ICES WGITMO REPORT 2012

ICES ADVISORY COMMITTEE

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

14 - 16 March 2012

Lisbon, Portugal

ICES
International Council for the Exploration of the Sea
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Contents

Executive summary

The 2012 meeting of the ICES Working Group on Introductions and Transfers of Marine Organisms (WGITMO) was held in at the European Maritime Safety Agency (EMSA) during 16-18. March with Brian Elliott (EMSA) as host and Henn Ojaveer as chair. The meeting was attended by 31participants from 18 countries andEMSA. Two countries contributed to the meeting by correspondence. The participants were from Belgium, Canada, Croatia, Estonia, Finland, France, Germany, Greece, Ireland, Israel, Italy, Lithuania, the Netherlands, Norway, Portugal, Spain, United Kingdom and United States while Poland and Sweden contributed by correspondence. Apologies were received from Lyndsay Brown (UK) and Malin Werner (Sweden).

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 MSFD requirements and the possible role of the working group in providing information to assist in D2 assessments, monitoring programs, database management and the potential for fouling of artificial structures. As usual, 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 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. Following the joint meeting discussion focused on the role the working group could have in the MSFD GES Description 2 assessments. The second day was spent on reports for each country in the form of a National Report. These are provided in Annex 3 and a short summary is given in the main body of the report.

For some Terms of Reference a more detailed presentation was given during the meeting and a short overview of the information and subsequent discussion is provided in the report at the end of each section. The report is structured so that each Term of Reference is dealt with in sequential order. The main body of the report contains summaries of the presentations and discussions with the more detailed documents being contained in the Annexes.

The group progressed in each of the Term of Reference by either completing the task or clearly identifying and agreeing on the intersessional activities required to finalise the work. Intersessional work is inherently becoming an integral component of future work for 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 March 14th, 2012 as a joint session with ICES/IOC/IMO Working Group on Ballast Water and Other Ship Vectors (WGBOSV). Tracy McCollin (Chair WGBOSV) and Henn Ojaveer (Chair WGITMO) welcomed all the participants and introduced Brian Elliott from the European Maritime Safety Agency (EMSA) who had kindly agreed to host the meeting. Brian Elliott welcomed everyone to Lisbon and gave a brief introduction to EMSA and the arrangements for the meeting. Tracy McCollin chaired the joint session. The session finished at 13:00 on March 14th and the WGITMO meeting started at 14:00.

2 Adoption of the agenda

The agenda was organized based on the Terms of Reference as given in ICES Resolution 2011/2/ACOM33 (see below). In addition, a few invited presentations on a specific topic and/or of generic interest, which, amongst others, might assist in defining ToR's for the coming years, were accommodated into the agenda which was adopted without changes. The 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). Cynthia McKenzie, Canada, acted as a rapporteur.

3 WGITMO Terms of Reference

2011/2/ACOM33 The **ICES Working Group on Introduction and Transfers of Marine Organisms** (WGITMO), chaired by Henn Ojaveer, Estonia, will meet 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 non-indigenous 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, WGBIODIV
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.

4 Progress in relation to Terms of Reference

The sections below provide information on the progress made by each of the Term of Reference, amended by more 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 via a short verbal report or in the form of more substantial presentation. The following sub-sections provide condensed highlights of all national reports received. For details please see Annex 3 (national reports) and Annex 4 (detailed summary information on new invasions and range expansions of already existing alien species as reported by countries).

4.1.1 Belgium

During 2011 five new introduced species were recorded: the bryozoan *Fenestrulina delicia*, the delphacid planthopper *Prokelisia marginata*, two red algae *Caulacanthus ustulatus* and *Gracilaria vermiculophylla*, and the spionid *Boccardia proboscidea*. All introduced species that were reported during previous years are still present and seem to be well-established and thriving.

4.1.2 Canada

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 as it is present in the United States.

4.1.3 Croatia

Nature Protection Directorate and Directorate for Nature Protection Inspection, State Institute for Nature Protection and Croatian Environment Agency are responsible for preparing incoming National Strategy on Invasive Alien Species in Croatia. In last three years, four new invasive alien species were recorded in the Eastern Adriatic Sea: bivalve *Anadara transversa* (Say, 1822), australian tubeworm, *Ficopomatus enigmaticus*, (Fauvel, 1923), dwarft flathead *Elates ransonnettii* (Steindachner, 1876) and creole fish *Paranthias furcifer* (Valenciennes, 1828). Populations of limpet snail *Sipho-*

naria pectinata (Linnaeus, 1758) were spreading along Middle Adriatic coastline, while population of blue crab, *Callinectes sapidus*, Rathbun, 1896, were established in the Neretva River Delta (Southern Adriatic). A remarkable increase in abundance of blue crab should be promoted as a new food source on the local market in terms of reducing eventual potentially negative impacts on the indigenous fauna.

4.1.4 Estonia

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.

4.1.5 Finland

No new alien species were found in Finnish waters in 2011. Crustaceans *Palaemon elegans, Gammarus tigrinus* and mud crab *Rhithropanopeus harrisii* were found to occur more widely in Finnish coastal waters than thought before. Also the round goby, *Neogobius melanostomus*, extended its distribution both locally and regionally. Finnish national strategy on invasive species, which aims to minimize the possibilities of new introductions of harmful alien species and the negative impacts of the established alien species, was completed in the end of March 2011 and will be accepted by the parliament during spring 2012. Finland is going to ratify the IMO's the BWM Convention during early summer 2012. A form for reporting observations on alien species is available in the internet http://www.riistakala.info/vieraslajit/index.php?lang=en.

4.1.6 France

Several projects were carried out and are in progress to investigate the presence of the alga *Undaria pinnatifida* and to evaluate its invasiveness. These studies emphasized the risk associated with the introduction of exotic species while, in the same time and the same area, another local project promoted its culture facilitating its expansion without precaution. This project was launched despite scientific reserves and total legal authorization. The possibility to pursue and extend the cultures of *U. pinnatifida* in Brittany is now examined by local authorities from a legal point of view –in particular considering the Regulation (EU) No 304/2011 of the European Parliament and of the Council of 9 March 2011 amending Council Regulation (EC) No 708/2007 concerning use of alien and locally absent species in aquaculture.

4.1.7 Germany

On 2 November 2011, a very dense, well established population of G3 *Claviceps purpurea* was found on the common cord-grass *Spartina anglica* C.E. Hubbard at two localities on the German North Sea coast in the Wadden Sea. The introduction vector is unclear. The German NEOBIOTA group noted that different approaches how to deal with seed mussel imports exist in the three Wadden Sea countries (NL, DE, DK).

4.1.8 Greece

In 2011 thee new marine aliens species were reported from the Greek Seas. These are the nudibranch *Flabellina rubrolineata* (from Syros isl, Kyklades Archipelago), the copepod *Parvocalanus crassirostris* (from Lesvos, an East Aegean island) and the platyelminth *Glyphidohaptor plectocirra* parasitising on siganids (*Siganus* spp.) from Rodos isl (SE Aegean). The occurrence of the macroalgae *Botryocladia madagascariensis,* a species previously overlooked at several localities attests its establishment success in the south Aegean and Ionian Sea. Considering the exclusion of *Amphistegina lessonii,* erroneously counted among aliens, the number of marine aliens in Greek waters increases from 237 to 240. Fifteen species have expanded their distribution in Greek waters, some of them (*Aplysia dactylomela, Cassiopea andromeda, Percnon gibbesi, Stephanolepis diaspros, Caulerpa racemosa* var. *cylindracea, Codium fragile* subsp. *fragile, Stypopodium schimperi*, *Asparagopsis taxiformis* and *Womersleyella setacea*) exhibiting invasive behaviour. One new fresh water alien fish, the monkey goby *Neogobius fluviatilis,* found in the mouth of Evros river, raises the number of aliens to 87.

4.1.9 Ireland

Of particular concern is the introduction of the Asian clam *Corbicula fluminea* which has been found at densities of >9,000 m^{-2} in the Barrow River in south-eastern Ireland . In Ireland's largest river, The Shannon, it has been recently found at densities of up to 3,000 m^{-2} ; and it continues to expand its range. The bloody red shrimp *Hemimysis anomala* is also found on the Shannon River in the larger lakes and there is currently a study on the interaction of this species with the native *Mysis salemaai*, there being concerns of competition between the two species, since during the winter both species occur in lake shallows. The slipper limpet *Crepidula fornicata* is now established in Belfast Lough althoughbeit occurring in relatively low numbers. The club tunicate *Styela clava* continues to expand its range to the north coast of Ireland.

4.1.10 Israel

In 2010-2011 28 new marine aliens species were reported from the Mediterranean coast of Israel. These include the mat-forming chlorophyte *Codium arabicum* commonly found in Haifa Bay and since 2008 become the dominant in the wreck. Believed to be introduced by vessels frequenting Haifa port. The bloom forming chlorophyte *Codium parvulum*. The authors believe it is a recent Erythrean introduction. The Indo-Pacific hydrozoans *Campanularia morgansi* and *Dynamena quadridentata*. The alien cephid scyphozoan *Marivagia stellata. S*pecimens of *Beroe ovata* were recorded and photographed outside the main breakwater of the Port of Ashdod. It is suggested that *B. ovata*, like *M. leidyi*, indigenous to western Atlantic coastal waters, may have been transported to Israel in vessels arriving from ports in the Black Sea. The nudibranchs *Aplysia dactylomela* and *Chromodoris annulata* have been found in several locations along the coast. The most probable pathway for *C. annulata* into the Mediterranean, like previously recorded Erythrean alien opisthobranchs, is through the Suez Canal. Nonetheless, the possibility of shipping as a vector does exist, as attested to by the specimen of *C. annulata* recorded from the Gulf of California. The neritid gastropod *Smaragdia souverbiana* was reported for the first time from the Mediterranean coast of Israel. A single shell was found in the intestines of *Callionymus filamentosus*, an Erythrean alien fish, which had been caught in Haifa Bay in 1987. This record predates the oldest published record of the species from Turkey by five years. 10 female specimens of a newly described siphonostomatoid copepod, *Lernanthropus callionymicola* were described from an Erythrean alien population of the blotchfin dragonet *Callionymus filamentosus*. A single specimen of the blacktail butterflyfish, *Chaetodon austriacus,* one of the most common chaetodontid fishes in the Red Sea, was collected near the port of Ashdod, a population of *C. austriacus* is known from a rocky reef off Nahsholim. Single specimens of the Orangeface Butterflyfish *Chaetodon larvatus* and the widely distributed Indo-Pacific *Pomacanthus imperator* were collected at the southern edge of Haifa Bay. A single specimen of the Indo-Pacific *Platax teira* was collected off Ashdod. It was first recorded from the Mediterranean by a single specimen from Bodrum, Turkey, and assumed to be an aquarium release. However, the finding of a second specimen in the Levant indicates that it is most likely an Erythrean introduction that has established a small population. A single specimen of *Priacanthus sagittarius* was collected off Tel-Aviv. This is the first record of this Indo West Pacific species from the Mediterranean and the first member of the Priacanthidae collected in the Levantine basin. A second specimen was collected off the southern edge of Haifa Bay. The finding of a second specimen in the Mediterranean in less than a year from its previous record suggests that this Erythrean alien species is establishing a population in its new region. The recent records of Erythrean coral-reef inhabiting fishes in the Mediterranean demonstrate a higher than expected plasticity in habitat choice and feeding habits. The cardinal fish *Cheilodipterus novemstriatus,* known from the Red Sea, Gulf of Oman, and Persian Gulf, was collected off Tel Aviv. It constitutes the fourth Erythrean alien cardinal fish species recorded within less than 5 years off the Israeli coastline. A single specimen of *Champsodon nudivittis* was collected off Ashdod. The occurrence of *Ch. nudivittis* in Israel and Turkey indicates the presence of a reproducing population in the Mediterranean of the Erythrean alien. A single specimen of *Cyclichthys spilostylus* was collected near Haifa Bay. The specimen constitutes the second record of the widely distributed Indo-Pacific species in the Mediterranean. A single specimen of the slender ponyfish *Equulites elongates,* widely distributed in the Indo-Pacific, was collected off Tel Aviv. A single specimen of the stonefish *Synanceia verrucosa* is the first record of this widely distributed Indo Pacific species from the Mediterranean. The stonefish is a venomous fish and its presence warrants special attention to ascertain whether it establishes a population.

A single specimen of *Trypauchen vagina* is the first record of the widely distributed Indo West Pacific species in the Mediterranean. A single specimen of the widely distributed Indo-Pacific tetraodontid fish *Tylerius spinosissimus* is the first record of the species from the SE Levant and the third record in the Mediterranean. A single specimen of the island grouper *Mycteroperca fusca* was speared near Tel Aviv. The species is known from the Azores, Madeira, Cape Verde, and the Canary Islands. It is the first record of the species in the Mediterranean Sea. Its presence in the SE Levant, but unknown elsewhere in the Mediterranean raises questions as to its possible vector. It may have entered through the Strait of Gibraltar and dispersed along the North African coast where it may have been overlooked or confused with it cogener *M. rubra,* introduced with ballast water or an escapee from a mariculture farm.

4.1.11 Italy

One algal species has been recorded for the first time in the Mediterranean (*Hypnea flexicaulis*). The Polychaete *Hesionura serrata* is recorded for the first time in Italy, from the Ionian Sea. Several studies describe biological features of established populations of microalgae forming harmful blooms. The spread of invasive macroalgae has been investigated in some areas, with a particular care about ecological relationships of the green benthic alga *Caulerpa racemosa* var. *cylindracea* with other algae and invertebrates. Some information has been published on bivalve and fish NIS.

4.1.12 Lithuania

No new NIS introductions in 2011 recorded. The round goby *Neogobius melanostomus* is still spreading further from the Klaipeda port area, both inside the Curonian Lagoon and northward along the mainland coast. Implementation of the EU Marine Strategy Framework Directive (in particular Articles 8, 9 and 10) required, *inter alia*, to assess non-indigenous species in Lithuanian marine waters.

4.1.13 The Netherlands

In 2012, seed mussels from seed mussel collectors will be transported from the Oosterschelde to the Wadden Sea. In the preparation phase of this transport, extensive monitoring campaigns on shellfish associated species have been conducted. This has resulted in more knowledge on the presence and distribution of exotic species. The pacific oyster has increased in the Oosterschelde. In the Wadden Sea it is allowed to collect Pacific oysters commercially in the wild. The razor clam (*Ensis directus*) has become by far the most dominant species in the Dutch coastal zone. There is commercial fishing on this species, but since the market is limited this does not have an effect on the stock sizes. No new exotic species have been observed in the Dutch waters in 2011.

4.1.14 Poland (by correspondence)

In 2011 deliberate releases of salmon (*Salmo salar*), sea trout (*Salmo trutta morpha trutta*) and whitefish (*Coregonus lavaretus*) were conducted. *Jaera istrii* Veuille, 1979 (Isopoda) in 2011 was recorded for the first time in Poland, in the Oder River. *Hypania invalida* (Grube, 1860) (Polychaeta) disappearanced in 2011 from the Szczecin Lagoon. *Gammarus varsoviensis* Jażdżewski, 1975 (Amphipoda) recognised until now as native to Central Europe is apparently an alien gammarid originated in the Pontic area. *Ameiurus nebulosus* (Lesueur) (Ictaluridae) was recorded for the first time in the Łyna River drainage basin in 2010. Parasites: *Diplostomum paracaudum* (Iles, 1959) (Digenea), *Eustrongylides tubifex* (Nitzsch, 1819) (Nematoda) and *Holostephanus luehei* Szidat, 1936 (Digenea) were recorded for the first time in Poland in the individuals of the Chinese (Amur) sleeper *Percottus glenii* Dybowski, 1877 (Perciformes: Odontobutidae), collected from 2008 to 2010 in the Włocławek Reservoir on the lower Vistula River. *Anquillicoloides crassus* (Kuwahara, Niimi et Itagaki, 1974) (Anqullicoidae) is increasing its range of occurrence in Poland. *Actis hypoleucos* (L., 1758) – is the new Polish host of trematodes (new records in Poland): *Plagiorchis nanus* (Rudolphi, 1802) (Digenea) and *Leucochloridium perturbatum* Polmańska, 1969 (Digenea). The digeneans were collected during 2005-2008, during a study on the food composition of the common sandpiper.

4.1.15 Portugal

A list of 81 aquatic non-indigenous species (NIS) is registered for the Portuguese estuarine and coastal aquatic systems, 9 of which were new additions to the 2011 report. 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 (since 2009). 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. A regional law on nature conservation and biodiversity, including exotic species issue was approved in the Azores. A specific law was published for regulation of fisheries in the Tagus estuary, including *Ruditapes philippinarum* as a legal capture.

4.1.16 Spain

The skeleton shrimp, ***Paracaprella pusilla***, was recorded for the first time in European waters in summer of 2010 in Cádiz harbor (36º 31'N, 6º 17'W), where it was present on the native bryozoan *Zoobotryon verticillatum* and the native hydroid *Eudendrium racemosum* in summer months, probably due to the higher water temperature during that season. Ship fouling is the most probable vector for its introduction.The **Royal Decree 1628/2011**, regulating the Spanish List and Catalogue of Invasive Exotic Species, was approved on 14th November, 2011. However, on February 24 2012, the Cabinet approved to revise the Royal Decree after the claims presented by some autonomous regions strongly opposing this legislation.Updated data on national production and prizes are presented for *Crassostrea gigas*, *Ruditapes philippinarum*, *Marsupenaeus japonicus* and *Undaria pinnatifida*.

4.1.17 Sweden (by correspondence)

There have been three new sightings in Swedish waters in 2011. The comb jelly, *Euplokamis dunlapae,* was found in the Gullmar fjord, southern Skagerrak, Conrad's false mussel, *Mytilopsis leucophaeata,* was found outside Forsmark nuclear power plant, in the southern Bothnian Sea and the Japanese skeleton shrimp, *Caprella mutica*, was found in the Koster area, in the Skagerrak. No new pathogens were reported.

4.1.18 United Kingdom

The invasive Carpet Sea-squirt (*Didemnum vexillum*) was found in a new area, along the north Kent coast, where it occurs in the low inter-tidal zone. In Wales, plans to re-attempt eradication of *Didemnum vexillum* in Holyhead harbour have been approved. In Scotland, consideration is being given to eradication from Largs marina and the surrounding area. Measures that were taken to prevent the spread of the predatory shrimp *Dikerogammarus villosus* appear to have been successful as there are no reported new sightings. Zebra mussels have spread to an additional seven lakes in Northern Ireland. No new species of non-native fish have been reported. A campaign aimed at recreational users of water bodies, entitled "Check, Clean, Dry", to stop the spread of aquatic invasive non-native species, was launched in March. Several research initiatives are underway or are planned. These include: obtaining records of American lobsters caught or seen by commercial fishermen, a biofouling on ships study; evaluation of pathway management, risk analysis, biosecurity and associated guidance; *D. vexillum* genetics; colonisation of offshore structures. The pathogens *Bonamia exitiosa* (in native oysters) and *Marteilia refringens* (in mussels) were recorded for the first time in the UK.

4.1.19 United States

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

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

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

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

4.2 Term of Reference b)

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

General

The information concerning the present monitoring programs and surveys, where non-indigenous species (NIS) could be observed, was collected from experts taking part to WGITMO meetings. The information was collected from the countries via an excel-sheet during autumn 2011/winter 2012. The information requested was on monitoring programs where information could be obtained on 1) presence/absence, 2) distribution or 3) abundance/biomass of NIS, and 4) if there exists monitoring in ports or 5) on ecological and socioeconomic impacts NIS cause.

