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Report of the Working Group on Introduction and Transfers of Marine Organisms (WGITMO)

16 – 18 March 2011

Nantes, France

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

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Executive summary

The 2011 meeting of the ICES Working Group on Introductions and Transfers of Marine Organisms (WGITMO) was held in IFREMER, Nantes, France, March 16-18, with Laurence Miossec as host and Henn Ojaveer as chair. The meeting was attended by 24 participants from 14 countries. Three participants contributed to the meeting by correspondence. The participants were from Belgium, Canada, Estonia, Finland, France, Germany, Italy, Lithuania, the Netherlands, Norway, Portugal, Spain, Sweden and United Kingdom while Croatia, Denmark, Poland and the United States of America contributed by correspondence. Apologies were received from Lyndsay Brown (UK).

The objectives of the meeting were to update information and discuss several aspects related to the introduction of alien species. The meeting dealt in more detail with the availability and usefulness of databases to obtain more comprehensive knowledge on alien species; gathering information on monitoring programs and projects which involve alien species; identifying criteria to develop risk categories for intentional introductions; summarizing information on targeted fishing on non-indigenous species; and discussing the non-indigenous species related issues of the Marine Strategy Framework Directive (MSFD). As usually, sufficient time was devoted to presentations of national reports and follow-up exchange of information.

The approach taken during the meeting facilitated presentations and discussions on the issues of relevance related to the Terms of References, but also on some generic and strategically important research issues (such as: networking experience to study alien species or methodologies for early detection and identification of alien species) relevant to bioinvasions, in general. The meeting started as a half-day joint meeting with the Working Group on Ballast and Other Ship Vectors (WGBOSV) during which issues of common interest were addressed and which was followed mostly with presentations after lunch. The second day was spent on routine (e.g., presentations of national reports) or new Term of References and planning of work in coming years, all of which required substantial discussions. The third day was largely spent on the work which had already been started in previous year(s) and/or requires intersessional activities.

The report summarises the discussion outcomes and indicates the progress made according to each Term of Reference. Background material, including national reports, is added to the annexes.

The group progressed in each of the Term of Reference by either completing the task (and in some cases proposing follow-up Term of Reference for 2012) or clearly identifying and agreeing on the intersessional activities required to finalise the work. It appears that intersessional work is inherently becoming an integral component of future work of WGITMO. To share the workload, several group members were asked to lead some specific tasks.

1 Opening of the meeting

The meeting was opened at 09:00 on 16th March, 2011 as a joint session with ICES/IOC/IMO Working Group on Ballast and Other Ship Vectors (WGBOSV). On behalf of the host, a welcoming word was given by Philippe Goulletquer and Laurence Miossec. Tracy McCollin and Henn Ojaveer also welcomed participants and Tracy McCollin chaired the joint session. The joint session finished at 13:00 on 16th March and WGITMO meeting started at 14:00.

2 Adoption of the agenda

The agenda was largely organized based on the Terms of Reference as given in ICES Resolution 2010/2/ACOM30 (see below). In addition, a few invited presentations on a specific topic and/or of generic interest, which, amongst others, might assist in defining ToRs for the coming years, were accommodated into the agenda which was adopted without changes. However, this agenda was later modified as a function of the development and success of discussions during the 1st and 2nd days of the meeting (Annex 2). Marie-Claude Fortin, Canada, acted as a rapporteur.

3 WGITMO Terms of Reference

WGITMO – Working Group on Introduction and Transfers of Marine Organisms 2010/2/ACOM30. The ICES Working Group on Introduction and Transfers of Marine Organisms (WGITMO), chaired by Henn Ojaveer*, Estonia, will meet in Nantes, France , 16–18 March 2011.to:

a) Synthesize and evaluate national reports using the adopted format for reporting and contributions to the database that includes species, locations (latitude and longitude), status of invasions from other ICES member countries as appropriate, status of eradication efforts, and habitat, and develop an annual summary table of new occurrences/introductions of aquatic invasive species in Member Countries.

b) Review options for utilizing existing databases and information resources (in ICES countries and elsewhere) to provide a more complete picture of introduced species distribution and abundance and discuss verification of species identifications.

c) Review and draft a compilation of existing monitoring activities and programs with the goal of avoiding duplications. A draft summary will be prepared for next year.

d) Continue to develop and discuss joint activities with PICES WG 21 and CIESM during intersession that furthers cooperation and communication for resources sharing and information on introduced species.

e) Identify the criteria used by ICES countries to develop lists of high, moderate and low risk for intentional introductions and for those introduced species already established and prepare a final report.

f) Finalize the 5 year summary report (2003–2007) during intersession. Note: WGITMO has a draft five-year report, but needs to have reviews of the sections.

g) Prepare a draft of the 25–30 year report based on earlier National reports, literature, and other ICES country information. An outline has been de-

veloped for a draft of the report. Given taxonomic name changes, status, and criteria for including species, the process will take several years.

h) Finalize preparation of a draft report on the different approaches taken by ICES countries on targeted fisheries of non-indigenous species and the impact that these fisheries have had in reducing the spread and abundance of non-indigenous species. This will require intersessional preparation and editing of the report.

i) WGMASC recommends that key persons of WGITMO dealing with the introduction of aquatic exotic species via shellfish transfers should be invited to the next WGMASC meeting to participate in preparing a joint report, identify information gaps and recommend specific research goals and management advice.

In addition, based on the requests from SCICOM and ACOM chairs, the following ToR's were added (see also Annex 3):

a) From the ICES Marine Strategy Directive Framework Steering Group (MSFDSG):

- identify elements of the EGs work that may help determine status for the 11 Descriptors set out in the Commission Decision (available at http://eurlex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:232:0014:0024:EN:PDF;
- provide views on what good environmental status (GES) might be for those descriptors, including methods that could be used to determine status.

b) From ICES Strategic Initiative on Area Based Science and Management SIASM:

- take note of and comment on the Report of the Workshop on the Science for area-based management: Coastal and Marine Spatial Planning in Practice (WKCMSP) http://www.ices.dk/reports/SSGHIE/2011/WKCMSP11.pdf
- provide information that could be used in setting pressure indicators that would complement biodiversity indicators currently being developed by the Strategic Initiative on Biodiversity Advice and Science (SIBAS). Particular consideration should be given to assessing the impacts of very large renewable energy plans with a view to identifying/predicting potentially catastrophic outcomes.
- identify spatially resolved data, for e.g. spawning grounds, fishery activity, habitats, etc.

4 Progress in relation to Terms of Reference

The sections below provide information on the progress made on each of the Term of Reference, amended further by important discussion items as well as relevant conclusions/suggestions as emerged from the group discussions.

4.1 Term of Reference a)

Synthesize and evaluate national reports using the adopted format for reporting and contributions to the database that includes species, locations (latitude and longitude), status of invasions from other ICES member countries as appropriate, status of eradication efforts, and

habitat, and develop an annual summary table of new occurrences/introductions of aquatic invasive species in Member Countries.

This Term of Reference was addressed by all meeting participants who provided information for their country according to the items of the reporting outline. This was done either by a short verbal presentation or in the form of a more substantial presentation. The following sub-sections provide condensed highlights of all national reports received (see also Annexes 5.1-5.18).

4.1.1 Belgium (see also National Report in Annex 5.1)

During 2010 no new invasive species have been recorded. All introduced species that were reported during previous years are still present and seem to be well-established and thriving, none seem to be affected by the exceptionally cold December. In 2009 *Ensis directus* had an extremely successful spatfall, the most successful ever, and the survivors of this spatfall – now in their second year – continue to dominate the coastal waters.

4.1.2 Canada (see also National Report in Annex 5.2)

In Canada, the Department of Fisheries and Oceans is currently developing a National Aquatic Invasive Species regulatory proposal under the *Fisheries Act* which will provide a legislative tool for assisting in the control and management of aquatic invasive species. In Atlantic Canada, intentional introductions and transfers activities were similar to previous years. Atlantic salmon (*Salmo salar*) and rainbow trout (*Oncorhynchus mykiss*) were the primary organisms being transferred and imported (primarily from the US) for aquaculture purposes. Important persistent aquatic invasive species in Atlantic Canada are green crab (*Carcinus maenas*) and tunicate species. These are also considered as new and future aquatic invasive species within this region as these organisms are spreading from one Atlantic province to the next. Pancake batter tunicate (*Didemnum vexillum*) has not yet arrived in the Atlantic provinces but may eventually spread into this region. The only pathogen reported is infectious salmon anaemia virus which was discovered in a rearing facility in Prince Edward Island.

4.1.3 Croatia (by correspondence, see also National Report in Annex 5.3)

During the past three years, new information has been collected on several alien species from the Croatian part of the Adriatic Sea. These are amongst algae and higher plants: *Ceratoperidinium yeye, Caulerpa taxifolia* and *Caulerpa racemosa*; amongst invertebrates: *Cladopsammia rolandi, Nerocila orbigny, Ceratothoa parallela, Thysanoteuthis rhombus, Paromola cuvieri, Callinectes sapidus,* and amonst fish: *Fistularia commersonni, Echeneis naucrates, Polyacanthonotus rissoanus, Caranx crysos, Regalecus glesne, Coryphaena hippurus, Elates ransonnetii* and *Perccottus glenii.*

As a part of scientific programs supported by Croatian Governement (Ministry of Science) few projects regarding biological invasions have been carried out. Ministry of Culture is responsible for problematics of invasive species in Croatia which is regulated by Low on Nature Protection. One of major projects supported by Ministry of Culture is monitoring and eliminating of algae *C. taxifolia* and *C. racemosa*.

4.1.4 Denmark (by correspondence, see also National Report in Annex 5.4)

Key to identification of marine introduced animal species in Nordic waters was recently developed and it is now available on NOBANIS web-site at: (http://www.nobanis.org/MarineIdKey/general%20intro/IntroMarineKey.htm). The Japanese oyster drill, *Ocinebrellus inornatus*, has been identified in the western part of the Limfjord. The round goby, *Neogobius melanostomus*, has become invasive in southern Denmark. It has also been found in freshwater.

4.1.5 Estonia (see also National Report in Annex 5.5)

Amendment to the national Nature Protection Act (in relation to the alien species) and Nature Protection Development Plan are still waiting for approval. Alien species monitoring was started in 2010 with field works in the biggest port area – Muuga Bay (Gulf of Finland). No new alien species were found in Estonian waters in 2010. Independent of the invasion time, organism group or the life-history stage, abundance and/or biomass of alien species in the Estonian coastal sea was during the previous decades either stable or displayed abrupt annual-scale increase over time. The timing in population shifts was species-specific with the observed large shifts in environmental parameters had no uniform consequences to the alien biota. There were no key environmental factors that affected most of the alien species, instead the effects varied among the studied gulfs and species. However, temperature seems to be a common significant forcing factor for the population dynamics of most of the species. Theme Session on 'Global change and aquatic bioinvasions' at the ICES ASC 2010 was co-chaired.

4.1.6 Finland (see also National Report in Annex 5.6)

No new alien species were found in Finnish waters in 2010. The oligochaete *Paranais frici*, crustaceans *Palaemon elegans* and mud crab *Rhithropanopeus harrisii* were considered to have established populations in Finnish coastal waters. Finnish national strategy on invasive species, which aims to minimize the possibilities of new introduction of harmful alien species and the negative impacts of the established alien species, is going to be completed in the end of March 2011. Finland is going to ratify the IMO's the BWM Convention during 2011 or latest 2012.

4.1.7 France (see also National Report in Annex 5.7)

Several national and European projects were carried out and are in progress to investigate presence of non-indigenous species and to evaluate the invasiveness of the invasive species already detected (i.e. *Undaria pinnatifida*, *Spartina alterniflora*, *Gracilaria vermiculophylla*, *Mnemiopsis leidyi*, *Crepidula fornicata*). More information are included in the report. The Lionfish (*Pterois volitans*) is now present in the French West Indies, observed for the first time in the Guadeloupe Island in September 2010.

4.1.8 Germany (see also National Report in Annex 5.8)

A "Platform for Information Exchange on Neobiota" has been established in the framework of the "Federal States Marine Monitoring Programme" the national body that takes care of the duties arising from national and international obligations. In order to fulfill the requirements a bundle of studies for different obligations are in preparation. For the Wadden Sea an inventory study to provide an overview of the state of the art regarding neobiota will be tendered by the Wadden Sea Secretariat. for the trilateral Wadden Sea Cooperation Area. For the German EEZ the Federal Agency

for the Environment and the Federal Agency for Nature Conservation prepared tenders for R&D-projects to prepare the implementation of the Marine Strategy Framework Directive (MSFD). It includes the development of concepts for indicators for the assessment and the respective monitoring aiming at an overall assessment of descriptor 2 (alien species) of the MSFD. In the context of the preparation of the implementation of the Ballast Water Management Convention a risk assessment was undertaken in the frame work of the Interreg IVB Ballast Water Opportunity Project (see WGBOSV 2011 report). In order to obtain experience in the application of risk assessments the German Maritime and Hydrographic Agency launched a project on risk assessments for exemptions of ballast water management for selected harbours in the North and the Baltic Seas.

Ludwigia grandiflora, an aquatic weed from South America, was recorded in NW Germany near Leer, Lower Saxony, in a tributary of the River Ems. It is the first record from Germany and it was found entangled with water lillies. The very first record was in 2004 and later a dense growth was occurred since 2009. This species is potentially invasive and was therefore added to the German Black List. As reported previously, *Hemigrapsus penicillatus* continues to spread. A new genetical study revealed that origin of earlier *Mnemiopsis leidyi* invasions (Black and Caspian Seas in the 1980s/1990s) originate from the Gulf of Mexico region. In contrast the 2006 invasion of the North and Baltic Seas was traced as to originate from New England. It was further concluded that the initial invasion of Northern Europe occurred in the Baltic Sea. *Gracilaria vermiculophylla,* first recorded along the German North Sea coast in 2002 and along the German Baltic coast in 2005, was now, due to genetical studies, identified as of Japanese Sea origin.

4.1.9 Italy (see also National Report in Annex 5.9)

One new sighting is described for the red alga *Gracilaria vermiculophylla.* The distribution of some alien species of algae and invertebrates has expanded and a few ecological observations on their new habitats have been made.

4.1.10 Lithuania (see also National Report in Annex 5.10)

No new NIS introductions were recorded in 2010. The round goby *Neogobius melanostomus* is spreading further from Klaipeda port area, both inside the Curonian Lagoon and northward along the mainland coast. A bioinvasion impact (biopollution) assessment has been performed for invasive species found in the Lithuanian coastal waters (including the Curonian Lagoon) in the framework of the overall biopollution review for the entire marine region, the Baltic Sea.

4.1.11 The Netherlands (see also National Report in Annex 5.11)

The interest in invasive species has increased in the Netherlands due to the transfer of shellfish and the risks of transferring exotic species with that. The shellfish transfer is essential for the Dutch shellfish culture. At present it is not allowed to transport shellfish from the Oosterschelde to the Wadden Sea. At present there are developments to make the transfer of mussels from the Oosterschelde to the Wadden Sea possible. Problem species are the oyster drills *Urosalpinx cinerea* and *Ocinebrellus inornatus.* The expansion of *Ensis directus* and *Crassostrea gigas* continued. Both are dominating the benthic community in the Dutch coastal waters. Developments have been made to adapt the existing monitoring programs to sample these dominant exotic species. New species observed in the Dutch waters in 2010 are *Gerlidium vagum* and *Celtodoryx ciocalyptoides*.

4.1.12 Norway (see also National Report in Annex 5.12)

Report on "Mapping and Surveillance of Alien species in Norway" was finalized. A pilot RAI study (marina pontoons) was conducted at the Western coast of Norway in 2010: no new NAS were detected, but new observations of the ascidian *Styela clava* were recorded. Ban on live import of American lobster was recommended, based on observations confirming presence of hybrid eggs and high risk for transfer of diseases. The red king crab has extended it range soutwards. The Pacific oyster (*Crassostrea gigas*) has suffered substantial set-back on studied localities (harsh winter) in SE Norway.

4.1.13 Poland (by correspondence, see also National Report in Annex 5.13)

Mytilopsis leucophaeta, a dreissenid bivalve, was for the first time recorded in the Gulf of Gdańsk in 2010 (southern Baltic Sea). *Hypania invalida,* a polychaete species of Ponto-Caspian origin, was for the first time recorded in the Szczecin Lagoon in 2010. Ponto-Caspian gammarid species *Pontogammarus robustoides*, *Obesogammarus crassus*, *Dikerogammarus haemobaphes* and *Dikerogammarus villosus* were recorded for the first time in the Gulf of Gdańsk in 2010. *Conger conger* was for the first time recorded in 2010 in the Szczecin Lagoon at Lubiń. *Mullus surmuletus*, striped red mullet (or surmullet), was for the first time recorded in the Pomeranian Bay (in 2007) and the occurrence of three very rare noted species (tub or yellow gurnard *Chelidonichthys lucerna*, Atlantic horse mackerel *Trachurus trachurus*, thicklip grey mullet *Chelon labrosus*) collected in years 2007-2008 in the Pomeranian Bay and Lake Dąbie were recorded.

4.1.14 Portugal (see also National Report in Annex 5.14)

A list of 72 aquatic non-indigenous species (NIS) is registered for the Portuguese estuarine and coastal aquatic systems, including 4 microalgae, 22 macroalgae and 46 invertebrate species. The inventory of NIS did not include fish species and freshwater species. Portugal has a law on introduction of exotic species, published in 1999, which is currently under revision. Although the current law does not include a list of marine species the revision document included marine species and refers to IMO and ICES criteria for ballast water management.

4.1.15 Spain (see also National Report in Annex 5.15)

In 2010, two new publications reported the sightings of the mollusk *Bursatella leachii* and the porifera *Paraleucilla magna*. The mollusk *B. leachii* was found in 2009 in Mar Menor (in SE Spain, Mediterranean coast). The population numbers of this species fluctuate sporadically. *B. leachii* is a circumtropical species, widespread along the temperate water of the Indo-Pacific and Atlantic Ocean, and common in the eastern Mediterranean. Its mode of introduction to the Mediterranean could have been either by ships from the tropical Atlantic or via the Suez Canal. The sponge *P. magna* was found in 2000 off the coast of Blanes (in NE Spain, Mediterranean coast). The introduced calcareous sponge *P. magna* has proliferated along the western Mediterranean during the last decade. It is resistant to pollution and seems to be a structurally important species of the fouling community. *P. magna* prefers to settle on mussel shells and may affect their growth, forcing local shellfish farmers to invest much effort in decreasing sponge growth. It originates from the SW Atlantic, and both bivalve farming and shipping are the most probable vectors of introduction into the western Mediterranean.

4.1.16 Sweden (see also National Report in Annex 5.16)

No new introduced species have been reported in Swedish coastal waters during 2010. To be able to receive reports on American lobsters (*Homarus americanus)*, there is a new fishing regulation soon to be implemented, stating that all suspected *H. americanus* should be reported, landed and examined, also outside normal lobster fishery regulations. The severe ice winter 2009/2010 reduced shallow-living Pacific oysters (*Crassostrea gigas*) substantially.

Round goby (*Neogobius melanostomus*) has now been found at four major harbours in Sweden, far from each other (Visby, Göteborg, Karlskrona and Karlshamn). The parasite *Marteilia refringens* has been confirmed in preliminary three new locations on the Swedish west coast, but in relatively few individuals of the host blue mussel (*Mylilus edulis*).

4.1.17 United Kingdom (see also National Report in Annex 5.17)

A live specimen of a blue crab (*Callinectes sapidus*) was caught in February during the annual Cefas/Maritime Division oyster survey of the Fal Estuary in Cornwall. This is a new species record for the UK.

The predatory shrimp *Dikerogammarus villosus* was found in September 2010 for the first time in the UK at Grafham Water, a drinking water reservoir located near Huntingdon, Cambridgeshire, England. The species was subsequently confirmed at two sites in south Wales at Cardiff Bay and Eglwys Nunydd Reservoir in Port Talbot. It is not known how it arrived, though boats and angling equipment have been mentioned. Measures are being taken to contain the species as much as possible.

Eradication of *Didemnum vexillum* in Wales (Holyhead harbour) was completed but new colonies have since appeared. Pathway management options to prevent further spread of the species in England, Scotland and Wales are being pursued. Currently no action or monitoring is taking place in Ireland.

There were several reports of American/Canadian lobsters (*Homarus americanus*) being collected from the wild, seven animals from the south coast of England and one from the north east coast of Scotland. It is thought that these animals were recent escapes from holding systems. Several review papers on non-native fishes and their management in the UK were published in 2010.

4.1.18 United States of America (by correspondence, see also National Report in Annex 5.18)

A first record of *Tricellaria inopinata* in Massachusetts, (identified by Dr. Judith Winston) was reported in 2010. Its status is unknown, but it is also likely that the species has been present but misidentified as one of the morphospecies present throughout New England.

We conducted a Rapid Assessment Survey in New England, from Casco Bay Maine to Point Judith, Rhode Island. We confirmed the presence of "*Herterosiphonia" japonica* in Rhode Island (a new report for 2010) and in Sandwich Marina, Massachusetts (also a new report). It is reported found around the North of Boston but is not reported in New Hampshire and Southern Maine. It was likely to have been present for years and unreported until recently (initially washed ashore by a hurricane).

A tropical, warm temperate species, a bryozoan *Zoobotryon 'verticillatum'* has been reported in the Mystic River in 2005 as a small colony and in 2010 at several locations

along 175 m of the Mystic River, Connecticut. Although it is found in Southeastern U.S. waters, it is not reported as far north as the Chesapeake Bay. The source of the bryozoan is not known; its population status is uncertain.

Eriocheir sinensis, the Chinese Mitten Crab is now considered established in the Hudson River, but not necessarily in Delaware Estuary or Chesapeake Bay where it was previously reported and continues to be found, but in decreasing numbers. It has not been reported in New England or south of the Chesapeake.

The light bulb tunicate, *Clavelina lepadiformis,* has not been reported outside of the Thames River, Stonington, Connecticut, Long Island Sound in 2008 and 2009 and is considered established there.

No records of *Hemigrapsus takanoi, Undaria pyriformis*, and *Sargassum japonica* have been reported.

4.2 Term of Reference b)

Review options for utilizing existing databases and information resources (in ICES countries and elsewhere) to provide a more complete picture of introduced species distribution and abundance and discuss verification of species identifications.

It was stated that currently, there are over 180 different alien species databases and information sources globally and to inventory and get an overview of all these sources would be an impossible task for the group to perform. Moreover, Joint Research Centre (JRC) of the European Union is currently preparing an overview on available European alien species databases.

To obtain a more complete picture of introduced species, we need a queryable database. For such a database, it would be important to agree on what should be the appropriate spatial resolution for the data (i.e., what are the considerations – provide data by spatially variable environmental conditions, bear in mind spatially-dependent management purposes, or just provide data by their availability) as well as what metric is used to describe abundance/biomass. Accompanying environmental data are also needed in the database, at least for key factors like salinity and temperature. It also needs to be considered what questions should be queryable, what answers we want to get; and how to ensure data quality.

It was stated that the recently started EU FP7 VECTORS project will deliver a European marine and other aquatic alien species database (incl. data from non-ICES member countries), which is expected in 2012-2013. The new database will be based on the deliverables of the previous EU FP6 project (DAISIE), which has been recently updated within the framework of the European Census of Marine Life project. However, this database will lack western Atlantic data i.e., those from Canada and US. The database format and data-categories (e.g., the spatial scale considered and how vectors of introduction should be classified) will be defined and agreed later in 2011. It will be ensured that the developed format will allow to add non-European data and that the database will provide a search function.

Concerning the data quality, it was stated that an editorial board of the database is needed. It should consist of specialists having knowledge on regional seas and taxonomic group experts. The editorial board should oversee that species names in the database are valid, that species are identified correctly and that all species related attributes such as biological traits, environmental data, possible introduction vector, impacts and other information are all accurately indicated in the database. The rough estimate is that 15-20 persons per regional sea would be required.

The group discussion concluded, that (see also Annex 4):

- The database issue needs to be maintained in the Terms of Reference for coming years;
- WGITMO should be actively involved in developing the framework and validating data and information to be included into the pan-European database on alien species;
- WGITMO should also play a key role to expand the database outside Europe, essentially to include US and Canadian data into the database.
- Sergej Olenin (Lithuania) will lead this activity and oversee the process.

4.3 Term of Reference c)

Review and draft a compilation of existing monitoring activities and programs with the goal of avoiding duplications. A draft summary will be prepared for next year.

Discussion of this Term of Reference was held after the Finnish case study presentation where representativeness and availability of alien species data from national marine monitoring programme was evaluated (see below).

Although much coordinated sampling / marine monitoring has taken place in several seas (e.g., the North and Baltic seas), none of these are specifically targeting AIS. Therefore, the suggestion was to consider under this Term of Reference 'Existing biological monitoring activities which might contain information on alien species'.

The reporting outline on monitoring activities was developed during the meeting. It was agreed, that detailed information should be provided by using the following types of alien species monitoring:

1) Presence/absence (incl. target species) monitoring
2) Spatial distribution monitoring
3) Abundance/biomass monitoring
4) Ecological impact monitoring
5) Port monitoring

Under each monitoring type consider providing the following information:

a) Since when (or which years)
b) Which organism group(s)
c) Sampling design and –frequency (by all investigated organism groups)
d) Sampling methods (by all investigated organism groups)
e) Sampling area/region/locations (give information by all organism groups, if different)
f) Habitat surveyed (incl. artifical habitat)
g) List of environmental parameters measured during the monitoring surveys
h) Status of data availability (i.e., are data available and if yes, under which conditions)

In addition, any information on the socio-economic impacts monitoring should be collected.

It is expected that the requested information will be received prior to the next meeting in order to finalise the report in 2012.

It was agreed that we don't need to provide a comprehensive list of all monitoring activities, as listing only the governmental laboratory long-term monitoring activities, which have been ongoing and have made a commitment to continue, may be sufficient to cover the important groups. Such information should be relatively easy and realistic to obtain. Data related to smaller independent monitoring projects may be harder to collect and therefore not be worth the time spent. It was also stressed that monitoring in private facilities are not always subjected to quality control as the samples which are collected are analyzed by poorly qualified staff and therefore cannot be used.

If collected, the assembled information would allow to perform a gap analysis of monitoring activities/programs to evaluate whether these activities and programs adequately cover alien species. It was also emphaiszed, that more success would be achieved in terms of alien species monitoring, if the already existing monitoring programs could be modified to accommodate alien species, instead of reinventing the wheel or asking for a new specific monitoring program for them.

Results of the ongoing monitoring programme in Finland (by Maiju Lehtiniemi and Lauri Urho)

It is important to know the present distribution and abundance of alien species as well as be able to detect new introductions in order to react rapidly for eradication or information spreading purposes. However, non-native species are usually not monitored through specifically designed monitoring programs and due to the lack of resources new monitoring programs are unlikely in the near future. Therefore the best option would be to amend present biological monitoring programs so that they also allow the detection of alien species.

The on-going biological monitoring programs and the data obtained through them were evaluated for Finland in order to see how well/poorly alien species are detected and how well the abundance and distribution of alien species may be estimated. The present monitoring programs were all identified and evaluated and their spatial and temporal coverage as well as the frequency of sampling noted.

There are currently macrophyte, phyto- and zooplankton, benthos and fish monitoring in the littoral and open sea areas. Open sea monitoring stations of all above mentioned biological groups adequately cover Finnish territorial waters although the station grid is scarce. Littoral monitoring covers phytoplankton, macrophytes and benthos adequately, however fish and zooplankton are sampled only on the southern coast of Finland leaving the entire Gulf of Bothnia unmonitored. The temporal coverage is poor in the open sea monitoring programs. Benthos, phyto- and zooplankton are sampled only once a year at a time of population peak abundances. Littoral monitoring covers better the entire productive season leaving only ice-covered period unsampled. Fish monitoring is an exception from other monitoring programs. Coastal fish sampling is conducted only once a year in summer but the open sea monitoring covers the entire year.

Although monitoring programs cover littoral and open sea environments, alien species detection is poor. Although only 2 alien species (out of a possible 29 species) can be detected, the abundances of these species are well estimated based on the current monitoring. Both species are benthic animals. All planktonic alien species can be detected but their abundances are underestimated. All shallow water fish, crustacean and mollusc species are left undetected in the present monitoring programs.

4.4 Term of Reference d)

Continue to develop and discuss joint activities with PICES WG 21 and CIESM during intersession that furthers cooperation and communication for resources sharing and information on introduced species.

Despite invitations and encouragements to start discussions on creating effective links and cooperative activities, there were no participants from either CIESM or PICES this year. It appeared, that because of the fixed term of WG's in PICES, WG 21 was disbanded. However, representatives of several Mediterranean Sea countries participated in WGITMO activities (see Annex 1) and close cooperation is also in place between several WGITMO members with Mediterranean alien species scientists representing non-ICES member countries (Italy, Israel, etc.). The joint WGITMO/WGBOSV group agreed that effective cooperation between different research organisations representing different regions would be beneficial. One of the options driven by the mutual interests and benefits would be to periodically (say about every 2-3 years) hold a joint ICES/CIESM/PICES Alien Species Symposium. These events would ensure more proactive role for these organisations in the international arena in the field of aquatic invasions. The joint WGITMO/WGBOSV group supported the proposed idea on having joint research symposia, but it was mentioned that these symposia should have a different emphasis than the current International Conference on Marine Bioinvasions and the International Conference on Aquatic Invasive Species.

It was suggested that the WGITMO chair should continue the ongoing efforts to effectively engage PICES and CIESM into ICES WGITMO work. It was raised that it may be beneficial if communication with PICES and CIESM were coordinated by the ICES secretariat.

4.5 Term of Reference e)

Identify the criteria used by ICES countries to develop lists of high, moderate and low risk for intentional introductions and for those introduced species already established and prepare a final report.

This Term of Reference was discussed at the meeting. Firstly, the risk assessment approach as outlined in the detailed appendices of the 2005 ICES Code of Practice (CoP) was presented. The relevant document was presented to ICES with an earlier Meeting Report with the request to publish the detailed CoP Appendices on the ICES webpage. Secondly, the Council Regulation (EC) No 708/2007 concerning use of alien and locally absent species in aquaculture was considered. The regulation includes a rank of low risk for species that have been in aquaculture for a long time and which have had no reported impacts. High risk considers problematic species unless proven otherwise. Screening is required to determine if high risk is likely.

Appendix B of ICES CoP 2005: Risk Review

This Appendix provides a detailed, consistent approach for evaluating the risk of genetic, ecological, and disease impacts in the proposed receiving environment, as well as the potential for introducing non-target species. This review should be based in part on the information provided in the Prospectus.

The precautionary principle will be taken into account in the final outcome of the risk assessment.

Definition of Overall Aquatic Organism Risk Potential

HIGH = Organism(s) of major concern (major mitigation measures are required). It is advised that the proposal be rejected unless mitigation procedures can be developed to reduce the risk to Low.

MEDIUM = Organism(s) of moderate concern. It is advised that the proposal be rejected unless mitigation procedures can be developed to reduce the risk to Low.

LOW = Organism(s) of little concern.

At each of steps as listed below, the element rating and rationale for the rating should be recorded, based on the following criteria:

A HIGH rating means that the risk is likely or very likely to occur.

A MEDIUM rating means that there is a probability of negative impact.

A LOW rating means that the risk is considered to be insignificant.

The level of certainty is intended to give an estimate of whether the element that is being rated is based on scientific knowledge, experience, or whether it is extremely subjective and based on "best guess". Such uncertainties need to be taken into account when making a decision.

The CoP risk evaluation is structured in two parts with individual steps as shown below.

Part I – Aquatic Organism Ecological and Genetic Risk Assessment Process

Step 1 Determining the Probability of Establishment

Step 2 Determining the Consequence of Establishment of an Aquatic Organism

Step 3 Estimating Aquatic Organism Risk Potential

Step 4 Completion of Risk Assessment Documentation

Part 2 – Pathogen, Parasite or Fellow Traveller Risk Assessment Process

Step 1 Determining the Probability of Establishment

Step 2 Determining the Consequence of Establishment of a Pathogen, Parasite or Fellow Traveller

Step 3 Estimating Pathogen, Parasite or Fellow Traveller Risk Potential

Step 4 Completion of Risk Assessment Documentation

Based on the round table discussion on: 1) which ICES countries were using the ICES Code of Practice and 2) if these countries used the ICES Code of Practice definition for low, medium and high risk, it appeared that only three countries are using the ICES COP, and by following the philosophy of the code then also they follow the definition of low, medium and high risk. However, although the CoP is not implemented directly by the majority of ICES member countries, the CoP is taken into account by Council Regulation (EC) No 708/2007 and therefore indirectly applied by EU member states. Thus, any country implementing this EC regulation should therefore be following CoP.

The UK non-native species Risk Assessment (UKNNRA) is based on principles and protocols derived from the European Plant Protection Organisation (EPPO) scheme,

with enhancements that include the incorporation of pre-screening tools and the assessment of assessor confidence (i.e. uncertainties). The EPPO and UKNNRA schemes have been re-developed simultaneously to create stand-alone electronic modular frameworks, CAPRA and NAPRA respectively. Closely related to the CAPRA and NAPRA is the European Non-native Species in Aquaculture Risk Scheme (ENSARS), which was developed for the EU Regulation on the Use of Alien Species in Aquaculture (EU ASR). The ENSARS protocols were developed to be consistent with the ICES Code of Practice and to be readily incorporated into the CAPRA/NAPRA framework. In all of these schemes, a pathway analysis approach is taken, with assessment of the risks of introduction, establishment, dispersal and impact. The scoring system involves responses that range from 1 (low risk) to 5 (high risk). The score summary calculation system is still under development, but it is based on matrix modelling to integrate both quantitative and semi-quantitative responses from the assessors. Over 35 species have been assessed using the UKNNRA and NAPRA schemes (https://secure.fera.defra.gov.uk/nonnativespecies/index.cfm?sectionid=51), with an equal number of assessments in process. ENSARS has been applied to two species on Annex IV of the EU ASR, with the remaining species on this annex list to be assessed during 2011.

Recommendations

- It was suggested that the generic ICES CoP definition of risk should be left as it is currently defined;
- It was proposed that we may need to revise the ICES CoP to make it clear that the Risk Assessment is only the first step, and explain the roles of different groups involved in the decision making;
- It was suggested that we may need to update the appendices and publish them online. This will also ensure the visibility of ICES CoP as it was felt that the lack of use of the ICES CoP is not due to the absence of interest, but rather a low level of awareness (or not having much marine aquaculture).

Closely related to establishing acceptable levels of risk for all countries, is the need to identify unintentional introductions that may also invade other countries. Several countries use an Early Detection and Rapid Response approach to address new potentially invasive invaders.

4.6 Term of Reference f)

Finalize the 5 year summary report (2003–2007) during intersession. Note: WGITMO has a draft five-year report, but needs to have reviews of the sections.

This Term of Reference has received low level of input intersessionally. Only one co-editor of the report (Laurence Miossec) attended the 2011 meeting. The current WGITMO chair is missing critical documentation for this ToR from the past as this activity was started several years ago without the current chair's involvement. The version of the summary report available for the 2011 meeting may not be the most recent one. However, this report is at a relatively advanced stage, but with several sections still requiring substantial and careful attention.

The common opinion was that the 5-years summary report needs to be finished and published. To accomplish this task, the following steps and/or allocation of duties were agreed upon:

- The report should be finalized in 2011;
- The chair will contact all five co-editors of the report and encourage them to finalise the report;
- Tracy McCollin will review the phytoplankton section;
- Malin Werner will re-read the fish section and ensure that all important information is included;
- Laurence Miossec will re-read the pathogens section and ensure that all important information is included;
- The chair will oversee the whole process to ensure effective and timely activities.

4.7 Term of Reference g)

Prepare a draft of the 25–30 year report based on earlier National reports, literature, and other ICES country information. An outline has been developed for a draft of the report. Given taxonomic name changes, status, and criteria for including species, the process will take several years.

Several meeting participants raised the following critical questions regarding the 25-30 year report:

- Compilation of the report is time consuming and this may not be proportional to the value of the product;
- The information available in WGITMO reports over time is in some cases non-systematic in terms of availability of the country reports and completeness of the information provided there;
- Adding literature searches to this activity makes it prohibitively time-consuming and for it to be effective, would require relatively strict focussing, for example on selected organism-categories, seas, etc., and would further involve the likely problem of different languages used in several nationally published papers/reports etc.;
- The number of people actually using this report might be not very high as more often, original research papers are cited;
- It is often difficult for the responsible authors/editors to find the required amount of time to successfully perform the allocated activity.

Therefore, preparing a draft of the 25-30 year report did not receive the support of the group and it was suggested that WGITMO efforts and activities be concentrated on more productive activities; such as active participation in developing/finalising the European alien species database (where all ICES WGITMO country report species-information will be included) and producing high-quality research papers based on this unique and complete data-source, or addressing some other currently emerging and/or important issues. These new strategic directions are already embedded into the proposed Terms of References for 2012 (Annex 4).

We may wish to find alternative ways of making the WGITMO work of the previous decades accessible and visible. One option would be to consider publishing the WGITMO reports from previous years (as a package) on the ICES website.

4.8 Term of Reference h)

Finalize preparation of a draft report on the different approaches taken by ICES countries on targeted fisheries of non-indigenous species and the impact that these fisheries have had in

reducing the spread and abundance of non-indigenous species. This will require intercessional preparation and editing of the report.

This Term of Reference was started during the WGITMO 2010 meeting with the aim of completing it in 2011. Because of the generally low level of intersessional activity, the relatively weak responses from a number of ICES member countries and the variability of information provided and/or potential misinterpretation of this ToR, it was critically discussed at the 2011 meeting and agreed that:

- This ToR will be addressed intersessionally with delivery of the report later in 2011;
- WGITMO members will be contacted after the meeting, provided with the explanatory notes on what kind of information is actually expected to fulfill this task, specifically on:
    - Any targeted fishery (recreational, commercial etc…) on alien species;
    - Impact of the fisheries in reducing spread and abundance of non-indigenous (may include expected results)
- The deadline for submission of the requested information by national representatives is May 2011.

Malin Werner (Sweden) kindly agreed to lead completion of this ToR.

4.9 Term of Reference i)

WGMASC recommends that key persons of WGITMO dealing with the introduction of aquatic exotic species via shellfish transfers should be invited to the next WGMASC meeting to participate in preparing a joint report, identify information gaps and recommend specific research goals and management advice.

This Term of Reference was addressed intersessionally as the WGMASC 2011 meeting was scheduled for early April 2011. The WGITMO chair established contact with WGMASC chair (Pauline Kamermans) and asked for further information and background of this request. One of WGMASC 2011 ToR's was to "Review and assess the potential for transfer of non-indigenous species and diseases; the potential genetic implications for wild stocks; the impact on recruitment to existing stocks by large-scale transfers, and scientific tools for decision support on cultured shellfish transfer issues".

One WGITMO member (Laurence Miossec, France) was already nominated as a potential participant to the WGMASC meeting. Laurence Miossec was available and kindly agreed to attend the WGMASC meeting, and WGITMO considered this ToR as completed.

4.10 Additional Term of References

In relation to the Marine Strategy Framework Directive:

- Identify elements of the EGs work that may help determine status for the 11 Descriptors set out in the Commission Decision
- Provide views on what good environmental status (GES) might be for those descriptors, including methods that could be used to determine status.

In relation to the Strategic Initiative on Area Based Science and Management:

- Take note of and comment on the Report of the Workshop on the Science for area-based management: Coastal and Marine Spatial Planning in Practice (WKCMSP) http://www.ices.dk/reports/SSGHIE/2011/WKCMSP11.pdf
- Provide information that could be used in setting pressure indicators that would complement biodiversity indicators currently being developed by the Strategic Initiative on Biodiversity Advice and Science (SIBAS). Particular consideration should be given to assessing the impacts of very large renewable energy plans with a view to identifying/predicting potentially catastrophic outcomes.
- Identify spatially resolved data, for e.g. spawning grounds, fishery activity, habitats, etc.

As these new ToRs were given just a few days before the meeting, in-depth planning and sufficient time allocation for these ToRs during the meeting was unfortunately impossible. These new ToRs were discussed during the joint meeting with WGBOSV and followed up on later during the separate WGITMO meeting.

During the joint meeting of the groups, a brief introduction on the Marine Strategy Framework Directive (MSFD) and the ICES Strategic Initiative on Area Based Science and Management were given by Tracy McCollin and Henn Ojaveer. It was pointed out that while there is a specific Descriptor of the Good Ecological Status (GES) for the non-indigenous species, WGITMO could potentially contribute to the following science needs and key gaps in knowledge as identified in the WKCMSP report:

- Methods for impact assessment including cumulative impacts evaluation, risk based output (probabilities);
- Definition of targets and measures (spatial/non-spatial);
- Understanding the linkages of scales (management scales, process scales, evaluation/monitoring scales);
- Risk assessment models based on probabilities and accounting for processes.

In addition, WGITMO could contribute to the following potential spatial planning need (as identified in WKCMSP; WGITMO context underlined):

ICES should identify <u>what indicators are available for assessment purposes</u> and suggest ones where these are lacking and also identify which species and habitats need protection, i.e. what are the key species and habitats. Has or can the WG <u>identify indicators for assessing which species or habitats need protection or which might be key indicator species for assessing the effects of human activities</u>. Particular consideration should be give to assessing the impacts of very large renewable energy plans with a view to identifying/predicting the potentially catastrophic outcomes. For such plans tipping point/carrying capacity analyses, models and indicators are needed.

During the course of the meeting, presentations were made by Sergej Olenin on the EU MSFD JRC/ICES TG2 Non-indigenous species report and the Online bioinvasion impact/biopollution assessment system BINPAS (see below). Group discussions focussed on assessing the impact of non indigenous species and the use of monitoring programmes. The need for baseline data against which to measure the management success was emphasized.

The general conclusions largely relevant for the both groups (i.e., ITMO and BOSV) were:

- Prevention is essentially important and systems should be put in place to prevent the introduction of species in the first place;
- Vectors and pathways need to be managed to minimise or prevent spread of already established species;
- Baseline surveys with consistent effort as well as ongoing long term monitoring are required. If possible, the ongoing monitoring should be adapted to cover alien species;
- Exemptions under the IMO Ballast Water Convention will require a risk assessment based on which species are present so this information will be needed to carry out such assessments;
- Information regarding which species may be introduced may also be required.

It was also discussed that intersessional work is likely needed, as developments related to MSFD GES are relatively rapid and not fully predictable. Amongst others, this also depends on the decisions of the ICES MSFD Steering Group (MSFDSG).

Overview on the EU MSFD JRC/ICES TG2 Non-indigenous species report (by Sergej Olenin)

The Marine Strategy Framework Directive (2008/56/EC) (MSFD) requires that the European Commission develop criteria and methodological standards to allow consistency in approach in evaluating the extent to which Good Environmental Status (GES) is being achieved. One of the GES descriptors is directly related to alien species and it reads: "Non-indigenous species introduced by human activities are at levels that do not adversely alter the ecosystems". The following key aspects of the report were briefly introduced: Definition of key terms (non-indigenous species, cryptogenic species, invasive alien species, levels that do not adversely alter the ecosystems); GES in relation to the descriptor; Key attributes of the descriptor (number of NIS recorded in an area, abundance and distribution range of NIS, NIS impact on native communties, NIS impact on habitats, NIS impact on ecosystem functioning); How are the indicators aggregated to assess GES for the descriptor; and What are the monitoring and research needs. It was also stressed that non-indigenous species are relevant for several GES Descriptors.

BINPAS – online bioinvasion impact/biopollution assessment system: call for cooperation (by Sergej Olenin)

The methodology of bioinvasion impact assessment is based on estimation of the abundance and distribution range of alien species in an assessment area and the magnitude of their impacts on native communities, habitats and ecosystem functioning, all aggregated in a hybrid ranking "Biopollution Level" (BPL) index (Olenin et al., 2007). The later ranges from "no impact" (BPL=0) to "massive impact" (BPL=4). BINPAS (Bioinvasion Impact / Biopollution Assessment System) is the computerised application of BPL methodology (available at http://www.corpi.ku.lt/databases/binpas) created using open source web technologies (Apache 2, PHP 5) and MySQL 5 relational database management system. BINPAS collects and stores standardized ecological data on bioinvasion impacts submitted by contributors. The system has been tested and validated on a number of case studies from various ecosystems. It proved to be feasible in integration and sharing of ecological data, providing reliable results for inter-regional comparisons and

meta-analysis of the bioinvasion effects on different spatial and temporal scales (Olenin, Narščius, 2010; Olenina et al., 2010; Zaiko et al., 2011).

4.11 Other discussion items

There were several strategically important generic discussion items and/or presentations which were not directly related to the Terms of References. These are briefly summarised below.

4.11.1 Name and subject of the expert group

This discussion item was raised by WGITMO chair, motivated, amongst others, from the fact that substantial development has occurred in the field of bioinvasions and the expert group name might need to be updated based on these developments in order better to correspond to the subject. Another consideration was that several new members have had difficulties discerning whether only marine alien organisms are dealt with by this group or if all biota occurring in the sea should be taken into account.

The group suggests on the consensus basis that:

- The expert group name should be retained as it is already known amongst marine ecologists globally;
- To adequately express the subject of this expert group, the following explanatory sentence should be added to the ICES WGITMO website as well as to the National Report format: "WGITMO deales with marine as well as freshwater species which have an influence on and/or occur in the marine environment".

4.11.2 Network approaches to studying aquatic invasive species in Canada (presentation by Hugh MacIsaac)

Canada's science agency – Natural Sciences and Engineering Research Council (NSERC) – funds comprehensive programs of research that are considered to be national priorities. Between 2006-2011, NSERC funded a research network called the Canadian Aquatic Invasive Species Network (CAISN), that includes 34 faculty members drawn from universities and federal Fisheries and Oceans labs across Canada, plus partners including Fisheries and Oceans Canada, Transport Canada, provincial governments, shipping and aquaculture industries, and NGOs. The network had three research priorities:

1) vectors and pathways

2) factors affecting establishment success

3) risk assessment.

Projects were conducted across eastern and western Canada, and the Great Lakes and included >20 projects. Common sampling teams collected all needed samples in three geographic areas, with samples couriered to individual labs for analysis. This approach is cost-efficient, allows a comparative approach to vector strength in different areas, and allows simultaneous analysis of a large number of taxonomic groups (e.g. viruses, bacteria, dinoflagellates, diatoms, benthic and planktonic invertebrates in ballast water). Results allowed CAISN to prioritize the need for management actions in different regions of the country regarding hull fouling, ballast water management etc.

In 2011, a new network, CAISN II, will commence activities. This network includes ~50% different composition in participating principal investigators (30), though many of the partners are the same. Priorities for the network include:

1) Early Detection

2) Rapid Response

3) Effects of multiple stressors involving aquatic invasive species

4) Managing Uncertainty

This network will conduct its activities across the same three geographic areas plus the Arctic. In sum, these two networks will train 90 MSc, PhD and PDFs, dramatically increasing Canada's expertise in the invasion field. These networks also provide science-based advice to government and industry to more effectively manage invasion vectors and manage invasion problems in Canada.

4.11.3 Early detection and identification of aquatic invasive species using molecular methods (presentation by Hugh MacIsaac and Aibin Zhan)

Effective management of AIS is contingent on early detection and species identification. These tasks are rendered difficult by the typical low population abundance of AIS when they are first introduced, and by taxonomic difficulties that are becoming ever more challenging as expertise is slowly lost. An alternative approach uses the growing databases of molecular characterization of species – barcodes. We propose a series of techniques that may be used with bulk water samples to:

i) case 1: identify unknown AIS, or

ii) case 2: seek to identify presence of targeted AIS. For example, this approach has already been used to determine presence of Asian carp species (silver and bighead carp) in waterways around Chicago, USA.

In case 1a, barcoding, raw water is collected, species are sorted under a microscope, DNA of single species (specimens) is extracted and amplified using PCR, sequenced using universal primers, and sequences then compared to 2 online databases NCBI (genebank; 3 web sites: Japan, USA, Europe) or BOLD (Barcoding of Life Database; Canada). Species identity given as probability based on similarity of sequences. Databases are expanding exponentially. Barcoding has proven much more capable of identifying species from resting eggs than traditional hatching and taxonomic identification (Briski *et al*. 2011).

In Case 1b, unknown species may be identified using pyrosequencing. Here, raw water sample is processed without separating species, and all DNA is homogenized. You can then use either universal primers (if available) or taxon-specific primers depending on objective. Some pyrosequencing processes require PCR, some don't. Technically, pyrosequencing can identify up to 1.4 million DNA sequences per plate (using single or combined samples). Combined samples can use tags to distinguish the different subsamples in a larger sample (e.g. spring and fall collections). Data requires a powerful computer to process (identify) all sequences against BOLD or BLAST databases. From this, we can potentially identify all species in a sample if those species are in reference databases. Otherwise, we get unidentified sequences that can be identified in future years. Technique is very expensive.

In Case 2a, we can identify target species using PCR and species-specific primers. Here, DNA is extracted from raw water and PCR amplification follows using species-specific primers.

