ICES WGBOSV REPORT 2007–2009

ICES ADVISORY COMMITTEE

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

For the years 2007–2009

ICES International Council for the Exploration of the Sea
CIEM Conseil International pour l'Exploration de la Mer

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Contents

Executive summary report WGBOSV 2007 – 2009

The ICES/IOC/IMO Working Group on Ballast and Other Ship Vectors (WGBOSV) had three meeting during the period 2007-2009:

- Dubrovnik, Croatia from 19–21 March, 2007
- ICES Headquarters, Copenhagen, Denmark, 10–12 March 2008
- Washington DC, USA, 9–11 March 2009

In 2008 and 2009 the WGBOSV meeting took place back-to-back with WGITMO with a common session each year.

The participants are summarised in Annex 1.

The following issues were discussed during the meetings:

1 Review and report on the status of ballast water research with an emphasis on new developments in ballast water treatment technology, risk assessment, ballast water sampling devices, and selection of ballast water exchange zones to contribute to guidelines currently in preparation by IMO

A substantial number of initiatives on ballast water research were reported by the participants at all three meetings. The national reports are presented in Annex 2 and Annex 3.

A number of treatment technologies have, or are approaching type approval. For these technologies, ship-board tests have been accomplished, are under way, or have been commissioned. Facilities for type approval have been established, but capacity might become a problem for future work. A need for inter-calibration, or control by independent third parties of type approval processes was communicated by correspondence. A number of initiatives to identify Ballast Water exchange zones were reported. The work on ballast water exchange zones have to a great extent been based on the previous "Scoping Study".

Lloyd's registers ballast water treatment technology guide (has been produced close to annually since 2007. Link to the most updated version: http://www.lr.org/Images/BWT0210_tcm155-175072.pdf . The Lloyd's reports give a good general overview of the current status for ballast water technology and the most recent was published online in March 2010. For 2007 and 2008, feedback on a questionnaire on BW technologies and status for implementation on the Ballast Water Convention was solicited from the participants of the group. As the Lloyd's reports has made update on BW technology somewhat redundant, the responses to the technological part are disregarded in this report. The responses to the BW Convention implementation are presented in Table 1.

Table 1 Responses to BW Questionnaire on status for national implementation of the BW Convention per 2007.

International Ballast Water Convention (BWC). Status, planned implementation and BW management pr 2007.					
Country	BWC ratified? (Y/date/N)	If N, when planned?	Stronger regulation than BWC?	Special regional regul.?	Other relevant information
Germany	N	"soon"	not likely	interested (EU)	
Norway	Y, Dec.2006		N	No, but will consider	Work in progress on BW exchange zones
the Netherlands	N	not known	N	No, but will consider	
Spain	Y (2005)		N		Only 6 counties (0.62% world ship´s) have been ratified BWC. BWC will be implemented when this percentage reached the 50%.So, we do not know when BWC will be implemented.

Sweden has considered BWE (Ballast Water Exchange zones) for the Baltic Proper and the Skagerrak and the Norwegian trench, respectively. (Andersson, P. 2007, a,b) available at: http://www.smhi.se/sgn0106/if/biblioteket/rapporter/o.htm#2007). The results showed that establishment of designated areas for ballast water exchange within the Exclusive Economic Zone of Sweden (EEZ) is not advisable, since the time for the exchanged water to reach protected areas or fish and mussel farms is too short (one day – one week). These results have also been included in the Ballast Water Management Inquiry as a basis for a suggested reservation, when Sweden accedes the Ballast Water Management Convention

Norway has considered BWE along the Norwegian coast, and an number of possible exchange zones has been identified. (Dragsund E, Botnen H, Jelmert A, Hackett B (2007).

"Utredning av områder for utskiftning av ballastvann". Rapport for Direktoratet for naturforvaltning Report no. 2007-0324 (in Norwegian).

Discussions on BWE zones for Croatia have been undertaken in a trilateral commission with Slovenia and Italy. The issue seemed unresolved by 2009.

- IMO Update

Stephan Gollasch has been appointed to represent ICES at the IMO sub-committee Bulk Liquid and Gases (BLG) and the Marine Environment Protection Committee

(MEPC). An update on IMO topics relevant to the work of WGBOSV is given in the German national report 2009 (Annex 3).

References

Andersson, P. 2007, a,b

Dragsund E, Botnen H, Jelmert A, Hackett B (2007

2 Continue the global review of shipping vectors through the participation of representatives from ICES, IMO, IOC, CIESM, BMB and PICES Member States and of invited experts

In 2007 a majority of the participants in the group reported increased focus on hull fouling (+ Sea chest etc.) as a vector for non-indigenous species.

This point has later been corroborated by several studies on the importance of hull fouling as a very important vector (e.g. IMO BLG/INF4, 2007).

Sightings of the comb jelly *Mnemiopsis leidyi* was reported from Germany, The Netherlands, Norway and Sweden. The comb jelly was found both along the North Sea Coast and in the South-western Baltic. A concerted initiative has been established to monitor the comb jelly in German and Scandinavian waters. In 2009 it appeared that the species found in the northern Baltic was another, not harmful comb jelly species *Mertensia ovum* originating from the Arctic.

In 2008, the continued need to also address hull fouling was stressed. However, Fred Dobbs (USA) pointed out that from a microbiological point of view, the ballast water is more important than biofilm and sediment when considering "risk based on numbers" (Drake et al. (2007), http://www.ncbi.nlm.nih.gov/pubmed/17215010).

References

IMO BLG/INF4, 2007

Drake , L.A., Doblin, M.A., Dobbs, F.C.. (2007) Potential microbial bioinvasions via ship's ballast water, sediment and biofilm. Marine Pollution Bulletin. 55 (7-9), 333-341.

3 Prepare a draft ICES Code of Best Practice for the Management of Ships Hull Fouling

With the emerging focus on hull fouling as an important vector, work on collecting the various protocols was initiated in 2007.

In 2008 it was agreed that a number of Australian / New Zealand initiatives and reports on best practices on hull fouling management was well suited as a framework and it was agreed that the CoBP should include a short "Background" chapter referring to recent findings of the importance of hull fouling, and a definition of terms. The meeting elaborated a set of definitions.

It was also agreed that a break-down in various vessel categories would ease the accessibility for the various users of the CoBP and that a separate section on "Niche areas", i.e. areas where Non-Indigenous Species may find particular good opportunities for attachment/hiding, was warranted.

Because the Anti Fouling Systems Convention has entered into force and the TBT use in marine coatings is prohibited for all vessel sizes, the previous distinction between vessels <25 m and > 25 m is no longer necessary.

The following classes of vessels categories as outlined in ICES CoRR 271 (Minchin, Gollasch and Wallentinus (2005)) were identified: commercial trading vessels, non trading commercial vessels, commercial fishing vessels, recreational vessels and others. Areas of special concern were identified as sea chest, rudder, internal tubing, propeller, support strips etc.

In 2009 it was reported that the work on hull fouling was reviewed at BLG13 which included a comprehensive list of literature regarding hull fouling studies. It was further discussed how to implement the hull fouling issue, i.e. whether this could become a guideline, could be attached to an existing convention or be developed towards a stand alone convention on hull fouling. The majority of the group favoured to develop a guideline first and decide later if an annex to an existing convention or a stand-alone convention is needed.

During 2009 the Code of Practice for Best Management of Hull Fouling was finalised. The guideline is presented in Annex 4.

The BLG13 agreed in principle to establish a working group on bio-fouling issues and initiated work. Due to the overlap of experts working on both subjects (ballast water and hull fouling), WGBOSV was of the opinion that only one group should be formed and deal with both subjects in the future.

References

Minchin,D. Gollasch, S. and Wallentinus, I. (2005) Vector pathways and the spread of exotic species in the sea. ICES Co-operative Research Report No. 271. ICES: Copenhagen.

4 Prepare an ICES Ballast Water Sampling Manual

A draft of the sampling manual was prepared for the 2007 meeting by Dr. Stephan Gollasch. A number of problems related to sampling techniques e.g. on how to enumerate and measure the size of chain-growing or colonial organisms, and the problem of variability was discussed. The group had substantial concerns with regards to appropriate sample volumes, sample numbers and the statistical methodology that would be required to ensure a robust result. The legalistic implications of uncertainty (in the context of compliance control) were discussed, and the group reached agreement that additional statistical expertise was needed.

The meeting in 2008 considered the feedback from statisticians on sampling guidelines. Initially it was noted that the sampling problem for ballast water is somewhat different than ordinary biological quantitative studies. With regards to compliance control, the numbers (with a measure for uncertainty/confidence) in some cases may have legal implications.

From previous work/data collection, the group was aware that organisms in Ballast Water (BW) tanks are notoriously non-homogenously distributed. This problem was also pointed out by the two statisticians who have been consulted. If one could assume that the biota was uniformly distributed, the statistical tools for describing the tanks through subsamples are straightforward. Other possibilities for non-uniform distributions exists, but in order to address this properly: 1) A better definition of the problem and the task (eventually with break-down in discrete sub-problems) is

needed; 2) Data to describe the type(s) and range of non-homogeneity is needed. This calls for new data-input from newly installed systems on board ships. The previous studies in BW tanks are of limited value for furthering this work. The sentiment of the statisticians was that a funded project is needed to address the problem properly.

Stephan Gollasch made the group aware of the current German suggestion to sample throughout the entire de-ballasting process. This method can potentially circumvent the statistical problems related to non-homogeneity, but a number of other issues need to be resolved.

- Does the sampling/collection over such a long period influence the viability of the organisms when caught in the sampling unit?
- What is the ratio between de-ballasting flow and sample flow?
- What is the variability between de-ballasting flow and sample flow?

The continuous approach seemed attractive for a number of reasons, including practicability. It is regarded to be a good working hypothesis, but the statistical implications should be resolved, as well as collecting data to verify the validity of the *a priori* assumptions.

Acknowledging that BW biota is non-homogenously distributed, reference was made to a fairly comprehensive study of zooplankton sampling (Downing *et al*, 1987), a field with similar problems related to non-homogeneities. With the data from 1189 sets of replicate samples, they developed a model for the number of samples necessary to obtain a given precision. The variance function showed how the required number of samples decreased with increasing population density, sample volume and lowered precision requirements (Downing *et al*.). For a precision level expressed as standard error/mean = 0.2, the models predicts that 17 (!) 1000 l samples are needed to detect 10 organism/m3 (i.e. the D2-standard for organisms >50 um) at the given precision level. To detect gross violation of the D2 standard, e.g. a density hundredfold the D-2 standard, three 1000 l samples are needed. The results from Downing *et al*. might have significant implications for sample design, result interpretation, and how compliance/ non-compliance can be resolved.

In the 2009 meeting new documents were provided. The intention was to merge the statistical considerations into a practical manual/report with recommendations. During the discussion four important issues emerged:

- The number and volumes of samples necessary to estimate the concentrations of organisms, within a specified statistical confidence, in ballast water (under discharge). This discussion centered on the theoretical methods for such estimates, which are well understood.
- The difference between precise estimates of density with different sampling, comparing sampling throughout discharge of a tank versus discontinuous replicate samples. This is not well developed and depends on spatial variation i.e. the degree of heterogeneity, of organisms in ballast tanks. A direct comparison of methods would be very useful.
- There are currently too little information/data on the distribution of organisms in BW tanks to make general statements about the degree of homogeneity in concentrations across ships, tanks, seasons, etc. We have data and general ideas of time-dependency and effects of environmental matching. We also find some patterns of distribution within ballast tanks, but these are currently not sufficient to make general statements.

- There is a fundamental difference between measuring concentration with high statistical confidence versus testing of ballast for concentrations that exceed a specified standard (threshold concentration). While the former may take many samples, the latter may not, especially if the question is to estimate the probability that a given sample exceeds a specific threshold. There is a strong need to clearly articulate the specific question/purpose being pursued.

The group identified a need for specific questions and approaches to be clearly stated.

The most appropriate methods may differ for technology testing versus compliance testing.

The WGBOSV could provide specific guidance on approaches and state of current understanding, based on biological measures in ballast tanks. While an obvious need to get more reliable data on the distribution of biota in ballast tanks and the "behavior" of the biota when discharged/sampled exists, a strong conceptual framework is now lacking in this area. The WGBOSV could develop this framework and evaluate its application using current data. This would also serve to identify the specific data needed to address the relevant questions in this area.

One issue that is already evident is that an opportunity exists to collect in an integrated fashion needed data across shore-based treatment facilities and on-going ship-based projects. It will probably be necessary to identify and employ considerable simplifying assumptions to find practical and feasible sampling strategies.

- Work within IMO on Ballast Water Sampling:

Of key interest to ICES may be the current development of the Ballast Water Sampling Guideline (G2) for compliance control with the standards as set forth in the IMO Ballast Water Management Convention. This guideline is now agreed. G2 contains generic information, but more details are required and worked on as a guidance document. In that sense the work of WGBOSV should be seen as contributing to this process.

At BLG13 a catalogue of questions was developed regarding port state control sampling and IMO member states are invited to inform BLG on possible sampling and sample processing strategies.

The entering into force dates of Regulation D-2 ballast Water Performance Standard were discussed.

Harmonization of land-based test procedures was briefly discussed. A harmonization of sampling protocols and sample analysis methods may be needed as all land-based test facilities to test the performance of ballast water treatment systems have chosen different approaches.

During BLG13 the GloBallast Industry Alliance (GIA) was introduced with several industrial partners involved as new public-private partnership. The GIA, which brings together some of the major shipping companies and shipbuilders to promote ballast water related initiatives and solutions, has agreed to support GloBallast.

References

Downing ,J.A., Pérusse, M., Yves, F. (1987). Effect of interreplicate variance on zooplankton sampling design and data analysis. Limnology and Oceanography. 32 (3), 673-680

5 Establish a shared information resource regarding the identification of species (barcoding)

Through cooperation with PICES, information on the progress on a database developed by Henry Lee II and Deborah Reusser has been provided (See also chapter 7). The scope of the work is to develop a distributed database with search interface into other separate national or regional databases. There remains however considerable challenges with differing systems for coding and recording etc. The database also has "Stand-alone" features, and during the 2007-2009 period, the database has been gradually "populated" generally with data on organisms from the Americas.

A short presentation was given at the overlapping WGITMO-session on barcoding This is an interesting emerging method which holds some promises for both rapid detection and resolving evolutionary, and thereby geographic, affiliations of introduced species. There has however been a slow progress in the BOSV community making use of the methodological opportunities. The WGBOSV will however continue to follow the development of this approach.

6 Review and develop a Code of Best Practice for Port Sampling.

Australia has considerable experience with port sampling protocols. Relevant information can be found here:

i) Hewitt Ch.L. and R.B. Martin, 1996. Port surveys for introduced marine species – background considerations and sampling protocols. CRIMP Technical Report No 4. CSIRO Division of Fisheries, Hobart. 40 pp.

ii) Hewitt Ch.L. and R.B. Martin, 2001. Revised protocols for baseline port surveys for introduced marine species: survey design, sampling protocols and specimen handling. CRIMP Technical Report No 22. CSIRO Division of Fisheries, Hobart. 46 pp.

Unfortunately no representative from Australia was present at the 2007 Meeting. The group had the impression that the cost of doing similar port sampling is prohibitively high. There were suggestions on how to find more cost-effective sampling strategies, and to find ways to combine port sampling with other ongoing monitoring work, like the monitoring requested by the water framework directive in Europe.

The rationale for doing port sampling and the general outline of port sampling has been discussed.

"Why doing Harbor sampling"?

- (Academic purposes)
- Risk assessment
    - To detect high-risk harbours
    - Eventually to exempt vessels according to guideline G7 and the convention
- Early detection (rapid response). Refer to ITMO early detection- rapid response. (WGITMO 2007 report, Annex 6).
- Management/ Control
    - To prove effectiveness of BW management measures

Overview of methods

- Linked/imported information from national or regional alga monitoring programs (serving the shellfish industry)
- Water samples e.g. Rüttner, Niskin bottles
- Grab samples - Sieving
- Dredge sampling
- Panels (including mesh/net) samples Shale better than plastic (Helge Botnen Pers.comm.)
- Baited traps
- Divers transects (harbor periphery)
- Littoral surveys
- Mudflats –Sieving
- Sampling design and statistical considerations
- Reference and voucher specimens, links to Manual for Marine Monitoring in the Combine Programme of HELCOM (www.helcom.fi)

Frequency

Doing a risk assessment would be a valuable input on decisions on sampling frequencies.

The frequency of sampling to achieve the above purposes is not easily prescribed. We suggest that frequency be determined, given input from local biological expertise and consideration of resources of time and money. Furthermore, not all the sampling methods suggested above need take place at the same frequency. For example, fouling panels are likely candidates for more frequent sampling than would be benthic dredge collections, diver transects.

The frequency of sampling may change should a new, non-indigenous species be found. That is, given a new situation in the donor area, the risk assessment parameters may be changed, especially in the view of the exemption provisions for BW management requirements according to the Guidelines G7. For example, panel sampling that normally occurs twice a year might be increased in frequency following discovery of a new species.

Harbor areas as donor regions.

Whenever a known aquatic nuisance species (indigenous or non-indigenous) is recorded in or near a harbor area, other harbors, authorities or management bodies may be interested to have such information.

How to report and disseminate the information.

Many well managed harbors have web-sites where the relevant information can be posted. Eventually harbor authorities could link to places where the information can be found. Regional and national authorities also should be informed, and the ultimately national or transnational organizations like USGS or MCA could be depositories for the information

It has been agreed that BOSV should not develop its own sampling manual, but continue to provide input to IMO, when appropriate.

References

Hewitt Ch.L. and R.B. Martin, 1996. Port surveys for introduced marine species – background considerations and sampling protocols. CRIMP Technical Report No 4. CSIRO Division of Fisheries, Hobart. 40 pp.