The detailed information on existing monitoring programs was received via excel sheets from 9 countries: Belgium, Canada, Finland, France, Estonia, Italy, UK, Spain and Sweden. Additional information in text format was received from Canada, France, Estonia, Germany, Israel, Lithuania, The Netherlands, Spain, Sweden and UK. Italy has declared that the contents of the excel sheet was gathered only by non-official ways from individual scientists that were involved in monitoring campaigns and volunteered the information provided. Denmark and Poland reported that no monitoring programs occur where NIS could be detected.

In many countries the monitoring activities are scattered under different institutes making it difficult to obtain all information concerning ongoing programmes, and thus the reported monitoring activities here may give an underestimate of the real situation. The detailed country-information by different monitoring types (on presence/absence; distribution and abundance/biomass; port monitoring; ecological impact; socioeconomic impacts) is given in Annex 5.

Results

Presence/absence of NIS

Presence or absence of NIS could be detected in many of the biological monitoring programs. Many countries report that phytoplankton, zooplankton, macrophytes and fish are monitored and NIS could be detected in those monitoring surveys.

UK (Scottish) monitoring programs include phyto- (started 1997) and zooplankton (1997) and invertebrates. Settling fauna was monitored at marinas along the Scottish coasts in 2009. This included ascidians, bryozoans, molluscs, barnacles, anemones, hydroids, sponges and polychates. Presence/absence could be specifically detected for *Crepidula fomicata, Styela clava, Sargassum muticum* and *Crassostrea gigas* on the western and eastern coasts of Scotland. These monitoring programs have started 2010 and 2011, respectively on different coasts. Also crustaceans *Caprella mutica* and *Eriocheir sinensis;* ascidians *Perophora japonica* and *Styela clava* and green algae *Codium* could be detected in Scottish monitorings, conducted from 2006 to 2009. In Wales (UK) macrophytes are monitored annually by divers. This monitoring started in 2008 in 12 locations, mainly in marinas.

In the Canadian monitoring surveys several NIS can be detected among phytoplankton (started 1987) , invertebrates and macrophytes (started 1987). A macrophyte *Codium fragile*, tunicates: *Botrylloides violaceus, Botryllus scholsseri, Ciona intestinalis, Didemnum vexillum, Diplosoma listerianum, Styla clava,* bryozoans *Membranipora membranacea* and crustaceans: *Caprella mutica, Carcinus maenas* can be detected in the monitoring programs. These sampling programs have started 2004 or few years after that and are conducted in several locations in Quebec, Bay of Fundy, Newfoundland and Labrador.

The monitoring programs of Belgium in the North Sea can detect NIS from various taxonomic groups. These groups are zooplankton, benthos (epibenthos, hyperbenthos, macrobenthos, meiobenthos), jellyfish (with special focus on *Mnemiopsis leidyi*), demersal and pelagic fish, seabirds and mammals. The oldest samplings have started 1978 (demersal fish and epibenthos), while more benthos monitoring programs were started 1997 and during the late 2000's the rest of the groups were included in the sampling schemes. The only ecxeption being macrophytes, which are not monitored in Belgium. Samples are taken at least twice a year, pelagic samples are collected every month (jellyfish, zooplankton, fish).

The biological monitoring covers most of the habitats and taxonomic groups in Italy. Soft bottom invertebrates were started to be monitored 1970, phyto- and zooplankton surveys 1982 and 1996, respectively and macrophytes 1986, angiosperms 1987 and fish 1994. The frequency of monitoring depends on the taxonomic group (from weekly sampling of phytoplankton to annual sampling of fish).

Phyto-, zooplankton, macrophytes, macrozoobenthos and fish are monitored in coastal habitats in Estonia. Zooplankton monitoring has continued since 1957, phytoplankton, macrophytes and benthos since 1993 and fish from 1992. Open sea monitoring stations do not exist.

Biological monitoring in Finland covers all taxonomic groups. Phyto-, zooplankton, macrozoobenthos and fish are monitored in several open sea and coastal stations and macrophytes in the coastal zone. Sampling has a poor coverage in time; samples are collected mainly once a year. Benthos monitoring began 1966, plankton 1979 and coastal fish monitoring 1990. Littoral monitoring is poorly conducted in Finland, which leaves molluscs, crustaceans and fish living among macrophytes outside of the monitoring.

Swedish monitoring programs include phyto- and zooplankton, macrophyte, benthic invertebrate and fish sampling. Samplings are conducted both in the coastal and open sea stations. Benthic invertebrate monitoring has started 1978, zooplankton 1979, open sea fish trawling in 1970's, phytoplankton samling 1983, coastal fish monitoring 1991(nets), 2001 trawling and macrophytes 1993. Sampling frequency varies from several times a year (plankton) to once-twice a year (benthos, macrophytes, fish).

Distribution and abundance/biomass of NIS

Distribution and abundance/biomass of NIS could be studied for phytoplankton, macrophytes, invertebrates including tunicates, bryozoans and crustaceans in Canada. The distribution and abundance of phytoplankton, zooplankton, macrophytes, macrozoobenthos and fish non-indigenous species could be studied in coastal habitats in Estonia. In Belgium NIS distribution and abundance could be studied for benthos (epibenthos, hyperbenthos, macrobenthos, meiobenthos), jellyfish (especially *Mnemiopsis leidyi*), demersal and pelagic fish, seabirds and mammals. In Finland distribution and abundance of NIS could be studied in phyto- and zooplankton, macrozoobenthos and fish. All the taxonomic groups that reported for presence/absence monitoring (phyto-, zooplankton, benthos, fish) may also give information on NIS distribution and abundance/biomass in Sweden. The only exception being macrophytes that are only photographed and thus give information on distribution but not on biomass. Italy reports that only fish distribution and abundance could be studied, but most probably also the taxonomic groups that are monitored for presence/absence by sampling (phyto-, zooplankton, macrophytes, angiosperms, macrozoobenthos and fish) could give information on species distribution and abundance as well.

Port monitoring

Port monitoring is not known to exist in Sweden, Italy, Germany and Finland.

Canadian ports are monitored since mid or late 2000's for certain invertebrates. UK (Scottish) ports are monitored (2009-2011) for hull fouling during dry docking of vessels. Taxa monitored include barnacles, mussels, macroalgae, amphipods, bryozoans, isopods, oysters and polychaetes. In Belgium two ports have NIS monitoring (2011-2012) conserning zooplankton, jellyfish and macrobenthos. The main port of Estonia is monitored since 1996 for zooplankton and macrozoobenthos. It is possible that some countries have monitoring activities near ports although monitoring is not especially targeted to the port area. Thus this report may give an underestimation of monitoring done near ports, which could give information on NIS transported via ships.

Ecological and socioeconomical impact monitoring

Ecological impacts of NIS are not reported to be monitored in Sweden, Finland, Estonia, Italy, and UK. Ecological impacts are monitored in Belgium since mid 2000's for fish, benthos and jellyfish. Ecological impacts of phytoplankton (since 1987) and certain groups and species of invertebrates since mid-2000 (including tunicate species, bryozoans and crustaceans (mainly *Carcinus maenas*)) are monitored in Canada. Socioeconomic impacts are not monitored in any of the 7 countries who reported their monitoring activities.

Further information by countries

Canada

In Canada the phytoplankton monitoring program began in 1987 following the detection of domoic acid containing diatoms which had caused amnesiatic shellfish poisoning (ASP) in mussels. Phytoplankton monitoring (coastal and near shore) continues in the province of New Brunswick through this program and through the Atlantic Zonal Monitoring Program (offshore transects). A dedicated NIS monitoring program began in 2005 as part of a National Aquatic Invasive Species strategy. The Atlantic Regions (Newfoundland and Labrador, Quebec, Nova Scotia, Gulf of St.

Lawrence and Bay of Fundy) conduct monitoring, surveys and rapid response programs which include early detection and spread of non-indigenous species of concern including the following: the macrophyte *Codium fragile*, tunicates-*Botrylloides violaceus, Botryllus scholsseri, Ciona intestinalis, Didemnum vexillum, Diplosoma listerianum, Styela clava,* bryozoans *Membranipora membranacea* and crustaceans- *Caprella mutica, Carcinus maenas.* Monitoring (spatial and temporal) details vary by region but standardized methods are used for each taxonomic group eg. phytoplankton, tunicates, crustaceans. Environmental data is also collected in support of this program. There is a separate research program for impact of NIS on biodiversity and habitat. For more information on the Canadian AIS program please use the following Newfoundland and Labrador based link www.nfl.dfo-mpo.gc.ca/AIS-EAE. The link also provides additional links to other regions and national strategies.

Estonia

Distribution monitoring on alien species is carried out for phytoplankton, zooplankton and macrozoobenthos in several stations (6-12) in all major sub-basins (Gulf of Finland, Gulf of Riga and Baltic Proper) since 1993. The methodology applied follow HELCOM recommendations. Start of some monitoring activities (on zooplankton and ichthyoplankton), which have been carried out until now by using the same methodology, date back to early 1950s (in the Gulf of Riga). Coastal fish monitoring is also carried out in several localities (with up to around 70 stations per locality) in all major sub-basins with the earliest time-series dating back to 1992. As for invertebrates, HELCOM methodology is applied in fish monitoring.

There are two alien species which have dedicated monitoring activities. These are Chinese mitten crab and round goby, which have been reported in gillnet catches in the Gulf of Finland since the early 1990. These surveys, together with sampling of the port area and adjacent areas of the Tallinn Port (see below), are part of the national marine alien species monitoring program, which is in place since 2010.

Surveys in adjacent area to the Port of Tallinn has been sampled for zooplankton and macrozoobenthos since 1996. More detailed survey on alien species directly in the Port has been in place since 2010. No special dedicated surveys on ecological not socioeconomic impact. However, several datasets allow evaluation of ecological impacts of alien species.

While information on phytoplantkon, zooplankton, macrozooplantkon and fish is relatively good, micro-organisms, meiobenthos and microzooplankton is not included in national monitoring activities.

France

There is no monitoring program for non-native species.

Monitoring programs for native species which could included non native species:

a) Protozoan organisms, bacteria and viruses:

Monitoring program called REPAMO based on EU directive 2006/88/CE since 2003 (with these strategies) which includes an active surveillance and a passive surveillance on notifiable diseases and pathogens ; type of monitoring data: presence/absence and distribution. New introductions can be recorded.

b) Phytoplankton

Monitoring program called REPHY since 1984. New introductions can be recorded. Type of monitoring data: presence/absence, distribution and abundance. Historical data could be available at the following address http://envlit.ifremer.fr/resultats/surval__1

c) Macroalgae

Monitoring program called REBENT, since 2000 around Brittany coasts and since 2006 along other French coasts including Mediterranean sea for the Water Framework monitoring program. Type of monitoring data: presence/absence and distribution

d) Phanerogams

Monitoring program called REBENT, since 2000 around Brittany coasts and since 2006 along other French coasts including Mediterranean sea for the Water Framework monitoring program. Species recorded: *Zostera marina, Zostera noltii, Posidonia oceanic*. Type of monitoring data: presence/absence and distribution

e) Soft bottom invertebrate

Monitoring program called REBENT, since 2000 around Brittany coasts and since 2006 along other French coasts including Mediterranean sea for the Water Framework monitoring program. No list provided. Type of monitoring data: presence/absence, distribution and abundance

f) Fish

Recurrent campaigns in Channel sea, Gulf of Biscay and Gulf of Lion for exploited resources evaluation including fish, crustaceans, cephalopods and bivalves but no monitoring programs.

g) Mammals

Observations recorded but no monitoring program.

Germany

The German Marine Monitoring Programme covers already established long term investigations in the North Sea and the Baltic in order to fulfil requirements that derive from national and international obligations such as the HELCOM Convention, the OSLO and Paris Convention and the European Water Framework- and Marine Strategy Framework directives. Short term scientific projects are not included. The monitoring is carried out in close cooperation of federal and federal state agencies and institutes. A detailed description of the German Marine Monitoring Programme the Monitoring Manual is available on the web page of the German "Bund- Länder Messprogramm" http://www.blmp-online.de/Seiten/Monitoringhandbuch.htm. It is subdivided into individual Monitoring Specifications covering, for example, "phytoplankton" or "fish". The Monitoring Manual is a so-called living document, which is updated continually as the monitoring programme is developed further. Monitoring focused on Neobiota is not yet included in the programme. Currently national research projects are launched to develop monitoring of neobiota for different purposes.

Israel

The National Marine Environmental Monitoring Program (NMEMP) off the Mediterranean coast of Israel is carried out by the National Institute of Oceanography of Israel Oceanographic and Limnological Research (IOLR). The report also presents trends of environmental changes based on analysis of long-term monitoring data.

The NMEMP is guided by the Marine and Coastal Environment Division of the Ministry of Environmental Protection. The overall aim of the program is to provide a scientific base for environmental management of the coastal waters area, including enforcement of the provisions of relevant national legislation and international conventions.

The NMEMP includes eight components:

- Monitoring of heavy metals in the coastal waters (carried out since 1978);
- Monitoring of the introduction of nutrients and particulate metals into the coastal waters throughcoastal rivers (since 1990);
- Monitoring of the atmospheric fluxes of nutrients and heavy metals into the coastal waters (since 1996);
- Monitoring of nutrient levels and algal populations in the coastal waters (since 2000);
- Monitoring of benthic communities along the coastline (since 2005);
- Monitoring of biological effects of pollution ('biomarkers') (since 2005);
- Environmental mapping of the coastal waters area based on satellite data (since 2005);
- Estimation of the overall pollution load introduced into the coastal waters derived from a database on point sources of pollution (since 2002).

The data collected within the framework of the NMEMP is archived at the Israel Marine Data Center (ISRAMAR), IOLR.

Benthic communities: analysis of the benthic infauna collected once a year (August) by van Veen grab and sieved on 250 micron sieve, at 4 shallow stations (< 12 m depth) in Haifa Bay and 9 stations along the coast between Haifa and Ashquelon (mainly polychaetes, crustaceans and molluscs).

GAP ANALYSIS: missing: a. epifauna, especially demersal; b. depth distribution – samples should cover communities to 100-120 m depth; c. seasonality – should at least add another sampling in spring (May); d. taxonomic knowledge for invertebrates is lacking, the two ichthyologists retired as well as the one marine malacologist. Since Israel is situated down current from the largest pathway of NIS into the Mediterranean Sea, absence of taxonomists means the erosion of early warning capability.

Lithuania

There is no dedicated monitoring on marine alien species. However, the biological monitoring is going on in the Lithuanian part of the Baltic Sea with methods applied in accordance to HELCOM and ICES recommendations. The following organism groups have been monitored in Lithuania:

- Phytoplanlankton (since 1980)
- Zooplankton (since 1995)
- Macrozoobenthos (since 1980)
- Macrophytobenthos (since 1995)
- Fish stock assessment and young stage coastal surveys (since 1993)
- Env. impact assessment surveys, including biological surveys in the port and in the vicinity of the offshore oil terminal (since 1997)

In addition, some historical data, based on non-systematic surveys, is available for the Curonian lagoon since the 1920s and for the open sea since the 1950s.

The Netherlands

There are many monitoring activities in the Netherlands. Some of the monitoring is long-term and many monitoring campaigns are project based. This document focusses on the long-term monitoring programs. In recent years, many of the surveys changed from single species monitoring to multi species monitoring programs. During these extensive surveys special attention is paid to presence of exotic and invasive species in the samples.

Fish

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

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

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

Benthos

Yearly surveys with benthos dredges are carried out at a large scale in the in the Dutch coastal zone, Wadden Sea and the Delta area. Dredges have a 5mm mesh size, providing information on shell fish, crustaceans and echinoderms. Occasionally, tube worms, hydrozoan, anthozoa and bryozoan are collected as well.

Within the MWTL program, benthos is sampled at various (soft substrate) locations in the Dutch marine waters. The effort in the delta area is higher than in the rest. The samples are sieved over a 1 mm sieve and analyzed for all species present.

Phytoplankton

The monitoring of phytoplankton (biweekly to monthly) is mainly focused on chlorophyll concentration. Information on species composition is generally lacking. In the shellfish production areas there is monitoring on harmfull algae. This monitoring is monthly to weekly (in summer season).

Specific monitoring on exotic species

Since the traditional monitoring in the Netherlands is focused on soft substrates (the natural habitats), specific monitoring is initiated on hard substrates. In the Wadden Sea a surveys have been done focussing on NIS by GiMARis. For this projects extensive fieldwork in which various monitoring methods were combined and as many different habitats as possible were searched

Shellfish Associated Species Inventarisations (SASI) have been done on mussel stocks in the Oosterschelde. The focus of these surveys is on the presence of exotic species.

Within the Settle project About 200 14x14 cm grey PVC plates, hanging on a depth of 1 meter in 16 harbours along the Dutch coast, are checked for species, renewed and analysed every three months. this project started in 2006

Other species

There is no regular monitoring of zooplankton in the Netherlands. There is also lack of expertise for this type of monitoring. The monitoring of macroalgae is mainly kwalitative and is mainly project based. The expertise, however, is rest to a few experts.

Spain

There are different monitoring programs in Spain, but only a few are at a national level. From these national ones, none are specific for NIS, and some lack updating. Regarding the regional programs or associations, some have recently started to have observer networks to identify particular NIS. A main gap is the general lack of time series in ports, apart from toxic/HABs phytoplankton species.

At national level:

REDIBAL - Red Ibérica de Algas Tóxicas y Biotoxinas (Iberian Network of Toxic Algae and Biotoxins) (http://www.redibal.org/index.php)

REDIBAL has been conceived as a professional thematic network dealing with harmful algae, and was born out of the spirit of promoting interaction among scientists, technicians, managers and other groups of interest in the Iberian Peninsula. The dispersion of coastal monitoring efforts and the continuous scientific advances made in the methods of detection and mitigation of harmful algae make it advisable to establish a system for the exchange of knowledge between scientists and environmental management agencies so that the effort dedicated to this matter can function more efficiently.

The aim of the REDIBAL's database (http://www.redibal.org/index.php?op_menu=bases) is to establish an immediate, interactive and updated information pathway on **HABs species** in the Iberian Peninsula, their distribution, effects and toxins. This database is the result of the compilation of information provided by different research groups and monitoring programs since the 90's. It is divided into different sections: Registered Personnel, Research Centers, Projects, Species, Toxins and Syndromes.

Spanish GBIF Node (http://www.gbif.es/index_in.php)

The Global Biodiversity Facility GBIF is an inter-governmental organization born in 2001 that currently comprises 53 governments and 43 international organizations. GBIF is a network of national nodes with an international mandate settled in Copenhagen. The main goal of GBIF is to provide free and open online access to global biodiversity data supporting at the same time scientific research, conservation and sustainable development.

Nowadays, GBIF priorities are focused on species and specimen-level data and within this level, the collections are its first priority. The four working programmes of GBIF going on at the moment are:

- Data access and data base interoperability - DADI.
- Electronic catalogue of names of Known Organisms - ECAT.
- Digitization of nature history collections - DIGIT.
- Outreach and capacity building - OCB.