In Case 2b, we can identify target species using Quantitative PCR (qPCR). Here we collect raw water, isolate DNA, amplify using qPCR for 40-45 cycles. Standard curve corrects for possible errors caused during PCR. We then use a standard curve (DNA quantity vs. PCR cycles) to estimate how much DNA we started with for a particular species.

In Case 2c, we identify target species using a micro-array. Here bulk DNA is extracted from a raw water sample. Hybridization with a microarray chip containing species-specific probes for AIS (40 global AIS in the case of CAISN). If any of these species are present in the sample, we will get a hit in the spot on the chip specific for that species. Identification is based on density of the signal and the colour of the signal.

Each of the above techniques has specific strengths and weaknesses, each of which varies over time. All of the techniques are dependent on existence of species-specific probes and/or appropriate reference databases. A key advantage is that they may identify a species at any stage of development, and they do not require any taxonomic expertise.

4.11.4 "I just can't bring myself to kill it" – How human weakness leads to the introduction and dispersal of non-native fishes (by Gordon H. Copp)

The demography of non-native fish introductions and dispersal processes (both human and natural) are examined within a risk analysis context. Introduction pathways are examined at local, regional and national scales, focusing on the potential relationships between the intensity (i.e. propagule pressure), the diversity of fish imports and the occurrence of non-native freshwater fishes in the wild, and human population densities. The role of humans at the local scale in the release of pet fish is examined using case studies, with examples also provided of other human-related introduction and dispersal pathways as well as a brief case study of the natural dispersal of an introduced fish species – pikeperch *Sander lucioperca*.

4.11.5 The impact of the invasive comb jelly *Mnemiopsis leidyi* in the North Sea (a PhD study as part of the MEMO project) (by Lies Vansteenbrugge Lies, Hostens Kris, Johan Robbens, Vincx Magda and the MEMO consortium)

Although the Belgian part of the North Sea (BPNS) is a very well studied ecosystem, the knowledge on jellyfish and more specifically ctenophores is poorly documented. Zooplankton research in the BPNS shows that several ctenophore species are facilitated by higher summer and autumn water temperatures. Recently it became obvious that these 'primitive' invertebrates are able to alter and control complete food webs.

The American comb jelly, *Mnemiopsis leidyi*, is one of the most notorious invasive species in the world. It caused massive ecological and economical damage to the Black Sea ecosystem. In the BPNS, it was observed for the first time in 2007.

To assess the impact of *M. leidyi* on different human activities (fisheries, energy providing industries and tourism) a detailed study will be carried out on the spatial and temporal distribution and the role of *M. leidyi* in the food web of the BPNS and the Westerschelde estuary. A standard Operational Protocol for sampling, conserving

and fixating these fragile species for different analysing purposes, will be further developed.

M. leidyi is known to predate on fish eggs and larvae and zooplankton. As such, it can be seen as a potential competitor and predator of zooplanktivorous fish. The position of *M. leidyi* in the food web will be assessed using stable isotopes and fatty acid analyses, and through the use of a genetic probe to identify *M. leidyi* at a larger North Sea – North Atlantic Ocean scale.

The obtained information will be useful to formulate national and international policy advice towards various sectors, including fisheries, energy providers and tourism.

This PhD study is a part of the MEMO project (*Mnemiopsis* Ecology and Modelling: Observation of an invasive comb jelly in the North Sea; www.ilvo.vlaanderen.be/MEMO), which frames in the Interreg IVa '2 Seas' programme. The MEMO project is a collaboration between ILVO (BE), CEFAS (GB), IFREMER (FR), ULCO-LOG (FR) and Deltares (NL).

5 Closing of the meeting

The meeting was closed at 13:00 on 18th March, 2011. The chair thanked IFREMER for providing the meeting venue and, specifically, Laurence Miossec for ensuring efficient logistics which were a backbone of the success of the meeting. The chair also thanked the meeting participants for their input and the rapporteur, Marie-Claude Fortin, for her extremely operational delivery of the meeting notes.

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Annex 2. Meeting agenda

WEDNESDAY 16th MARCH

Joint meeting with WGBOSV

09.00 Opening of the meeting

Welcoming remarks

Philippe Goulletquer, Ifremer, Prospective & Scientific Strategy Division in charge of Marine Biodiversity

Tracy McCollin and Henn Ojaveer.

Logistics

Introduction of Participants and Guests.

09.45 Review of Terms of Reference and Agenda Items relevant to both groups

Marine Strategy Framework Directive and role of both BOSV and ITMO (see folder on WGBOSV SharePoint and files on WGITMO Sharepoint)

- Identify elements of the EGs work that may help determine status for the 11 Descriptors set out in the Commission Decision
- Provide views on what good environmental status (GES) might be for those descriptors, including methods that could be used to determine status.

ICES Strategic Initiative on Area Based Science and Management (SIASM) and role of both BOSV and ITMO (see ICES WKCMSP 2011 report on WGITMO Sharepoint)

- take note of and comment on the Report of the Workshop on the Science for area-based management: Coastal and Marine Spatial Planning in Practice (WKCMSP) http://www.ices.dk/reports/SSGHIE/2011/WKCMSP11.pdf
- provide information that could be used in setting pressure indicators that would complement biodiversity indicators currently being developed by the Strategic Initiative on Biodiversity Advice and Science (SIBAS). Particular consideration should be given to assessing the impacts of very large renewable energy plans with a view to identifying/predicting potentially catastrophic outcomes.
- identify spatially resolved data, for e.g. spawning grounds, fishery activity, habitats, etc.

ToR f

Update on the collaboration with the WG on Harmful Algal Bloom Dynamics (WGHABD) and the outcome of the joint workshop on harmful phytoplankton that could potentially be transported or introduced by ballast water (WKHABAL). **Tracy McCollin**

ToR d

Cooperation with PICES WG 21.

11.00 – 11.30 Coffee break

- Seaweed introductions: studies on vectors and cryptogenic species. **Frederic Mineur**

Discussion regarding Fred's project and possible collaboration with WGBOSV and WGITMO.

- Network approaches to study of aquatic nonindigenous species in Canada: CAISN I and CAISN II. **Hugh MacIsaac**

Any other issues of interest to both groups

12.30 Closing WGBOSV and concluding remarks

13.00 – 14.00 Lunch

Modern molecular and imaging approaches to identification of aquatic nonindigenous species in Canada. **Hugh MacIsaac, Aibin Zhan and Sarah Bailey**.

Overview on the EU MSFD JRC/ICES TG2 Non-indigenous species report. **Sergej Olenin**

15.00 – 15.30 Coffee break with presentation:

Live food import ban on American lobster and ecotox testing. **Anders Jelmert**

15.30

BINPAS – online bioinvasion impact/biopollution assessment system: call for cooperation. Sergej Olenin

ToR e: Identify the criteria used by ICES countries to develop lists of high, moderate and low risk for intentional introductions and for those introduced species already established and prepare a final report.

17.00 Close of the day

THURSDAY 17th MARCH

09.00 Review of Terms of Reference and Agenda

09.15

ToR a: Synthesize and evaluate national reports using the adopted format for reporting and contributions to the database that includes species, locations (latitude and longitude), status of invasions from other ICES member countries as appropriate, status of eradication efforts, and habitat, and develop an annual summary table of new occurrences/introductions of aquatic invasive species in Member Countries.

Highlights from national reports (max 15 min. per country)

Belgium	Francis Kerckhof and Lies Vansteenbrugge
Canada	Marie-Claude Fortin
Estonia	Henn Ojaveer
Finland	Maiju Lehtiniemi and Lauri Urho
France	Laurence Miossec
Germany	Manfred Rolke and Stephan Gollasch
Italy	Anna Occhipinti-Ambgroi

11.00 - 11.15 Coffee break

Lithuania	Sergej Olenin
Norway	Anders Jelmert
Portugal	Paula Chainho
Spain	Gemma Quilez-Badia
Sweden	Malin Werner
The Netherlands	Jeroen Wijsman
United Kingdom	Gordon Copp

13.00 – 14.00 Lunch

ToR c: Review and draft a compilation of existing monitoring activities and programs with the goal of avoiding duplications. A draft summary will be prepared for next year.

Results of the ongoing monitoring programme in Finland. **Maiju Lehtiniemi and Lauri Urho**

15.00 – 15.20 Coffee break

ToR b: Review options for utilizing existing databases and information resources (in ICES countries and elsewhere) to provide a more complete picture of introduced species distribution and abundance and discuss verification of species identifications.

ToR g: Prepare a draft of the 25–30 year report based on earlier National reports, literature, and other ICES country information. An outline has been developed for a draft of the report.

The ctenophore *Mnemiopsis leidyi* in the North Sea. **Lies Vansteenbrugge**

Arrangements for 2012 meeting and AOB

ToR's

Meeting venue

Inter-sessional work

Invitation of presentations

Expert group topic and name

18:00 Close of the day

FRIDAY 18th MARCH

09. 00

ToR f: Finalize the 5 year summary report (2003–2007) during intersession. Note: WGITMO has a draft five-year report, but needs to have reviews of the sections.

ToR h: Finalize preparation of a draft report on the different approaches taken by ICES countries on targeted fisheries of non-indigenous species and the impact that these fisheries have had in reducing the spread and abundance of non-indigenous species.

ToR i: WGMASC recommends that key persons of WGITMO dealing with the introduction of aquatic exotic species via shellfish transfers should be invited to the next WGMASC meeting to participate in preparing a joint report, identify information gaps and recommend specific research goals and management advice.

11.00 - 11.20 Coffee break

I just can't bring myself to kill it" – How human weakness leads to the introduction and dispersal of non-native fishes. **Gordon Copp**

ToR d: Continue to develop and discuss joint activities with PICES WG 21 and CIESM during intersession that furthers cooperation and communication for resources sharing and information on introduced species.

Continue and finish request from ICES MSFDSG and SIASM.

13.00 Close of the meeting

Annex 3 Additional Terms of References

ICES
CIEM

International Council for the Exploration of the Sea

Conseil International pour l'Exploration de la Mer

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To: Science and Advisory Expert Group Chairs

Our Ref: JJ/MB/vp/mo B.10 10 March 2011

Dear Expert Group Chairs,

As you well know, ICES wants to better integrate its scientific and advisory work to meet the challenges of implementing an ecosystem approach. Today, we want to bring to your attention two groups that have been created jointly by ACOM and SCICOM, the **Marine Strategy Directive Framework Steering Group** (MSFDSG) and the **Strategic Initiative on Area Based Science and Management** (SIASM). These two groups need input from Expert Groups to meet their objectives.

The **MSFD** is cross-cutting and will have implications for most of ICES work. We would like EGs to identify and briefly describe the work streams of relevance to the Descriptors with particular emphasis on linkages that could be made between fish stock and ecosystem/environmental monitoring and assessments.

From the MSFDSG, the following ToRs will be added to all EGs during 2011:

- Identify elements of the EGs work that may help determine status for the 11 Descriptors set out in the Commission Decision (available at http://eurlex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:232:0014:0024:EN:PDF;
- Provide views on what good environmental status (GES) might be for those descriptors, including methods that could be used to determine status.

The main objective of the SIASM is to demonstrate to ICES clients, Member Countries and stakeholders that ICES has the expertise and facilities to deliver solid, robust and independent science and advice on marine area based management and spatial planning.

From SIASM, the following ToRs will be added to all EGs for 2011:

- take note of and comment on the Report of the Workshop on the Science for area-based management: Coastal and Marine Spatial

Planning in Practice (WKCMSP)
http://www.ices.dk/reports/SSGHIE/2011/WKCMSP11.pdf

- provide information that could be used in setting pressure indicators that would complement biodiversity indicators currently being developed by the Strategic Initiative on Biodiversity Advice and Science (SIBAS). Particular consideration should be given to assessing the impacts of very large renewable energy plans with a view to identifying/predicting potentially catastrophic outcomes.
- identify spatially resolved data, for e.g. spawning grounds, fishery activity, habitats, etc.

Your input to these groups is important. We would appreciate your responses either through your EG meeting reports, or directly to the contacts below if your EG has already met in 2011. Queries regarding the **MSFDSG** should be addressed to Claus Hagebro of the ICES Secretariat (Claus@ices.dk) and those regarding **SIASM** to Søren Anker Pedersen also at the ICES Secretariat (sorenap@ices.dk), as the first port of call.

Thank you very much for your cooperation.

Sincerely,

Manuel Barange,
Chair, ICES Science Committee

Jean-Jacques Maguire,
Chair, ICES Advisory Committee

Annex 4 Proposed Terms of Reference for 2012

The **ICES Working Group on Introduction and Transfers of Marine Organisms** (WGITMO), chaired by Henn Ojaveer, Estonia, will meet in in Lisbon, Portugal from 14–16 March 2012 , with a back to back meeting with the ICES/IOC/IMO Working Group on Ballast and Other Ship Vectors (WGBOSV) to:

a) Synthesize and evaluate national reports using the adopted format for reporting and contributions to the database that includes species, locations (latitude and longitude), status of invasions from other ICES member countries as appropriate, status of eradication efforts, and habitat, and develop an annual summary table of new occurrences/introductions of aquatic invasive species in Member Countries.

b) Prepare final report on existing monitoring activities and programs, including consider the gap analyses.

c) Review and update accordingly the detailed appendices of the 2005 ICES CoP with the aim to get it published on ICES webpage and communicate the findings as appropriate.

d) Verify selected datasets of the newly developing database on marine and other aquatic organisms in European waters with the ultimate goal to make it available online. This activity will mostly be carried out intersessionally and take several years.

e) Identify and evaluate climate change impacts on the establishment and spread of non-indigenous species. This activity will mostly be carried out intersessionally and take several years.

f) Continue efforts to establish effective cooperation with PICES and CIESM

WGITMO will report by 10 April 2012 for the attention of ACOM.

SUPPORTING INFORMATION

Priority:	The work of the Group is the basis for essential advice to prevent future unintentional movements of invasive and/or deleterious aquatic species including disease agents and parasites with the legitimate trade in species required for aquaculture, table market, ornamental trade, fishing and other purposes and to assess the potential of species moved intentionally to become a nuisance in the area of introduction. The work of this Group supports the core role of ICES in relation to planned introductions and transfers of organisms.
Scientific justification and relation to action plan:	a) We plan to identify and evaluate climate change impacts on the establishment and spread of alien spoecies; b) We plan to actively contribute in verification of selected datasets of the newly developing database on marine and other aquatic organisms in European waters. This will be essentially important for WGITMO to contribute as a group into this database building; c) We plan to continue efforts to establish effective cooperation with PISCES and CIESM on introduced species; d) We have developed and outline to report on existing monitoring activities and programs. This will also allow to identify gaps in such activities. The work is largely based on intersessional activities and will be finalised in 2012; e) Intersessionally, WGITMO will finalize the 5-year summary report. f) Intersessionally, WGITMO will finalise compilation of country records of nonindigenous species that have become targeted fisheries.
Resource requirements:	None required other than those provided by ICES Secretariat and national members
Participants:	WGITMO members and invited experts from, e.g., Australia, New Zealand, Mediterranean countries that are not members of ICES, representatives from PICES and CIESM.
Secretariat facilities:	Meeting room providen by the host
Financial:	None required
Linkages to advisory committees:	WGITMO reports to ACOM
Linkages to other committees or groups:	WGHABD, WGEIM, WGBOSV, WGAGFM, WGMASC, WGBIO
Linkages to other organizations:	WGITMO urges ICES to encourage and support a continued dialogue between WGBOSV and BMB, PICES, IMO, IOC, EU, HELCOM, EIFAC, CIESM.

Annex 5. National reports

5.1 Belgium

Prepared by Francis Kerckhof, MUMM, Marine Ecosystem Management Section, Royal Belgian Institute of Natural Sciences, Belgium, with support of Lies Vansteenbrugge, Institute for Agricultural and Fisheries Research, Animal Sciences Unit – Fisheries, Belgium.

1. Laws and regulations

There is no new legislation to report.

2. Intentional introductions

There is no information available on intentional introductions if any.

3. Unintentional introductions:

All introduced species that were reported during previous years are still present and seem to be well-established and thriving, even after a relative cold winter period in December 2010. An overview of the current status of alien species in Belgian marine waters can be found in Kerckhof *et al*. 2007.

During 2010, in the framework of a master thesis, a survey was conducted of the occurrence and status of alien macro invertebrates in the Belgian coastal harbours (Hebbelinck, 2010) which confirmed the importance and omnipresence of alien species.

During 2009 *Ensis directus* had an extremely successful spat fall, the most successful ever. This cohort is still dominant in the coastal waters.

During 2008 six windmills were built on the Thornton Bank some 30 km off Zeebrugge (C-Power Windmill Park). In December 2010 a second wind mill park of 55 wind turbines (Belwind) became fully operational. It was built on the Bligh sandbank, 46-52 kilometer off Zeebrugge, work had started in September 2009. A monitoring programme was set up to sample the new hard substrates associated with the windmills.

On the C-Power site already after 3.5 months, a high species richness was found, including four non-indigenous species: the slipper limpet *Crepidula fornicata*, the New Zealand barnacle *Elminius modestus*, the giant barnacle *Megabalanus coccopoma* and *Telmatogeton japonicus*. (Kerckhof *et al*., 2009). During 2010 also *Hemigrapsus sanguineus* and *Crassostrea gigas* were sampled on this site, while *M. coccopoma, T. japonicus* and *E. modestus* were early colonisers on the Belwind site (Kerckhof in prep.).

All these species, already known from the area, are opportunists and early colonisers after disturbance, taking advantage of man-made structures and disturbed conditions to settle.

Species Not Seen Yet

Several species associated with oysters and recently reported from surrounding countries (France & Dutch Oosterschelde) can be expected to turn up in the Spuikom in Oostende. The Spuikom is a saline pond in connection with the harbour, were some aquaculture (including relaying of oysters) takes place. Examples are the predatory gastropods *Urosalpinx cinerea* (Say, 1822) and *Ocinebrellus inornatus* (Récluz, 1851) (Faasse, 2009) and the Manila clam *Ruditapes philippinarum* (Adams & Reeve, 1850)

(Faasse, M., Ligthart, M. 2008). They have not been found yet, however *R. philippinarum* has already been relayed in the Spuikom in the past.

4. Pathogens

No information

5. Meetings

6. Research projects:

In 2009, the two year research project EnSIS: "Ecosystem Sensitivity to Invasive Species", (2009 -2010), was funded by the Belgian Science Policy Research programme "Science for a sustainable development" Targeted actions North Sea. It aims at (1) characterizing the ecological features of *E. directus* in Belgian waters, (2) evaluating the ecological impacts of *E. directus*' introduction and (3) assessing the impact of possible *E. directus*' fisheries.

In January 2011, the research project 'MEMO: *Mnemiopsis* Ecology and Modeling: Observation of an invasive comb jelly in the North Sea' started. The MEMO project, framed in Interreg IV A '2 Seas', is a cross-border cooperation between ILVO (Institute for agricultural and fisheries research, Belgium), IFREMER (Institut français de recherche pour l'exploitation de la mer, France), ULCO-LOG (Université du Littoral Côte d'Opale-Laboratoire d'Océanologie et de Géosciences, France), CEFAS (Centre for Environment, Fisheries and Aquaculture Science, Great-Britain) and Deltares (the Netherlands). It consists of three main activities. The first activity will monitor the spatial and temporal distribution of *Mnemiopsis leidyi* in the 2 seas region. A habitat model based on biological and environmental parameters will be made. The second activity focuses on the biology, physiology and feeding behavior of *Mnemiopsis leidyi*. Using prey-predator interactions, a life cycle model will be constructed. The third activity will develop an applied integrated plankton ecosystem model to predict ecological and socio-economical impacts.

7. References and bibliography

Faasse M., Ligthart M. 2008. De exotische tapijtschelp *Ruditapes philippinarum* (Adams & Reeve, 1850) vestigt zich in Nederland. Het Zeepaard 68(6): 175-179

Faasse M. 2009. Geen Europese, maar Japanse stekelhoren, *Ocinebrellus inornatus* (Récluz, 1851), in de Oosterschelde. *Het Zeepaard 69(6)*: 194

Kerckhof, F., Haelters, J., Gollasch, S. 2007. Alien species in the marine and brackish ecosystem: the situation in Belgian waters. *Aquatic Invasions 2(3)*: 243-257.

Hebbelinck, L. (2010). Monitoring van exotische macro-invertebraten in de Vlaamse havens. MA Thesis. Universiteit Gent. Faculteit Bio-ingenieurswetenschappen: Gent. 87 pp.

Kerckhof F., Norro A., Jacques Th., and Degraer S. 2009. Early colonisation of a concrete offshore windmill foundation by marine biofouling on the Thornton Bank (southern North Sea), *in*: Degraer, S.; Brabant, R. (Ed.) (2009). *Offshore wind farms in the Belgian part of the North Sea: State of the art after two years of environmental monitoring.* pp. 39-51

Soors, J.; Faasse, M.; Stevens, M.; Verbessem, I.; De Regge, N.; Van den Bergh, E. (2010). New crustacean invaders in the Schelde estuary (Belgium) Belg. J. Zool. 140(1): 3-10

Soenen, K.; Rappé, K.; Van Ginderdeuren, K.; Vansteenbrugge, L. (2010). Mnemiopsis leidyi (A. Agassiz, 1865): weldra heer en meester in de Spuikom van Oostende? De Strandvlo 30(4): 131-137.

5.2 Canada

Compiled by Marie-Claude Fortin and Joanne E. Power, Department of Fisheries and Oceans Canada.

1. Laws and regulations

Fisheries and Oceans Canada (DFO) continues to work on the development of an Aquatic Invasive Species regulatory proposal under the *Fisheries Act*, providing a legislative tool that can assist in the control and management of aquatic invasive species in Canada. This regulation may include provisions targeted at preventing the introduction of new species as well as provisions that would facilitate rapid response to invasions.

In New Brunswick under the *General Regulation-Aquaculture Act* (NB Regulation 91-158), the regulatory requirement under Section 14.1 (6) to report a breach of containment of farmed Atlantic salmon in New Brunswick of in excess of 100 fish came into force on August 25, 2010.

In Nova Scotia, changes to the Fisheries and Coastal Resources Act were introduced in November, 2010 to address Nova Scotian aquatic invasive species issues. Specific regulations that will protect native fish species will be implemented this angling season. These changes are intended to protect against the unauthorized introduction of any fish into provincial waters. The amendment is specific to sportfish and in most cases, the possession of live fish will be prohibited.

2. Intentional releases and planned introductions

2.1 Synthesis of Domestic Introductions and Transfers

Province		Species	Number (or weight)	Location and Lat & Long (if provided)	Reason	Notes & Website info if provided
Newfound-land & Labrador	Finfish	Steelhead / rainbow trout (Oncorhynichus mykiss)	1,000,000	South Coast aquaculture sites NL	Commercial aquaculture importation from Nova Scotia	Commercial aquaculture importation from Nova Scotia
		Arctic Charr (Salvelinus alpinus)	150,000	Bay d'Espoir	Commercial aquaculture importation from Nova Scotia	Supplier Nova Scotia hatcheries
		Atlantic salmon (Salmo salar)	7,230,000	South Coast aquaculture sites NL	Commercial aquaculture importation from New Brunswick	Supplier New Brunswick hatcheries
		Atlantic salmon (Salmo salar)	1,245,000	South Coast aquaculture sites NL	Commercial aquaculture importation from Nova Scotia	Supplier Nova Scotia hatcheries
		Atlantic salmon (Salmo salar)	500	Exploits River Fishway & Upper Exploits River, NL (48°55′, 55°35′)	Enhancement program, in conjunction with DFO, to increase spawning and populations in area.	General website: http://www.exploitsriver.ca/history.php
		Atlantic salmon (Salmo salar)	100	Kidney Pond Brook, Baie Verte Peninsula, (Middle Arm Brook Watershed), NL (49°44′55″, 56°19′09″)	Enhancement program, in conjunction with DFO, to increase spawning and populations in area.	General website: http://www.exploitsriver.ca/history.php

Province		Species	Number (or weight)	Location and Lat & Long (if provided)	Reason	Notes & Website info if provided
		Atlantic salmon (Salmo salar)	50	Rattling Brook, NL (49°37′, 56°11′)	DFO directive to local power company to ensure safe fish passage around a hydro obstruction.	General website: http://www.exploitsriver.ca/history.php
	Invertebrates	American Lobster (Homarus americanus)	≈ 750 larvae	Placentia Bay, NL (47°20′, 54°24′)	Lobster population enhancement experiment.	Release stage IV larvae back to area where broodstock was captured.
		Blue mussels (Mytilus edulis)	~3,220 kg	Within NL	Aquaculture - Seed stocking among NL sites.	Moved by site owners.
	FinFish	Atlantic Halibut	9,447	Land based fish farm, Victoria, PE	aquaculture	Juveniles
		Atlantic Salmon	1,000,000	Land based fish farm, Rollo Bay, PE	aquaculture,	Eyed eggs
			666,600	Land based research facilities	research	Eggs and fry
		Brook trout	9,300	Carraghers, Rollo Bay, Bernards,	enhancement	

Province		Species	Number (or weight)	Location and Lat & Long (if provided)	Reason	Notes & Website info if provided
Prince Edward Island				Hermitage Creek, Bristol, Rackhams and Mooneys Ponds		
		Rainbow Trout	3,350 & 800	Land based research facilities	research	
	Inverteebrates	Various species	800	Land based research facilities	research	
		Sea Lice	5,000	Land based research facility	research	
		Bay Scallop	140,000	Tracadie Bay, St. Peters Bay and South Lake	aquaculture	
		Blue Mussel	~13,265,913kg & ~ 2,000,000 in count (see note)	Various Bays in PEI	aquaculture, processing	Difficult to determine "Number" since I&T requests are made using different measures (pounds, boxes etc,) This includes mussel seed for on-growing and final crop for processing.
		European Green Crab	135	Land based research facility	research	
		American Oyster	286,420 kg and 55,002 in count see note	Various Bays in PEI	aquaculture	Difficult to determine "Number" since I&T requests are made using different measures (pounds, boxes etc,)
		Oysters & Quahaugs	5,000	PEI	Processing	
		Quahaugs	~11,340 kg and 5,000 in count	PEI	Processing	

Province		Species	Number (or weight)	Location and Lat & Long (if provided)	Reason	Notes & Website info if provided
Nova Scotia	Finfish	Atlantic Salmon	9,073,000	Marine and land based facilities	Aquaculture Research and Enhancement	Various life stages (eggs to adults)
			Milt from 35 males	Research facility, NS	Research	
		Rainbow Trout (Oncorhynchus mykiss)	3,515,000	Marine and land based facilities	Aquaculture Research and Enhancement	Various life stages (eggs to adults)
		Tomcod (Microgadus tomcod)	6	NS land based facility	Research	Adults
		Arctic Char (Salvelinus alpinus)	400,000	NS land based facilities	Aquaculture	Various life stages
		Atlantic cod (Gadus morhua)	1,175	NS land based facilities	Research and Aquaculture	Various life stages
		Atlantic Halibut (Hippoglossus hippoglossus)	57	NS land based facilities	Research and Aquaculture	Various life stages
	Invertebrates	Blue mussels (Mytilus edulis)	789680 kg	NS marine sites	Aquaculture	Various life stages
			4000	NS marine research locations	Research	Juveniles
		American oysters (Crossostrea virginica)	2,170,000	NS marine sites	Aquaculture and Relay from Commercial fishery	Various life stages
			~100,000	NS marine site	Relay from Commercial fishery	Adults
		Bay Scallops (Argopectic	190,000	NS marine sites	Aquaculture	Seed

Province		Species	Number (or weight)	Location and Lat & Long (if provided)	Reason	Notes & Website info if provided
		Irradians)				
		Soft Shell Clams (Mya arenaria)	7000	NS land based facility	Research	Seed
		Hyalella azteca	600	NS River	Research	
New Brunswick	FinFish	Atlantic Salmon (S. Salar)	6,000,000	Bay of Fundy	Marine Aquaculture	Smolts
		Atlantic Salmon (S. Salar)	17,000,000	NB hatcheries	Smolt production for Aquaculture	All life stages
		Atlantic Salmon (S. Salar)	6,000,000	NB rivers	Enhancement	All life stages
		Atlantic Salmon (S. Salar)	2,000,000	NB	Research	All life stages
		Landlock Salmon (Salmo salar)	60,000	NB Lakes	Enhancement	
		Brook Trout (Salvelinus fontinalis)	450,000	NB	(4 K for Aqua/ 45K for Research/ 400 K for Enhancement	
		Rainbow Trout (Oncorhynchus mykiss)	90,000	NB	Aquaculture	
		Arctic Char (Salvelinus alpinus alpinus)	50,000	NB	Aquaculture	

Province		Species	Number (or weight)	Location and Lat & Long (if provided)	Reason	Notes & Website info if provided
		Shortnose Sturgeon (Acipenser brevirostrum)	230	NB	Aquaculture (30) / Research (200)	
		Halibut (Hippoglossus hippoglossus)	40,000	Bay of Fundy	Aquaculture	
		Cunners (Tautoglobras adsperus)	10,000	NB	Research	
	Invertebrates	American Oysters (C. virginica)	14,000,000	Gulf of Saint Lawrence	Aquaculture	
	Invertebrates	Mussels (Mytilus edulis)	170 kg	Bay of Fundy	Aquaculture	Spat
	Invertebrates	Scallop (Placopecten magellanicus)	2,000,000	Gulf of Saint Lawrence	Aquaculture	
	Invertebrates	Quahog (Mercenaria mercenaria)	125,000	Gulf of Saint Lawrence	Aquaculture	
Québec	Poissons	Loup tacheté (Anarhichas minor)	1600	Institut Maurice-Lamontagne (IML)	Recherche	
	Invertébrés	Pétoncle géant (P.	1,,000	Institut Maurice-	Recherche	

Province		Species	Number (or weight)	Location and Lat & Long (if provided)	Reason	Notes & Website info if provided
		magelanicus)		Lamontagne		
		Pétoncle géant (P. magelanicus)	4,000	Gaspésie (4 sites)	Recherche	
		Moules bleues (M. edulis)	3,250 kg	Gaspésie (2 sites) and IML	Recherche	
		Huître américaine (C. virginica)	40,200	Iles-de-la-Madeleine	Research and enhancement	24 000 pour recherche en aquaculture
		Codium fragile	200	Institut Maurice-Lamontagne	Recherche	Moved into a land based, quarantine facility
British Columbia	Finfish	Anchovy - Northern	100	Simon Fraser University	Research	1 application
		Bass – Largemouth	12	Fraser Valley Trout Hatchery, Abbotsford	Education	1 application
		Burbot	1,500	Kootenay River, Creston; U of Idaho	Research	2 applications
		Char – Lake (eggs)	20,000	Van. Isl. Trout Hatchery, Duncan	Enhancement	1 application
		Dace	400	UBC	Research	1 (imported into BC from AB) application
		Dace - Longnose	80	Pepin Creek, Aldergrove	Enhancement	1 application
		Dogfish – Pacific	20	CAER	Research	1 application
		Eulachon	1600	Eurocan Pulp and Paper, Kitimat	Research	1 application
		Hagfish – Pacific	360	CAER; Univ. of Guelph; UBC	Research	3 applications

Province	Species	Number (or weight)	Location and Lat & Long (if provided)	Reason	Notes & Website info if provided
	Herring – Pacific	5,400	PBS, Nanaimo	Research	1 application
	Lamprey – Brook (L. pacifica)	150	UBC	Research	1 application
	Lamprey – Sea (P. marinus)	160	UBC	Research	1 application
	Pike – Northern	30	DFO W. Van. Lab	Research	1 application
	Rockfish – Copper	15	Vancouver Aquarium	Research	1 application
	Sablefish	1,100	Nanaimo, Saltspring Island	Broodstock	3 application
	Sablefish	2,150	CAER, W. Van.; PBS, Naniamo	Research	4 applications
	Sablefish	831,000	Kyuoquot Sound	Commercial	2 applications
	Salmon – Atlantic	11,069,500	Jackson Pass; Glacial Creek, Powell River; Fortune Channel; Ocean Falls; Bickley Bay; Upper Retreat; Arrow Pass; Cleagh Creek; Lochalsh Bay; Mathieson Channel; Finlayson Channel	Commercial	10 applications
	Salmon – Atlantic	2,050	SFU; VIU, Nanaimo	Research	3 applications
	Salmon – Chinook	13,720	Pacific Enviro. Sci. Centre, N. Van.; PBS, Nanaimo; Yellow Isl. Aquaculture Ltd. Campbell River	Research	4 application

Province	Species	Number (or weight)	Location and Lat & Long (if provided)	Reason	Notes & Website info if provided
	Salmon – Chinook	50,000	Middle Bay, Campbell River	Commercial	1 application
	Salmon – Chinook (eggs)	900,00	Omega Pacific Hatchery, Port Alberni	Commercial	1 application
	Salmon – Chinook (eggs)	63,000	Falls River Tail Pond, Prince Rupert; Phillips Arm; Nahmint River	Enhancement	3 applications
	Salmon – Chinook (eggs)	5,000	CAER, W. Van.	Research	1 application
	Salmon – Chinook (smolts)	30	VIU, Nanaimo	Education	1 application
	Salmon – Chum	180,000	Silver Creek; Powrivco River (46 adult) ; Beljay Creek, Moore Creek (96 adults)	Enhancement	3 applications
	Salmon – Coho (eggs)	7,000	Jordan River	Research	2 applications
	Salmon – Coho	4,374	Sandhill Creek; Gorge Harbour Creek, Cortez Isl.; Storrie Creek; Takelly Cove Creek; Nookliklonnick Creek;	Enhancement	5 applications
	Salmon – Coho	4,550	CAER; UVIC,	Research	4 application

Province	Species	Number (or weight)	Location and Lat & Long (if provided)	Reason	Notes & Website info if provided
			Victoria; UBC		
	Salmon – Coho	20	Upper Bulkley River	Education	1 application (resulting fry released to same system)
	Salmon – Kokanee	55,000	Timothy Lake; various locations; Ten Mile Lake	Enhancement	5 applications (blanket transfer licence issued to Provincial government for their stocking program does not report number of fish…)
	Salmon – Kokanee	100	Kootenay Lake	Research	1 application
	Salmon – Kokanee (eggs)	600	Burnaby	Research	1 application
	Salmon – Sockeye	2,366	UBC; PBS, Nanaimo; SFU; Cultus Lake Lab	Research	15 applications
	Salmon – Sockeye	2,200	Okanagan River; Penticton Channel	Education	2 applications
	Salmon – Sockeye	932,060	Okanagan River; Cultus Lake Research lab; Snootli Creek Hatchery	Enhancement	4 applications
	Salmon – Sockeye (eggs)	1,850,000	Williams Creek, Snootli Hatchery; Shuswap River Hatchery	Enhancement	2 applications
	Salmon – Sockeye	5,000,000	Richard Henley Farm	Milt (sperm)	1 application
	Sculpin - Grunt	3	Douglas College, New Westminister	Education	1 application
	Sculpin – Plainfin Midshipman	9	PBS, Nanaimo	Research	1 application

Province	Species	Number (or weight)	Location and Lat & Long (if provided)	Reason	Notes & Website info if provided
	Sculpin – Sailfin	730	UBC	Research	3 applications
	Sculpin – Sailfin	40	Living Elements, Vancouver	Commercial	1 application
	Sculpin – Sailfin	5	Douglas College, New Westminister	Education	1 application
	Sculpin – Slimy (eggs and milt from 20 fish)	20	Burnaby	Research	1 application
	Stickleback – 3 spine	1,450	Michigan State Univ.; Clark Univ.; Roberts Lake, Little Mud Lake, Gosling Lake; East Caroline Univ.; Harvard Univ.	Research	5 applications
	Stickleback – 3 spine (eggs)	No number	Univ. of Texas	Research	1 application
	Sturgeon - milt	1,000	VIU, Nanaimo	Research/Education	2 applications
	Sturgeon - white	700,020	Kootenay Stur. Hat., Cranbrook; Columbia River, Revelstoke; Columbia River, Castlegar;	Enhancement	3 applications
	Sturgeon - white	12	VIU, Nanaimo	Education	1 application
	Sturgeon – eggs	20	Nachalah Farm, Nanaimo	Commercial	1 application
	Sturgeon – eggs	100,000	Kootenay Stur. Hat., Cranbrook	Enhancement	1 application

Province	Species	Number (or weight)	Location and Lat & Long (if provided)	Reason	Notes & Website info if provided
	Sturgeon – eggs	250,000	Univ. of Saskatachewan, Saskatoon	Research	1 application
	Trout- Cutthroat (Coastal Anadromous)	No numbers given; 30	Various lakes; W. Van Lab (DFO)	Enhancement	2 applications (FFSBC blanket permit)
	Trout – Cutthroat (Coastal Non-anadromous) (eggs)	360	Burnaby	Research	1 application
	Trout – Cutthroat (Coastal Non-anadromous) (eggs)	No numbers given	Various lakes	Enhancement	1 application (FFSBC blanket permit)
	Trout – Cutthroat (Westslope)	100	Ventego Creek	Enhancement	1 application
	Trout - Rainbow	5,050	Vancouver Isl. Trout Hatchery; Pear Lake; Quesnel River Research Centre; UBC;	Research	7 applications
	Trout – Rainbow	5,000	Corbett Lake, Merrit; Brighton Lake, Williams Lake	Commercial	2 applications
	Trout – Rainbow	666,500	Slim Lake, Little Fish Lake; various lakes (FFSBC blanket permit); Fish Lake; Green Lake; Eagle Lake; Lake 6267	Enhancement	8 applications (FFSBC – blanket movements – no numbers given)

Province	Species	Number (or weight)	Location and Lat & Long (if provided)	Reason	Notes & Website info if provided
	Trout – Rainbow (eggs)	6,500	Shea Lake	Research	1 application
	Trout – Rainbow (eggs)	200,000	Clearwater Trout Hatchery; Slim Lake	Enhancement	2 applications
	Trout – Rainbow (eggs)	160,000	Miracle Springs Inc., Mission; Henly Farm, Langley	Commercial	2 applications
	Trout - Steelhead	28,000	Capilano River	Enhancement	2 applications
	Trout – Steelhead	400	Bamfield Marine Science Centre, Bamfield;	Research	1 application
	Trout – Steelhead (eggs)	600	Burnaby	Research	1 application
	Trout - Bull	75	Tumbler Ridge	Research	1 application
	Whitefish – Mountain (eggs and milt)	30,000	Burnaby	Research	1 application
	Wolfeel	45	Living Elements, Vancouver	Commercial	2 applications
	Wolfeel	16,850	Island Scallops, Courtenay; UBC-CAER	Research	5 applications
	Wolfeel	400	Island Scallops, Courtenay	Broodstock	1 application
	Wolfeel (eggs)	700	West Van Labs; Island Scallops, Qualicum Beach	Research	2 applications

Province		Species	Number (or weight)	Location and Lat & Long (if provided)	Reason	Notes & Website info if provided
	Invertebrates	Abalone	9	Sandford Island, Barkley Sound	Broodstock	1 application
		Abalone	5,000	West Price Island, Higgins Pass	Enhancement	1 application
		Abalone	20	Shaw Ocean Discovery, Sidney; Vancouver Aquarium	Education	2 applications
		Abalone	12,300	Pacific Biological Station, Nanaimo; Pacific waters	Research	2 applications
		Cockles	10,100	Pacific Biological Station, Nanaimo; Center for Shellfish Research, Deep Bay.	Research	2 applications
		Crab – Green	75	Pacific Biological Station, Nanaimo	Research	1 application
		Crayfish – Signal	17,000	Chemainus crayfish aquaculture facility	Broodstock	5 applications
		Crayfish – Signal	700	Cordova Bay Golf Course, Victoria; Kingzett Lake	Enhancement	2 applications
		Crayfish – Signal	5,930	University of Victoria; Cordova Bay Gold Course	Research	3 applications

Province	Species	Number (or weight)	Location and Lat & Long (if provided)	Reason	Notes & Website info if provided
			Ponds, Victoria		
	Eohaustaurius estuarius	2,000	Pac. Env. Sci. Centre., N. Van	Research	1 application
	Clam – Pacific geoduck	5,605,500	Jervis Inlet, BC; Marina Isl., Texada Isl., Savory Isl.; Union Bay; BC Aqua licence #129; Lasquetis Isl.; Mansons Pass;	Commercial	13 applications
	Clam – Pacific geoduck	450	Island Scallop tenure #32; Island Scallops Harchery; Gartley Pt. Aqua. Facility, Royston;	Broodstock	3 application
	Clam – Pacific geoduck	150	PBS, Naniamo; Centre for Shellfish Research	Research	2 application
	Invertebrates – general		Pipers Lagoon	Education	1 application
	Mussels – blue	900	Howe Sound, Britannia Beach	Research	1 application
	Mussels – freshwater	400	Ketchum creek, Smithers	Research	1 application
	Mussels – (M. californicus)	2,800 + 2,000 kg	CFIA biotoxin lab, Burnaby; Area 13-19 & 25; Various marine stations	Research	3 applications

Province	Species	Number (or weight)	Location and Lat & Long (if provided)	Reason	Notes & Website info if provided
	Octopus (O. dofleini)	2	Satellite Channel; Saanich Inlet, Sidney	Release	2 applications
	Sand Dollar – Eccentric	200	Pac. Env. Sci. Centr, N. Van.	Research	1 application
	Scallops – Japanese	50	Gartley Pt. Aquaculture, Royston	Broodstock	1 application
	Scallops - Japanese	650,000	Kyuquot Sound; Kagan Bay	Commercial	3 applications
	Scallops – Spiny	600	Centre for Shellfish Research	Research	1 application
	Sea Cucumber	60,000	17-2&17-3 (PBS) ;Kyuquot Sound	Research	2 applications (PBS – no numbers given)
	Sea Urchin – green	3,500	Kyuquot Sound	Education	1 application
	Sea Urchin - purple	50	PBS, Nanaimo	Research	1 application

2.2. Imports into Canada

Province		Species	Country of Origin	Location of import	End use & Other Information as provided (#s etc)
Newfound-land & Labrador	Invertebrates	Ghost shrimp, (Neotrypaea californiensis)	United States	Research facility: Memorial University of Newfoundland, St. John's, NL (47.6°, 52.8')	Research – Closed containment facility only General website: http://www.mun.ca/
		Mud Shrimp, (Upogebia pugettensis)	United States	Research facility: Memorial University of Newfoundland (47.6°, 52.8')	Research – Closed containment facility only General website: http://www.mun.ca/
		Lugworm, (Arenicola marina)	United Kingdom	Research facility: Memorial University of Newfoundland (47.6° , 52.8')	Research – Closed containment facility only General website: http://www.mun.ca/
Prince Edward Island	Finfish	Rainbow Trout	United States	Land based aquaculture facilities – Brookvale and Murray River, PEI	Aquaculture
	Invertebrates	Various shellfish	PEI, Canada, International	Land based research facilities	Research
		American Oyster	United States	Land based research facility	Research
Nova Scotia	Finfish	Atlantic salmon (Salmo salar)	United States	NS land based facilities	Aquaculture – 8,000,000 organisms
		Rainbow Trout (Oncorhynchus mykiss)	United States	NS land based facilities	Aquaculture – 2,873,000 organisms
		European Sea Bass (Dicentrachus labrax)	France	NS land based facility	Aquaculture – 100,000 organisms
New Brunswick	Finfish	Atlantic Salmon (S. Salar)	United States	NB hatcheries	Aquaculture smolt production All life stages – 3,000,000 organisms
Quebec	Nil reported				
	Finfish	Carp - Koi	Various	Various contained locations	Commercial 40,963 organisms for 35 applications

Province		Species	Country of Origin	Location of import	End use & Other Information as provided (#s etc)
British Columbia		Carp - Koi	Various	Various contained locations	hobby 43 organisms for 2 applications
		Carp – Koi	Various	Various contatined locations	Display 200 organisms for 1 application
		Guppy – Poecilia reticulata	Guyana	Simon Fraser Univ.	Research 500 organisms for 1 application
		Sablefish	US	Egmont; Jarvis Inlet	Commercial 22,000 organisms for 2 applications
		Tilapia	United States	Live Table Market, Vancouver	Commercial 11 applications
		Tilapia	United States	Sumas Lake Aquafarm, Abbotsford	Commercial (aquaculture) 20,000 organisms for 1 application
		Tilapia	United States	Microtek, Uvic, Victoria	Research 2,000 organisms for 1 application
		Trout – Rainbow (eggs)	United States	Lois Lake	Commercial 460,000 organisms for 4 applications
		Trout – Rainbow (eggs)	United States	Burnaby	Research 6,000 organisms for 1 application
		Trout – Fry	United States	UVic, Victoria	Research 900 organisms for 1 application
		Trout (eggs)	United States	UVic, Victoria; Fraser Valley Hatchery; Burnaby	Research 107,000 organisms for 3 applications
	Inverts	Clam – Hard	United States	Island Scallops, Qualicum Beach	Commercial 400 organisms for 1 application
		Clam – Manila	United States	Baynes Sound; Ladysmith Harbour;	Commercial 72,500,000 organisms for 6 applications
		Clam – Pacific Geoduck	United States	Qualicum Beach	Broodstock 400 organisms for 2 appliations
		Mussels – various	United States	Baynes Sound	Commercial 1,000,000 organisms for 1 application
		Oyster – Pacific	United States; Alberta	Kagan Bay; Baynes Sound; Cortez Island	Commercial 2,002,000,000 organisms for 7 applications

3. Unintentional releases.

3.1. Persistent AIS Sightings:

AIS present in province/region prior to 2010, who is still present in the province/region now and whose range may have expanded

Region/ Province	Species name	Country of origin	Date of first sighting	Location of sightings in region/ Potential location future AIS threat		Eradication/ control efforts	Range expansion	General Information
				Geographical	lat_long			
NEWFOUNDLAND	Carcinus maenas	Europe via Maritimes	23-Aug-07	North Harbour, Placentia Bay	47.854984 - 54.10007	directed capture mitigation, stewardship, numbers reduced but not significantly	expanding throughout Placentia Bay and west coast of NL	Website under construction; regional DFO AIS website should be operational within weeks
	Membranipora membraniceae	Europe	2005	Bonne Bay, West coast	49.505760 - 57.916660	none		particularly invasive on kelp habitat on west coast of NL
	Botryllus schlosseri	Europe	07-Dec-06	Argentia, Placentia Bay, Arnold's Cove Placentia Bay, Hermitage, Hermitage Bay	47.292000 - 53.990417	none	throughout Placentia Bay	earlier report on west coast in 1970's not confirmed
	Botrylloides violaceus	Asia	24-Oct-07	Belleoram, Fortune Bay	47.527194 - 55,409167	eradication attempt through wrapping of ships and pilings, eradication unsuccessful, however no spread beyond initial detection.	none	
	Caprella mutica	Japan	20-Oct-06	Salmonier Cove, Connaigre Bay, several locations within Placentia Bay	47.586883 - 55.783200	none	South Coast	

Region/ Province	Species name	Country of origin	Date of first sighting	Location of sightings in region/ Potential location future AIS threat		Eradication/ control efforts	Range expansion	General Information
				Geographical	lat_long			
PRINCE EDWARD ISLAND	Botrylloides violaceus		Oct-10	Covehead Bay	46.4186, -63.1602	Restrictions on Shellfish transfers		found in several locations within the bay
	Botrylloides violaceus		Oct-10	Lennox Channel	46.6143, -63.8679	Restrictions on Shellfish transfers		
	Botrylloides violaceus		Oct-10	Mill River	46.7723, -64.097	Restrictions on Shellfish transfers		
	Botrylloides violaceus		Nov-10	Gibbs Creek (Foxley River)	46.7339, -64.0784	Restrictions on Shellfish transfers		
	Botrylloides violaceus		Oct-10	Dock River	46.7767, -64.079	Restrictions on Shellfish transfers		
	Botrylloides violaceus		Sep-10	Kildare River	48 22.752, -64 34	Restrictions on Shellfish transfers		found in several locations within the bay
	Ciona intestinalis		Sep-10	Souris River	46.3714, -62.2857	Restrictions on Shellfish transfers	Yes	Expansion from Souris Harbour to an area up the river.
	Botryllus schlosseri		Dec-10	North Rustico Bay	46.4379, -63.3076	Restrictions on Shellfish transfers		
	Botryllus schlosseri		Oct-10	Covehead Bay	46.4186, -63.1602	Restrictions on Shellfish transfers		found in several locations within the bay
	Carcinus maenas		Sep-10	Enmore River		None		On the south coast of PEI, the furthest West this species was found was Summerside Harbour. This represents a significant jump along the coast. On the North shore of the Island, the species had been found as far West as Malpeque Bay