Hewitt Ch.L. and R.B. Martin, 2001. Revised protocols for baseline port surveys for introduced marine species: survey design, sampling protocols and specimen handling. CRIMP Technical Report No 22. CSIRO Division of Fisheries, Hobart. 46 pp.

7 Continue and elaborate the cooperation with PICES WG 21.

In 2008 reference was made to a joint meeting in Boston. There seemed to be interest for some common issues:

- Linked species database
- CoBP for Hull fouling
- CoBP for BW sampling
- Barcoding – several participants voiced interest for this approach.

There was some confusion whether ICES should pursue a separate linked species database, or incorporate it into the PICES database. A widespread concern for continued funding for the database was raised. Who would maintain and update (i.e. fund) the database in the future? The worries was based on concerns for how large and valuable databases like DAISIE (Delivering Alien Invasive Species In Europe, (http://www.europe-aliens.org) should be secured a more long-term funding. DAISIE was funded under the sixth framework programme of the European Commission.

8 Provide data and information on how climate change may alter the distribution of NIS and shipping operations, and hence the risks for introductions of NIS via shipping.

Transportation by ships in the Arctic is expected to increase significantly in the 21st century due to anticipated reduced sea ice, but Arctic voyages are expected to be overwhelmingly regional, not trans-Arctic by 2020. This traffic is partly related to the developing Russian oil and gas industry in the Pechenga-Yamal region and increasing tourist ship activity (AMSA, 2009, Bambulyak, and Frantzen, 2009). While a trans-Arctic route from Rotterdam to Yokohama is approximately 40% shorter compared to the route through the Suez Canal (Liu and Kronbak, 2009), additional capital and running costs will be incurred for the ice-class vessels needed for this route. Additional costs can also be expected for piloting, insurance, and more frequent repairs of hull, propellers and steering (Liu and Kronbak, 2009). Viability of the trans-Arctic sea route will be dependent on a minimum size of the "navigable window", i.e. the extent and distribution of sea-ice during summer/fall in the 21st century (Somanathan *et al.*, 2009).

References

AMSA, 2009,

Bambulyak, and Frantzen, 2009

Liu and Kronbak, 2009

Somanathan *et al.*, 2009

9 Transparency

Transparency was discussed in 2008. Some participants have previously been, or may in the future be involved in particular developments of BW treatment systems. This could in some instances lead to financial or intellectual preferences. Hypothetically also national interests or preferences could be imposed via participants of the group. It was not considered a problem for the current members of the group and their activities, and the general sentiment was to follow common practice for resolving eventual conflicts of interest, where members of the group may be omitted from the relevant parts of the discussion.

10 Merging of WGITMO and WGBOSV

In 2007 WGBOSV was asked to consider and respond to the recommendation from ACME to merge in 2008 WGITMO and WGBOSV into a single working group with a broadened mandate for the occurrence and impact of marine invasive and/or pest organisms.

This subject was discussed with representatives from both WGs at the joint meeting. Although pros and cons were presented for merging or remaining independent of each other, it was agreed that it would be in the best interest of both groups to remain separate, but continue to meet back to back.

There were several main reasons for this: First and foremost there is a clear, logical distinction between the mandate and activities of each group. WGBOSV works on specifically identified vectors - ballast and hull fouling, whereas WGITMO's work focuses on what happens when an invasive species is found in a water body – status of the invasion, potential impacts, options for mitigation and/or eradication, and sharing information with other countries. Also, the focal point for the groups is likely to diverge even more in the future. Additionally, several representatives, including the representative from IOC voiced a very clear preference for keeping the groups separate, but back to back.

A joint statement from the two working groups on this issue was prepared and forwarded to ACME (Annex 5)

11 Other issues discussed

- New scientific problems of interest

The group felt that the current set of problems related to sampling and taxonomic issues are challenges enough for the time being. The chair encouraged the members to look for emerging methods enabling scientists and management bodies to resolve the issues of sampling and viability determination.

- Input to IMO on "minimum dimension" issue

Stephan Gollasch reviewed the input from BOSV 2006 to IMO regarding the "minimum dimension" issue for D2. WGBOSV's recommendations that "minimum dimension" should mean:

- omitting bodily appendages like antennas, etc
- the dimensions and number of the individuals, if in a colony or assemblage of individuals

- the minimum means the width, not the length of an oblong organism

The group's recommendations were taken on board.

- - Liaison with "parent "Organizations

IMO: The IMO appreciates the input and feedback from WGBOSV. Nevertheless, the background /history for WGBOSV's affiliation with IMO seems somewhat unclear, but is probably related to the enthusiastic involvement in BW issues of the now retired Manfred Nauke at IMO. The inclusion of IMO as an affiliation was likely made under Jim Carlton's chairmanship, and with the support of said Manfred Nauke. No official document apparently exists on this at IMO.

During the early part of the 2000s, Steve Raaymakers was employed at the IMO Globallast Program and was also appointed Co-chair of WGBOSV. ICES should try to enforce the IMO involvement and express interest/support for an eventual co-chair with WGBOSV.

IOC: IOC has an interest in BW issues with issues related to HAB events, but also more general questions are of concern. IOC will support training in alga taxonomy and the practical issues with respect to the determination of "viability".

Annex 1 Participants list: WGBOSV 2007 – 2009

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Annex 2 National reports 2008

Croatia

Report prepared by Josip Mikuš and Marijana Pećarević

Ballast Water Projects

Ballast Water Treatment

Project on ballast water treatment at the University of Dubrovnik is still in progress, as a unique project recognized and supported by Croatian Ministry of Science, Education and Sports. Research includes mechanical (cyclonic separation) and chemical treatment (UV and AOP) which is performed in the land-based treatment facility. Test organisms are farmed in the Research and Development Center for Mariculture in Bistrina Bay near Ston. The preliminary test of the facility has been performed on board the research vessel of the University of Dubrovnik in 2007.

Monitoring of introduced species

Monitoring of introduced species is still part of regular national scientific projects accepted by the Ministry of Science, Education and Sport. In the Southern Adriatic there is an open sea sampling station near island of Lokrum. Analyses of samples can indicate input of non-indigenous planktonic species from Mediterranean.

Monitoring and analyses of the marine plankton communities sampling at the stations in two major harbors in Southern Croatia (Port of Ploče and Port of Gruž, Dubrovnik), as well as hull fouling and biofouling communities analyses in marinas in the Southern Adriatic are planned to be performed by experts from University of Dubrovnik.

Ballast Water Management and Croatian regulations

A new Regulation on Management and Control of Ballast Water has been enacted by the Croatian Parliament in September 2007. This regulation enacts the principles and methods in managing and controlling of the ballast water in floating objects during their stay or voyage in Croatian parts of the Adriatic Sea (including Ecological and Fisheries Protection Zone), but the list of target organisms comprises only phytoplanktonic species (Appendix 1). Moreover, it is not yet clear which laboratories are licensed to carry out sampling and analyzing.

Although the project for oil export from Croatian Port of Omišalj at the Island of Krk (Družba Adria Project) is stopped by the decision of Croatian Government. Danger of increase of ballast water impact in the Adriatic Sea still exist because of possible building of the harbour for oil export in Vllora, Albania. This could have a great influence to the entire Adriatic Sea because of currents that enter the Adriatic along the Albanian coast. So, implementation of Regulations should be established as soon as possible.

Ballast Water Exchange

Discussion about Ballast Water Exchange Zones is still on with Slovenia and Italy (Trilateral Commission). There was an interruption in trilateral discussions because

of the implementation of the Croatian Ecological and Fisheries Protection Zone (Croatian: *Zaštićeni ekološko-ribolovni pojas*, ZERP) to member countries of the EU.

Appendix 1 (Croatia)

List of target organisms that must not be found in the ballast water

Cyanobacteria
- *Hormothamnion enteromorphoides* Grunow.
- *Lyngbia mayascula* Harvey
- *Anabaena spp.*
- *Aphanizomenon spp.*
- *Microcystis spp.*
- *Nostoc spp.*
- *Oscillatoria spp.*
- *Synechococcus spp.*
- *Trichodesmium spp.*

Raphidophyta
- *Olisthodiscus luteus N.* Karter
- *Heterosigma akashiwo* Hada
- *Chatonella spp.*

Haptophyta
- *Chrysochromulina spp.*
- *Phaeocystis spp.*
- *Prymnesium spp.*

Dinoflagellata
- *Amphidinium carterae* Hulburt
- *Alexandrium minutum* Halim
- *Alexandrium tamarense (Lebour)* Balech
- *Cochlodinium polykrikoides* Margalef
- *Coolia monotis* Meunier
- *Dinophysis acuminata* Claparède et Lachmann
- *Dinophysis acuta* Ehrenberg
- *Dinopyisis caudata* Saville-Kent
- *Dinophysis fortii* Pavillard
- *Dinophysis mitra* (Schutt) Abe
- *Dinophysis norvegica* Claparède et Lachmann
- *Dinophysis rotundata* Claparède et Lachmann
- *Dinophysis sacculus* Stein
- *Dinophysis tripos* Gourret
- *Gonyaulax polygramma* Stein
- *Gymnodinium catenatum* Graham
- *Karenia brevis (Davis)* Hansen et Moestrup
- *Karenia¸mikimotoi* (Miyake et Kominami ex Oda) G. Hansen and Moestrup
- *Lingulodinium polyedrum* (Stein) Dodge
- *Pfiesteria piscicida* Steidinger et Burkholder
- *Prorocentrum lima* (Ehrenberg) Dodge

Ciliata
- *Mesodinium rubrum* (Lohmann) Hamburger & Buddenbrock

FRANCE

Report prepared by Laurence Miossec, Ifremer AGSAE, Laboratory Genetic and Pathology, BP 133, 17390 La Tremblade, FRANCE

Overview:

Two new European directives dealing with invasive species issues were adopted in 2007, the European Marine Strategy Directive and the directive on the use of alien species in aquaculture.

Bonamia exitiosa, an exotic pathogen of flat oysters, was detected for the first time in

Europe (in Spain) in July 2007.

Regulations:

Council regulation (EC) n° 708/2007, 11 June 2007, concerning use of alien and locally absent species in aquaculture: This regulation establishes a framework governing aquaculture practices related to exotic and locally absent species in order to assess and minimize the possible impact of these and any "hitchhiker" species on aquaticenvironment.

The European Parliament adopted on December the 11th 2007, a new directive called Marine Strategy Directive (SEC (2005) 1290) setting out guidelines for the protection of the marine environment during its plenary session in Strasbourg. The Thematic Strategy on the Protection and Conservation of the Marine Environment aims to achieve good environmental status of the EU's marine waters by 2021 and to protect the resource base upon which marine-related economic and social activities depend. The Marine Strategy Directive is consistent with the water framework directive from 2000 which requires that surface freshwater and ground water bodies (lakes, streams, rivers, estuaries, coastal waters…) achieve a good ecological status by 2015 and that the first review of the River Basin Management Plan should take place in 2021. Characteristics and environmental status of ecoregions will included, among the listed variables, biological elements as introduction of alien species and biological disturbance as pathogens and non-native species.

Intentional introductions:

EU project IMPASSE, (2006-2008) is in progress (www.hull.ac.uk/hifi/IMPASSE/): The overall objective of the IMPASSE project is to develop guidelines for environmentally sound practices for introductions and translocations in aquaculture, guidelines on quarantine procedures and risk assessment protocols, and procedures for assessing the potential impacts of invasive alien species in aquaculture. The verifiable scientific and technological objectives of IMPASSE are:

1) review of introductions and translocations in aquaculture and for aquaculture-based restocking and assess the economic importance of introductions and translocations resulting from aquaculture and aquaculture-based restocking in the Community;

2) audit the state of knowledge of the results of operations concerning introductions and translocations of aquatic organisms for aquaculture purposes, particularly concerning environmental and economic impacts and genetic interactions with wild populations; to analyse the economic importance of restocking, particularly for community aquaculture enterprises;

3) develop risk assessment protocols for future aquatic species introductions and aquaculture, with specific models and sub-routine assessments to consider economic issues, the potential environmental and economic impacts of diseases in wild aquatic organisms and ecosystems, genetic interactions with wild populations, and the disruption of ecosystem structure and function. Special attention will be given to assessing whether modern land-based closed aquaculture facilities can be considered bio secure and to what extent movements into these facilities can be differentiated from movement into open aquaculture facilities under Community rules;

4) provide guidelines for quarantine procedures to account for phylum-specific peculiarities, developmental stages and risk levels, including procedures for containment and control where invasive species are identified as a problem; and

5) provide guidelines for environmentally sound practices for introductions and translocations in aquaculture and stock enhancement operations.

Unintentional introductions:

Protists

Quinqueloculina carinatastriata in Marennes-Oleron bay and Ile de Re Large populations of the living benthic foraminifera *Quinqueloculina carinatastriata* (Wiesner, 1923) were reported for the first time from intertidal mudflats of the French Atlantic coast (Marennes-Oléron Bay and Ile de Ré) in 3 June 2004 (Bouchet *et al.*, 2007). The species was previously described from the Adriatic and Tyrrhenian Seas (central Mediterranean Sea) and reported from the Eastern Mediterranean and Red Seas, as well as tropical and subtropical regions.

Sampling sites were located at Bellevue (45°56'32.14" N; 1°12'20.72" O), Les Traires (45°52'41.75" N; 1°10'36.44" O) and Daire (45°51'57.14" N; 1°09'11.18" O) from the Marennes-Oléron Bay and Rivedoux (46°09'52.79" N; 1°16'22.55" O) from Ile de Ré. Living specimens were found in fourteen of a total of thirty-two samples. The large population of *Q. carinatastriata* (2500 living individuals in 50 cm3 of sediment at Les Traires) shows that this species has found favorable conditions for its growth and reproduction along the French Atlantic coast. Maximum abundance of living individuals in September suggests a massive reproduction during summer, when water and superficial sediments at low tide are the warmest, reflecting the origin of the species from warmer climates, which seems to corroborate Mediterranean and/or tropical-subtropical origin. A survey of available literature to trace records of the species in muddy shallow habitats along the western coasts of Europe and Africa reveals that the species is unrecorded from Western Mediterranean Sea and is unknown in the Eastern Atlantic Ocean from Ivory Coast to Denmark, including the British Islands. The Marennes-Oléron Bay is Europe's largest production area for the Pacific oyster, which was introduced during the 1970's. The nearest major seaport handling international cargo is the Port de La Rochelle-Pallice, which is located north of the Marennes-Oléron Bay and east of the Ile de Ré. Shellfish industries and ballast waters discharged from ships have both led to numerous human mediated dispersal of non-indigenous species. This supports the hypothesis that the species has been accidentally introduced outside its natural range as a probable result of mariculture trade and/or shipping activities. This is the first report of a successful introduction of non-indigenous benthic foraminifera to the Atlantic coast of Europe.

Crustaceans

Several individuals of the oriental shrimp *Palaemon macrodactylus*, have been reported from 2 estuaries along the French Atlantic coast, Gironde estuary (45°20' ; 0°45') and Adour estuary (43°53'; 1°53') respectively in August 2006 and September 2006 (Beguer *et al*. 2007). Examinations of previous samples collected din Gironde estuary revealed one specimen in 1998 and several in 1999 and 2000. This species should have been present since 1998. Authors suspected ballast water as probable vector. Several ovigerous females were identified indicating that the population of *P. macrodactylus* might be established. This species could compete with local shrimp populations and consequently reduce the native species abundance. In spring 2007, *Palaemon macrodactylus* specimens have been collected in Charente estuary (45°55'47''N; 1°0'18''W – WGS 84, Google Earth – Modéran, thesis in progress, P.-G. Sauriau pers. Com.).

Molluscs

PROGIG, a French program on Pacific oyster (*Crassostrea gigas*) proliferation on the French Atlantic and Channel coasts: statement, dynamics, ecological and socio-economical consequences (contact : Christian Hily, University of West Brittany, European Institute of Marine Studies, Brest, Christian.Hily@univbrest. fr). Introduced in the early seventies in the main shellfish production areas, *Crassostrea gigas* established successfully and produced rapidly spatfall which settled outside the farms and constituted "natural populations" in many sites south the Loire estuary. In the nineties, this phenomenon extended to the North, along the Brittany and the Channel coasts. The objective of the PROGIG program is to evaluate consequences of this expansion in the natural ecosystems. Since 18 months, following results have been obtained:

1) The assessment of the sites concerned by proliferation in the natural environment on the French Atlantic coast of Brittany is partially done and integrated in a GIS. The whole coasts of Brittany were visited. Most of sites showed the presence of oysters even if the most opened and exposed sites showed low densities. The proliferation remains localized in sheltered bays and estuaries.

2) Twenty eight sites with permanent quadrats are currently monitored from Normandy to the Basque coasts to study dynamic of colonization. Spatfall settlement, growth, mortality of oysters and competition with other species are recorded.

3) The global warming appears as a facilitator factor regarding the reproduction of oysters. An adaptation of the species can also occur and natural selection of individuals is demonstrated at the local scale.

4) *C. gigas* settles preferentially on the intertidal areas. In subtidal areas this species occurs only in estuaries. The presence of oyster reefs, on rocky shores and on mud flats, increases the diversity of macrofaunal invertebrates at the local scale.

5) The study of impacts of the biological activities of *C. gigas* (filtration, biocalcification and biodeposition) on the ecosystem functioning is on the way.Firts results demonstrated that the role of biodeposits on the biogenic silicium cycle and further for the primary production of diatoms is important at the scale of the Bay of Brest ecosystem.

6) Socio-economical studies underline the negative impact of this proliferation on shellfish farming industry. Farmers spend time and money to clean

their gears. The presence of lots of oysters induces injuries for beach users. On the other hand, this situation allows large oyster gathering for recreational purposes.

7) Management options are understudied to limit the negative effect of this proliferation. Some local options will be tested in order to maintain some reference areas without wild oysters in some Special Areas of Conservation.