The Spanish GBIF Node is called "GBIF-España" or simply GBIF.ES. In February 2001, the Spanish Ministry of Science and Technology signed the Memorandum of Understanding (MoU). Thus, Spain became a member and voting participant of GBIF. The Ministry of Science and Technology commissioned the Spanish High Council of Research (CSIC) - by means of the Government Official Journal (BOE) - to initiate and coordinate the activities of GBIF in Spain. The CSIC, with support and advice of the Museo Nacional de Ciencias Naturales (National Museum of Natural Sciences) and the Real Jardín Botánico (Royal Botanical Garden) established the Coordination Unit, which begins its activities in June 2003. GBIF.ES is set up as a network of data nodes (institutes, projects, departments and individuals) and a Coordination Unit.

The Spanish Biodiversity Data Portal (with the sections: Algae and phytoplankton; Fungi and Lichens; Mosses and Liverworts; Vascular Plants and Germplasm (Herbaria, Germplasm banks, Inventories and Catalogs of references); Invertebrates (Collections, Inventories); Vertebrate (Collections, Inventories); Fabrics; Paleontological Collections; Miscellaneous) can be found in the following link:

http://taray.csic.es:8080/pres/PresentationServlet?action=menu&loc=http%3A%2F%2Fdigir.sourceforge.net%2Fschema%2Fconceptual%2Fdarwin%2F2003%2F1.0%2Fdarwin2Infodo.xml&reqType=search#

Plankton communities

Recognising the necessity to include mesozooplankton in time series of oceanographic data, and within the frameworks of international initiatives such as IGBP, IOC, GLOBEC, GOOS, OSPAR, etc. (related with global warming, ocean observation and ecosystem protection), the Instituto Español de Oceanografía (IEO) has established a core strategic programme to obtain and analyse long-time series data. A sampling programme (“Studies on time series of oceanographic data”) of systematic observations of ocean properties and biological communities was established in 1987 (Valdés *et al.*, 2002). The network of time series stations sampled include, along the

Spanish coast of the Bay of Biscay (Cantabrian Sea) and Galicia: Santander (starting in 1991), Gijón (in 2001), Cudillero (in 1993), Coruña (in 1988) and Vigo (in 1987); in the rest of Spain: Balearic Islands (off E coast of Spain) (starting in 1993), Fuengirola (S of Spain) (1992) and Cabo de Palos (SE Spain) (1996). At each of these locations (apart from the last two, which are sampled seasonally) a coastal-ocean gradient is sampled monthly for hydrography, nutrients and planktonic communities. The temporal resolution of this project allows the study and resolution of seasonal to inter-annual plankton dynamics, and allows for comparisons to be made among areas. Such studies on physical properties of surface water, and cross-shelf trends in phytoplankton and mesozooplankton abundance and biomass in the same area have been published elsewhere ([Valdés *et al*., 1991], [Varela, 1996], [Poulet *et al*., 1996], [Valdés and Lavín, 2002] and [Blanco-Bercial *et al*., 2006]). Biological variables measured include structural parameters such as abundance, biomass, species composition, body sizes and physiological rates such as production, respiration and consumption.

Each station was sampled following standard protocols for hydrography, nutrients and plankton (González-Pola *et al*. 2005). The upwelling index at each location was obtained using the Pacific Fisheries Environmental Laboratory Global Upwelling Index (http://las.pfeg.noaa.gov/las6_5/servlets/constrain?var=81). Zooplankton was sampled using 40-cm diameter WP-2 plankton nets with 200 µm mesh size (Vigo, Coruña, Cudillero) or in Santander the Juday-Bogorov net of 50 cm diameter and 250 µm. Nets were equipped with General Oceanic Flowmeters for the calculation of water filtered and depth recorders. Tows were vertical (WP-2) or double oblique (Juday-Bogorov) from 5 m from the bottom or from 100 m depth at deeper stations, except in Santander where only the upper 50 m is sampled. Samples were preserved in 2–4% sodium borate-buffered formaldehyde.

Both hydrographic and zooplankton results were reported annually to the ICES and summarized together with other time series from Europe, Canada and USA in the annual ICES Climate (e.g., Hughes and Lavín, 2004) and Zooplankton Status Report (e.g., Valdés *et al*., 2005).

A complete list of papers published from 1986 to 2009 within the project "RADIALES" can be accessed at: http://www.seriestemporales-ieo.com/resultados/publi_crono.pdf

At regional level:

Zooplankton in the Bay of Biscay (1995-2004, yearly DEPM surveys) (North of Spain) (http://bio.emodnet.eu/portal/index.php?dasid=2774) (http://data.gbif.org/datasets/resource/1935)

Density of zooplankton species was identified during the yearly spring DEPM surveys (1995-2004). DEPM survey had as a main objective the assessment of anchovy (*Engraulis encrasicolus*) stock biomass. This collection is completed until new projects allow identification over more samples from this survey.

Responsible: Marine Research Unit, AZTI, Spain (http://www.azti.es/)

Monitoring network of the ecological status of transitional and coastal waters (1995 – 2010) (North of Spain)**:** Benthic macroinvertebrates of soft substrate have been sampled annually in all of the Basque Autonomous Region estuaries and in coastal sampling stations at approximately 30 m depth. In addition, four phytoplankton samples are taken per year. Also, since 2002, macroalgae have been sampled in estuaries (four estuaries each year, so that all estuaries are sampled every three years) and benthos of hard substrate in coastal intertidal (a series of annual transects, so all estuaries are sampled every three years). Most reports are publicly available (in Spanish) at: http://www.uragentzia.euskadi.net/u81-0003/es/contenidos/informacion/calidad_aguas/es_doc/calidad_aguas_superficiales_transicion_costeras_in.html

Environmental monitoring of Nervión, Barbadún and Butrón estuaries (North of Spain):

Nervión estuary has been monitored since 1989 (the other two estuaries were added later). AZTI (http://www.azti.es/) began the sampling in 1994. They have data on **soft substrate benthic macroinvertebrates** for the entire period (annual samples taken at several stations) and also annual samples of **phyto-and zooplankton**. The reports are not public, but some could be requested.

Instituto de Ecología Litoral (Coastal Ecology Institute) in Valencia (East of Spain).

They have a network of observers for:

- Invasive species (Red de observación de especies invasoras (http://www.ecologialitoral.com/content/especies-invasoras)) which started in 1998, for *Caulerpa taxifolia*. Now they have also included *C. racemosa*, *Asparagopsis taxiformis* and *Lophocladia lallemandii.*
- *Jellyfish* (Observación de Medusas en la Comunidad Valenciana (http://www.ecologialitoral.com/content/medusas)) which started in 2009. The ctenophore *Mnemiopsis leidyii* is one of the species included in their pamphlet.

Observatorio de la Reserva Marina de las Islas Medes (Observatory of the Marine Reserve of the Medes Islands) (Northeast Spain) (http://www.ceab.csic.es/web/?page_id=3553): Since the beginning of the 90s, monitoring studies on the population of several benthonic species potentially affected by the protection (of the Marine Reserve) started, hence documenting their dynamics. Moreover, since the early 70's, various meteorological and oceanographic parameters have been recorded in the area on a weekly basis.

Zooplankton long-time series (in Mallorca, Balearic Islands, Mediterranean Sea): The long-term and seasonal changes in biomass and zooplankton abundance at a station off Mallorca Island (Balearic Sea) were studied in relation to the main physical and chemical conditions. From January 1994 to December 2003, a monitoring station at 77-m bottom depth was visited every 10 d at the same time of day (10:00 to 12:00). To determine hydrographic factors and nutrients, water samples were collected with 5-l Niskin bottles at 0-, 15-, 25-, 50-, and 75-m depth. CTD data were also used to describe the hydrographic conditions. (Fernández de Puelles *et al* 2004; Fernández de Puelles and Molinero 2008).

FAMOSO (Fate of the northwestern Mediterranean open sea spring bloom) project (from 01/01/2009 to 31/12/2011) which has studied phytoplankton dynamics in the Mediterranean Sea (http://www.utm.csic.es/proyecto.asp?id=%7BC586B4F0-BA7B-48E0-A858-9026876049DA%7D&switchlang=2). In the context of the FAMOUS project, one of the main objectives was the analysis of the zooplankton community and, more specifically, its role as a community liaison between the "bloom" of phytoplankton in spring and the higher organisms of the food web that feed on them.

ACA – Agència Catalana de l'Aigua (Catalan Water Agency) and **CEAB - Center for Advanced Studies of Blanes** (in Catalonia, NE Spain). In 1992, when *Caulerpa taxifolia* was first found in Spain, a network of surveillance aimed at preventing the introduction of this alga in the Catalan coast was established. With the arrival of *Caulerpa racemosa* var. *cylindracea* to Mallorca in 1998, *C. taxifolia*'s monitoring network was expanded to search for this new species. In 2006, the Catalan Water Agency (ACA) in collaboration with the Center for Advanced Studies of Blanes (CEAB) developed a new monitoring network to detect new introductions of algae at their incipient stages. This network has 126 stations that are sampled for two years and 60 transects, where algal communities along the bathymetric gradient on areas particularly susceptible to the introduction of these species are studied and quantified. This surveillance network has allowed also the detection of many exotic marine invertebrates.

In particular, the Department of Planning and Sustainability (from the Catalan Government), through the ACA, has recently promoted the creation of a database of aquatic (not just marine) exotic species that have appeared or have the risk of appearing in the aquatic environment, along with a series of useful data for assessing the risk of expansion and the potential impacts associated with each case. The database is called "SI-ExoAqua" and can be accessed from: http://delfos.creaf.uab.es/exoaqua/exoaqua/llistartaxons.htm

The project ExoAqua, sponsored by the ACA and conducted by the Autonomous University of Barcelona, has allowed the collection of all the recorded information on invasions in the aquatic environment in Catalonia. The results of the project have been recently published (in Catalan) and can be accessed from: http://aca-web.gencat.cat/aca/documents/ca/aigua_medi/especies_invasores/Informe_EXOAQUA_2011.pdf

FECDAS – Federació Catalana d'Activitats Subaqüàtiques (Catalan Federation of Underwater Activities) (in Catalonia, NE Spain)

http://www.fecdas.cat/agenda_list.php?modal_id=42&dep_nom=Mediambient&osCsid=33ip42r80ibe3fm6u8ca7pish7

This association has an Environment Department, which has recently started collaborating with scientists to monitor NIS. Information on *Caulerpa racemosa* and *C. taxifolia*, as well as an article on NIS in the Catalan coast can be found on their web page to increase the awareness among its members: http://www.fecdas.cat/docs/093926_Especies%20invasores.pdf

Sweden

There is no regular monitoring aiming directly at non-indigenous species. Comments below consider regular monitoring, where NIS could be found.

Hard bottom substrates and fauna living there are neglected. Only algae are studied there.

Some crusteceans and molluscs are less/not at all monitored, especially if they are living in shallow areas. I think this is a constraint in the gear used and stations studied in the monitoring programs. (No Chinese Mitten crabs, Pacific oysters or American lobsters have been found in the regular monitoring programs thought at least the first two have been found in numerous numbers.)

Microorganisms are almost only considered if they are causing a disease that has to be reported, except a monitoring on bacteria (production and cell volume, I think not species identification) in the Gulf of Bothnia.

Lack of taxonomic knowledge about introduced species can be a problem, especially when there are similar species already living in the area, but also because many species are morphologically similar, especially in their larval stages (e.g. *Mnemiopsis-Mertensia*, *Marenzelleria* sp., *Crassostrea gigas*). Genetic methods to distinguish between species are developed more and more.

Considering seasonal coverage, it varies a lot. Plankton is studied 1-25 times per year at different stations while macrozoobenthos are sampled once a year in spring. Macro fauna is also studied once a year in late summer or fall. Pelagic fish are studied twice a year (spring and fall). Coastal fish are studied in a number of different monitoring programs but often once or twice a year in the fall.

Website where the information can be found:

SMHI Shark database has a lot of information, but it is in Swedish:

http://www.smhi.se/klimatdata/oceanografi/Havsmiljodata/marina-miljoovervakningsdata

There are data on phytobethos, phytoplankton, zoobenthos, zooplankton, seals, bacterioplankton, and also sedimentation, primary production, chlorofyll and hydrography.

Fish databases are found at the new Swedish Agency for Marine and Water Management.

Coastal fish:

http://www.havochvatten.se/kunskap-om-vara-vatten/miljo--och-resursovervakning/provfiske-i-kust---sotvatten/provfiske-vid-kusten.html

UK

In the UK there is a Marine Monitoring and Assessment Strategy (UKMMAS) that aims to provide a better integrated understanding of our marine environment. The UKMMAS community reports to the UK Marine Science Co-ordination Committee.

UKMMAS works with the Marine Environmental Data and Information Network (MEDIN), a partnership of UK organisations committed to improving access to marine data. UKMMAS contributes to the:

- MERMAN database which has evidence of contaminants, biological effects and biology from 80 sites around the UK; and
- UK Marine and Coastal Resource Atlas, part of the MAGIC initiative, which contains environmental and other resource datasets covering the Great Britain coastline and marine areas of the UK Continental Shelf.

Much of the information held is for contaminants, although there is also a biological component, but this is not currently concerned with non indigenous species.

It is intended that the UKMMAS community will provide the necessary monitoring for the implementation of the EU Marine Strategy Framework Directive and to do so this will require greater coordination of information on non-indigenous species.

4.3 Term of Reference 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.

This activity was mostly performed intersessionally. Comments received on final draft of ICES Code of Practice (CoP) on the Introductions and Transfers of Marine Organisms (2005) appendice were discussed and reviewed during the meeting. Finalised appendices are found in Annex 6. Although additional examples for the CoP would be considered useful, the delay in submitting the document this would cause was not supported. The group was of consensus opinion, that the appendices should be made available via ICES webpage.

4.4 Term of Reference 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.

VECTORS - Introduction to an EU FP7 "Oceans of Tomorrow" project (presentation by Stephan Gollasch)

'VECTORS seeks to develop integrated, multidisciplinary research-based understanding that will contribute the information and knowledge required for addressing forthcoming requirements, policies and regulations across multiple sectors.'

Marine life makes a substantial contribution to the economy and society of Europe. In reflection of this VECTORS is a substantial integrated EU funded project of 38 partner institutes and a budget of €16.33 million. It aims to 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[1], outbreak forming species[2], and changes in species distribution and productivity. New and existing knowledge and insight will be synthesized and integrated to project changes in marine life, ecosystems and economies under future scenarios 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

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[1] **Invasive alien species** (IAS, based on Olenin *et al*., 2010) are a subset of established alien (non-indigenous species, non-native, exotic), which have spread, are spreading or have demonstrated their potential to spread elsewhere and have an adverse effect on one or more of the following; biological diversity, ecosystem functioning, socio-economic values or human health in invaded regions.

[2] **Outbreak forming species** (OFS) are indigenous species or invasive alien species (IAS) undergoing pulse-like, short-term (days to few months) exponential population growth during which they have an adverse effect on one or more of the following: biological diversity, ecosystem functioning, socio-economic values and human health. With this, **IAS are limited to non-indigenous species and OFS include both native and non-indigenous species.**

and especially 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.

Discussion

One of the key objectives in VECTORS is to prepare a comprehensive database of alien and cryptogenic species in the three seas bein in the VECTORS focus, i.e. the Baltic, North and western Mediterranena Seas (http://www.marine-vectors.eu/)

Currently, the database 'level' is LME (Large Marine Ecosystem) and country, so there are no options to enter species findings by coordinates neither to include NIS abundance data. This is different from several other approaches having ecoregional approach or designation of reporting areas by physical features / watershed areas. In the US, each state keeps their local information.

Cooperation with countries and experts not directly involved in the database work will be secured through WGITMO.

Practically essentially important and strategic questions are those related to i) data quality; ii) how to ensure data quality, iii) how to ensure a post-project life of a database, and iv) how to make an alien species database useful for research and practical for management. One of the possible solutions for some of these concerns is open access (Wiki principle; not open for everybody). These important issues will be dealt with in coming years.

Data quality issue could be solved by establishing editorial board + nominating an editor in chief. He /she will channel the relevant questions to relevant people. There were discussions whether or not WGITMO group could serve as editorial board and generic consensus was that this might be the most practical solution.

With regard the database host after the lifetime of the EU FP7 project VECTORS, several potential options should be considered. For instance, European Environment Agency (EEA) and Joint Research Council (JRC) were proposed as potential options. However, this list is not exhuastive and other options might be sought. However, it was also stated that the database should preferably be in the hands of those who developed it. Links/module to connect other existing major databases (like OBIS, DAISIE) should be developed.

Managers interests connected to this database could be identified as: i) CBD (e.g., number of NIS per sea/LME/country); ii) MSFD Descriptor 2 (e.g., number of NIS/NS ratio and NIS impacts); and iii) BWMC (species found in Ports, NIS potentially transportable by ballast water – all info available in the species traits block of the database). However, there might be other uses of the database and these should be identified in future.

4.5 Term of Reference 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.

This is planned as a multi-annual ToRwith the the primary product as a manuscript to be submitted to a high-profile scientific peer-reviewed journal. The working title of the manuscript is 'Non-Indigenous Species in the Sea: How Climate Change Will Alter Patterns of Distribution, Abundance, Community Structure, and Future Invasions' co-authored by Anna Occhipinti-Ambrogi, Henn Ojaveer, Judith Pederson, and James T. Carlton. The authorship list is not complete as yet and additional authors are likely to be invited. This will happen as soon as the first author of the paper will be agreed upon.

According to the currently proposed working schedule, the manuscript will: review the world's literature on (1) changes over the past several decades in the abundance and distribution of established non-indigenous species in shallow coastal waters from the Arctic to the Antarctic, and (2) new invasions that have been linked to facilitation due to climate change. In addition, we consider the status of monitoring programs and experimental studies on marine invasions, as related to climate change scenarios, in selected marine ecosystems globally. We further consider, and incorporate into our predictions, projections of trade routes and shipping patterns derived from the marine transportation literature. The manuscript will have the following major sections (tentatively):

1. *How Climate Change Will Alter the Distribution of Established Non-Indigenous Species;*
2. *How Climate Change Will Alter the Abundance of Established Non-Indigenous Species;*
3. *How Climate Change Will Alter Existing Community Structure and the Environment;*
4. *How Climate Change Will Alter Future Invasions;*
5. *Applicable Management Strategies.*

The first draft of the paper will be expectedly available by WGITMO 2013 meeting.

4.6 Term of Reference f)

Continue efforts to establish effective cooperation with PICES and CIESM.

This matter was discussed last year at WGITMO meeting as well as WGITMO chair discussed this issue with ACOM and SCICOM chairs.

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

Unfortunately, all efforts to establish contacts with CIESM have failed until now.

4.7 Other discussion items

There were several strategically important generic discussion items and/or presentations which did not directly qualify to under none of the Terms of References. These are briefly summarised below.

4.7.1 MSFD Descriptor 2 (Non-indigenous species introduced by human activities are at levels that do not adversely alter the ecosystem)

EC Decision (2010/477/EU) defines the two criteria for assessing progress towards good environmental status relevant to descriptor 2 "*Non-indigenous species introduced by human activities are at levels that do not adversely alter the ecosystem*":

1) Abundance and state characterisation of non-indigenous species (NIS), in particular invasive species

2) Environmental impact of invasive non-indigenous species

General discussion points, suggestions and concerns raised. These are important for EU member countries by providing guidance and assistance to address not only the near-future tasks (i.e., articles 9 and 10 of the MSFD), but also more generic issues, like designation of special monitoring programs and identification of parameters measured/estimated.