Region/ Province	Species name	Country of origin	Date of first sighting	Location of sightings in region/ Potential location future AIS threat		Eradication/ control efforts	Range expansion	General Information
				Geographical	lat_long			
NEW BRUNSWICK	Botryllus schlosseri		Oct-10	Caraquet, NB	47.796666 -64.927222			
	Botryllus schlosseri		Oct-10	Shediac Bay, NB	46.240277 -64.527777			
	Botrylloides violaceus		Oct-10	Shediac Bay, NB	46.240277 -64.527777			
	Carcinus maenas		Sep-10	Cocagne, NB	46.367240 -64.617380			
	Carcinus maenas		Jun-10	expansion within Shediac Bay, NB	46.273319 -64.273319			
	Carcinus maenas		Oct-10	Egmont Bay, PEI				
MARITIMES	Ciona intestinalis	Europe		Digby	44.6254, -65.7551			
	Ciona intestinalis	Europe		Meteghan	44.1934, -66.167			
	Ciona intestinalis	Europe		Yarmouth Bar	43.8161, -66.1476			
	Ciona intestinalis	Europe		Wedgeport	43.7136 -65.9690			
	Ciona intestinalis	Europe		Camp Cove	43.7242, -65.8399			
	Ciona intestinalis	Europe		Clark's Harbour	43.4450, -65.3353			
	Ciona intestinalis	Europe		Ingomar	43.5642, -65.3633			

Region/ Province	Species name	Country of origin	Date of first sighting	Location of sightings in region/ Potential location future AIS threat		Eradication/ control efforts	Range expansion	General Information
				Geographical	lat_long			
MARITIMES (continued)	Ciona intestinalis	Europe		Shelburne	43.7578 -65.3224			
	Ciona intestinalis	Europe		Lunenburg	44.3757 -64.3073			
	Ciona intestinalis	Europe		Indian Point	44.4581 -64.30682			
	Ciona intestinalis	Europe		Chester	44.5359 -64.2418			
	Ciona intestinalis	Europe		Halifax, Bedford Insitute of Oceanography jetty	44.6809 -63.6109			
	Ciona intestinalis	Europe		Venus Cove	45.6151, -61.3901			
	Ciona intestinalis	Europe		Sydney	46.1399, -60.1678			
	Ciona intestinalis	Europe		North Sydney	46.1988, -60.2579,			
	Ciona intestinalis	Europe		Dingwall	46.9032 -60.4605			
	Ciona intestinalis	Europe		Eel Lake	43.8267 -65.9077			
	Ciona intestinalis	Europe		Halifax, Royal Nova Scotia Yacht Squadron	44.6209 -63.5804			
	Botryllus schlosseri			Cheticamp	46.6268 -61.0161			
	Botryllus schlosseri			Digby	44.6254 -65.75507			
	Botryllus schlosseri			Meteghan	44.1934 -66.167			
	Botryllus schlosseri			Yarmouth Bar	43.8161 -66.1476			

Region/ Province	Species name	Country of origin	Date of first sighting	Location of sightings in region/ Potential location future AIS threat		Eradication/ control efforts	Range expansion	General Information
				Geographical	lat_long			
MARITIMES (continued)	Botryllus schlosseri			Wedgeport	43.7136 -65.9690			
	Botryllus schlosseri			Camp Cove	43.7242 -65.8399			
	Botryllus schlosseri			Clark's Harbour	43.4450 -65.3353			
	Botryllus schlosseri			Ingomar	43.5642 -65.3633			
	Botryllus schlosseri			Shelburne	43.7578 -65.3224			
	Botryllus schlosseri			Lunenburg	44.3757 -64.3073			
	Botryllus schlosseri			Indian Point	44.4581 -64.30682			
	Botryllus schlosseri			Chester	44.5359 -64.2418			
	Botryllus schlosseri			Venus Cove	45.6151 -61.3901,			
	Botryllus schlosseri			St. Peter's	45.6615 -60.8749			
	Botryllus schlosseri			Whycocomagh	45.9683 -61.1128			
	Botryllus schlosseri			Orangedale	45.9005 -60.0880			
	Botryllus schlosseri			Eskasoni	45.9555 -60.5860			
	Botryllus schlosseri			Baddeck	46.0994 -60.7472			
	Botryllus schlosseri			Sydney	46.1399 -60.1678			
	Botryllus schlosseri			Louisburg	45.9180 -59.9894			
	Botryllus schlosseri			North Sydney	46.1988 -60.2579			

Region/ Province	Species name	Country of origin	Date of first sighting	Location of sightings in region/ Potential location future AIS threat		Eradication/ control efforts	Range expansion	General Information
				Geographical	lat_long			
MARITIMES (continued)	Botryllus schlosseri			Dingwall	46.9032 -60.4605			
	Botryllus schlosseri			Port Mouton	43.9194 -64.8434			
	Botryllus schlosseri			East Bay	46.0136 -60.3892			
	Botryllus schlosseri			Eel Lake	43.8267 -65.9077			
	Botrylloides violaceus	Asia		Cheticamp	46.6268 -61.0161			
	Botrylloides violaceus	Asia		Digby	44.6254 -65.75507			
	Botrylloides violaceus	Asia		Meteghan	44.1934 -66.167			
	Botrylloides violaceus	Asia		Yarmouth Bar	43.8161 -66.1476			
	Botrylloides violaceus	Asia		Wedgeport	43.7136 -65.9690			
	Botrylloides violaceus	Asia		Camp Cove	43.7242 -65.8399			
	Botrylloides violaceus	Asia		Clark's Harbour	43.4450 -65.3353			
	Botrylloides violaceus	Asia		Ingomar	43.5642- 65.3633			
	Botrylloides violaceus	Asia		Lunenburg	44.3757 -64.3073			
	Botrylloides violaceus	Asia		Indian Point	44.4581 -64.30682			
	Botrylloides violaceus	Asia		Chester	44.5359 -64.2418			

Region/ Province	Species name	Country of origin	Date of first sighting	Location of sightings in region/ Potential location future AIS threat		Eradication/ control efforts	Range expansion	General Information
				Geographical	lat_long			
MARITIMES (continued)	Botrylloides violaceus	Asia		North Sydney	46.1988 -60.2579			
	Botrylloides violaceus	Asia		Dingwall	46.9032 -60.4605			
	Caprella mutica	Asia		Digby	44.6254 -65.75507			
	Caprella mutica	Asia		Wedgeport	43.7136 -65.9690			
	Caprella mutica	Asia		Yarmouth Bar	43.8161 -66.1476			
	Caprella mutica	Asia		Clark's Harbour	43.4450 -65.3353			
	Caprella mutica	Asia		Lunenburg	44.3757 -64.3073			
	Caprella mutica	Asia		Indian Point	44.4581 -64.30682			
	Caprella mutica	Asia		Halifax, Bedford Insitute of Oceanography jetty	44.6809 -63.6109			
	Caprella mutica	Asia		Dingwall	46.9032 -60.4605			
	Caprella mutica	Asia		Halifax, Royal Nova Scotia Yacht Squadron	44.6209 -63.5804			
	Carcinus maenus	Europe		Wedgeport	43.7136 -65.9690			
	Carcinus maenus	Europe		Camp Cove	43.7242 -65.8399			
	Carcinus maenus	Europe		Dingwall	46.9032 -60.4605			
	Carcinus maenus	Europe		Cheticamp	46.6268 -61.0161			
	Carcinus maenus	Europe		North Harbour	46.9070 -60.4702			

Region/ Province	Species name	Country of origin	Date of first sightin g	Location of sightings in region/ Potential location future AIS threat		Eradicati on/ control efforts	Range expansion	General Information
				Geographical	lat_long			
MARITIMES (continued)	Membranipora membranacea	Europe		Meteghan	44.1934 -66.167			
	Membranipora membranacea	Europe		Yarmouth Bar	43.8161 -66.1476			
	Membranipora membranacea	Europe		Camp Cove	43.7242 -65.8399			
	Membranipora membranacea	Europe		Clark's Harbour	43.4450 -65.3353			
	Membranipora membranacea	Europe		Shelburne	43.7578 -65.3224			
	Membranipora membranacea	Europe		Lunenburg	44.3757 -64.3073			
	Membranipora membranacea	Europe		Indian Point	44.4581 -64.30682			
	Membranipora membranacea	Europe		Chester	44.5359 -64.2418			
	Membranipora membranacea	Europe		Halifax, Bedford Insitute of Oceanography jetty	44.6809 -63.6109			
	Membranipora membranacea	Europe		Venus Cove	45.6151 -61.3901			
	Membranipora membranacea	Europe		Orangedale	45.9005 -60.0880			
	Membranipora membranacea	Europe		Eskasoni	45.9555 -60.5860			
	Membranipora membranacea	Europe		Baddeck	46.0994 -60.7472			
	Membranipora membranacea	Europe		Dingwall	46.9032 -60.4605			
	Membranipora membranacea	Europe		Cheticamp	46.6268 -61.0161			
	Membranipora membranacea	Europe		Port Mouton	43.9194 -64.8434			
	Membranipora membranacea	Europe		North Harbour	46.9070 -60.4702			
	Membranipora membranacea	Europe		Halifax, Royal Nova Scotia Yacht Squadron	44.6209 -63.5804			

Region/ Province	Species name	Country of origin	Date of first sighting	Location of sightings in region/ Potential location future AIS threat		Eradication/ control efforts	Range expansion	General Information
				Geographical	lat_long			
MARITIMES (continued)	Botrylloides violaceus		05/11/2009	Campobello, NB		Continue AIS tunicate monitoring efforts		
	Caprella mutica			Bay of Fundy				
	Codium fragile			Bay of Fundy				
	Membranipora membranacea			Bay of Fundy				
	Attheya longicornis		2004	Bay of Fundy				
	Mediopyxis helysia		2003	Bay of Fundy				
	Membraneis challengeri		2004	Bay of Fundy				
	Odontella sinensis		2000	Bay of Fundy				
	Pseudo-nitzschia fraudulenta		2000	Bay of Fundy				
	Pseudo-nitzschia subpacifica		2001	Bay of Fundy				
	Pseudo-nitzschia turgidula		2008	Bay of Fundy				
	Pseudo-nitzschia heimii		2008	Bay of Fundy				
	Pseudo-nitzschia lineola		2008	Bay of Fundy				
	Thalassiosira punctigera		2001	Bay of Fundy				
	Amphidinium carterae		2000	Bay of Fundy				

Region/ Province	Species name	Country of origin	Date of first sighting	Location of sightings in region/ Potential location future AIS threat		Eradication/ control efforts	Range expansion	General Information
				Geographical	lat_long			
MARITIMES (continued)	Amphidinium sphenoides		2000	Bay of Fundy				
	Dinophysis tripos		1993	Bay of Fundy				
	Polykrikos schwartzii		2001	Bay of Fundy				
	Preperidinium meuneri		2001	Bay of Fundy				
QUEBEC	Diplosoma listerianum		2008	Îles-de-la-Madeleine		Rapid risk assessment in 2010		
CENTRAL AND ARCTIC	Neogobius melanostomus			Great Lakes			spreading into Great Lakes Tributaries	
PACIFIC	Same as last year- please see ICES WGITMO Canadian Country Report for 2009							

3.2. **New AIS Sighting:** AIS observed for the first time in 2010

Region/ Province	Species name	Country of origin	Date of first sighting	Location of sightings in region/ Potential location future AIS threat		Eradication/ control efforts	Range expansion	General Information
				Geographical	lat_long			
NEWFOUNDLAND/ PRINCE EDWARD ISLAND	None							
NEW BRUNSWICK	Botryllus schlosseri		Oct-10	Caraquet, NB				
	Botryllus schlosseri		Oct-10	Shediac Bay, NB				
MARITIMES	Chaetoceros peruvianus		Sep-10	Bay of Fundy		Continue phytoplankton monitoring		
QUEBEC	Botrylloides violaceus		2010	Îles-de-la-Madeleine				
CENTRAL AND ARCTIC	Oreochromis niloticus		19-Jun-10	Nepean Creek (stormwater pond). Ottawa, Ontario, Canada				suspected illegal aquaculture operation
	Oreochromis niloticus		23-Jun-10	Grand River (near Kitchener), Ontario, Canada.				suspected food trade release
	Eichhornia crassipes		fall 2010	Great Lakes-St Clair				
	Pistia stratiotes		fall 2010	Great Lakes-St Clair				
PACIFIC	None							

3.3. Future AIS threat: AIS not yet in the province/region which may arrive from another province/region or country

Region/ Province	Species name	Country of origin	Date of first sighting	Location of sightings in region/ Potential location future AIS threat		Eradication/ control efforts	Range expansion	General Information
				Geographical	lat_long			
NEWFOUNDLAND	Codium fragile	Japan		South coast at risk recently discovered on St. Pierre Michelon				
	Ciona intestinalis Europe			South coast at risk found in North Sydney, NS yacht club				
	Styela clava	western pacific		South coast at risk currently found in many areas of maritimes				
	Didemnum vexillum	Pacific		South coast at risk currently found on coast of Maine				
PRINCE EDWARD ISLAND	Didemnum vexillum							Didemnum is of primary concern to marine based stakeholders in PEI. See Locke, A. 2009. A screening procedure for potential tunicate invaders of Atlantic Canada. Aquatic Invasions Volume 4, Issue 1: 105-110 http://www.aquaticinvasions.ru/2009/AI_2009_4_1_Locke.pdf
NEW BRUNSWICK	Didemnum vexillum							Didemnum is of primary concern to marine based stakeholders in NB. See Locke, A. 2009. A screening procedure for potential tunicate invaders of Atlantic Canada. Aquatic Invasions Volume 4, Issue 1: 105-110 http://www.aquaticinvasions.ru/2009/AI_2009_4_1_Locke.pdf

Region/ Province	Species name	Country of origin	Date of first sighting	Location of sightings in region/ Potential location future AIS threat		Eradication/ control efforts	Range expansion	General Information
				Geographical	lat_long			
MARITIMES	Didemnum vexillum							
	Styela clava							
	Diplosoma listerianum							
	Didemnum vexillum			Deer Island, Campobello, NB		Completed another Rapid Assessment in Sept 2010		
CENTRAL AND ARCTIC	Hypophthalmichthys nobilis		tbd	Great Lakes				Fisheries and Oceans Canada is undertaking a binational risk assessment (with the United States) to best inform prevention, monitoring and control activities
	H. molitrix		tbd	Great Lakes				Fisheries and Oceans Canada is undertaking a binational risk assessment (with the United States) to best inform prevention, monitoring and control activities
	Dreissena polymorpha		unknown	Canadian portion of the Red River basin, ManitobaFocus on education to minimize spread				

4. Pathogens

Infectious Salmon Anaemia (ISA) was discovered in a land based research/rearing facility in Prince Edward Island (PEI). This is the first occurrence of ISA in PEI. The Canadian Food Inspection Agency (CFIA) reported it to the World Organization for Animal Health (OIE).

5. Meetings, conference, symposia or workshops

- **3rd Newfoundland AIS Workshop.** March 18, 2010, St. John's, Newfoundland.
- **AIS Coastal Shipping Risk Assessment meeting**. April 30, 2010, Toronto, Ontario.
- **AIS Planning Workshop for Department of Fisheries and Oceans**. June 9-18, 2010, Prince Edward Island, Nova Scotia, Pacific.
- **Aquaculture Canada 2010 & Cold Harvest 2010 Conference and Trade Show.** May 16-19, 2010, St. John's, Newfoundland.
- **Aquatic Invasive Species Awareness Workshop**. December 14, 2010, Moncton, New Brunswick. *Purpose of the meeting was to discuss AIS awareness material that has been developed over the years.*
- **Aquatic Invasive Species working group** conference call, Department of Fisheries and Oceans. November 15, 2010.
- **Atlantic Introductions and Transfers Committees Chairs Workshop.** October 26- 27, 2010, Halifax. *Federal I&T Committee Chairs from Quebec, Prince Edward Island, Nova Scotia, New Brunswick, and Newfoundland and Labrador met to review delivery of federal responsibilities with the objective of harmonizing and streamlining delivery of I&T services.*
- **Canadian AIS Research and Monitoring Workshop**. June 9-10, 2010, Brackley, Prince Edward Island.
- **Canadian Aquatic Invasive Species Network Annual General Meeting.** April 26-28, 2010, Victoria, British Columbia.
- **Canadian Aquatic Invasive Species Network meeting**. Summer 2010, Victoria, British Columbia.
- **Canadian Science Advisory Council, Regional Advisory Process on European green crab**. March 17, 2010, St. John's, Newfoundland.
- **CFIA Industry Information Session on Imports/Exports.** April, 2010.
- **ICES Annual Science Conference,** September 20-24, 2010, Nantes, France.
- **International Conference on Aquatic Invasive Species (17th)**. August 29-September 2, 2010. San Diego, United States.
- **International Invasive Sea Squirt Conference III**. April 27-28, 2010, Woods Hole, United States of America.
- **National Aquatic Invasive Committee** conference call, Department of Fisheries and Oceans. November 15,2010.
- **National Aquatic Invasive Committee** conference call, Department of Fisheries and Oceans. March 8 ,2010.
- **National Invasive Alien Species Forum**, Environment Canada. March 25-26, 2010, Ottawa.
- **New Zealand Mud Snail Risk Assessment Meeting.** March, 2010.

- **Procès-verbal – Rencontre Espèces Envahissantes**. October 14, 2010, Baie de Caraquet, New Brunswick. *This information meeting was attended by aquaculturist, Eel River Bar First Nation, Province and Federal departments. The purpose of the meeting was to inform and address questions concerning the new arrival of the golden star tunicate, Botryllus schlosseri in Caraquet, New Brunswick.*
- The Prince Edward Island (PEI**) Introductions and Transfers Committee** has an **Aquatic Invasive Species (AIS) focused subcommittee** that provides industry stakeholders an opportunity for input to the Introductions and Transfers process with the aim to reduce the spread of AIS. This committee meets 2 to 4 times per year.
- Industry, government and academic stakeholders in PEI are members of an **AIS Steering Committee** whose mandate is to coordinate all activities related to AIS (monitoring, funding applications etc.) This committee meets 1 to 2 times per month.

6. References and bibliography

Abbott, C.L, D. Ebert, A. Tabata, and T.W. Therriault. 2010. Twelve microsatellite markers in the invasive tunicate, *Didemnum vexillum*, isolated from low genome coverage 454 pyrosequencing reads. Conservation Genetics Resources (in press).

Abbott, C.L, D. Ebert, A. Tabata, and T.W. Therriault. 2010. Twelve microsatellite markers in the invasive tunicate, Didemnum vexillum, isolated from low genome coverage 454 pyrosequencing reads. Conservation Genetics Resources (in press).

Adebayo,A.A, E.Briski, O. Kalaci, M. Hernandez, S. Ghabooli, B. Beric, F. T. Chan, A. Zhan, E. Fifield, T. Leadley and H. J. MacIsaac. 2011. Water hyacinth (Eichhornia crassipes) and water lettuce (Pistia stratiotes) in the Great Lakes: playing with fire? Aquatic Invasions 6 (1), doi:10.3391/ai.2011.6.1

Bélair, M.-C. and G. Miron. 2009. Predation behaviour of *Cancer irroratus* and *Carcinus maenas* during conspecific and heterospecific challenges. Aquat. Biol.. 6: 41-49.

Bélair, M.-C., and G. Miron. 2009. Time budget of *Cancer irroratus* (Say) and *Carcinus maenas* (L.) under various temperature and prey density conditions during conspecific and heterospecific challenges. J. Shellfish Res. 28: 923-930.

Bernier, R., A. Locke, and J.M. Hanson. 2009. Lobsters and crabs as potential vectors of tunicate dispersal in the southern Gulf of St. Lawrence, Canada. Aquat. Invasions 4: 105-110.

Best, K., C.H. McKenzie, and C. Couturier. 2009. Early life stage biology of a new population of green crab, *Carcinus maenas*, in Placentia Bay: implications for mussel culture in Newfoundland. Aquaculture Association of Canada Spec. Publ. No. 15: 48-50.

Blakeslee, A.M.H., C.H. McKenzie, J.D. Darling, J.E. Byers, J.P. Pringle, and J. Roman. 2010. A hitchhiker's guide to the Maritimes: anthropogenic transport facilitates long-distance dispersal of an invasive marine crab to Newfoundland. Diversity Distrib. 16: 879-891.

Callahan, A.G., D. Deibel, C.H. McKenzie, J. R. Hall and M.L Rise. 2010. Survey of harbours in Newfoundland for indigenous and non-indigenous ascidians and an analysis of their cytochrome *c* oxidease I gene sequences. Aquatic Invasions 5(1):31-39.

Clarke Murray, C., E.A. Pakhomov, and T.W. Therriault. (in review). Recreational boating: a large unregulated vector transporting marine invasive species. Diversity and Distributions.

Clarke Murray, C., E.A. Pakhomov, and T.W. Therriault. Recreational boating: a large unregulated vector transporting marine invasive species. Diversity and Distributions (in review).

Crawford, W.R. 2010. Global and North Pacific conditions – Temperatures in 2009: Globally warm but locally cool, p 21-26 In: Crawford, W.R., and J.R. Irvine. (Eds.). State of physical, biological, and selected fishery resources of Pacific Canadian marine ecosystems in 2009. DFO Can. Sci. Advis. Sec. Res. Doc. 2010/053: viii + 137 p.

Darbyson, E., A. Locke, J.M. Hanson and J.M.H. Willison. 2009. Marine boating habits and the potential for spread of invasive species in the Gulf of St. Lawrence. Aquat. Invasions 4: 87-94.

Darbyson, E., J.M. Hanson, A. Locke and J.M.H. Willison. 2009. Settlement and potential for transport of clubbed tunicate (*Styela clava*) on boat hulls. Aquat. Invasions 4: 95-103.

Darbyson, E., J.M. Hanson, A. Locke and J.M.H. Willison. 2009. Survival of European green crab exposed to simulated overland and boating-vector transport conditions. J. Shellfish Res. 28: 377-382.

DFO, 2010. Proceedings of the National peer review on Alternate Ballast Water Exchange zones for vessel traffic to Newfoundland and the Arctic. January 13-14, 2009. DFO Can. Sci. Advis. Sec. Proceed. Ser. 2009/054: vi+23 p.

DFO. (in Prep) Proceedings of the Regional Advisory Process on European Green Crab, *Carcinus maenas*, Population and Mitigation in Newfoundland. March 17, 2010. DFO Can. Sci. Advis. Sec. Proceed. Ser. 2010/nnn

DFO. 2010. Review of Alternate Ballast Water Exchange Zones for vessel traffic to Newfoundland and Labrador and the Canadian Arctic. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2010/026. 7 p.

DFO. 2010. Ecological Assessment of the Invasive European green crab, (*Carcinus maenas*) in Newfoundland 2007-2009. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2010/033: 10 p.

Dimond, P.E., N.E. Mandrak, and B. Brownson. 2010. Summary of the rapid response to Round Goby (*Neogobius melanostomus*) in Pefferlaw Brook with an evaluation of the national rapid response framework based on the Pefferlaw Brook experience. DFO Can. Sci. Advis. Sec. Res. Doc. 2010/036: vi+33 p.

Epelbaum A., C.M. Pearce, D.J. Barker, A. Paulson, T.W. Therriault. 2009. Susceptibility of non-indigenous ascidian species in British Columbia (Canada) to invertebrate predation. Mar. Biol. 156: 1311-1320.

Epelbaum A., L.M. Herborg, T.W. Therriault, C.M. Pearce. 2009. Temperature and salinity effects on growth, survival, reproduction, and potential distribution of two non-indigenous botryllid ascidians in British Columbia. J. Exp. Mar. Biol. Ecol. 369: 43-52.

Epelbaum A., T.W. Therriault, A. Paulson, C.M. Pearce. 2009. Botryllid tunicates: culture techniques and experimental procedures. Aquat. Invasions 4: 111-120.

Galbraith J., and B. Crawford. 2009. Contours of Average Temperature and Salinity in the Gulf of Alaska http://www.pac.dfo-mpo.gc.ca/science/oceans/data-donnees/Alaska/index-eng.htm (website accessed 2010-10-15)

https://www1.cmos.ca/Amsoft%20Web%20Data/upload/abstracts115/2010-06-04archive.html

Huot *et al*. (in prep.). Évaluation des risques d'introduction de la caprelle japonaise (Caprella mutica) lors du transfert de pétoncles juvéniles en provenance des Îles-de-la-Madeleine.

Jansen, W., N. Geard, T. Mosindy, G. Olson, and M. Turner. 2009. Relative abundance and habitat association of three crayfish (*Orconectes virilis*, *O. rusticus*, and *O. immunis*) near an invasion front of *O. rusticus*, and long-term changes in their distribution in Lake of the Woods, Canada. Aquat. Invasions 4: 627-649.

Kanary, L., A. Locke and J. Watmough. 2010. Evaluating the effectiveness of SCUBA-based visual searches for tunicates in a Prince Edward Island estuary. Aquat. Invasions 5: 41-47.

Klein, G., Martin, J.L., and Kaczmarska, I. 2010. Biological synopsis of phytoplankton new to the Bay of Fundy. Can. Manuscr. Rep. Fish. Aquat. Sci. 2919: v + 28 p.

Koops, M.A., J. Gerlofsma, and J. Marty. 2010. Risk assessment of the bloody red shrimp (*Hemimysis anomala*) in Canada. DFO Can. Sci. Advis. Sec. Res. Doc. 2009/107: iv+20 p.

LeGresley, M.M., Martin, J.L., McCurdy, P. Thorps, B., and Chang, B.D. 2008. Non-indigenous tunicate species in the Bay of Fundy, eastern Canada. ICES Journal of Marine Science. 65:770-774.

Lejeusne, C., D. Bock, H.J. MacIsaac, T.W. Therriault, and M.E. Cristescu. 2010. Comparative phylogeography of two colonial ascidians reveals contrasting invasion histories in North America. Biol. Invasions (in press).

Lejeusne, C., D. Bock, T.W. Therriault, H.J. MacIsaac, and M.E. Cristescu. 2010. Comparative phylogeography of two colonial ascidians reveals contrasting invasion histories in North America. Biological Invasions (in press).

Lejeusne, C., D. Bock, T.W. Therriault, H.J. MacIsaac, and M.E. Cristescu. 2010. Comparative phylogeography of two colonial ascidians reveals contrasting invasion histories in North America. Biological Invasions. (in press).

Locke, A., K. Doe, W. Fairchild, P. Jackman and E. Reese. 2009. Preliminary evaluation of effects of tunicate management with acetic acid and calcium hydroxide on non-target marine organisms in Prince Edward Island, Canada. Aquat. Invasions 4: 221-236.

Lowen, J.B., D. Deibel, M.L. Rise, R.J. Thompson, K. Ma, and C.H. McKenzie. 2010. Life-history, population dynamics, diversity and abundance of *Botryllus schlosseri* in a sub-arctic environment (Arnold's Cove, Placentia Bay, NL). Aquaculture Canada 2010 & Cold Harvest 2010 Conference and Trade Show St. John's, NL 16-19, May 2010.

Ma, KCK, D. Deibel and C.H. McKenzie. 2010. Non-indigenous and indigenous ascidians of Newfoundland and Labrador. Aquaculture Canada 2010 & Cold Harvest 2010 Conference and Trade Show St. John's, NL 16-19, May 2010.

Ma, Z., G. Han, B. De Young, M. Foreman. 2010. Simulation of temperature and currents in Placentia Bay. The 2010 CMOS-CGU Congress, Ottawa.

Mallet, J.-F., A.R. LeBlanc, M. Ouellette and L.A. Comeau. 2009. Abundance and function of rock crabs (*Cancer irroratus*) in longline mussel (Mytilus edulis) farms. Can. Tech. Rep. Fish. Aquat. Sci. 2862: viii+53 p.

Mandrak,N.E. and Cudmore, B. 2010. The fall of Native Fishes and the rise of Non-native Fishes in the Great Lakes Basin. Aquatic Ecosystem Health and Management. 13:255-268.

Marson, D., Cudmore, B., Drake, D.A.R. and Mandrak, N.E. 2009. Summary of a survey of aquarium owners in Canada. Can. Manuscr. Rep. Fish. Aquat. Sci. 2905: iv + 20 p.

Marson, D., Cudmore, B., Drake, D.A.R. and Mandrak, N.E. 2009. Summary of a survey of water garden owners in Canada. Can. Manuscr. Rep. Fish. Aquat. Sci. 2906: v + 23 p.

Martin, J.L., LeGresley, M.M., Cooper, J.A., Thorpe, B., Locke, A., Simard, N., Sephton, D., Bernier, R., Bérubé, I., Hill, B., Keays, J., Knox, D., Landry, T., Lander, T., Nadeau, A. and Watson, E.J. 2010. Rapid Assessment for *Didemnum vexillum* in southwest New Brunswick.. Can. Tech. Rep. Fish. Aquat. Sci. 2882: iii + 15p.

Marty J., K. Bowen, M.A. Koops, and M. Power. 2010. Distribution and ecology of *Hemimysis anomala*, the latest invader of the Great Lakes basin. Hydrobiologia. 647: 71-80.

Mather, L., MacIntosh, K., Kaczmarska, I., Klein, G. and Martin, J.L. 2010. A checklist of diatom species reported (and presumed native) from Canadian coastal waters. Can. Tech. Rep. Fish. Aquat. Sci. 2881: iv- 78 p.

McKenzie, C. H., G. Han, M. He, T. Baines and G. Maillet. 2010. Alternate Ballast Exchange zones for the Newfoundland and Labrador Region- An Aquatic Invasive Species Risk Assessment based on oceanographic modeling, ecologically and biologically significant areas and sustainability of fisheries and Aquaculture. Can. Sci. Advis. Sec. Res. Doc. 2010/087: 41 p.

McKenzie, C.H. 2010. Review of Newfoundland and Labrador Region AIS research and monitoring 2009 activities and plans for 2010. Canadian AIS Research and Monitoring Workshop, Brackley, PEI, June 9-10, 2010.

McKenzie, C.H., T. Wells, and A. Vickerson. 2010. Ecological assessment of the invasive European green crab, *Carcinus maenas*, in Newfoundland 2007-2009. 3rd Newfoundland AIS Workshop, St. John's, NL , March 18, 2010.

McKenzie, C.H., T. Wells, and A. Vickerson. 2010. Ecological assessment of the invasive European green crab, *Carcinus maenas*, in Newfoundland 2007-2009. Canadian Science Advisory Council, Regional Advisory Process on European green crab, St. John's, NL , March 17, 2010.

McKindsey, C.W., Lecuona, M., Huot, M., Weise, A.M., 2009. Biodeposit production and benthic loading by farmed mussels and associated tunicate epifauna in Prince Edward Island. Aquaculture. 295: 44-51.

Pilgrim, B.B. and C. H. McKenzie.2010. The control and management of an invasive colonial tunicate *Botrylloides violaceus* in Newfoundland. Aquaculture Canada 2010 & Cold Harvest 2010 Conference and Trade Show St. John's, NL 16-19, May 2010

Ramsay A., J. Davidson, D. Bourque, and H. Stryhn. 2009. Recruitment patterns and population development of the invasive ascidian *Ciona intestinalis* in Prince Edward Island, Canada. Aquat. Invasions. 4: 169-176.

Rooney, R.C., and M.J. Paterson. 2009. Ecosystem effects of rainbow smelt (*Osmerus mordax*) invasions in inland lakes: a literature review. Can. Tech. Rep. Fish. Aquat. Sci. 2845: iv+33 p.

Rosenberg, D.M., M.A. Turner, W. Jansen, T. Mosindy and D.A. Watkinson. 2010. Threats to Lake of the Woods and the Winnipeg River by the rusty crayfish (*Orconectes rusticus*), an aquatic invader. Ont. Min. Natur. Resour., Northwest Sci. & Info., NWSI Tech. Workshop Rpt. TWR-005. 54 p.+append.

Rup M.P., S.A. Bailey, C.J. Wiley, M.S. Minton, A.W. Miller, G.M. Ruiz, H.J. MacIsaac. 2010. Domestic ballast operations on the Great Lakes: potential importance of Lakers as a vector for introduction and spread of nonindigenous species. Can. J. Fish. Aquat. Sci. 67: 256-268.

Simard *et al*. (in prep). Synthèse des activités de monitorage (2004-2009) effectuées dans la région du Québec.

Simard *et al*. (submitted). Net efficacy of open ocean ballast water exchange on plankton communities.

Sutherland, T., C. Levings, and C. Wiley. (in prep). Quantifying Aquatic Invasive Species in Accumulated Ballast Sediment Residuals - "Swish": Preliminary Results.

Switzer, S.E., T.W. Therriault, A. Dunham, and C.M. Pearce. Assessing potential control options for the invasive tunicate *Didemnum vexillum* in shellfish aquaculture. Aquaculture (in review).

Switzer, S.E., T.W. Therriault, A. Dunham, and C.M. Pearce.(in review). Assessing potential control options for the invasive tunicate Didemnum vexillum in shellfish aquaculture. Aquaculture.

Sylvester, F., O. Kalaci, B. Leung, A. Lacoursière-Roussel, C. Clarke Murray, F.M. Choi, M.A. Bravo, T.W. Therriault, and H.J. MacIsaac. (in press). Invasion vectors: can simple models explain a complex problem? Journal of Applied Ecology.

Sylvester, F., O. Kalaci, B. Leung, A. Lacoursière-Roussel, C. Clarke Murray, F.M. Choi, M.A. Bravo, T.W. Therriault, and H.J. MacIsaac. (in press). Invasion vectors: can simple models explain a complex problem? Journal of Applied Ecology.

Therriault, T.W., A.M. Weise, G.E. Gillespie, and T.J. Morris. 2010. Risk Assessment for New Zealand Mud Snail (*Potamopyrgus antipodarum*) in Canadian Waters. Canadian Science Advisory Secretariat Research Document 2010/108 (in press).

Turcotte, C. 2010. La caprelle japonaise Caprella mutica et son impact sur l'élevage de moules *Mytilius* spp.: un cas de cleptoparasitisme? Mémoire M.Sc., Université du Québec à Rimouski, Rimouski, 98 p.

Vélez-Espino, L.A., M.A. Koops and S. Balshine. 2010. Invasion dynamics of round goby (*Neogobius melanostomus*) in Hamilton Harbour, Lake Ontario. Biol. Invasions. 12: 3861-3875.

5.3 Croatia

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1. Laws and Regulations

Croatian Law System (Marine Fisheries Act from 1997, updated in 2005), prohibit introduction of non-indigenous marine species in the Adriatic Sea. Farming of non-indigenous marine species is allowed by special permissions of Ministry of Environmental Protection, Physical Planning and Construction and Ministry of the Sea, Tourism, Transport and Development, but such cases are not yet recorded.

2. Deliberate Introductions and Transfers

Due to restrictive Croatian legislation deliberate introduction is not recorded.

3. Accidental Introduction and Transfers

Papers regarding new records in Adriatic sea (Croatian part), published in last three years are presented in this report.

3.1. Fish

On 7 November and 15 December 2006, two specimens of the Lessepsian migrant *Fistularia commersonni* were caught in trammel nets off the coastal waters of Tricase Porto (southwestern Adriatic, Italy) and Sveti Andrija (southeastern Adriatic, Croatia), respectively. These represent the first records of this species in the Adriatic Sea (Dulčić *et al*. 2008).

On 23 July 2007 a specimen of very rare live sharksucker *Echeneis naucrates* was caught in Ombla River near Dubrovnik, south-eastern Adriatic. First data on biometric lengths and morphology of this species are presented for the eastern Adriatic (Skaramuca *et al*. 2008).

One specimen (total length: TL= 108 mm, weight: W = 0.70 g) of smallmouth spiny eel *Polyacanthonotus rissoanus* (De Filippi & Verany, 1857) (Notacanthidae) was captured at a depth between 1192 and 1200 m in the area of the southern Adriatic Pit (42° 05.80 N; 17° 38.00 E). This is the first record of this species for the Adriatic (Isajlović *et al*. 2009). Specimen is stored in the Ichthyological collection of the Institute of Oceanography and Fisheries, Split, under the number IOR-18.

On the 27 August 2008, a 368 mm total length (Lt, weight W= 634 g) specimen of the blue runner *Caranx crysos*, was caught by spear gun, on the shallow Čivran (Červar Porat), between Poreč and Novigrad (northern Adriatic, Croatian coast, peninsula Istra) (45°16'39'' N 13°34'41'' E) at approximately 8 m depth. This is the first record for

the Adriatic Sea, and the northernmost record of this species in the Mediterranean area (Dulčić *et al*. 2009).

On 11 May 2009, a specimen of Oarfish, *Regalecus glesne* Ascanius, 1772, was collected in the vicinity of Stobreč, Croatia. This rare fish was found alive, swimming near the coast. This is first record of this species from the eastern Adriatic coast and second from the entire Adriatic. Previous record considered a mutilated and only partly preserved specimen, which was captured in 1932. (Dulčić *et al*. 2009).

According to Dragičević *et al*. (2010) two juvenile specimens of *Coryphaena hippurus* have been found in the Adriatic for the first time. Prior to this, larval stages were also encountered in the Adriatic which, along with findings of juveniles, might indicate that *C. hippurus* reproduces in these waters. In the last few years, records of larval and juvenile stages of the species that were previously rare or relatively rare in the area became more common.

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

The sports fisherman caught the rotan in the central course of the Sava River (Danube tributary), near the city of Slavonski Brod, at river kilometre 380 (45°09'13''N, 17°59'45''E) in a channel periodically connected to the river. This finding is the first record of rotan (*Perccottus glenii* Dybowsky, 1877) (Gobioidei, Odontobutidae) in Croatia, and the most western finding in Europe (Ćaleta *et al*. 2011).

3.2. Invertebrates

Kružić (2008) reported about confirmation of *Cladopsammia rolandi* presently living in the Adriatic Sea.The known geographical distribution of the colonial scleractinian coral *C. rolandi* Lacaze-Duthiers, 1897 has been extended with new records from the Adriatic Sea. This mediterranean endemic scleractinian coral was found in spring 2002 on the cliff at the south of Lastovo Island and in summer 2005 on the two locations at the south-west of Mljet Island (South Adriatic).

Two isopod species, *Nerocila orbigny* and *Ceratothoa parallela* (Crustacea, Isopoda, Cymothoidae) are reported for the first time on and in the black scorpionfish, *Scorpaena porcus*, collected from the eastern Adriatic Sea. Cymothoids parasitized 5.5 % (6 of 109) of the collected fish (Ferri *et al*. 2008).

Marčić *et al*. (2008) described catching of a single male specimen of *Thysanoteuthis rhombus*, using a hand squid jig just after dusk on 26 December 2006, 15 meters offshore of Dolfin Islet (44°41'N 14°41'E) at a depth of 10 m in the eastern part of the northern Adriatic Sea. This is the first record of this species in the Adriatic Sea and the northernmost capture in the Mediterranean Sea.

Isajlović *et al*. (2009) reported the first occurrence of *P. cuvieri* in the eastern Adriatic, in Croatian waters, and at the same time the northernmost record for the Adriatic. On the 1st of July 2008, a specimen of *Paromola cuvieri* was collected about 20 km off Dubrovnik (south-east Adriatic) at a depth between 370 and 380 m by a type of bottom trawl called „tartana".

Dulčić *et al*. (2010) are reporting on the new record of the blue crab *Callinectes sapidus* in the Adriatic Sea. The specimen was found at the mouth of the river Neretva in No-

vember 2009. From the very first record of this species, dating from 1949, another 12 records of the species have been detected in the Adriatic Sea. The majority of sites where the blue crab was found are coastal lagoons.

3.3. Algae and Higher Plants

The species *Ceratoperidinium yeye* was found in net samples from the coastal waters of the eastern Adriatic Sea in summer 2003. The species was found in both the northern and the middle parts of the sea. In the northern Adriatic, it was found at stations A (45º15'5''N, 13°34'5''E) and B (45º17'4''N, 13º32'2''E; and, in the middle Adriatic, at station C (43º45'38'', 15º51'1''E). The dinoflagellate was found at all three stations during summer when the sea water temperature was above 20ºC. Abundance was less than 1 cell/l. Because this species was found in net samples, it cannot be indicated whether *C. yeye* occupies the surface layer, the bottom layer, or the whole water column (Ninčević *et al*. 2006).

Since 1994, in the Croatian part of the Adriatic Sea, two invasive species of alga Caulerpa were found, *Caulerpa taxifolia* (Vahl) C. Agardh and *Caulerpa racemosa* (Forssk.) J.Agardh.

4. Live Imports and Transfers

5. Live Exports to ICES Member Countries

6. Meetings, Conferences, Symposia, Workshops, Research Programs etc.

Paper work „Ballast Water Treatment – New Method" (Lovrić *et al*. 2009) was presented on Second Conference on Marine Technology, Rijeka, November, 2009.

As a part of scientific programs supported by Croatian Governement (Ministry of Science) few projects regarding biological invasions have been carried out.

Ministry of Culture is responsible for problematics of invasive species in Croatia which is regulated by Low on Nature Protection. One of major projects supported by Ministry of Culture is monitoring and eliminating of algae *Caulerpa taxifolia* and *Caulerpa racemosa*.

7. Bibliography

Ćaleta M, Jelić D, Buj I, Zanella D, Marčić Z, Mustafić P, Mrakovčić M (2011) First record of the alien invasive species rotan (*Perccottus glenii* Dybowski, 1877) in Croatia. Journal of Applied Ichthyology 27: 146–147

Dragičević B, Dulčić J, Pallaoro A, Paladin A, Stagličić N (2010) First record of dolphin-fish juveniles, *Coryphaena hippurus* (Linnaeus, 1758), in the Eastern Adriatic. Annales, Series Historia Naturalis 20(2): 157-160

Dulčić J, Scordella G; Guidetti, Paolo (2008) On the record of the Lessepsian migrant *Fistularia commersonii* (Rüppell, 1835) from the Adriatic Sea. Journal of Applied Ichthyology 24(1): 101-102

Dulčić J, Dragičević B, Tutman Pero (2009) Record of *Regalecus glesne* (Regalecidae) from the eastern Adriatic Sea. Cybium 33(4): 339-340

Dulčić J, Pallaoro A, Dragičević B (2009) First record of the blue runner, *Caranx crysos* (Mitchill, 1815), for the Adriatic Sea. Journal of Applied Ichthyology 25(4): 481-462

Dulčić J, Dragičević B, Lipej L (2010) New record of the Blue Crab, *Callinectes sapidus* Rathbun, 1896, (Decapoda: Brachyura) in the Adriatic Sea. Annales, Series Historia Naturalis 20(1): 23-28

Dulčić J, Pallaoro A, Dragičević B, Stagličić-Radica N (2010) On the record of dwarf flathead *Elates ransonnetii* (Platycephalidae) in the Adriatic Sea. Cybium 34(2): 222-223

Ferri J, Petrić M, Matić-Skoko S, Dulčić J (2008) New host record, black scorpionfish *Scorpaena porcus* (Pisces, Scorpaenidae) for *Nerocila orbigny* and *Ceratothoa parallela* (Crustacea, Isopoda, Cymothoidae). Acta Adriatica 49(3): 255-258

Isajlović I, Piccinetti C, Vrgoč N, Dulčić J (2009) First record of the smallmouth spiny eel, *Polyacanthonotus rissoanus* for the Adriatic Sea. Cybium 33 (2): 169-170

Isajlović I, Vrgoč N, Dulčić J (2009) On a record of the box crab, *Paromola cuvieri* (Risso, 1816) (Decapoda, Brachyura, Homolidae) in the south-east Adriatic (Croatian waters). Crustaceana 82(8): 1087-1090

Kružić P. (2008) First records of *Cladopsammia rolandi* (Cnidaria, Anthozoa) in the Adriatic Sea. Nat. Croat. 17(1): 9-14

Lovrić J, Pećarević M, Mikuš J, Barač I, Juretić H, Dobrović S. (2009) Obrada vodenog balasta - nova metoda. Zbornik radova III. In: Rožanić I (ed) Zbornik radova III. Savjetovanja o morskoj tehnologiji, Rijeka, Croatia 16-30.

Marčić Z, Ćaleta M, Buj I, Mrakovčić M, Mustafić P, Zanella D, Dulčić J (2008) First record of *Thysanoteuthis rhombus* (Cephalopoda: Thysanoteuthidae) in the Adriatic Sea. JMBA2 - Biodiversity Records. Art. No. 6086; 1-3

Ninčević Gladan Ž, Skejić S, Marasović I, Žuljević A (2006) First record of *Ceratoperidinium yeye* in the eastern Adriatic Sea. Acta Adriatica 47(2): 207-210

Skaramuca D, Skaramuca B, Dulčić J (2008) On the record of live sharksucker, *Echeneis naucrates* (Osteichthyes: Echeneidae), from the osuth-eastern Adriatic (Croatian coast). JMBA2 - Biodiversity Records 6086

5.4 Denmark

Prepared by Kathe R. Jensen, Zoological Museum, Denmark.

1. Regulations

There has been a merger of the Danish Forest and Nature Agency, which was responsible for invasive species, and the Agency for Spatial and Environmental Planning, which was responsible for the marine environment. The new agency is called the Danish Nature Agency. Their web-site, http://www.naturstyrelsen.dk/, is still under construction, especially the English language part.

In accordance with the National Action Plan on Invasive Species, the process of risk assessment of individual species is now in progress. Assessments are carried out in accordance with the Belgian guidelines for environmental impact assessment and list classification of non-native organisms (Harmonia; available at http://ias.biodiversity.be/documents/ISEIA_protocol.pdf). The result of this excercise will be updated "Black List", "Observation List" and "Alert List".

Work in preparation for the ratification of the Ballast Water convention has been continued by the Danish Nature Agency with the aim of ratifying the convention during 2011.

A web-based identification key of marine introduced invertebrates in Nordic waters is now available at the NOBANIS web-site

(http://www.nobanis.org/MarineIdKey/general%20intro/IntroMarineKey.htm). It contains keys to 11 major groups, introductions to 26 supraspecific taxa, and fact-sheets for 63 species. In addition there are numerous links to other web-sites with descriptions of native species for comparison and to other web-sites describing alien species.

2. Intentional introductions

Glass eel, juvenile *Anguilla anguilla*, imported from southern Europe, cultured in eel farms and checked for parasites and diseases have been released every year since 1987 into fresh- and brackish-water localities (Pedersen, 2009). This species is not alien, and recent studies have shown that European populations are not genetically distinct (Als *et al*., in press).

Imports and exports of live marine species

Danish fisheries' statistics do not permit distinction between amounts for human consumption, industrial processing and release for aquaculture (see reports for previous years). The Fisheries' Statistics for 2009 was published in September 2010, and is available at http://webfd.fd.dk/info/sjle3/fsa_bog2009/Fiskeristatistisk.pdf).

3. Unintentional introductions

Invertebrates:

The hydroid polyp *Pachycordyle navis* (Millard, 1959) (=*Thieliana n.*; *Clavopsella navis*) has been recorded from the Isefjord, where it had been originally misidentified as *Corydendrium dispar* Kramp, 1935 (Rasmussen, 1973). Rasmussen's material has been re-examined and identified as *P. navis* (Schuchert, 2004). It may be a Ponto-Caspian species, but as the origin is uncertain it should be considered cryptogenic. It has been found in South Africa, the Black Sea, the Baltic, the U.K., Germany and is established in the Netherlands (Wolff, 2005).

Mnemiopsis leidyi A. Agassiz, 1865 was scarce through the beginning of the year, but showed distinct mass occurrence in the late summer (August) in inner Danish water (see newsreport at http://www.fyens.dk/article/1667138:Indland-Fyn--Draebergoplerne-er-tilbage and http://videnskab.dk/miljo-naturvidenskab/draebergopler-invaderer-os-i-sensommeren [About *Mnemiopsis* in Danish waters in the summer of 2010]). Several scientific papers have been published on the biology of this species; some publications are in collaboration with other North European countries (Jaspers *et al*., 2011; Madsen & Riisgård, 2010; Riisgård *et al*., 2010).

The Japanese oyster drill *Ocinebrellus inornatus* (Récluz, 1851) has been identified by molecular methods. It occurs in the western part of the Limfjord (Lützen *et al*., 2010) and has previously been misidentified based on shell morphology as *Ocenebra erinacea* (Jensen & Hoffmann, 2007). It is not very common and the local fishers have been asked not to return the snails if they find them in their fishing nets. As there has been no legal introduction of live shellfish to the Limfjord for more than 20 years, and *O. inornatus* does not have free-swimming larvae, it was most likely introduced to the Limfjord with illegal introductions of oysters or blue mussels.

The Pacific oyster, *Crassostrea gigas* (Thunberg, 1793), continues to spread in inner Danish waters. It has now been found in Odense Fjord and Kerteminde Fjord in addition to the localities mentioned in previous reports. It seems likely that spat has been transferred with mussel seed for aquaculture. Dispersal in Nordic waters has been

summarized in Wrange *et al*. (2010). An attempt to model larval dispersal in the Limfjord was carried out by students from Roskilde University (Davids *et al*., 2010).

One study has experimentally shown that bird predation on the American razor clam in the Wadden Sea has shown that predation was more severe at sites in the lower intertidal zone than in high intertidal sites (Freudenthal *et al*., 2010).

The distribution of the spionid polychaete *Marenzelleria viridis* (Verrill, 1873) (Table 1) has been the topic of a MS thesis from Roskilde University (Christoffersen, 2010). He also tried to correlate the distribution with various environmental factors. Molecular methods identified only *M. viridis*, but a fairly high proportion of the collected worms did not produce usable results using these methods. Prior to this study *M. viridis* has been found in Ringkøbing Fjord and Nissum Fjord, both on the North Sea coast of Denmark (Jensen & Knudsen, 2005), Odense Fjord (Quintana *et al*., 2007, 2010), and the Isefjord (Olsen *et al*., 2008).