Pathogens:

Bonamia exitiosa was detected for the first time in July 2007 in Europe following mortality in a Spanish hatchery. This first occurrence was notified to the OIE in October 2007 after diagnostic confirmation (http://www.oie.int/wahid-prod/public.php?page=event_summary&reportid=6368) Infected flat oyster *Ostrea edulis* were cultured in hatchery troughs with imported seed.

No increase in mortality has been observed. No other susceptible species are cultured in this area. The origin of the infection is unknown and the epidemiological investigation was inconclusive.

Bonamia exitiosa is currently reported in flat oysters from New Zealand and Chile. Similar parasites were also reported from *Ostrea angasi* in Australia; *Ostrea puelchana* in San Antonio Bay, Argentina; *Ostrea equestris* in North Carolina, USA; and *Crassostrea ariakensis* experimentally introduced into North Carolina, USA. For additional information see http://www.pac.dfo-mpo.gc.ca/sci/shelldis/title_e.htm.

Meetings:

- Deuxièmes rencontres francophones Invasions Biologiques et Traits d'Histoire de Vie

Variabilité, plasticité et adaptation. Rennes, du 14 au 16 novembre 2007(http://www.inra.fr/colloque_invasions)

Three presentations and one poster were related to marine species:

Le Cam S. And Viard F. Relations entre dynamique de population et changement de sexe chez le gastéropode protandre invasif, *Crepidula fornicata*. 2ème rencontres francophones « Invasions biologiques et traits d'histoire de vie ***Variabilité, plasticité et adaptation*** ». Rennes, 14-16 novembre 2007.

Voisin M., Viard F. Influence de l'habitat et des pressions anthropiques sur la structure génétique de l'algue *Undaria pinnatifida*, cultivée et introduite en Bretagne. 2ème rencontres francophones « Invasions biologiques et traits d'histoire de vie ***Variabilité, plasticité et adaptation*** ». Rennes, 14-16 novembre 2007.

Stiger-Pouvreau V., Rohfristch A., Zubia M. et Payri C. Comparaison des traits d'histoire de vie de deux algues brunes *Sargassaceae* proliférant sur les récifs de Polynésie française. 2ème rencontres francophones « Invasions biologiques et traits d'histoire de vie ***Variabilité, plasticité et adaptation*** ». Rennes, 14-16 novembre 2007.

Rigal F., Comtet T., Viard F. Impact de la température sur la variabilité ede la durée de vie larvaire : implication dand la dynamique de l'espèce invasive *C. fornicata*. Poster. 2ème rencontres francophones « Invasions biologiques et traits d'histoire de vie ***Variabilité, plasticité et adaptation*** ». Rennes, 14-16 novembre 2007.

The proceedings of this conference are available at the following address:

(http://www.inra.fr/colloque_invasions/actes_et_presentations/documents)

- International conference on Marine Bioinvasions, Cambridge (MA), USA, May 21-24, 2007.

Hily C., Lejart M., Miossec L. The invasion of the Atlantic and Channel coasts of France by the alien oyster, Crassostrea gigas: assessment, causes, ecological and socioeconomical consequences – The PROGIG research program. Poster, International Conference on Marine Bioinvasions, Cambridge (MA), USA, May 21-24, 2007.

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Miossec, L., Goulletquer, Ph. The Pacific cupped oyster *Crassostrea gigas :* a species introduced in Europe for aquaculture in the 70's to become invasive in the late 90's. Communication International Conference on Marine Bioinvasions, Cambridge (MA), USA, May 21-24, 2007.

Voisin M., Viard F. Populations of the introduced alga *Undaria pinnatifida* suffering different anthropogenic pressures display dissimilar genetic properties. Communication International Conference on Marine Bioinvasions, Cambridge (MA), USA, May 21-24, 2007.

10th International Conference on Shellfish Restauration (ICSR) 2007 November 12-16, Vlissingen, The Netherlands.

Hily Ch., Lejard M. Ecological consequences of the Pacific oyster (*Crassostrea gigas*) invasion on coastal habitats in Western Europe. Communication, 10th International Conference on Shellfish Restauration (ICSR) 2007 November 12-16, Vlissingen, The Netherlands.

Meisterzheim A., Le Goïc N., Marhic A., Tartu C., Boudry P., Thébault M. Adaptation capacities of an invasive species, the Pacific oyster *Crassostrea gigas*, along the French Atlantic ocean coasts. Communication, 10th International Conference on Shellfish Restauration (ICSR) 2007 November 12-16, Vlissingen, The Netherlands.

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Nezan, E., N. Chomerat, M.P. Crassous, and E. Antoine. 2007. Identification of *Pseudonitzschia multistriata* and *P. subpacifica* from French waters. Were they part of the cryptic flora? Harmful Algae News No. 35, p. 5-6.

The final report on the INVABIO program, coordinated by Guy Bachelet (CNRS, university of Bordeaux) and funded by the French Ministry of Environment (2001-2004) is available online in French at the following address

Germany.

Report prepared by Stephan Gollasch and Manfred Rolke

A. Transport vectors:

Ballast Water Exchange in Europe

The Contracting Parties of HELCOM and OSPAR consider to require a voluntary interim application of the D-1 Ballast Water Exchange Standard in the North-East Atlantic and the Baltic Sea. The D-1 Standard requires at least 95% volumetric ballast exchange (empty/refill) or when using the pump though method - pumping through three times the volume of each tank. All ballast tanks should be exchanged at least 200 nautical miles from the nearest land in water at least 200 metres deep. If this is impossible the exchange should be undertaken as far from the nearest land as possible, and in all cases in waters at least 50 nautical miles from the nearest land and at water depths of at least 200 metres. Provided this approach is agreed, the target application date for this requirement is within the next 12 months.

Ballast Water treatment.

Onboard tests of ballast water treatment systems developed by German vendors are ongoing. The tests are carried out according to IMO guidelines. One vendor completed the ship-board tests, another is planning those tests to start soon. Several other vendors are in a preparational stage. The Federal Maritime and Hydrographic Agency is responsible for the type approval of ballast water treatment systems in Germany and is currently carrying out several approval procedures. The first German system to receive Final Approval from IMO, a prerequisite for issuance of a type approval, is likely the system developed by the Hamann AG. The treatment system includes a mechanical separation (hydrocyclone and 50 µm filtration) to be followed by the injection of a chemical (Peraclean® Ocean).

Hull fouling. No new measures beyond the AFS convention have been suggested.

Germany follows with interest the hull fouling discussions at IMO.

B – Occurrence of new ship-mediated aliens.

The first record of *Hemigrapsus penicillatus* in Europe was in 1993 during the German Shipping Study in hull fouling samples of a commercial vessel in Bremerhaven (Gollasch 1999[1]). In 1994 it was found in the Bay of Biscay (France) and since 1996 also in

[1] Gollasch S (1999) The Asian decapod *Hemigrapsus penicillatus* (de Haan, 1833) (Decapoda, Grapsidae) introduced in European waters, status quo and future perspective. Helgol Meeresunters 52: 359-366

Spain. The species spread further and was in 1997 found in Le Havre (France). Dutch records are reported since 2000 in the Oosterschelde estuary and later also from the Westerschelde (D´Udekem d´Acoz and Faasse 2002[2]). *H. penicillatus*. was found in 2007 for the first time in German waters along the coast of the southwestern Wadden Sea (Gehrmann et al. 2007[3], Markert & Wehrmann in prep.[4]). Other studies in 2007 also documented the presence of *H. takanoi* and *H. sanguineus* from the area (Obert et al. 2007[5]). *H. takanoi* is supposed to be a sibling form of *H. penicillatus* who is also known to compete with larger decapods (D´Udekem d´Acoz and Faasse 2002).

A new German record for *Hemigrapsus* cf. *penicillatus*, not shown on the map below, was made later in 2007 for Büsum (north of the Elbe river estuary) and the German Wadden Sea island Amrum (Borcherding pers. com).

Flyers were released to inform the public of this newly arrived invader also asking to report findings.

Please also consult the 2008 German National Report to WGITMO for further details.

F. Other relevant information.

In Germany the national marine monitoring fulfils the requirements of the Marine Conventions (OSPAR and HELCOM). Traditionally the monitoring focusses on the effects of pollutants to be able to assess the state of the marine environment. New requirements e.g. the inclusion of biodiversity aspects in the marine conventions, the EU Water Framework Directive and the upcoming EU Marine Strategy Framework Directive are the reason for a revision of the national marine monitoring. In this connection the issue of alien species will be given more importance in the monitoring.

The next meeting of the EU funded Project "Sustainable Ballast Water Management Plant" (BaWaPla) will be held in mid May 2008.

The IMO Marine Environment Protection Committee will hold its 57th meeting from March 31 to April 4th at the International Maritime Organization (IMO) headquarters in London. At this meeting the findings of the recent sub-committee meeting of the Bulk, Liquid and Gases (BLG) group will also be discussed. Of key interest to ICES may be the current development of the Ballast Water Sampling Guideline (G2) for compliance control with the standards as set forth in the IMO Ballast Water Management Convention.

As reported last year Germany continues to be active in the relevant working group of the IMO.

On a biannual basis Singapore runs a meeting on ballast water treatment systems. This year the 4th International Conference and Exhibition on Ballast Water Management (ICBWM) meeting is to be held October 16-17.

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[2] D´Udekem d´Acoz C, Faasse M (2002) De huidige status van *Hemigrapsus sanguineus* (de Haan, 1835) en *H. penicillatus* (de Haan, 1835) in de noordelijke Atlantische Oceaan, in het bijzonder in Nederland, met opmerkingen over hun biologie (Crustacea, Decapoda, Brachyura). Het Zeepaard 62(4): 101-115

[3] http://www.nordseefauna.de/Brachyura_Trox.htm, assessed March 4th 2008

[4] Markert. A & Wehrmann, A. (in prep.) The Asian crab *Hemigrapsus penicillatus* (de Haan 1835) invades new established Pacific oyster reefs in the Wadden Sea, German Bight (North Sea).

[5] Obert B, Herlyn M, Grotjahn M (2007) First Records of two crabs from the North West Pacific *Hemigrapsus sanguineus* and *H. takanoi* at the coast of Lower Saxony, Germany. Waddensea Newsl 33: 21-22

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Norway.

Report prepared by Anders Jelmert, Institute of Marine Research. Flødevigen N-4817 His

A. Transport vectors.

Ballast water. No scientific studies on BW biota as such.

Collection of data on traffic, frequency, BW volumes, and ships' last port of call, etc, for report on ballast water exchange zones (Dragsund *et al*. 2007)

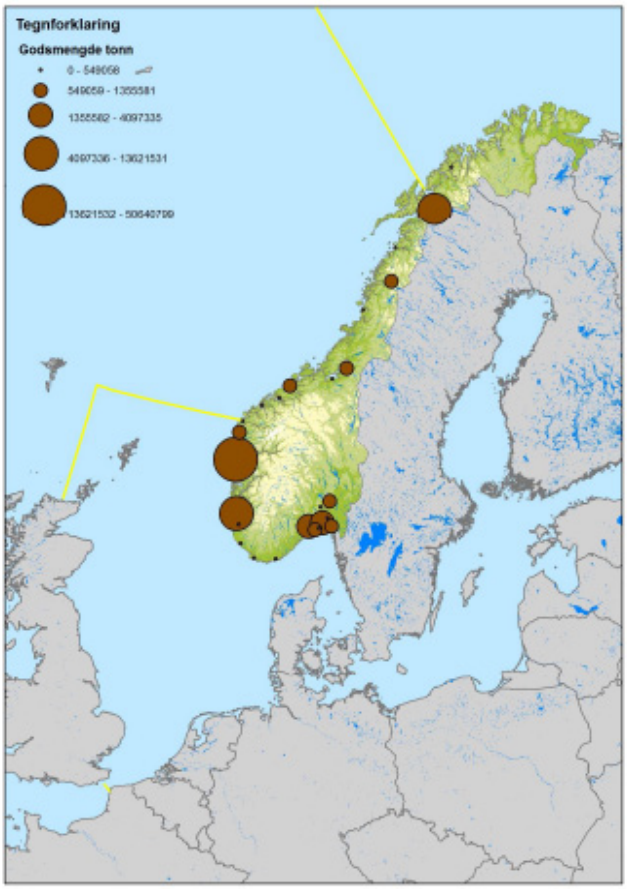

Figure 1. Cargo volume exported from Norwegian harbours in 2006. A rough indicator of volumes of BW import. Yellow lines indicate suggested OSPARCOM bioregion borders. (From Figure 5.2 in Dragsund et al, 2007).

Considering the time needed to complete the Ballast Water exchange according to D-1 standard, a typical vessel entering Norwegian waters will need from 1000 - 2000 km. This is basically not possible to accomplish within normal sailing routes within Norwegian territorial waters.

If partial fulfilment of D-1 were considered to be a risk reducing action, a number of possible areas have been identified:

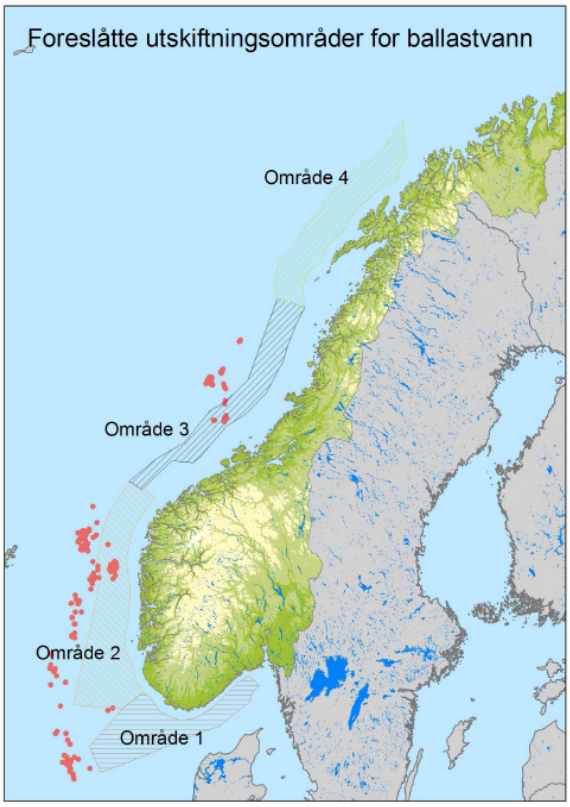

Figure 2. Suggested areas for BW exchange. Area 1 is delimited by Norwegian EEZ towards Denmark. Red dots are permanent oilfield installations. (From Figure 8.1. Dragsund *et al*, 2007).

The presence of the Snow crab in the Barents Sea has been attributed to ballast water (V. Kuzmin PINRO). However, DNA fingerprinting of specimen from the Norwegian and Russian waters were significantly different from specimen in NW Atlantic origin (K. Jørstad, IMR, pers. comm.). The further spread of the red king crab and the snow crab is tabulated in the report to WGITMO.

Ballast Water treatment. Two BW treatment systems are in the process of type approval testing and shipboard testing will commence. Manufacturer: "Ocean Saver" TM. And "Optimarin" TM. Test Facilities: Ballast-Tech NIVA (see below)

Ballast water sampling. No new scientific studies launched. A test facility for type approval of BW treatment systems have been established in accordance with the guidelines for approval of BWM systems (G8). Ballast-Tech NIVA:

http://www.niva.no/symfoni/infoportal/PUBLIKASJON.NSF/redirectEng?ReadForm&Url=http://www.niva.no/symfoni/infoportal/PUBLIKASJON.NSF/.vieEngInterForsideNIVA/FC4979404066E770C125729D0050FCE8?OpenDocument

Hull fouling. No new measures beyond the AFS convention have been suggested.

Other ship Vectors. Nothing to report

C. Invasive species management:

Eradication programmes: Nothing to report for shipping as vector.

Management and control of introduced species. A decimation fishery for the red king crab with no quotas limits has been initiated west of "Cape North" (W of 26 E). Reported to WGITMO

Impact of invaders. The previously reported harmful algae *Chattonella cfr verruculosa* has been closely examined and important new information has emerged. The algae has been transferred to a new genus and renamed. The Norwegian strains are not similar to previously collected strains from Japan. (It is likely that also the Japanese strains should be transferred to the new genus (L. Naustvoll, IMR, Pers. comm.)). This alga is likely of European origin and has been overlooked in the samples and some museum material (L. Naustvoll, IMR, pers. Comm.).

The American lobed comb jellyfish *Mnemiopsis leidyi* has been present in the plankton more or less throughout the year. No exceptional blooms has been observed, but the persistent presence is considered worrying.

Risk Assessment approaches. A Norwegian "species databank" has been established and staffed. Its first task: a thorough revision of the "red list" was finalised autumn 2006, and a revised alien database including a risk assessment has been developed. The list was published may, 2007. The alien list also includes selected "fact sheets". (http://www.artsdatabanken.no/ThemePage.aspx?m=148&amid=2312)

In total, 40 marine or brackish species have been evaluated.

D. Occurrence of new ship-mediated aliens.

First report of the Japanese red alga *Antithamnion nipponicum* (Ceramiales, Rhodophyta) in western Norway, (Ruenes *et al*, 2007). While it is difficult to determine exact vector, shipping is the most likely transporatioin means. From its native range in Japan and Korea, it was introduced to the Mediterranean in the eighties. Except a possible report from the Azores, there are no other published records for European waters (Rueness et al., op. cit.).

F. Other relevant information.

Proactive measures. A report (Gap analysis) on how to implement and coordinate existing research activity to facilitate a better and more effective mapping and monitoring of marine introduced species have been commissioned (Directorate for Nature Management and Directorate for Fisheries).

Preparatory work for developing by-laws for the implementation of the Ballast Water Convention has been made. In particular, a study on possible areas for ballast water exchange has been finalised (Dragsund et al., 2007).