- The first D2 criterion and indicator deals with prevention of an arrival while the others deal with different invasion stages.
- It is not yet clear and commonly agreed on how are/should the baselines to be measured. Further discussions are needed in this issue and generic understanding needs to be created.
- One option would be that for each assessment period a new baseline could be created, what is added to this within an assessment period is what is used to evaluate management 'success'.
- Concerns were raised that it is not yet clear on how to deal with the situation when presence of some alien species was overlooked before a baseline assessment.
- Should it be decided that a new baseline will be developed for each assessment period, then those species already present may have a higher impact as these may go on to have an outbreak period. In addition, there may also be local expansions that may need to be quantified.
- The recording of new species arrivals is not enough, their impact also needs to be quantified as NIS with a low level of impact should be scored differently.
- There should be different weights applied to different species as some species may be more sensitive to the presence of aliens over others.
- One of the options might be to look for 'hot-spot' areas and, over time, see if there is a trend showing a reduction in non native species introductions.
- There was a concern that natural spread from adjacent countries could result in an increase in NIS numbers within the recipient country not responsible for such an introduction.
- Canada has set-up an method based on a 'health of the ocean' index which might be worth to be consulted while developing MSFD D2 indicators in EU member countries.

- Taxonomic groups which are well known and studied should be selected as not all species can be adequately recognized on arrival on account of their specialized taxonomy, size or cryptic state.
- Good monitoring and a good taxonomic resource for a specific country may put that country at a disadvantage in relation to other countries that do not have the same abilities because more non-indigenous species may be indetified due to more comprehensive monitoring and the taxonomic expertise available.

One of the criteria for assessing progress towards good environmental status in relation to the Descriptor 2 is *'Environmental impact of invasive non-indigenous species'* with the following indicator *'Ratio between invasive non-indigenous species and native species in some well studied taxonomic groups (e.g. fish, macroalgae, molluscs)...'*

When considering this criterion and the associated indicator, the following should be kept in mind:

- It should be based on what is present while sampling as the native species numbers may have changed based on samples obtained within an assessment area.
- Changes in the ratio may relate to declines in native species rather than increases in alien species.
- Other drivers may influence ratios and may depend on the functional group or taxon.
- Ratios may depend on geographical region with areas with less diversity having different results.

In summary, it was agreed that the following ten generic points should be considered when addressing this descriptor:

1) Availability of taxonomic expertise is critical to address MSFD D2 criteria and indicators;

2) Evaluation of the numbers of NIS, their spread and impact need to be standardized;

3) Evaluation of the newly arrived NIS may start with selected well studied taxonomic groups;

4) Ratio of NIS/NS (native species) in a region or habitat is to be calculated and evaluated based on contemporary reliable data;

5) Ratios (NIS/NS) and NIS impacts may vary with habitat, region, and presence of other drivers, and so could be independent of NIS management actions;

6) NIS with lesser recognized impact may be evaluated separately;

7) NIS inventories should be accompanied by pathways and vectors analyses;

8) Selected areas (hot-spots) could be used in monitoring to improve cost-effectiveness;

9) Management options should be agreed by neighboring countries because of the risk of secondary spread of NIS, as appropriate;

10) NIS with known impact(s) are to be managed as is practicable and on the basis of this the success of managements effort should be evaluated.

It was agreed that it would be good to present the current WGITMO work related to the MSFD D2 at the Marine Strategy meeting in Copenhagen May 14-16, 2012 "Research and Ecosystem Based Management Strategies in Support of the Marine Strategy Framework Directive".

4.7.2 Lessons learned on Terms of Reference completed intersessionally

2010 ToR f) Finalize the 5 year summary report (2003 – 2007) during intersession. The 5 year summary Cooperative Research Report was completed and has been submitted to ICES. Discussion on lessons learned from this summary indicates that considerable effort is required by several members to provide this summary as records were incomplete. Suggestions that another 5 year summary 2008-2012 be considered was not supported as annual reports are now available on line or through the sharepoint site for members, which was not the case for older reports. It was suggested and supported that archived reports which are not currently available to the scientific community be made available. Also, it was discussed and agreed that priority of the group should be to spend more time for timely and strategically important issues, like MSFD D2 and alien species database verifications.

2010 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. The report was finalized in November and submitted to ICES as an annex for 2011 report.

4.7.3 Matters of joint interest to WGITMO and WGBOSV

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

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

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

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

Descriptor 2. In addition, it allows incorporation of rich North-American experience and expertise to MSFD-related work within ICES.

4.7.4 Invasive Alien Species in the Mediterranean Sea - trends and management options

(presentation by Bella Galil)

Over 660 alien marine multicellular species have been recorded in the Mediterranean Sea, with many establishing viable populations and subsequently dispersing from their points of entry. A brief overview was presented of the current state of knowledge of bioinvasions in the Mediterranean Sea. A database of alien species records was used to characterize their identity, pattern of expansion, native region, and the relative importance of different taxa and vectors in the various regions of the sea. Although thermophilic species constitute the majority of Mediterranean aliens, Erythrean aliens are predominant in the east, with shipping and mariculture being mainly responsible for introductions in the northwest. The propagule pressure driving the Erythrean invasion is powerful in the establishment and spread of alien species in the eastern Mediterranean. The implications of the enlargement of Suez Canal, reflecting patterns in global trade and economy, were briefly discussed. Finally, as alien species inventories play a pivotal role in informing regional policy and management decisions and identifying resource priorities, the scientific community is called upon to pay particular attention to their accuracy and veracity.

4.7.5 Introduction and transfer issues of special concern to Portugal

(presentation by Paula Chainho and Ana Amorim)

The Portuguese team will try to develop future projects to address two invasive species, namely the bivalve *Ruditapes philippinarum* and the cnidaria *Blackfordia virginica*.

Ruditapes philippinarum – this species was registered in the Tagus estuary in 2000 and its populations have increased greatly along the last 5 years. It is currently the dominant benthic species in some areas of the Tagus estuary, mainly shallow bays with extensive intertidal areas. The increase in abundance of the Manila clam was simultaneous to a strong reduction of the native congeneric species Ruditapes decussatus. The Manila clam occurs in areas identified as below microbiological standards, requiring long term depuration before consumption. Illegal fishing is a major problem since although it is legal to harvest this species since 2011, there is no specific regulation. Management of harvesting for this species and microbiological criteria are major issues that need to be addressed by future projects.

Blackfordia virginica – this species was registered only in the Guadiana and Mira estuaries, but large blooms occur in the Mira estuary during summer. Since high densities were measured in the water column a considerable impact over fish species is expected to occur. The lack of specific studies and management actions for this species indicate the need for developing a specific research project in the Mira estuary.

4.7.6 How will non-native fishes and riverine food webs in the U.K. respond to climate change? – a few case studies

(presentation by Gordon H. Copp with with J. Robert Britton, Emily Fobert, Michael G. Fox, Michael J. Godard, Rodolphe E. Gozlan, Gérard Masson, Katja Sievers & Grzegorz Zięba)

Of the issues governments face regarding with non-native species, there are two key challenges: forecasting which new species might arrive under current and future conditions (and how to stop them); and predicting how existing species will respond to climate change. This presentation presented results from three complementary studies undertaken in the U.K.: 1) predictive modelling at the species level to determine which existing non-native freshwater fishes will benefit from climate change; 2) experimental trials to determine how an 'example' non-native species will respond in reproductive terms to a warmer climate and how it interacts under current and climate warmed conditions; modelling of at the foodweb level to predict how a typical river system in southern England will respond to species introductions (non-natives and a translocated native) and to climate warmed conditions. Six extant non-native species were predicted to benefit from warmer conditions, four 'ornamental' species and two angling species, with the latter species expected to create the greatest environmental impacts because of the elevated likelihood that they will be introduced more widely (illegally) in order to enhance angling amenity. One of the ornamental species, pumpkinseed (*Lepomis gibbosus*), was used as the 'example species' in the experimental trials, and under climate warmed conditions, it was found to spawn earlier, which led to a longer YOY pre-winter period of somatic growth, which is expected to enhance fitness and increase survival rate. Experiments to examine an early assumption by a French biologist that pumpkinseed impacts negatively on the growth of Eurasian perch (*Perca fluviatilis*) provided no evidence in support of this assumption, as no growth impacts were observed. Growth of the species together was similar (in perch) or enhanced (in pumpkinseed) relative to the controls, and this was determined to be the result of a repartition of available food by the two species, the perch reducing its intake of Chironomidae and increasing the amount of microcrustaceans, whereas the pumpkinseed took more Chironomidae and less microcrustaceans. The predictive modelling of a riverine food web used the River Frome (Dorset) as the example, due to the extensive amount of data on all trophic levels for that system. The modelled food web was found to be fairly resilient and no 'keystone' species were revealed when species were removed from the foodweb, one by one. Introduction of a top non-native predator (pikeperch *Sander lucioperca*) had a moderate impact on the food web. Introduction of a large-bodied, translocated native (barbel *Barbus barbus*), i.e. a species not native to the river, at an intermediate trophic level had no impact. Whereas, the greatest impacts on the food web were observed with the introduction of a small competitor (topmouth gudgeon *Pseudorasbora parva*) at an intermediate trophic level.

4.7.7 Fouling communities on offshore windmill parks

(presentation by Francis Kerckhof with S. Degraer, A. Norro & B. Rumes)

There is a world-wide concern of the expansion of non-indigenous species because they alter local biodiversity and sometimes compete with native species, some of which of commercial interest. This is especially the case in shallow coastal waters, subject to a multitude of human activities, including the construction of artificial hard substrata. We took the opportunity of the construction of numerous windmills off the Belgian coast to study the colonisation of non-indigenous species on these new artificial structures. Therefore we monitored the fouling communities of the wind farms on a regular basis from the beginning of their installation. We demonstrated that the new artificial hard substrata of the windmills offer new opportunities for non-indigenous species (introduced and southern Northeast Atlantic range-expanding species) to enter the Southern North Sea. Or, if already present, to expand their population size and hence strengthen their strategic position in the Southern North Sea. This is particularly important for the obligate intertidal hard substrata species, for which other offshore habitat is rare to non-existing.

During the considered period – late 2008-mid 2011 – we identified 26 species in the intertidal samples at the windmills. Of these species we considered 17 species as intertidal. The non-indigenous species form an important part of the intertidal fouling community. We found eight non-indigenous species. These include six introduced species: the oyster *Crassostrea gigas*, the barnacles *Elminius modestus* and *Megabalanus coccopoma*, the amphipod *Jassa marmorata*, the crab *Hemigrapsus sanguineus* and the midge *Telmatogeton japonicus*, and two range expanding species: the barnacle *Balanus perforatus* and the limpet *Patella vulgata*. The ratio for non-indigenous to introduced species is high 1/3. Their relative abundance, as estimated from the SACFOR scale, is in most cases high almost from the beginning.

This study demonstrated that the newly introduced hard substrata within offshore wind farms play an important role in the establishment and the expansion of the population size of non-indigenous species, thus strengthening their strategic position in the Southern North Sea. This is particularly important for the obligate intertidal hard substrata species, for which offshore habitat is rare to non existing.

4.7.8 Discussion of the usage of the term "invasive" as a descriptive term

Concern was expressed over the usage of the term "invasive" as a non-quantified term. The term non-indigenous was agreed to be more scientifically accurate however the use of invasive is embedded in the terminology due to long and common usage, particularly among managers. Amongst others CBD is using the term of invasive alien species for a subset of the most damaging species.

4.7.9 Discussion on visibility of WGITMO products

It was discussed and agreed that all WGITMO reports as well as relevant CRR's to WGITMO should be made available through WGITMO site.

5 Closing of the meeting

The meeting was closed at 13:30 on March 16th, 2012. The chair thanked the group for all their input and participation during the meeting and intersessionally. Brian Elliott and Eleonora Panella of EMSA were also thanked for hosting the meeting and for their participation throughout the week. The Portuguese delegates were also thanked for their hospitality and contributions to the meetings success. The chair also thanked Cynthia McKenzie for acting as rapporteur during the meeting.

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Annex 2. Meeting agenda

ICES WORKING GROUP ON INTRODUCTION AND TRANSFERS OF MARINE ORGANISMS

European Maritime Safety Agency (EMSA)
Cais do Sodré, 1249-206 Lisbon, Portugal

14th March – 16th March, 2012

WEDNESDAY 14TH MARCH

JOINT MEETING WITH WGBOSV

09.00 Opening of the meeting

Welcoming remarks (Tracy McCollin and Henn Ojaveer)

Logistics

Introduction of participants

09.30 WGBOSV ToR d: and other matters of joint interest to groups

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

11.00-11.30 Coffee break

- General discussion
- Wrapping up
- Location of next meeting
- AOB

13.00 End of joint meeting

13.00-14.00 Lunch break

Invasive Alien Species in the Mediterranean Sea - trends and management options. **Bella Galil**

MSFD GES Descriptor 2: where we are and how WGITMO can/should contribute. **Sergej Olenin, Dan Minchin**

15.00 – 15.30 Coffee break

Discussion on MSFD D2 issues (as arisen from presentations)

17:00-19:00 ToR d: VECTORS alien species database sub-group meeting

19.00 Close of the day

THURSDAY 15th 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. 10 minutes per country)

Belgium	Francis Kerckhof
Canada	Cynthia McKenzie
Croatia	Marijana Pecarevic, Joško Mikus
Finland	Maiju Lehtiniemi, Lauri Urho
France	Laurence Miossec
Germany	Stefan Kacan, Stephan Gollasch
Greece	Argyro Zenetos
Italy	Anna Occhipinti-Ambrogi
Ireland	Dan Minchin
Israel	Bella Galil

11.00 - 11.20 Coffee break

Lithuania	Sergej Olenin
Netherlands	Jeroen Wijsman, Andrea Sneekes
Norway	Anders Jelmert
Portugal	Paula Chainho, Ana Amorim, Joao Canning-Clode
Spain	Gemma Quilez-Badia
United Kingdom	Ian Laing, Gordon Copp, Tracy McCollin
United States	Judith Pederson
Estonia	Henn Ojaveer

13.00 – 14.00 Lunch

Trends indicator of the most invasive marine species in European Seas. **Argyro Zenetos**

Fouling communities on offshore windmill parks. **Francis Kerckhof**

How will non-native fishes and riverine food webs in the U.K. respond to climate change? – a few case studies **Gordon Copp**

15.00 – 15.30 Coffee break

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

VECTORS - Introduction to an EU FP7 "Oceans of Tomorrow" project. **Stephan Gollasch**

17:00-19:00 ToR d: VECTORS alien species database sub-group meeting

19.00 Close of the day

FRIDAY 16th MARCH

09. 00

ToR 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.

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

11.00 - 11.30 Coffee break

Arrangements for 2013 meeting and AOB:

- ✓ Lessons learned from intersessional work: Tor h) for 2011 (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)

- ✓ Five years reports: lessons learned and future planning (report for 2008-2012)
- ✓ Meeting ToR's for 2013
- ✓ Meeting venue for 2013

ToR 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

13.30 Close of the meeting

Annex 3. National reports

3.1 Belgium

Prepared by Francis Kerckof, Royal Belgian Institute of Natural Sciences, with support of Lies Vansteenbrugge, Institute for Agricultural and Fisheries Research, 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:

After some years of no new records (2008 – 2010) during 2011 five new introduced species were recorded.

Several colonies of the bryozoan *Fenestrulina delicia* Winston, Hayward & Craig, 2000 were present on stones of the scour protection of one of the windmills of the C-Power windmill park, collected on January 31st 2011.

This is the first autochthonous record in Belgian waters, until now the species was only found on stranded plastic objects.

During 2011 the spionid polychaete *Boccardia proboscidea* Hartman, 1940 was discovered in the marine growth on several groins along the Belgian coast although in low densities. There it lives intermingled with *Polydora ciliata* or amongst barnacles. This is de second record for Europe and the first for the North Sea (Kerckhof *et al* in prep.)

During August and September of 2011 high densities of the delphacid planthopper *Prokelisia marginata* (Van Duzee, 1897) were found to be present on *Spartina tonwsendii* along the Belgian coast e.g. in the nature reserves of the „Baai van Heist" and „Het Zwin" (De Blauwe, 2011).

Two red algae *Caulacanthus ustulatus* (Mertens ex Turner) Kützing, 1843 and *Gracilaria vermiculophylla* (Ohmi) Papenfuss 1967 where found in the nature reserve Baai van Heist in December 2011. *C. ustulatus* was present on the stones of the dam bordering the harbour of Zeebrugge and the nature reserve while *G. vermiculophylla* was found to be present on patches of intertidal mussels (*Mytilus edulis*) and *Crassostrea* (Kerckhof *et al*. 2012)

All introduced species that were reported during previous years are still present and seem to be well-established and thriving. Noteworthy was the find of a carapax of the *Callinectes sapidus* on the beach of De Panne on the 8th of October 2011 indicating that this species is still present

4. Pathogens

No information

5. Research projects:

In 2009 the research project EnSIS: "Ecosystem Sensitivity to Invasive Species", was funded by the Belgian Science Policy Research programme "Science for a sustainable development" Targeted actions North Sea. This project came to an end in 2011. The final report wil be available from http://www.belspo.be/belspo/NorthSea/program/phaseVII_en.stm

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.

6. References and bibliography

Kerckhof F., Verbeke D. & Bauwens F. 2012. Nieuws uit de Baai van Heist: *Caulacanthus ustulatus* (Mertens ex Turner) Kützing, 1843 en *Gracilaria vermiculophylla* (Ohmi) Papenfuss 1967 twee nieuwe roodwieren voor de Belgische kust en een merkwaardig habitat van intertidale mossels. De Strandvlo 32(1): 19 – 23.

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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.

Kerckhof F.; Degraer S.; Norro A.; Rumes B. 2011. Offshore intertidal hard substrata: a new habitat promoting non-indigenous species in the Southern North Sea: an exploratory study, in: Degraer, S. *et al*. (Ed.) (2011). Offshore wind farms in the Belgian part of the North Sea: Selected findings from the baseline and targeted monitoring. pp. 27-37 In: Degraer, S. *et al*. (Ed.) (2011). Offshore wind farms in the Belgian part of the North Sea: Selected findings from the baseline and targeted monitoring. Royal Belgian Institute of Natural Sciences. Management Unit of the North Sea Mathematical Models. Marine Ecosystem Management Unit: Brussels. 157 pp

Van Ginderdeuren, K; Hoffman, S; Hostens, K. Vansteenbrugge, L; Soenen, K; De Blauwe, H; Robbens, J; Vincx, M; 2012. Distribution of the invasive ctenophore Mnemiopsis leidyi in the Belgian part of the North Sea. Aquatic invasions Aquatic Invasions 7 (2): 163–169

3.2 Canada

Compiled by Sophie Foster, 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.

DFO has designated Caraquet Bay, Shediac Bay and Cape Tourmentine as restricted waters for the movement of both wild and cultured oysters and mussels with the requirement for an Introduction and Transfer licence including recommended treatment prior movement of shellstock for violet and golden star tunicates. This process is though the spat collection licence issuance.