Table 1 Records and densities of *Marenzelleria viridis* in Danish waters (from Christoffersen, 2010)

Station	Latitude	Longitude	*Marenzelleria* spp. (ind. m^{-2})
GS1 southeastern Lolland	54° 38,7' N	11° 47,8' E	75 ± 37
SF1 northern Lolland	54° 51,6' N	11° 28,0' E	151 ± 19
KB1 Køge Bugt (southern Sound)	55° 24,4' N	12° 17,0' E	453 ± 118
SB1 Sejrø Bugt (northeastern Belt Sea)	55° 43,9' N	11° 15,1' E	151 ± 82
RF1 northern Ringkøbing Fjord	56° 04,4' N	08° 16,2' E	151 ± 82
HB1 southwestern Fyn (Fuhnen)	55° 08' N	10° 02,5' E	113 ± 86
STB1 southeastern Sjælland (Zealand)	55° 02,1' N	12° 08,6' E	rare
VF1 Vejle Fjord (Little Belt)	55° 41,2' N	09° 40,8' E	868 ± 95
KV1 Kalø Vig (northwestern Belt Sea)	56° 11,3' N	10° 22,0' E	170 ± 65
MF1 Mariager Fjord (eastern Kattegat)	56° 41,8' N	10° 06,7' E	57 ± 57
NB1 Nissum Bredning (western Limfjord)	56° 37,6' N	08° 13,8' E	rare
HO1 Ho Bugt (Wadden Sea)	55° 32,4' N	08° 19,7' E	396 ± 150

There have been few records of *Rhithropanopeus harrisii* (Gould, 1841) in 2010. In June a single specimen was found at Amager Strand, near Copenhagen. It has apparently established a permanent population along the coast of Lolland in southeastern Denmark, and it has also been found a few other places along the coast of southern Sjælland (Zealand) (O. Tendal, pers. comm.).

There have been no reports of catching Chinese mitten crab, *Eriocheir sinensis* Milne-Edwards, 1853 in 2010 (O. Tendal, pers. comm.).

Fish:

The round goby, *Neogobius melanostomus* Pallas, 1914, is now highly invasive in southern Denmark, e.g. Kerteminde Fjord, Guldborgsund. Also, it has now been found in freshwater (Sørup Å in Falster, Southern Denmark). Shrimp-fishers have caught 90 kg of this fish per day around Lolland, Falster, Møn and southern Sjælland. It now breeds in Danish waters; juveniles have been found in Klintholm Harbour in October 2010 (http://snm.ku.dk/forskning/projekter/fiskeatlas/nyheder/2008053/).

Species of sturgeon are occasionally caught by Danish fishermen. The Danish Natural History Museum attempts to spread awareness that these fish are threatened and protected, and must be released. Also, they collect information about size, fishing gear, locality, date and tag-ID if available. In 2010 information has been obtained about the following captures: Beluga sturgeon, *Huso huso* was captured on 7 December 2010 at 18 m depth near the island Langeland in the southern Storebælt (Great Belt). It was 1.5m long and weighed 20kg, thus still a juvenile specimen, probably from a hatchery in eastern Europe. It was released after measuring, weighing and photographing (http://snm.ku.dk/forskning/projekter/fiskeatlas/nyheder/2008057/). Another sturgeon species was also captured for the first time in 2010, namely *Acipenser stellatus*, which was caught on 15 May near Hejlsminde. It was caught in gill-net, and frozen. It was about 125 cm long (http://snm.ku.dk/forskning/projekter/fiskeatlas/nyheder/2008042/). A European sturgeon (tagged), *Acipenser sturio*, was captured on 5 April 2010 near Blåvandshuk in the North Sea. It was 53 cm long and had been released in the river Elbe in May 2009. It was released after measuring and photographing (http://snm.ku.dk/forskning/projekter/fiskeatlas/nyheder/2008037/).

Macroalgae:

Gracilaria vermiculophylla (Ohmi) Papenfuss, 1967 has not been recorded from new localities in 2010, but appears to become more abundant in some localities. A study carried out in 2008 showed that density may be 300 times higher in eutrophic areas than in oligotrophic areas (Nejrup & Pedersen, 2010). This alga has been shown to have a negative effect on photosynthesis of the seagrass *Zostera marina* (Martinez-Lüscher and Holmer, 2010), but Thomsen (2010) showed a positive effect of this alga on invertebrates in a seagrass bed in eastern Jylland (Jutland).

Higher plants:

Spartina anglica. There has been some discussions in the Danish group of experts about whether this species should be considered alien. One scientific paper has been published which shows a negative impact of *Spartina anglica* on benthic invertebrates (Tang & Kristensen, 2010).

Species not yet seen:

The barnacles *Fistulobalanus pallidus* and *F. albicostata*, tropical mangrove species from Africa and Asia respectively, have not been observed in Danish waters, though they were recently described as "flying barnacles" attached to plastic leg rings of ringed gulls, *Larus fuscus*, which breeds in the Baltic Sea and in northern Norway and migrates south along the European coast to Africa and the Middle East (Tøttrup *et al*., 2010).

Also, the predatory gastropods *Rapana venosa* and *Urosalpinx cinerea* have not yet been recorded.

4. Pathogens

Cockle (*Cerastoderma edule*) fishery in the Wadden Sea was closed in August 2010 due to occurence of the toxic dinoflagellate *Dinophysis acuminata*, which may cause DSP (diarrhetic shellfish poisoning) (see http://www.foedevarestyrelsen.dk/Nyheder/Nyheder/2010/Giftige_muslinger_i_Vadehavet.htm).

5. Meetings

Symposium om marine bioinvasioner i Danmark, September 3, 2010, Institute of Biology, University of Copenhagen. Book of abstracts available at http://cis.danbif.dk/cooperation/fol195769/symposium-om-marine-bioinvasioner-i-danmark-/Symposium_Danish_Marine_Invasions_Abstracts_Booklet_2010.pdf.

Neobiota 2010 conference held in Copenhagen 14-17 September. As usual, very few marine presentations were given. Abstracts are available at http://cis.danbif.dk/neobiota2010/documents/NBT2010_abstractbook_web.pdf.

Danish Society for Marine Biology, meeting 8 December 2010: Presentations on interactions between blue mussel and Pacific oyster (B.W. Hansen and H.T. Christensen).

The 16th National Meeting of Marine Scientists, 18-20 January 2011 had one session of 3 presentations as well as several posters on marine alien species.

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6. References

Als, T.D., Hansen, M.M., Maes, G.E., Castonguay, M., Riemann, L., Aarestrup, K., Munk, P., Sparholt, H., Hanel, R. and Bernatchez, L. In press. All roads lead to home: panmixia of European eel in the Sargasso Sea. Molecular Ecology (DOI: 10.1111/j.1365-294X.2011.05011.x).

Christoffersen, K.L. 2010. Udbredelse af den invasive børsteorm *Marenzelleria* spp. i danske farvande – Relationer til bentisk samfund og miljø. MS Thesis, Roskilde University (RUC), Environmental Biology and Molecular Biology, 105pp. (in Danish with an English abstract).

Davids, J., Grandorf, U.S., Holm, M.W. and Olsen, J. 2010. Evaluating on the possibilities of modeling dispersal of Pacific oyster larvae (*Crassostrea gigas*) in the Limfjord. MS Project Geography, Roskilde University, 50pp. (available at http://rudar.ruc.dk/bitstream/1800/6052/1/Evaluating%20on%20the%20possibilities%20of%20modelling%20dispersal%20of%20Pacific%20oyster%20larvae%20(Crassostrea%20gigas)%20in%20the%20Limfjord.pdf).

Freudendahl, A.S.L., Nielsen, M.M., Jensen, T. and Jensen, K.T. 2010. The introduced clam *Ensis americanus* in the Wadden Sea: field experiment on impact of bird predation and tidal level on survival and growth. Helgoland Marine Research 64: 93-100.

Jaspers, C., Titelman, J., Hansson, L.H., Haraldsson, M. and Ditlefsen, C.R. 2011. The invasive ctenophore *Mnemiopsis leidyi* poses no direct threat to Baltic cod eggs and larvae. Limnology and Oceanography 56(2): 431-439.

Jensen, K.R. and Knudsen, J. 2005. A summary of alien marine benthic invertebrates in Danish waters. Oceanological and Hydrobiological Studies 34, Supplement 1: 137-162.

Lützen, J., Glenner, H., Hoffmann, E. and Rees, D. 2010. Ny indslæbt art til Danmark: japansk østers boresnegl *Ocinebrellus inornatus* fundet i Limfjorden. Flora og Fauna 116(3): 55-60.

Madsen, C.V. and Riisgård, H.U. 2010. Ingestion-rate method for measurement of clearance rates of the ctenophore *Mnemiopsis leidyi*. Aquatic Invasions 5(4): 357-361.

Martinez-Lüscher, J. and Holmer, M. 2010. Potential effects of the invasive species *Gracilaria vermiculophylla* on *Zostera marina* metabolism and survival. Marine Environmental Research 69: 345-349.

Nejrup, L.B. and Pedersen, M.F. 2010. Growth and biomass development of the introduced red alga *Gracilaria vermiculophylla* is unaffected by nutrient limitation and grazing. Aquatic Biology 10: 249-259.

Olsen, J., Kayicki, O., Reyhe, T.S. and Happel, E.M. 2008. The effects of *Marenzelleria* spp. on the benthic macro fauna community structure in the Isefjord. Student project report, Roskilde University, 42pp. (Available at http://rudar.ruc.dk/bitstream/1800/3809/1/The%20Effects%20of%20Marenzelleria%20spp%20on%20the%20Benthic%20Macro%20Fauna%20Community%20Structure%20in%20the%20Isefjord.pdf).

Pedersen, M.I. 2009. Does stocking of Danish lowland streams with elvers increase European eel populations? American Fisheries Society Symposium 58: 149-156.

Quintana, C.O., Tang, M. and Kristensen, E. 2007. Simultaneous study of particle reworking, irrigation transport and reaction rates in sediment bioturbated by the polychaetes *Heteromastus* and *Marenzelleria*. Journal of Experimental Marine Biology and Ecology 352: 392-406.

Quintana, C.O., Hansen, T., Delefosse, M., Banta, G. and Kristensen, E. 2011. Burrow ventilation and associated porewater irrigation by the polychaete *Marenzelleria viridis*. Journal of Experimental Marine Biology and Ecology 397(2): 179-187.

Rasmussen, E. 1973. Systematics and ecology of the Isefjord marine fauna (Denmark). Ophelia 11: 1-507.

Riisgård, H.U., Barth-Jensen, C. and Madsen, C.V. 2010. High abundance of the jellyfish *Aurelia aurita* excludes the invasive ctenophore *Mnemiopsis leidyi* to establish in a shallow cove (Kertinge Nor, Denmark). Aquatic Invasions 5(4): 347-356.

Schuchert, P. 2004. Revision of the European athecate hydroids and their medusae (Hydrozoa, Cnidaria): Families Oceanidae and Pachycordylidae. Revue Suisse de Zoologie 111(2): 315-369.

Tang, M. and Kristensen, E. 2010. Associations between macrobenthos and invasive cordgrass, *Spartina anglica*, in the Danish Wadden Sea. Helgoland Marine Research 64: 321-329.

Thomsen, M.S. 2010. Experimental evidence for positive effects of invasive seaweed on native invertebrates via habitat-formation in a seagrass bed. Aquatic Invasions 5(4): 341-346.

Tøttrup, A.P., Chan, B.K.K., Koskinen, H. and Høeg, J.T. 2010. 'Flying barnacles': implications for the spread of non-indigenous species. Biofouling 26(5): 577-582.

Wolff, W.J. 2005. Non-indigenous marine and estuarine species in The Netherlands. Zoologische Mededelingen 79(1): 1-116.

Wrange, A.-L., Valero, J., Harkestad, L.S., Strand, Ø, Lindegarth, S., Christensen, H.T., Dolmer, P., Kristensen, P.S. and Mortensen, S. 2010. Massive settlements of the Pacific oyster, *Crassostrea gigas*, in Scandinavia. Biological Invasions 12: 1453-1458. (and 1145-1152). [for some unexplainable reason 2 almost identical papers with identical title and identical authors have been published]

5.5 Estonia

Compiled by Henn Ojaveer, Estonian Marine Institute, University of Tartu, Estonia

1. Regulations: An update on new regulations and policies (including, aquaculture and vector management)

In 2009 was drafted an amendment of Nature Protection Act (2004) and the list of species whose import into Estonia is forbidden. According to the amendment, the regime of complete ban will be replaced by system of permits of different restrictions and permits. No new fish species will be added to the list. This amendment is still processed inside of Ministry of the Environment.

Nature Protection Development Plan (NPDP) was finalized during 2010, but is now waiting for approval from other ministries and the Government. Fisheries is part of the plan and this part of harmonized with Ministry of Agriculture and Ministry of Economy.

During 2010 Marine Policy was drafted by the Ministry of Economy and it will be hopefully approved in 2011.

2 Intentional introductions

Estonia continues live fish imports from various countries. The statistical nomenclature categories doesn't always allow to identify the species, rather gives fish by origin or taxonomic groups. During the past two years, only salmonids (salmon and sea trout) are released to the natural water bodies in order to enhance fishery resources.

LIVE IMPORTS

2009

Country	*Fish*	*Quantity (kg)*
Colombia	Ornamental freshwater fish	113
Germany	Ornamental freshwater fish	238
Singapore	Ornamental freshwater fish	1865
Czech Republic	Ornamental freshwater fish	430
Indonesia	Ornamental marine fish	203
Singapore	Ornamental marine fish	24
Finland	Ornamental marine fish	2779
Sri Lanka	Ornamental marine fish	200
Lithuania	*Oncorhynchus apache* and *O. chrysogaster*	1086
Latvia	*Oncorhynchus apache* and *O. chrysogaster*	546
Norway	*Oncorhynchus apache* and *O. chrysogaster*	92947
Lithuania	*Salmo trutta*, *Oncorhynchus mykiss*, *O. clarki*, *O. aguabonita*, *O. gilae*	168
Latvia	*Salmo trutta*, *Oncorhynchus mykiss*, *O. clarki*, *O. aguabonita*, *O. gilae*	155071
Norway	*Salmo trutta*, *Oncorhynchus mykiss*, *O. clarki*, *O. aguabonita*, *O. gilae*	8059
Denmark	*Salmo trutta*, *Oncorhynchus mykiss*, *O. clarki*, *O. aguabonita*, *O. gilae*	18008
Holland	*Anguilla anguilla*	28

Latvia	cyprinids	7215
Lithuania	*Thunnus maccoyii*	51
Latvia	*Thunnus maccoyii*	38
France	*Thunnus maccoyii*	3
Canada	*Oncorhynchus nerka, O. gorbuscha, O. keta, O. tschawytscha, O. kisutch, O. masou, O. rhodurus, Salmo salar, Hucho hucho*	70
Lithuania	*Oncorhynchus nerka, O. gorbuscha, O. keta, O. tschawytscha, O. kisutch, O. masou, O. rhodurus, Salmo salar, Hucho hucho*	377
Norway	*Oncorhynchus nerka, O. gorbuscha, O. keta, O. tschawytscha, O. kisutch, O. masou, O. rhodurus, Salmo salar, Hucho hucho*	38823
Israel	Unidentified freshwater fish	585
Latvia	Unidentified freshwater fish	104

2010 (January-November)

Country	*Fish*	*Quantity (kg)*
Colombia	Ornamental freshwater fish	76
Indonesia	Ornamental freshwater fish	46
Latvia	Ornamental freshwater fish	2
Singapore	Ornamental freshwater fish	1710
Thailand	Ornamental freshwater fish	88
Czech Republic	Ornamental freshwater fish	362
Singapore	Ornamental marine fish	67
Lithuania	*Oncorhynchus apache* and *O. chrysogaster*	95
Norway	*Oncorhynchus apache* and *O. chrysogaster*	632
Lithuania	*Salmo trutta, Oncorhynchus mykiss, O. clarki, O. aguabonita, O. gilae*	53
Norway	*Salmo trutta, Oncorhynchus mykiss, O. clarki, O. aguabonita, O. gilae*	19415
United Kingdom	*Anguilla anguilla*	300
Latvia	cyprinids	3066
France	*Thunnus maccoyii*	66
Canada	*Oncorhynchus nerka, O. gorbuscha, O. keta, O. tschawytscha, O. kisutch, O. masou, O. rhodurus, Salmo salar, Hucho hucho*	299
Lithuania	Unidentified freshwater fish	3500
Latvia	Unidentified marine fish	101
Unknown	Unidentified marine fish	182

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Country	*Fish*	*Quantity (kg)*
Latvia	*Oncorhynchus apache, O. chrysogaster*	3028
Holland	*Anguilla anguilla*	26373
Switzerland	Ornamental marine fish	20

20010 (January-November)

Country	*Fish*	*Quantity (kg)*
Holland	*Anguilla anguilla*	12265
Lithuania	*Anguilla anguilla*	80
Latvia	*Anguilla anguilla*	73
Russian Federation	*Unidentified fish*	13750
Lithuania	*Unidentified fish*	40

Official data on fish releases of Estonia for 2009 and 2010 (in thousands)

Species/year	**2009**	**2010**
Salmon (*Salmo salar*)	190,710	159,800
Sea trout (*Salmo trutta trutta*)	97,380	121,740

3. Unintentional introductions

No new alien species were found in Estonian waters in 2010.

Temporal variability of eleven alien species representing different trophic levels and ecological functions were investigated in two gulfs of the brackish Baltic Sea in relation to environmental change with some datasets going back to the 1950s. The studied species were: the cirriped *Balanus improvisus*, the gibel carp *Carassius gibelio*, the predatory cladoceran *Cercopagis pengoi*, the Chinese mitten crab *Eriocheir sinensis*, the amphipod *Gammarus tigrinus*, the cladoceran *Evadne anonyx*, the zebra mussel *Dreissena polymorpha*, the polychaete *Marenzelleria neglecta*, the soft shell clam *Mya arenaria,* the round goby *Neogobius melanostomus* and the New Zealand mud snail *Potamopyrgus antipodarum*. It appeared that independent of the invasion time, organism group or the life-history stage, abundance and/or biomass of the investigated alien species was either stable or displayed abrupt increases over time. Timing in population shifts was species-specific and exhibited no generic patterns indicating that the observed large shifts in environmental parameters have no uniform consequences to the alien biota. In general, the inter-annual dynamics of alien and native species was not largely different, though native species tended to exhibit more diverse variability patterns compared to the alien species. There were no key environmental factors that affected most of the alien species, instead the effects varied among the studied gulfs and species. However, temperature seems to be a common significant forcing factor for the population dynamics of most of the species The non-indigenous species have caused prominent structural changes in invaded communities as a result of exponential increase in the most recent invasions as well as increased densities of the already

established alien species. Compared to the native species, alien species tended to exhibit less diverse annual-scale variability patterns and act therefore as a stable and important structural and functional compartment of the invaded ecosystems (Ojaveer *et al*. 2011).

The recorded highest single abundance value of *Cercopagis pengoi* exceeded the level of 1200 ind/m^3 in 2010. This value was observed in the Gulf of Riga where *C. pengoi* was much more abundant than in the other major basin - Gulf of Finland (max. abundance 218 ind/m^3; Anon. 2011). In both basins, *C. pengoi* was generally less abundant in 2010 than in previous years. Since the invasion in the early 1990s, abundance of *C. pengoi* has shown two abrupt increases: in the end-1990s and mid 2000s (Ojaveer *et al*. 2011).

Highest abundances of the cladoceran *Evadne anonyx* remained at the level of 120-125 ind/m^3 which is comparable to that during previous years. This alien species occurs much later in the season than the native similar species – *Evadne nordmanni*, whose maximum abundance is 20-30 times higher than that of the alien species (Anon., 2011). However, overall biomass contribution of both *Evadne* species together to the total zooplankton biomass is very marginal.

Larvae of the polychaete *Marenzelleria neglecta* were very abundantly present in zooplankton in the NE Gulf of Riga in 2010 (mean for May-October 2.5 thousand ind/m^3), which is the fourth highest abundance since the invasion in the early 1990s. As evidenced by the results from the alien species monitoring programme (started in 2010), the species was very frequently present in zoobenthic communities in Muuga Bay (Gulf of Finland), which hosts the largest port in Estonia. The samples taken both from the harbour area as well as adjacent localities confirm that *M. neglecta* was the most frequently found alien species in these areas (with co-domination in a few localities), with the other zoobenthic alien species being *Potamopyrgus antipodarum*, *Balanus improvisus* and *Mya arenaria*.

Paramysis intermedia (Czerniavsky) was recorded first time in the Baltic Sea in 2008. The species was recorded in the eastern Gulf of Finland and in the central Gulf of Riga (Herkül *et al*. 2009). The species was not found in 2010. However, it does not imply that the species has disappeared from the Estonian coastal sea. Currently, the potential habitats of *P. intermedia* are not included to the national monitoring programmes.

Gammarus tigrinus Sexton was first found in Kõiguste Bay, northern Gulf of Riga, in 2003 (Herkül & Kotta 2007). The amphipod invaded the Archipelago Sea and Pärnu Bay in 2004-2006 and the western Gulf of Finland in 2007. There were first records of the species in the central and eastern Gulf of Finland in 2008. The range of *G. tigrinus* remained the same in 2010 as in 2009.

Chelicorophium curvispinum (Sars) was found for the first time in the Estonian coastal sea near Sillamäe in Narva Bay, the eastern Gulf of Finland, in 2005 (Herkül & Kotta 2007). Similarly to 2009, *C. curvispinum* was found in Sillamäe and Narva-Jõesuu area, the eastern Gulf of Finland, in 2010.

Pontogammarus robustoides (Sars) was recorded for the first time in the Estonian coastal sea in Narva Bay, eastern Gulf of Finland, in 2006 (Herkül *et al*. 2009). The species was found in Sillamäe and Narva-Jõesuu area, the eastern Gulf of Finland, in 2008. In 2009, *P. robustoides* was found in Narva-Jõesuu area, eastern Gulf of Finland. In 2010, the distribution range of *P. robustoides* has remained similar.

Catch index of the Chinese mitten crab *Eriocheir sinensis* has been monitored in gillnet fishing nets in Muuga Bay (Gulf of Finland) since 1991. While until 2002, the species was relatively rarely found, significantly elevated catch index level was recorded since then. However, while, no crabs were found in the bay in 2009 (Ojaveer *et al*. 2011), the calculated catch index of the species in 2010 was substantial and roughly at the mean level for the period of 2002-2010.

The round goby *Neogobius melanostomus* continues to increase in population abundance in the Gulf of Finland. The center of the distribution area is Muuga Bay where the species has increased exponentially since 2005 (Ojaveer *et al*. 2011). In 2010, round goby constituted over 80% of the catch, both in terms of abundance and biomass, with gillnets nets of smaller mesh size (36-44mm; A. Jaanus, pers. comm.).

5. Meetings

Theme Session on 'Global change and aquatic bioinvasions' at the ICES ASC 2010 (co-chairs: H. Ojaveer, S. Gollasch and H. MacIsaac).

6. References and bibliography

Anon 2011. Operational monitoring of the coastal sea. Report for 2010. Estonian Marine Institute. Tallinn, 151pp.

Herkül, K., Kotta, J., Püss, T., Kotta, I. 2009. Crustacean invasions in the Estonian coastal sea. Estonian Journal of Ecology, 58 (4), 313-323

Herkül, K., Kotta, J. 2007. New records of the amphipods *Chelicorophium curvispinum*, *Gammarus tigrinus*, *G. duebeni*, and *G. lacustris* in the Estonian coastal sea. Proc. Estonian Acad. Sci. Biol. Ecol., 56, 290–296.

Kotta, J., Orav-Kotta, H., Herkül, K., Kotta, I. 2011. Habitat choice of the invasive Gammarus tigrinus and the native Gammarus salinus indicates weak interspecific competition. Boreal Environmental Research, in press.

Kotta, J., Orav-Kotta, H., Herkül, K. 2010. Separate and combined effects of habitat-specific fish predation on the survival of invasive and native gammarids. Journal of Sea Research, 64, 369–372.

Ojaveer, H., Eek, L., Kotta, J. 2011. Handbook of aquatic alien species in Estonia, in press (in Estonian).

Ojaveer, H., Jaanus, A., MacKenzie, B.R., Martin, G., Olenin, S., Radziejewska, T., Telesh, I., Zettler, M.L., Zaiko, A. (2010) Status of biodiversity in the Baltic Sea. PLoS ONE 5(9): e12467. doi:10.1371/journal.pone.0012467.

Ojaveer, H., Kotta, J., Põllumäe, A., Põllupüü, M., Jaanus, A., Vetemaa, M. (2011) Alien species in a brackish water temperate ecosystem: annual-scale dynamics in response to environmental variability. Environmental Research (conditionally accepted).

Olenina I. , N. Wasmund, S. Hajdu I. Jurgensone, S. Gromisz, J. Kownacka, K. Toming, D. Vaiciute, S. Olenin 2010. Assessing impacts of invasive phytoplankton: The Baltic Sea case. Marine Pollution Bulletin 60: 1691–1700.

5.6 Finland

Compiled by Maiju Lehtiniem, Finnish Environment Institute, Finland; and Lauri Urho, Finnish Game and Fisheries Research Institute, Finland.

1. Regulations: An update on new regulations and policies (including, aquaculture and vector management)

The National Strategy on Invasive Species (coordinated by the Ministry of Agriculture and Forestry) was started in 2009 and is going to be completed in the end of March 2011. The strategy aims to list all harmful and potentially harmful alien species in Finland (and species that could come to Finland) as well as to suggest the most important management options and authorities responsible for the management. The strategy will also have impacts on the national legislation, which is going to be changed according to the strategy.

Finland is going to ratify the International Maritime Organization's International Convention for the Control and Management of Ships' Ballast Water and Sediments (the BWM Convention) during 2011 or latest 2012.

2. Intentional introductions

Deliberate releases into the Baltic Sea were (including rivers draining into the Baltic) for fisheries and fish stock enhancement purposes in 2010 as follows (some values are underestimates):

- 0.4 million newly hatched and 1.7 million older salmon (*Salmo salar*), and
- 0.5 million newly hatched and 1.0 million older sea trout (*Salmo trutta* m. *trutta*),
- something around 43 million newly hatched and 7.6 million older whitefish (*Coregonus lavaretus*).

Disinfected eggs of (sheefish/inconnu/nelma) *Stenodus leucichthys nelma* (5 liters) were imported from Russia for food fish cultivation purposes in Finland.

3. Unintentional introductions

No new alien species were found in Finnish waters in 2010. However there were changes in species status as some species were properly reported for the first time, established to Finnish waters or increased in abundance or distribution.

Invertebrates:

The oligochaete *Paranais frici,* has been observed from 2006 onwards in monitoring samples of Kymijoen vesi ja ympäristö ry (Anttila-Huhtinen 2010) in the eastern Gulf of Finland, between the cities of Loviisa and Hamina, but the information on its first observation has not reached the national reports until 2010. It seems that the species is relatively common and established permanently in the area.

The crustacean *Palaemon elegans* has been observed only once in Finnish waters before. The first sighting was in the Gulf of Finland, in Tvärminne archipelago in 2003 (Lavikainen & Laine 2004). 2010 the species was observed in Naantali area in the Archipelago Sea (northern Baltic Sea) where several specimens were caught by a specific crayfish trap (Lauri Urho pers. comm.). The species identification was made by Ursula Janas (University of Gdansk). Thus it seems that the species has established permanently in the Archipelago Sea.

The crustacean, mud crab *Rhithropanopeus harrisii* was observed for the first time in 2009 in Naantali area in the Archipelago Sea (northern Baltic Sea). During 2010 several specimens were found from the same area. Also egg-carrying female crabs were observed, which indicates that the species is able to reproduce in the area and has established there (Lehtiniemi 2010).

There have been several reports of individual mitten crabs, *Eriocheir sinensis* from the coasts of the Gulf of Finland as well as of the Gulf of Bothnia in 2010. The number of sightings has been on the same level as in last years.

The predatory cladoceran *Evadne anonyx* was observed also in 2010 in the monitoring samples. It still occurs in low abundances in the open sea, but could have higher abundances in the coastal waters. Coastal monitoring is however very scarce and those samples are not yet counted.

Fish:

The round goby, *Neogobius melanostomus*, were observed to reproduce in the water off the city of Helsinki, where first individuals were caught in 2009. Due to fast reproduction and growth the distribution areas extended locally in Helsinki. Only one new observation was registered in the Archipelago Sea area, where it was first found in Finland in 2005.

Some new findings of the gibel carp, *Carassius auratus* m. *gibelio*, were recorded in the Gulf of Finland within its previous year range. It was also observed to reproduce in several ponds connected to the sea. In one of the shallow ponds (max depth around 1m), where the gibel carp was first noticed by anglers in 2003, it has become more and more abundant. The catch with four trap nets contained more than 80 % of gibel carp, which shows its potential to produce fast and exploit ponds connected the sea for the own production. Only female gibel carps have been observed in that 10 ha pond. Fast growth during the first summer produced even 10 cm fish with a weight of 10 g and ready spawn next summer. The growth rate seems to slow down with age. However, in the sea a 50 cm individual with a weight of 3.5 kg was aged to be 15 years old.

4. Species Not Yet Observed

The Amur sleeper, *Perccottus glenii*, has not been observed in Finnish waters, although it is known to occur in the Russian side of the Gulf of Finland. The American comb jelly, *Mnemiopsis leidyi,* has not been observed (genetically confirmed) in Finnish waters. *Pontogammarus robustoides* (Sars) has not been observed in Finnish waters although it has been recorded for the first time in the Estonian coastal sea in Narva Bay, eastern Gulf of Finland, in 2006 and thereafter. *Paramysis intermedia* (Czerniavsky) has not been recorded either although is present in the eastern Gulf of Finland.

5. Research projects

- A research project on climate change, fish fauna and alien fish species has been funded by the Ministry of Agriculture and Forestry, Finland.
- A research project on the strategy of alien species to spread and reproduce has been funded by the Walter and Andrée de Nottbeck Foundation
- A research project on the development of alien species monitoring, early warning system and risk assessment in the Finnish waters (VISEVARIS) funded by the Ministry of Agriculture and Forestry, Finland

6. Meetings

ICES Annual Science Conference 2010 in Nantes, France: Theme Session on 'Global change and aquatic bioinvasions'.

7. References and bibliography

Anttila-Huhtinen, M. 2010. Benthos studies in Pyhtää-Kotka-Hamina area in 2006-2009. Kymijoen vesi ja ympäristö ry, Kouvola. Kymijoen vesi ja ympäristö ry:n julkaisu no 192/2010. 53 s. [Pohjaeläintutkimukset merialueella Pyhtää-Kotka-Hamina vuosina 2006–2009 ja vertailua aiempiin tuloksiin. In Finnish]

La Carbona S, Viitasalo-Frösen S, Masson D, Sassi J, Pineau S, Lehtiniemi M, Corroler D 2010: Efficacy and environmental acceptability of two ballast water treatment chemicals. Science of the Total Environment 409: 247–255.

Ljungberg R, Lehtiniemi M 2011: Collecting information of alien species by diving. Sukeltaja 1: 14-15. [Sukeltamalla tietoa rannikon vieraslajeista. In Finnish]

Lehtiniemi, M. 2010: New crab species establishing to Finnish waters. Finnish Environment Institute. Press release 3.9.2010. [Uusi taskurapulaji on asettumassa Suomen vesille. In Finnish.] (http://www.itameriportaali.fi/fi/ajankohtaista/itameri-tiedotteet/2010/fi_FI/uusi_taskurapu/)

Lehtiniemi, M., Pikkarainen, A., Ljungberg, R., Urho, L. 2010. VISEVARIS studies alien species in brackish waters of Finland. Kalastaja 5/2010: 6. [VISEVARIS tutkii Suomen merialueen vieraslajeja. In Finnish]

Lehtiniemi, M., Setälä, O. 2010: Gelatinous future? Helsingin Sanomat, Tiede-sivut 6.7.2010. [Tulevaisuus yhtä hyytelöä? In Finnish]

Lehtonen, H., Urho, L. 2010. Acipenseridae in Finnish coastal waters. Vapaa-ajan kalastaja 4: 4. [Sampia Suomen rannikkovesissä. In Finnish]

Ojaharju, J., Pennanen, J., Urho, L. 2010. Gibel carp – a threat to native fish species. Kalastuslehti 3/10: 50–51. [Hopearuutana on uhka alkuperäisille kalalajeille. In Finnish]

Urho, L., Pennanen, T.J., Deinhardt, M. 2010. Dispersal of Gibel carp should be stopped. Suomen Kalastuslehti 8/2010: 22–24. [Hopearuutanan leviäminen estettävä. In Finnish]

Urho, L., Lehtonen, H. 2010. Sturgeons/Acipenseridae in Finland. Suomen Kalastuslehti 6: 22–25. [Sampikalat Suomessa. In Finnish]

Zaiko A, Lehtiniemi M, Narščius A, Olenin S 2011: Assessment of bioinvasion impacts on a regional scale: a comparative approach. Biological Invasions DOI 10.1007/s10530-010-9928-z

5.7 France

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1. Regulations

Following mass mortality of oysters (*Crassostrea gigas*) observed in France and Ireland in 2008, then in France, Ireland and Channel Islands in 2009, the EU commission provided a new regulation 175/2010, which requires all member states to test areas of large scale mortality for presence of *Ostreid herpesvirus* 1 µvar (OsHV-1 µvar). If the virus is present, containment zones are established and movements in and out of that zone prohibited. This regulation was due to expire on 31th December 2010. However due to situation still of major concern to the shellfish industry, it has been extended until 30th April 2011. Annexes detailed the sampling strategy and the diagnostic methods of detecting OsHV-1 µvar.

2. Intentional introductions

No information

3. Unintentional introductions

Algae and marine plants

Spartina alterniflora: A PhD student supervised by Nathalie Poupart and Olivier Ragueneau at the University of West Brittany (UBO) works on the invasiveness of *Spartina alterniflora* Loisel in the Rade of Brest: ecophysiology, primary production and biochemistry. This study is part of a French multidisciplinary program focusing on this invasive species (Poupart, pers. comm.).

Undaria pinnatifida: As part of the PhD thesis of D. Grulois, supervised by F. Viard at the Station Biologique of Roscoff, field observations (French project Ecokelp and EU project Marinexus), carried out in 3 bays in northern Brittany (Ile d'Ouessant, Aber Wrac'h and bay of St Malo), showed large algal populations in areas where aquaculture was developed in the past and where this species is still cultured (Grulois *et al.*, accepted upon revision). New wild populations were observed in the bay of Morlaix (North Brittany) and in 2 recently built marinas (Aber Wrac'h and St Cast Le Guildo, North Brittany) demonstrating the high capacity of this alga to colonize new habitats (Viard, Riquet and Leveque, pers. comm.). Although this species is now common and conspicuous, its distribution is likely underestimated due to constrained scuba diving observations.

Gracilaria vermiculophylla : This species, originated from Japan and possibly introduced concomitantly to *Crassostrea gigas*, was observed for the first time in the Belon estuary (South Brittany) in 1996. Since then it has been expanding northward and southward along the Brittany coast. A study has been carried out in 2011 by the CEVA (Seaweed technology Center), to evaluate its invasiveness status in this area.

Polyopes lancifolius (Halymeniales, Rhodophyta): this alga was recorded for the first time in the Gulf of Morbihan (Brittany) in summer 2008. The taxonomy was confirmed by phylogenetic analysis (Mineur *et al*, 2010).

Grateloupia turuturu: This species, originated from Japan, and possibly introduced, concomitantly to oysters, was observed for the first time in France, in Thau lagoon in 1982, at Fort Bloqué (South Brittany) in 1989 and at Callot Island (North Brittany) in 1992. Since these dates, *G. turuturu* expanded its distribution all around Brittany, from Normandy to Vendee. Populations of this invasive species are monitored each year. Two PhD thesis were devoted to this species: (1) Simon-Colin (2001) in term of estimation of density and of its potentiality of osmoregulation, in two sites (Callot and Fort Bloqué) and (2) Plouguerné (2006) who followed the spatio-temporal variability of populations of *G. turuturu* in three sites around Brittany and studied the chemical ecology of this invasive macroalga. *Grateloupia turuturu* is monitored each year all around Brittany. It was studied by researchers from the University of Nantes for its Phycoerythrin richness within the European Project BIOTECMAR (Interreg; see page 8).

Sargassum muticum: This species continues to be studied in French Laboratories. Two PhD thesis were devoted to this species: (1) Plouguerné (2006) who followed the spatio-temporal variability of populations of *S. muticum* in three sites around Brittany and studied the chemical ecology of this invasive macroalga and (2) Le Lann (2009) who studied its interaction with native species and its chemical ecology. *Sargassum muticum* is monitored each year all around Brittany. Some applications of the biomass of this invasive species are researched within the European Project BIOTECMAR (Interreg; see page 8).

Rugulopteryx okamurae: this species observed for the first time in 2002 in the Thau lagoon has become established in 2008 along the north coast of the Thau lagoon (Verlaque *et al.*, 2009).

Ctenophora

Mnemiopsis leidyi:

A 3 year study (Memo project, Interreg 2 sea program) has been initiated by ILVO **(Oostende, Belgium)** regarding the ***Mnemiopsis leidyi*** invasion in the North Sea with the participation of Ifremer among partners

(**http://www.ilvo.vlaanderen.be/Default.aspx?alias=www.ilvo.vlaanderen.be/memo**).

In the **MEMO project**, a genetic tool will be developed to facilitate identification of *N. leidyi*. A standardized sampling protocol will be set up to collect and preserve comb jellies for morphological and genetic characterization. Samples will be gathered on several surveys and on a joint dedicated cruise. Appropriate methods will be applied to investigate the spatio-temporal distribution and spread of *M. leidyi* along the coasts and harbours of the 2 seas region (English Channel and southern North Sea). All combined data will prompt the development of distribution maps and habitat models.

Although less impacted than Belgium and Denmark, several individuals have been recorded in Gravelines – Dunkerque areas (France). The recent oceanographic campaign for fisheries management, carried out early 2011 in this area, reported additional individuals.

Molluscs

Crepidula fornicata:

Rigal et al. (2010) demonstrated that the limitation in larval supply resulting from the interactions between spawning location and local hydrodynamics patterns may impede the species proliferation, well established over more than 50 years in the Bay of Morlaix. This study provided an example of factors contributing to the failure of the transition between two major steps of biological invasions, i.e. sustainable establishment and proliferation.

A 37 month survey was carried out on Crepidula fornicata population of the Bay of Morlaix. Size, sex, female reproductive status and sponge-infestation stage were recorded on a monthly basis on 300 individuals. In the 12 049 individuals examined, the prevalence of Cliona celata was high with a monthly average of 43.1% of the individuals hosting the sponge. The limited effects of the endolithic sponge on C. fornicata contrast with the documented damage to some local species - including commercially exploited shellfish such as Pectinids -, suggesting that C. fornicata may alter the infestation dynamics in the surrounding native community (Le Cam *et al.*, in press).

A new process based on cold shelling was developed by the French private company Britexia to use the slipper limpet for food consumption. It is now exploited by SLP (Slipper Limpet Processing) based in Cancale (Brittany), aiming to use around 10 000 tons of Crepidula fornicata/year.

Ocinebrellus inornatus (gastropod): 3 specimens of this gastropod were recorded in October 2009 for the first time in Ploubazlanec (Northern Brittany; proxi 48°48' 8.31N and proxi 3°0'11.630W). Spawns observed in April 2010 suggested that the species, likely introduced by oyster culture, is now established in this area (Le Quement, 2010)

Crassostrea gigas:

A new event of mass mortalities of Pacific oysters (*Crassostrea gigas)* was recorded in 2010 in most French oyster production areas. Starting at the end of April in the Mediterranean seaside, the phenomenon was observed in early June along the Atlantic coast up to the Northern Brittany, when the sea temperature reached 16°C. In Normandy region, oyster mortality occurred in the second fortnight of June. Two additional production areas were affected later on, by the end of June and early August: Morlaix in the North Brittany and the bay of Quiberon (Southern Brittany - deep water rearing site).

The national cumulative mortality rate, observed between March and December 2010, reached 71% (http://wwz.ifremer.fr/observatoire_conchylicole). As previously observed, oyster juveniles were mainly affected without any difference between wild-caught and hatchery-bred spat oysters. The herpes-virus OsHV-1 µvar is suspected to be the mainly risk factor involved in this phenomenon.

Before the start of the phenomenon in 2010, the French Ministry of Agriculture asked ANSES (initially AFSSA, French Agency for Food, Environmental and Occupational Health and Safety) to provide advice to limit the risk of new outbreaks of excess mortality. This recommendation, published in April 2010, indicated that the herpesvirus OsHV-

1 μvar seemed to be the main culprit for the phenomenon of excess mortality along the French coastline in 2008 and 2009. The Agency also specified that there are biological reservoirs for this virus and its variants which are mainly bivalve molluscs (e.g., Pacific and European oysters, clams, pectinids). Infected asymptomatic adults of Pacific oysters appear to predominate because this oyster species is dominant in the French shellfish culture. The Agency concluded that this is very likely that those outbreaks of excess mortality will recur in future years. They provided a series of recommendations intended to limit the risk of new outbreaks and prevent further spread of the phenomenon by avoiding the contamination of areas that are still unaffected (i.e. selection of broodstocks showing resistance to excess mortality, modification of cultural practices, disposal of dead oysters,…).

Crustacea

Three benthic peracarids were recently identified in the Arcachon Bay (Sorbe *et al*., 2010): *Paranthura* cf *japonica* Richardson, 1909 (Isopoda, Paranthuridae), *Aoroides* cf *secundus* Gurjanova, 1938 (Amphipoda, Aoridae) and *Zeuxo* "*holdichi*" Bamber, 1990 (Tanaidacea, Tanaidae). These species were suspected to be introduced in the seventies during oyster spat transfers from Japan.

A recent paper (Lavesque *et al*, 2010a) reports at large spatial expansion of the oriental shrimp *Palaemon macrodactylus* along the French Atlantic and Channel coastline over the 2007-2010 period of time. This shrimp has been observed in numbers of estuaries but has apparently not yet colonized the most northern estuaries. In the South-west of France along the Atlantic coastline, the first specimens of *P. macrodactylus* (adults and zoe larvae) were collected in the Charente estuary in September 2007. In Arcachon Bay, 9 specimens were collected in the oceanic part of the bay in January 2010 (Lavesque *et al*, 2010b).

A single male of *Hemigrapsus takanoi* measuring 19.2x17.2 mm (width x length) was collected on 2nd May 2010 at Blainville sur mer (49°03'51''N, 01°37'11''W, Normandy, western English Channel). This species has a wide geographical distribution extending from Spain to Germany, but forms sporadic populations along the French coast except in some hot spots (Dauvin and Delhay, 2010). In a previous publication, Dauvin (2009) reported the Asian shore crab *Hemigrapsus sanguineus* population status around the Cotentin Peninsula (Normandy, France).

Tunicata

Styela clava: A recent publication demonstrated that at least two different introductions of *Styela clava* occurred in Europe, identified as distinct genetic clusters: northern Danish populations (close to a Japanese population), and populations observed in the rest of Europe (Dupont *et al*., 2010). The results of the study by Dupont *et al.* (2010) were later confirmed by Goldstein *et al.* (2011) based on the analysis of other molecular markers and a worldwide sampling of this highly invasive ascidian species. Moreover, a sample from Shoreham (England) possibly represents a third introduction. In North America, the population from the Atlantic was genetically similar to the majority of European populations, suggesting a European origin for populations on this seaside whereas Pacific coast populations were genetically similar to the same Japanese population as the Danish populations.

Finfish

Several specimens of the Lionfish (*Pterois volitans*) have been observed for the first time in the French West Indies - overseas territories - (in Pointe Noire in Guadeloupe Island, 16°13'52.58 N and 61°47'26.66 W) in September 2010. This species was sus-

pected to have been introduced in the western Atlantic ocean by intentional and non-intentional aquarium releases. First observed in Florida in 1992, it has been expanded throughout the Caribbean Sea. Individuals, collected in the Guadeloupe Island, were sent for taxonomic identification to the local environmental government agency (Franck Mazeas, DREAL) and to the Antilles-Guyane university (Yolande Bouchon and Claude Bouchon). This information was largely disseminated since the first Lionfish was observed, using targeted leaflets distributed to fishermen, recreational divers and medical services. Furthermore, information to the general public was carried out throughout media coverage to prevent painful wounds due to this poisonous fish.

4. Pathogens

A new pathogen, similar to *Perkinsus chesapeaki* was detected in 2005 by PCR-RFLP and confirmed by sequencing in two clams collected in Leucate lagoon (42°53'22.920N and 3°18'17.388E) in the Mediterranean seaside. Additional samples were collected in 2008: two clams among 60 specimens showed *P. chesapeaki* profile and two other co-infection profiles with *Perkinsus olseni* (Arzul *et al*, 2010a). It is the first report of this species in Europe. The origin of this exotic pathogen is unknown.

Following the detection of *Bonamia exitiosa* in flat oysters in Spain in 2007 and in Italy in 2008, a work programme was proposed at a European level to find out the present distribution of *B. exitiosa* previously considered as exotic in EU. In this context, *Bonamia exitiosa* was detected in flat oysters collected in France in Corsica (Diana lagoon, 42°07'32.772N, 9°32'27.672E) and in the Mediterranean Sea. The origin of this pathogen is not known, as its impact on flat oyster populations.

5. General information and meetings

France

1 - ICES Annual Science Conference, 20-24 September 2010 in Nantes (France) with a special session on "Global change and aquatic bioinvasions".

http://www.ices.dk/iceswork/asc/2010/index.asp read 17 February 2011

Details of the theme sessions are available at the following address:

http://www.ices.dk/iceswork/asc/2010/themesessions.asp read 17 February 2011

2 - Following the work of the working group formed by the National Agency for Water and Aquatic Environments (ONEMA) at the beginning of 2009, a seminar was organised in October 12th, 13th and 14th 2010 in Paris on the management of the invasive species in the aquatic environments. Nearly 130 participants were present, involved in research and management of the aquatic environments. It was divided in four sessions:

- International and national policy and state of the scientific knowledge
- Prevention, early detection and rapid responses
- Contribution of the social sciences to the invasive species issues
- Control, mitigation and restoration

Additional information (in French), including power-point presentations, are available at the following address: http://www.onema.fr/cr-seminaire-especes-invasives (read 17 February 2011).

3 - The second workshop of the REBENT project took place in October 2010 in Brest. This project aims to collect and format data relating to seabed habitats and associated coastal benthic biocenosis, to provide relevant and coherent data to scientists, marine

environment management bodies and the general public. Those observations, which concern data relating to spatial extension and to fauna and flora distribution, are common to various needs: accidental pollutions, protected marine reserves, Water Framework Directive, integrated management (http://www.rebent.org/?lang=en).

The main results, collected since the project implementation, were presented using geomatics mapping methods, data base tools, benthic community monitoring along the English Channel, the Atlantic and Mediterranean coasts.

4 – MWFSD: A review of institutional indicators on marine biodiversity - including invasive species - was performed to assess validity, efficiency, and effective implementation. This was done to sustain the implementation of the Marine Water framework Strategy Directive (Levrel *et al*, 2010).

5 – Biodiversity: At the national level, a significant effort has been carried out to interoperate large biodiversity databases and provide computing tools to facilitate access for data storage. The 'SINP' (Système d'Information Nature & Paysage) aims to facilitate the reporting to the GBIF (Global Biodiversity Information Facility) and improve interoperability at the national level. Ifremer is in charge of the infrastructure development, whereas the MNHN (Muséum National d'Histoire Naturelle) and AAMP (French National Agency for Marine Protected Areas) are committee members. Moreover, the ONB (National Observatory of Biodiversity) is currently under development, based upon several databases such as SINP, to built new indicators to facilitate public decision makings. Meanwhile, a new project, entitled ECOSCOPE, also aims to develop cooperation among research biodiversity observatories so as to facilitate scientific expertise and decision makings. It should be listed as a large infrastructure to develop links with the EU LIFEWATCH project.

6- An international collective expertise on marine biodiversity including the invasive species issue was carried out in 2010 aiming to develop an updated scientific research strategy for Ifremer. A book (Quae edition) will be published in 2011 (Goulletquer *et al.*, pers. com.).

As a follow up of the Nagoya conference (CDB), the French government has initiated a revision of its national biodiversity strategy, including a revised research strategy. The strategy will be released in April 2011. Similarly, a review of negative incentives to biodiversity is currently under development by the Stategic Analysis Center (CAS).