G. References.

http://www.artsdatabanken.no/ThemePage.aspx?m=148&amid=2312

Dragsund, E., Botnen, H. Jelmert, A. and Hackett, B. 2007. Utredning av områder for utskifting av ballastvann (in Norwegian) DN report 2007 -0324

http://www.dirnat.no/content.ap?thisId=500028164 choose hypertext "Svar på oppdrag"

Edvardsen, B., Eikrem, W., Shalchian-Tabrizi, K., Riisberg, I., Johnsen, G., Naustvoll, L. and Throndsen, J., 2007. *Verrucophora farcimen* gen. et sp. nov. (Dictyochophyceae, heterokonta) – A bloom forming ichthyotoxic flagellate from the Skagerrak, Norway.

Journal of Phycology, **43, Number 5**, pp. 1054-1070

Rueness J, E Heggøy, V Husa & K Sjøtun 2007. First report of the Japanese red alga *Antithamnion nipponicum* (Ceramiales, Rhodophyta) in Norway, an invasive species new to northern Europe. Aquatic Invasions 2: 431-434

Spain

Report prepared by Jesus Cabal. Instituto Español de Oceanografía. Centro Oceanográfico de Gijón.

Studies of Invasive Alien species in Spain will be developed in the next years because there were important issues involved in this matter with the Law 45/2007 of Natural Heritage and Biodiversity. Furthermore, Ministry of Environmental have been supported the "European Conference on Invasive Alien Species" in January 2008, so research based in alien species will be promoted from the National Science Foundation programmed by the Government.

Regulations

In 2007 there was a new national Law related to Invasive Alien Species. The Law 45/2007 of Natural Heritage and Biodiversity, on the 13 of December, .In this Law, the Title III is related to Conservation of Biodiversity, and his Chapter III has mentioned the prevention and control of invasive alien species The Article 61 indicated that it is necessary the creation of a catalogue the Invasive Alien Species.

Projects

Non-Native species of Plankton at the Port of Gijón (Biscay Bay). OVAL.

Host Institute: Instituto Español de Oceanografía. Centro Oceanográfico de Gijón.

Coordinator: Jesús Cabal. Project duration: 2006-2009

Key Objectives:

- Identification on zooplankton species in the coastal area at the Port of Gijón. The main goal is generate a baseline dataset on the zooplankton species in the study area
- Zooplankton species in the ballast water by cargo´s ship at the Gijón Port. Sampling the ballast water of the ships . Port of Gijon is located in the south of Bay of Biscay, a temperate sea, and more of the ship traffic is also with port located in temperate seas, so the risk of introduction of species with similar ecological characterised is high. No research on BW treatment was permitted.

New recorded species

In the last years more alien species were recollected. Some information is from 2005, but until now we do not have been information about them. The list of new alien marine species is the Table I.

Table I. First records from Spain (2007)

Genus	Species	Common n:	Locality	Latitude	longtitude	comments	date	Reference
Rapana	*venosa*	mollusca	Cambados	42º31´433"	8º50´524"	present	2007	Rolan and Bañon, 2007
Crepipatella	dilatata	mollusca	Muelle Aldán (Ponte	42º27´26´´	8º55´06´´	frequent	2005	Rolán and Horro 2005
Branchiomm	Luctuosum	Polychaeta	Valencia Port	39º25´58"	0º18´53"	present	2007	El Haddad et al. , 2007
Branchiomm	Luctuosum	Polychaeta	Cullera	39º19´11"	0º14´06"	present	2005	El Haddad et al. , 2007
Branchiomm	Luctuosum	Polychaeta	Vinaroz	40º28´15"	0º28´28"	present	2006	El Haddad et al. , 2007
Branchiomm	Luctuosum	Polychaeta	Portitxol port (Balea	39º 33´34"	2º40´07"	present	2006	El Haddad et al. , 2007

Meetings

"European Conference on Invasive Alien Species". This Conference was celebrated in Madrid from 15 to 16 of January. This conference provides stakeholders with an opportunity to meet and exchange knowledge on the issues involved in this matter. The Conference will be attended by around 250 participants: representatives from governments and international organizations, experts in species and trade issues, networks and NGO. Further information in http:// www.fundacion-biodiversidad.info/eei/.

References and bibliography

El Haddad, M., Capaccioni Azzati, R., and. García-Carrascosa, A.M. 2007. Branchiomma luctuosum (Polychaeta:Sabellidae): a non-indigenous species at Valencia Port (western Mediterranean Sea, Spain). JMBA Biodiversity Records 1-8.

Rolán, E, and Bañon Diza, R. 2007. Primer hallazgo de la especie invasora Rapana venosa y nueva información sobre Hexaplex trunculus (Gastropoda: Muricida) en Galicia. Noticiario SEM 47: 57-59.

Rolán, E., and Horro, J. 2005. Crepipatella dilatata (Gastropoda, Calyptraeidae) nueva especie introducida en aguas gallegas. Noticiario SEM, 44: 60-63.

Other publications related to marine alien species in Spain are:

Graci, M.E., Trigo, J.E., Pascual, S., González, A.F., Rocha, F, and Guerra, A. 2007. Xenostrobus securis (Lammarck, 1819) (Mollusca: Bivalvia): first report of an introduced species in Galician waters. Aquacult. Int. 15: 19-24

Capdevila, L., Iglesias, A., Orueta, J. and Zilleti, B. 2006. Especies exóticas invasoras: Diagnóstico y bases para la prevención y el manejo. . Organismo autónomo Parques nacionales Ministerio de Medio Ambiente. 287 pp.

SWEDEN

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A Transport Vectors

1 Ballast Water

The Swedish EPA together with the Swedish Maritime Administration have asked the Swedish Meterological and Hydrological Institute (SMHI) to conduct modelling studies of any prospect of designating Ballast Water Exchange areas in the Baltic proper or in the Skagerrak and the Norwegian Trench (Andersson 2007 a,b, see also WGBOSV 2007). The results showed

that establishment of designated areas for ballast water exchange within the Exclusive Economic Zone of Sweden (EEZ) is not advisable, since the time for the exchanged water to reach protected areas or fish and mussel farms is too short (one day – one week). These results have also been included in the Ballast Water Management Inquiry as a basis for a suggested reservation, when Sweden accedes the Ballast Water Management Convention (see A 1.4).

1.2 Ballast Water Treatment

The Swedish company Alfa Laval Tumba AB has developed the treatment system PureBallast in cooperation with Wallenius Water. The system and active substances were approved in 2007, first Basic approval for land-based tests (carried out at NIVA in Norway) and then Final approval for tests on board ships, so far with tree units installed (Lloyd's Register 2007). The system uses both self-cleaning filters to limit the intake of organisms and sediment at ballasting and is then treated by a patented Benrad AOT unit in which UV-light and TiO_2 produces oxygen radicals, killing the organisms. Treatment and filtering also occurs at deballasting (www.alfalaval.com). The PureBallast system has also received the Swedish WWF's Baltic Leadership Award (www.alfalaval.com).

1.3 Ballast Water Legislation/Regulations

A Ballast Water Management Inquiry (SOU 2008:1), accounting for the prerequisites for Sweden to accede to the International Convention for the Control and Management of Ships' Ballast Water and Sediments (the Ballast Water Management Convention) was handed over to the Swedish Government in January 2008.

It is the opinion of the Ballast Water Management Inquiry that Sweden should accede to the Ballast Water Management Convention as soon as the adequate prerequisites exist. This would also contribute to a fulfilment of the international commitments of Sweden. Within the framework of the Convention on the Protection of the Marine Environment in the Baltic Area (the Helsinki Convention) and the Convention for the Protection of the Environment of the North-East Atlantic (OSPAR), work is in progress to promote the accession of the member states to the Ballast Water Management Convention. A Directive on a marine strategy, aiming at a good environmental status in the seas of the EU in 2020, at the latest, has been adopted by the European Parliament and the Council of Ministers in December, 2007. For any possibilities to designate Ballast Water Exchange areas, see A 1.

Thus the Inquiry suggests that Sweden should accede to the Ballast Water Management Convention and, in this connection, register a reservation that Sweden, for geographical, hydrographical and hydrological reasons, will not be able to fully comply with the stipulations of the Convention as regards to ballast water exchange in all ships to which the Convention will be applicable. However, this reservation will be in force for a limited period of time. As from the year 2016 Sweden will be in a position to comply fully with the stipulations of the Convention as regards ballast water management.

The Inquiry furthermore proposes the Swedish Maritime Administration (SMA) to be assigned the task to implement great parts of the Ballast Water Management Convention regulations and to supervise the ships' compliance

with the regulations. Up till the time when ships are obliged to have approved management systems on board, ballast water exchange should be conducted, where this can be performed pursuant to the regulations of the Convention. Sediment reception facilities should be established in places where cleaning or repair of ballast tanks occur, as decided by the SMA. It is also proposed that the Swedish Meteorological and Hydrological Institute (SMHI) should be commissioned to issue warnings against ballast water intake in certain areas.

2.1 Biology of Hull Fouling

"New Marine Paint" is a multidisciplinary research programme funded by The Foundation for Strategic Environmental Research – Mistra until 2010, carried out at University of Gothenburg and Chalmers University of Technology, both in Göteborg. (See also WGBOSV 2007). It aims at developing new and effective marine antifouling paints, which are more environmentally friendly than those in use today. Also, focus is on predictive methods for analysing mixture toxicity at the community level and to exploit and to use ecotoxicological and risk assessment skills proactively, to help designing new antifouling coatings. Traditionally, risk and hazard assessment approaches generally have simplified the situation: the effects of individual substances are determined in single species studies after a pre-defined, constant exposure. However, mostly chemical mixtures are used, and one major aim is the development of appropriate modelling approaches and tools. In that context they are currently investigating the joint action of substances as antifoulants on microalgal and bacterial communities to achieve an efficient paint with low risks. Risk assessments are based on concepts from pharmaceutical studies.

Another approach of the programme, carried out within the field of applied surface chemistry, is to be able to control the release from the paint of the new, environmentally benign substances that has been found to be able to prevent settling of barnacles without damaging other organisms.

2.4 Hull Fouling Legislation/Regulations

In Sweden, as for all other EU member countries, following the Directive 782/2003, it is since January 2008 a ban on using organic tin compounds as biocides on ship's hulls, unless the ship hull has a cover preventing leakage of these substances. Sweden has ratified the IMO Antifouling Convention, which will come into force in September 2008.

D New Introduced Species

Two new species were detected on the Swedish west coast during 2007. However, both are most probably secondary introductions from Denmark through drifting larvae or seeds (the grass seeds might even have been brought by birds), although transport by ballast cannot be completely ruled out.

Large numbers of the Japanese oyster *Crassostrea gigas*, < 1 year old, were reported from the Swedish west coast in summer 2007 within an area almost 300 km long, from close to the Norwegian border and down to the city of Falkenberg (ca 56°54' N, 12°30' E), province of Halland. In the north densities were > 400 ind. m^{-2}, while being less dense further south (Susanne Lindegarth, Univ. of Gothenburg, pers. comm.). Although some specimens from Wales had been introduced during 1973-76, it is be-

lieved these originate from newly introduced spat from populations in Denmark or Germany, probably having had good growth conditions due to the mild winter and spring 2007. One record at the Tjärnö Marine Biological Laboratory (58°52' N, 11°06'E) was from a boat motor, which had been hanging in the water since October 2006, thus these specimens were younger than 1 year.

The saltmarsh grass *Spartina anglica* was detected as an isolated population on the island of Rörö (56°47.5' N, 11°36.2' E) in the northern archipelago of Göteborg in summer 2007 (Ferm 2007). This first record for Sweden consists of a population of around 7 m^2, probably having been there for some years, but did not exist there in the mid 1990s. The nearest area, where it occurs, is on the Danish island of Læsø, in the northern Kattegat, ca 70 km southwest of the Swedish site.

F Other Relevant Information

There is no monitoring specifically designed for alien species in Swedish waters, despite previous suggestions on monitoring harbours and/or protected areas. Nor have to my knowledge any harbour baseline studies been performed, although a small project surveyed eight marinas and nearby shorelines on the Swedish west coast for epilithic and/or fouling alien species (see WGBOSV 2006).

6. References and bibliography

Andersson P (2007a) Ballast Water Exchange areas - Prospect of designating BWE areas in the Baltic Proper. Oceanography Series Report 85, SMHI, Göteborg, 80 pp.

(available at http://www.smhi.se/sgn0106/if/biblioteket/rapporter/o.htm#2007)

Andersson P (2007b) Ballast Water Exchange areas - Prospect of designating BWE areas in the Skagerrak and the Norwegian Trench. Oceanography Series Report 88, SMHI, Göteborg, 68 pp.

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Ferm L (2007) Spartina anglica found in Sweden. Svensk Botanisk Tidskrift 101: 306-308

(In Swedish with English abstract and legends)

Lloyd's Register (2007) Ballast Water Treatment Technology – Current status. Lloyd's, London, 28 pp.

SOU (2008) Barlastvattenkonventionen – om Sveriges anslutning. Betänkande av Barlastvattenutredningen. Statens Offentliga Utredningar, 2008:1, Stockholm 226 pp. (In Swedish with English summary)

(available at http://www.sjofartsverket.se/templates/SFVXPage____4288.aspx)

United Kingdom

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Transport Vectors

Ballast. The Maritime and Coastguard Agency (MCA) has issued a Marine Information Notice (MIN 305) regarding The Control and Management of Ships' Ballast Water and Sediments, which provides information and interim guidance for use until the Convention has been implemented. The MCA has also been involved in a project to develop OSPAR/HELCOM General Guidance on the Voluntary Interim Application of the D1 Ballast Water Exchange Standard in the North-East Atlantic. These have now been finalised and accepted by all of the Contracting Parties to the OSPAR and HELCOM Conventions. They are due to be sent to IMO in a joint letter by the OSPAR and HELCOM Secretariats imminently, with the entry into force date of 1st April 2008.

Newcastle University is a partner in an EU funded project known as BaWaPla, which aims to develop a new hybrid BW treatment technology (UV, filters and electrolysis) into a self-controlled BW treatment system. The main objective of the project is the invention of an effective treatment technology incorporating non permanent, sea-water-generated active substances as a necessary additional measure to UV and Filter treatment technology. By producing active substances through electrolysis of sea water, there will be no need to carry or store hazardous and corrosive chemicals on-board ships. It also represents a more economical alternative to using chemicals for treating large volume of ballast water onboard ships. This project will also install the proposed treatment system onboard a ship and will conduct onboard tests.

BaWaPla started in November 2006 and is funded for 3 years. It has 12 partners, of which 3 are from the UK, 3 from Germany and 1 each from Spain, Israel, Turkey, France and Portugal.

Hull fouling. Fisheries Research Services (Marine Laboratory, Aberdeen) are partners in a project (Marine Aliens II), funded by the Esmée Fairbairn Foundation, which has the following objectives:

- to quantify the risk from two high risk anthropogenic vectors; hull fouling on commercial and recreational vessels and unintentional aquaculture escapes,
- to assess the effectiveness of various monitoring and control mechanisms in minimising colonisation and spread of invasive marine species and their associated parasites and hence reduce the impact on native marine biodiversity; and
- inform management/ eradication programs.

The project will be starting in April 2008 and will run for three years. It is also hoped that a larger, related project on hull fouling will obtain funding and run in parallel with this work.

G References

McCollin, T., Quilez-Badia, G., Josefsen, K., Vordachas, T., Gill, M., Mesbahi, E. and Frid, C. (2007) Ship board testing of deoxygenation ballast water treatment. *Marine Pollution Bulletin* 54, 1170-1178.

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McCollin, T., Shanks, A.M. and Dunn, J. (2007) The efficiency of regional ballast water exchange: Changes in phytoplankton abundance and diversity. *Harmful Algae* **6,** 531-546

Quilez-Badia, G., McCollin, T., Josefsen, K.D., Vourdachas, T., Gill, M., Mesbahi, E. and Frid, C. (2008) On board short-time high temperature heat treatment of ballast water: a field trial under operational conditions. *Marine Pollution Bulletin* 56, 127-135.

Annex 3 – National reports 2009

Canada

Report prepared by Nathalie Simard, Fisheries and Oceans Canada, Maurice Lamontagne Institute, 850 Route de la mer, P.O. Box 1000, Mont-Joli (Quebec), G5H 3Z4, Canada

A. Transport vectors:

1. Ballast Water

Canadian Aquatic Invasive Species Network (CAISN) (on going)

Contact: Hugh MacIsaac (lead research scientist), University of Windsor

The Canadian Aquatic Invasive Species Network (CAISN) is a national group of specialists created with the goal of predicting and preventing new aquatic invasive species (AIS) from entering Canada, determining factors that affect successful colonization by AIS, and modelling the invasion process for both potential and existing AIS. CAISN studies will increase understanding of the invasion process, train personnel to prevent future invasions and minimize spread of AIS already established in our lakes and coastal marine ecosystems. The research objectives for CAISN are directed at three theme areas:

Theme 1: Vectors and Pathways

- identification and quantification of primary and secondary pathways that transmit AIS to and within Canada, and determination of the relationship between propagule supply and invasion success

Theme 2: Factors Affecting Establishment Success

- assessment of the physical, chemical and biological factors that affect establishment success of AIS

Theme 3: Risk Assessment Modelling

- develop risk assessment models to predict which species are most likely to invade, where they will invade, and the relative importance of human vs. natural dispersal

CAISN uses a combination of four types of studies to investigate these themes across and within Canada's coastal and inland lake ecosystems:

- large-scale synoptic surveys
- smaller-scale intensive surveys
- lab and field experiments; and
- modelling

Studies began with broad geographic coverage, allowing for identification of large scale patterns of AIS and native species distributions. These studies are essential as a benchmark for establishing the complement of species present and for modelling purposes. Intensive studies at a finer geographic scale allow CAISN to identify the mechanisms that limit or enhance invasion success. These mechanisms are formally tested using a more limited set of lab or field experiments. Lastly, modelling exercises

are used to forecast which areas are most vulnerable to new AIS invasions, the species with the best opportunities to establish, the mechanisms most likely to contribute to new invasions, and possible intervention strategies to reduce risk of new invasions.