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 and Labrador	Salvelinus alpinus (Arctic Charr)	35,000 K	Bay d'Espoir, NL 55°70′ 47°50′	Aquaculture	
	Salvelinus alpinus	2,000	St. John's, NL 47°.60′ 52°80′	Research	
	Onchorhynchus mykiss (Steelhead trout)	2,400,000	Bay D'Espoir, NL 55°70′ 47°50′	Aquaculture	Closed Containment facility only
	Gadus morhua (Atlantic cod)	50	Bay Bulls, NL 47°15′ 52°80′	Enhancement	
	Gadus morhua	250	St. John's, NL 47°.60′ 52°80′	Research	Release back to area where broodstock was captured
	Limanda ferruginea (Yellowtail flounder)	100	St. John's, NL 47°.60′ 52°80′	Research	Closed Containment facility only
	Salmo salar	200	St. John's, NL 47°.60′ 52°80′	Research	
	Salmo salar	10,000,000	South Coast, NL	Aquaculture	Destination Closed Containment facility only
	Salmo salar	400	Rattling Brook 49°00′ 55°20′	Enhancement	Transfers from commercial hatcheries
	Mytilus edulis, Blue Mussels	2,332,500 kg	Within NL	Aquaculture	
	Crassostrea virginica (American oysters)	50	St. John's, NL 47°.60′ 52°80′	Research	Seed transfers

Province	Species	Number (or weight)	Location and Lat & Long (if provided)	Reason	Notes & Website info if provided
	American oysters (crassostrea virginica)	2,500,000	St. John's and Placentia Bay, NL 47°.60′ 52°80′ and 47°40′ 54°15′	Research and Aquaulture	Destination Closed Containment facility only
	Placopecten magellanicus (Sea scallops)	1000	St. John's, NL 47°.60′ 52°80′	Research	Eyed larvae and spat to closed containment and farm sites
	Carcinus maenas (Green crab)	700	St. John's, NL 47°.60′ 52°80′	Research	Destination Closed Containment facility only
	Chionoecetes opilio (Snow crab)	13,000	Within NL St. John's, NL 47°.60′ 52°80′	Research	Destination Closed Containment facility only
Prince Edward Island	Atlantic halibut	16,500	Land-based fish farm in Victoria, PE	Aquaculture, rearing for export	Juveniles, various sizes
	Atlantic salmon	472,320	Various land-based research facilities	Research	Various life stages eggs to post smolt
	Atlantic salmon	2,000,000	Land-based fish farm in Souris, PE	Aquaculture, rearing to smolt size for export	Ova
	Atlantic salmon	9,500	Morell River, PE	Population Enhancement	Fry and juveniles released into system
	Atlantic sturgeon	120	Charlottetown, UPEI/AVC land-based research	Research	Eggs

Province	Species	Number (or weight)	Location and Lat & Long (if provided)	Reason	Notes & Website info if provided
			facility		
	Brook trout	24,100	Various Rivers on PEI: Big Pierre Jacques, Mill, Trout (Coleman), Wilmot, Dunk, West, Brudenell, Morell	Population Enhancement	Juveniles, to stock rivers, and to enhance populations following summer fish kills
	Rainbow trout	20,400	Various land-based aquaculture facilities	Aquaculture	Various life stages
	Rainbow trout	104,000	Land-based research facilities in Victoria and Fortune, PE	Research	Eggs and fry
	Rainbow Trout	525	Kensington and Kinkora, PE	Population Enhancement	Released fish into systems
	Short-nosed sturgeon	100	Charlottetown, UPEI/AVC land-based research facility	Research	Juveniles
	American oyster- seed/spat	54,380 lbs	Various Bays on PEI	Aquaculture	
	American oyster-cocktail	7,000 pcs and 90,000 lbs	Conway Narrows, Ellerslie	Processing, aquaculture	Pcs are individual oysters and one request was done so in pounds
	American oyster- market size	217,537 pcs and 6,000 lbs	Various Bays on PEI	Processing	Pcs are individual oysters and one request was done so in pounds

Province	Species	Number (or weight)	Location and Lat & Long (if provided)	Reason	Notes & Website info if provided
	Bay scallop-spat	40, 000 spat	St. Peters and Cardigan Bays	Aquaculture	
Prince Edward Island	Blue mussel- Transfer of mussel seed for culture	60,000 (ind) and 2,533,300 lbs	Various bays on PEI	Aquaculture	Many I&T requests are done so in pounds; therefore, the exact number cannot be determined and is given as number where possible and pounds.
	Eastern oyster	34 collectors of spat	St. Peters Bay	Research	
	Eastern oyster-wild	500 (ind)	Charlottetown, PE UPEI/AVC land-based research facility	Research	
	Quahaug	22,830 lbs	Freeland Creek	Processing	
	Soft-shell clams	65,000 lbs	Springbrook	Processing	
Nova Scotia	Atlantic salmon (Salmo salar)	9,119,450	Marine and land based facilities	Aquaculture (Domestic)	
		400	Research facility, NS		Research
		300,000	Local rivers	Enhancement	Various life stages Provincial Stocking Program Website http://www.gov.ns.ca/fish/sportfishing/stocked/
	Rainbow Trout (Oncorhynchus mykiss)	2,759,000	Marine and land based facilities	Aquaculture	Various life stages (eggs to adults)
		1680	Research facilities, NS	Research	Juveniles
		2,001,200	Local rivers and land based facilities	Enhancement	Various life stages (eggs to adults) Provincial Stocking Program Website http://www.gov.ns.ca/fish/sportfishing/stocked/

Province	Species	Number (or weight)	Location and Lat & Long (if provided)	Reason	Notes & Website info if provided
	Arctic Char (Salvelinus alpinus)	185,000	NS land based facilities	Aquaculture	eggs
		15,000	Research facility, NS	Research	eggs
	Atlantic cod (Gadus morhua)	2000	NS land based facilities	Aquaculture	Various life stages
		275	Research facility, NS	Research	Various life stages
	Atlantic Halibut (Hippoglossus hippoglossus)	12170	NS land based facilities	Aquaculture	Various life stages
	Smallmouth Bass (Micropterus dolomieu)	15	Research facility, NS	Research	Juvenile
	Striped bass (Morone saxatilis)	5787	NS land based facilities	Aquaculture	Juvenile
	Winter skate (Leucoraja ocellatta)	46	Research facility, NS	Research	Adults
	Little skate (Leucoraja erinacea)	46	Research facility, NS	Research	Adults
	Blue mussels (Mytilus edulis)	1,121,361 (Kgs)	NS marine sites	Aquaculture	Various life stages
		1500 (individuals)	NS marine research locations	Research	Juveniles
	American oysters (Crossostrea virginica)	1,905,000	NS marine sites	Aquaculture and Relay from Commercial fishery	Various life stages
	Hyalella azteca	700	NS River	Research	Adults

Province	Species	Number (or weight)	Location and Lat & Long (if provided)	Reason	Notes & Website info if provided
New Brunswick	Atlantic Salmon (S. Salar)	6.9 M	Bay of Fundy	Aquaculture to Marine sites	Smolts
	Atlantic Salmon (S. Salar)	18.4 M	NB Hatcheries	Aquaculture	All life stages
	Atlantic Salmon (S. Salar)	5.4 M	NB	Enhancement	All life stages
	Atlantic Salmon (S. Salar)	300 K	NB	Research	All life stages
	Rainbow Trout (Oncorhynchus mykiss)	200 K	NB	Aquaculture / Research	All life stages
	Artic Char (salvelinus alpinus)	30K / 50	NB	Aquaculture / Research	
	Landlock Salmon (Salmo salar)	230 K	NB Lakes	Enhancement	All life stages
	Brook Trout (Salvelinus fontinalis)	370 K / 800 / 600	NB	Enhancement / Aquaculture/ Research	All life stages
	Shortnose Sturgeon (Acipenser brevirostrum	10 K	NB	Aquaculture	Juveniles
	Atlantic Cod (Gadus morhua)	400	Huntsman Marine Science Center	Research	Juveniles
	Cunner (Tautogolabrus adspersus)	2800	Huntsman Marine Science Center / Bay of Fundy	Research	Adults

Province	Species	Number (or weight)	Location and Lat & Long (if provided)	Reason	Notes & Website info if provided
	American Oysters (C. virginica)	7 M	Gulf	Aquaculture	Spat
	Mussels (Mytilus edulis)	91 K kg	Bay of Fundy	Aquaculture	Spat
	Scallop (Placopecten magellanicus)	30 k	Gulf	Aquaculture	Spat
	Quahog (Mercenaria mercenaria)	7 M	Gulf	Aquaculture	Spat
Québec	Morue arctique (Boreogadus saida)	15	Univ. Laval		Recherche/ Research
	Pétoncle géant (Placopecten magelanicus)	50 000	Site aquacole près de Newport (Qc) 48 17 44.34 N 64 41 41.64 W		Production aquacole/ Aquaculture
	Pétoncle géant (Placopecten magelanicus)	2 050 000	Baie de Gaspé (Qc) 48 51 17.60 N 64 27 39.60 W		Production aquacole/ Aquaculture et recherche/ Research
	Pétoncle géant (Placopecten magelanicus)	34 000	Institut Maurice-Lamontagne, Mont-Joli		Recherche/ Research
	Huître américaine	17 000	Iles-de-la-Madeleine,Qc		Aquaculture
	Moules bleues	3 000 kg	Institut Maurice-Lamontagne, Mont-Joli		Recherche/ Research

Province	Species	Number (or weight)	Location and Lat & Long (if provided)	Reason	Notes & Website info if provided
	Laminaire	3 x 420 m de ficelle, plantules de 4 mm	Îles-de-la-Madeleine 47 25 17.60 N 61 50 5.90 W		Recherche/ Research aquaculture
	Crevette nordique (Pandulus borealis)	1500	Institut Maurice-Lamontagne, Mont-Joli		Recherche/ Research
	Homard américain	30	Institut Maurice-Lamontagne, Mont-Joli		Recherche/ Research
	Codium fragile (AIS)	200	Institut Maurice-Lamontagne		Recherche/ Research

2.2. Imports into Canada

Province	Species	Country of Origin	Location of import	End use & Other Information as provided (#s etc)
Newfound-land & Labrador	Salmo Salar	United States	South Coast	Aquaculture
Prince Edward Island	Koi	USA	Victoria, PEI	Research Landbased research facility
	Rainbow trout	USA	Dover, PEI	Aquaculture
	Rainbow trout	USA	Victoria, PEI	Research Landbased research facility
Nova Scotia	Atlantic salmon (Salmo salar)	USA	NS land based facilities	Aquaculture 7,000,000 Eggs
	Rainbow Trout (Oncorhynchus mykiss)	USA	NS land based facilities	Aquaculture 2,690,000 Eggs
	Gilthead sea bream (Sparus aurata)	USA	NS land based facility	Aquaculture 121,000 Fry
	Cuttlefish (Sepia officianlis)	USA	Research facility, NS	Research 10 Adults
New Brunswick	Atlantic Salmon (S. Salar)	USA	NB Hatcheries	Aquaculture All life stages 18.7 M
	Rainbow Trout (Oncorhynchus mykiss)	USA	NB Hatcheries	Aquaculture All life stages 750 K
	Atlantic Cod (Gadus morhua)	USA	Huntsman Marine Science Center	Research Juveniles 3500
	Lobster (Homarus americanus)	USA	DFO St Andrews Biological Station	Research Stage V 900

3. Unintentional releases

3.1. New Sightings

In 2011 there were no new species of non-native species recorded in Canadian Atlantic Ocean waters.

3.2. Persistent AIS Sightings:

The following provides as complete an overview as possible at the time of publication and does not represent all datapoints collected during the 2011 sampling season. Canada provided a full list of sampling in the Atlantic in response to the request for the terms of reference b) Prepare final report on existing monitoring activities and programs, in-cluding consider the gap analyses. Canada has a database that is updated on an ongoing basis, based on regional staff capacity.

Records included here represent persistent AIS, or AIS that have been detected in the area in previous years, or species that are undergoing range expansion within the Canadian Atlantic zone. Range expansion has been identified for Europeen Green Crab, Vase Tunicate, Golden Star Tunicate, *Botrylloides violaceus*, and *Codium*.

Some specific examples include; Golden star tunicates expanding to three sites Gulf - Cribbons Point, Ballantynes Cove and Tatamagouche, Nova Scotia; Green Crab expansion to Kouchibouguac River (opposite Loggiecroft wharf) and in Bouctouche, New Brunswick ;and, Codium expansion in Petit Cap, New Brunswick.

In addition, juvenille Green Crabs (*Carcinus maenas*) were detected for the first time in Gaspé, Quebec in August 2011. The crabs were trapped at Chandler (2, mean carapace = 2.9 mm) and Grande-Rivière (14, mean carapace = 3.3 mm). Additional fishing effort as well as diving did not detect any additional green crabs.

(En août 2011, des crabes verts (Carcinus maenas) juvéniles ont été détectés pour la première fois en Gaspésie. Ces crabes ont été observés sur des collecteurs installés à Chandler (2 crabes) et Grande-Rivière (14 crabes). La largeur moyenne de la carapace était de 2,9 mm pour Chandler et de 3,3 pour Grande-Rivière. Tous les efforts de pêche supplémentaires et les inspections en plongée n'ont pas permis de trouver d'autres crabes verts dans l'ensemble des sites visités.)

Table of

Species name	Country of origin	Date of first sighting/	Location of sightings **Geographical	lat_long	Population status
Ciona intestinalis	Europe	13-Oct-11	Digby	44.6525, -65.7551	
Ciona intestinalis	Europe	19-Oct-11	Meteghan	44.1934, -66.167	
Ciona intestinalis	Europe	19-Oct-11	Yarmouth Bar	43.8161, -66.1476	
Ciona intestinalis	Europe	19-Oct-11	Camp Cove	43.7242, -65.8399	
Ciona intestinalis	Europe	18-Oct-11	Clark's Harbour	43.4450, -65.3353	
Ciona intestinalis	Europe	18-Oct-11	Lockeport	43.6995, -65.1074	
Ciona intestinalis	Europe	19-Oct-11	Shelburne	43.7578, -65.3224	
Ciona intestinalis	Europe	17-Oct-11	Lunenburg	44.3757, -64.3073	
Ciona intestinalis	Europe	25-Oct-11	Indian Point	44.4581, -64.30682	
Ciona intestinalis	Europe	17-Oct-11	Chester	44.5359, -64.2418	
Ciona intestinalis	Europe	15-Oct-11	Halifax, Bedford Insitute of Oceanography jetty	44.6809, -63.6109	
Ciona intestinalis	Europe	15-Oct-11	Halifax, Armdale Yacht Club		
Ciona intestinalis	Europe	Nov-11	Country Harbour	45.23217, -61.759	
Ciona intestinalis	Europe	Nov-11	Whitehead	45.26, -61.16	
Ciona intestinalis	Europe	11-Oct-11	Cape Canso	45.3345, -60.9861	
Ciona intestinalis	Europe	11-Oct-11	Venus Cove	45.6151, -61.3901	
Ciona intestinalis	Europe	12-Oct-11	Petit de Grat	45.5071, -60.9605	
Ciona intestinalis	Europe	12-Oct-11	D'Escousse	45.5887, -60.9618	
Species name	Country of origin	Date of first sighting/	Location of sightings **Geographical	Population status lat_long	
Ciona intestinalis	Europe	12-Oct-11	Louisbourg	45.91798, -59.98935	
Ciona intestinalis	Europe	13-Oct-11	Sydney	46.1399, -60.1678	
Ciona intestinalis	Europe	13-Oct-11	North Sydney	46.1988, -60.2579	
Ciona intestinalis	Europe	13-Oct-11	Dingwall	46.9032, -60.4605	
Ciona intestinalis	Europe	Nov-11	Robin's Cove	45.5062, -61.0999	
Botryllus schlosseri		13-Oct-11	Digby	44.6254, -65.75507	
Botryllus schlosseri		19-Oct-11	Meteghan	44.1934, -66.167	
Botryllus schlosseri		19-Oct-11	Yarmouth Bar	43.8161, -66.1476	

Botryllus schlosseri		19-Oct-11	Camp Cove	43.7242, -65.8399
Botryllus schlosseri		18-Oct-11	Clark's Harbour	43.4450, -65.3353
Botryllus schlosseri		18-Oct-11	Lockeport	43.6995, -65.1074
Botryllus schlosseri		19-Oct-11	Shelburne	43.7578, -65.3224
Botryllus schlosseri		17-Oct-11	Lunenburg	44.3757, -64.3073
Botryllus schlosseri		17-Oct-11	Orangedale	45.9005, -60.0880
Botryllus schlosseri		25-Oct-11	Indian Point	44.4581, -64.30682
Botryllus schlosseri		17-Oct-11	Chester	44.5359, -64.2418
Botryllus schlosseri		15-Oct-11	Halifax, Bedford Insitute of Oceanography jetty	44.6809, -63.6109
Botryllus schlosseri		15-Oct-11	Halifax, Armdale Yacht Club	44.63588, -63.6131
Species name	Country of origin	Date of first sighting/	Location of sightings **Geographical	Population status lat_long
Botryllus schlosseri		12-Oct-11	Petit de Grat	45.5071, -60.9605
Botryllus schlosseri		12-Oct-11	D'Escousse	45.5887, -60.9618
Botryllus schlosseri		13-Oct-11	Little Harbour	45.58333, -60.74067
Botryllus schlosseri		12-Oct-11	St. Peter's	45.66115, -60.8744
Botryllus schlosseri		03-Nov-11	Whycocomagh	45.9683, -61.1128
Botryllus schlosseri		03-Nov-11	Eskasoni	45.9555, -60.5860
Botryllus schlosseri		14-Oct-11	Baddeck	46.0994, -60.7472
Botryllus schlosseri		12-Oct-11	Louisbourg	45.91798, -59.98935
Botryllus schlosseri		13-Oct-11	North Sydney	46.1988, -60.2579
Botryllus schlosseri		13-Oct-11	Dingwall	46.9032, -60.4605
Botryllus schlosseri		18-Oct-11	Port Mouton	43.9194, -64.8434
Botryllus schlosseri		Nov-11	East Bay	46.0136, -60.3892
Botryllus schlosseri		22-Oct-11	Cheticamp	46.6268, -61.0161
Botrylloides violaceus	Asia	13-Oct-11	Digby	44.6254, -65.75507
Botrylloides violaceus	Asia	19-Oct-11	Meteghan	44.1934, -66.167
Botrylloides violaceus	Asia	19-Oct-11	Yarmouth Bar	43.8161, -66.1476
Botrylloides violaceus	Asia	19-Oct-11	Camp Cove	43.7242, -65.8399
Botrylloides violaceus	Asia	18-Oct-11	Clark's Harbour	43.4450, -65.3353
Species name	Country of origin	Date of first sighting/	Location of sightings	Population status