SINP (in French): http://www.naturefrance.fr/

ECOSCOPE: http://www.ecoscopebc.ird.fr/EcoscopeKB/ShowProjectInformation

7 – Marinexus project (leader, M. Cock, Station Biologique Roscoff): this interreg IV A project was launched at the beginning of January 2010. The main objective is to establish a permanent network of marine specialists from Plymouth (UK, lead) and Roscoff (France) to provide and to communicate relevant and easily understood knowledge concerning coastal and marine ecosystem of the west English Channel, to stakeholders, academic and general public. A special attention is focused on non-indigenous and invasive species detected in marinas and harbours (co-leaders F. Viard, Station Biologique Roscoff & J. Bishop, MBA Plymouth). In 2010, a rapid assessment survey was carried out along the coastline of north Brittany and south England in marinas to collect non indigenous species. Identification of species are in progress using morphological and molecular tools (barcoding). This survey emphasized the common distribution of the ascidian *Asterocarpa humilis*, identified for the first time in February 2006 in Brittany (unknown localisation). More information will be available next year.

8 – BIOTECMAR (**BIOTEChnological exploitation of MARine products and by-products) project (www.biotecmar.eu)**: this Interreg IV B project started in January 2009. The main objectives are to develop an integrated chain (from biomass to market), to federate the Atlantic area actors in order to exploit the underexploited marine biomass, to help companies of Atlantic area (SMEs,…) to take advantage of the use of modern biotechnologies and finally to contribute to a diversification of activities derived from marine biomass exploitation. A special attention is attributed to invasive species in term of potential applications.

Europe

The Quality Status Report 2010 – the QSR 2010 – was published last year (OSPAR, 2010). This summary report provides policy makers and the wider public with a condensed overview of current knowledge on trends in pressures and impacts and the quality status of the North-East Atlantic and its Regions. The QSR 2010 reflects the collective effort made by Contracting Parties over the period 1998 to 2008 to manage, monitor and assess the many pressures on the various ecosystems of the North-East Atlantic and the resulting impacts. Thirty non-indigenous species were identified, by the ICES-WGITMO as problematic in the OSPAR area (see chapter 9, Other human uses and impacts).

6. References and bibliography

2009

Dauvin, J-C. 2009. Asian shore crabs *Hemigrapsus spp.* (Crustacea: Brachyura: Grapsoidea) continue their invasion around the Cotentin Peninsula, Normandy, France: status of the *Hemigrapsus* population in 2009. *Aquatic Invasions* 4 (4): 605-611.

Le Berre, I., Hily, C., Lejart, M. & Gouill R. 2009. Analyse spatiale de la prolifération de *C. gigas* en Bretagne. *Cybergeo/ European Journal of Geography*, Environnement, Nature, Paysage 478, on line http://cybergeo.revues.org/index22818.html read 10 February 2011.

Le Lann, K., 2009. Etude de la biodiversité des Sargassaceae (Fucales, Phaeophyceae) en milieux tempéré et tropical : écologie, chimiotaxonomie et source de composés bioactifs. Thèse de Doctorat de l'Université de Bretagne Occidentale (UBO), sous le sceau de l'Université Européenne de Bretagne (UEB). Mention : Biologie marine, 350 p.

Verlaque, M., Steen, F. & De Clerck O. 2009. *Rugulopteryx* (Dictyotales, Phaeophyceae), a genus recently introduced to the Mediterranean. *Phycologia* 48 (6), 536-542.

2010

Anonymus (2010). Assessing biodiversity in Europe – the 2010 report. EEA report, N°5, 64 pages. http://www.eea.europa.eu/publications/assessing-biodiversity-in-europe-84 read 17 February 2011.

Arzul I. , Omnes E., Robert M., Chollet B., Joly J.P., Miossec L., François C., Garcia C. 2010. Distribution of *Bonamia exitiosa* in flat oyster *Ostrea edulis* population in France. Oral communication, World Aquaculture Society, San Diego, California, March 1-5, 2010.

Arzul I., Chollet B., Michel J., Robert M., Miossec L., Joly JP, François C., Garcia C. *Perkinsus olseni* and a new *Perkinsus* sp., closed to *P. chesapeaki*, sympatric in clams *Ruditapes decussatus* from Leucate lagoon, France. Oral communication, World Aquaculture Society, San Diego, California, March 1-5, 2010.

Barbault, R. & Atramentowicz, M. (coord.) 2010. Les invasions biologiques, une question de natures et de sociétés. Editions Quae, Paris, 180 pages.

Boudouresque, F. & Verlaque, M. 2010. Is global warming involved in the success of seaweed introductions in the Mediterranean Sea ? In Seaweeds and their role in globally changing

environments. Ed by A. Israel, R. Einav and J. Seckbach, Springer Dordrech, Heidelberg, London and New-York.

Dang, C., de Montaudouin, X., Gam, M., Paroissin, C., Bru, N. & Caill-Milly N. 2010. The Manila clam population in Arcachon Bay (SW France) : can it be kept sustainable ? *Journal of Sea Research* 63: 108-118.

Dauvin, J-C & Delhay, J-B. 2010. First record of *Hemigrapsus takanoi* (Crustacea: Decapoda: Grapsidae) on the western coast of northern Cotentin, Normandy, western English Channel. *Marine biodiversity records* 3: 1-3.

Dupont, L., **Viard, F.,** Davis, M., Nishikawa, T. & Bishop J. 2010. Pathways of spread of the introduced ascidian *Styela clava* (Tunicata) in Northern Europe, as revealed by microsatellite markers. *Biological Invasions*, 12: 2707-2721.

Estoup, A. & Guillemaud, T. 2010. Reconstructing routes of invasion using genetic data: why, how and so what? *Molecular ecology* 19: 4113-4130.

Grulois, D., Lévêque, L. & Viard, F. (under revision). Mosaic genetic structure and sustainable establishment of the invasive kelp *Undaria pinnatifida* at a bay scale (St Malo Bay, Brittany). Cahiers de Biologie Marine.

Lavesque, N., Bachelet, G., Béguer, M., Girardin, M., Lepage, M., Blanchet, H., Sorbe J-C, Modéran, J., Sauriau P-G & Auby, I. 2010a. Recent expansion of the oriental shrimp *Palaemon macrodactylus* (Crustacea : decapoda) on the western coasts of France. *Aquatic Invasions* 5, supp 1 : S103-S108.

Lavesque, N., Bachelet, G., Blanchet, H., Modéran, J., Sauriau P-G, Auby, I., & Sorbe J-C. 2010b. First record of the successful invader *Palaemon macrodactylus* in Arcachon Bay and Charente estuary (SW France). Poster at EMBS (European Marine Biology Symposium) 45, 23-27 August 2010, Edinburgh Scotland.

Le Cam, S. & Viard, F. (*in press*). Infestation of the invasive mollusc *Crepidula fornicata* by the native shell-borer Cliona celata: high parasite load without detrimental effects. Biological Invasions.

Lejart, M. & Hily, C. 2010. Differential response of benthic macrofauna to the formation of novel oyster reefs (*Crassostrea gigas*, Thunberg) on soft and rocky substrate in the intertidal of the Bay of Brest, France. *Journal of Sea Research* 5: 84-93.

Lejeusne, C., Chevaldonne, P., Pergent-Martini, C., Boudouresque, C. F. & Perez, T. 2010. Climate change effects on a miniature ocean: the highly diverse, highly impacted Mediterranean Sea. *Trends in Ecology & Evolution* 25- 4: 250-260.

Le Quement, M., 2010. Mollusques. Une nouvelle espèce dans la baie de Paimpol : *Ocinebrellus inornatus*. Lettre du réseau des naturalistes armoricains, N°104 février 2010, p 2.

Le Quement, M., 2010. Espèces introduites : du nouveau en Côtes d'Armor. *Xénophora* (Avril Mai Juin 2010 N°130) de l'Association Française de Conchyliologie, 1p.

Levrel, H., Fossat, J & Pelletier, D. 2010. Les indicateurs de biodiversité marine et côtière: état des lieux institutionnels. *VertigO La revue en sciences de l'environnement* 10 (2): 22 p.

Mineur, F., De Clerck, O., Le Roux, A., Maggs, C ; A. & Verlaque M. 2010. *Polyopes lancifolius* (Halymeniales, Rhodophyta), a new component of the Japanese marine flora introduced to Europe. *Phycologia* 49 (1): 86-96.

Peeler, E.J., Oidtmann, B. C., Midtlyng, P. M., Miossec, L. & Gozlan, R. E. 2010. Non-native aquatic animals introductions have driven disease emergence in Europe. *Biological Invasions* Online first November 2010, 13 pages.

OSPAR, 2010. Quality Status report 2010. OSPAR commission. London, 176 pp.

Rigal, F., Viard, F., Sakina-Dorothée, A. & Compet T. 2010. Does larval supply explain the low proliferation of the invasive gastropod *Crepidula fornicata* in a tidal estuary? *Biological Invasions 12: 3171-3186.*

Sauriau, P-G, & Pigeot, J. 2010. Contribution à l'inventaire de la macrofaune marine en Baie de Marennes-Oléron. *Annales de la Société des Sciences Naturelles de la Charente Maritime* 10 (1) : 23-44.

Segarra, A., Pepin, J-F, Arzul, I., Morga, B., Faury, N. & Renault, T., 2010. Detection and description of a particular Ostreid herpesvirus 1 genotype associated with massive mortality outbreaks of Pacific oysters, *Crassostrea gigas*, in *France* in 2008. *Virus Research* 153-1: 92-99.

Sorbe, J.C., Gouillieux, B., Lavesque, N., Bujan, S., Bachelet, G., Blanchet H. & De Montaudouin X. 2010. Exotic peracarid crustaceans on mussel/oyster beds of the Arcachon Bay (southern Bay of Biscay). International Symposium on Oceanography of the Bay of Biscay "ISOBAY 12". Book of abstracts, pp. 223-224.

2011

Goldstien, S.J., Dupont, L., Viard, F., Hallas, J.P., Nishikawa, T., Schiel, D.R., Gemmell, N.J., Bishop, J.D.D. 2011. Global Phylogeography of the Widely Introduced North West Pacific Ascidian Styela clava. PLoS ONE 6(2): e16755.

Web sites

Les espèces marines invasives en Bretagne. 2010. GIP Bretagne environnement http://www.bretagne-environnement.org/especes-invasives/a-telecharger/doc_download/6-livret-especes-invasives-marines.html read 10 February 2011.

5.8 Germany

Prepared by S. Gollasch, GoConsult, Germany; and M. Rolke, Federal Maritime and Hydrographic Agency, Germany.

1. Regulations

Platform for Information Exchange on Neobiota

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

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

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

In order to obtain an overview into the current status regarding neobiota an outline for a trilateral inventory was formulated.

An inventory study shall provide an overview of the state of the art regarding neobiota, as a basis for the development of a trilateral strategy on neobiota for the trilateral Wadden Sea Cooperation Area. Furthermore, the inventory shall provide recommendations for the main elements of a trilateral strategy.

The study will consist of an inventory part and an analysis part:

R&D-project on certain aspects according to the implementation of the MSFD

The German **Federal Environment Agency** on behalf of the Federal Ministry for the Environment, Nature Protection and Nuclear Safety to fund a R&D-project on certain aspects of the implementation of the MSFD. The overall task is to develop concepts for the assessment and monitoring of selected "pressure descriptors" of the Marine Strategy Framework Directive. One work package will be dealing with non-indigenous species (descriptor 2) and has the following objectives:

1) Developing a working definition of non-indigenous / invasive species

2) Checking whether all or only some of the three indicators listed in the EU Commission Decision should be considered in national monitoring;

3) Making selected indicators ready for use by suggesting quantitative targets and respective monitoring programmes

4) Evaluating how the selected indicators could be combined to an overall assessment of descriptor 2 and how descriptor 2 would feature within an overall assessment of "Good Environmental Status".

The German **Federal Agency for Nature Conservation** on behalf of the Federal Ministry for the Environment, Nature Protection and Nuclear Safety is currently preparing a tender for R+D projects in order to develop a basis for the fulfilment of the requirements arising from different european and international fora. The requirements ask for regular assessments of the status of habitat types and biotopes respectively, the benthos and non-indigenous species. Within the framework of the EU Fauna-Flora-Habitat directive it will be necessary to prepare until 2012 a comprehensive assessment of all of the FFH habitat types

In order to achieve this aim concerning the issue of the monitoring an assessment of „non-indigenous species" it is planned to

- (further) develop and implement a screening procedure for early detection and spreading of marine non-indigenous species as well as the determination of trends in the newly appearing non-indigenous species in the German North Sea and Baltic;
- The development and application of indicators for the assessment of pathways and vectors as well as for the trend of non-indigenous species within the framework of the EU Marine Strategy Framework Directive
- Evaluation of existing data from environmental impact studies relevant for the assessment of the status of non-indigenous species in the German EEZ of the North sea and the Baltic.

2. Intentional intorductions

No major changes since last years National Report. The species which were reported earlier include Sturgeons, salmonid species, rainbow trouts, carps, *Crassostrea gigas*, *Homarus americanus* and *Palmaria palmate*.

3. Unintentional introductions

New Sightings (see also national Report for WGBOSV).

Taxon	Year of first record	Location of first record	Possible introduction vector*	Invasion Status**	Reference
Chaetoceros circinalis	March 2010	Already known for Kattegat and Beltsea but first records for: Kiel Bight and Mecklenburg Bight	unknown		Norbert Wasmund, Leibnitz Institute for Baltic Sea Research, Seestr.15, 18119 Warnemünde, GERMANY
Chaetoceros pseudobrevis					
Alexandrium pseudo-gonyaulax	10.08. 2010	Already known for Kattegat and Beltsea but first records for station: "Heiligendamm" Position 54° 08,55′ N 11° 50,00′ E	unknown		
Pseudosolenia calcar-avis	since 29.9. 2010				
Ludwigia grandiflora	2004 (1st individuals), since 2009 dense growth	Near Leer, River Leda, a tributary of the River Ems (53°11.01'N and 7°38.77'E)	**Ornamental?**		Nehring, S. & Kolthoff, D. (2011)

New Sightings

***Ludwigia grandiflora*,** an aquatic weed from South America, was recorded in NW Germany near Leer, Lower Saxony, in a tributary of the River Ems. It is the first record from Germany and it was found entangled with water lillies. The very first record was in 2004 and later a dense growth was occurred since 2009. This species is potentially invasive and was therefore added to the German Black List. In Belgium, France and Switzerland the occurrence of *L. grandiflora* was documented with negative effects on biodiversity and water quality (Nehring & Kolthoff 2011). The authors are unspecific about the introduction vector, but its occurrence with water lilies and the beautiful yellow flower indicates a possibility of an ornamental release. However, this assumption needs to be tested (Nehring & Kolthoff 2011).

Previous Sightings

As reported previously, ***Hemigrapsus penicillatus***. was in 2007 found for the first time in German waters (southwestern Wadden Sea) (Gehrmann *et al*. 2007, Markert &

Wehrmann in prep.[1]). Other studies in 2007 also documented the presence of ***H. takanoi*** *and* ***H. sanguineus*** from the area (Obert *et al*. 2007[2]). The crab continues to spread.

As reported before, in October 2006 the invasive ctenophore ***Mnemiopsis leidyi*** was first recorded in the Kiel Bight and is today found in all Baltic countries. *M. leidyi* also invaded the North Sea. However, this invasion may have been overlooked as the species was misidentified as a native comb jelly (Faasse & Bayha 2006)[3]. Using microsatellites, developed for the first time in the phylum Ctenophora, it was shown that **Mnemiopsis leidyi has colonized Eurasia from two source areas**. Comparisons were made with speciments from four sites within the assumed source region (US East Coast and Gulf of Mexico) and 10 invaded locations in Eurasia. Bayesian clustering and phylogeographic analysis revealed that the **origin of earlier invasions (Black and Caspian Seas in the 1980s/1990s) originate within or close to the Gulf of Mexico**. In contrast **the 2006 invasion of the North and Baltic Seas was traced as to originate from New England** (pairwise FST = 0). We found no mixing evidence among both gene pools in the invaded areas. While the genetic diversity (allelic richness) remained similar in the Baltic Sea compared to the source region New England, it was reduced in the North Sea, supporting the view of **an initial invasion of Northern Europe to the Baltic Sea**. In Black and Caspian Sea samples, we found a gradual decline in allelic richness compared to the Gulf of Mexico region, supporting a stepping-stone model of colonization with two sequential genetic founder events (Reusch *et al* 2010).

Gracilaria vermiculophylla, first recorded along the German North Sea coast in 2002 and along the German Baltic coast in 2005, continues to spread. Preliminary results from the Baltic show that *G. vermiculophylla* may have a potential to compete with the native *Fucus vesiculosus* in shallower and less exposed areas. Genetical studies have recently revealed that the Japanese Sea is the area of origin of all European invasive populations of this species (Kim *et al*. 2010).

4. Pathogens

No new records.

5. Meetings and projects

A new alien species related research project was launched with its kick-off meeting in February 2011, i.e. the VECTORS project.

VECTORS will elucidate the drivers, pressures and vectors that cause change in marine life, the mechanisms by which they do so, the impacts that they have on ecosystem structures and functioning, and on the economics of associated marine sectors and society. **VECTORS will particularly focus on causes and consequences of invasive alien species**, outbreak forming species, and changes in fish distribution and productivity. New and existing knowledge and insight will be synthesised and integrated to project changes in marine life, ecosystems and economies under future sce-

[1] 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).

[2] 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

[3] Faasse MA and Bayha KM (2006) The ctenophore *Mnemiopsis leidyi* A. Agassiz 1865 in coastal waters of the Netherlands: an unrecognized invasion? Aquatic Invasions 1(4): 270-277

narios for adaptation and mitigation in the light of new technologies, fishing strategies and policy needs. VECTORS will evaluate current forms and mechanisms of marine governance in relation to the vectors of change. Based on its findings, VECTORS will provide solutions and tools for relevant stakeholders and policymakers, to be available for use during the lifetime of the project. The project will address a complex array of interests comprising areas of concern for marine life, biodiversity, sectoral interests, regional seas, and academic disciplines as well as the interests of stakeholders. VECTORS will ensure that the links and interactions between all these areas of interest are explored, explained, modelled and communicated effectively to the relevant stakeholders. The VECTORS consortium is extremely experienced and genuinely multidisciplinary. It includes a mixture of natural scientists with knowledge of socio-economic aspects, and social scientists (environmental economists, policy and governance analysts and environmental law specialists) with interests in natural system functioning. VECTORS is therefore, fully equipped to deliver the integrated interdisciplinary research required to achieve its objectives with maximal impact in the arenas of science, policy, management and society.

The geographic focus is put on the western Mediterranean, North and Baltic Seas.

The specific objectives of VECTORS include:

- To collate understanding of the different current and potential future pressures and vectors of change in the marine environment;
- To better understand the mechanisms of changes in marine life and the role of human activity;
- To determine the impacts of changes in marine life on ecosystems, their structure and functioning, the services they provide, as well as the economic and societal implications
- To project the future changes and consequences of multi sectoral human activity in the marine environment under future possible scenarios of adaptation and mitigation
- To synthesise the derived information into innovative predictive management tools and strategies targeted to different policy makers and other stakeholders

The existing alien species databases generated during the EU-funded DAISIE and IMPASSE projects will be updated and the databases will further be modified and expanded to meet the VECTORS needs. The project will also contribute to ballast water management, risk assessments and decision support systems.

The project is coordinated by Melanie Austen, Plymouth Marine Laboratory, United Kingdom and has a duration of 4 years. In total the project is structured in 8 Work Packages with 37 partners being included to contribute more than 1600 person months during the project duration. The overall requested financial EU contribution is ca. 12.5 Mill €.

6. References and bibliography

It seems that the vector pet trade and ornamental release becomes more into focus as two recent publications address this invasion pathway.

Beukema J.J., R. Dekker. 2010. Extraordinarily low mortality rates reported in juvenile Pacific oysters in the German Wadden Sea. Helgol Mar Res (2010) 64: 69–70

Buschbaum, C., K. Reise 2010: Globalisierung unter Wasser. Neues Leben im Weltnaturerbe Wattenmeer. Biol. Unserer Zeit 3/2010 (40), 202-210

Brandorff, G.-O.: 2011. The copepod invader Skistodiaptomus pallidus (Herrick, 1879) (Crustacea, Copepoda, Diaptomidae) from North America in water bodies of Bremen, northern Germany. Aquatic Invasions (2011) Volume 6, Supplement 1: S1–S5

David, M. & Gollasch, S. 2010. Ballast Water Risk Assessment for intra North Sea Shipping prepared for Interreg IVB Project Ballast Water Opportunity. 48 pp.

Elsner, N.-O. • Sabine Jacobsen •David W. Thieltges • Karsten Reise 2010. Alien parasitic copepods in mussels and oysters of the Wadden Sea. Helgol Mar Res. 9 pp.

Gollasch, S. 2010. Canals. 92-95. In Daniel Simberloff & Marcel Rejmánek (eds.). Encyclopedia of Biological Invasions..

Gollasch; S. & David. M. 2010. Testing Sample Representativeness of a Ballast Water Discharge and developing methods for Indicative Analysis: Tender N° EMSA/NEG/09/2010: European Maritime Safety Agency; LISBOA; Portugal. 124 pp.

Javidpour J, JC Molinero & U Sommer (2010), Reconsidering evidence for Mnemiopsis invasion in European waters: reply. Journal of Plankton Research 32(1): 97-98

Kim, Su Yeon, Florian Weinberger and Sung Min Boo 2010. Genetic Data Hint at a Common Donor Region for Invasive Atlantic and Pacific Populations of Gracilaria Vermiculo Phylla (Gracilariales, Rhodophyta). J. Phycol. 46.

Lang, A.-C., C. Buschbaum 2010. Facilitative effects of introduced Pacific oysters on native macroalgae are limited by a secondary invader, the seaweed Sargassum muticum. Journal of Sea Research 63 (2010) 119–128

Lehmann A & J. Javidpour (2010) Potential pathways of invasion and dispersal of Mnemiopsis leidyi in the Baltic Sea. Hydrobiologia 649:107-114

Montserrat V., C. Basnou, P. Pysvek, M. Josefsson, P. Genovesi, S.Gollasch, W. Nentwig, S. Olenin, A.Roques, D. Roy, P.- E. Hulme, and DAISIE partners. 2010. How well do we understand the impacts of alien species on ecosystem services? A pan-European, cross-taxa assessment. Front Ecol Environ 2010; 8(3): 135–144, doi:10.1890/080083 (published online 20 Apr 2009)

Nehring, S., K. Reise, N. Dankers and Per S. Kristensen, 2009. Alien species. Thematic Report No. 7. In: Marencic, H. & Vlas, J. de (Eds), 2009. Quality Status Report 2009. WaddenSea Ecosystem No. 25. Common Wadden Sea Secretariat, Trilateral Monitoring and Assessment Group, Wilhelmshaven, Germany.

Nehring, S., Franz Essl, Frank Klingenstein, Christelle Nowack, Wolfgang Rabitsch, Oliver Stöhr, Christian Wiesner und Christian Wolter. 2010. Schwarze Liste invasiver Arten: Kriteriensystem und Schwarze Listen invasiver Fische für Deutschland und für Österreich. BfN-Skripten 285. 185 pp.

Nehring, S. & Meer, U. van der (2010): First record of a fertilized female blue crab, Callinectes sapidus Rathbun, 1896 (Crustacea: Decapoda: Brachyura), from the German Wadden Sea and subsequent secondary prevention measures. - Aquatic Invasions 5: 215-218.

Nehring, S., Kleinbauer I., Dullinger S., Essl, F., Klingenstein, F. & May, R. (2010): Climate change threats to biodiversity in Germany and Austria: The potential distribution of alien

plants. - In: Secretariat of the Convention on Biological Diversity (Ed.), Biodiversity and Climate Change: Achieving the 2020 Targets. CBD Technical Series 51: 57-59.

Nehring, S. (2011): Invasion history and success of the American blue crab Callinectes sapidus Rathbun, 1896 in European and adjacent waters. - In: Galil, B.S., Clark, P.F. & Carlton, J.T. (Eds.), In the Wrong Place - Alien Marine Crustaceans: Distribution, Biology and Impacts. Invading Nature - Springer Series in Invasion Ecology 6: 607-624.

Nehring, S. & Kolthoff, D. (2011): The invasive water primrose Ludwigia grandiflora (Michaux) Greuter & Burdet (Spermatophyta: Onagraceae) in Germany: First record and ecological risk assessment. - Aquatic Invasions 6.

Neumann, H., Siegfried Ehrich and Ingrid Kröncke. 2010. Establishment of the angular crab Goneplax rhomboides (Linnaeus, 1758) (Crustacea, Decapoda, Brachyura) in the southern North Sea. Aquatic Invasions (2010) Volume 5, Supplement 1: S27-S30

Olenin,S., F. Alemany, A. C. Cardoso, S. Gollasch, P. Goulletquer, M. Lehtiniemi, T. McCollin, D. Minchin, L. Miossec, A. Occhipinti Ambrogi, H. Ojaveer, K. Rose Jensen, M. Stankiewicz, I. Wallentinus & B. Aleksandrov. 2010. MARINE STRATEGY FRAMEWORK DIRECTIVE Task Group 2 Report Non-indigenous species. Prepared under the Administrative Arrangement between JRC and DG ENV (no 31210 – 2009/2010), the Memorandum of Understanding between the European Commission and ICES managed by DG MARE, and JRC's own institutional funding. 44 pp. JRC 58108, EUR 24342 EN, ISBN 978-92-79-15655-7, ISSN 1018-5593, DOI 10.2788/87092

Panov, V.E., Alexandrov, B., Arbačiauskas, K., Binimelis, R., Copp, G.H., Grabowski, M., Lucy, F., Leuven, R.S.E.W., Nehring, S., Paunović, M., Semenchenko, V. & Son, M.O. (2010): Risk assessment of aquatic invasive species introductions via European inland waterways. - In: Settele, J., Penev, L., Georgiev, T., Grabaum, R., Grobelnik, V., Hammen, V., Klotz, S., Kotarac, M. & Kühn, I. (Eds.), Atlas of Biodiversity Risk. Pensoft, Sofia: 140-143.

Reichert, K. and Jan Beermann, 2011. First record of the Atlantic gammaridean amphipod Melita nitida Smith, 1873 (Crustacea) from German waters (Kiel Canal). Aquatic Invasions (2011) Volume 6, Issue 1, in press.

Reise, K.: 2010. How to deal with alien species in the Wadden Sea? Ecosystem, Species Trends and Assessment, Wadden Sea Ecosystem No. 26, 69-73

Reusch TBH., S Bolte, M Saprwel, A Moss, J Javidpour (2010) Microsatellites reveal origin and genetic diversity of Eurasian invasions by one of the world's most notorious invader, Mnemiopsis leidyi (Ctenophora). Mol Ecol 19: 2690-2699

Savini, B._D., A. Occhipinti–Ambrogi, A. Marchini, E. Tricarico, F. Gherardi, S. Olenin and S. Gollasch. 2010. The top 27 animal alien species introduced into Europe for aquaculture and related activities. J. Appl. Ichthyol. 26 (Suppl. 2) (2010), 1–7

Schaber, M., Haslob, H., Huwer, B., Harjes, A., Hinrichsen, H.H., Köster, F.W., Storr-Paulsen, M., Schmidt, J.O., Voss, R., 2011. The invasive ctenophore *Mnemiopsis leidyi* in the central Baltic Sea - Seasonal phenology and hydrographic influence on spatio-temporal distribution patterns. Journal of Plankton research, fbq167 first published online February 7, 2011, doi:10.1093/plankt/fbq167

Schaber, M., Haslob, H., Huwer, B., Harjes, A., Hinrichsen, H.H., Storr-Paulsen, M., Schmidt, J.O., Voss, R., Neumann, V., Köster, F.W., 2011. Spatio-temporal overlap of the alien invasive ctenophore *Mnemiopsis leidyi* and ichthyoplankton in the Bornholm Basin (Baltic Sea). Biological Invasions, doi: 10.1007/s10530-011-9936-7

Schmidt, A., A. Wehrmann, S. Dittmann. 2010. Low mortality rates of juvenile PaciWc oysters in the German Wadden Sea are characteristic for invasive species: a reply to Beukema and Dekker. Helgol Mar Res (2010) 64: 71–73

Secretariat of the Convention on Biological Diversity (2010). Pets, Aquarium, and Terrarium Species: Best Practices for Addressing Risks to Biodiversity. Montreal, SCBD, Technical Series No. 48, 45 pages.

Shine, C., Kettunen, M., Genovesi, P., Essl, F., Gollasch, S., Rabitsch, W., Scalera, R., Starfinger, U. and ten Brink, P. 2010. Assessment to support continued development of the EU Strategy to combat invasive alien species. Final Report for the European Commission. Institute for European Environmental Policy (IEEP), Brussels, Belgium. 297 pp.

Simons, S.A. and De Poorter, M. (eds.) 2009. Best Practices in Pre-Import Risk Screening for Species of Live Animals in International Trade: Proceedings of an Expert Workshop on Preventing Biological Invasions, University of Notre Dame, Indiana, USA, 9-11 April 2008. Global Invasive Species Programme, Nairobi, Kenya. 30pp.

Wiersma, A.-P., Albert P. Oost, Meindert W. van der Berg, Peter C. Vos, Veronique Marges and Sieb de Vries, 2009. Geomorphology. Thematic Report No. 9. In: Marencic, H. & Vlas, J. de (Eds), 2009. Quality Status Report 2009. WaddenSea Ecosystem No. 25. Common Wadden Sea Secretariat, Trilateral Monitoring and Assessment Group, Wilhelmshaven, Germany.

Wiesner,C., Christian Wolter, Wolfgang Rabitsch und Stefan Nehring. 2010. Gebietsfremde Fische in Deutschland und Österreich und mögliche Auswirkungen des Klimawandels. BfN-Skripten 279. 192 pp.

University of California Press, Berkeley, Los Angeles, London. 765 pp.

Witte, S., Christian Buschbaum,•Justus E. E. van Beusekom • Karsten Reise 2010. Does climatic warming explain why an introduced barnacle finally takes over after a lag of more than 50 years? Biol Invasions (2010) 12:3579–3589

Wolff, W.-J., Jan P. Bakker, Karsten Laursen, Karsten Reise, 2010. The Wadden Sea Quality Status Report - Synthesis Report 2010. Wadden Sea Ecosystem No. 29. Common Wadden Sea Secretariat, Wilhelmshaven, Germany, page 25 - 74.

5.9 Italy[4]

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[4] **Note:** This report is the outcome of a special working group of the Italian Marine Biology Society (SIBM) on a voluntary basis. It does not reflect an official position or knowledge of the relevant Italian Government bodies.

It has been prepared according with the guidelines for ICES WGITMO National Reports; it updates the Italian status of 2010.

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1 Regulations: An update on new regulations and policies (including, aquaculture and vector management)

As required by the article 23rd of the Council Regulation N°708/2007, concerning the use of alien and locally absent species in aquaculture, a public register of introductions and translocations is now available and can be accessed (in Italian and English) at: http://www.flktest.com/835ICR/icr_index.php?action=home&op=&lang=en

The need of strictly enforcing existing regulations, namely EC Directives, has been advocated, observing the cases of alien species introduced as epiphytes of oysters imported from foreign cultures (Petrocelli and Cecere, 2010).

2. Intentional introductions

No new intentional introductions have been reported.

3. Unintentional introductions

New Sightings

Algae & higher plants

The first occurrence of the red alga *Gracilaria vermiculophylla* (Ohmi) Papenf. in the Mediterranean Sea was reported from the Po Delta lagoons in 2008, probably introduced by the importation of the Manila clam *Tapes philippinarum*. It was found only near some clam-farming areas, but it is expected to spread in other lagoons as already observed for other alien species in the area, such as *Agardhiella subulata* and *Solieria filiformis (*Sfriso *et al*., 2010).

Previous Sightings

Algae & higher plants

A considerable interest has been shown towards HAB forming microalgae. Although the species that have caused the blooms in Italy are not demonstrated aliens, we continue in recording the information that we have gathered, especially regarding species that were mentioned in the previous National Reports for Italy. Clarification of the origin of these species is sought by means of population genetic structure in the case of *Alexandrium minutum* (Casabianca *et al*. 2010). Monitoring of the benthic/epiphytic genus *Ostreopsis*, known to produce palytoxin-like compounds, has been performed in 20 sites during 2007 in the Adriatic Sea in comparison with the Catalan Sea (Totti, 2010). A PCR based assay combined with light microscopy was used (Battocchi *et al*., 2010). Two more sites around Bari (S Adriatic Sea) have been

monitored in 2008, in an area where *O. ovata* is known since 2000 (Ungaro *et al*., 2010). Blooms of *Ostreopsis ovata* have been observed in 2009 from the Gulf of Trieste, N Adriatic (Cabrini *et al*., 2010), following those of 2005-2006 in Liguria (Ciminiello *et al*., 2008) and other Italian localities (Congestri, 2006).

The benthic microalga *Chrysophaeum taylorii*, typical of coral reefs, has been recorded in summer 2007 in Sardinia, where it was associated to mucus forming episodes locally very intense. A monitoring campaign in summer 2009 has shown a consistent presence of the species in 17 sites in Central and Eastern Sardinia, following the first bloom in two marine protected areas (Luglié, 2008; Caronni *et al*., 2009, 2010).

During a survey of benthic macroalgae in 2007 along the dykes and the extensive stone breakwaters of the island of Lido (Lagoon of Venice), nineteen alien species were recorded (Sfriso and Facca, 2011). Among them *Sargassum muticum*, *Scytosiphon dotyi*, *Polysiphonia morrowii*, *Antithamnion hubbsii* and *Ulva fasciata* are seasonally invasive in the anthropic constructions of the Venice littoral. On the contrary *Undaria pinnatifida*, that is spread along many other areas of the Lagoon, did not colonized neither the dykes nor the Murazzi. The macroalgae *Sargassum muticum, Antithamnion hubbsii, Grateloupia turuturu* were recorded in the harbour of Ancona (Central Adriatic) (Falace *et al*., 2010).

The pattern and degree of substitution by either native (*Cymodocea nodosa* and *Caulerpa prolifera*) or alien (*Caulerpa taxifolia* and *C. racemosa*) species in 17 *Posidonia oceanica* meadows along the coast of Liguria (Italy, NW Mediterranean) were investigated. The non-native species were found to be stronger colonizers than the native ones, in terms of habitat occupancy within meadows (Montemartini *et al*., 2010).

Invertebrates

Ruditapes philippinarum has been found in the wild, together with native populations of *Ruditapes decussatus* in the Gulf of Olbia (NE Sardinia) (Cannas, 2010). The Atlantic bobtail squid *Stoloteuthis leucoptera* (two specimens) was recorded in Sardinia in 2005 and 2007. Only a few previous records exist for Italian waters (Cuccu, 2010). The opistobranch mollusc *Aplysia dactylomela,* since the first record from the island of Lampedusa (2002), has been recorded from eastern Sicily (2003, 2006, 2008), Greece (starting in 2005), Croatia (2006), Cyprus (2005), Southern Turkey (2006) and Malta in 2008 (Di Silvestro, 2010).

A survey of *Percnon gibbesi* in the island of Linosa (Sicilian Straits) was conducted, after ten years from the first sighting (Raineri and Savini, 2009). The crab has been able to colonize the whole superior infralittoral fringe, reaching higher densities (30-50 ind. 10 m) in localities characterized by a microhabitat of large boulders covered by coralline algae. The larvae of alien Crustacean in Italy have been reviewed by Pessani (in press).

Not Seen Species Yet

The brown alga *Rugulopteryx okamurae* has been recorded in the lagoons of Southern France (Verlaque *et al*., 2009).

During an experimental trawl survey in June 2006, several specimens of the Western-Atlantic penaeid shrimp *Rimapenaeus similis* were caught in the Gulf of Gabes (southern Tunisia, Central Mediterranean). This represents the first record for the Mediterranean Sea (Ben Hadj Hamida-Ben Abdallah, 2010).

4. Pathogens

No data

5. Meetings and research projects

The final Workshop of the Research Programme on *Ostreopsis,* financed by the Italian Ministry of the Environment was held in Rome on 30 April 2010, with the title "*Ostreopsis ovata* and *Ostreopsis* spp: new risks of microalgal toxicity in Italian Seas".

A series of methods, suggestions and "tricks" to facilitate the detection and study has been given by Azzurro (2010), as an output of the Interreg III A Project "MonItaMal" between Italy and Malta, with the aim of extracting information from rare and difficult to observe occurrences of alien species.

A review was published of 38 nonindigenous marine species (NIS) (macroalgae, sponges, hydrozoans, molluscs, polychaetes, crustaceans, ascidiaceans and fish), from the Apulian coast of Italy. Shipping, aquaculture and migration through the Suez Canal are the main pathways of introduction of the NIS (Gravili *et al*., 2010).

A review of the information about the genetics of 14 Lessepsian species that have passed through the Suez canal in different times and with varying colonization success was published by Bernardi *et al*. (2010) including examples of alien species in Italy.

An updated list of the NIS marine species recorded in Italy from 1945 to 2009 was published by Occhipinti-Ambrogi *et al*. (2010). The paper represents the contribution by Italian scientists, who have undertaken this task on a voluntary basis, being part of the ''Allochtonous Species Group'' (ASG) within the Italian Society of Marine Biology (SIBM), and provided the information for the ICES National Reports for Italy. The data have been reviewed according to the taxonomic expertise of the authors and are organized in a referenced database containing information on each species about: distribution along Italian coasts, the native range, most probable vectors of introduction, population status and impact.

6. References and bibliography

Azzurro E. (2010). Unusual occurrences of fish in the Mediterranean Sea: an insight into early detection. In: D. Golani & B. Appelbaum-Golani (Eds) Fish Invasions of the Mediterranean Sea: Change and Renewal, Pensoft Publishers, Sofia, Moscow, pp. 99-126.

Battocchi C., Totti C., Vila M., Masò M.,Capellacci S., Accoroni S., Reñé A., Scardi M., Penna A. (2010). Monitoring toxic microalgae *Ostreopsis* (Dinoflagellate) species in coastal waters of the Mediterranean Sea using molecular PCR-based assay combined with light microscopy. Mar. Pollut. Bull. 60 (7) :1074-1084.

Ben Hadj Hamida-Ben Abdallah O., Ben Hadj Hamida N., Jarboui O., Froglia C. (2010). First occurrence of the yellow roughneck shrimp, *Rimapenaeus similis* (Smith, 1885) (Crustacea: Decapoda: Penaeidae) in the Mediterranean Sea (Tunisian waters). Biol. Invasions, 12: 999–1001DOI 10.1007/s10530-009-9536-y

Bernardi G., Golani D., Azzurro E. (2009) The genetics of Lessepsian bioinvasions. In: D. Golani & B. Appelbaum-Golani (Eds) Fish Invasions of the Mediterranean Sea: Change and Renewal, Pensoft Publishers, Sofia, Moscow, pp. 71-84.

Cabrini M., Fornasaro D., Lipizer M., Guardiani B. (2010). First report of *Ostreopsis* cf. *ovata* bloom in the Gulf of Trieste. Biol. Mar. Medit., 17 (1): 366-367.

Cannas A., Trentadue M., Manca S., Mura L., Fois N. (2010). Insediamento di *Ruditapes philippinarum* (Adams & Reeve) nel golfo di Olbia (Sardegna, Italia) e distribuzione in rapporto a *Ruditapes decussatus* (L.). Biol. Mar. Medit., 17 (1): 320-321.

Caronni S., Casu D., Ceccherelli G., Lugliè A., Navone A., Occhipinti-Ambrogi A., Panzalis P., Pinna S., Satta C., Sechi N. (2009). Distribuzione e densità della microalga bentonica *Chrysophaeum taylorii* Lewis & Bryan nell'Area Marina Protetta di Tavolara-Punta Coda Cavallo. Biol. Mar. Medit., 16 (1): 250-251.

Caronni S., Ceccherelli G., Navone A., Occhipinti-Ambrogi A., Panzalis P., Pinna S., Sechi N. (2010). Distribution and density of the benthic microalga *Chrysophaeum taylorii* Lewis & Bryan from northern to central-eastern Sardinian coasts. Biol. Mar. Medit., 17 (1): 292-293.

Casabianca S., Pecchioli E., Vernesi C., Penna A. (2010). Population genetic structure of the toxic Dinophyceae *Alexandrium minutum* in the Mediterranean Sea: a case study. Biol. Mar. Medit., 17 (1): 106-108.

Ciminiello P., Dell'Aversano C., Fattorusso E., Forino M., Tartaglione L., Grillo C., Melchiorre N. (2008). Putative palytoxin and its analogue ovatoxin-a, in *Ostreopsis ovata* collected along the Ligurian coasts during the 2006 toxic outbreaks. J. Amer. Soc. Mass Spectrom., 19: 111-120.

Congestri R., Penna A., Zingone A. , Giacobbe M.G., Totti C., Ciminiello P., Lugliè A, Bottalico A., Scardi M., Bastianini M., Grillo C., Poletti R., Pistocchi R., Casotti M., Caroppo C., Barone R., Cabrini M., Tubaro A., Mangialajo L. (2006). BENTOXNET, a research and management initiative on *Ostreopsis* and other benthic microalgal blooms on the Italian coasts. Harmful Algae News, 32: 11-12.

Cuccu D., Mereu M., Masala P., Cau A., Jereb P. (2010). First record of *Stoloteuthis leucoptera* (Cepahlopoda : Sepiolidae) in the Sardinian waters. Biol. Mar. Medit., 17 (1): 334-335.

Di Silvestro D., Garzoli L., Lodola A. (2010). Colonization status of the Mediterranean Sea by the tropical sea hare *Aplysia dactylomela* (Opisthobranchia, Anaspidea). 5th International Student Conference "Biodiversity and functioning of aquatic ecosystems in Baltic Sea region" 6-8 October 2010 Palanga, Lithuania.

Falace A., Alongi G., Spagnolo A., Fabi G. (2010). Segnalazione di macroalghe non-indigene nel porto di Ancona (Medio Adriatico). Biol. Mar. Medit., 17 (1): 300-301.

Gravili C., Belmonte G., Cecere E , Denitto F., Giangrande A., Guidetti P., Longo C., Mastrototaro F., Moscatello S., Petrocelli A., Piraino S., Terlizzi A., Boero F. (2010). Non-indigenous species along the Apulian coast, Italy. Chemistry and Ecology, 26 (suppl.): 121-142.

Luglié A. (2008). What is *Chrysophaeum taylorii* Lewis & Bryan doing in Sardinia (Tyrrhenian Sea, Mediterranean)? Harmful Algae News, 36 : 4-6.

Mastrototaro F., D'Onghia G., Corriero G., Matarrese A., Maiorano P., Panetta P., Gherardi M., Longo C., Rosso A., Sciuto F., Sanfilippo R, Gravili C, Boero F., Taviani M., Tursi A. (2010). Biodiversity of the white coral bank off Cape Santa Maria di Leuca (Mediterranean Sea): An update. Deep-Sea Research II, 57: 412–430.

Montefalcone M., Albertelli G.C., Morri C., Bianchi C.N. (2010). Patterns of wide-scale substitution within meadows of the seagrass *Posidonia oceanica* in NW Mediterranean Sea: invaders are stronger than natives. Aquatic Conserv: Mar. Freshw. Ecosyst. 20: 507–515.

Occhipinti-Ambrogi A., Marchini A., Cantone G., Castelli A., Chimenz C., Cormaci M., Froglia C., Furnari G., Gambi M.C., Giaccone G., Giangrande A., Gravili C., Mastrototaro F., Mazziotti C., Orsi-Relini L., Piraino S. (2011). Alien species along the Italian coasts: an overview. Biol. Invasions, 13: 215–237.

Pessani D. (in press). Allochtonous decapod species in Mediterranean: state of knowledge about their larva. Monografie del Museo Regionale di Scienze Naturali di Torino, (2010): 389-403.

Petrocelli A., Cecere E. (2010). Biodiversity and mollusc transfer: need of observance of the laws to avoid alien seaweeds introduction. Biol. Mar. Medit., 17 (1): 175-176

Raineri P. and Savini D. (2010). *Percnon gibbesi* (H. Milne Edwards, 1853) in Linosa island ten years after its first record. Rapp. Comm. int. Mer Médit., 39: 643

Sfriso A., Facca C. (2011). Macrophytes in the anthropic constructions of the Venice littorals and their ecological assessment by an integration of the "CARLIT" index. Ecological Indicators 11: 772–781

Sfriso A., Maistro S., Andreoli C., Moro I. (2010). First record of *Gracilaria vermiculophylla* (Gracilariales, Rhodophyta) in the Po delta lagoons, Mediterranean Sea (Italy). J. Phycol., 46: 1024-1027.

Totti C., Accoroni S., Cerino F., Cucchiari E., Romagnoli T. (2010). *Ostreopsis ovata* bloom along the Conero Riviera (Northern Adriatic Sea): relationships with environmental conditions and substrata. Harmful Algae, 9: 233-239.

Ungaro N., Pastorelli A.M., Di Festa T., Galise I., Romano C., Assennato G., Blonda M., Perrino V. (2010). Annual trend of the dinoflagellate *Ostreopsis ovata* in two sites along the southern Adriatic coast. Biol. Mar. Medit., 17 (1): 183-184.

Verlaque M., Steen F., De Clerck O. (2009). *Rugulopteryx okamurae* (Dictyotales Phaeophyceae), a genus recently introduced to the Mediterranean. Phycologia, 48 (6): 536-542.

5.10 Lithuania

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1. Regulations: An update on new regulations and policies (including, aquaculture and vector management)

In 2002 the Ministry of Environment has issued the order (2002-07-01, Nr. 352) on "Introduction, re-introduction and transfer program and control and eradication of invasive species" in Lithuania. In 2004 the list of invasive species has been confirmed by the Ministry (2004-08-16, D1-433). In this "black list" there are 10 aquatic animal species (of them 7 crustaceans) which should be controlled or/and eradicated.

It is planned to reintroduce the Atlantic sturgeon *Acipenser oxyrhynchus* Mitchill (meeting of the Invasive species control council under the Ministry of Environment, 2011, February 23).

2. Intentional introductions

No intentional introductions were reported to the Lithuanian coastal waters in recent years.

3. Unintentional introductions

No new alien species were found in Lithuanian waters in 2010.

Presently 30 aquatic non-indigenous species (NIS) are known from the Lithuanian coastal marine waters and the Curonian Lagoon, 25 of them considered to be established (Table 1), status of the Chinese mitten crab is unknown.

Table 1. List of NIS known in Lithuanian waters: BS - Baltic Sea (Lithuanian part); CL – Curonian Lagoon (Lithuanian part). Underlined: established NIS

Species	Common name	Where found	
Acipenser baeri	Siberian sturgeon		CL
Acipenser gueldenstaedti	Russian sturgeon		CL
Acipenser ruthenus	sterlet		CL
Anguillicola crassus	eel swim-bladder nematode	BS	CL
Balanus improvisus	acorn bay barnacle	BS	CL
Carassius gibelio	Gibel carp		CL
Cercopagis pengoi	fish-hook water flea	BS	CL
Chaetogammarus ischnus	gammarid amphipod		CL
Chaetogammarus warpachowskyi	gammarid amphipod		CL
Chelicorophium curvispinum	Caspian mud shrimp	BS	CL
Cordylophora caspia	freshwater hydroid	BS	CL
Coregonus peled	peled		CL
Cyprinus carpio	carp		CL
Dreissena polymorpha	zebra mussel		CL
Eriocheir sinensis	Chinese mitten crab	BS	CL
Gammarus tigrinus	gammarid amphipod		CL
Hemimysis anomala	bloody-red shrimp	BS	CL
Limnomysis benedeni	mysid shrimp		CL
Lithoglyphus naticoides	gravel snail		CL
Marenzelleria neglecta	red-gilled mud worm	BS	CL
Mya arenaria	soft-shelled clam	BS	
Neogobius melanostomus	round goby	BS	CL
Oncorhynchus mykiss	rainbow trout		CL
Obessogammarus crassus	gammarid amphipod		CL
Orconectes limosus	spinycheek crayfish		CL
Paramysis lacustris	mysid shrimp		CL
Pontogammarus robustoides	gammarid amphipod		CL
Potamopyrgus antipodarum	New Zealand mud snail		CL
Prorocentrum minimum	bloom-forming dinoflagellate	BS	CL
Rhithropanopeus harrisii	mud crab		CL

Most of the aquatic NIS are known from the Curonian Lagoon, a large shallow (total area 1584 km^2, mean depth 3.8 m), mostly freshwater body with irregular salinity fluctuations (0-7 PSU) in its narrow northern part connected to the Baltic Sea. Within the Lagoon most of benthic NIS are found either at artificial hard bottom substrates in the port of Klaipeda area or in the habitat formed by dense colonies of the zebra mussel (Zaiko *et al*., 2007).

By the origin, most of NIS came from Ponto-Caspian area (60%), North America (24%) and temperate regions of Asia and Pacific (14%); most of them are crustaceans (14 out of 21 known invertebrate NIS).

Most aquatic introductions to Lithuania are secondary spread from elsewhere, except six species of the Ponto-Caspian amphipods and mysids, which have been intentionally introduced into the Lithuanian inland waters and the Curonian Lagoon in 1960-s from Dnieper and Simferopol water reservoirs in Ukraine (Olenin, 2005; Arbačiauskas 2008 and references therein).