A variety of projects that address the subject of shipping as a vector and pathway for the introduction of aquatic exotic species (AES) are being done within CAISN, a joint research network with funding largely from the Natural Science and Engineering Research Council (NSERC) and Fisheries and Oceans Canada (DFO) with PIs from a number of universities and DFO research Institutes. This is being done using a hierarchical approach to better understand the *potential*, *actual*, and *effective propagule pressure* related to shipping.

These three levels are here defined as 1) the potential introduction of exotic species based on ship characteristics (ship size, volume of ballast water released), as a proxy for direct sampling of propagules, 2) the number and identity of propagules that may be released, as determined by direct sampling, and 3) the number of propagules that are released that may actually survive and grow after their release in the receiving areas. *Potential propagule pressure* is being estimated through the development of a comprehensive and searchable geo-referenced database of shipping activity, including deballasting information, for both the east and west coasts of Canada. This database was developed largely through DFO and in collaboration with Transport Canada (TC) and is now warehoused by TC. The data are currently being analysed for shipping traffic and deballasting patterns. *Actual propagule pressure* is being examined through two large projects and a related third project. The first examines the abundance and identity of viruses, bacteria, phytoplankton (dinoflagellates and diatoms) and zooplankton in ballast water and sediments in ships on both the Atlantic and Pacific coasts of Canada with 3 classes of ballast: i) exchanged ballast water from transoceanic ships; ii) exchanged ballast water from ships from the USA; and iii) unexchanged ballast water from ships from the USA. Ships are also being sampled in the Great Lakes (BOB ships) but only ships in the first category will be targeted. A total of 20 ships will be sampled for each of these 7 classes of ships for each type of sample (i.e., water and sediment samples). Almost all the samples have been sampled to date. There are a large number of graduate students and postdoctoral fellows working on these projects.

The second project targets bacteria, phytoplankton and zooplankton in ballast water and documents the change in the structure of these communities throughout transoceanic cruises. Work on this concentrated on trans-Pacific voyages in 2007 and on trans-Atlantic voyages in 2008. The third project is examining the communities of organisms fouling commercial ships and is being led by a postdoctoral fellow. This is being done by hiring commercial divers to sample ships opportunistically on both coasts as well as in the Great Lakes. *Effective propagule pressure* is being examined through two projects. The first will evaluate the survivorship and growth of a number of representative species found in ballast arriving in Canadian ports under conditions that they will have to endure once introduced (i.e., temperature, salinity, nutrients). This information will be used to develop port-specific lists of potential invaders. The second project is evaluating the relationship between the various levels of propagule pressure that have been evaluated and the load of AES in ports on both the east and west coasts. West Coast ports were sampled in 2007 and East Coast ports were sampled in 2008. Port sampling is targeting fouling communities, benthic communities, intertidal communities, and dinoflagellates (cysts in bottom sediments). Finally, data from these various studies will be used to construct population viability analysis models to estimate invasion risk.

2. Ballast Water treatment

No Invasive Species OnBoard (NISOB) (final report completed)

Contact: Nathalie Simard, Fisheries and Oceans Canada

The NISOB project is an innovative collaboration and partnering amongst the private sector (MD Technologies and Degussa (now Evonik)) and in academic (the University of Quebec at Rimouski), not-for-profit organizations as Maritime Innovation and the Marine Biotechnology Research Centre (MBRC) and the federal government (Fisheries and Oceans Canada).

Laboratory and onboard tests of ballast water treatment systems developed by Degussa (Peraclean® Ocean) and MDTech (Ballaclean) were realized. Three transatlantic voyages have been conducted onboard a general cargo to test the efficiency of Peraclean® Ocean in operational conditions. The tests were carried out according to IMO guidelines.

Final report: Bourgeois, M, N Simard, S Cartier, D Hamel, S Roy and A Rochon. 2008. Test of Paraclean Ocean as an Active Substance for shipboard treatment of ballast waters on three transatlantic voyages from the North Sea (Europe) to the marine St. Lawrence System (North America).

Ballast Water Monitoring Program (2009-2010)

Host institute: Fisheries and Oceans Canada, in partnership with Transport Canada and the University of Windsor

Contact: Sarah Bailey, Research Scientist, Fisheries and Oceans Canada, 867 Lakeshore Road, Burlington, ON, L7R 4A6, Canada. Email: sarah.bailey@dfo-mpo.gc.ca

Evaluation of NaCl brine as a treatment solution for the control of aquatic nonindigenous species introductions by ballast water

The objective of this project is to evaluate the use of sodium chloride (NaCl) brine as an immediately available treatment practice for ships unable to comply with current ballast water management regulations. Laboratory studies have been conducted to determine the toxicity of NaCl brine on freshwater and marine organisms at two temperatures. Results indicate that NaCl brine may be highly protective against both freshwater and marine invertebrate taxa in ballast water. Future research plans include shipboard brine studies on operational commercial trade vessels in the Great Lakes.

Tool Development

This part of the monitoring program will work to develop methodologies to evaluate ballast water treatment technologies – primarily looking at tools for rapid assessment of plankton density and viability. Most of this work will involve lab testing of a high resolution laser optical plankton counter and a FlowCAM (equipment purchased with Transport Canada and AIS monitoring funds in 2008).

3. Hull fouling

See CAISN description.

Sea-chests as a Potential Vector for Aquatic Invasive Species along Canadian Coasts (2007-2010)

Contact: Nathalie Simard, Fisheries and Oceans Canada

The primary goal of this national program 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. Although the possible transfer of AIS in sea-chests has been suggested, there has been limited research directed at quantifying the propagule pressure or potential risks associated with this vector. Much recent research has focused either on ballast water/sediments and hull fouling. However, a ship's sea-chest may be an equally important location that may harbour potential AIS. In fact, for many fragile species with short-lived free-living stages, such as the suite of invasive tunicates plaguing both coasts at this time, this may be the major vector for introduction via shipping. Until the strength of this vector is assessed both locally and nationally, the risks associated with the potential transfer of AIS via sea-chests will remain unknown. Once the importance of this potential vector has been quantified it can be ranked with other vectors within an overall risk assessment framework. For example, how do sea-chests rank relative to ballast water, ballast sediment or external hull fouling? Until now, 34 ships have been sampled in dry dock facilities (Halifax, Vancouver and Les Mechins).

Question 1: Do seachests serve as an important vector for transporting aquatic species in Canadian waters?

Question 2: Do seachests, by introducing non-indigenous species or facilitating the dispersal of native species, pose a risk to Canadian waters?

Small craft traffic as a vector for aquatic invasive species (AIS) dispersal Pacific and Atlantic Canada and the Great Lakes (2008-2010)

Contact: Tom Therriault, Fisheries and Oceans Canada

The proposed study will identify the potential risk of dispersal by aquatic invasive species (AIS) associated with small crafts (recreational boaters) along the both Canadian coast lines and within the Great Lakes basin. While ongoing ballast water and hull fouling studies are investigating the potential of commercial vessels to spread AIS along our coastlines and within the Great Lakes, we know very little about the risk associated with recreational boating. Whereas large commercial vessels have the potential to introduce AIS across Oceans into a limited number of commercial ports, small recreational vessels can spread these species to a large number of widely distributed locations, including anchorages in remote areas. An additional concern is the potential to carry AIS from heavily invaded areas like San Francisco Bay to BC waters, or species like *Didemnum vexillum* from east coast US waters into Atlantic Canada. The understanding of the frequency and patterns of recreational boating movements would greatly aid the management of ongoing invasions. For example, the clubbed tunicate (*Styela clava*), violet tunicate (*Botrylloides violaceus*), and golden star tunicate (*Botryllus schlosseri*) currently are spreading on the east coast and west coast of Canada, causing considerable damage to aquaculture industries (see tunicate risk assessment). These marine biofouling species could easily be dispersed to additional locations via small craft on both coasts.

4. Sediments

See CAISN description.

Evaluation of the discharge of ballast sediments with deballasting (2009-2010)

Contact: Nathalie Simard, Fisheries and Oceans Canada

Propagule pressure associated with sediments is simply calculated as the product of the quantity of discharged sediments × the density of organisms in the sediments × the proportion of these that are viable. It is assumed that all viable cysts and diapausing stages in NOBOB sediments excyst/hatch when ballast is taken on in the Great Lakes and are released with ballast water in subsequent ballast exchanges. The work being done through several projects assumes that the propagule pressure associated with sediments may also be described by this simple equation. However, this is not the case as all the sediments are not released. In fact, we have no idea of the proportion of sediments that are released. Without this information, all estimates of propagule pressure associated with ballast sediments are essentially meaningless.

We will examine the proportion of ballast sediments that is released during deballasting procedures. We will also examine which portion (i.e., strata) of the sediments that are released. That is, are only surficial sediments released or are sediments and their associated fauna mixed at each ballasting and/or deballasting event. This information is also important because if only surficial sediments are released, then only the viability of these organisms should be included in estimates of propagule pressure. This is not done at the current time. The work will also evaluate the sediment strata-dependent viability of phytoplankton cysts and diapausing stages.

5. Risk Assessment

Assessment of the current risk of introduction of AIS to the Canadian Arctic via ballast water discharge and hull fouling of commercial vessels (2009)

Contact: Sarah Bailey, Fisheries and Oceans Canada

Evaluation of Methodologies for Pathway Risk Assessments (2009-2010)

Contact: Marten Koops and Becky Cudmore, Fisheries and Oceans Canada

The Centre of Expertise for Aquatic Risk Assessment (CEARA) is in the process of preparing to conduct pathway risk assessments of the live food trade, aquarium and water garden industry, recreational boats, ballast water, bait fish, canals, biological supply houses and unauthorized introductions. CEARA does not currently have guidelines for conducting pathway risk assessments, and there is no single generally accepted approach to conducting such risk assessments. This past year, building upon the development of the Quantitative Biological Risk Assessment Tool (QBRAT; which was funded from AISP research funds), we provided CEARA with an evaluation of the alternative methods for conducting single species risk assessments which helped to inform the development of national guidelines for single species risk assessments. We propose to do a similar analysis for pathway risk assessment methods. The objective is to evaluate the relative performance of pathway risk assessment methodologies. This objective will be achieved by (i) reviewing the existing approaches to pathway risk assessments, (ii) simulate the output of alternative methods to pathway risk assessments, and (iii) evaluate the performance of the alternate methods in relation to the objectives of a pathway risk assessment.

Ship Transit and Species' Impact Research to Support CEARA Shipping Vector Risk Assessment (2009)

Contact: Sarah Bailey, Fisheries and Oceans Canada,

Before a national risk assessment for the Shipping Vector can be conducted, two significant research objectives must be completed:

Vector Analysis for Select Regions in Canada

Propagule pressure, typically measured as volume of ballast water discharged for the shipping vector, is identified as a leading predictor of the probability of invasion success1. Information on the number of ships and transit history (e.g., ballast water source) is well documented for the Great Lakes region as a result of the Domestic Ballast Water project funded with AIS Research funds in 2007/08 and 1008/09. While a similar analysis is being proposed for the Arctic with AIS monitoring funds, such assessments are lacking for the West Coast, St. Lawrence Estuary, Gulf of St. Lawrence and the West Coast. The research proposed here will include assembling port-specific ship transit information for these regions for the period 2005-2008 including, for example, the number of ships arriving to each port, the date of arrival and the type of vessel. This information will be obtained and verified from a number of sources, including the Canadian Coast Guard Information System on Marine Navigation (INNAV), the Transport Canada/CAISN Ballast Water Database, the U.S. National Ballast Information Clearinghouse, Statistics Canada and Canada Customs, as available. For each ship arrival, the history of the vessel will be researched to determine port of origin for the transit, as well as for any ballast water carried on board.

Research on potential impacts of Species in Dominant Source Ports

Once an analysis of vector traffic has been completed for all regions in Canada, it will be necessary to research species lists for ports serving as dominant sources of ship traffic and ballast water, at least for ports with similar habitat to the receiving region in Canada. Lists will be assembled through exhaustive literature search, as well as by contacting local experts. Research will also be conducted to determine habitat requirements of species as well as any history of invasiveness or negative impact.

National Risk Assessment of Ship-mediated Vectors of AIS Introductions (2009-2010)

Contact: Sarah Bailey, Fisheries and Oceans Canada, in collaboration with Transport Canada

We will conduct a national risk assessment of the Shipping Vector to assess the risk of AIS introductions to regions across Canada (including the Great Lakes, Arctic, West Coast, St. Lawrence Estuary, Gulf of St. Lawrence and the East Coast).

The introduction and establishment of AIS follows a sequence of steps or stages that must be transitioned for successful invasion: uptake of AIS from a donor region by a transportation vector; transportation between donor and recipient habitats; release into the recipient habitat; survival; and reproduction, which may lead to secondary introductions wherein the invasion process begins anew. In order to predict new AIS, and to efficiently manage vectors of introduction, rigorous risk assessments must be conducted to quantify propagule pressure and evaluate probabilities of survival at each stage of the invasion process for all potential recipient habitats.

This risk assessment will be based on analyses of vector activity, environmental matching between donor and recipient ports, and species-specific assessments of the probability of establishment and negative impact. The risk assessment will include

analysis of all ship-mediated invasion pathways (e.g., ballast water, sediments, hull fouling) and will follow CEARA risk assessment guidelines.

B. Monitoring

Buoy Monitoring Program (on going)

Fisheries and Oceans Canada in collaboration with Coast Guard and University of Quebec at Rimouski

This monitoring program using navigational buoys aims to detect rapidly invasive species and determine/follow their distribution. Since 2005, sampling efforts permit to investigate numerous locations in the Gulf and the Estuary of the St. Lawrence as well as around Newfoundland and up the coast of Labrador. We are in the process of compiling the data into a reference database for the Region of Newfoundland and Labrador.

Monitoring biofouling in the Atlantic Zone: ecological surveys (on going)

Contact: Dawn Sephton, Fisheries and Oceans Canada

The Atlantic (eastern) Canada monitoring, based on a common protocol and collector plates standardized in 2006, is being done in high risk areas at specific locations. These are selected based on the presence of "risk factors" such as commercial ports or ferry terminals, processing plants receiving US lobsters, high risk fishing ports (with respect to the fishing grounds targeted and fleet movements), shellfish processing plants, and sites for which specific management advice (e.g. I&T) is required. Depending on the Region, the deployment and retrieval of collector plates is being done with the increasing collaborations of the provincial governments, community groups and universities.

The ecological impact (biodiversity, ecosystem function) of new fouling organisms, such as invasive tunicates, in a given environment remains largely unstudied, but they probably compete with other shallow-water invertebrates, algae and grasses for space and/or food resources. Although not a benthic predator like the green crab, tunicates may disrupt native assemblages, especially in the fouling community, sometimes by excluding native species (as observed for *C. intestinalis* in southern California). The ecological impact of tunicates can be investigated at a small scale and at a limited number of locations using a combination of surveys (including underwater video surveys):

- Structural surveys: floating docks, aquaculture lease marker buoys, mooring buoys and ropes, channel buoys and markers, wharfs (pilings, rungs, and bumpers) and boat hulls.
- Diving surveys
- Beach surveys

Baseline biotic surveys will be undertaken in various community types using quadrat sampling and/or scraping followed by the identification of native, cryptogenic and/or introduced species in a separate project (see Rapid Assessment below).

AIS monitoring: Rapid Assessment component (2009)

Contact: Andrea Locke, Fisheries and Oceans Canada

As the number of reports of AIS and further spread of AIS into new regions increases, the ability to respond to new reports and understanding to what extent ecosystem function (productivity and biodiversity) is being affected is a necessity. This project will expand from an identification and confirmation function (former Stewardship monitoring project) to take on a port survey approach to gather a solid database on biodiversity in areas with and without the confirmed presence of AIS. This will provide us with an AIS monitoring database as well as a database of biodiversity impacts that can be used to develop an understanding of the complex questions surrounding the establishment, spread and impacts of AIS on the ecosystem.

Monitoring the European Green Crab, *Carcinus maenas*, distribution and abundance of a high risk invasive species in the Canadian Atlantic Zone (2008-2010)

Contact: Cynthia McKenzie, Fisheries and Oceans Canada

The methods used for the monitoring of green crab will be standardized between regions to enable direct comparisons and data exchange. The monitoring program will include three elements to include as many life stages of the organism as possible. These elements include the following: 1. larval monitoring using vertical and horizontal net tows in areas with high concentrations of green crabs; 2. beach seines will be used to sample green crabs in inshore areas; and 3. trapping of adult and juvenile crabs using standardized traps.

Monitoring and research of *Hemimysis anomala* impacts and their role in the aquatic food web (2009-2010)

Contact: Kelly Bowen, Christine Brousseau, and John Fitzsimons, Fisheries and Oceans Canada

The objectives of this integrated research and monitoring program are as follows:

- Monitoring activities will focus on completing a strategy for freshwater monitoring of lower trophic level organisms and fishes in the Great Lakes from work that was initiated under DFO's AIS monitoring plan in 2006 while simultaneously collecting data to address the role of *Hemimysis anomola* in Great Lakes' ecosystems.
- Research activities will focus on the role of the new invertebrate invader, *Hemimysis anomala*, as a new prey source and competitor in the Lake Ontario food web.

C. Regulations

Ballast Water Exchange Zones

The Canadian Ballast Water Management Regulations is enforced since June 2006. To support this regulation, several efforts were put to evaluate and/or identify ballast water exchange zones on both Canadian coasts. Three recent CSAS reports were peer-reviewed during a national workshop, are presently in revision and should be completed in the next weeks.

1) Cynthia H. McKenzie, Guoqi Han, Moqin He, Terri Baines and Gary Maillet. Alternate Ballast Exchange Zones for the Newfoundland and Labrador Region – An Aquatic Invasive Species Risk Assessment Based on Oceano-

graphic Modelling, Ecologically and Biologically Significant Areas and the Sustainability of Fisheries and Aquaculture.