			**Geographical	lat_long
Botrylloides violaceus	Asia	25-Oct-11	Indian Point	44.4581, -64.30682
Botrylloides violaceus	Asia	17-Oct-11	Chester	44.5359, -64.2418
Botrylloides violaceus	Asia	11-Oct-11	Cape Canso	45.3345, -60.9861
Botrylloides violaceus	Asia	12-Oct-11	Petit de Grat	45.5071, -60.9605
Botrylloides violaceus	Asia	12-Oct-11	D'Escousse	45.5887, -60.9618
Botrylloides violaceus	Asia	13-Oct-11	Little Harbour	45.58333, -60.74067
Botrylloides violaceus	Asia	13-Oct-11	North Sydney	46.1988, -60.2579
Botrylloides violaceus	Asia	13-Oct-11	Dingwall	46.9032, -60.4605
Botrylloides violaceus	Asia	22-Oct-11	Cheticamp	46.6268, -61.0161
Caprella mutica	Asia	13-Oct-11	Digby	44.6254, -65.75507
Caprella mutica	Asia	19-Oct-11	Meteghan	44.1934, -66.167
Caprella mutica	Asia	18-Oct-11	Clark's Harbour	43.4450, -65.3353
Caprella mutica	Asia	19-Oct-11	Yarmouth Bar	43.8161, -66.1476
Caprella mutica	Asia	25-Oct-11	Indian Point	44.4581, -64.30682
Caprella mutica	Asia	17-Oct-11	Lunenburg	44.3757, -64.3073
Caprella mutica	Asia	11-Oct-11	Cape Canso	45.3345, -60.9861
Caprella mutica	Asia	12-Oct-11	Petit de Grat	45.5071, -60.9605
Species name	Country of origin	Date of first sighting/	Location of sightings	Population status
			**Geographical	lat_long
Carcinus maenus		28-Jun-11	Indian Point	44.45669, -64.31584
Carcinus maenus		29-Jun-11	East River Point	44.57316, -64.16053
Carcinus maenus		29-Jun-11	Graves Island	44.56242, -64.2093
Carcinus maenus		29-Jun-11	Marriotts Cove	44.54999, -64.2818
Carcinus maenus		28-Jun-11	Oak Island	44.51123, -64.30192
Carcinus maenus		12-Jul-11	Halifax, Bedford Insitute of Oceanography jetty	44.6853, -63.6139
Carcinus maenus		11-Jul-11	Mahone Bay	44.44424, -64.36714
Carcinus maenus		13-Jul-11	Mill Cove	44.58025, -64.05365
Carcinus maenus		24-Aug-11	Central Port Mouton	43.9187, -64.84468
Carcinus maenus		24-Aug-11	East Port Medway	44.15152, -64.57648
Carcinus maenus		24-Aug-11	East Side Port L'Hebert	43.8197, -64.92887

Carcinus maenus		24-Aug-11	St. Catherine's River	43.84076, -64.86216
Carcinus maenus		11-Jul-11	First Peninsula - Lunenburg	44.38464, -64.431126
Carcinus maenus		28-Jul-11	East Chezzetcook	44.71095, -63.23633
Carcinus maenus		28-Jul-11	Lower Three Fathom Harbour	44.63778,- 63.27592
Carcinus maenus		28-Jul-11	Rainbow Haven	44.65189, -63.41907
Carcinus maenus				
		28-Jul-11	Cole Harbour South	44.6535, -63.4251
Species name	Country of origin	Date of first sighting/	Location of sightings **Geographical	Population status lat_long
Carcinus maenus		22-Sep-11	East Jeddore	44.72897, -63.00447
Carcinus maenus		22-Sep-11	Clam Bay Causeway	44.73377, -62.90678
Carcinus maenus		22-Sep-11	Ostrea Lake	44.71837, -63.08877
Carcinus maenus		22-Sep-11	DeBaie's Cove	44.75445, -62.80772
Membranipora membranacea	Europe	13-Oct-11	Digby	44.6254, -65.75507
Membranipora membranacea	Europe	19-Oct-11	Meteghan	44.1934, -66.167
Membranipora membranacea	Europe	18-Oct-11	Clark's Harbour	43.4450, -65.3353
Membranipora membranacea	Europe	25-Oct-11	Indian Point	44.4581, -64.30682
Membranipora membranacea	Europe	19-Oct-11	Camp Cove	43.7242, -65.8399
Membranipora membranacea	Europe	18-Oct-11	Lockeport	43.6995, -65.1074
Membranipora membranacea	Europe	17-Oct-11	Chester	44.5359, -64.2418
Membranipora membranacea	Europe	18-Oct-11	Port Mouton	43.9194, -64.8434
Membranipora membranacea	Europe	12-Oct-11	Petit de Grat	45.5071, -60.9605
Membranipora membranacea	Europe	11-Oct-11	Venus Cove	45.6151, -61.3901
Membranipora membranacea	Europe	12-Oct-11	D'Escousse	45.5887, -60.9618
Membranipora membranacea	Europe	03-Nov-11	Eskasoni	45.9555, -60.5860
Membranipora membranacea	Europe	13-Oct-11	North Sydney	46.1988, -60.2579
Species name	Country of origin	Date of first sighting/	Location of sightings **Geographical	Population status lat_long
Membranipora membranacea	Europe	12-Oct-11	Louisbourg	45.91798, -59.98935
Codium fragile	Japan	13-Jul-11	Mill Cove	44.58025, -64.05365

Codium fragile	Japan	29-Jun-11	East River Point	44.57316, -64.16053	
Ciona intestinalis	Europe	01-Nov-11	Sambro	44.47861, -63.59953	Range expansion
Botryllus schlosseri		01-Nov-11	Sambro	44.47861, -63.59953	Range expansion
Botryllus schlosseri		13-Oct-11	Little River	46.44712, -60.45936	Range expansion
Botryllus schlosseri		20-Oct-11	Cribbon's Point	45.75587, -61.89745	Range expansion
Botryllus schlosseri		20-Oct-11	Ballantyne's Cove	45.85862, -61.91945	Range expansion
Botrylloides violaceus	Asia	01-Nov-11	Sambro	44.47861, -63.59953	Range expansion
Caprella mutica	Asia	19-Oct-11	St. Ann's Bay	46.2514, -60.5871	Range expansion
Caprella mutica	Asia	09-Dec-11	Ship Harbour	44.8101, -62.84322	Range expansion
Caprella mutica	Asia	13-Oct-11	Little River	46.44712, -60.45936	Range expansion
Membranipora membranacea	Europe	19-Oct-11	St. Ann's Bay	46.2514, -60.5871	Range expansion
Carcinus maenas	Europe	August 23, 2007	North Harbour, Placentia Bay	47.854984 -54.10007	
Membranipora membraniceae	Europe	2005	Bonne Bay, West coast	49.505760 -57.916660	
Botryllus schlosseri	Europe	December 7, 2006	Argentia, Placentia Bay, Arnold's Cove Placentia Bay, Hermitage, Hermitage Bay	47.292000 -53.990417	throughout Placentia Bay was detected for the first time in Foxtrap Marina, Conception Bay
Botrylloides violaceus	Asia	October 24, 2007	Belleoram, Fortune Bay	47.527194 -55,409167	
Caprella mutica	Japan	October 20, 2006	Salmonier Cove, Connaigre Bay, several locations within Placentia Bay	47.586883 -55.783200	

3.3. Future AIS threat:

Didemnum vexillum is considered a threat to Atlantic Canada as it is present in nearby US waters. Canada conducted a Rapid Assessment for *Didemnum vexillum* in the Bay of Fundy in September. No *Didemnum* was detected.

4. Pathogens

None reported

5. Meetings, conference, symposia or workshops

17th International Conference on Aquatic Invasive Species (San Diego, California) Aug-Sept 2010

16th International Conference on Aquatic Invasive Species (Quebec, Ca) April 2009 DFO Aquatic Invasive Species Workshop (January 2009)

7th International Conference on Marine Bioinvasions. Barcelona, Spain August 23-25, 2011.

McKenzie, C. H., Brooks Pilgrim, Don Deibel, Ben Lowen, Kevin Ma, Raymond J. Thompson. 2011. Mitigation and control of two aquatic invasive species in Newfoundland, Canada: Case studies on the violet tunicate, *Botrylloides violaceus*, and the European green crab, *Carcinus maenas*.

Rossong, Melanie, A., Timothy J. Barrett, Pedro A Quijon, Paul V.R. Snelgrove, **Cynthia H. McKenzie** and Andrea Locke. 2011. Regional differences in foraging behaviour and morphology of invasive green crab (Carcinus maenas) populations in Atlantic Canada.

Bailey, Sarah, A., Farrah Chan, Jennifer Bronnenehuber, Nathalie Simard, Kimberly Howland, Jennifer Martin, **Cynthia McKenzie**, and Terri Sutherland. 2011. Risk assessment of ship-mediated introductions to Canada.

6th International Tunicate Meeting, Montreal QB, July 3-7, 2011

Deibel, Don, Ben Lowen, Kevin Ma, Cynthia McKenzie, Matt Rise, Gavin Applin and R.J. Thompson. Rationale and design of a collaborative study of non-indigenous ascidians on the south coast of insular Newfoundland,

Lowen, J. Ben, Don Deibel, Kevin Ma, Cynthia H. McKenzie, Ray Thompson Life-history Constraints Affecting Invasion Success in *Botryllus schlosseri*

Ma, Kevin, Ben Lowen, Don Deibel, Cynthia McKenzie· Seasonal variability in realised larval recruitment of the non-indigenous *Botryllus schlosseri* in Arnold's Cove, Newfoundland.

Canadian AIS Monitoring Workshop, Moncton, NB, March 30, 2011.

McKenzie, C.H. and Terri Wells "Review of Newfoundland and Labrador Region AIS research and monitoring 2010 activities and plans for 2011."

Canadian Science Advisory Sector Meetings

CSAS Risk Assessment for ship-mediated introductions of aquatic non-indigenous species to the Great Lakes and the Canadian Arctic, Burlington, ON, March 1-2, 2011.

CSAS AIS Regulatory Meeting Montreal Quebec, March 9-10, 2011.

CSAS Screening-Level Risk Assessment Priorization Protocol for Aquatic Non-Indigenous Species. Montreal, Quebec, November 22-24, 2011

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Locke A, Hanson JM (2011) Trends in invasive ascidian research: A view from the 3rd International Invasive Sea Squirt Conference 6: 367-370.

Locke A, Mandrak NE, Therriault TW (2011) A Canadian Rapid Response Framework for Aquatic Invasive Species. Canadian Science Advisory Research Document 2010/114: 30p.

Ma, Kevin C.K, Don Deibel and Cynthia McKenzie. 2011. Indigenous and non-indigenous ascidian tunicates of Newfoundland and Labrador. ACC Advance Spec. Publ. No. 17:58-63.

Reebs SG, Jackman PM, Locke A, Fairchild WL (2011) Avoidance by sand shrimp, *Crangon septemspinosa*, of sandy patches covered by hydrated lime (calcium hydroxide) deposits. Canadian Technical Report of Fisheries and Aquatic Sciences 2938: 7p.

Rossong, M.A., T.J. Barrett, P.A. Quijon, P.V.R. Snelgrove, C. H. McKenzie and A. Locke. 2011. (published online 25 Sep 2011) Regional differences in foraging behavior and morphology of invasive green crab (Carcinus maenas) populations in Atlantic Canada. Biological Invasions DOI 10.1007/s10530-011-0107-7

Sephton, D., Vercaemer, B., Nicolas, JM and Keays, J. 2011. Monitoring for invasive tunicates in Nova Scotia, Canada (2006-2009). Aquatic Invasions 6: 391-403.

Vercaemer, B., Sephton, D. Nicolas, JM, Howes, S and Keays. J. 2011. *Ciona intestinalis* environmental control points: Field and laboratory investigations. Aquatic Invasions 6: 477-490.

Vickerson, Andrew, Cyr Couturier, Cynthia H McKenzie. 2011. Managing mussel, *Mytilus* spp. Seed Health: The effects of brine, lime and acetic acid antifouling treatments and transport on mussel seed performance. Proceedings of the Canadian Freshwater Symposium Aquaculture Canada 2007. AAC Spec. Publ. No. 13: 48-50.

3.3 Croatia

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1. Regulations:

The fundamental act regulating nature protection is the Nature Protection Act, passed on 20 May 2005 and promulgated on 27 May 2005. The act came into effect on 16 June 2005, and was published in the Official Gazette (70/05 of 8 June 2005). In December 2008, the Act on Amendments to the Nature Protection Act (OG 139/08) was passed. The consolidated text of the Act is available on web pages: http://www.dzzp.hr/eng/regulations/k/laws-and-regulations-702.html.

The National Strategy and Action Plan for the Protection of Biological and Landscape Diversity (NSAP) is the fundamental strategic document for nature conservation in the Republic of Croatia.

Nature Protection Directorate and Directorate for Nature Protection Inspection, State Institute for Nature Protection and Croatian Environment Agency are responsible for preparing incoming National Strategy on Invasive Alien Species in Croatia.

2. Intentional:

Synthesis of introductions – No data available.

3. Unintentional:

New Sightings

Invertebrates

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

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

The specimens of *Melibe viridis (Kelaart, 1858)* (syn. *Melibe fimbriata* Alder & Hancock, 1864) were found during October 2001 in Stari Grad Bay (Island of Hvar, Croatia) in *Cymodocea nodosa* and *Posidonia oceanica* beds on sandy and sandy–muddy bottoms at depths of 2 to 15 m. Presently, this is the northernmost record of this lessepsian immigrant in the Mediterranean basin (Despalatović *et al*. 2002).

An abundant population of limpet snail *Siphonaria pectinata* (Linnaeus, 1758) (Mollusca, Gastropoda, Pulmonata) was recorded for the first time in the Adriatic Sea near Split in spring 2003. It is probably introduced by ballast water. In 2009 populations of this species were found in the coastal area from Rogoznica to Omiš spreading to island of Brač. *S. pectinata* population took over the indigenous species of genus *Patella* (Despalatović *et al*., 2009).

Alien species *Ficopomatus enigmaticus*, australian tubeworm, was recorded on two locations along the eastern Adriatic coast, Krka River Estuary and Neretva River Delta in 2009. It is probably introduced as ship fouling (Cukrov *et al*. 2010).

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

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

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

<u>Vertebrates</u>

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 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).

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. Specimen is stored in the Ichthyological collection of the Institute of Oceanography and Fisheries, Split, under the number IOR-18 (Isajlović *et al*. 2009).

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

On 21 June 2010, a specimen of the tripletail, *Lobotes surinamensis*, was caught by purse seine near Biševo Island. This is the first record of this species in the Adriatic Sea.

One specimen of the dusky spinefoot, *Siganus luridus* (Rüppell, 1829) (♀, total length = 17.3 cm, total weight = 87.61 g), a lessepsian migrant, was captured in the Mljet Channel (Southern Adriatic, Croatian coast) on 15 November 2010. This is the second record of this species from the Adriatic, but first well documented and based on the captured specimen. First record occurred earlier in the Northern Adriatic, but was based solely on underwater observations (Dulčić *et al*. 2011a).

The presence of *Siganus luridus* in the Adriatic could be a consequence of the "Adriatic ingressions" (periodically intensified influx of the Ionian water into the Adriatic which influences oceanographic parameters like salinity, temperature, transparency, as well as primary production) and oceanographic changes in the Adriatic Sea (Dulčić and Grbec 2000). The entrance of new alien organisms during the period of Adriatic ingressions was already observed (see Dulčić and Grbec 2000, Civitarese *et al*. 2010). Individuals from the Adriatic probably originate from some relatively close southern areas like Ionian Sea (Gulf of Patras), Cretan waters or Strait of Sicily where established populations of these fishes exist (Dulčić *et al*. 2011a). This could be a sound explanation considering the hypothesis of Azzurro *et al*. (2006) regarding dispersal dynamics of this species, where they indicated that siganid larvae could be dispersed for up to 1000 km. This could have also been facilitated by the impact of the bimodal oscillating system (BiOS) on the biogeochemistry of the Adriatic and Ionian seas (Eastern Mediterranean) (Civitarese *et al*. 2010). A second hypothesis on the origin of the Adriatic specimens could be related to the anthropogenic transport of the species from some other area such as the eastern Mediterranean Sea or the Red Sea through ship's ballast water. The area of capture is close to one of major cargo harbours in Croatian waters (Harbour Ploče) and this hypothesis remains plausible, as anthropogenic transport constitutes one of the major causes of introduction of exotic species, including teleost fish. Recent report of an exotic dwarf flathead, *Elates ransonnettii* (Steindachner, 1876), from the Adriatic Sea evidenced a species introduction caused by the anthropogenic transport, probably by the ballast waters (Dulčić *et al*. 2010).

4. Pathogens

Sightings/records – No data available.

General information - No data available.

5. Meetings

Past year

The Second National Task Force Meeting on implementation of the GloBallast Partnerships Project in Croatia was held in Zagreb on 11 November 2011. The Meeting was concerned on national regulations on ballast water management, as well as the report of environmental zero status in three Croatian ports, Rijeka, Split and Ploče.

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3.4 Estonia

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

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

In 2009, an amendment of Nature Protection Act (2004) was drafted 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 being 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. It is still waiting for approval.

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

2010

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	387
Singapore	Ornamental marine fish	67
Lithuania	Oncorhynchus apache and O. chrysogaster	119
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	19916
United Kingdom	Anguilla anguilla	300
Latvia	cyprinids	3206
France	Thunnus maccoyii	75
Canada	Oncorhynchus nerka, O. gorbuscha, O. keta, O. tschawytscha, O. kisutch, O. masou, O. rhodurus, Salmo salar, Hucho hucho	305
Lithuania	Unidentified freshwater fish	3500
Latvia	Unidentified marine fish	101
Unknown	Unidentified marine fish	182

2011 (January-November)

Country	*Fish*	*Quantity, kg*
China	Ornamental freshwater fish	100
Latvia	Ornamental freshwater fish	11
Singapore	Ornamental freshwater fish	1265
Czech Republic	Ornamental freshwater fish	213
Lithuania	Oncorhynchus apache and O. chrysogaster	57
Norway	Salmo trutta, Oncorhynchus mykiss, O. clarki, O. aguabonita, O. gilae	
Latvia	cyprinids	1651
France	Thunnus maccoyii	68
Lithuania	Unidentified freshwater fish	31500

LIVE EXPORTS

2010

Country	*Fish*	*Quantity, kg*
Holland	Anguilla anguilla	18333
Lithuania	Anguilla anguilla	80
Latvia	Anguilla anguilla	73
Russian Federation	Unidentified fish	13750
Lithuania	Unidentified fish	40

2011 (January-November)

Country	*Fish*	*Quantity, kg*
Latvia	Anguilla anguilla	182

Official data on fish releases of Estonia for 2010 and 2011 (in thousands)

Species/year	**2010**	**2011**
Salmon (*Salmo salar*)	159,75	108,93
Sea trout (*Salmo trutta trutta*)	121,74	162,18

3. Unintentional introductions

Cercopagis pengoi invaded the Gulf of Riga in 1992. It is known, that the species prefers warm water environment, preferably sheltered from winds. The second largest density value (annual mean ca. 5500 ind. m^{-2}) was recorded for the alien predatory cladoceran *C. pengoi* in the zooplankton long-term monitoring area in the NE Gulf of Riga in 2011 (Figure 1). In Tallinn and Muuga bays (southern Gulf of Finland), *C. pengoi* density has been relatively low both in 2010 and 2011 (annual mean less than 400 ind. m^{-2}; Figure 2, Anon 2012). We have compared the seasonality of the likely prey of *C. pengoi*, the small-sized native cladoceran *Bosmina* spp. in years 1973-1991 and 1992-2010. The comparison was performed in two different parts of the NE Gulf of Riga – the inner part of Pärnu Bay and more open area of the Gulf of Riga. Population size and timing of the population abundance peak of *Bosmina* spp. clearly differed during these two periods and, therefore, seem to be directly related to the presence of the predatory cladoceran *C. pengoi*. Significantly lower population size and earlier peak of *Bosmina* spp. were observed during the period of presence of the invertebrate predator in the inner bay. The timing of the abundance peak of *Bosmina* spp. advanced at a rate of approximately 0.8 days a $year^{-1}$ in the inner part while no significant earlier abundance peak neither abundance shifts during the two time-periods were observed for *Bosmina* spp. in the outer part (Põllupüü *et al*. under review).