The most recent (>2000) records to the Lithuanian coastal waters (both sea and lagoon) are:

- the mud crab *R. harrisii* - found at a navigational buoy in Klaipeda port in 2000 (Olenin, unpubl.) and in benthic samples taken in the port area (Bacevičius, Gasiūnaitė, 2008);
- the round goby *N. melanostomus* – first found by SCUBA divers and anglers at the breakwaters (stones and concrete blocks) of Klaipeda port in August 2002 (J.Maksimov, pers. comm.; Bacevicius 2004; Olenin 2005). It is likely that the species came to the Lithuanian waters due to shipping activity: the round goby was newer found in the littoral fish fry surveys along the Curonian Spit, where the environment is not suitable for its establishment (exposed sandy beaches, no stony substrates). Now species is spreading inside the Curonian Lagoon and northward from Klaipeda, where morainic stony ridges exist.
- the gammarid *G. tigrinus* – first found in the littoral part of the Curonian Lagoon in September 2004 (Daunys, Zettler 2006).

A bioinvasion impact (biopollution) assessment has been performed for the Lithuanian coastal waters (including the Curonian Lagoon) in the framework of the overall biopollution review for the entire marine region, the Baltic Sea (Zaiko *et al*. 2011). The methodology is based on a classification of the abundance and distribution range of NIS and the magnitude of their impacts on native communities, habitats and ecosystem functioning aggregated in a "Biopollution Level" index (BPL) which ranges from 'no impact' (BPL=0) to 'massive impact' (BPL=4) (Olenin *et al*., 2007). The assessment performed for nine Baltic sub-regions revealed that documented ecological impact is known only for 44 alien species out of 119 registered in the Sea. The highest biopollution (BPL=3, strong impact) occurs in coastal lagoons, inlets and gulfs, and the moderate (BPL=2) - in the open sea areas. The methodology was also used to classify species into alien (BPL=0) versus 'impacting' species (BPL>0), which can be divided into 'potentially invasive' (BPL=1) and 'invasive' (BPL>1) ones. No clear correlation between the number of established alien and impacting species was found in the subregions of the Baltic Sea. The methodology, although requiring a substantial research effort, proved to be useful for interregional comparisons and evaluating the bioinvasion effects of individual alien species.

The same BPL methodology was applied to assess the impacts of invasive alien phytoplankton in the Baltic Sea during 1980 to 2008 (Olenina *et al*. 2010). The method was applied to phytoplankton monitoring data collected from eleven sub-regions of the Baltic Sea. Of the twelve alien/cryptogenic phytoplankton species recorded in the Baltic Sea only one (the dinoflagellate *Prorocentrum minimum*) was categorized as an IAS, causing a recognizable environmental effect.

4. Meetings and projects

Meetings

Changing Seas. Workshop on effects of climate change on marine ecosystems, 9-10 March 2010, Copenhagen. Invited lecture:

- S. Olenin. Global change and biological invasions in the Nordic-Baltic area

Annual Conference of the Coalition Clean Baltic. Palanga, Lithuania, 7-9 May 2010. Invited lecture:

- S. Olenin. Marine invasive species in the Baltic Sea.

National Conference "Sea and coast", Palanga, Lithuania, April, 2010.

- A. Narščius, A. Zaiko, S. Olenin. Biological invasion impact assessement system for marine and estuarine environment
- A. Zaiko, A. Narščius, S. Olenin. Invasive species in the Baltic Sea: comparative analysis and integrated impact assessment

The 6th NEOBIOTA Conference: Biological Invasions in a Changing World - from Science to Management. Copenhagen, Denmark, 14-17 September 2010. Presentations:

- I. Olenina. Identifying traits of invasive marine phytoplankton.
- S. Olenin. Invasive species and environmental quality assessments (Session chair and primary talk).
- A. Zaiko, A. Narščius, S. Olenin. Bioinvasion impact assessment: the Baltic Sea case.
- A. Narščius, A. Zaiko, S. Olenin. Building a database on bioinvasion impacts: it's time to use a standardized approach.

Projects:

- BINLIT. Biological invasions in Lithuanian ecosystems under the climate change: causes, impacts and projections. National project funded by the Research Council of Lithuania (2008-2010).

The first national project aimed at gaining fundamental knowledge on the scope of the biological invasion problem in Lithuania. By December 2010, 994 alien species (AS) were registered in Lithuania. Most of them are vascular plants (61%), fungi and fungi-like organisms (23%) and arthropods (16 %). The largest influx of alien was observed in last decades of XX century, which is related to the intentional introductions of target species (prior to the Restoration of Independence), intensification of international trade and increasing people's mobility since 1990. Most of AS originate from temperate latitude regions with similar climatic conditions to Lithuania: Europe, temperate Asia and North America. In recent years, however, the proportion of AS of tropical origin is increasing which may be related to the potential effects of climate change (warming). An integrated information system on alien species in Lithuania was developed within the project that allows register AS in Lithuania, assess their impact on the environment and collect information on their biological traits in the standardized way. The BINLIT information system consists of three modules: 1) Lithuanian alien species database, 2) Biological invasion impact assessment system (BINPAS) and 3) Lithuanian invasive species descriptions database.

- MEECE. Marine Ecosystem Evolution in a Changing Environment. EU FP7 project (2008-2012)

This is a European FP7 project that uses predictive models to explore the impacts of both climate drivers (acidification, light, circulation and temperature) and human induced drivers (fishing, pollution, invasive species and eutrophication) on marine ecosystems. CORPI is responsible for invasive species component (http://www.meece.eu/).

- VECTORS. Wectors of Change in Oceans and Seas Marine Life, Impact on Economic Sectors (2008-2012)

The project will address a complex array of interests comprising areas of concern for marine life, biodiversity, sectoral interests, regional seas, and academic disciplines as well as the interests of stakeholders. One of the main tasks if CORPI is to integrate the Baltic Alien Species Database and BINPAS (see below).

5. References and bibliography

CORPI maintains the Baltic Sea Alien Species Database (online since 1997, available at: http://www.corpi.ku.lt/nemo/mainnemo.html) which provides a qualified reference system on alien species for the Baltic Sea area and updates information on the Baltic Sea alien species, their biology, vectors of introduction, spread, impacts on environment and economy.

CORPI develops BINPAS (Bioinvasion Impact / Biopollution Assessment System available at http://www.corpi.ku.lt/databases/binpas/). The bioinvasion impact assessment methodology is based on estimation of the abundance and distribution range of alien species and the magnitude of their impacts on native communities, habitats and ecosystem functioning, all aggregated in a hybrid ranking "Biopollution Level" index (BPL). The later ranges from "no impact" (BPL=0) to "massive impact" (BPL=4). BINPAS was created using open source web technologies (Apache 2, PHP 5) and MySQL 5 relational database management system. BINPAS collects and stores standardized ecological data on bioinvasion impacts submitted by contributors. The system has been tested and validated on a number of case studies from various terrestrial and aquatic ecosystems. It proved to be feasible in integration and sharing of ecological data, providing reliable results for inter-regional comparisons and meta-analysis of the bioinvasion effects on different spatial and temporal scales (Olenin, Narščius, 2010).

Publications cited in this report

Arbačiauskas K., 2008. Amphipods of the Nemunas River and the Curonian Lagoon, the Baltic Sea basin: where and which native freshwater amphipods persist? Acta Zoologica Lituanica 18(1): 10-16

Bacevičius E. 2004. The new data on ecology of alien fish species and fish metazoan parasites in the Curonian lagoon and Lithuanian coastal zone. Baltic - the sea of aliens, Gdynia, Poland 25-27.08.2004, Book of Abstracts: 17-18.

Bacevičius, E., Gasiūnaitė, Z. R. 2008. Two crab species- Chinese mitten crab (*Eriocheir sinensis* Edw.) and mud crab (*Rhithropanopeus harrisii* (Gould) ssp. tridentatus (Maitland) in the Lithuanian coastal waters, Baltic Sea. Transitional Waters Bulletin, 2 (2): 63-68

Daunys D., Zettler M.L. 2006. Invasion of the North American amphipod (*Gammarus tigrinus* Sexton, 1939) into the Curonian Lagoon, south-eastern Baltic Sea. Acta Zoologica Lithuanica, 16 (1): 20-26

Olenin, S., 2005. Invasive Aquatic Species in the Baltic States. Monograph. E. Leppäkoski & D. Minchin (reviewers). Klaipėda University Press, Klaipeda: 42 p.

Olenin S., Narščius A. 2010. "Beaufort Scale" for bioinvasion impacts. Aliens: The Invasive Species Bulletin. Newsletter of the IUCN/SSC Invasive Species Specialist Group. ISSN 1173-5988, 29: 52-54

Olenina, I., Wasmund, N., Hajdu, S., Jurgensone, I., Gromisz, S., Kownacka, J., Toming, K., Vaiciute, D., Olenin, S. 2010. Assessing impacts of invasive phytoplankton: The Baltic Sea case. Marine Pollution Bulletin, 60 (2010) 1691–1700

Zaiko A., Olenin S., Daunys D., Nalepa T. (2007). Vulnerability of benthic habitats to the aquatic invasive species. Biological invasions, 9: 703–714

Zaiko A., Lehtiniemi M., Narščius A., Olenin S. 2011. Assessment of bioinvasion impacts on a regional scale: a comparative approach. Biol Invasions. DOI 10.1007/s10530-010-9928-z

Other recent (since 2005) publications on aquatic NIS

Daunys D., Zemlys P., Olenin S., Zaiko A., Ferrarin C. 2006. Impact of the zebra mussel *Dreissena polymorpha* invasion on the budget of suspended material in a shallow lagoon ecosystem. Helgoland Marine Research, 60 (2): 113-120

Galil B.S., Gollasch S., Minchin D., and Olenin S. 2009. Alien Marine Biota of Europe. In: DAISIE. Handbook of Alien Species in Europe. Invading Nature - Springer Series In Invasion Ecology. V. 3, Springer: 93-104.

Gherardi F., Gollasch S., Minchin D., Olenin S., and Panov V.E. 2009. Alien Invertebrates and Fish in European Inland Waters. In: DAISIE. Handbook of Alien Species in Europe. Invading Nature - Springer Series In Invasion Ecology. V. 3, Springer: 81-92.

Hewitt C., Minchin D., Olenin S., Gollasch S. (2006). Epilogue. Canals, Invasion Corridors and Introductions. Bridging Divides. Maritime Canals as Invasion Corridors. Monographiae Biologicae 83, Springer, 301-306, 2006, ISBN: 1-4020-5046-1

Hulme P.E., Bacher S., Kenis M., Klotz S., Kühn I., Minchin D., Nentwig W., Olenin S., Panov V., Pergl J., Pyšek P., Roque A., Sol D., Solarz W., Vilà M. 2008. Grasping at the routes of biological invasions: a framework for integrating pathways into policy. Journal of Applied Ecology, 45(2): 403-414

Karatayev A.Y., Burlakova L.E., Padilla D.K., Mastitsky S.E., Olenin S. 2009. Invaders are not a random selection of species. Biological Invasions, 11: DOI 10.1007/s10530-009-9498-0

Karatayev A.Y., Mastitsky S.E., Burlakova L.E., Olenin S. (2008). Past, current, and future of the central European corridor for aquatic invasions in Belarus. Biological Invasions, 10 (2): 215-232

Minchin D, Gollasch S, Cohen AN, Hewitt CL, Olenin S. (2009) In: G. Rilov, J.A. Crooks, Jeffrey A. (Eds.) Characterizing Vectors of Marine Invasion. Biological Invasions in Marine Ecosystems Ecological, Management, and Geographic Perspectives. Series: Ecological Studies, 204 (XXVI): 109-116

Minchin D., Galil B.S., David M., Gollasch S., Olenin S. (2006). Overall Introduction. In: (Golash S, Galil BS, Cohen AN eds). Bridging Divides. Maritime Canals as Invasion Corridors. Monographiae Biologicae 83, Springer, 1-4, 2006, ISBN: 1-4020-5046-1

Ojaveer H, Jaanus A, MacKenzie BR, Martin G, Olenin S, Radziejewska T, Telesh I, Zettler MI, Zaiko A. 2010. Status of Biodiversity in the Baltic Sea. PLoS ONE 5(9): e12467. doi:10.1371/journal.pone.0012467 eISSN-1932-6203

Olenin S, Minchin D, Daunys D (2007). Assessment of biopollution in aquatic ecosystems. Marine pollution bulletin, 55 (7-9), 2007, 379-394

Olenin S. 2009. *Cordilophora caspia* (Pallas), freshwater hybroid (Clavidae, Cnidaria). In: DAISIE. Handbook of Alien Species in Europe. Invading Nature - Springer Series In Invasion Ecology. V. 3, Springer: 307.

Olenin S. 2009. *Marencelleria neglecta* Mesnil, red-gilled mud worm (Spionidae, Annelida). In: DAISIE. Handbook of Alien Species in Europe. Invading Nature - Springer Series In Invasion Ecology. V. 3, Springer: 285.

Olenin S. and Didziulis V. 2009. Introduction to the List of Alien Taxa. In: DAISIE. Handbook of Alien Species in Europe. Invading Nature - Springer Series In Invasion Ecology. V. 3, Springer: 129-132.

Olenin S. and Olenina I. 2009. *Balanus improvisus* Darwin, bay barnacle (Balanidae, Crustacea). In: DAISIE. Handbook of Alien Species in Europe. Invading Nature - Springer Series In Invasion Ecology. V. 3, Springer: 271.

Olenin S., Alemany F., A. Cardoso C., Gollasch S., Goulletquer P., Lehtiniemi M., McCollin T., Minchin D., Miossec L., Occhipinti Ambrogi A., Ojaveer H., Jensen K.R., Stankiewicz M., Wallentinus I. & Aleksandrov B. 2010. Marine Strategy Framework Directive - Task Group 2 Report. Non-indigenous species. EUR 24342 EN. ISBN 978-92-79-15655-7. ISSN 1018-5593. DOI 10.2788/87092. Luxembourg: Office for Official Publications of the European Communities. 44 pp

Olenin S., Minchin D., Daunys D., Zaiko A. 2010. Biological Pollution of Aquatic Ecosystems in Europe. Chapter 06-3. 2010. In: Settele J., Penev L, Georgiev T., Grabaum R., Grobelnik V., Hammen V., Klotz S., Kotarac M. & Kuhn I. (Eds). Atlas of Biodiversity Risk. Pensoft. Sofia. ISBN 978-954-642-446-4. pp. 136-137

Olenin S., Minchin D., Daunys D., Zaiko A. 2010. Pathways of Aquatic Invasions in Europe. Chapter 06-4. 2010. In: Settele J., Penev L, Georgiev T., Grabaum R., Grobelnik V., Hammen V., Klotz S., Kotarac M. & Kuhn I. (Eds). Atlas of Biodiversity Risk. Pensoft. Sofia. ISBN 978-954-642-446-4. pp. 138-139

Olenin, S. Daunys, D., 2005. Invaders in suspension-feeder systems: variations along the regional environmental gradient and similarities between large basins. In: Dame, R. and Olenin, S. (ed-s). The Comparative Roles of Suspension-Feeders in Ecosystems. NATO Science Series. Earth and Environmental Series 47: 221-237

Olenina I. and Olenin S. 2009. *Alexandrium catenella* (Whedon & Kofoid) Balech (Goniodomataceae, Pyrrophycophyta). In: DAISIE. Handbook of Alien Species in Europe. Invading Nature - Springer Series In Invasion Ecology. V. 3, Springer: 270.

Ovčarenko I., Audzijonytė A., Gasiūnaitė Z. R., 2006. Tolerance of *Paramysis lacustris* and Limnomysis benedeni (Crustacea, Mysida) to sudden salinity changes: implications for ballast water treatment. Oceanologia, 48 (S): 231-242.

Ovcharenko I., Olenin S., and Gollasch S. 2009. *Ensis americanus* (Gould), American Jack knife clam (Solenidae, Mollusca). In: DAISIE. Handbook of Alien Species in Europe. Invading Nature - Springer Series In Invasion Ecology. V. 3, Springer: 281

Paavola, M., Olenin, S., Leppäkoski, E., 2005. Are invasive species most successful in habitats of low native species richness across European brackish water seas? Estuarine, Coastal and Shelf Science 64: 738-750

Padilla DK, Karatayev A, Burlakova L, Olenin S, Boltovskoy D, Minchin D (2006) Predicting the characteristics of aquatic invertebrate invaders. ANSRP Technical Notes Collection (ERDC TN-ANSRP-05-6), U.S. Army Engineer Research and Development Center, Vicksburg, MS.

Pilecka-Rapasz M., Kesminas V. 2006. Investigations of the nematode Anguillicola crassus (Nematoda, Dracunculoidea) in Lake Dringis, Lithuania. Ekologija, 65-69

Rakauskas V., Bacevičius E., Pūtys Ž., Ložys L., Arbačiauskas K. 2008. Expansion, feeding and parasites of the round goby, *Neogobius melanstomus* (Pallas, 1811), a recent invader in the curonian lagoon, Lithuania. Acta Zoologica Lituanica. Vol. 18 (3): 180-190

Rakauskas V., Ruginis T. and Arbačiauskas K., 2010. Expansion of the Spinycheek Crayfish, *Orconectes limosus* (Rafinesque 1817), in the Nemunas River Basin, Lithuania. Freshwater Crayfish 17:73–76.

Reise K., Olenin S., Thieltges DW. (2006). Are aliens threatening European aquatic coastal ecosystems?, Helgoland Marine Research, 60 (2): 106 - 112

Santagata, S., Z. R. Gasiūnaitė, E. Verling, J. R. Cordell, K. Eason, J. S. Cohen, K. Bacela, G. Quilez-Badia, T. H. Johengen, D. F. Reid, G. M. Ruiz. 2008. Effect of osmotic shock as a management strategy to reduce transfers of nonindigenous species among low-salinity ports by ships. Aquatic Invasions 3 (1): 61-76.

Savini D., Occhipinti–Ambrogi A., Marchini A., Tricarico E., Gherardi F., Olenin S., Gollasch S. 2010. The top 27 animal alien species introduced into Europe for aquaculture and related

activities. Journal of Applied Ichthyology, 26 (2), 1–7 doi: 10.1111/j.1439-0426.2010.01503.x. ISSN 0175–8659

Vilà M, Basnou C, Pysek P, Olenin S, 2009. How well do we understand the impacts of alien species on ecosystem services? A pan-European, cross-taxa assessment. Frontiers in Ecology and the Environment; doi:10.1890/080083

Zaiko A. and Olenin S. 2009. *Dreissena polymorpha* (Pallas), zebra mussel (Dreissenidae, Mollusca). In: DAISIE. Handbook of Alien Species in Europe. Invading Nature - Springer Series In Invasion Ecology. V. 3, Springer: 310.

Zaiko A., Paškauskas R., Krevš A. 2010. Biogeochemical alteration of the benthic environment by the zebra mussel *Dreissena polymorpha* (Pallas) Oceanologia, 52(4), 649-667

5.11 The Netherlands

Prepared by Jeroen W.M. Wijsman, IMARES, The Netherlands.

1. Policy and management measures

1) The licence granted under the national law implementing the EU Habitat and Bird Directives to import mussels from Ireland and UK into the Oosterschelde was legally challenged successfully, because the court of justice argued that it could not be garantueed that the introduction of alien species was prevented. The monitoring protocol for invasive alien species, developed by Gittenberger (2010) was subsequently extended and a new licence has been issued.
2) Import of mussels from Denmark into the Oosterschelde was permitted under licence.
3) An experimental import of mussel seed from Norway into the Wadden Sea was permitted under licence.
4) The number of permits for fishing razor clams (*Ensis directus*) have been doubled. This is prompted by the current large biomass of *Ensis* in the Dutch coastal zone.

2. Intentional introductions

There are currently no intentional introductions of alien marine species into Dutch coastal waters. This is partly due to the limited use of the sea area for aquaculture. Fish aquaculture, which is carried out in cages in the open sea is not applied in the Netherlands. Limited fish aquaculture is practiced in closed RAS systems on land. Shellfish aquaculture with new species only take place in closed systems on land.

For the implementation of the COUNCIL REGULATION (EC) No 708/2007 concerning the use of alien and locally absent species in aquaculture, a national regulation which includes"A decision flowchart" has been developed to evaluate requests for new introductions. Part of this evaluation procedure is a risk assessment and the development of risk mitigating measures to reduce the probability of introducing invasive alien species. This procedure is in accordance with the ICES Code of Practice on the Introductions and Transfers of Marine Organisms 2005.

3. Unintentional introductions

New Sightings

Gerlidium vagum (Oosterschelde, near oyster ponds), Herre Stegenga (Anecdotical information at received at the WGITMO meeting 2011)

Celtodoryx ciocalyptoides Oosterschelde (http://www.duikeninbeeld.tv/duiken/artikel/gele-wratspons-nieuw-in-nederland/)

Previous Sightings

The lists of Wolff (2005) on exoticspecies in the Dutch coastal waters has been recently updated. The reason for the update is the import of shellfish (mussels and oysters) from Ireland and the UK, but also from Denmark, Sweden and Norway into the Netherlands. The shellfish culture areas in the Netherlands are all situated in Natura 2000 areas and protected under EU law (Habitat and Bird Directives). It is recognized that invasive alien species can have a significant negative impact on the conservation objectives of a Natura 2000. Therefore, import and relay of shellfish into Natura 2000 areas for which there is a probability of introducing invasive alien species can only occur under licence. For the Southwestern part of the Oosterschelde, overview of alien species is presented by (Gittenberger 2009, Wijnhoven & Hummel 2009, Wijsman & De Mesel 2009). For the Wadden Sea overviews are presented by (Wijsman & De Mesel 2009, Gittenberger *et al.* 2010).

The Pacific oyster is already for several years a dominant species in the Oosterschelde and Wadden Sea. A new inventory on the distribution in the Oosterschelde has been carried out in 2011. In the Wadden Sea the expansion of *Ensis directus* continued. At present it is the most dominant species in the Dutch coastal zone.

(Potential) problem species in the coastal waters of the Netherlands are *Gracilaria vermiculophylla, Undaria pinnatifida, Mnemiopsis leidyi, Didemnum vexillum* (Gittenberger 2010), *Botrylloides violaceus, Crassostrea gigas, Ensis directus, Ruditapes philippinarum, Urosalpinx cinerea, Ocinebrellus inornatus, Hemigrapsus sanguineus, Hemigrapsus takanoi, Eriocheir sinensis, Mytilicola intestinalis.*

Mnemiopsis leidyi has been recorded (in relatively high densities) in many coastal water bodies (Gittenberger 2008(De Mesel 2007, Gittenberger 2008)). In the saltwater lake Grevelingen, layman reports have been made on sea bather's eruption in the summer of 2010. A survey was carried out but *Edwardsiella lineata* was not detected.

In 2010, juvenile *Homarus americanus* were recorded in the Kanaal door Zuid Beveland, connecting the Oosterschelde and the Westerschelde (Herebout perscomm.).

The presence of oyster drills *Urosalpinx cinerea* and *Ocinebrellus inornatus* at several locations in the Oosterschelde have been reported. They are present in the Oyster ponds and near Gorishoek (Faasse & Ligthart 2007, 2009). There is concern about the expansion of the species which might impact the mussel and oyster culture. The presence of the oyster drills are a risk for the transport of mussels from the Oosterschelde to the Wadden Sea. A risk assessment based on the FAO guidelines and the EISIA guidelines have been made for *Urosalpinx cinerea*, *Ocinebrellus inoratus* and *Rapana venosa* (Fey *et al.* 2010). Eradication trials have been applied by mussel farmers in Summer 2010 in the Oosterschelde. Oyster drills were collected and removed from the system.

4. Pathogens

A survey of the presence of the oyster herpes virus (OsHV-1) µvar was carried out in the Oosterschelde in the summer of 2010 as part of an European surveillance study. The oyster herpes virus was detected in Pacific oysters in the Oosterschelde. This was the first occurrence of this species in the Netherlands. However, no impact in terms of mass mortality was observed.

Surveillance on shellfish diseases and pathogens (*Bonamia Ostrea*, *Marteilia refringens*, etc) was continued.

5. Meetings

Trilateral Conference on Neobiota in the Wadden Sea - Challenges for Nature Conservation was held 26 August 2010 in Germany (Wilhelmshaven). Presentations were given on the Dutch situation by Hein Sas, Arjan Gittenberger and Jeroen Wijsman. (http://www.waddensea-secretariat.org/news/symposia/WaddenSeaDay2010/WaddenSeaDay2010.html).

A meeting with the shellfish producing sector was held in Yerseke on 28 January 2011 on the possibilities and risks of transporting mussels from the Oosterschelde into the Wadden Sea (http://www.imares.wur.nl/NL/onderzoek/aquacultuur/Produs/studiedagen-mosselsector/)

6. References and bibliography

De Mesel I. (2007) Profielschets *Mnemiopsis leidyi*, Wageningen IMARES, Yerseke

Faasse M.A., Ligthart M. (2007) The American oyster drill, *Urosalpinx cinerea* (Say, 1822), introduced to The Netherlands - Increased risks after ban on TBT? Aquatic Invasions 2:402-406

Faasse M.A., Ligthart M. (2009) American (*Urosalpinx cinerea*) and Japanese oyster drill (*Ocinebrellus inornatus*) (Gastropoda: Muricidae) flourish near shellfish culture plots in The Netherlands. Aquatic Invasions 4:321-326

Fey F.E., Van Den Brink A.M., Wijsman J.W.M., Bos O.G. (2010) Risk assessment on the possible introduction of three predatory snails (*Ocinebrellus inornatus, Urosalpinx cinerea, Rapana venosa*) in the Dutch Wadden Sea. Report No. C032/10, Wageningen IMARES

Gittenberger A. (2009) Exoten in de Oosterschelde. Report No. 2009.08, GiMaRIS

Gittenberger A. (2010) Schelpdier import monitoring protocol. Report No. GIMARIS report 2010.10, GIMARIS

Gittenberger A., Rensing M., Stegenga H., Hoeksema B.W. (2010) Native and non-native species of hard substrata in the Dutch Wadden Sea. Nederlandse Faunistische Mededelingen 33:21-76

Wijnhoven S., Hummel H. (2009) Historische analyse exoten in de Zeeuwse delta. De opkomst, verspreiding, ontwikkeling en impact van exoten onder de macrofauna van het zachte substraat in de Zeeuwse brakke en zoute wateren. Report No. Monitor Taskforce Publication Series 2009 – 11, NIOO-CEME

Wijsman J.W.M., De Mesel I. (2009) Duurzame Schelpdiertransporten. Report No. C067/09, Wageningen IMARES, Yerseke

5.12 Norway

Prepared by Anders Jelmert, Institute of Marine Research, Norway.

Laws and regulations

"Naturmangfoldloven" (The law for Natural Diversity) was passed in 2009, but quite a number of by-laws are being developed in 2011 after a second round of hearings.

Management tools

- A proposal of an extension of the northern delimitation of the area for quota regulated fisheries on red king crab. The proposal has been contested.
- The first in a planned series of Regional Action Plans (including NAS) has been finalized. The plans are operative at the county-level (Oslo and Akershus)
- A report on "Mapping and Surveillance of Alien species in Norway " was finalized (Johansen *et al*. 2010) http://www.niva.no/symfoni/RappArkiv7.nsf/URL/6E46523D3A95AE1EC12577EE00334AC1/$FILE/5969-2010_200dpi.pdf
- Plans are being developed for a study of the ecological, genetically and fish health effects of the wrasse fishery and translocation practices (Biological control of salmon lice)
- A report on import of freshwater aquarium organisms has been finalized. A report of import of marine aquarium species , bioassay organisms and live feed production will be finalized soon.
- Reccomendation for a ban on live import of Am. Lobster. Confirmed observation of hybrid eggs, risk for transfer of diseases (Epizootic Shell disease and gaffkemia).

Research

- A pilot RAI study (marina pontoons) was conducted at the Western coast of Norway in 2010. No new NAS were detected, but new observations of the ascidian *Styela clava*. http://www.imr.no/nyhetsarkiv/2010/desember/leter_etter_introduserte_arter/nb-no
- Report on the effects on red king crab effects on soft-bottom biota: (Oug *et al*, 2010) http://www.dirnat.no/multimedia/47416/6037_NIVArap_effekter_kongekrabben_200dpi.pdf&contentdisposition=attachment

New observations:

- 4 specimen of confirmed Am lobster was found. One specimen with conspicuous signs of shell disease (suspected Epizootic shell disease). One berried female. The eggs (hached eggs?) were analyzed and had the hybrid genetic makeup of H.americanus female and H.homarus male.(Contact A.-L. Agnalt, IMR)

Status for established species

- The red king crab has extended its range southward. Sporadic confirmed findings of single specimen (probably deliberately translocated) as far south as Kristiansund (63 11.744, E07 41.261). Other fisheries do fairly often get specimen in the net catches in the "Lopphavet" area. (N 70 19.506, E 21 2.998, Jan Sundet IMR, Pers. Comm.)
- The Pacific oyster (*Crassostrea gigas*) has suffered substantial set-back on studied localities (Harsh winter-conditions) in SE Norway.
- The ascidian *Styela clava* now found in "Bømlo" municipality (N59 44.485 E5 14.012) (Contact V. Husa, A-L. Aganalt, IMR)

http://www.imr.no/nyhetsarkiv/2010/desember/leter_etter_introduserte_arter/nb-no

Databases

- The Norwegian alien species list (2007) is under revision. Will be finalized in 2011. A new protocol for risk evaluation has been developed (using a two dimensional set of criteria based on peer rev. documented observations) I) ecological impact, II) capacity for spread . ("risk matrix") The revised list will include "door-knockers", but not:
  - Cultureed /breed varieties (e.g. salmon)
  - "Norw." species translocated within Norway
  - Live food import e.g. (Am. lobster)
  - Aquarium and ecotox-testing organisms
  - Live feed production (for marine fish)

5.13 Poland

Prepared by Aldona Dobrzycka-Krahel and Anna Szaniawska, Department of Experimental Ecology of Marine Organisms, Institute of Oceanography, University of Gdańsk, Poland

1. Regulations

Nothing new recorded, still in force : CBD Convention (05 June 1992), Act on Fishery (19 February 2004) and Nature Conservation Act (16 April 2004).

2. Intentional intorductions

Synthesis of introductions:

Deliberate releases of salmon (*Salmo salar*), sea trout (*Salmo trutta morpha trutta*) and whitefish (*Coregonus lavaretus*) were consistent in 2010. Additionally releases of vimba (*Vimba vimba*) and reintroduction of *Acipenser* were in 2010 (unpublish data of Department of Migratory Fish, Inland Fisheries Institute, Poland).

3. Unintentional intorductions

Invertebrates

- *Cercopagis pengoi* was recorded in more saline waters along the Polish Baltic coast in stable and relatively abundant populations, in the samples being taken from the eastern (Krynica Morska profile – K1-K4, Świbno profile – Sw2-Sw4) and western (Mechelinki profile – M2, Sopot profile – So1-So4 and J23) parts of the Gulf of Gdańsk (Bielecka & Mudrak 2010). In previous studies the species has been recorded only at irregular intervals and only at single sites, but there is not much information regarding its presence in the more saline waters along the Polish Baltic coast (Olszewska & Bielecka 2004, Bielecka *et al*. 2005, Olszewska 2006).
- *Mytilopsis leucophaeta* a dreissenid bivalve was for the first time recorded in the Gulf of Gdańsk (southern Baltic Sea) (Dziubińska A. submitted).
- *Hypania invalida* – a polychaete species – was for the first time recorded in the Szczecin Lagoon in 2010 (Woźniczka *et al*. in press).
- Ponto-Caspian gammarid species: *Pontogammarus robustoides*, *Obesogammarus crassus*, *Dikerogammarus haemobaphes* and *Dikerogammarus villosus* were re-

corded for the first time in waters of the Gulf of Gdańsk. The animals were recorded in the shallow littoral zone.

P. robustoides, *O. crassus* and *D. haemobaphes* were found at the Świbno (near the mouth of the River Vistula) N 54° 21.598′ E 18° 56.636′, at the Górki Wschodnie N 54° 22.009′ E 18° 47.468′ and at the Sobieszewo sampling stations N 54° 21.110′ E 18° 51.222′. Additionally *D. villosus* was found at the Sobieszewo sampling station N 54° 21.110′ E 18° 51.222′ (Dobrzycka-Krahel & Rzemykowska 2010). *D. villosus* is the latest colonizer, being first recorded in the River Odra in 1999 (Gruszka 1999) and subsequently in the Szczecin Lagoon in 2002 (Gruszka & Woźniczka 2008). The penetration of the species into the Odra basin was possible via the so-called southern corridor, i.e. the river Danube (Bij de Vaate *et al*. 2002).

The discovery in 2003 of this species in the River Bug (Konopacka 2004) showed that this species also migrates to Poland along the central migration corridor, that is, via the Pripet-Bug connection. Later, the species was recorded in the River Vistula – near Wyszogród in 2007 (Bącela *et al*. 2008). The floods that afflicted Poland in May and June 2010 could have had accelerated the arrival of individuals into the Gulf of Gdańsk in 2010 (Dobrzycka-Krahel & Rzemykowska 2010). To date it has not been recorded in the Vistula Delta or the Vistula Lagoon.

Fish

Conger conger was for the first time recorded in October 2010 in the Szczecin Lagoon at Lubiń (Woźniczka 2010).

Mola mola (syn. *Mola rotunda* Cuvier, 1798; *Tetraodon mola* Linnaeus, 1758; *Diodon mola* Pallas, 1770; *Pedalion gigas* Guilding, 1838) was found in October 2010 at Łeba in the Baltic Sea (Grygiel 2010). Previous sightings of this species were noted in October 2000 in Rynna Słupska and in November 2005 at Pogorzelica, along Polish Baltic coast.
Mullus surmuletus - striped red mullet (or surmullet) was for the first time recorded in the Pomeranian Bay (in 2007) and the occurrence of three very rare noted species (tub or yellow gurnard *Chelidonichthys lucerna*, Atlantic horse mackerel *Trachurus trachurus*, thicklip grey mullet *Chelon labrosus*) collected in years 2007-2008 in the Pomeranian Bay and Lake Dąbie were recorded (Więcaszek *et al*. in press).

Neogobius melanostomus, the round goby, is abundant also in the River Odra estuary (Czugała A. and Woźniczka A. 2010). Single round goby specimens have been first recorded in the Odra estuary in 1996 (Anonymous, http://www.hel.univ.gda.pl), albeit it was not well documented sighting. Until this time, knowledge on the presence of *N. melanostomus* in the Polish part of the Odra estuary was limited to undocumented, sparse sighting of specimens caught mainly by anglers. The first round gobies, identified as *N. melanostomus*, were retrieved from the Sea Fisheries Institute's catches in July and August 2009.

The round goby invasion in the Baltic is thought to have begun in the Gulf of Gdańsk; the first specimens were spotted there in 1990 (Skóra and Stolarski 1993). In 1994, the species was present throughout the entire Polish part of the Gulf of Gdańsk (Kuczyński 1995, Sapota & Skóra 2005). At present, the species occurs in the Gulf of Gdańsk, particularly in Puck Bay (Sapota 2005,

Sapota & Skóra 2005, Wandzel 2003). The round goby specimens have been recorded for the first time in the Vistula Lagoon in 1999 (Borowski 1999).

4. Pathogens

None

5. Meetings

None

6. References and bibliography

Bącela K., Grabowski M., Konopacka A. 2008, *Dikerogammarus villosus* (Sowinsky, 1894) (Crustacea, Amphipoda) enters Vistula – the biggest river in the Baltic basin, Aquat. Invas., 3 (1), 95-98.

Bielecka L., Krajewska-Sołtys A., Szymanek L., Szymelfenig M., 2005, Mesosooplankton In the Hel upwelling region (the Balic Sea), Oceanol. Hydrobiol. Stud., 34 (Suppl. 2), 137-161.

Bielecka L., Mudrak S. 2010, New data on the non-indigenous cladoceran Cercopagis pengoi (Ostroumov 1891) in the Gulf of Gdańsk (Baltic Sea), Oceanologia 52(1), 147-151.

Bij de Vaate A., Jażdżewski K., Ketelaars H. A. M., Gollash S., Van der Velde G. 2002, Geographical patterns in range extension of Ponto-Caspian macroinvertebrate species in Europe, Can. J. Aquat. Sci., 59 (7), 1159-1174.

Borowski W. 1999, Babka bycza w Zalewie Wiślanym. [Round goby from Vistula Lagoon]. Magazyn Przemysłu Rybnego 4(12): 39.

Czugała A., Woźniczka A. 2010, The River Odra estuary – another Baltic Sea area colonized by the round goby *Neogobius melanostomus* Pallas, 1811. Aquatic Invasions Vol. 5, Suppl. : S61-S65.

Dziubińska A., submitted, *Mytilopsis leucophaeta*, a dreissenid bivalve discovered in the Gulf of Gdańsk (southern Baltic Sea). Oceanologia.

Dobrzycka-Krahel A., Rzemykowska H. 2010, First records of Ponto-Caspian gammarids in the Gulf of Gdańsk (southern Baltic Sea). Oceanologia 52 (4), 727-735.

Gruszka P. 1999, The River Odra estuary as a gateway for alien species immigration to the Baltic Sea basi, Acta Hydroch. Hydrob., 27 (5), 374-382.

Gruszka P., Woźniczka A. 2008, *Dikerogammarus villosus* (Sowinsky, 1894) in the River Odra estuary – another invader threating Baltic Sea coastal lagoons, Aquatic Invasions 3 (4), 395-403.

Grygiel W. 2010, Samogłów, nowy przykład bioróżnorodności ichtiofauny Bałtyku. Wiadomości Rybackie 11-12(178), 22-25.

Konopacka A. 2004, Inwazyjne skorupiaki obunogie (Crustacea, Amphipoda) w wodach Polski, Prz. Zool., 48 (3-4), 141-162.

Kuczyński J. 1995, Babka krągła *Neogobius malanostomus* (Pallas 1811) – emigrant z basenu pontokaspijskiego w Zatoce Gdańskiej. [Round Goby *Neogobius malanostomus* (Pallas 1811) – an imigrant from the Ponto-Caspian basin into the Gulf of Gdańsk], Biuletyn Morskiego Instytutu Rybackiego 2(135): 68 – 71.

Olszewska A., Bielecka L. 2004, Predatory waterflea *Cercopagis pengoi* in the Polish zone of the Southern Baltic, Int. Conf. 'Baltic Sea – the Sea of Aliens', Gdynia, 25-27 August 2004, Abstracts, 42-43.

Olszewska A. 2006, New records of *Cercopagis pengoi* (Ostroumov 1891) in the southern Baltic, Oceanologia 48 (2), 319-321.

Sapota M. R. 2005, Biologia i ekologia babki byczej *Neogobius melanostomus* (Pallas 1811), gatunku inwazyjnego w Zatoce Gdańskiej. Biology and ecology of round goby *Neogobius*

melanostomus (Pallas 1811), invasive species in the Gulf of Gdańsk]. Wydawnictwo Uniwersytetu Gdańskiego 117 pp.

Sapota K. R., Skóra K.E. 2005, Spreading of alien (non-indigenous) fish species Neogobius malnostomus In the Gulf of Gdańsk (South Baltic). Biological Invasions 7: 157-164.

Skóra A.E., Stolarski J. 1993, New fish species in the Gulf of Gdańsk, *Neogobius sp.* [cf. *Neogobius melanostomus* (Pallas 1811)]. Bulletin of the Sea Fisheries Institute 1 (128): 83-84.

Wandzel T. 2003, Babka okrągła *Neogobius melanostomus* (Pallas, 1811) – nowy component ichtiocenozy południowego Bałtyku. Rola w ekosystemie I rybołówstwie.[The round goby *Neogobius melanostomus* (Pallas, 1811) - a new komponent of the southern Balic ichthyocenosis. Its roles in the ecosystem and fisheries]. Gdynia MIR: 76.

Więcaszek B., Sobecka E., Dudko S., Keszka S. in press, Records of new and visiting fish species with description of their parasite fauna in the Pomeranian Bay and Lake Dąbie in years 2007-2008. Oceanologia

Woźniczka A. 2010, Konger spod lubińskiego klifu. Wiadomości Rybackie Nr 11-12(178), 30.

Woźniczka A., Gromisz S., Wolnomiejski N. in press, *Hypania inwalida*, a polychaete species new for the southern Baltic estuarine area: the Szczecin Lagoon and the River Odra mouth. Aquatic Invasions.

5.14 Portugal

Compiled by Paula Chainho, Centro de Oceanografia, Faculdade de Ciências da Universidade de Lisboa, Portugal.

1. Regulations: An update on new regulations and policies (including, aquaculture and vector management)

Decree-law nr. 565/99, 21th December 1999, defines the legal restrictions to the introduction of exotic species (marine species are not listed). It is currently under revision and the revised document includes reference to ballast water (IMO and ICES guidelines are applied) and a list of marine species. In addition to the Decree-law nr. 565/99, there are regional resolutions applied in the Azores archipelago (regional Decree-law nr. 148/98, 25 June 1998) to restrict the spread of exotic species and in Madeira archipelago (regional Decree-law nr. 27/99/M) to restrict the transportation and position of non-indigenous species.

The Decree-law nr. 235/2000 on marine pollution considers introduction of organisms that may affect the environment within the concept of marine pollution. Portugal has signed the OSPAR convention and the International Convention for the Control and Management of Ships Ballast Water & Sediments.

2. Intentional introductions

Information available for introductions in Portuguese estuarine and coastal waters is insufficient to separate between intentional and unintentional introductions.

3. Unintentional introductions

A list of 72 aquatic non-indigenous species (NIS) is registered for the Portuguese estuarine and coastal aquatic systems (Table 1), including 4 microalgae, 22 macroalgae and 46 invertebrate species. The inventory of NIS did not include fish species and freshwater species.

Table 1. List of NIS registered in Portuguese waters

Taxa	Year of first record	Location of first record	Possible introduction vector	Invasion Status	References
Gymnodinium catenatum Graham	1981	Mainland Portugal (SW coast)	Ballast water	Established (recurrent HABs)	Estrada, 1995
Gymnodinium microreticulatum Bolsch, Negri & Hallegraeff	1999	Mainland Portugal	Ballast water	Established	Amorim *et al*. 2001
Ostreopsis cf. *siamensis* Schmidt	2008	Mainland Portugal (Sines)	Unknown	Unknown	Amorim *et al*., 2010
Pseudo-nitzschia multistriata (Takano) Takano	2003	Mainland Portugal (Aveiro)	Unknown	Established	Churro *et al*. 2009
Anotrichium furcellatum (J. Agardh) Baldock	1970	Mainland Portugal	Ballast water; Fouling	Established	Ardré, 1970
Antithamnion densum (Surh) M.A. Howe	2009	Mainland Portugal (N coast)	Unknown	Unknown	Araújo *et al*., 2009
Antithamnion diminuatum Wollaston	1989	Azores	Unknown	Established	Athanasiadis & Tittley, 1994
Antithamnion pectinatum (Montagne) J.Brauner	1989	Azores	Unknown	Established	Athanasiadis & Tittley, 1994
Antithamnionella spirographidis (Schiffner) E.M. Wollaston	1974	Madeira	Ballast water; Fouling	Established	Levring, 1974
Antithamnionela ternifolia (J.D. Hooker & Harvey) Lyle	1970	Mainland Portugal (S coast)	Ballast water; Fouling; Aquaculture	Established	Ardré, 1970
Asparagopsis armata Harvey (+ estadio *Falkenbergia rufolanosa*)	1928	Azores	Ballast water; Fouling; Aquaculture	Established	Schmidt, 1931
Asparagopsis taxiformis (Delile) Trevisan de Saint-Léon	1928	Azores	Ballast water; Fouling; Aquaculture	Established	Schmidt, 1931
Bonnemaisonia hamifera Hariot	1989	Azores (Faial, Graciosa and Flores)	Fouling	Established	Athanasiadis & Tittley, 1994
Dasya sessilis Yamada	2009	Mainland Portugal (N coast)	Aquaculture	Established	Araújo *et al*., 2009
Gracilaria vermiculophylla (Ohmi) Papenfuss	2005	Mainland Portugal (S coast)	Aquaculture	Established	Rueness, 2005
Grateloupia turuturu Yamada	2009	Mainland Portugal (N coast)	Unknown	Established	Araújo *et al*., 2009

Neosiphonia harveyi (J. Bailey) M.-S. Kim, H.-G. Choi, Guiry & G.W. Saunders	2009	Mainland Portugal (N coast)	Ballast water; Fouling; Aquaculture	Established	Araújo *et al.*, 2009
Scageliopsis patens Wollaston	1989	Azores (Faial and São Miguel)	Fouling	Established	Athanasiadis & Tittley,1994
Symphyocladia marchantioides (Harvey) Falkenberg	1971	Azores (Santa Maria, Sâo Miguel and Graciosa)	Fouling	Established	Ardré *et al.*, 1974
Caulerpa webbiana Montagne	2002	Azores (Faial)	Ballast water, Fouling	Established	Cardigos *et al.*, 2006
Cladophoropsis membranacea (Hofman Bang ex C.Agardh) Børgesen	1973	Azores	Unknown	Established	Cardigos *et al.*, 2006
Codium fragile spp. *fragile* (Suringar) Hariot	1993	Azores (São Miguel and Corvo)	Ballast water; Fouling; Aquaculture	Established	Neto, 1994
Colpomenia peregrina Sauvageau	1951	Portuguese coast	Ballast water; Fouling; Aquaculture	Established	Palminha, 1951
Endarachne binghamiae J. Agardh	1995?	Azores (Faial, Pico, São Miguel and Terceira)	Fouling	Established	Tittley & Neto, 1995
Sargassum muticum (Yendo) Fensholt	1994	Mainland Portugal (N coast)	Ballast water; Fouling; Aquaculture	Established	Rull Lluch *et al.*, 1994
Undaria pinnatifida (Harvey) Suringar	2009	Mainland Portugal (N coast)	Ballast water; Fouling; Aquaculture	Established	Araújo *et al.*, 2009
Blackfordia virginica Mayer, 1910	1984	Mainland Portugal (Mira estuary)	Ballast water;, Fouling	Established	Moore, 1987
Gonionemus vertens A. Agassiz, 1862	<1700	Mainland Portugal	Ballast water; Fouling; Aquaculture	Established	Edwards, 1976
Tubularia crocea (Agassiz, 1862)	1989	Azores (Faial)	Fouling	Unknown	Cornelius, 1992
Tubularia indivisa Linnaeus, 1758	1989	Azores (Faial)	Fouling	Unknown	Cornelius, 1992
Branchiura sowerbyi Beddard, 1892	2009	Azores (S. Miguel)	Unknown	Unknown	Raposeiro *et al.*, 2009
Ficopomatus enigmaticus (Fauvel, 1923)	1979	Mainland Portugal (Santo André lagoon)	Ballast water;, Fouling	Established	Cancela da Fonseca *et al.*, 1989
Hydroides elegans (Haswell, 1883)	2000	Azores	Fouling	Unknown	Morton & Briton, 2000
Spirorbis marioni (Caullery & Mesnil, 1897)	1979	Azores (S. Miguel and Faial)	Fouling	Unknown	Zibrowius & Bianchi, 1981

Tricellaria inopinata Ambrogi, 1985	2004	Mainland Portugal Ria de Aveiro	Fouling	Established	Marchini *et al.*, 2007
Zoobotryon verticillatum Della Chiaje, 1828	2009	Azores (S. Miguel, Faial and Pico)	Fouling	Established	Amat & Tempera, 2009
Corbicula fluminea (O. F. Müller, 1774)	1978	Mainland Portugal (Tagus estuary)	Ballast water	Established	C. Reis (com. pess.)
Crassostrea gigas (Thunberg, 1793)	1960	Mainland Portugal (Ria de Aveiro)	Fouling; Aquaculture	Established	Ruano & Sobral, 2000
Hexaplex trunculus (Linnaeus, 1758)	1919	Azores (S. Miguel and Faial)	Ballast water	Established	Nobre, 1930
Mercenaria mercenaria (Linnaeus, 1758)	2010	Mainland Portugal (Sado estuary)	Ballast water	Not established	Miguel Gaspar (com. pess.)
Mya arenaria Linnaeus, 1758	1982	Mainland Portugal (Ria Formosa)	Ballast water	Established	C. Reis (com. pess.)
Mytilus sp. Linnaeus, 1758	1998	S. Miguel (Azores)	Fouling	Not established	Ávila *et al*., 1998
Pinctada radiata (Leach, 1814)	1998	Azores (S. Miguel and Faial)	Fouling	Unknown	Ávila *et al*., 1998
Potamopyrgus antipodarum J. E. Gray, 1843	1978	Mainland Portugal (Santo André lagoon)	Ballast water;, Fouling	Established	Cancela da Fonseca, 1991
Ruditapes philippinarum Adams & Reeve, 1850	<1990	Mainland Portugal (Ria Formosa)	Aquaculture	Not established	Gaspar, 2010
Truncatella subcylindrica (Linnaeus, 1758)	1960	Azores (Terceira and Graciosa)	Unknown	Unknown	Frias Martins (com. pess.)
Acartia tonsa Dana, 1849	<1985	Mainland Portugal (Tagus estuary)	Ballast water	Established	Sobral, 1985
Ampelisca heterodactyla Schellenberg, 1925	<1986	Mainland Portugal (W coast)	Unknown	Unknown	Marques & Bellan-Santini, 1991
Artemia franciscana	1997	Mainland Portugal (Tagus coastal area)	Unknown	Unknown	Gaudêncio & Guerra, (com. pess.)
Austrominius modestus Darwin, 1854	1956	Mainland Portugal	Ballast water Ballast water; Fouling	Established	Fischer-Piette & Prenant, 1957
Balanus amphitrite Darwin, 1854	1854	Mainland Portugal (Algarve coast)	Ballast water; Fouling; Aquaculture	Unknown	Cancela da Fonseca *et al*, 2007

Balanus eburneus Gould, 1841	1998	Azores (Faial)	Fouling	Unknown	Southward, 1998
Balanus improvisus Darwin, 1854		Mainland Portugal (Tagus estuary)	Fouling	Unknown	Calvário, 1982
Balanus trigonus Darwin, 1854	1887	Azores (S. Miguel, Faial, Graciosa, Terceira, S. Jorge and Santa Maria)	Ballast water;, Fouling	Established	Gruvel, 1920
Callinectes sapidus Rathbun, 1896	1978	Mainland Portugal (Tagus estuary)	Ballast water	Not established	Gaudêncio & Guerra, 1979
Diamysis lagunaris Ariani & Wittmann, 2000	1995	Mainland Portugal (Ria de Aveiro)	Ballast water	Established	Cunha *et al.*, 1999
Eriocheir sinensis H. M. Edwards, 1853	1988	Mainland Portugal (Minho estuay)	Ballast water	Established	Cigoña *et al.*, 1996
Jasus lalandii (H. M. Edwards, 1937)	1980	Mainland Portugal (Cascais)	Ballast water	Unknown	Guerra & Gaudêncio, 1982
Limnoria quadripunctata Holthuis, 1949	1995	Mainland Portugal (N coast)	Fouling	Not established	Nolting, 1995
Marsupenaeus japonicus (Bate, 1888)	1989	Mainland Portugal (Sado estary)	Aquaculture	Unknown	Dinah Sobral (com. pess.)
Palaemon macrodactylus Rathbun, 1902	2008	Mainland Portugal (Guadiana estuary)	Ballast water	Unknown	Chícharo *et al.*, 2009
Percnon gibbesi (H. Milne Edwards, 1853)	<1931	Mainland Portugal (Mira estuary)	Ballast water	Unknown	Nobre, 1931
Rhithropanopeus harrisii (Gould, 1841)	1991	Mainland Portugal (Mondego estuary))	Ballast water	Established	Gonçalves *et al*, 1995
Botrylloides violaceus Oka, 1927	2009	Mainland Portugal (Nazaré)	Fouling; Aquaculture	Unknown	Nagar *et al.*, 2010
Botryllus schlosseri (Pallas, 1766)	1970	Mainland Portugal (Arrábida)	Unknown	Established	Saldanha,1974
Clavelina lepadiformis (O.F. Müller, 1776)	1971	Azores	Ballast water; Fouling	Established	Monniot, 1974
Clavelina oblonga Herdman, 1880	1971	Azores (Pico and Faia)	Ballast water	Unknown	Monniot, 1974
Corella eumyota	2008	Mainland Portugal	Fouling; Aquaculture	Established	Nagar *et al.*, 2010

Traustedt, 1882		(Póvoa do Varzim)			
Distaplia corolla Monniot, 1975	1971	Azores	Ballast water	Established	Monniot, 1974
Microcosmus squamiger Michaelsen, 1927	2009	Azores (Faial)	Ballast water; Fouling	Unknown	Marc Rius (com. pess.)
Styela clava (Herdman, 1882)	2003	Mainland Portugal (Leixões, Cascais and Tagus estuary)	Fouling	Unknown	Davis & Davis, 2005
Styela cf. *plicata* (Lesueur, 1823)	2009	Mainland Portugal (Nazaré, Peniche and Albufeira)	Ballast water; Fouling	Unknown	Nagar *et al.*, 2010

5. Meetings and projects

Meetings

Torres, P., S. Ávila, P. Chainho, A. Costa, M.J. Costa, Marine alien species of the Azores, Second DIVERSITAS Open Science Conference: Biodiversity and Society: Understanding Connections, Adapting to Change, Cape Town, South Africa, October 2009.