2) D.B. Stewart and K.L. Howland. An Ecological and Oceanographical Assessment of the alternate ballast water exchange zone in the Hudson Strait.

3) An Ecological and Oceanographic Assessment of the Beaufort Sea Region: Evaluation of the Risks Associated with Ballast Water Exchange.

D. Other research projects

The effect of the vase tunicate, *Ciona intestinalis*, on ecosystem productivity and biodiversity (2008-2010)

Contact: Daniel Bourque and Andrea Locke, Fisheries and Oceans Canada

Ecosystem Interactions between Invasive Tunicates and Cultured Mussels: Importance of Food Partitioning and Phytoplankton Size-Structure (2009-2010)

Contact: Peter Cranford, Fisheries and Oceans Canada

This proposal initiates new work needed to understand the impacts of invasive tunicate species (*Styela clava*, *Ciona intestinalis*, *Botrylloides violaceus*, *Botryllus schlosseri*) on the health of mussels (*Mytilus* sp.) cultured throughout Atlantic Canada. It also addresses ecosystem interactions between tunicates and mussels by filling gaps in knowledge on; (1) food partitioning between species, which defines the degree of competition for resources, and (2) spatial and temporal variations in the partitioned components of the food supply. Targeted research on animal feeding physiology defines the degree of food partitioning between species that, when combined with geographic data on relevant properties of the food supply, determines the degree of competition that ultimately affects mussel and tunicate health, growth and survival. Knowledge on ecosystem interactions informs pathway risk assessments for invasive tunicates and the development of control/mitigation measures.

Invasive colonial tunicates as ecosystem engineers: fouling impacts in seagrass beds (2009-2010)

Contact: Melisa Wong, Fisheries and Oceans Canada

Although many studies have examined the impacts of invasive tunicates on bivalve fisheries and aquaculture, little work has focussed on impacts to valuable nearshore habitats. The proposed research will study interactions between colonial invasive tunicates and seagrass beds in the Maritimes. The work will increase understanding of habitat modifications caused by invasive tunicates, and identify potential consequences for ecosystem integrity.

National comparison of the impact of the European green crab, *Carcinus maenas*, on biodiversity and habitat (2009-2010)

Contact: Cynthia McKenzie, Fisheries and Oceans Canada

Theme 1 – Population Ecology -factors affecting green crab establishment

Theme 2 - Impact on Biodiversity and Habitat Usage

Invasive Tunicates and Shellfish Aquaculture: Assessing Impacts and Testing Solutions

Contact: Tom Therriault, Fisheries and Oceans Canada

The goals of this project are: (1) to evaluate the efficiency and practicability of various local control methods for colonial invasive tunicates found in Canadian waters in shellfish aquaculture settings; and (2) to evaluate the effects of invasive tunicate fouling and fouling control methods on cultured bivalves.

Temperature-related growth and spread of *Codium fragile* in eelgrass beds

Contact: Chris McKindsey, Fisheries and Oceans Canada

The proposed research will complete work that is already well underway to understand the factors that allow the expansion of the range of the invasive green macroalga *Codium fragile* ssp. *tomentosoides*. Specifically, it will evaluate the growth potential of the alga at different temperatures and light levels and complete work started to better understand the factors linked to the spread/recruitment of the species within eelgrass beds.

Effects of the invasive green macroalga Codium fragile ssp. tomentosoides on seagrass beds in Magdelen Islands, Quebec (PhD of Annick Drouin)

Objectives are:

1) Define the factors that determine spatial recruitment of *Codium* in seagrass beds.
2) Determine the influence of *Codium* on *Zostera*.
3) Determine the influence of *Codium* on communities invertebrates and fishes associated to seagrass beds.

Estonia

Report prepared by Henn Ojaveer, Estonian Marine Institute, University of Tartu, Estonia

Although there are no research carried out and no relevant programs/projects in place which address invasion vectors and their management, two related relatively recent activities could be mentioned:

Contribution to the development of 'The outline for a road map towards implementation of the IMO Ballast Water Convention', through participation in HELCOM Correspondence Working Group on Implementation of the HELCOM Ballast Water Road Map. In Estonia, relevant national responsibilities will be covered by the Ministry of Economic Affairs and Communications and the Ministry of the Environment which have the required competence. The discussions on delegation of the concrete responsibilities by ministerial authorities are still ongoing. Through a series of ministerial-level meetings, the ballast water and alien species issue has received elevated attention from various stakeholder groups.

Designation of ballast water exchange areas in Estonian marine waters (by Dr. Jonne Kotta from Estonian Marine Institute, University of Tartu). There are no areas in Estonian waters which comply with the ballast water exchange requirements in the International Convention for the Control and Management of Ships' Ballast Water and Sediments (i.e. >50nm from the coast with a depth of >200m). Based on mainly ecological aspects, it was concluded that in case ballast water exchange is inevitable, it

should not take place closer than 5 miles from the identified sensitive coastal areas and preferably in the deepest possible regions with active movement of watermasses.

Germany

Report prepared by S. Gollasch and M. Rolke

Overview

- A new project, funded by the European Regional Development Fund (ERDF), aims at the unified ratification and implementation of the BWMC in the North Sea Region (Ballast Water Opportunity).
- IMO agreed to work towards an instrument to reduce the risk to introduce alien species in the bio-fouling of vessels. Further, additional guidance is required for compliance control sampling with the D-2 Ballast Water Performance Standard and all IMO member states are invited to contribute submissions to the next session of BLG (spring 2009).
- The free journal of applied research on biological invasions in aquatic ecosystems, Aquatic Invasions, is now issuing its 4rd volume (http://www.aquaticinvasions.net/). Contributions to the journal from WGITMO members are more than welcome. Please submit manuscripts to Vadim Panov at vpanov@aquaticinvasions.ru or vpanov@mail.ru.

1. Regulations:

Approval of Ballast Water Treatment Systems

The Federal Maritime and Hydrographic Agency is responsible for the type approval of ballast water treatment systems in Germany and is currently carrying out several approval procedures. The German system developed by the Hamann AG received Final Approval from IMO the prerequisite for the certification that was issued in June 2008. The treatment system includes a mechanical separation (hydrocyclone and 50 µm filtration) to be followed by the injection of a chemical (Peraclean Ocean). Another eleven applications for approval procedures from different companies are currently handled by the Federal Maritime and Hydrographic Agency. For further details see www.bsh.de.

Ballast Water Exchange in Europe

The Contracting Parties of HELCOM and OSPAR agreed on a voluntary interim application of the Ballast Water Exchange Standard (Regulation D-1 on the IMO Ballast Water Management Convention). The D-1 Standard requires at least 95% volumetric ballast exchange (empty/refill) or when using the pump though method - pumping through three times the volume of each tank. All ballast tanks should be exchanged at least 200 nautical miles from the nearest land in water at least 200 metres deep. If this is impossible the exchange should be undertaken as far from the nearest land as possible, and in all cases in waters at least 50 nautical miles from the nearest land and at water depths of at least 200 metres. This requirement applies to ships crossing the Atlantic and arriving in the area via the Cape of Good Hope.[6]

For a summary of ballast water management approaches in the Mediterranean, Black and Caspian Seas please consult David & Gollasch (2008).

[6] Please note that the ROPME area (Persian Gulf) has suggested a similar approach which will go into effect Nov. 1st 2009.

2. Projects

EU Interreg Project Ballast Water Opportunity (BWO)

This project is funded by the European Regional Development Fund (ERDF) and aims at the unified ratification and implementation of the BWMC in the North Sea Region. 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.

For this project approval was granted by the Steering Committee of the Interreg IVb North Sea Region Programme in December and it started January 1st 2009.

This Interreg IVb North Sea project involves all relevant stakeholders in the North Sea region. The project is composed of 6 Workpackages:

- WP1 - Organisation, Coordination and Management
- WP2 - Coherence, Harmonisation & Transparency
- WP3 - Knowledge transfer, Innovation, Test bed, Demonstration and Certification for Ballast Water Treatment Systems (BMTS)
- WP4 - Knowledge transfer, Innovation, Test bed and Certification for Detection, Monitoring, and Compliance Enforcement Technology.
- WP5 - Strategies
- WP6 - Dissemination

Germany is responsible for WP2 (BSH) and WP4 (GoConsult).

3 Meetings

3.1 Past year

Due to activities in the framework of the first GloBallast Programme and the Black Sea Conferences on Ballast Water Control and Management a ballast water related Regional Task Force was implemented to minimize the transfer of harmful aquatic organisms and pathogens in ships' ballast water. Ballast Water Management (BWM) was also incorporated in the revised Strategic Action Plan of the Black Sea. At a recent OSCE International Expert Conference on The Safety of Navigation and Environmental Security in a Transboundary Context in the Black Sea Basin, held in Odessa in June 2008, one session dealt with BWM. At this meeting it became clear that the Black Sea countries have divided positions regarding how to address BWM. Also, the level of detail regarding existing national BWM requirements varies substantially within the Black Sea countries, i.e., a harmonized and agreed upon uniform approach is lacking.

More meetings of the EU funded Project "Sustainable Ballast Water Management Plant" (BaWaPla) were in May 2008 in Lisbon, Portugal and Nov. 2008 in Bremerhaven, Germany. It is currently planned to extend the project duration. The core team is busy testing a candidate ballast water treatment system in a land-based set-up.

3.2 Future meetings

The kick-off meeting of the Interreg project Ballast Water Opportunity is planned for March 23 to 24 2009 at the BSH in Hamburg. All work packages will be presented and several workshops and break out groups will develop guidance for the project.

4 IMO Upate

Number of countries and world fleet tonnage: As per March 2009, 18 countries with 15.36% of the world fleet tonnage have ratified the Ballast Water Management Convention. For entry into force 30 countries with 35% are needed.

Meetings

The IMO Marine Environment Protection Committee (MEPC) had its 58th meeting from Oct 6th to 10th 2008 at the International Maritime Organization (IMO) headquarters in London. Further, the recent sub-committee meeting of the Bulk. Liquid and Gases group was held March 2nd to 6th 2009 (BLG 13). MEPC59 is scheduled for July 2009 and the following meetings of both BLG and MEPC will be between February and April 2010.

Evaluation of ballast water treatment systems which make use of "active substances"

Ballast water treatment systems using active substances, such as chemical formulations, need to go through a rigorous assessment to proof environmental acceptability. The independent body to undertake the reviews is the Joint Group of Experts on the Scientific Aspects of Marine Environment Protection (GESAMP[7]) Ballast Water Working Group (BWWG). The administrative work is undertaken by IMO. Before MEPC59, two GESAMP BWWG meetings were held. Due to the outstanding workload when evaluating such systems, only three systems may be considered at each meeting. However, 12 dossiers for basic or final approval were received and it was agreed to add Saturday as an extra working day to evaluate as many dossiers as possible. At the first meeting of GESAMP BWWG prior MEPC59 five dossiers were evaluated. At the next meeting of the group it may only be possible to work through three dossiers. As a consequence four dossiers cannot be evaluated prior MEPC59. To cope with the workload the GESAMP BWWG agreed to have another two meetings before MEPC60. Assuming that here again three dossiers may be evaluated at each meeting the first of these two meetings will already be busy. It is also expected that more dossiers will be submitted over the next months and it may happen that not all such dossiers can be considered before MEPC60. All involved tried hard to overcome this unsatisfactory situation, but additional meetings could not be arranged due to the limited availability of the experts involved. It is also planned to simplify the review process of dossiers with the aim to evaluate more than three dossiers per meeting.

Ballast Water Sampling

Of key interest to ICES may be the current development of the Ballast Water Sampling Guideline (G2) for compliance control with the standards as set forth in the IMO Ballast Water Management Convention. This guideline is now agreed. G2 con-

[7] GESAMP sponsores are IMO, FAO, UNESCO-IOC, WMO (since 1968), IAEA (since 1969), UN (since 1971), UNEP (since 1977), and UNIDO (since 2006).

tains generic information, but more details are required and worked on as a guidance document. At BLG13 a catalogue of questions was developed regarding port state control sampling and IMO member states are invited to inform BLG on possible sampling and sample processing strategies. The next meeting of BLG is in spring 2010. The 59th meeting of MEPC will be held July 13th to 17th 2009. At this meeting many ballast water treatment systems which make use of "active substances" will be evaluated.

Entry into force dates of Regulation D-2 ballast Water Performance Standard

It was of controversial view whether or not the standard should be followed in the beginning or end of the specific year. The current wording is. *Ships with ballast water capacity between 1,500 and 5,000 m³ are required to comply with the D-2 standard not later than the first intermediate or renewal survey, whichever comes first, after the anniversary date of the ship in 2014 under Regulation B-3.1.1. Ships with ballast water capacity less than 1,500 and greater than 5,000 m³ are required to comply with the D-2 standard not later than the first intermediate or renewal survey, whichever comes first, after the anniversary date of the ship in 2016 under Regulation B-3.1.2.*

Harmonization of land-based test procedures

It was briefly discussed that a harmonization of sampling protocols and sample analysis methods may be needed as all land-based test facilities to test the performance of ballast water treatment systems have chosen different approaches. As a first step an exchange of information workshop may be held later in 2009.

Hull fouling

The correspondence group results were reviewed at BLG13 and include a very comprehensive list of literature regarding hull fouling studies. It was further discussed how to implement the hull fouling issue, i.e. whether this could become a guideline, could be attached to an existing convention or to develop towards a stand alone convention on hull fouling. The majority favors to develop a guideline first and decide later if an annex to an existing convention or a stand-alone convention is needed.

BLG13 agreed in principle to establish a working group on bio-fouling issues. Due to the overlap of experts working on both subjects (ballast water and hull fouling), it was agreed that only one group can be formed and should deal with both subjects in the future.

GloBallast partnerships

During BLG13 the GloBallast Industry Alliance (GIA) was introduced with several industrial partners involved as new public-private partnership. The GIA, which brings together some of the major shipping companies and shipbuilders to promote ballast water related initiatives and solutions, has agreed to support GloBallast.

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Norway

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A. Transport vectors:

1) **Ballast water.** No scientific studies on BW biota as such.

Figure 1 (From Figure 5.2 in Dragsund et al, 2007). Cargo volume exported from Norwegian harbours in 2006. A rough indicator of volumes of BW import. Yellow lines indicate suggested OSPARCOM bioregion borders.

Considering the time needed to complete the Ballast Water exchange according to D-1 standard, a typical vessel entering Norwegian waters will need from 1000 - 2000 km. This is basically not possible to accomplish within normal sailing routes within Norwegian territorial waters.

If partial fulfilment of D-1 were considered to be a risk reducing action, a number of possible areas have been identified:

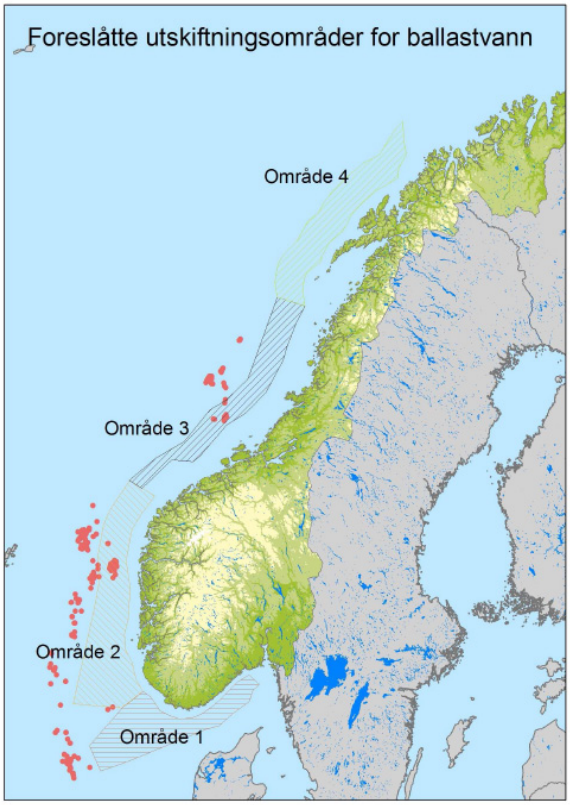

Figure 1 Suggested areas for BW exchange. Area 1 is delimited by Norwegian EEZ towards Denmark. Red dots are permanent oilfield installations. (From Figure 8.1. Dragsund et al, 2007).

A by-law for the establishment of BW exchange zones for Norway has been proposed (Based on the report of Dragsund *et al*. 2007) and is on hearing

2) **Ballast Water treatment**. Two BW treatment systems are in the process of type approval testing and shipboard testing. Manufacturer: "Ocean Saver" TM. And "Optimarin" TM. Test Facilities: Ballast-Tech NIVA (see below)

Ballast water sampling. No new scientific studies launched. A test facility for type approval of BW treatment systems have been established in accordance with the guidelines for approval of BWM systems (G8). Ballast-Tech NIVA:

http://www.niva.no/symfoni/infoportal/PUBLIKASJON.NSF/redirectEng?ReadForm&Url=http://www.niva.no/symfoni/infoportal/PUBLIKASJON.NSF/.vieEngInterForsideNIVA/FC4979404066E770C125729D0050FCE8?OpenDocument

3) Hull fouling. No new measures beyond the AFS convention have been suggested.

A research project on a non-toxic technology to prevent hull fouling is initiated.

4) Other ship Vectors. Nothing to report

B. Invasive species management:

Eradication programmes: Nothing to report for shipping as vector.

Management and control of introduced species. A decimation fishery for the red king crab with no quotas limits has been initiated west of "Cape North" (W of 26 E). Reported to WGITMO

1) Impact of invaders.

The American lobed comb jellyfish *Mnemiopsis leidyi* has been present in the plankton more or less throughout the year. High numbers in the area from the Swedish border to Bergen has been observed. It is not only present in the coastal current, but also in the fjords along the coast. While no dedicated studies have been carried out, *M. leidyi* appears in significant higher numbers than the local *Bolinopsis infundibulum*.