Abundance of larvae of the polychaete *Marenzelleria neglecta* has been declining in the NE Gulf of Riga since 2007, from the record-high density value of 58 thousand ind/m^2 (Figure 1). In 2011, abundance of *M. neglecta* was 7800 ind/m^2. At the same time, *M. neglecta* larvae were very abundant in Tallinn and Muuga bays with the record-high value in 2011 – over 8000 ind/m^2; Figure 2). As evidenced by the results from the national alien species monitoring programme (started in 2010), this species was commonly 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* (Anon. 2012). The status of other recent benthic invertebrate invaders *Paramysis intermedia*, *Gammarus tigrinus*, *Chelicorophium curvispinum* and *Pontogammarus robustoides* has remained relatively the same as in previous years.

The Atlantic shrimp *Palaemon elegans* was caught for the first time from the Estonian coastal sea in July 2011. Within same month the species was simultaneously found at high densities in three water basins: the Gulf of Finland, the Gulf of Riga and the Baltic Proper and later on in the West Estonian Archipelago Sea. Among samples many mature females were found. Thus, providing wide distribution range, high densities and reproduction potential of the species, *P. elegans* has likely formed permanent population all over the Estonian coastal sea.

The Harris mud crab *Rhithropanopeus harrisii* was first found in Estonian waters in 2011. Seven individuals were found in pike-perch artificial spawning substrata, consisting of linen small mesh-sized gillnets, in northern coast of Pärnu Bay (NE Gulf of Riga) when collecting them out of the sea in August. Artificial spawning substrata have been provided to pike-perch in the same area annually since the end of the 1980s. However, the Harris mud crab was never before found in these nests neither during the routine check of nests for fish eggs nor when transported to the land after the end of the spawning season of pike-perch.

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, no crabs were found in the bay in 2011 (Figure 3; Anon 2012).

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 2011, round goby constituted nearly 87% in terms of biomass and over 90% of abundance in experimental catches with gillnets nets of mesh size of 36-44mm (Figure 3, Anon 2012). In addition, the species is also spreading spatially. The latest evidence from 2011 shows that round goby is now also present in herring trawl catches in the Gulf of Riga.

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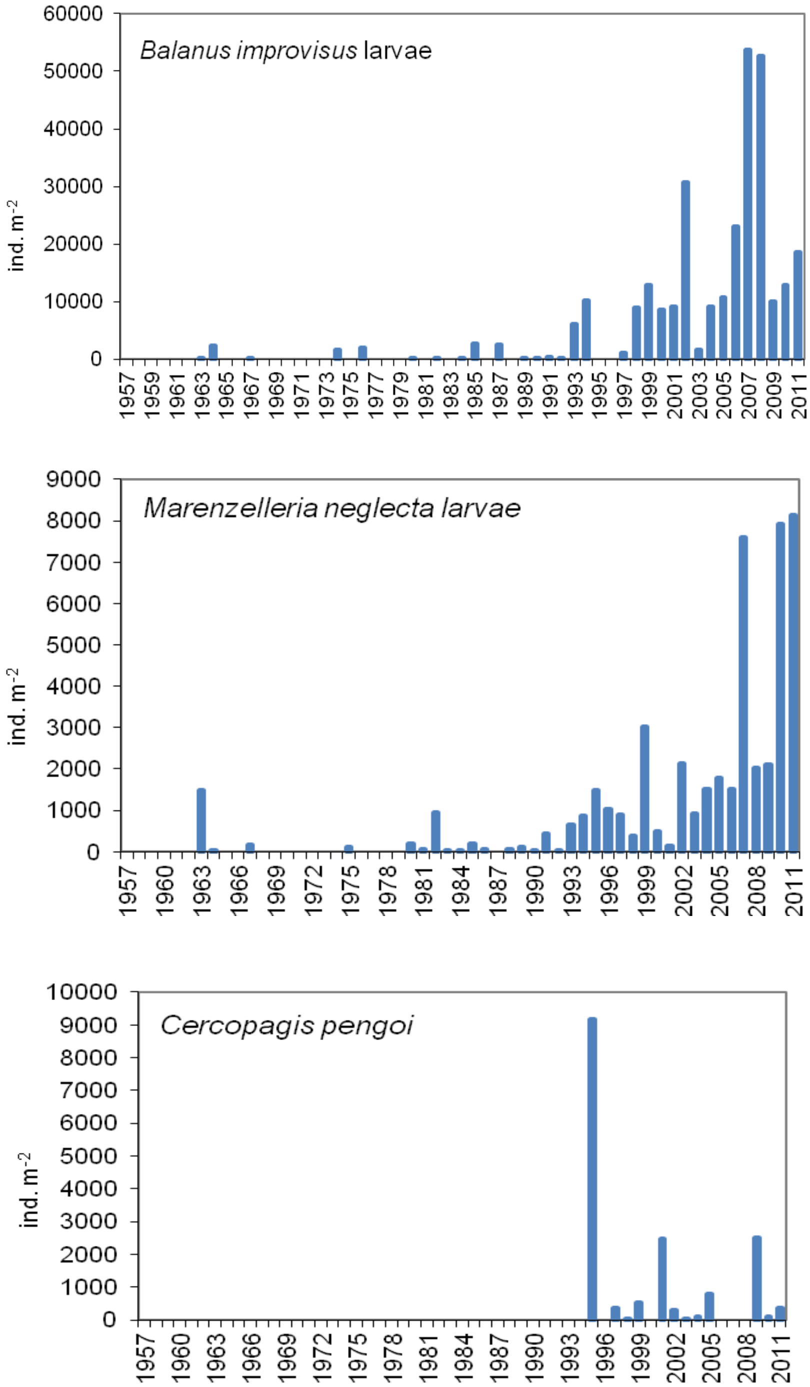

Figure 1. Long-term abundance dynamics of *Balanus improvisus* larvae, *Marenzelleria neglecta* larvae and *Cercopagis pengoi* in the NR Gulf of Riga (Baltic Sea). From Anon 2012.

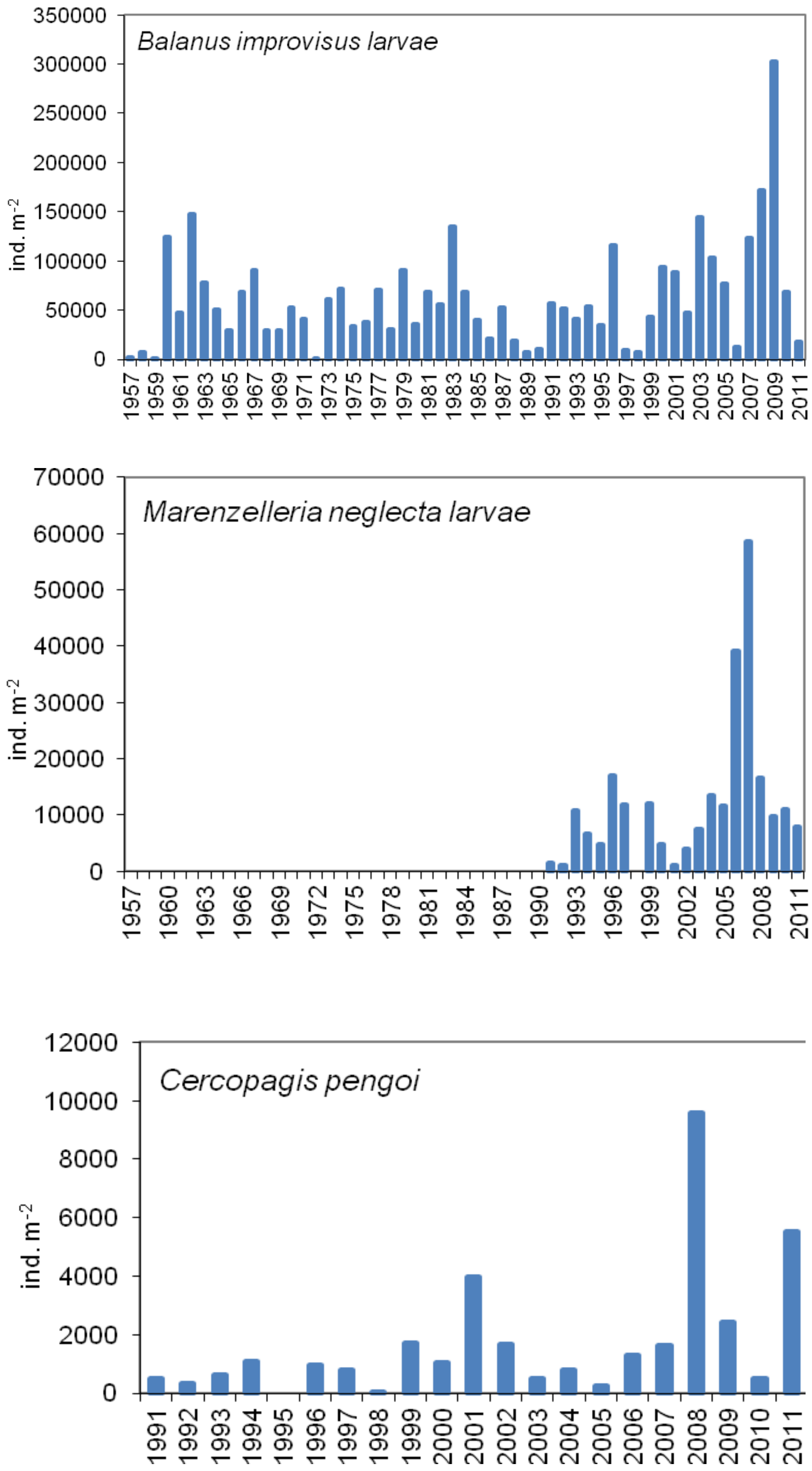

Figure 2. Long-term abundance dynamics of *Balanus improvisus* larvae, *Marenzelleria neglecta* larvae and *Cercopagis pengoi* in Tallinn and Muuga Bays (Gulf of Finland, Baltic Sea). From Anon 2012.

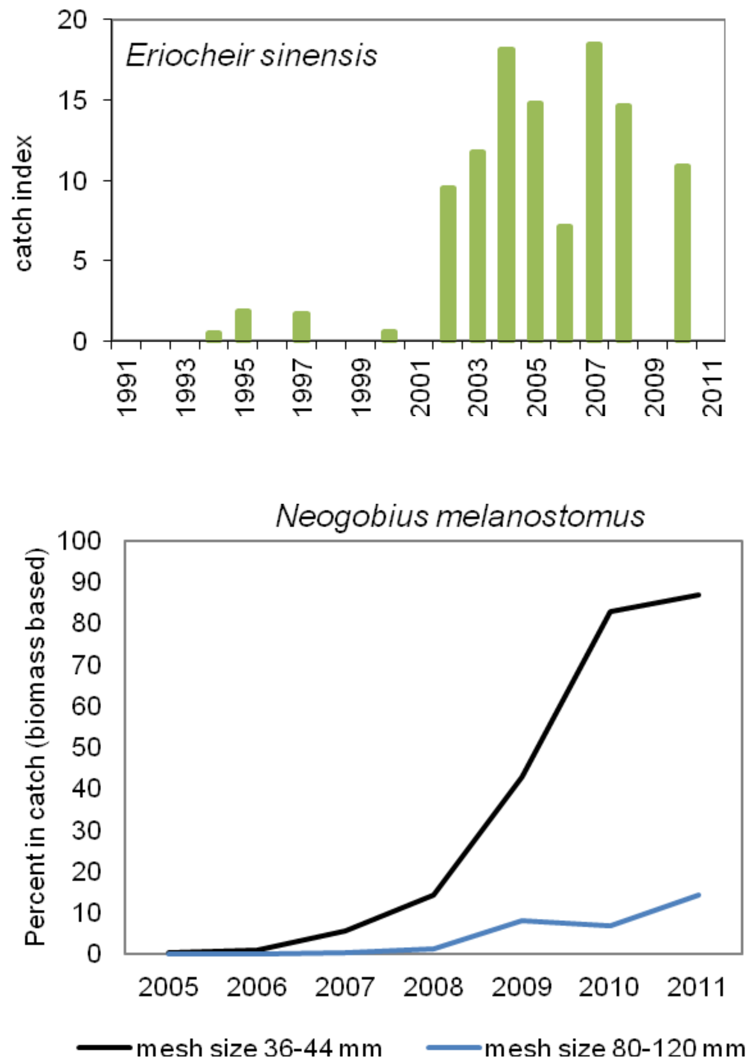

Figure 3. Cacth index of Chinese mitten crab *Eriocheir sinensis* (upper panel) and percent contribution of the round goby *Neogobius melanostomus* (lower panel) in experimental gillnet catches in Muuga Bay (Gulf of Finland, Baltic Sea). Data from Ojaveer *et al*. 2011 and Anon 2012.

3.5 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 accepted by the parliament during spring 2012. 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 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 2011 as follows (some values are underestimates):

0.6 million newly hatched and 1.6 million older salmon (*Salmo salar*), and

0.6 million newly hatched and 1.0 million older sea trout (*Salmo trutta* m. *trutta*),

something around 25,6 million newly hatched and 4.6 million older whitefish (*Coregonus lavaretus*).

Rainbow trout (*Oncorhynchus mykiss*) were imported from Denmark and Sweden to Finland for cultivation. Eels were imported from France via Sweden.

3. Unintentional introductions

No new alien species were found in Finnish waters in 2011. However there were large changes in species abundance and distribution.

Invertebrates:

The crustacean *Palaemon elegans* was observed the first time in the Gulf of Finland, in 2003. 2010 several specimens were observed in the Archipelago Sea. 2011 littoral samples were collected along the Finnish southern coastline and *P. elegans* was observed in several localities from the eastern Gulf of Finland to 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) and during 2010 it largely increased in abundance. 2011 mud crab was found to increase its distribution in the Archipelago Sea as well as increased in abundance.

There have been several reports of mitten crabs, *Eriocheir sinensis* from the coasts of the Gulf of Finland as well as of the Gulf of Bothnia in 2011. The number of sightings was on the same level as during the last years.

The predatory cladoceran *Evadne anonyx* was observed also in 2011 in the monitoring samples. It occurs in low abundances in the open sea and at the coastal monitoring stations during late summer and early autumn.

Fish:

The round goby, *Neogobius melanostomus*, were observed in three new areas, all near ports. In Helsinki area, were the round goby was first found in 2009, the distribution areas has extended locally from less than 1 km^2 in 2009 to 3 km^2 in 2010 and 27 km^2 in 2011.

The gibel carp, *Carassius auratus* m. *gibelio*, were recorded in the Gulf of Finland and in the Archipelago Sea within its previous year range. It reproduces in several ponds connected to the sea. In two 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 20 tones catch with trap nets in 2010-2011 contained about 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 those 10 ha ponds.

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 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

VISEVARIS-project was aimed to develop detection and create Early Warning and Information System (EWS) for alien species in the coastal areas of Finland. A conceptual framework and required sub-sections of the EWS were created to be developed further in subsequent projects. During the project, the efficiency of the ongoing surveys in detecting alien species was estimated and the results showed that the majority of the alien species were poorly detected. Current surveys functioned especially poorly in the shallow coastal hard bottom ecosystems and additional sampling effort should be aimed to these habitats. Also, an array of suggestions to increase the detection of alien species was made, including aiming the sampling to areas prone for invasion, such as harbors, or to locations where species may pose a threat, such as power plants. Within the project an alien species identification guide was created. The guide includes descriptions, identification details and images of 35 alien invertebrate and 21 fish species that have been observed in the Baltic Sea and may be found in the coastal areas of Finland at present or in the near future. Risk-analysis was performed for freshwater invertebrates and -fish using Fi-ISK and FISK tools, respectively. Based on the assessment, alien species can be classified based on their potential invasiveness. Based on the risk assessment trial, these before-mentioned tools should be further developed to better reflect the brackish Baltic Sea conditions.

Project also designed and developed a website where the public and professionals can report their observations on alien species. Website also functions as an interactive tool in sharing information on alien species and their distribution in coastal areas of Finland.

A project to develop alien species monitoring in coastal areas of Finland has been funded by the Ministry of Environment.

A research project on the strategy of alien species to spread and reproduce has been funded by the Walter and Andrée de Nottbeck Foundation

6. Meetings

National meetings related to alien species.

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3.6 France

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1. Regulations:

No information

2. Intentional:

No information

3. Unintentional:

Algae:

Undaria pinnatifida : as part of an Interreg program (project Marinexus, http://www.marinexus.org/) and a European program funded by the AXA Research fund (project MAAC), a monitoring and regional sampling was carried out by one French (cord. F. Viard, Station Biologique Roscoff) and one English team (resp. J. Bishop, MBA Plymouth) on both side of the Western English Channel during spring and summer 2011. Large populations were observed in all sites, most of them being marinas and harbours in addition to natural habitats, where the species was previously recorded and confirm the long-term stability (over a decade) in France at a regional scale as already observed at a local scale (i.e. within a bay, St-Malo area) during the PhD work carried out by Daphné Grulois at the Station Biologique of Roscoff (Grulois *et al.* 2011). Genetic analyses are on-going to examine if this demographic steadiness is associated with genetic stability.

Cultures of *Undaria* in Brittany were the primary vector of release in the wild. The long term stability of spontaneous populations established in artificial or natural habitats showed the risks associated to any project aiming to increase the geographical coverage of cultures of this alga.

Undaria pinnatifida is one of the species targeted in a new large-scale project funded by the ANR, the "IDEALG" project (coord. P. Potin, Station Biologique Roscoff; http://www.sb-roscoff.fr/images/stories/sbr/actualites/86_CP_Station_bio_Roscoff_Idalg.pdf; in French). IDEALG aims to demonstrate the feasibility of exploiting genomics research in seaweed biotechnology (including metagenomics of closely associated micro-organisms) and also develop new genetic approaches to develop seaweed cultivation. In this programme, *U. pinnatifida* is not targeted as a crop for the future because of its non-native status[3]. It is however used to exemplify and study the risks associated to the escape of cultivated genotypes into the wild as well as to explore the evolution towards domestication syndrome. Domestication is defined here as the genetically determined physiological changes (i.e. domestication syndrome) undergone by organisms in response to cultivation.

Other initiatives interested in promoting the culture of *U. pinnatifida* are nevertheless on-going in France, for example in the project CHACO. Facing the oyster (*Crassostrea gigas*) mortality occurring in France, CHACO aims at developing seaweed cultures to diversify the activities carried out in oyster farms. Despite scientific reserves, prelim-

[3] The strain of *Undaria pinnatifida* first introduced into Europe (Thau lagoon) was highly suspected to be a domestic strain (Voisin *et al.*, 2005 – Verlaque com.pers.).

inary trials have been conducted in 2011 using several species including *U. pinnatifida* with good results as expected (see web site: http://www.slideshare.net/CEVAVEILLE/projet-breizhalg-chaco-restitution-des-essais; in French only). The legal framework for carrying out these trials was not totally approved by the local governmental agencies. The possibility to pursue and extend the cultures of *U. pinnatifida* in Brittany is now examined by local authorities from a legal point of view –in particular considering the Regulation (EU) No 304/2011 of the European Parliament and of the Council of 9 March 2011 amending Council Regulation (EC) No 708/2007 concerning use of alien and locally absent species in aquaculture.