Costa, M.J., A. Amorim, S. Ávila, J. Brum, J. Castro, N. Castro, A. Costa, L. Costa, T. Cruz, A. Fernandes, R. Melo, J. Monteiro, S. Ribeiro, J. Semedo, T. Silva, C. Soares, D. Sobral, M. Sousa, P. Torres, V. Veloso, P. Chainho, INSPECT Project. Introduced marine non-indigenous in Portuguese estuaries and coastal areas, World Conference on Biological Invasions and Ecosystem Functioning, Porto, Portugal, October 2009.

Chainho, P., A. Amorim, J. Castro, A. Costa, L. Costa, A. Fernandes, N. Castro, S. Gollasch, J. Semedo, M.J. Costa. Ballast water as a potential introduction pathway of non-indigenous aquatic species in Portugal coastal and estuarine areas, World Conference on Biological Invasions and Ecosystem Functioning, Porto, Portugal, October 2009.

Neves, J., L. Ferreira, M. Simões, M. Madeira & L. Gazarini. Comparison of biomass production and nutrient dynamics between the invasive *Spartina densiflora* Brong. and the native *Arthrocnemum macrostachyum* (Moric.) Moris, in Southern Portugal. World Conference on Biological Invasions and Ecosystem Functioning, Porto, Portugal, October 2009.

Araújo, R., J. Violante, R. Pereira, H. Abreu & I.S. Pinto. Colonization of disturbed patches in native communities by the introduced species *Grateloupia turuturu*. World Conference on Biological Invasions and Ecosystem Functioning, Porto, Portugal, October 2009.

Folhas, H., G. Franco, R. Melo, H. Cabral & E. Gonçalves. Characterization of an algal assemblage temporally dominated by an alien species (*Asparagopsis armata*) at the Arrábida Marine Park. World Conference on Biological Invasions and Ecosystem Functioning, Porto, Portugal, October 2009.

Sousa, R., F. Freitas, M. Ilarri, S. Costa-Dias, C. Antunes & L. Guilhermino. *Corbicula fluminea* as ecosystem engineer: Effects on macrozoobenthic assemblages. World Conference on Biological Invasions and Ecosystem Functioning, Porto, Portugal, October 2009.

Chícharo, M.A., T. Leitão, P. Range, C. Gutierrez, J. Morales, P. Morais & L. Chícharo. New alien species in a temperate estuary, *Blackfordia virginica* (Cnidaria) and Paleamon macrodactylus (Crustacea): Potential impacts and mitigation measures. World Conference on Biological Invasions and Ecosystem Functioning, Porto, Portugal, October 2009.

Hipólito, C., P. Torres, A. Costa, P. Chainho & M.J. Costa. Aspects of the biology of the invasive species *Zoobotryon verticillatum* (Della Chiaje, 1822) at São Miguel Island, Azores, XVI Simpósio Ibérico de Estudios de Biologia Marinha (SIEBM), Alicante, Espanha, September 2010.

Fernandes, A., P. Chainho, J.L. Costa, J. Castro, D. Sobral, M. Sousa & M.J. Costa. Introduction of exotic macroinvertebrate species in estuarine and coastal Portuguese waters, 12º Encontro Nacional de Ecologia, Porto, Portugal, October 2010.

Grazziotin-Soares, C., E. Berecibar, R. Melo, A. Fernandes, P. Chainho, J.L. Costa & M.J. Costa. Macroalgae communities of Sines and Oeiras marinas (Portugal): analysis of assemblages structure in different substrate and new occurrences of non-indigenous species, International Meeting on Marine Resources, Peniche, Portugal, November 2010.

Amorim, A., V. Veloso, C. Battochi & A. Penna. First detection of *Ostreopsis* cf. *siamensis* in Portuguese coastal waters. 14th International Conference on Harmful Algae, Crete, Greece, November 2010.

Amorim, A., V. Veloso, P. Chainho, J.L. Costa, A. Fernandes, A. Costa, P.M. Torres, J. Semedo & M.J. Costa. Dinoflagellate cysts as tracers of ballast water exchange risk in Portuguese ports. 14th International Conference on Harmful Algae, Crete, Greece, November 2010.

Ribeiro, S., A. Amorim, F. Abrantes, M. Ellegaard. Resolving the historical record of *Gymnodinium catenatum* and other microreticulate cysts in the NE Atlantic. 14th International Conference on Harmful Algae, Crete, Greece, November 2010.

Veloso, V. & A. Amorim. ALISU the culture collection at the University of Lisbon. 14th International Conference on Harmful Algae, Crete, Greece, November 2010.

Chainho, P., J.L. Costa J.P. Medeiros & M.J. Costa. The influence of exotic species in the assessment of ecological status based on estuarine benthic communities. VII Iberian Water Congress, Talavera de la Reina, Spain, February 2011.

Projects:

- INSPECT- Introduced marine alien species in Portuguese estuaries and coastal areas: patterns of distribution and abundance, vectors and invading potential (PTDC/MAR/73579/2006) (October 2008 - September 2011). Funded by National Foundation for Science and Technology. (website: http://projectos.lpn.pt/inspect). The principal contractor is the Centre of Oceanography, Faculty of Sciences of the University of Lisbon (CO/FCUL) and project partners are (i) Universities of Lisbon, Évora, and Azores; (ii) Institute for Nature Conservation and Biodiversity (ICNB); (iii) Institute for Ports and Maritime Transport (IPTM); (iv) Nature Conservation NGO

(LPN). The main objectives are:(1) to identify marine alien species and their invasive status; (2) investigate major vectors of introduction; (3) study the role of the Azores Islands as a donor area of marine alien species for mainland Portuguese estuaries and coastal areas; (4) evaluate if environmental conditions in Portuguese estuaries favor or inhibit invasions; (5) determine the importance of intraregional transport and other vectors compared to ballast water; (6) identify priority species and/or areas for control or mitigation purposes;(7) communicate scientific results to the general public to promote stakeholders commitment in prevention and remediation of adverse impacts of alien species. The major tasks of this project include (1) a comprehensive literature review on non-indigenous marine and estuarine species and on maritime traffic routes that include Portuguese harbors, (2) port surveys focused on phytoplankton and zooplankton, and on macroalgae and invertebrates from both mobile and hard substrates (3) building a guideline document to support managers and decision-makers on the allocation of resources to prevent and/or mitigate the impacts of invaders and (4) raising public awareness for the threats of alien species' introductions. It is the first national project focusing on the systematization of data on alien species and invasive pathways.

- NISTRACKS - Processes influencing the invasive behaviour of the non indigenous species Corbicula fluminea (Mollusca: Bivalvia) in estuaries – identification of genetic and environmental key factors (2010 – 2013). Funded by National Foundation for Science and Technology.

6. References and bibliography

Amat, J.N., & F. Tempera. 2009. *Zoobotryon verticillatum* Della Chiaje, 1822 (Bryozoa), a new occurrence in the archipelago of the Azores (North-Eastern Atlantic). Marine Pollution Bulletin, 58:761-764.

Amorim, A., B. Dale, R. Godinho & V. Brotas. 2001. *Gymnodinium catenatum*-like (Dinophyceae) cysts in recent sediments from the coast of Portugal. Phycologia, 40: 572-582.

Amorim A., V. Veloso & A. Penna. 2010. First detection of *Ostreopsis* cf. *siamensis* in Portuguese coastal waters. Harmful Algae News, 42: 6-7.

Araújo R., Bárbara I., Tibaldo M., Berecibar E., Tapia P.D., Pereira R., Santos R. & Souza Pinto I. 2009. Checklist of benthic marine algae and Cyanobacteria of northern Portugal. Botanica Marina, 52: 24-46.

Ardré, F. 1970. Contribution a L'étude des algues marines du Portugal. I La flore. Portug. Acta Biol. 556p.

Ardré F, Boudouresque C-F, Cabioch J. 1974. Présence remarquable du *Symphocladia marchantioides* (Harvey) Falkenberg (Rhodomélacés, Céramiales) aux Açores. Bull de Soc Phycologique de Fr, 19:178–182.

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

Ávila SP, Azevedo JMN, Gonçalves JM, Fontes J, Cardigos F. 1998. Checklist of the shallow-water marine molluscs of the Azores: 1—Pico, Faial, Flores and Corvo islands. Açoreana 8:487–523.

Calvário, J. 1982. Povoamentos Bentónicos Iniertidais (substratos móveis). Estudo Ambienta1 do Estuário do Tejo. CNAREJO no 19 - Rrl. 18. Lisboa.

Cancela da Fonseca, L. 1991. Caracterização das comunidade bentónicas da Lagoa de Santo André. IV Congresso sobre o Alentejo. Sines.

Cancela da Fonseca, L., Boaventura, D., Ré, P., Ferreira, P., Santos, M. N. 2007. Caracterização das Comunidades de Macroinvertebrados Bentónicos no Sistema Recifal do Alvor (Costa Sul do Algarve). 13º Congresso do Algarve. Lagos.

Cancela da Fonseca, L., Costa, A.M., Bernardo, M.J., 1989. Seasonal variation of benthic and fish communities in a shallow land-locked coastal lagoon (St. André, SW Portugal).Topics in Marine Biology. Ros, J.D. (Ed.). Scientia Marina, 53: 663 - 669.

Cardigos, F., F. Tempera, S. Ávila, J. Gonçalves, A. Colaço & R.S. Santos. 2006. Non-indigenous marine species of the Azores. Helgol Mar Res, 60: 160–169.

Chícharo, M.A., Leitão, T., Range, P., Gutierrez, C., Morales, J., Morais P., Chícharo, L. 2009. Alien species in the Guadiana estuary (SE‑Portugal/SW-Spain): *Blackfordia virginica* (Cnidaria, Hydrozoa) and *Palaemon macrodactylus* (Crustacea, Decapoda): potential impacts and mitigation measures. Aquatic Invasions 4: 501-506.

Churro, C. I., Carreira C. C., Rodrigues F. J., Craveiro S. C., Calado A. J., Casteleyn G., *et al*. 2009. Diversity and Abundance of Potentially Toxic Pseudo-Nitzschia Peragallo in Aveiro Coastal Lagoon, Portugal and Description of a New Variety, P-Pungens Var. Aveirensis Var. Nov.. Diatom Research. 24, 35-62.

Cigoña EF de la, Ferreira S. 1996. Tres Crustáceos del Bajo Miño: el carangrejo chino *Eriocheir sinensis*; el carangrejo de río Ibérico *Austrapotamobius pallipes* y el carangrejo de río Americano *Procambarus clarkii*. Actas do I Simpósio Ibérico sbre a bacia Hidrográfica do rio Minho, 26-28 Junho de 1996, Vila Nova de Cerveira, Portugal.

Cornelius P. 1992. The Azores hydroid fauna and its origin, with discussion of rafting and medusa suppression. Arquipélago— Life Mar Sci 10:75–100.

Cunha, M.R., Moreira, M.H., Sorbe, J.C. 1999. *Diamysis bahirensis*: a mysid species new to the Portuguese fauna and first record from the west European coast. Crustacean Issues 12: 139-152.

Davis, M.H. & M.E. Davis. 2005. *Styela clava* (Tunicata: Ascidiacea) a new addition to the fauna of the Portuguese coast. Journal of the Marine Biological Association of the UK, 85: 403-404.

Edwards, C. 1976 A study in erratic distribution: the occurrence of the medusa *Gonionemus* in relation to the distribution of oysters.

Estrada, M. (1995). Dinoflagellate assemblages in the Iberian upwelling area In: Lassus, P., Arzul, G., Erard-le Denn, E., Gentien, P., Marcaillou-le Baut, C. (Eds.). Harmful Marine Algal Blooms. pp. 157-162.

Fischer-Piette, E. & Prenant, M., 1957. Quelques données ecologiques sur les cirripèdes intercotidaux du Portugal, de l'Espagne du sud et du nord du Maroc. Bulletin du Centre d´Études et de Recherches Scientifiques Biarritz, 1: 361-368.

Gaspar M, 2010. Distribuição, abundância e estrutura demográfica da amêijoa--japonesa (*Ruditapes philippinarum*) no Rio Tejo. Relatório do IPIMAR, 6pp.

Gaudêncio, M.J., Guerra, M.T. 1979. Note sur la presence de *Callinectes sapidus* Rathbun 1896 (Crustacea Decapoda Branchyura) dans l'estuaire du Taje. Boletim do Instituto Nacional de Investigação das Pescas 2: 67‑73.

Gonçalves F, Ribeiro R, Soares AMVM. 1995. *Rhithropanopeus harrisii* (Gould), an American crab in the estuary of the Mondego River, Portugal. J Crustac Biol 15:756–762.

Gruvel A. 1920. Cirripédes. Résultats des Campagnes Scientifiques. Accomplies sur son Yacht par Albert 1er. Prince Souverain de Monaco 53:1–88

Guerra M.T, Gaudêncio, M.J. 1982. Première capture de la langouste du Sud.Ouest Africain, *Jasus lalandii* (H. Milne-Edwards, 1837), sur la côte portugaise. Memórias do Museu do Mar, Série Zoológica 2.

Levring T. 1974. The marine algae of the Archipelago of Madeira. Bol. Mus. Munic. Funchal 28: 5¬111.

Marchini, A., Cunha, M.R., Occhipinti-Ambrogi, A. 2007. First observations on bryozoans and entoprocts in the Ria de Aveiro (NW Portugal) including the first record of the Pacific invasive cheilostome *Tricellaria inopinata*. Marine Ecology 28: 154-160.

Marques, J.C., Bellan-Santini D. 1991. Gammaridea and Caprellidea (Crustacea, Amphipoda) of the Portuguese south-western continental shelf: taxonomy and distributional ecology. Bijdragen tot de Dierkunde 61: 65-87.

Monniot, F. 1974. Ascidies littorales et bathyales récoltées au cours de la campagne Biaçores: Aplousobranches. Bull Mus Natn Hist nat 3 sér 251:1287–1325.

Moore, S.J. 1987. Redescription of the leptomedusan Blackfordia virginica. Journal of Marine Biological Association of the United Kingdom 67: 287‑291.

Morton B, Britton JC. 2000. Origins of the Azorean intertidal biota: the significance of introduced species, survivors of chance events. Arquipélago—Life Mar Sci (Suppl 2, Part A):29–51

Nagar, A., Huys, R., Bishop. D. D. 2010. Widespread occurence of the Southern Hemisphere ascidian *Corella eumyota* Traustedt, 1882 on the Atlantic coast of Iberia. Aquatic Invasions 5: 169 - 173.

Neto AI. 1994. Checklist of the benthic marine macroalgae of the Azores. Arquipélago—Life Mar Sci 12A:15–34

Nobre A. 1930. Materiais para o estudo da Fauna dos Açores. Instituto de Zoologia da Universidade dos Açores, 108pp

Nobre, A. 1931. Crustáceos Decápodes e Stomatópodes marinhos de Portugal. Imprensa Portuguesa, 1 - 307.

Nolting, C. 1995. Die litorales Isopodenfauna Nord-Portugals (Crustacea, Peracarida): Untersuchung zur Zusammensetzung und Zoogeographie. Diplomarbeit. Fakultät für Biologie. Universität Bielelfeld. 107 pp.

Palminha F.P. 1951. Contribuição para o estudo das algas marinhas Portuguesas I. Bol. Soc. Port. Ciênc. Nat., 2 (3): 226 ‑ 250.

Raposeiro, P.M., J.C. Ramos & A.C. Costa. 2009. First record of *Branchiura sowerbyi* Beddard, 1892 (Oligochaeta: Tubificidae) in Azores. Aquatic Invasions 4: 487-490.

Ruano, F., Sobral, D.V. 2000. Espécies não indígenas em ambiente marinho - a situação em Portugal. Pp. 58-63. In: Rodrigues, L., Reino, L., Godinho, L.O., Freitas, H. (Eds.). Actas do 1º Simpósio sobre espécies Exóticas: Introdução, Causas e Consequências. Liga para a Protecção da Natureza, Lisboa.

Rueness J. 2005. Life history and molecular sequences of *Gracilaria vermiculophylla* (Gracilariales, Rhodophyta), a new introduction to European waters. Phycologia 44: 120-128

Rull Lluch, J., Gómez Garreta, A., Barceló, M.C. & Ribera, M.A. 1994. Mapas de distribución de algas marinas de la Península Ibérica e Islas Baleares. VII. *Cystoseira* C. Agardh (Grupo *C. baccata*) y *Sargassum* C. Agardh (*S. muticum* y *S. vulgare*). Botanica Complutensis 19: 131-138.

Saldanha, L. 1974. Estudo do povoamento dos horizontes superiores da rocha litoral da costa da Arrábida (Portugal). Arquivos do Museu Bocage (2ª série), 1: 1-382

Schmidt, O.C., 1931. Die marine vegetation der Azoren in ihren Grundzuegen dargestellt. Bibl. Bot., 102: 1-116.

Sobral, P., 1985. Distribuçao de *Acartia tonsa* Dana no estuario do Tejo e sua relação com *Acartia clausi* Giesbrecht. Bol. Inst. Nac. Invest. Pescas, Lisboa 13, pp. 61–75.

Southward AJ. 1998. New observations on barnacles (Crustacea: Cirripedia) of the Azores region. Arquipélago- Life Mar Sci 16A:11–28

Tittley I, Neto AI. 1995. The marine algal flora of the Azores and its biogeographical affinities. Bol Mus Mun Funchal Sup 4:747– 766

Zibrowius H, Bianchi CN. 1981. *Spirorbis marioni* et *Pileolaria berkeleyana*, Spirorbidae exotiques dans les ports de la Mediterranée nord-ocidentale. Rapp et proc-verb reun Commis Int Explor Sci Mer Mediterr Monaco 27(2):163–164

5.15 Spain

Prepared by Gemma Quilez-Badia, WWF Mediterranean Programme Office, Spain.

1. **Regulations**: An update on new regulations and policies (including, aquaculture and vector management)

   - **Ley 42/2007**, de 13 de diciembre, de Patrimonio Natural y de la Biodiversidad. Capítulo III. Artículo 61 sobre creación del Catálogo Español de EEI (Law 42/2007, December 13, for the Spanish Natural Heritage and Biodiversity. Chapter III Prevention and Control of Alien Invasive Species. Art. 61 on the creation of the Spanish NIS Catalog). It can be accessed (in Spanish) at: http://noticias.juridicas.com/base_datos/Admin/l42-2007.t3.html#c3

     Such Article states that "The inclusion in the Spanish Catalog entails a general prohibition of possession, transportation, traffic or trade of live or dead specimens, their remains or propagules, including foreign trade. This ban may be lifted upon administrative approval, when needed for research purposes, human health or safety".

     The drafting of the Royal Decree Project to develop the Spanish Non-Indigenous Species Catalog is currently being circulated between the Spanish Ministry of the Environment and Rural and Marine Affairs and the Autonomous Communities but it is not public yet.

     However, part of its contents was released to the press in November last year, and there we learnt that even though the order is to eradicate invasive species because they threaten the ecosystem, not all of them are included. The Ministry plans a separate chapter for a group of alien species that may remain under control in some areas. This is the case for the Wels catfish (*Silurus glanis*) in the Ebro River, the Barbary sheep (*Ammotragus lervia*) in Sierra Espuña, or the catfish (*Ictalurus melas*) in the rivers Júcar, Ebro and Tagus. All these are species that have hunting or fishing interest.

   - **Ley Orgánica 5/2010**, de 22 de junio, por la que se modifica la Ley Orgánica 10/1995, de 23 de noviembre, del Código Penal (Organic Law 5/2010, June 22, by which Organic Law 10/1995, November 23, on Criminal Code, is modified).

     It can be accessed (in Spanish) at: http://www.boe.es/boe/dias/2010/06/23/pdfs/BOE-A-2010-9953.pdf

     Page 54858:

     Amending Article 333, which reads as follows:

     "The person introducing or releasing non-native plant or animal species, so that it harms the biological balance, thus violating the law or general provi-

sions that protect flora and fauna species, shall be punished with imprisonment for four months to two years or with a fine of eight to twenty four months, and in any case, with special disqualification from working during one to three years".

Entry into force on December 23, 2010.

- In 2010 a **Database on Introduced Species in the Canary Islands** was created.

  Available at (in Spanish): http://www.interreg-bionatura.com/especies/index.php?opt=verDatos

  It is not specific for aquatic organisms. The Ministry of Agriculture, Livestock, Fisheries and Environment of the Canary Islands has quantified at least 1,434 species introduced in the Canary Islands, which represents about 11 % of all species of the archipelago, as recorded by the Canary Strategy for the Prevention and Control of Invasive Species.

  The **Canary Strategy for the Prevention and Control of Invasive Alien Species**, so far, is a document prepared by the autonomous Ministry proposing to develop regional strategies to identify existing problems due to the presence of these species and to propose priorities, actions to be developed and people responsible for its implementation.

  - The **Action Plan** envisaged by the Canary Strategy for the Prevention and Control of Invasive Alien Species proposes prevention actions, early detection and immediate action, eradication, control, containment and monitoring, education, public awareness and information, technical training, information systems, inter-administrative coordination, and legal and financial resources for its implementation.

2. **Intentional introductions**

   Crassostrea gigas

   I could not find any numbers for 2010. The latest are from 2009:

   http://www.mapa.es/estadistica/pags/pesquera/acuicultura/produccion/2009/2009_04_Prod_marina_fase_agua_grupo_especie.pdf

   In 2009 there was a production of 1,146.5 t, which represented a value of 1.9 million €.

3. **Unintentional introductions**

   New Sightings

   Bursatella leachii and ***Paraleucilla magna*** (see "Species_list_Spain_2010")

   The mollusk ***Bursatella leachii*** was found in 2009 in Mar Menor (province of Murcia, SE Spain, in the Mediterranean Sea) (37º 44' 03" N, 0º 46' 30" W) (Ramos Esplà *et al.*, 2010). *Bursatella leachii*, the ragged sea hare, is a medium- to large-sized benthic opisthobranch mollusk within the Order Anaspide, the sea hares. The body is variably colored, grayish-green to white-tan with dark brown blotches and spots, compact and rounded, with distinct head and neck regions evident. The body is also covered with numerous long, branching fleshy papillae that give the animal its ragged appearance. The gill is covered by a pair of fleshy parapodia. Two long, retractile olfactory tentacles called rhinophores occur on the head, and also two fleshy enrolled oral tentacles oc-

cur at each side of the mouth. Adults completely lack a shell (Voss 1980, Kaplan 1988, Rupert and Fox 1988). The population numbers of this species fluctuate sporadically. It is now a common species in the eastern Mediterranean, where thousands of individuals can be present in a small area of a lagoon, in very dense aggregations, but may be entirely absent a few weeks later (Zenetos *et al*., 2004). Ragged sea hare densities can at times become as great as to negatively impact commercial shrimping operations (Rudloe, 1971). *Bursatella leachii* is a circumtropical species, widespread along the temperate water of the Indo-Pacific and Atlantic Ocean, and common in the eastern Mediterranean (Zenetos *et al*. 2004). Its mode of introduction to the Mediterranean could have been either by ships from the tropical Atlantic or via the Suez Canal (Zenetos *et al*., 2004).

The sponge ***Paraleucilla magna*** was found in 2000 off the coast of Blanes (Catalan Sea, NE Spain, in the Mediterranean Sea) (41º 39' 18" N, 2º 49' 43" E) (Guardiola *et al*., 2010). The introduced calcareous sponge *Paraleucilla magna* has proliferated along the western Mediterranean during the last decade. The current species distribution in NE Spain is patchy with either single individuals or dense populations (Guardiola *et al*., 2010). In other areas where it has previously been recorded, such as the Mar Piccolo of Taranto in Italy, *Paraleucilla magna* is seasonally abundant, showing a propensity for colonizing natural hard substrata (Gravili *et al*., 2010). It is resistant to pollution and seems to be a structurally important species of the fouling community. *Paraleucilla magna* prefers to settle on mussel shells and may affect their growth, forcing local shellfish farmers to invest much effort in decreasing sponge growth (Longo *et al*., 2007). The rapid colonization pattern and the remarkable abundance of *Paraleucilla magna* along the western Mediterranean suggest that it is an invasive species (Gravili *et al*., 2010). It originates from the SW Atlantic (Zammit *et al*., 2009), and both bivalve farming and shipping are the most probable vectors of introduction into the western Mediterranean (Longo *et al*., 2007).

4. Pathogens

Sightings/records

General information

(Add links and references)

5. Meetings

Future meetings:

Quilez-Badia, G. and Ruiz G.M. (2011) 'Iberian Peninsula marine and estuarine invasions'. Presentation at VII International Conference on Bioinvasions, Barcelona, Spain, 23-25 August, 2011.

6. References and bibliography

Gravilia, C., Belmontea, G., Cecereb, E., Denittoa, F., Giangrandea, A.,

Guidettia, P., Longoc, C., Mastrototaroc, F., Moscatelloa, S., Petrocellib, A., Pirainoa, S., Terlizzia, A. and Boeroa, F. 2010. Nonindigenous species along the Apulian coast, Italy. *Chemistry and Ecology*. 26: 121-142.

Guardiola, M., Froster, J., Ageli, G. & Uriz, M.J., 2010. Temporal variation in connectivity and genetic structure among populations of a foreign calcareous sponge in the western Medi-

terranean: approaching the invasive capacity of the species. p. 152. In: *Abstracts XVI Simposio Ibérico de Estudios de Biologáa Marina,* Alicante, España, 6-10 September 2010.

Kaplan EH. 1988. A Field Guide to Southeastern and Caribbean Seashores: Cape Hattaras to the Gulf Coast, Florida, and the Caribbean. Peterson Field Guide Series. Houghton Mifflin Company, NY. 425 p.

Longo, C., Mastrototaro, F. and Corriero, G. 2007. Occurrence of *Paraleucilla magna* (Porifera, Calcarea) in the Mediterranean Sea. *J. Mar. Biol. Ass. UK*. 87: 1749–1755.

Ramos-Esplá, A.A., Izquierdo, A., Vázquez, M., Lozano, F. and Giménez-Casalduero, F. 2010. Introducciones recientes de especies de afinidades cálidas en el litoral del SE Ibérico. p. 271. In: Bayle Sempere, J.T. *et al.* (Eds), *XVI Simposio*

Ibérico de Estudios de Biología Marina. Libro de resúmenes. Universidad de Alicante.

Rudloe, J. 1971. The Erotic Ocean. Thomas Y. Crowell Co., NY. 448 pp.

Rupert, E.E. and Fox R.S. 1988. Seashore Animals of the Southeast. A Guide to Common Shallow-Water Invertebrates of the Southeastern Atlantic Coast. University of South Carolina Press. 429 pp.

Voss, G.L. 1980. Seashore Life of Florida and the Caribbean. Dover Publications, Inc., NY. 199 pp.

Zenetos, A., Gofas, S., Ruso, G., Templado, J. 2004. CIESM Atlas of Exotic Species in the Mediterranean. Vol. 3. Molluscs. In: F. Briand (Ed). CIESM Publishers, Monaco, 376 pp.

5.16 Sweden

Prepared by Malin Werner, Institute of Marine Research, Swedish Board of Fisheries,

Sweden; and Inger Wallentinus, Department of Marine Ecology, University of Gothenburg, Sweden

1. Regulations:

To be able to record any new sightings of American lobster (*Homarus americanus)*, a new regulation has recently been decided by the Swedish Board of Fisheries. It allows anyone catching a suspected *H. americanus*, with any kind of gear, any part of the year and also female lobsters with eggs, to take it ashore for investigation. (Normal regulations do not allow you to land egg-carrying females and no lobsters may be landed during the period May to late September. There are also regulations on what fishing gear to use.) You need a permit to land the suspected American lobster, which can be obtained by contacting scientists at the Swedish Board of Fisheries before coming ashore. Public information about the regulations will soon be launched.

The proposition for a new legislation on Pacific oyster (*Crassostrea gigas)* (Proposition 2009/10:MJ245 in September 2009), to allow anyone to collect that species was turned down, referring to ongoing large changes in the fishery legislation.

2. Intentional introductions:

No numbers of intentionally introduced species are supplied. There are few alien species intentionally introduced in marine or brackish waters in Sweden.

3. Unintentional introductions:

New Sightings:

No new introductions are reported in Swedish coastal waters.

Previous Sightings:

Fish

Neogobius melanostomus, Round goby

During an angle fishing competition in Göteborg (N 57° 42' 2", E 11° 57' 29") a round goby was found in May 2010. In October 2010, a specimen of the same species was caught on the island of Gotland in Visby harbour (N 57° 37', E 018° 17'). It has also been recorded from Karlshamn (N 56° 09', E 014° 05') 2009 (Wikström *et al.* 2010) and Karlskrona (N 59° 09', E 015° 33') 2008. All in all four major harbours, with a large geographical separation (Figure 1) and with intense shipping with Gdansk/Gdynia ((Pers. com. Ann-Britt Florin, Swedish Board of Fisheries, who is writing a national report on the subject at the moment.)

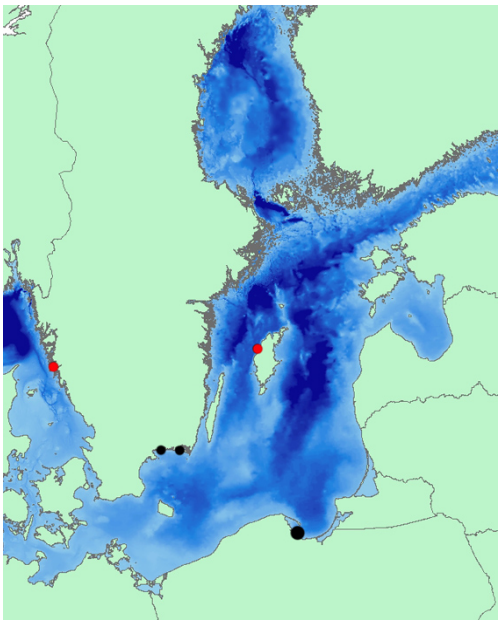

Figure 1. New reports of Round goby in Sweden 2010 are shown as red dots and earlier reports as black dots. The black dot in Poland shows a possible donor area (Pers. com. Ann-Britt Florin, Swedish Board of Fisheries).

Invertebrates

Crassotrea gigas, Pacific oyster

Winter mortality (number of oysters) on the Swedish west coast was severe during the extreme winter 2009/2010. In general, most animals at shallow (< 50 cm) depth were killed during that winter. It is unlikely that winter mortalities during 2010/2011 will be as high due to the present shift to deeper habitats of the species. Despite the massive mortalities, large amounts of oysters still remain and spreading is expected to continue (Pers. com. Åsa Strand, Univ. of Gothenburg). Results from these studies are planned to be published this year. Harvest for sale of Pacific oyster was first recorded in 2009 and about 10,000 oysters were registered as harvested (compared to the harvest of the European oyster *Ostrea edulis* of 89000 individuals). In 2010 the number dropped to approximately 3,500 harvested *Crassostrea gigas*, perhaps due to the ice winter. (Data from the National Food Administration in Sweden.)

Mnemiopsis leidyi, American comb jelly

The distribution of the comb jelly and its parasite *Edwardsiella* sp. is the same as last year (Pers. com. Lene Friis Möller, Univ. of Gothenburg). See Selander *et al.* (2010) for information on the parasite. Recent experiments (Jaspers *et al.* 2011) indicate that the American comb jelly does not pose a direct threat to Baltic cod eggs as the clearance rate was negligible and the cod egg did not seam to trigger the capture response on the comb jelly. Cod larvae were eaten, but not at a very high rate, which could be due to low temperature in the experiment, that simulated normal conditions for egg and larvae of cod in the Bornholm Basin. Another study by Colin *et al.* (2010) showed that the feeding success in *M. leidyi* lies in its ability to create a feeding current that is hard to detect by the prey and thus the ctenophore acts as an effective stealth predator. Hosia *et al.* (2010) suggest a size refuge from predation in *M. leidyi* from *Beroe gracilis,* a native comb jelly, in the Gullmarfjord, but larger prey could be partly eaten.

Marenzelleria spp.

In a publication by Blank *et al.* (2008) it was shown, with molecular methods, that all three species of *Marenzelleria* can be present in the same area (e.g. in the Askö-Himmerfjärden - approximately N 58° 49',E 017° 41') in the Baltic Sea. Earlier they were thought to be geographically separated. The distribution is continuing to increase in Swedish waters. In August 2010 *Marenzelleria viridis* was found in Idefjorden (Hansson 2011), a fjord on the border to Norway, which is the northernmost record on the Swedish west coast. It was also found again in 2010 in the Gullmar fjord (Pers. comm. Leif Pihl, Univ. of Gothenburg).The number of *Marenzelleria* is varying though. On the south west coast where this polychaete was quite common in 2007, there were much fewer records in 2010 (Simonsson 2010). In the Baltic proper the number had decreased at some monitoring locations in 2009, while it had increased in the Bothnian Sea (see Gunnarsson *et al.* 2010).

Eriocheir sinensis, Chinese mitten crab

There has not been a single record of mitten crabs in lake Vänern during 2010. The peak number of crabs, from private reports of by-catch from trap-net fishermen, was in 2005. The peak in lake Mälaren (in a part called Galten) was in 2002. The abundance pattern in both lake Vänern and lake Mälaren, suggests a pulsed invasion instead of a constant supply by migration (Drotz *et al.* 2010 a & b).

Homarus americanus, American lobster

One specimen was found in the Gullmarfjord near Bornö in October 2010 (Approximately N 58° 23', E 11° 36'). There have been scattered findings since 2008 and the number of unrecorded cases is expected to be higher. Therefore the Swedish Board of Fishery has decided on new regulations, if suspected *H. americanus* are caught (see 1. Regulations).

Macroalgae

Samples of the Asiatic red alga *Gracilaria vermiculophylla* were collected and analyzed by mitochondrial cytochrome c oxidase subunit I (*cox*1) from both its native area in northeast Asia (37 sites) and from sites in Europe, North America and northern Africa where it has been introduced (32 sites). Seventytwo specimens where sampled from five sites on the Swedish west coast in September 2007 (between 57°14'54'' N, 12°06'91'' E and 57°53' 41'' N, 11°35'35'' E). Additionally, samples from four sites in northern France, three sites in Germany, one site in Denmark, and 17 sites in SE USA were analyzed. For all introduced populations the same haplotype was present and

on a few sites genes from another haplotype were present as well, while 17 haplotypes were found in the native area. The dominant haplotype in the introduced areas was also found in east Korea, west Japan and eastern Russia, suggesting that the common donor area is the East sea/Sea of Japan, thus the likely origin for the introduced populations in the east and west Atlantic and in the east Pacific (Kim *et al.* 2010).

Microalgae

According to Olenina *et al.* (2010) *Prorocentrum minimum* is the only phytoplankton considered an AIS (Alien Invasive Species) in the Baltic Sea, using the Bio Pollution Level index method (Olenin *et al.* 2007).

Not Seen Species Yet:

Melita nitida (gammaridae, found in the Kiel Canal, according to Sture Nellbring, County Administrative Board, Stockholm)

Bonamia ostreae, parasite to oysters, is added to the Alert list for Sweden. (se reference list)

Pachygrapsus marmoratus, a crab found on the south coast of England and northwest coast of France.

4. Pathogens

The paramyxean unicellular parasite *Marteilia refringens* was initially found in blue mussels (*Mytilus edulis*) in a mussel farm on the west coast of Sweden in 2009 (see WGITMO 2010). Preliminary results from sampling in 2010 and PCR-analyses showed presence of the parasite in a few mussels (about one out of 30 analysed) at three locations in the waters around Orust Island. The disease marteiliosis caused by the parasite, is compulsory to report and the investigation and analyses continues by the National Veterinary Institute. (Pers. com. Anders Alfjorden, National Veterinary Institute)

The parasite can cause major damage to oysters, but have not yet been found in oysters, only in blue mussels, in Sweden.

5. Meetings and research projects

Past year:

CIS-WORKSHOP: Invasive arter i praksis: Forebyggelse, begrænsning og bekæmpelse . **25. januar 2010.**Det Biovidenskabelige Fakultet (LIFE), Københavns Universitet (Åsa Strand, Univ. of Gothenburg participated)

Nordic workshop on research of *Crassostrea gigas* in relation to present distribution in Nordic areas, ecology, risk assessment in relation to impact of *C. gigas* on the ecosystem and commercial exploitation. 24 -25 March 2010. DTU Aqua, Charlottenlund, Denmark (Åsa Strand, Univ. of Gothenburg , participated)

National "Water days", Gothenburg, 8-10 December. 2010.A seminar and a small workshop was held about introduced species, concerning mostly fresh water species but also some living in brackish waters. (Stefan Lundberg, Swedish Museum of Natural History, Sture Nellbring, County Administrative Board, Stockholm, Marcus Drotz, Lake Vänern museum Lidköping, participated.)

HELCOM CORESET, Gothenburg 16-18 February 2011. Meeting to discuss possible indicators to determine Good Environmental Status (GES), under the Marine Strategy Framework Directive (MSFD). Descriptor 2 in MSFD = "Non-indigenous species in-

troduced by human activities are at levels that do not adversely alter the ecosystem". (Malin Werner, Swedish Board of Fisheries, participated)

Future meetings:

ICES WGPDMO (Pathology and diseases) has a meeting in Aberdeen 1-6 March 2011. Every year, outbreaks of newly arrived diseases are reported in different areas. (Vidar Öresland, Swedish Board of Fisheries, & Anders Alfjorden, National Veterinary Institute, will participate.)

HELCOM CORESET, preliminary 15-17 June 2011 in Latvia. Continuing the discussion for suggested indicators for GES.

Research projects:

Investigations and tests of hypotheses about the ongoing invasion of the Pacific oyster (*Crassostrea gigas*): Can management effectively prevent permanent establishment in Sweden (project 2010-2011) Åsa Strand, Univ. of Gothenburg, and her colleagues.

There is a report on "Monitoring of non-native species in lake Mälaren" written in 2010 by Sture Nellbring, County Administrative Board, Stockholm, but not yet published by the Swedish Environmental Protection Agency. It is about freshwater, but including also brackish water species.

Papers and a thesis are still coming out from the national research program AquAliens (2002-2007), concerning introduced species in Sweden, from both marine and freshwater habitats (Sahlin (2010), Almqvist *et al.* (2010), Björklund & Almqvist (2010 a & b), Sahlin *et al.* (2010), Järemo & Bengtsson (2011).

A PhD student at the University of Gothenburg, Stefan Kalogirou has published work from the Mediterranean Sea (Corsini-Foka *et al.* (2010), Kalogirou (2010a & b), Kalogirou *et al.* (2010)).

Doctoral thesis

Sahlin U (2010) From data to decision - Learning by probabilistic risk analysis of biological invasions. PhD thesis. Department of Biology, Lund University. 62 pp and 5 papers. ISBN 978-91-7105-308-4

6. References and bibliography

Almqvist G, Strandmark AK & M Appelberg (2010) Has the invasive round goby caused new links in Baltic food webs? Environ. Biol. Fish. 89:79–93.

Ardehed A, (2010) Genetic variation in an invasive species, the Giant Pacific Oyster *Crassostrea gigas* (Mollusca: Ostreidae). Master thesis in zoological systematics and biodiversity, University of Gothenburg, 2009/2010.

Blank M, Laine AO, Jürss K & R Bastrop (2008) Molecular identification key based on PCR/RFLP for three polychaete sibling species of the genus *Marenzelleria*, and the species current distribution in the Baltic Sea. Helgol. Mar. Res. 62: 129-141.

Björklund M & G Almqvist (2010a) Is it possible to infer the number of colonisation events from genetic data alone? Ecological Informatics 5:173–176

Björklund M & G Almqvist (2010b) Rapid spatial genetic differentiation in an invasive species, the round goby *Neogobius melanostomus* in the Baltic Sea. Biol Invasions 12:2609–2618.

Colin SP, Costello JH, Hansson LJ, Titelman J & JO Dabiri (2010) Stealth predation and the predatory success of the invasive ctenophore *Mnemiopsis leidyi*. PNAS vol. 107 no. 40. 17223–17227. www.pnas.org/cgi/doi/10.1073/pnas.1003170107

Corsini-Foka M, Pancucci-Papadopoulou MA, Kondilatos G. & S Kalogirou (2010) Gonioinfradens paucidentatus (A. Milne Edwards, 1861) (Crustacea, Decapoda, Portunidae): a new alien crab in the Mediterranean Sea. Medit. Mar. Sci., 11(2): 331-340. http://www.medit-mar-sc.net

Drotz K, Berggren M, Lundberg S, Lundin K & T von Proschwitz (2010a) Invasion routes, current and historical distribution of the Chinese mitten crab (*Eriocheir sinensis*, H. Milne Edwards, 1853) in Sweden. Aquatic Invasions Vol 5 (4): 387-396.

Drotz KM, Lundin K, Aneer G, Berggren M, Lundberg S. & T von Proschwitz (2010b) Kräftgång för ullhandskrabban. Fauna & Flora 105:12-17

Forslund H, Wikström SA & H Pavia (2010) Higher resistance to herbivory in introduced compared to native populations of a seaweed. Oecologia 164:833–840.

Gunnarsson J, Cederwall H, Agrenius S & J Albertsson (2010) Macrofauna mjukbotten. In: Havet 2010. Om miljötillståndet i Svenska havsområden. Swedish Environmental Protection Agency and The Swedish Institute for the Marine Environment. pp. 50-51.

Hansson HG (2011) Marina syd-skandinaviska "evertebrater" – ett naturhistoriskt urval. Internet edition January 2, 2011, 352 pp. Sven Lovén centrum för marina vetenskaper, Tjärnö, University of Gothenburg.

Hosia A, Titelman J, Hansson LJ & M Haraldsson (2011) Interactions between native and alien ctenophores: *Beroe gracilis* and *Mnemiopsis leidyi* in Gullmarsfjorden. Mar. Ecol. Prog. Ser. Vol 422: 120-138.

Järemo, J & G Bengtsson (2011) On the importance of life history and age structure in biological invasions. Ecological Modelling 222: 485-492.

Jaspers C, Titelman J, Hansson LJ, Haraldsso M & C Røllike Ditlefsen (2011) The invasive ctenophore *Mnemiopsis leidyi* poses no direct threat to Baltic cod eggs and larvae. Limnol. Oceanogr. 56(2): 431-439.

Kalogirou S (2010a) Fish Community Structure and the Role of Non-Indigenous Species Associated to Seagrass Ecosystems of Eastern Mediterranean. Licenciate thesis. Gothenburg University. ISBN number: 91-89677-45-5.

Kalogirou S (2010b) First record of the non-indigenous fangtooth moray *Enchelycore anatina* from Rhodes Island, south- eastern Aegean Sea. Medit. Mar. Sci., 11(2): 357-360. http://www.medit-mar-sc.net

Kalogirou S, Corsini-Foka M, Sioulas A, Wennhage H & L Pihl (2010) Diversity, structure and function of fish assemblages associated with *Posidonia oceanica* beds in an area of the eastern Mediterranean Sea and the role of non-indigenous species. Journal of Fish Biology 77: 2338–2357.

Kim SY, Weinberg F & SM Boo (2010) Genetic data hint at a common donor region for invasive Atlantic and Pacific populations of *Gracilaria vermiculophylla* (Gracilariales, Rhodophyta). J. Phycol. 46 : 1346-1349 plus supplementary material on internet DOI: 10.1111/j.1529-8817.2010.00905.x

Larsson AI, Mattsson-Thorngren L, Granhag LM & M Berglin (2010) Fouling-release of barnacles from a boat hull with comparison to laboratory data of attachment strength. JEMBE 392: 107–114

Olenin S, Minchin D & D Daunys (2007) Assessment of biopollution in aquatic ecosystems, Mar. Pollut. Bull. doi:10.1016/j.marpolbul.2007.01.010.

Olenina I, Wasmund N, Hajdu S, Jirgensone I, Gromisz S, Kownacka J, Toming K, Vaiciute D & S Olenin (2010) Assessing impacts of invasive phytoplankton : The Baltic Sea case. Marine Pollution Bulletin 60: 1691–1700

Sahlin, U, Smith HG, Edsman L & G Bengtsson (2010) Time to establishment success for introduced signal crayfish in Sweden – a statistical evaluation when success is partially known. Journal of Applied Ecology 47: 1044–1052.

Selander E, Friis Møller L, Sundberg P & P Tiselius (2010) Parasitic anemone infects the invasive ctenophore *Mnemiopsis leidyi* in the North East Atlantic. Biol Invasions 12: 1003-1009.

Simonsson D (2010) Monitoring Programme of Shallow Water Fauna in Coastal Areas of Helsingborg Municipality, Sweden, summer 2010. Environmental Department - Helsingborg. 23 pp. (In Swedish with an English summary).

Vergara-Soto O, Calliari D, Tiselius P, Escribano R, González ML & S Soto-Mendoza (2010) Functional response of *Sagitta setosa* (Chaetognatha) and *Mnemiopsis leidyi* (Ctenophora) under variable food concentration in the Gullmar fjord, Sweden. Revista de Biología Marina y Oceanografía 45(1): 35-42.