Risk Assessment approaches. A Norwegian "species databank" has been established and staffed. Its first task: a thorough revision of the "red list" was finalised autumn 2006, and a revised alien database including a risk assessment has been developed. The list was published may, 2007. The alien list also includes selected "fact sheets". (http://www.artsdatabanken.no/ThemePage.aspx?m=148&amid=2312)

In total, 40 marine or brackish species have been evaluated.

Two studies on the impact of on impact of the changes in biodiversity (including the impacts of the introduced red alga *Heterosiphonia japonica)* has been presented (Husa et al. 2008Sjøtun et al. 2008). While present in many communities in the study area, larger impact over the time-span for the study was observed for "North sea" species expanding their growth range northwards

A study of the impact of the Red King Crab *Paralithoides camtschaticus* is in progress in the Porsanger area of Norway (Lis Jørgensen, IMR, Pers Comm).

C. Occurrence of new ship-mediated aliens.

First report of the Japanese red alga *Antithamnion nipponicum* (Ceramiales, Rhodophyta) in western Norway, (Ruenes et al, 2007). While it is difficult to determine exact vector, shipping is the most likely transporatioin means. From its native range in Japan and Korea, it was introduced to the Mediterranean in the eighties. Except a possible report from the Azores, there are no other published records for European waters (Rueness *et al*., op. cit.).

D. Other relevant information.

Upcoming meetings

A workshop on "Indicator based methods to assess and map Biological pollution in Norwegian Waters will be hold in Bergen may 26 and 27.

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Sjøtun, K., Husa, V. and Peña, V., 2008 Present distribution and possible vectors of introductions of the alga *Heterosiphonia japonica* (Ceramiales, Rhodophyta) in Europe . Aquatic Invasions, Vol 3, Issue 4: 377-394

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A Transport Vectors

1 Ballast Water

1.2 Ballast Water Treatment

Wallenius Water and Alfa Laval have worked together to produce PureBallast, which in June 2008 (Lloyd's Register 2008) was given type approval certificate by the DNV, a global, independent certification body, together with the UN's marine body the IMO (International Maritime Organization). In summer 2008, 5 units were reported as installed (Lloyd's Register 2008). It is the first and so far only chemical-free ballast water treatment in the world to have been approved by the IMO.

Wallenius Water was founded in 1996 and is an environmental technology company that has developed a chemical-free method of water purification. This patented method, Wallenius AOT™, is currently used to purify everything from drinking water to the water employed in cooling towers and greenhouses to the water in various industrial processes and ballast water. The technology is effective, economical and ecologically sound (for more details on the technique see Lloyds Register 2008).

Swedish scientists are still co-operating with these companies by performing biological tests (Elena Gorokhova, Stockholm Univ., pers. comm.).

1.3 Ballast Water Legislation/Regulations

A Swedish national strategy and action plan for alien species has been developed and was presented in December 2008, but is not yet adopted. It was suggested there (Naturvårdsverket 2008) to give a very high priority to that Sweden should adopt and implement the IMO Ballast Water Convention of 2004, and that Sweden also should act to make other countries ratify the Convention, by cooperating within the

HELCOM Commission and OSPAR Convention. Since April 2008, awaiting that the Ballast Water Convention will come in force, Sweden, as part of these organisations, will make it possible for ships coming from Transatlantic routes or passing West Africa to use voluntary guidelines for ballast water exchange.

2 Hull fouling

The Swedish action plan (mentioned under 1.4) also suggested that a high priority should be given to that Sweden should be active internationally to take measures to minimize the movements of invasive aquatic organisms through hull fouling.

2.1 Biology of Hull Fouling

Marine Paint (www.marinepaint.se) is a biofouling research programme at the University of Gothenburg and Chalmers University of Technology, financed since 2004 by MISTRA – The Foundation for Strategic Environmental Research in Sweden. Around 25 researchers are involved in the programme. The first results from Marine Paint are close to usage and the next phase will deliver new generations of results with a broader range of applications, with the ultimate goal of stopping biofouling of ships and boats.

The most important results hitherto are:

- A novel antifouling substance, medetomidine, effectively prevents barnacles (N.B. the introduced *Balanus improvisus* is often dominant as fouling organism) from adhering to ships' hulls. Medetomidine does not seem to endanger other marine organisms due to its efficacy at extremely low concentrations and its specific non-lethal mode of action. Under the ownership and management of the commercial partner, I-Tech, the substance is currently undergoing registration as a biocide according to the European Biocide Directive.
- A deep and detailed understanding of the mechanism of action of medetomidine on barnacles has been gained – down to the gene level.
- A working model is developed to find the best (efficacy and sustainability) combinations of available and EU approved biocides to hinder the whole spectrum of fouling – not only barnacles. The model builds on the emerging science of biocide mixtures and has been validated to accurately predict efficacy of a biocide.
- A generic paint formulation concept, by employing encapsulation, makes it possible to harbour the most efficient and sustainable set of biocide combination in a marine paint. This also makes it possible to control the leakage rate of biocides from the paint into the marine environment to the lowest level. A large-scale production has been shown possible for the concept, both from a cost-efficient as well as environmental perspective.

The strategy of optimizing combinations of antifouling biocides has the major advantage of being extremely flexible, thus the next generation of paints can easily be adapted to:

- different fouling pressure in different oceans in which the ship operates.
- any new scientific evidence on the environmental hazard of antifouling biocides.
- new authorisations or restrictions of biocide use as imposed by regulatory authorities.

- new economic developments with respect to pricing and marketing of individual antifoulants.

2.4 Hull Fouling Legislation/Regulations

In Sweden, as for all other EU member countries, following the Directive 782/2003, it is since January 1, 2008 a ban on using organic tin compounds as biocides on ships' hulls, unless the ship hull has a cover preventing leakage of these substances. Sweden has ratified the IMO Antifouling Convention, which came into force September 17, 2008. Naval and military support vessels and ships owned by the state are exceptions.

A study (Eriksson 2009) of long-term effects of Irgarol, used in antifouling paints, has shown that some microalgae and cyanobacteria have developed mechanisms that make them tolerant towards the substance, also during the intense boating season. Since other species still are sensitive they might be out-competed by the tolerant ones and there is a risk they may disappear. Even species living in the outer archipelagoes have to some extent acquired those mechanisms, indicating that the Irgarol toxicity is not only affecting harbours and marinas. Irgarol thus seems to have resulted in an impact on a gene, which codes for a photosynthetic protein, which in turn has a negative effect on photosynthesis. The use of this substance might restricted by the Swedish Chemicals Agency (KemI).

D New Introduced Species

Four new species, for which the introduction might be related to shipping, were detected in Swedish waters during 2007-2008. In addition two other new introduced species were found. For more details see Swedish National Report in ICES WGITMO 2009.

A few specimens of the round goby *Neogobius melanostomus* were caught by an observant private person in Saltösund, in the outer part of the town of Karlskrona (N 56°9'52", E 15°34'10") in southern Sweden in July 2008. The probable vector is shipping, since Karlskrona has an intense boat traffic with the Polish coast, including a ferry line to Gdynia. One specimen sent in for analysis was a 96 mm long male, about 2-3 years old (Gustaf Almqvist, Swedish Board of Fisheries, pers. comm.).

The invasive Ponto-Caspian cladoceran crustacean *Evadne anonyx*, first recorded from the innermost part of the Gulf of Finland in 2000, was in 2008 recorded for the first time in Sweden in small numbers at Swedish monitoring sites in the Baltic proper, from the Arkona Basin in the southern part (N 55° 00', E 14° 05') to the Landsort Deep and Askö in the northern part (N 58° 48', E 17° 37') as well as in the Bothnian Sea (Elena Gorokhova, Stockholm Univ., pers. comm.). A likely vector for its arrival in the Baltic Sea could be shipping on the rivers from the Caspian Sea.

All development stages of the marine chironomid *Telmatogon japonicus* were found in two offshore windmill parks (Utgrunden N 56°22'22", E 16°14'55", and Yttre Stengrund ca. N 56°10', E 16°0') south of the city of Kalmar in the southern Baltic Sea in 2007 (Brodin & Andersson 2008). There is a thorough discussion in the paper whether this is an alien species or not (cf. Kerckhof et al. 2007). However, since it here, as well as in many other areas, has been found not far from harbours, it was suggested that shipping has been a vector. The species was first identified in the Baltic Sea in Germany in the 1960s and in Poland in the 1970s (Brodin & Andersson 2008 and references therein).

The diatom *Chaetoceros concavicornis* was first seen on the Swedish west coast in 2007, when it was common in the eastern Kattegat all autumn from September, but was

also present in the eastern Skagerrak (Karlson 2008). This species can be harmful to farmed fish due to the sharp long spines that can damage the gills. It was again seen in the autumn of 2008, but so far no damage has been reported from Sweden (Bengt Karlson, SMHI, pers. comm.). The vector for the introduction is not known, but ballast water discharges cannot be ruled out.

According to Øresland and Ulmestrand (2009) three of the four records of the American lobster, *Homarus americanus*, caught on the Swedish west coast in traps just outside Smögen (N 58°21', E 11°14') in late September and October 2008, had the normal size of American lobster imported live for the food market. Two of these also had their claws fixed by a red rubber band, implying they had been kept alive in the sea and escaped. The fourth specimen was quite a large female caught in May 2008 by trawling north of Skagen (N 58°23', E 10°41') at a depth of 80-100 fathoms. It can be assumed that this female had survived several changes of the exoskeleton, while it is not known how it came there.

A large male of the European velvet swimming crab, *Necora puber*, was first caught (Hansson 2009: 277) on the Swedish west coast in September 2007 in a Norwegian lobster trap at Måseskär (N 58°05', E 11°17'). Another male was caught in a lobster trap at Ramsö (N 58°50', E 11°05') in November 2008. In October 2008 two drifting cages, originating from Aberdeen, Scotland, with 15 live and several dead crabs in each, were spotted west of Hållö (N 58°20', E 11°13'). Since this species occur as far north as Scotland and is known to vary in abundance with winter temperatures, this is probably a range extension. It is not known if the ones caught alive in our waters also had come by drifting cages or as larvae.

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United Kingdom.

Report prepared by Tracy McCollin. Fisheries Research Services (FRS) Marine Laboratory, Aberdeen, 375 Victoria Road, Aberdeen, United Kingdom AB11 9DB.

Transport Vectors

Ballast

The Maritime and Coastguard Agency has commissioned two reports in relation to ballast water:

Enshaei, H., Mesbahi, E. 2009. The Identification of the amount and origin of the BW discharged annually in UK ports. Report for the Maritime and Coastguard Agency prepared by Newcastle University, United Kingdom. Project No. RP577.

Pazouki, K., Cabezas-Basurko, O., Mesbahi, E., Kemp, J. 2009 Ballast water sampling: Methods, Analysis, Representativeness and Legal Issues. Report for the Maritime and Coastguard Agency prepared by Newcastle University, United Kingdom. Project No. RP577.

Both reports are available at the following website: www.mcga.gov.uk.

Hull fouling

Marine Aliens II

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A project known as Marine Aliens II titled "Controlling Marine Invasive Species by Targeting Vectors of Dispersal" started in 2008 and will run for three years. The project is funded by the Esmée Fairbairn Foundation, which has the following objectives:

- to quantify the risk from two high risk anthropogenic vectors; hull fouling on commercial and recreational vessels and unintentional aquaculture escapes,
- to assess the effectiveness of various monitoring and control mechanisms in minimising colonisation and spread of invasive marine species and their associated parasites and hence reduce the impact on native marine biodiversity; and
- inform management/ eradication programs.

The first set of fieldwork will start in June 2009.

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

Project leader: Tracy McCollin, Fisheries Research Services (FRS) Marine Laboratory Aberdeen, 375 Victoria Road, Aberdeen, AB11 9DB. t.a.mccollin@marlab.ac.uk

This project will start in April 2009 and the objectives are:

- A comprehensive review of the literature concerned with biofouling and the methods used to assess the risk associated with this vector. Contact will also be made with scientists in New Zealand and Australia to obtain information regarding sampling techniques and the guidelines that have

been developed to reduce the risk of introducing non native species via this vector.

- Information regarding the dry docks, ports and marinas in Scotland will be obtained and contact made with the operators to discuss access for sampling. This may include site visits to ensure that the sites are suitable for sampling and to discuss arrangements with the operators to ensure a safe working environment.
- A vessel sampling methodology will be developed and will include a suite of techniques such as sampling vessels in dry docks, using remotely controlled cameras from the quayside and also divers. This will include discussions with the engineers and divers within FRS to develop and test suitable sampling devices. The sampling design will be discussed with FRS statisticians to ensure that the results are robust.
- Extensive taxonomic training will be undertaken in a number of ways. This could include attending courses run by taxonomic experts, visiting laboratories with the relevant experts to work through samples and learn by identifying species from realistic samples or by arranging in house training at FRS. By participating in the Marine Aliens II project FRS has access to a number of taxonomic experts that can be contacted for training and identification advice.
- The chosen dry docks, ports and marinas will be visited and the relevant techniques used to take samples from the vessels. The sampling protocol will be backed up by a questionnaire survey to obtain information regarding the vessel's maintenance recored with regard to the application of anti foulants and the trading pattern of the vessel. This will provide preliminary information towards identifying high risk vessels and routes that will enable the risk of introducing non-native species via hull fouling to be managed more effectively.
- The samples will be analysed at FRS and a reference collection of specimens developed. The presence of any suspected non native species will be confirmed by other experts. The results of this project will be written up as FRS reports and also as peer reviewed papers.
- The results of this research will be an initial starting point that could be used to provide preliminary information regarding whether non native species are present on vessels that are arriving into Scottish ports and will provide the basis of FRS advice regarding the development of any policy or legislation on biofouling e.g. an IMO Convention. This information could be used for assessments of the risk of vessels transporting non native species between ports.

Advisory Work

Fisheries Research Services (FRS) Marine Laboratory Aberdeen will be represented on the following groups in relation to non native species:

ICES Advice Drafting Group on Alien Species which will be held in Copenhagen from 30-31st March, 2009.

Joint Research Council/International Council for the Exploration of the Sea Working Group.

This group will prepare the scientific basis for the development of criteria and methodological standards in relation to the Good Environmental Status descriptors in the EU Marine Strategy Framework Directive. The aim is to establish criteria and standards which will ensure consistency and comparability in the determination of GES.

Annex 4 – CODE OF PRACTICE FOR BEST MANAGEMENT OF HULL FOULING (31 March 2009)

Introduction

The issue of bio-fouling on vessels has been highlighted as an important vector for the transfer of non native species worldwide (Skerman, 1960; Rainer, 1995; James and Hayden, 2000; Lewis et al., 2006). Although in many cases it can be difficult to assess whether a species was introduced by ballast water or bio-fouling, studies have estimated that up to 80% of known introduced marine organisms have been associated with bio-fouling as a means of introduction (Cranfield et al., 1998; Eno et al., 1997; Gollasch, 2002; Gollasch et al., 2009). Studies carried out in New Zealand and Australia have sampled a large number of different vessel types, from a variety of source locations and across seasons of arrival (BLG 12/INF.4, Florel *et al*. 2005). These studies indicated that the level of fouling rank on the hull area for passenger and commercial vessels was between 0 and 1 (0=clean hull, 1=biofilm on a scale up to 5=heavily fouled), substantially lower than the values for yachts. The fouling rank attributed to a vessel from examination of the hull alone tended to underestimate the level of hull fouling in the niche areas and the incidence of substantial niche fouling was highest among yachts.

The results of studies such as these have provided some of the data useful to develop practical guidelines for minimizing the translocation of invasive aquatic species through bio-fouling of ships. In this regard, countries such as Australia and New Zealand are currently drafting guidelines. It has been recognized, however, that a standardized approach would be more appropriate and the issue of bio-fouling is now an agenda item to be discussed at the International Maritime Organization with the intention of developing international measures. Because it is likely that any international measures will take some years to be agreed upon and adopted, this document aims to provide an interim set of practical guidelines to minimise the risk of transporting non native species through bio-fouling of vessels within the ICES area. This document's guidelines are based on those already developed elsewhere in the world (cf. Department of Agriculture, Fisheries and Forestry 2009. National Biofouling Management Guidance www.marinepests.gov.au) but with changes to take into account problems or issues specific to the seas within the ICES area. These guidelines are not intended to be comprehensive, but should serve to make clear certain fundamental points and guide the reader to other, more in-depth documents such as BLG 13/9, the GISP report (2008), and ANZECC (2008).

Definitions

antifouling systems-- a coating, paint, surface treatment, surface, or device that is used on a ship to control or prevent attachment of unwanted organisms.

attached organisms--those organisms permanently fixed to a solid substrate.

biofouling--the attachment of aquatic (fresh or seawater) organisms to any part of a vessel (including the hulls, rudders, propellers and other hull appendages). This also includes internal seawater systems (such as sea chests and engine cooling pipes), or any equipment attached to or on board the vessel, aquaculture equipment, mooring devices or the like.

docking support strips--the areas of the hull that are covered by supporting blocks when a vessel is dry-docked.

equipment--includes anchors, anchor chains, warps, cables and remotely deployed equipment (for example, as used by cable and research ships).

hull--includes, where appropriate, sea chests, rudders, propellers and areas of the hull in way of the propeller and rudder stocks.

internal water systems (IWS)--the piping in a vessel that draws and carries external water for machinery cooling and other purposes.

introduced species (= non-indigenous species = exotic species)--any species transported intentionally or accidentally by a human-mediated vector into aquatic habitats outside its native range. Note: Secondary introductions can be transported by human-mediated or natural vectors.

"niche" area--a protected or refuge area within or on a ship where bio-fouling can occur, for example, cable lockers, wet wells, bilges, or equipment. Also uncoated areas or areas where antifouling coating breakdown is common enabling the settlement of aquatic organisms.

primary biofouling no more than a slime layer (biofilm).

secondary biofouling--fouling that is anything more than a primary layer (slime/biofilm).

vector--any living or non-living carrier that transports living organisms intentionally or unintentionally.

