em></td>
<td>2010</td>
<td>Gulf of Maine, Cape Cod, MA</td>
<td>Unknown</td>
<td>Established</td>
<td>Carlton et al. In press</td>
</tr>
<tr>
<td><em>Palaemon macrodactylus</em></td>
<td>2010</td>
<td>Narragansett Bay to New York</td>
<td>Unknown</td>
<td>Established</td>
<td>Warkentine and Rachlin, 2010</td>
</tr>
<tr>
<td><em>Clavelina lepadiiformis</em></td>
<td>2009</td>
<td>Long Island Sound</td>
<td>Ship fouling</td>
<td>Established</td>
<td>Whitlatch, pers. comm.</td>
</tr>
<tr>
<td><em>Synidotea laevidorsalis</em></td>
<td>2003</td>
<td>New York City</td>
<td>Ship fouling</td>
<td>Established may spread</td>
<td>Carlton, pers. comm.</td>
</tr>
<tr>
<td><em>“Heterosiphonia” japonica</em></td>
<td>2009</td>
<td>LIS to Cape Ann, MA</td>
<td>Ship fouling</td>
<td>Established and abundant</td>
<td>Bracken, pers. obs.</td>
</tr>
<tr>
<td><em>Tricellaria inopinata</em></td>
<td>2010</td>
<td>Woods Hole, MA</td>
<td>Recreational vessels</td>
<td>Established</td>
<td>Johnson, pers. obs.</td>
</tr>
</tbody>
</table>

* Duplication with WGITMO report if the vector is unknown
** When spreading see details in Section E
E IMPACT OF INTRODUCED SPECIES

Economic - no data on the new introductions to date.

Ecological

The red alga, “Heterosiphonia” japonica, has a negative impact on native flora and fauna, very abundant where present. The bryozoan, Tricellaria inopinata, outcompetes native bryozoans and has the potential to spread beyond the localized pond in which it is currently found.

F OTHER RELEVANT INFORMATION

The University of California has a series of information sheets on nontoxic antifouling strategies. Visit: http://ucanr.org/sites/coast/Nontoxic_Antifouling_Strategies/

Ballast water reports available the National Ballast Information Clearinghouse at http://invasions.si.edu/nbic/overview.html.

Under the National Invasive Species Act of 1996, the U.S. Coast Guard and the Smithsonian Environmental Research Center (SERC) created the National Ballast Water Information Clearinghouse (NBIC) to collect and analyze national data relevant to shipping and ballasting practices as they relate to coastal marine invasions. Established at SERC in 1997, the principal goal of NBIC has been to track:

Nationwide Patterns of Ballast Water Delivery and Management. All commercial ships arriving to all U.S. ports from report information about the quantity, origin, and possible control measures for their ballast water - a primary mechanism for transfer of non-native marine species throughout the world. At present, NBIC receives roughly 115,000 ballast water reporting forms per year from overseas and domestic arrivals. Every two years, NBIC provides a detailed analysis and report to the U.S. Coast Guard on the patterns of ballast water delivery by coastal state, vessel type, port of origin, and season. A key issue is the extent to which ships undertake ballast water exchange, a management technique to flush potential invaders out of the tanks prior to arrival in U.S. waters. NBIC’s analyses are used by the U.S. Coast Guard and the U.S. Congress to assess national needs with respect to ballast water management and to track program performance.

G REFERENCES


General ballast outreach materials can be found at http://ballast-outreach-ucsgpe.ucdavis.edu/General non-native species information can be found at http://nemis.mit.edu


ANNEX 5 Terms of Reference for the next meeting

The ICES/IOC/IMO Working Group on Ballast and Other Ship Vectors (WGBOSV), chaired by Sarah Bailey, Canada will meet in Montréal, Canada from 18-22 March 2013, with a back to back meeting with the Working Group on Introductions and Transfers of Marine Organisms (WGITMO) to:

a) Continue to critically review and report on the status of shipping vector research with an emphasis on new developments in ballast water treatment technologies, ballast water sampling and analysis and methods used by testing facilities in order to support the ongoing work at IMO.

b) Provide scientific input on how the IMO Guidelines for approval of ballast water management systems (G8 guidelines) could be improved following the output from MEPC 64. This could include consultations with groups such as the GloBal TestNet.

c) Further discuss and evaluate the sampling and analysis strategies under consideration at IMO and provide comment to relevant IMO committees. Solicit experts’ statistical advice to support this work.

d) Summarise the existing issues with regard to the rationale for the granting of exemptions in the IMO Guidelines for risk assessment under regulation A-4 (G7 guidelines).

e) Summarise available information on the effects of treated or exchanged ballast water on the aquatic environment.

f) Investigate and report on non-native species issues associated with artificial structures in the marine environment (joint Term of Reference with WGITMO).

Supporting Information

**Priority:**

The Working Group review and report on the scientific and technical development in relation to ballast water and shipping vectors. As a joint working group it also follows and supports the work within IMO and IOC on these topics.

**Scientific justification and relation to action plan:**

WGBOSV has a long history of providing scientific support to the development of international measures to reduce the risk of transporting non native species via shipping vectors. The group has had input into the issue of Ballast Water Sampling guidelines in several ways.

The issue has been discussed at the annual meetings of the Working Group

The working group has previously submitted documents to meetings at IMO to support the development of guidelines.

This type of input helps ensure that the guidelines are based on accurate scientific information and supports the implementation of the Ballast Water Management Convention.

**Resource requirements:**

None
<table>
<thead>
<tr>
<th><strong>Participants:</strong></th>
<th>The Group is normally attended by some 25–35 members.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Secretariat facilities:</strong></td>
<td>None.</td>
</tr>
<tr>
<td><strong>Financial:</strong></td>
<td>No financial implications.</td>
</tr>
<tr>
<td><strong>Linkages to advisory committees:</strong></td>
<td>ACOM</td>
</tr>
<tr>
<td><strong>Linkages to other committees or groups:</strong></td>
<td>There is a very close working relationship with the working Group on Introductions and Transfers of Marine Organisms (WGITMO) and the Working Group on Harmful Algal Bloom Dynamics (WGHABD). There is also a link to PICES.</td>
</tr>
<tr>
<td><strong>Linkages to other organizations:</strong></td>
<td>The work of this group is closely linked to work carried out by the European Maritime Safety Agency (EMSA), the International Maritime Organization (IMO) and the Intergovernmental Oceanographic Commission (IOC).</td>
</tr>
</tbody>
</table>