Wikström A, Engdahl A & O. Lövgren (2010) Underlag för miljökonsekvens-beskrivningar avseende fisk i Blekinge Offshore AB:s projekteringsområde för havsbaserad vindkraft i Hanöbukten, Delstudie 1 - Lek av sill (*Clupea harengus*). Marine Monitoring AB.

Web page:

Alert-list on the Swedish Introduced Species web page, at http://www.frammandearter.se/

The web page is in Swedish but choose "Nya arter" in the menu to the left and then "alertlista!".

7. Acknowledgement

We thank our colleagues at governmental agencies, universities, museums and companies for their help with information in this report.

5.17 United Kingdom

Prepared by Gordon Copp, Ian Laing, Tracy McCollin and Holly Niner.

Overview

A live specimen of a blue crab (*Callinectes sapidus*) was caught in February in the Fal Estuary in Cornwall. This is a new species record for the UK.

The predatory shrimp *Dikerogammarus villosus* was found in September 2010 for the first time in the UK at Grafham Water, a drinking-water reservoir located near Huntingdon, Cambridgeshire, England. The species was subsequently confirmed at two sites in south Wales at Cardiff Bay and Eglwys Nunydd Reservoir in Port Talbot. It is not known how it arrived. Measures are being taken to contain the species as much as possible.

Eradication of *Didemnum vexillum* in Wales (Holyhead harbour) was completed but new colonies have since appeared. Pathway management options to prevent further spread of the species in England, Scotland and Wales are being pursued. Currently no action or monitoring is taking place in Ireland.

Imports for human consumption of live non-native bivalve molluscs and crustaceans continue. Just over 500 tonnes of live Canadian/American lobsters (*Homarus americanus*) were brought in to the UK in 2010. This is a slight reduction in trade compared with previous years. There were several reports of this species being collected from the wild, seven from the south coast of England and one from the north east coast of

Scotland. Several review papers on non-native fishes and their management in the UK were published in 2010.

1. Regulations

Following a consultation process, the UK Department for Environment, Food and Rural Affairs (Defra) has added 24 animals and 38 plants to Schedule 9 of The Wildlife and Countryside Act 1981, making it illegal to plant them in, or release them into, the wild. This came into force on 6 April 2010, and species added include slipper limpet (*Crepidula fornicata*), Chinese mitten crab (*Eriocheir sinensis*), spiny-cheek crayfish (*Orconectes limosus*), red swamp crayfish (*Procambarus clarkii*) and the American oyster drill (*Urosalpinx cinerea*). A number of other species were considered for inclusion but not added.

Progress has been made towards transposing Council Regulation 708/2007/EC (on use of alien and locally absent species in aquaculture) into national legislation, expected in 2011.

In Northern Ireland, further progress was made towards enacting new legislation to be entitled 'The Wildlife and Natural Environment Act 2010'. This covers the unlawful introduction of 'non native' animal or plant species and greater offences will apply to the release, spread or sale of non-native invasive species.

In Scotland, similar legislation is in preparation and more details can be found at: http://www.scotland.gov.uk/Topics/Environment/Wildlife-Habitats/WildNatEnvBill

Commission Regulation (EU) No 175/2010 implementing Council Directive 2006/88/EC as regards measures to control increased mortality in Pacific oysters (*Crassostrea gigas*) in connection with the detection of Ostreid herpesvirus 1 μvar (OsHV-1 μvar) was published in March 2010. This is to control the spread of this highly pathogenic agent.

2. Intentional introductions

Fish

Summaries of imports of salmonid eggs into the UK can be found in Finfish News for England and Wales (http://www.cefas.co.uk/publications/finfish-news.aspx) and Marine Scotland Science publications for Scotland (http://www.scotland.gov.uk/Topics/marine/science/Publications/publicationslatest/FishFarmProductionSurveys). UK export statistics are also presented in these publications.

Invertebrates

Deliberate releases of Pacific oysters for cultivation, mainly from UK hatcheries, continue at a similar level to that in previous years. Annual production of market-sized oysters remains at a little over 1,000 tonnes. Stock for on growing was imported from Carlingford (Ireland) and Guernsey. There were no imports from France, Jersey or other parts of Eire in 2010 due to restrictions to prevent the spread of a new and highly pathogenic strain of oyster herpes virus (OsHV-1 μvar). This affects only Pacific oysters and the movement controls are prescribed by EU legislation (Commission Regulation (EU) No 175/2010).

Imports of non-native species of live bivalve molluscs and crustaceans for human consumption continue. Just over 500 tonnes of live Canadian/ American lobsters were brought in to the UK in 2010. This is a slight reduction in trade compared with previous years. In 2010, 14 Canadian/American lobsters were captured in pots set in the

wild: 13 along the south coast of England and one from the Moray Firth, north east Scotland. One lobster was banded and lack of bio-fouling on all animals suggested recent escapes from holding systems. The potential for using existing disease control legislation (gaffkaemia) to regulate better the industry to minimise escapes is being reviewed.

3. Unintentional introductions

New sightings –

A live specimen of a blue crab (*Callinectes sapidus*) was caught in February during the annual Cefas/Maritime Division oyster survey of the Fal Estuary in Cornwall (Vanstaen & Ellis, 2010). The crab was a juvenile female, and it is a first record for the UK. Blue crabs are edible and are native to the Western Atlantic Ocean and Gulf of Mexico. They are caught extensively for food in the USA. This individual may have arrived either accidentally via ship's ballast water or possibly carried up from Southern Europe in water currents as a larva. It is an established alien species in the Mediterranean, as well as the Black Sea, and there are individual records from the Atlantic coasts of Spain and France.

The predatory shrimp (*Dikerogammarus villosus*) was found in September for the first time in the UK at Grafham Water, a drinking-water reservoir located near Huntingdon, Cambridgeshire, England (MacNeil *et al*. 2010). The species was subsequently confirmed at two sites in south Wales at Cardiff Bay and Eglwys Nunydd Reservoir in Port Talbot. It is not known how it arrived. Measures are being taken to contain the species as much as possible. The response to this species in England and Wales is being led by a Task Group chaired by the Environment Agency. They will coordinate delivery of the response plan and the key high level actions necessary to contain *D. villosus*, to prevent further spread and protect vulnerable sites from invasion. This group will oversee a series of projects aimed at addressing these issues and will report to the GB Non Native Species Programme Board. A suite of web-based information is available at: https://secure.fera.defra.gov.uk/nonnativespecies/alerts/index.cfm?id=3

Previous sightings –

Algae

Nothing to report

Invertebrates

Further investigations, following the detection of the slipper limpet (*Crepidula fornicate*) for the first time in Belfast Lough in 2009, were made. Chains and solitary individuals were found, some with egg capsules, at several localities within Belfast Lough. The species is widely dispersed, being found on the lower shore to depths of 7 m attached to scallops, mussels and stones and so is considered to be established. Shell winter growth checks indicated a possible arrival in or before 2004. While there have been previous records of this invasive species in Ireland, this is the only known established population (McNeill *et al*. 2010).

The presence of zebra mussels in Lough Bresk, County Fermanagh, Northern Ireland, was confirmed for the first time. The first sighting in Northern Ireland was in 1994 at Lough Erne, where they have significantly altered fish communities, and they have since been reported in Lough Neagh.

A study of the ascidian *Corella eumyota*, originally from the Southern Hemisphere, along the south coast of England at Brighton, Portsmouth and Weymouth has shown that it has established reproductive populations on natural and semi-natural shores of Plymouth Sound and the adjacent coastline. The species is largely restricted to relatively sheltered sites in the lower reaches of estuaries, where it is generally the most abundant non-colonial ascidian. The species clearly has the capacity to become a significant component of the biota of sheltered shores in the Northern Hemisphere (Collin *et al*. 2010). It has also been recently discovered at four locations on the west coast of Scotland by the Scottish Association of Marine Science (SAMS). The first specimen was recorded in 2009 with a further three that year. Last year three more populations were discovered. Records have been submitted to the MarLIN website (www.marlin.ac.uk).

The first eradication attempt of *Didemnum vexillum* from Holyhead Harbour in Wales has been completed, however new colonies have since appeared. A second eradication plan aimed over a shorter time frame was proposed by the Countryside Council for Wales but this has now been abandoned due to lack of funds. Efforts are now focussing on pathway management and biosecurity (quarantine and antifouling mechanisms) within the marina. Much larger populations are present in Scotland, on the Clyde, and on the south coast of England, mainly in the Solent. It is not expected that eradication will be possible in England, where a report was commissioned in which it was concluded that pathway management should be used to control the spread (Laing *et al*. 2010) and recommendations and costing are going forward. Eradication at any newly infected sites maybe considered if those sites were of high importance. The GB Working Group for *Didemnum* is looking at pathway management across the whole of GB and is currently putting together a pathway management document. A feasibility study for eradication of the populations in Scotland has been completed. The logistics of treatment would be difficult due to the size of the marina and surrounding areas (compared to Holyhead) and the likelihood of success was considered low. Actions are now focussing on pathway management and best practice methods to reduce any further spread. No funds are currently available in Ireland, so no monitoring or action is taking place.

The warm water decapod crustacean species, Henslow's swimming crab *Polybius henslowii*, and the angular crab *Goneplax rhomboids*, which previously were only rarely recorded in the North Sea, are becoming increasingly common in this area. The increase in these new species is attributed to climate change and may help to explain how the effects of climate change have been amplified by the marine food web to bring about abrupt changes in the North Sea ecosystem (Lindley *et al*. 2010).

Three mantis shrimp (*Rissoides desmaresti*) were reported from Dungeness, Kent, in December 2010. This species was first reported from in UK waters from north Wales in 1999, with a subsequent sighting in Suffolk (Ellis *et al*. 2006). This species is normally found in the Mediterranean and is not native to the UK.

Fish

A review of recent records of non-native fishes revealed an increasing occurrence of aquarium fishes being abandoned in the environment (Zięba *et al*. 2010). However, the only potential new record in 2010 is an unconfirmed report of fathead minnow (*Pimphales promelas*) at a fish farm in Kent (K.J. Wesley, personal communication). To examine the likely response of existing non-native fishes to predicted conditions of climate change, a modelling study revealed six fish species likely to benefit from the predicted warming temperatures (Britton *et al*. 2010a). These include common carp

(*Cyprinus carpio*), European catfish (*Silurus glanis*), pumpkinseed (*Lepomis gibbosus*), goldfish (*Carassius auratus*), fathead minnow and bitterling (*Rhodeus amarus*), though the latter species would be able to benefit only where suitable mussel hosts are present.

Species not yet reported or observed

Research undertaken in the lower Rhine (Borcherding *et al*. 2011) indicates that the densities of Ponto-Caspian gobies are increasing. These fish species are expanded up the River Danube system and then down the River Rhine, presumably as hitch-hikers (hull foulants) of river barges, due to their first records in, and dispersal from, river shipping ports (Wiesner 2005). This same vector has been identified as the likely pathway for arrival in the UK (Parrott *et al*. 2009).

4. Pathogens

Sightings/records

The new and highly pathogenic variant of oyster herpes virus (OsHV-1 µvar) was detected in Whitstable Kent in July 2010. A containment zone was immediately established around the affected area, and restrictions are in place to control the movement of live Pacific oysters into and out of the zone. A sampling and testing programme has been set up to ensure early detection of any further occurrence of OsHV-1 µvar in farms or mollusc farming areas elsewhere in the UK. See http://www.efishbusiness.co.uk/news/oyster-herpesvirus-outbreak.asp for further information.

Two non-native parasites, *Minchinia tapetis* and *Minchinia mercenaria*, that are endemic to US waters, have been found in association with cockle mortalities in the Burry Inlet beds in South Wales. Chronic mass mortalities of cockles have taken place here since 2002, incurring losses of about EUR 17.5 million for the commercial fishery. For further details see http://www.bbc.co.uk/news/uk-wales-south-west-wales-12299593

General information

A review of fish introductions revealed that the rate of introductions has doubled worldwide in the space of 30 years, with aquaculture (39%) and improvement of wild stocks (17%) being the main reasons for the introductions (Gozlan *et al*. 2010). Only a small proportion of introduced fishes become invasive, causing adverse ecological effects, and a review of management actions (Britton *et al*. 2010c) has emphasized the need to minimize their dispersal and impacts, either through rapid response eradication or control by suppression and containment. The financial cost of invasive non-native species on the British economy has been unveiled in a new report. The report, entitled 'The Economic Cost of Invasive Non-Native Species to the British Economy' (Defra 2010), suggests that invasive species cost £1.7 billion every year. Similarly, a paper has appeared in which the cost of controlling freshwater invasive species in Great Britain is estimated to be ≈£26.5 million year^{-1}; however, the costs of control could total £43.5 million year^{-1} if management efforts were undertaken at all infested locations (Oreska & Aldridge 2011).

In February 2010, a population of fathead minnow *Pimephales promelas*, a small-bodied North American cyprinid fish, was eradicated from a pond in Yorkshire, Northern England. Until recently, this species was sold widely in aquarium shops and garden centres, and it is known in the UK to have established populations in garden ponds (Parrott *et al*. 2009, Zięba *et al*. 2010). However, this population was the first feral population to be found 'in the wild', so to speak. The water body was far

from the nearest water course, the species is the lowest scoring of high risk species in a pre-screening study (Copp *et al*. 2009), and the population was the subject of research by Cefas to inform the risk analysis process because little is known of this species in European waters. Despite objections from Cefas, the UK Environment Agency nonetheless went forward with the eradication. Given that the species was discovered in the pond in August 2008, this eradication cannot be considered a rapid response action. The outcome (success or not) of the eradication remains to be assessed, however this eradication is one of three (the others being on topmouth gudgeon *Pseudorasbora parva*; Britton *et al*. 2010b) that has been assessed retrospectively using a new tool for evaluating the impacts of management options (Britton *et al*. 2011).

Researchers at Harper Adams University College have been investigating ways to improve information use and sharing within the invasive species community. This study included a questionnaire survey. Results of the study are still in preparation (http://www.harper-adams.ac.uk/postgraduate/research/research.cfm?ID=32)

A project, 'Recording Invasive Species Counts (RISC)', was launched in London in March. This will encourage members of the public to record sightings of ten invasive non-native plants and animals, including the Chinese Mitten Crab and the Zebra mussel, within the UK. Data collected by RISC will help scientists both understand the distribution and ecology of these species, and investigate their impacts on wildlife in the UK. https://secure.fera.defra.gov.uk/nonnativespecies/index.cfm?sectionid=81

5. Meetings

Past year (2010)

In September 2010, the Shellfish Association of Great Britain, the Non-Native Species Secretariat and the Joint Nature Conservation Committee co-hosted a workshop on the Pacific oyster, aiming to establish an agreed, science based, rationale for dealing with this species in the aquaculture cultivation sector. In addition, the possibility of establishing a wider Code of Conduct for shellfish aquaculture in dealing with non-native species was discussed. A project is proposed to produce a report which would consider all the issues surrounding Pacific oyster cultivation to provide an agreed evidence-base to enable effective decision-making on next steps, if any.

The International Maritime Organization (IMO) continues to develop international management measures for reducing the risk of introducing non native species *via* ballast water and biofouling. These issues were discussed at the Marine Environment Protection Committee in March and September 2010.

In October 2010, Cefas co-convened an international workshop, held in Mugla (Turkey), on "*New approaches for assessing the impacts of non-native freshwater fishes in the Mediterranean Region*". Although focused mainly on freshwater species, the techniques and methods discussed can be applied more widely.

Meetings in 2011

A joint meeting of the Linnean Society of London and the Marine Aliens II consortium "Controlling Marine Invasive Species by Targeting Vectors of Dispersal" is to be held in London on 10 February 2011. http://www.marlin.ac.uk/marine_aliens/symposium.php

There will be a meeting of the Bulk Liquids and Gases Sub Committee at IMO from 7–11 February, 2011, where the final version of the Biofouling guidelines will be discussed with the intention of agreeing a final document for approval.

The Institute of Ecology and Environmental Management will hold a meeting on "*Invasive Species*: *New natives in a Changing Climate*?", 23 March 2011, in London.

The annual conference of the Fisheries Society of the British Isles, 18–22 July 2010, "*Fish Diversity and Conservation: Current state of knowledge*", includes a themed session on "The role of introduced species in the decline of fish diversity" (www.fsbi.org.uk/2011/index.html).

6. References

Borcherding, J., Staas, S., Krüger. S., Ondračková, M., Šlapanský, L. & Jurajda, P. (2011). Non-native Gobiid species in the lower River Rhine (Germany): recent range extensions and densities. *J. Appl. Ichthyol.* (doi: 10.1111/j.1439-0426.2010.01662.x)

Britton, J.R., Copp, G.H. & Davies, G.D. (2011). A modular assessment tool for managing introduced fishes according to risks of species and their populations, and impacts of management actions. *Biol. Invasions* (in press)

Britton, J.R., Cucherousset, J., Davies, G.D., Godard, M.J. & Copp, G.H. (2010a). Non-native fishes and climate change: predicting species responses to warming temperatures in a temperate region. *Freshwat. Biol.* **55**, 1130–1141.

Britton, J.R., Davies, G.D. & Brazier, M. (2010b). Towards the successful control of the invasive *Pseudorasbora parva* in the UK. Biological Invasions 12, 125–131.

Britton, J.R., Gozlan, R.E. & Copp, G.H. (2011). Managing non-native fish in the environment. *Fish Fish.* (in press)(doi: 10.1111/j.1467-2979.2010.00390.x)

Collin, S.B., Oakley, J.A., Sewell, J. & Bishop, J.D.D. (2010). Widespread occurrence of the non-indigenous ascidian *Corella eumyota* Traustedt, 1882 on the shores of Plymouth Sound and Estuaries Special Area of Conservation, UK. *Aquat. Invasions* **5**, 175–179.

Copp, G.H., Vilizzi, L., Mumford, J., Fenwick, G.V., Godard, M.J. & Gozlan, R.E. 2009. Calibration of FISK, an invasive-ness screening tool for non-native freshwater fishes. *Risk Analy.* **29**, 457–467.

Copp, G.H., Vilizzi, L. & Gozlan, R.E. (2010a). Fish movements: the introduction pathway for topmouth gudgeon *Pseudorasbora parva* and other non-native fishes in the UK. *Aquat. Conserv. Mar. Freshwat. Ecosyst.* **20**, 269–273.

Copp, G.H., Vilizzi, L. & Gozlan, R.E. (2010b). The demography of introduction pathways, propagule pressure and non-native freshwater fish occurrences in England. *Aquat. Conserv. Mar. Freshwat. Ecosyst.* **20**, 595–601.

Defra (2010). The economic cost of invasive non-native species to the British economy. Defra, London. (https://secure.fera.defra.gov.uk/nonnativespecies/index.cfm?sectionid=59)

Ellis, J., Warr, K., Cooper, K. & de Boois, I.J. (2006) The occurrence of mantis shrimp *Rissoides desmaresti* (Crustacea: stomatopoda) off the Suffolk coast. Trans. Suffolk Nat. Soc. 42: 43–47.

Gozlan, R.E., Britton, J.R., Cowx, I.G. & Copp, G.H. (2010). Current knowledge on non-native freshwater fish introductions. *J. Fish Biol.* **7c**, 751–786.

Laing, I., Bussell, J. & Somerwill, K. (2010) Project report: Assessment of the impacts of *Didemnum vexillum* and options for the management of the species in England. Report to Defra/GBNNSS, October 2010.

Lindley, J.A., Beaugrand, G., Luczak, C., Dewarumez, J-M. & Kirby R. R. (2010). Warm-water decapods and the trophic amplification of climate in the North Sea. *Biol. Lett.* **6**, 773–776.

MacNeil, C., Platvoet, D., Dick, J.T.A., Fielding, N., Constable, A., Hall, N., Aldridge, D., Renals T. & Diamond, M. (2010). The Ponto-Caspian 'killer shrimp', *Dikerogammarus villosus* (Sowinsky, 1894), invades the British Isles. *Aquat. Invasions* **5**, 441–445.

McNeill, G., Nunn J., & Minchin, D. (2010). The slipper limpet *Crepidula fornicata* Linnaeus, 1758 becomes established in Ireland. *Aquat. Invasions* **5**, S21–S25.

Oreska, M.P.J. & Aldridge, D.C. (2011). Estimating the financial costs of freshwater invasive species in Great Britain: a standardized approach to invasive species costing. *Biol. Invasions* (doi: 10.1007/s10530-010-9807-7)

Parrott, D., Roy, S., Baker, R., Cannon, R., Eyre, D., Hill, M., Wagner, M., Preston, C., Roy, H., Beckmann, B., Copp, G.H., Edmonds, N.J., Ellis, J., Laing, I., Britton, J.R., Gozlan, R.E. & Mumford, J. (2009). Horizon scanning for new invasive non-native species in England. Research Report, Natural England, Peterborough, 127 pp.

Vanstaen, K. & Ellis, J. (2010). Blue crab found in Cornwall. *Shellfish News* **29**, 26.

Wiesner, C. (2005). New records of non-indigenous gobies (*Neogobius* spp.) in the Austrian Danube. *J. Appl. Ichthyol.* **21**, 324–327.

Zięba, G., Copp, G.H., Davies, G.D., Stebbing, P., Wesley, K.J. & Britton, J.R. (2010). Recent releases and dispersal of non-native fishes in England and Wales, with emphasis on sunbleak *Leucaspius delineatus*. *Aquat. Invasions* **5**, 155–161.

5.18 United States of America

Prepared by Judith Pederson, MIT Sea Grant College Program, USA.

1. Regulations: An update on new regulations and policies

The Ballast Water Discharge Standard Notice of Proposed Rulemaking (NPRM) was published in the Federal Register on August 28, 2009 for public review and comment. The comment period for this proposed rule was extended from November 27 to December 4, 2009." http://www.uscg.mil/hq/cg5/cg522/cg5224/bwm.asp

2. Intentional:

Synthesis of introductions

We do not have anything to add in this section.

3. Unintentional:

3.1. Fish

We do not have anything to add to this section.

Atlantic/Gulf Coasts

Lionfish of the *Pterois miles/volitans* complex, native to the Indo-Pacific, are well-established on the southern Atlantic coast of the US, and are continuing to expand their range through the Caribbean Sea and Gulf of Mexico [Both species have been identified in US waters by molecular methods, but are not easily separated morphologically (Freshwater et al. 2009)]. Lionfish were first seen in Biscayne Bay, Florida, in 1993, probably released from aquaria, and were discovered to be well-established in waters off North Carolina in 2000. In 2010, lionfish appeared to spreading across the northeastern Gulf of Mexico, with numerous specimens caught from the Tampa Bay area to the Mississippi Delta in Louisiana. The first record from the Gulf was in 2006, in Pinellas County, Florida, but there were no further records until 2009. Lionfish have spread across the Caribbean to the coasts of Venezuela and Colombia (Aguilar-Perera and Tuz-Sulub 2010; USGS Nonindigenous Aquatic Species Program 2010),

but have not yet been reported from the northwestern Gulf (northeast Mexico, Texas, western Louisiana).

Single specimens of two other marine aquarium fishes, Clown Triggerfish (*Balistoides conspicillum*) and White-streaked Grouper **(***Epinephelus ongu*s) were collected off Boca Raton, Florida (USGS Nonindigenous Aquatic Species Program 2011). This is one of at least 27 exotic marine aquarium species, mostly Indo-Pacific natives, which have been seen in Florida waters (Semmens et al. 2004**;** USGS Nonindigenous Aquatic Species Program 2011) in the last two decades. Most of these records are single specimens. So far, only three species of stenohaline marine fishes are known to have established populations in US Atlantic/Gulf of Mexico/Caribbean waters. These are the two Lionfish species and the South American Tessellated Blenny (*Hypsoblennius invemar*). The latter species, native to the South American Caribbean coast, may have entered US waters on offshore oil platforms (USGS Nonindigenous Aquatic Species Program 2011).

Other invaders of saline coastal waters are euryhaline fishes, mostly of the family Cichlidae, which were freshwater aquarium and/or aquaculture releases. At least 6 species of cichlids are established in Florida coastal marine and estuarine waters. A popular aquarium fish, the African Jewelfish (*Hemichromis letourneauxi* has spread rapidly in southern Florida, since 1965, and has been collected, since 2005, in marine waters (Charlotte Harbor and Biscayne Bay). In experimental trials, this fish tolerated salinities from 0 to 40 PSU (Langston et al. 2010), but did not tolerate temperatures below 12°C. It is expected to colonize more southern Florida estuaries, but be limited by winter temperatures (Schofield et al. 2009).

3.2 Invertebrates

Atlantic/Gulf Coasts

Tubastraea micranthus, Black Sun Coral- This Indo-Pacific cup coral was collected for the first time in the Atlantic Ocean in 2006, on an oil platform off Louisiana, in the Gulf of Mexico. Its congener, *T. coccinea*, has invaded widely in the western Atlantic, from Brazil to Texas and Florida. However, *T. micranthus* was found on only one oil platform out of 83 examined (Sammarco et al. 2010). Unlike other scleractinian corals, including *T. coccinea, T. micranthus* lacks zooxanthellae. This coral has a reputation for opportunistic and rapid colonization in its native range. Since its invasion may be in its early stages, Sammarco et al. (2010) suggest the possibility of eradication.

Rapana venosa, Veined Rapa Whelk- This northwest Pacific gastropod has invaded the Black, Mediterranean, and North Seas, the La Plata estuary in South America, and since 1998, Chesapeake Bay. Up to now, it has been collected only in the Chesapeake, in US Atlantic waters. However, from 2005 to 2009, eight Loggerhead Turtles (*Caretta caretta*, nesting on Wassaw Island, Georgia, had specimens of *R. venosa* as epibionts. This snail was also found on a Loggerhead stranded in lower Chesapeake Bay in 2008 (Harding et al., in press). These turtles normally host a rich community of epibiotic organisms including barnacles and bivalves. The small size of the whelks found on the Wassaw Island turtles indicates that they settled on the turtles in the vicinity of Wassaw Island, and strongly suggests that an undiscovered spawning population of the whelks occurs nearby in Georgia or South Carolina waters. The occurrence of the snails on the turtles also provides an interesting mode of dispersal for *Rapana venosa* (Harding et al., in press).

Perna viridis, Green Mussel- *Perna viridis* was first collected in the western Atlantic in Trinidad in 1970, and was first collected in US waters in 1999, in Tampa Bay, in the

Gulf of Mexico. In 2002, it was collected on the Atlantic Coast at Ponce de Leon Inlet, Florida, and subsequently was collected in harbors, and on boats, buoys, docks, etc., as far north as Virginia Beach, Virginia (Baker et al. 2007). However, established populations do not occur much further north than the Florida-Georgia border. Experimental studies indicate that this bivalve has a lower temperature threshold for survival of 10-14°C, corresponding with its present distribution (Urian et al. 2010). The unusually severe winter of 2009-2010 may have caused the range of this bivalve to contract - attempts to collect this bivalve in Tampa Bay in 2000 were unsuccessful, and local biologists suggested that the population had been greatly reduced (Joao Canning-Clode, personal communication). It is likely that ranges of several other shallow-water subtropical invaders (e.g. *Petrolisthes armatus*, Green Porcelain Crab; *Mytella charruana*, Charru Mussel, *Megabalanus coccopoma,* Titan Acorn Barnacle) in the southeastern United States were also affected by the severe winter, a reminder that rare weather events can curtail the expansion of invading species.

Megabalanus coccopoma, Titan Acorn Barnacle- This Eastern Pacific Barnacle invaded Brazil in the 1960s, and later became established in the Netherlands and Belgium, and most recently in West Africa (Kerckhof et al. 2010). In US Atlantic waters, it was first found in Louisiana in 2001 (Perreault et al. 2005), but established populations have not been found in the Gulf, to our knowledge. In 2005, it was found to be established in the Indian River Lagoon Florida, and has been found as far north as Core Sound, North Carolina (USGS Nonindigenous Species Program 2011). This barnacle was found to be reproducing and settling in the Intracoastal waterway at St. Augustine, Florida (Gilg et al. 2010).

Eriocheir sinensis, Chinese Mitten Crab- Since the first capture in Chesapeake Bay in 2006, 165 Chinese Mitten Crabs have been caught in US Atlantic Coast waters, 40 of these in 2010. However, this is a sharp decrease from 83 in 2009, and may reflect the decreasing novelty of these crabs, especially in the Hudson River and Raritan Bay systems (Darrick Sparks, personal communication). In January 2010, 17 gravid female crabs and 2 males were dredged in New York Harbor (Sparks, Ruiz, and Ferrante, unpublished data), and 6 crabs were caught in July-September 2010, in Fall Kill, a tributary stream near Poughkeepsie, New York. In spring and summer of 2010, 10 adult crabs were caught on the Delaware side of the Delaware River estuary, one in Toms River, tributary to Barnegat Bay, New Jersey, and one in Great Egg Harbor, at Ocean City New Jersey, the first capture in this estuary. The distribution of Chinese Mitten Crabs in 2010 remains roughly what it was in 2009, with an apparently established population in the Hudson River system, and scattered catches of adult crabs in coastal New Jersey bays, and Delaware Bay. However, none were reported in Chesapeake Bay in 2010.

Palaemon macrodactylus, Oriental Shrimp- This shrimp, native to the coasts of China, Korea, and Japan, has become established on the Pacific coast of the US, Europe (Germany-UK, Spain, Black Sea), and Argentina (Spivak 2006; González-Ortegón et al. 2007**;** Micu 2009). It is now well-established on the East Coast of the U.S. from New York Harbor to Narragansett Bay, Rhode Island. In the vicinity of New York City, it was first collected in 2001 in the Bronx and Hudson Rivers (Warkentine and Rachlin 2010). At the eastern end of Long Island Sound, *P. macrodactylus* was abundant in the Mystic River, Connecticut in 2009 (James T. Carlton, personal communication), and in 2010, it was found in the Providence River, at the head of Narragansett Bay (Cremins 2010). Only 3 specimens of this shrimp, collected from 2007 to 2009, are known from Chesapeake Bay (Ruiz et al. unpublished data), and the full range of this shrimp on the East Coast is not known.

Palaemon elegans, Rockpool Shrimp- *Palaemon elegans* is native to the eastern Atlantic from Norway to South Africa. It has been introduced to the eastern Baltic, the Caspian and Aral Seas, and the Persian Gulf (Holthuis and Hassan 1975; Grabowski 2006). In 2010, it was collected during a Rapid Assessment Sampling expedition in Salem Harbor, Massachusetts Bay (7/31/2010, MIT Sea Grant 2010; Commonwealth of Massachusetts, Executive Office of Energy and Environmental Affairs 2010). The population appears to be established, but the extent of this shrimp's range in US waters is not known.

Penaeus monodon, Asian Tiger Shrimp- This Indo-Pacific shrimp is widely reared in tropical waters. In 1988, there was a mass escape of *P. monodon* from an aquaculture operation in South Carolina, which led to captures of more than 1000 Tiger Shrimp from North Carolina to Florida. However, there were no further captures until 2006 and 2007, when at least 9 specimens were caught from Louisiana to Pamlico Sound, North Carolina. In 2008, at least 15 Tiger Shrimp were reported over this range, and in 2009, at least 9 more adult shrimp were caught from Vermillion Bay, Louisiana to the Cape Fear River, North Carolina (USGS Nonindigenous Aquatic Species Program 2010). In 2010, at least 27 of these shrimp were captured from Louisiana to South Carolina (USGS Nonindigenous Aquatic Species Program 2011). While this shrimp is no longer widely cultured in the tropical Atlantic, breeding populations may occur in the Caribbean (Perez et al. 2007). So far, there is no evidence for reproduction in US waters.

Tricellaria inopinata, Bryozoan - *Tricellaria inopinata* d;Hondt and Occhipinti Ambrogi, 1985 is a Pacific bryozoan closely resembling *T. occidentalis and T. porteri* (Dyrynda et al. 2000). High variability of distinguishing characteristics clouds identifying the precise origins of the species. It was identified in the in Venice Lagoon (Adriatic Sea) in 1982 and in the coast of Southern England in 1998 and found in Australia, New Zealand, and the West Coast of North America. As a fouling organism it has become widespread. It is likely spread by shipping and rafting (Watts 1998). It has been found in Eel Pond, Woods Hole, Massachusetts in 2010 (Collin Johnson, pers. comm. and subsequently identified by Judith Winston, Virginia Museum of Natural History). As with other species, it may have been overlooked or misidentified as one of the native morphospecies.

Zoobotryon "verticillatum", a southern affinity bryozoan. *Zoobotryon "verticillatum"* was first observed in the Mystic River, Connecticut, Long Island Sound in 2005 in one location, presumably from hull fouling (J. Carlton, pers. comm.). In 2010 it was found at several locations and on settling plates in areas where vessels do not dock (J. Carlton, pers. comm.) in depths of 0 to 3 m, at salinities of 24-28.5 psu. It is not expected to survive the colder waters, but the number and size of the colonies suggests that it may. It known from the Southeastern U.S. and is considered a tropical, warm temperate cosmopolitan species. It has not been reported from the Chesapeake Bay area and its occurrence in Long Island Sound is unique.

3.3. Algae and higher plants

Atlantic Coast-

'Heterosiphonia' japonica - The proper genus of *H. japonica* is uncertain, so the genus name is often presented in quotation marks (Schneider 2010). When it first appeared in Europe, it was initially identified as *Dasysiphonia* sp. (Sjotun et al. 2008). Morphologically, it appears most similar to species of *Dasysiphonia*, but more study of the group is needed before a definite assignment of a genus (Schneider 2010). This alga is native to the northwest Pacific, including China, Korea, Japan, and Russia. It was

first recorded in Europe in 1994, in the Netherlands, and is now found from Norway to Spain, and at a few locations in the Mediterranean (Sjotun et al. 2008). In 2009, it was found washed up on Quonochontaug Beach, on the south coast of Rhode Island, and was found at several nearby locations (Schneider et al. 2010). It was identified at two locations in Connecticut (J. Carlton, pers. comm.; identified by R. Rock-Blake). This alga can be expected to rapidly expand its range in US waters.

Ulva pertusa - The use of molecular techniques has greatly altered the systematic and identification of the sheet-like green algae of the genus *Ulva*, uncovering misidentifications, cryptic species, and cryptic invasions. In Great Bay, New Hampshire, where previously only *U. lactuca* was known, 4 species of *Ulva* were found, including the Indo-Pacific *Ulva pertusa* (Hofmann et al. 2010). The latter alga ranges from east Africa to Japan and Indonesia, with cryptogenic occurrences in California and New Zealand. In Europe, this alga is known from the Netherlands, Spain (Atlantic), and France (Mediterranean) (Guiry and Guiry 2011).

3.4 Parasites, pathogens, and other disease agents

New Sightings

General information

Species lists (x,y coordinates) (see database format)

Add links (and references)

Previous Sightings

(General information (as a previously overlooked species))

Species lists

Range expansions

(Add links and references)

Not Seen Species Yet

General Information

Species lists

(Add links and references)

4. Pathogens

Sightings/records

General information

(Add links and references)

5. Meetings

Past year

Marine Bioinvasion

6. References and bibliography

New publications on non-indigenous species in US Atlantic waters, and papers cited US summary

Aguilar-Perera A and Tuz-Sulub A (2010) Non-native, invasive Red lionfish (*Pterois volitans* [Linnaeus, 1758]: Scorpaenidae), is first recorded in the southern Gulf of Mexico, off the northern Yucatan Peninsula, Mexico. Aquatic Invasions 5 (Supplement 1): S9-S12.

Altieri AH, Van Wesenbeeck B, Bertness MD and Silliman BR (2010) Facilitation cascade drives positive relationship between native biodiversity and invasion success. Ecology 91: 1269–1275

Baker P, Fajans JS, Arnold WS, Ingrao DA, Marelli DC and Baker SM (2007) Range and dispersal of a tropical marine invader, the Asian green mussel, Perna *viridis*, in subtropical waters of the southeastern United States. Journal of Shellfish Research 26: 345-355

Brooks WR and Jordan RC (2010) Enhanced interspecific territoriality and the invasion success of the spotted tilapia (*Tilapia mariae*) in South Florida. Biological Invasions 12: 168-171

Carman MR, Morris JA, Karney RC and Grunden DW (2010) An initial assessment of native and invasive tunicates in shellfish aquaculture of the North American east coast. Journal of Applied Ichthyology 26: Suppl. 2

Carroll JM, Peterson BJ, Bonal DW, Andrew, Smith CF and Tettelbach ST (2010) Comparative survival of bay scallops in eelgrass and the introduced alga, *Codium fragile*, in a New York estuary. Marine Biology 157: 249-259

Commonwealth of Massachusetts Executive Office of Energy and Environmental Affairs (8/19/2010) State Researchers Find New Non-Native Invasive Species (Press release). p 1, Commonwealth of Massachusetts Executive Office of Energy and Environmental Affairs, Boston

Compton TJ, Leathwick JR and Inglis GJ (2010) Thermogeography predicts the potential global range of the invasive European green crab (*Carcinus maenas*). Diversity and Distributions 16: 243-255

Cremins C (10/17/2010) Invasive shrimp found in Bay. Warwick Beacon, published online, Warwick RI. http://www.warwickonline.com/view/full_story_news/9818225/article-Invasive-shrimp-found-in-Bay?instance=secondary_stories_left_column

Dyrynda PE, Fairfall VR, Occhipinti Ambrogi A and d'Hondt J-L (2000) The distribution, origins and taxonomy of *Tricellaria inopinata* d'Hondt and Occhipinti Ambrogi, 1985, an invasive bryozoan new to the Atlantic. Journal of Natural History 2000: 1993-2006

Fautin D, Dalton P, Incze LS, Leong J-AC, Pautzke C, Rosenberg A, Sandifer P, Sedberry G, Tunnell JWJ, Abbott I, Brainard RE, Brodeur M, Eldredge LG, Feldman M, Moretzsohn F, Vroom PS, Wainstein M and Wolff N (2010) An overview of marine biodiversity in United States waters. PLOS One 5: published online

Fourqurean JW, Smith TJI, Possley J, Collins TM, Lee D and Namoff S (2010) Are mangroves in the tropical Atlantic ripe for invasion? Exotic mangrove trees in the forests of South Florida. Biological Invasions 12: 2509–2522

Freestone AL, Osman RW and Whitlatch RB (2010) Latitudinal gradients in recruitment and community dynamics in marine epifaunal communities: implications for invasion success. Smithsonian Contributions to the Marine Sciences 38: 238-258

Freshwater DW, Hamner RM, Parham S and Wilber AM (2009) Molecular evidence that the lionfishes *Pterois miles* and *Pterois volitans* are distinct species. Journal of the North Carolina Academy of Science 125: 39-46

Gilg MR, Hoffman EA, Schneider KR, Ryabubiov J, El-Khoury C and Walters LJ (2010) Recruitment preferences of non-native mussels: Interaction between marine invasions and land-use changes Journal of Molluscan Studies 76: 333–339

Gilg MR, Lukaj E, Abdulnour M, Middlebrook M, Gonzalez E, Turner R and Howard R (2010) Spatio-temporal settlement patterns of the non-native titan acorn barnacle, *Megabalanus coccopoma*, in northeastern Florida. Journal of Crustacean Biology 30: 146-150

Gonzalez-Ortegon E, Cuesta JA, Pascual E and Drake P (2010) Assessment of the interaction between the white shrimp, *Palaemon longirostris*, and the exotic oriental shrimp, Palaemon macrodactylus, in a European estuary (SW Spain). Biological Invasions 12: 1731-1745

Grabowski M (2006) Rapid colonization of the Polish Baltic coast by an Atlantic palaemonid shrimp *Palaemon elegans* Rathke, 1837. Aquatic Invasions 1: 116-123

MIT Sea Grant (8/18/2010) First European marine shrimp to invade North America discovered in Salem Massachusetts on July 31. Retrieved from http://seagrant.mit.edu/news/press_releases.php?ID=150 on

Guiry MD and Guiry GM, http://www.algaebase.org; searched on 10 March 2011. (2011) AlgaeBase. Retrieved from http://www.algaebase.org on 3/10/2010 2010

Hale SS (2010) Biogeographical patterns of marine benthic macroinvertebrates along the Atlantic Coast of the Northeastern USA. Estuaries and Coasts 33: 1039–1053

Harding JM, Walton WJ, Trapani CM, Frick MG and Mann R (2011 (In press)) Sea turtles as potential dispersal vectors for non-indigenous species: the veined rapa whelk as an epibiont of loggerhead turtles. Southeastern Naturalist 10

Haydar D, Hoarau G, Olsen JL, Stam WT and Wolff WJ (2011) Introduced or glacial relict? Phylogeography of the cryptogenic tunicate *Molgula manhattensis* (Ascidiacea, Pleurogona). Diversity and Distributions 17: 68-80

Hofmann LC, Nettleton JC, Neefus CD and Mathieson AC (2010) Cryptic diversity of *Ulva* (Ulvales, Chlorophyta) in the Great Bay estuarine system (Atlantic USA): introduced and indigenous distromatic species. European Journal of Phycology 45: 230-239

Holthuis LB and Hassan AM (1975) The introduction of *Palaemon elegans* Rathke, 1837 (Decapoda, Natantia) in Lake Abu-Dibic, Iraq. Crustaceana 29: 141-148

Institute EL (2010) Status and trends in state invasive species policy: 2002-2009 p47, Environmental Law Institute, Washington DC

Jones E and Thornber CS (2010) Effects of habitat-modifying invasive macroalgae on epiphytic algal communities. Marine Ecology Progress Series 400: 87-100

Kerckhof F, Haelters J and Degraer S (2010) The barnacles *Chirona* (*Striatobalanus*) *amaryllis* (Darwin 1854) and *Megabalanus coccopoma* (Darwin 1854) (Crustacea, Cirripedia): two invasive species new to tropical West African waters. African Journal of Marine Science 32: 265 -268

Kettenring KM, McCormick MK, Baron HM and Whigham DF (2010) *Phragmites australis* (Common Reed) invasion in the Rhode River subestuary of the Chesapeake Bay: disentangling the effects of foliar nutrients, genetic diversity, patch size, and seed viability. Estuaries and Coasts 33: 118-126

Kimball ME, Able KW and Grothues TM (2010) Evaluation of long-term response of intertidal creek nekton to *Phragmites australis* (Common Reed) removal in oligohaline Delaware Bay salt marshes. Restoration Ecology 18: 772-779

Kipp R, Bailey SA, MacIsaac HJ and Ricciardi A (2010) Transoceanic ships as vectors for non-indigenous freshwater bryozoans. Diversity and Distributions 16: 77–83

Langston JN, Schofield PJ, Hill JE and Loftus WF (2010) Salinity tolerance of the African jewelfish *Hemichromis letourneuxi*, a non-native cichlid in south florida (USA). Copeia 2010: 475-480

Lejeusne C, Bock DG, Therriault TW, J. MH and Cristescu ME (2011) Comparative phylogeography of two colonial ascidians reveals contrasting invasion histories in North America. Biological Invasions 13: 635-650

Martin CW and Valentine JF (2010) Impacts of a habitat-forming exotic species on estuarine structure and function: an experimental assessment of Eurasian Milfoil. Estuaries and Coasts 34: 364-372

Martin CW, Valentine MM and Valentine JF (2010) Competitive interactions between invasive Nile tilapia and native fish: the potential for altered trophic exchange and modification of food webs. PLOS One 5: published online

McCormick MK, Kettenring KM, Baron HM and Whigham DF (2010) Extent and reproductive mechanisms of *Phragmites australis* spread in brackish wetlands in Chesapeake Bay, Maryland (USA). Wetlands 30: 67-74

Meyerson LA, Viola DV and Brown RN (2010) Hybridization of invasive *Phragmites australis* with a native subspecies in North America. Biological Invasions 12: 103-111

Micu D and Niţă V (2009) First record of the Asian prawn *Palaemon macrodactylus* Rathbun, 1902 (Caridea: Palaemonoidea: Palaemonidae) from the Black Sea. Aquatic Invasions 4: 597-604

Mozdzer TJ, Zieman JC and McGlathery KJ (2010) Nitrogen uptake by native and invasive temperate coastal macrophytes: importance of dissolved organic nitrogen. Estuaries and Coasts 33: 784-797

Munguia P, Osman RW, Hamilton J, Whitlatch RB and Zajac RN (2010) Modeling of priority effects and species dominance in Long Island Sound benthic communities. Marine Ecology Progress Series 413: 229–240

O'Connor NJ and Judge ML (2010) Molting of megalopae of the Asian shore crab *Hemigrapsus sanguineus* in intertidal habitats of Northeastern North America. Journal of Experimental Marine Biology and Ecology 385: 92-97

Osman RW, Munguia P and Zajac RN (2010) Ecological thresholds in marine communities: theory, experiments and management. Marine Ecology Progress Series 413: 185–187

Perreault RT (2004) An exotic tropical barnacle Megabalanus coccopoma in Louisiana: its = probable arrival and environmental implications. Proceedings of the Louisiana Academy of Sciences 66: 13-16

Peter CR and Burdick DM (2010) Can plant competition and diversity reduce the growth and survival of exotic *Phragmites australis* invading a tidal marsh? Estuaries and Coasts 33: 1225-1236

Program UNAS (2011) Nonindigenous Aquatic Species database on 3/9/2011 2011

Reinhardt JF, Stefaniak LM, Hudson DM, Mangiafico J, Gladych R and Whitlatch RB (2010) First record of the non-native light bulb tunicate *Clavelina lepadiformis* (Müller, 1776) in the northwest Atlantic. Aquatic Invasions 5: corrected proof

Ruhl HA and Rybicki NB (2010) Long-term reductions in anthropogenic nutrients link to improvements in Chesapeake Bay habitat. Proceedings of the National Academy of Sciences 107: 16566–16570

Sammarco PW, Porter SA and Cairns SD (2010) A new coral species introduced into the Atlantic Ocean - *Tubastraea micranthus* (Ehrenberg 1834) (Cnidaria, Anthozoa, Scleractinia): An invasive threat? Aquatic Invasions 5: 131-140

Schneider CW (2010) Report of a new invasive alga in the Atlantic United States: ''*Heterosiphonia*'' *japonica* in Rhode Island. Journal of Phycology 46: Journal of Phycology

Schofield PJ and Nico LG (2009) Salinity tolerance of non-native Asian swamp eels (Teleostei: Synbranchidae) in Florida, USA: comparison of three populations and implications for dispersal. Environmental Biology of Fishes 85: 51-59

Semmens BX, Buhle, Salomon AK and Pattengill S (2004) A hotspot of non-native marine fishes: evidence for the aquarium trade as an invasion pathway. Marine Ecology Progress Series 266: 239-244

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 3: 377-394

Spivak ED, Bosch EE and Martorelli SR (2006) Presence of *Palaemon macrodactylus* Rathbun 1902 (Crustacea: Decapoda: Caridea: Palaemonidae) in Mar del Plata harbor, Argentina: first record from southwestern Atlantic waters. Biological Invasions 8: 673-676

Stenyakina A, Walters LJ, Hoffmam EA and Calestani C (2010) Food availability and sex reversal in *Mytella charruana*, an invasive bivalve in the southern United States. Molecular Reproduction and Development 77: 222-230

Strayer DL (2010) Alien species in fresh waters: ecological effects, interactions with other stressors, and prospects for the future. Freshwater Biology 55: 152–174

Swearingen J and Saltonstall K (2010) *Phragmites* Field Guide: Distinguishing native and exotic forms of Common Reed (*Phragmites australis*) in the United States., p 34, Plant Conservation Alliance, Weeds Gone Wild.

Sylvester F and MacIsaac HJ (2010) Is vessel hull fouling an invasion threat to the Great Lakes? Diversity and Distributions 16: 132–143

Thomsen MS, Wernberg T, Altieri A, Tuya F, Gulbransen D, McGlathery KJ, Holmer M and Silliman BR (2010) Habitat cascades: The conceptual context and global relevance of facilitation cascades via habitat formation and modification. Integrative and Comparative Biology 50: 158–175

Urian AG, Hatle JD and Gilg MR (2010) Thermal constraints for range expansion of the invasive green mussel, *Perna viridis*, in the southeastern United States. Journal of Experimental Zoology 315: 12-21

Warkentine BE and Rachlin JW (2010) The first record of *Palaemon macrodactylus* (Oriental Shrimp) from the eastern coast of North America. Northeastern Naturalist 17: 91-102

Watts PC, Thorpe JP, and Taylor PD (1998) Natural and anthropogenic dispersal mechanisms in the marine environment: a study using cheilostome Bryozoa. Philosophical Transactions of the Royal Society (London) Ser. B., 353: 453-464.

Whitlow WL (2010) Changes in survivorship, behavior, and morphology in native soft-shell clams induced by invasive green crab predators. Marine Ecology 31: 418-430

Winston JE (2010) Stability and change in the Indian River area bryozoan fauna over a twenty-four year period. Smithsonian Contributions to the Marine Sciences 38: 229-239

Yuan W, Walters LJ, Schneider KR and Hoffman EA (2010) Exploring the survival threshold: a study of salinity tolerance of the nonnative mussel *Mytella charruana*. Journal of Shellfish Research 29: 415-422