GENERAL PRACTICES FOR ALL VESSELS

Hull cleaning and cleaning permission

- Clean painted and unpainted hull areas.
- ***Where possible, and practicable, remove slime (primary biofouling) from the hull in order to prevent the build-up of heavier, secondary biofouling.***
- To kill or greatly reduce marine fouling organisms, move the ship from high to low salinity, preferably freshwater when feasible or possible.
- Out of water cleaning – a hull treated with antifouling paints is only to be cleaned with the written permission of the relevant administering authority.
- Out of water cleaning – no matter the paint type, hull cleaning may be permitted only providing that any debris, including all removed organisms, is not allowed to re-enter the aquatic environment.
- In water hull cleaning is prohibited, except under extraordinary circumstances, i.e., evidence that invasive species are fouling the vessel, and no other cleaning options are available. Cleaning should be done in a manner that minimises the release of organisms and chemicals to the surroundings. When the vessel is coated with antifoulants containing toxic substances, in water cleaning enhances their release to the water column, as opposed to cleaning of foulant release coatings (silicones or Teflon-like materials) or untreated hulls.

Dockyards

- New dry docks, slipways--no water should run off work areas without treatment to remove toxic substances and particulate matter (turbidity).
- Existing dry docks, slipways--measures should be adopted to minimise water runoff and the release of potentially toxic and turbid discharges.
- Water blasting--run off should be avoided and, where practical, water should be collected for recycling and/or treatment before re-entry into the aquatic environment.
- All antifouling residues should be treated as contaminated wastes, as they are all potentially contaminated with biocides. Such wastes are to be collected for disposal in accordance with requirements of local environmental and/or waste disposal authorities, and prevented from entering adjacent waterways. Disposal of tributyltin-contaminated wastes in the aquatic environment should be avoided whenever possible.
- Biological materials removed from fouled hulls should be treated and not allowed to flush back into the aquatic environment.
- Encourage regular slipping or dry-docking of the vessel to remove biofouling at a licensed facility having adequate waste management facilities to capture and dispose of hull scrapings.

Cleaning of equipment

Aquatic species may become attached to, or entangled in, anchors, anchor chains or warps, deck gear, or other equipment. To avoid this issue:

- Inspect and clean equipment routinely to ensure that it is, as far as practicable, free from biofouling.

- Anchors, chains and warps should, where practicable, be cleaned by high pressure hosing while the anchor is being weighed.
- Mooring lines should be cleaned when they are retrieved on board and allowed to dry out where possible.
- Inspect and clean vessel equipment
    - prior to the vessel sailing from one locality to another;
    - if the vessel has remained at the same site for an extended period of time (e.g., on a mooring, at anchor, or alongside a jetty);
    - when the vessel is slipped or dry-docked.
- Any plants or animals discovered on or in equipment should be disposed of on land to avoid their re-entry into the aquatic environment and reported to the relevant authorities.

Application of antifouling paints

The effectiveness of antifouling paint can be maximised through observance of the following:

- obtaining manufacturer's advice as to the most appropriate paint for a vessel's hull, in regard to:
- the material of its construction;
- the proposed sailing patterns;
- the type of work in which the vessel is likely to be engaged;
- the localities in which the vessel is likely to operate.
- applying the paint on all parts of the hull, including the docking support strips (see below), in accordance with the manufacturer's instructions;
- re-application of antifouling in the event of damage to the paint surface; and
- maintaining the effectiveness of the paint by reapplying it at appropriate intervals, in accordance with the manufacturer's instructions.

Docking Support Strips

Moving the position of docking blocks at dry docking event or at each consecutive dry dock visit will likely be an effective practice to reduce bio-fouling.

Niche areas

Niche areas, also called areas of special concern, are found on all vessel types. The terms refer to protected or refuge areas within or on a ship where bio-fouling can occur, and also to areas uncoated by antifouling paints or areas where antifouling coating breakdown is common. These areas of special concern include, but are not limited to: sea chests and gratings, bow thrusters, cable lockers, wet wells, bilges, dry dock support strips, anodes, rudder, shaft, propeller, equipment, and docking support strips.

Despite the effectiveness of modern antifouling paints used in commercial shipping, hull fouling sampling studies revealed that niche areas of ships can especially become fouled and present a risk of introducing aquatic species to a new environment. In this regard, it is instructive to summarize a New Zealand study that assessed biofouling on international arrivals (BLG 12/INF.4). Niche areas were fouled at a higher level than areas of the ship above water and underwater. The degree of hull fouling was not predictive of the frequency with which niche areas were fouled. Yachts exhibited

the highest incidence of niche fouling, greater than that exhibited by commercial and passenger vessels.

- When possible and appropriate disposal measures are in place, these niche areas should be cleaned with disinfectant and any runoff water should be disposed of properly.
- To kill or greatly reduce marine fouling organisms, move the ship from high to low salinity, preferably freshwater when feasible or possible. This practice serves the dual purpose of reducing hull fouling as well.

Design considerations for new ships

To reduce the accumulation of bio-fouling, the following ship design modification for new ships should be considered:

- Reduce niche areas.
- Create flush surfaces where possible, so as to maximize water velocity over the surface.
- Replace square bars on intake and outlet grates with round bars.
- Use different antifouling coatings in different areas on the hull depending on the hydrodynamic characteristics of the specific area.

Special considerations

- Hull cleaning measures may be required before re-entry into a country, especially for vessels which have been proven to be heavily fouled at the early call in a port/country.
- Removal of bio-fouling if the vessel has remained stationary for some period of time: If a vessel has remained at the same site (e.g., on a mooring, at anchor, or alongside a wharf) and developed secondary fouling (easily seen from the dock or boat), it should, as far as practicable, be inspected, slipped, and scraped clean before departing the site.
- Removal of bio-fouling prior to relocating the vessel from one area of operation to another: Prior to sailing from one area of operations to another, the vessel's hull should be inspected and, in the event that it has secondary fouling, slipped and scraped clean.
- In the event that an aquatic pest emergency is declared in a region, a SCUBA survey of the vessel is recommended.

Reporting and recording non native species

- Any new sightings of unidentified species or known non natives should be reported to the relevant authorities
- If possible keep a record of non native species e.g. record the date, time, location and depth at which it was collected or seen. If possible provide a photograph.
- Be aware that there may be restrictions imposed on where vessels can go if there is an outbreak of a non native species or if control measures are to be put in place.

Specific Practices by Vessel Type

The risk of introducing non native species *via* vessels of any kind can be reduced by good vessel maintenance, cleanliness, and effective antifouling. This portion of the Code of Best Practice provides guidelines to reduce the risk of entraining and translocating non native species through local and nonlocal ship movements and activities. The following approach uses guidelines developed in Australia (Best Practice Guidelines in reference list) to which the reader is referred for elaboration.

Vessel types have been partitioned into several broadly ranging categories: 1) fishing and recreational vessels, 2) commercial vessels, and 3) other vessels and floating structures. Each of the following sections begins by listing vessels encompassed by a particular category. In the first of these sections, fishing and recreational vessels, many of the suggested best practices apply universally. To minimize redundancy in subsequent sections, therefore, only practices specific for those particular vessel types are listed.

I. Fishing and recreational vessels

This general category is subdivided into two groups:

Recreational and similar small craft--All kinds of recreational boats (including commercially rented ones), e.g., powerboats, sailing boats, and pleasure craft for which IMO regulations do not apply. Includes recreational vessels that have been assessed as unseaworthy or that are heavily fouled.

Commercial and chartered fishing vessels--These are in principle similar to recreational vessels, but typically are in more frequent use than recreational vessels. They may also have more regular service intervals.

Clearly, these two groups encompasses a very wide variety and size of boat. They may be small enough to be trailered, e.g., smaller sailboats or motorboats, but the category also includes large cabin cruisers and even tall ships. Over their "lifetimes", they may travel only tens of kilometers or in the case of large yachts, tens of thousands of kilometers around the world. They may move from fresh- to saltwater and vice-versa, and in the case of the smaller ones, routine overland transport (via trailers) is possible.

A. Vessel maintenance

1. General maintenance

When cleaning and scraping hull, use a designated on-shore facility such as a marina or slipway with waste trapping facilities. All biological material and the water used to clean the vessel must be collected and disposed of using onshore waste management facilities and must not be returned to the waterway. In water cleaning by diving or careening should be discouraged.

Clean and, if possible, dry any spaces that could potentially harbour pests. For boats that have been in saltwater, rinse with fresh water when possible. For boats that have been in fresh water, rinse with an appropriate and permissible disinfectant, e.g. dilute bleach solution if possible. Treat any internal water systems (IWS) by physical cleaning at access points and by periodic flushing with fresh water. If the vessel has been immobile for a prolonged period, assess the effectiveness of the antifouling coating and clean and re-apply if necessary before proceeding to sea.

2. Vessels that use antifouling coatings

Select the best antifouling coating system appropriate for the vessel based on its type, where it will be operating, its construction, and the voyage profile. For surfaces that are not usually antifouled, e.g., propellers, use commercially available greases or similar coatings to help keep them clean.

Application and removal of the antifouling should be carried out at approved facilities and in accordance with the manufacturer's instructions. The antifouling should be applied at the appropriate frequency. Records of hull maintenance and antifouling coatings should be recorded in the vessel's operations and maintenance manuals.

3. Disposing of wastes and effluent from hull maintenance activities

The biofouling and antifouling runoff should be contained by using facilities that have waste containment receptacles built in. This waste should then be disposed of using appropriate measures and facilities. The water contaminated by fouling organisms should not be allowed to run back into the surrounding water and aquatic pests should never be released back into the environment.

4. Actions for trailered vessels

Remove any entangled or attached biological matter from the boat and trailer and ensure its disposal in bins or landfill. The biological matter is not to be returned to the water. Also, check the outboard and hull fixtures for water that could harbour potential pests and rinse the boat inside and out with fresh water or a disinfectant, drain and allow to dry if possible. Periodically removing slime from the hull will help prevent the build up of heavier secondary biofouling.

B. Vessel Operations

1. During normal deck activities

- Clear decks and any refuge areas on deck that may harbour a pest, such as spaces under winches and around deck fittings.
- Clean and dry mooring lines that have biofouling attached.
- Clear warps and anchors of biological matter and mud/sand as they are hauled.
- Periodically clean anchor and chain wells and lockers.
- Rinse vessels with fresh water or an appropriate and permissible disinfectant whenever possible.
- Never release a known aquatic pest back into the water.

2. During fishing and recreational activities

- Use locally sourced bait wherever possible to prevent the introduction of pests and diseases.
- Return bycatch to the sea as near as possible to the point of capture where it is legal to do so.
- Retain bycatch on board if cleaning gear away from fishing grounds if it is legal to do so. Keep it as ordinary rubbish.
- Dispose of bycatch in land based facilities if cleaning gear in port.
- Be aware of encounters with unusual organisms, known pests or potential pests that may lead to the accidental movement of species.

- Divers ensure that biological material entangled in dive gear is not transported to other sites.
- Rinse trailer vessels with fresh water and allow surfaces to dry if moving between locations within 48 hrs.
- Never release a known aquatic pest back into the water.
- Stream nets as close to the fishing grounds as possible. When possible nets should be dried out, particularly when being transferred to another vessel. However, as streaming nets could move non native species around, do not undertake this procedure in an area where it is known or suspected that there are non native species.

3. Managing the use of raw water, including brine tanks, live tanks and wells, and ballast systems

- Water, including brine tank water, should be exchanged offshore so that water collected from one port is not discharged into another port.
- If water is transported long distances for any reason, effort should be made to exchange in an offshore location (high risk of translocation in water transported between ports).
- Live tanks, live wells and well holes should be regularly checked for aquatic life and cleaned and dried if necessary.

II. Commercial vessels

This general category is subdivided into two groups:

Commercial trading vessels--All kinds of vessels carrying cargo on a commercial basis, including, but not limited to: oil tanker, container, bulk ore, and chemicals vessels.

Commercial non-trading vessels--These include: Barges, cable ships, coastal patrol vessels, cruise/passenger vessels, customs launches, defence vessels (including commissioned, contracted, and chartered vessels), dredges, ferries, fisheries vessels, harbour services craft, heavy lift vessels, lighters, marine administration vessels, marine safety vessels, national/marine parks vessels, offshore support vessels, pilot boats, research vessels, slow moving wooden vessels, seismic survey ships, trailered vessels, water police vessels, water taxis, and aquaculture vessels (well boats and service boats).

These vessels can have much greater hull area than fishing and recreational ships, potentially increasing the area for bio-fouling. Furthermore, because some of these vessels often travel across oceans and between biogeographic regions, they pose a higher risk of translocating species from distant origins. On the other hand, the degree of biofouling on commercial vessels may be less than that for smaller boats, e.g., yachts, as the former are in constant use with accompanying strong water movement. The smaller boats may represent a higher risk of transporting a non native species around a region once it has been introduced. Many of these vessels have regular docking periods that are driven by law, e.g., for safety inspections, or by hull fouling, because a cleaner hull means a faster voyage for less fuel. It is precisely at these docking periods when many of the generally applicable practices listed above for fishing and recreational vessels should be employed.

Indeed, adherence to the codes of practice listed earlier in this document, when applicable and practicable, will serve to minimize hull fouling for commercial vessels. In addition, onboard records should be kept of:

- previous dry dock visits (when, where, and details of hull cleaning)
- applications of antifouling paints (when and what type of paint?)
- any in-water cleaning (when and where?)

III. Other vessels and floating structures

These include: Fixed and floating platforms (e.g., drilling platforms, lighthouse ships, weather station vessels, sediment extractors, navigational buoys, wind farms, floating docks (floating dry docks), decommissioned vessels, vessels to be recycled or sunk as an artificial reef, abandoned vessels (for which an owner cannot be located), unseaworthy vessels (vessels that have no current survey), shipwrecks, and impounded ships.

Opportunities for hull fouling on such permanent or semi-permanent vessels and structures will usually be very good. The absence of shearing forces experienced by fouling communities on moving vessels increases the probability of bio-fouling. In addition, because such structures often are anchored in an area for prolonged periods (months to years), usually without cleaning, they can be very heavily colonized. Finally, given a long time to grow, the hull fouling community is likely to contain organisms that have reached sexual maturity. Therefore, if and when such vessels or structures are moved to a new area, there is the risk that any attached, non-native species will colonize the new environment

The presence of extensive fouling communities, possibly containing sexually mature organisms, warrants specific attention and action before translocation of the vessel or structure.

- Choice of antifouling painting:
    - For slow-moving or permanently fixed structures, the antifouling substance used should not be one whose effect requires water movements, thus, sloughing paints are not useful.
- Drydocking before moving:
    - If possible, structures with heavy fouling should be taken out of the water for cleaning and a new antifouling coating before moved.
    - The cleaning and coating processes should as far as possible follow the recommendations outlined elsewhere in this document.
- When dry-docking is unavailable:
    - Some structures may have a shape or size rendering them unfit for docking.
    - In some areas docking capacity is not available without moving the structure considerable distances.
    - When feasible and permissible, consider moving the vessel from fresh to saltwater, or vice-versa, to kill biofouling organisms.
    - If no other options are available, in water cleaning may be considered, following recommendations (outlined elsewhere in this document) to minimize the introduction of organism and toxic chemicals to the aquatic environment.

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Annex 5 – Joint response from WGBOSV and WGITMO regarding the possible merging of the two expert groups.

April 12, 2007

Adi Kellerman

ICES
H. C. Andersens - Boulevard 44-46
DK-1553
Copenhagen V
Denmark

Dear Adi:

As was requested in the terms of reference for the ICES Working Group on Ballast and Other Shipping Vectors (WGBOSV) and Working Group on Introductions and Transfers of Marine Organisms (WGITMO) discussed this issue of whether we should merge or remain as two separate groups. Although pros and cons were presented for merging or remaining independent of each other, it was agreed that it would be in the best interest of both groups to remain separate, but continue to meet back to back. There were several main reasons for this:

1) There is a clear, logical distinction between the mandate and activities of each group. WGBOSV work on specifically identified vectors - ballast and hull fouling, whereas WGITMO's work focuses on what happens when an invasive species is found in a water body – status of the invasion, potential impacts, options for mitigation and/or eradication, and sharing information with other countries.

2) The future direction of each group is very distinct; and diverging workloads are expected. WGITMO is more concerned with ecological risk assessments, ploidy science, population modelling, documenting the impacts of species and communicating this information with ICES countries. WGBOSV is moving towards technological and engineering studies, with biological input.

3) If groups were merged, but the Terms of Reference were kept the same it would result in a reduction in the amount of "real" work being completed during meetings and intersessionally.

4) The proposed EU legislation on introduction of alien species in aquaculture clearly establishes the need for a specialist group of experts on this issue within ICES:

- *Article 10*

  Decision period

  1) The applicant shall be informed in writing within a reasonable time of the decision to issue or refuse a permit, and in any case shall not be informed later than six months from the date of application, excluding time when an applicant provides additional information if the advisory committee so requests.

2) Member States which are signatories to ICES may request to have applications and risk assessments regarding marine organisms reviewed by ICES prior to the issuing of an opinion by the advisory committee. In such cases an additional period of six months shall be allowed.

WGITMO has and is prepared to continue to serve in that role.

The consensus was that although the groups should remain separate, because of the overlapping membership between the groups it would be logical to hold back-to-back meetings with one overlapping day in which issues of joint concern could be discussed. The issues of joint concern are vectors, cooperation and communication with PICES Working Group 21, sharing data and databases, experts, information on invasive species, risk assessment, and implications of ballast water standards and new technologies to address these standards.

We therefore request that ICES consider our request to remain as two separate working groups, but that we continue to meet back to back to with a day of overlap to exchange information and communicate with our colleagues on matters of shared interest.

On behalf of the two committee members,

Sincerely yours,

Judith Pederson, WGITMO Chair

Anders Jelmert, WGBOSV