The risks associated with these projects to expand the culture of *U. pinnatifida* in the Channel and French Atlantic coasts will probably require a specific attention of the ICES-WITMO in a very near future.

Ctenophora

No information

Molluscs:

Rapana venosa

A specimen, an adult, was caught for the first time by a fisherman in the Marennes Oléron Bay (46° 00.5649 N ; 1° 15, 8846 W). Initially, observations of this exotic species were restricted along the Brittany coast, mainly in the Bay of Quiberon (south Brittany). This specimen was probably introduced in this area with oyster batches from the Bay of Quiberon because some shellfish farmers have leases in this Bay to start growing their oysters ; they bring them back in Marennes Oleron just before commercialisation.

Crassostrea gigas

Two thesis on *Crassostrea gigas* were defended respectively in Bordeaux and La Rochelle universities.

A comparative analysis of natural and farmed populations of the Pacific oyster, *Crassostrea gigas* in a macrotidal lagoon (Arcachon bay): biological cycle, trophic relations and effects on benthos (Salvo, 2010).

In Arcachon Bay (SW France), the cupped oyster develops as both farmed and feral populations. Oyster reefs are complex tridimensional structures (agglomerated oysters, in contact with the sediment, populations with many classes), while farmed oysters are cultivated off-bottom in plastic bags (isolated oysters, populations with a single age class). The respective effects of these two oyster configurations were studied according to three research axes: (1) a comparison of the dynamics of farmed and wild oyster populations, in terms of growth, reproduction, and biochemical composition; (2) the effect of oyster feeding on accessible preys and the associated particulate fluxes; and (3) the effects of oysters on the sediment and benthic communities. The two years of study were characterized by a delay in the spawning periods (year 1) and an unusually low growth rate (year 2) in oysters, which were related to low summer water temperatures (year 1) and a low food availability in spring (year 2); reproduction cycles also appeared slightly shifted between farmed and wild oysters. An *in situ* experiment with benthic tunnels at three periods of the year was designed to quantify the flux of matter and the consumption of nutrients and planktonic species by the two oyster populations during a tidal cycle. Sediment in the vicinity of oysters contained more fine particles and organic matter, due to changes in local hydrodynamism and oyster production of faeces. These sedimentary changes modified the structure of benthic infaunal assemblages. Oyster reefs form a new habitat of hard substrate in Arcachon Bay, where only sedimentary habitats naturally occur; they have an epifauna with high biomass and diversity, that increases the local biodiversity.

Ecology of the reproduction of the cupped oyster on the French Atlantic coasts (Bernard, 2011).

This thesis aimed to identify the origin of the variability of oyster recruitment. This question is addressed by different methods for each step of the reproduction of oyster: a DEB model for gametogenesis, valvometry for spawning, cohort analysis for larval stage and hydrodynamic models for dispersion. At the stage of the gametogenesis, variations of fecundity appear to be mainly based on sea temperature. Arcachon and Marennes-Oléron Bays seem also to depend on the variability of larval supply: the supply of larvae is provided by a source of larvae in the north of spat collecting areas in Charente and by a local source that seems to decrease for Arcachon. This decrease of larval supply and the climate effect are the two suspected origins of the increased variability of spat collecting in Arcachon Bay.

The biomass of cultivated and wild cupped oysters (*Crassostrea gigas)* was evaluated in the Arcachon Bay in 2009 and 2011 (Scourzic *et al*., 2012). A total of 82 500 metric tons of oysters were quantified in the Arcachon Bay with respectively 16 600 mt of farmed oysters (evaluation in 2009) and 65 000 mt of wild population (evaluation in 2011). The important biomass of wild oysters indicates that the species is not in danger, even in the context of mass mortalities observed in the recent years on young oysters, associated with Herpes virus. This wild stock could represent a complementary source of supply of spat, juvenile and adult oysters in this period of crisis.

Crepidula fornicata

The figure 1 shows the *Crepidula fornicata* distribution in 2011, in the English Channel. It synthesized observations collected during a 20 years survey during Ifremer cruises. Samplings were realized using dredge or grab from boats (Blanchard, comm.. pers.).

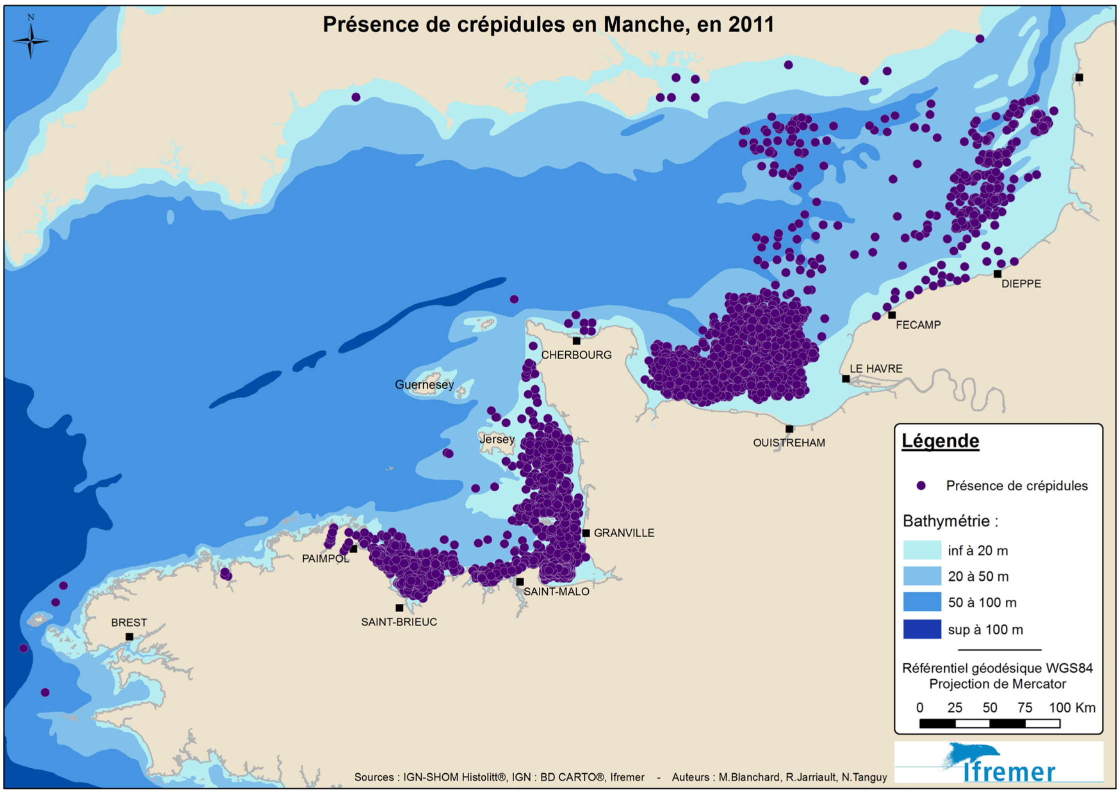

Figure 1: Distribution of *Crepidula fornicata* in the English Channel following a 20 years survey (Blanchard M., R. Jarriault, N. Tanguy, Ifremer Data).

A new *Crepidula fornicata* stock assessment was performed in the Arcachon Bay in 2011. Results showed that the total biomass remained low and stable since 1999. However, the slipper limpet continued to spread within the lagoon. The presence of this invasive species was correlated with lower megafauna diversity (Hippert *et al.*, 2011).

Crustacea :

Two surveys, carried out between 2008 and 2011, evaluated the populations of 2 species of exotic crabs, *Hemigrapsus takanoi* and *H. sanguineus* along the Normandy coast from the Mont Saint-Michel bay (about 48° 43′ 22 N ; 1° 31′ 27 W) to North of Dieppe (about 50° 5′ 20 N and 1° 25′ 19 E). The first one started in 2008 and was done from the Mont St Michel bay to Le Havre (49° 29′ 20 N ; 0° 5′ 41 E). More than 50 sites were monitored including 19 around the Cotentin Peninsula which was prospected each year from 2008 to 2011. Both species were found ; abundances varied according to species and geographical areas. Only few individuals of *H. takanoi* were observed. The survey of the 3 most colonized sites indicates that the density doubled from 2009 to 2011 (Dauvin *et al.*, 2011; Dauvin et Dufossé, 201; Pezy, 2011).

The second survey was carried on in 2011along the Cauchois coast between Le Havre (49° 29′ 20 N ; 0° 5′ 41 E) and North of Dieppe (about 50° 5′ 20 N and 1° 25′19 E). *Hemigrapsus takanoi* was less abundant than in the past (2008). *H. sanguineous* was numerous: more than 500 specimens were observed in a rocky area near Dieppe in less than 2 hours of time (Vincent, comm.. pers.).

Juveniles and ovigerous females were observed in all surveys, demonstrated that the species were established.

Tunicata:

Asterocarpa humilis: As part of the Interreg Marinexus project and the AXA Research Fund program MAAC, surveys of the sessile fauna inhabiting marinas and harbours were carried out over 2005-2011. The styelid unitary ascidian *Asterocarpa humilis* has been found on the coast of NW France (Brittany) from St-Malo to Quiberon and the south coast of England from Falmouth to Brighton, and also in north Wales (Bishop *et al*. submitted). The first documented occurrence was in 2005 in Brittany, but the species was found to be widespread at regional scale and common in several places in Brittany during surveys carried out in 2009-2011. It has possibly been present but overlooked for some time. These are the first records of this species in the Northern Hemisphere which were confirmed based on morphological and molecular (barcoding) identification.

Fish:

No information

4. Pathogens

A recent publication demonstrated that flat oysters larvae can be infected with *Bonamia ostreae*. The parasite was usually observed inside haemocytes and sometimes free, in gill epithelia suggesting a parasite release through this organ. But, the infective form and ways of entry and release remained undetermined. Flat oysters incubating larvae were sampled in Bay of Quiberon, the French most important area for flat oyster spat collection and moreover an area infected with *Bonamia ostreae* since 1979. PCR tests including *in situ* hybridisation revealed the presence of parasite DNA in adults and larvae. This study suggested that larvae might contribute to the spread of the parasite during their planctonic life and consequently transfer of all life stages for aquaculture or enhancement purposes needs to be controlled specially when they are exported from infected areas (Arzul *et al*., 2011).

The EU reference laboratory of La Tremblade (Ifremer-France) confirmed the presence of the pathogen *Bonamia exitiosa* in one flat oyster *Ostrea edulis* collected in River Fal, Corn wall (England) following an outbreak started at the beginning of December 2010. Wild population of flat oyster was in poor condition but no mortality event was recorded. It was the first time that this pathogen was observed in this area where *Bonamia ostreae* was already present.

5. General information and meetings

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). A plenary meeting was held on June 2011 to summarize the first achievements of the project. Concerning aquatic invasions, a new species was recorded (see *Asterocarpa humilis*). Additional informations are provided on the web site http://www.marinexus.org/

An assessment of the biological invasion (in land and water including marine water) in the West Indies was launched in 2011 in Martinique and Guadeloupe islands (West Indies) to establish the state of the knowledge and consequently strategies of survey and prevention. This study is realized by a consulting office specialized in environmental issues (Impact-mer) and funded by the regional office of the ministry of environment (DEAL). The same initiative is in progress in La Réunion Island (Indian Ocean).

A survey on recreational fisheries activity was carried out during three years by Vivarmor Nature, a local NGO in North Brittany, with numerous goals including the evaluation of this activity on intertidal biodiversity. In this context, the presence of exotic species were recorded (*i.e Cyclope neritea*, *Gibbula albida* and *Grateloupia turuturu*; see previous WGITMO French reports). Information regarding exotic species, recorded during this study, are available on the following web site http://www.observatoire-biodiversite-bretagne.fr/especes-invasives. The conclusions of this study will be available soon.

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3.7 Germany

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

1. Regulations:

1.1 Platform for Information Exchange on Neobiota

The issue neobiota in the marine environment including the coastal areas and the harbours attracts growing interest worldwide. 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 authorities 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 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.

1.2 Trilateral Wadden Sea Plan

Two major issues, relevant to alien species, are noted (1) seed mussel imports and (2) pleasure boating.

1.2.1 Seed mussel imports

During recent consultations in the framework of the Trilateral Wadden Sea Plan it was noted that seed mussel imports are addressed differently by the three countries so that no harmonized procedure exists. The species involved are *Crassostrea gigas* and the native *Mytilus edulis*. Whether or not the ICES Code of Practice is followed in the exporting countries is unknown. After arrival in Germany, it is recommended to place the oysters for two hours into freshwater as a risk reducing measure to treat potential fouling organisms. However, this measure is not controlled.

It was reported from the Netherlands that seed mussel imports are permitted with some reservations. In Denmark seed mussel imports are not regulated as in NL and DE. In Germany two federal states are affected, i.e. Lower Saxony and Schleswig-Holstein. Due to the Wadden Sea status as UNESCO World Heritage Site the import of seed mussels into the protected parts of the Wadden Sea in Schleswig-Holstein are prohibited. In Lower Saxony the same rule applies, however, it is known that (illegal) seed mussel imports occur.

According to the Common Wadden Sea Secretariat (CWSS)[4] offshore wind-parks are screened for neobiota as these installation represent a rare hard-bottom habitat in the region.

1.2.2 Pleasure boating

Pleasure boating was identified as species introduction vector, especially for secondary spread. The management of this vector was not yet agreed in the Trilateral Wadden Sea Plan.

1.3 Good Environmental Status

As reported last year, one of the 12 identifiers of Good Environmental Status (GES) are alien species. There are discussions at national and HELCOM as well as OSPAR level how to use alien species to qualify the status. A trend indicator (rate of new invasions) and an impact indicator (invasiveness) are discussed. One of the key issues is to identify where to draw the "bottom line", i.e. what is currently the number of alien species so that future newly found aliens are new introductions and not overlooked already earlier introduced species. This is important should in the future the new situation need to be compared to today´s situation to identify trends and to answer questions like "Does vector management reduce the arrival of new alien species?"

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[4] The Common Wadden Sea Secretariat started its work already in 1985 to successfully establish trilateral work on the protection of the Wadden Sea.

1.4 Alien species monitoring programmes

German coastal waters are monitored quite well in comparison to other Baltic Sea countries including studies targeting alien species in ports and the taxonomic expertise to process these samples is well available. Almost all regular monitoring activities are also made aware to report on the occurrence of alien species. Comparing all known Baltic Sea alien species records internationally, the German coastal waters have the highest numbers (Fig. 1 in German National Report of WGBOSV 2012). It is questionable if this reflects the real situation or if this may be a result of "the more you look, the more you find". This gives an interesting perspective regarding the EU qualifiers for GES. Does Germany have a worster status when looking at alien species due to the higher number of these species, or are simply more species found due to targeted monitoring and awareness raising in regular monitoring studies?

Another interesting aspects in this regard is how new alien species found in e.g. the Baltic are added to the alien species database. A new species may be found in Finland, but it is native to German waters. This Finnish finding could have been a result of secondary spread or an introduction. Should this species be added to the list of aliens in the Baltic this needs to be treated with care that this does not become a new entry for the entire Baltic Sea!

1.5 Summary of German coastal monitoring activities

A comprehensive summary of German coastal monitoring activities is available online at:

http://www.blmp-online.de. The Federal and State Monitoring Programme (Bund-Länder Meßprogramm) is also responsible for the preparation of Germany´s marine strategies including a guide to implementing the Marine Strategy Framework Directive (MSFD) for the initial assessment, determination of good environmental status and establishment of environmental targets in the German North and Baltic Seas and The Water Framework Directive (WFD).

The BSH (Federal Maritime and Hydrographic Agency of Germany) issues various status reports of the North and Baltic Seas as the Marine Environment Reporting System (MURSYS) http://www.bsh.de/en/Marine_data/Observations/MURSYS_reporting_system/index.jsp

which is published in form of reports providing information on physical and chemical parameters (weather, sea surface temperatures, water levels, current conditions, nutrient concentrations, oxygen situation) and biological parameters (occurrence of algae and toxic algae, blue mussel stocks, fish stocks etc.) in the North and Baltic Seas.

2. Intentional:

No major changes since last year's National Report. The species which were reported earlier include Sturgeons, salmonid species, rainbow trouts, carps, *Crassostrea gigas, Homarus americanus* and the red alga *Palmaria palmata*.

Seed mussels (*Crassostrea gigas*) were imported to the northern Wadden Sea from Ireland, United Kingdom and the Netherlands (Oosterschelde) (see above).

3. Unintentional:

New Sightings

The most up-to-date list of alien species in German coastal waters can be found at www.aquatic-aliens.de/species-directory.htm. This is a private initiative of Stefan Nehring and the hompage is updated frequently.

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

4. Pathogens

No new records.

5. Meetings

The above mentioned NEOBIOTA group met in Hamburg in March 2012 and the agenda items discussed at the meeting considerably contributed to the development of this report. A follow up meeting is planned for Fall 2012.

6. References and bibliography

Please consult the 2012 report of WGBOSV for references.

A project funded by the German Federal Agency for Nature Conservation (Bundesamt für Naturschutz, BfN) is underway to identify a summary of black, grey and white listed alien species which do not yet occur in German waters, but are known from neighbor countries or nearby areas (Rabitsch *et al*. in prep.). The species of greatest concern are included in the black lists.

Another project, funded by the Alfred-Wegener-Institute, addresses alien species monitoring in selected German ports (commercial ports and marinas) in the North and Baltic Seas. The study focusses on benthos and fouling organisms. As an initial result, it seems that there is a tendency that primary introductions of alien species prevail in artificial, man-made habitats.

3.8 Greece

Prepared by: Argyro Zenetos, Stefanos Kalogirou and Kostas Tsiamis, Hellenic Centre for Marine Research

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

POLICIES:

Greek Law No 3937/ 31.03.2011 for conservation of Biodiversity has provision for alien species. In particular Article 12 includes specific Regulations for Invasive alien species such as: preparation of an inventory of all species classified according to their potential risk in ecosystem functioning; preparation of management plans according to their risk assessment; and issue of leaflets with the most invasive species for the wider public.

Greece is among the participating countries of the new Network ESENIAS [East and South European Network for Invasive Alien Species] (http://www.esenias.org).

ESENIAS is a regional data portal on invasive alien species (IAS) that has been initiated with the participation of all the countries in the region [Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Greece, Kosovo under UNSC Resolution 1244/99, FYR Macedonia, Montenegro, Serbia, Romania (invited country) and Turkey] and with the support of the European Environment Agency which will provide data on Invasive alien species in East and South Europe.

2. Intentional:

Synthesis of introductions

Add websites for more details rather than summarizing the amounts etc., e.g. amounts, live imports and exports (to the extent possible). The amount seems to be difficult to obtain in some countries.

3. Unintentional:

New Sightings-New species to the Greek Alien biota

Mollusca

A specimen of the nudibranch ***Flabellina rubrolineata*** (O'Donoghue, 1929) was photographed from Syros isl, Kyklades, at a depth of 10 m by the underwater diver George Rigoutsos from a location known as Gaidouronisi (Poursanidis in Eleftheriou *et al*, 2011)

Crustacea

The copepod ***Parvocalanus crassirostris*** **(**Dahl, 1894) was found in Kalloni Gulf, a semi-enclosed and shallow (depth < 20 m) ecosystem of Lesvos island in the NE Aegean Sea. The occurrence of *P. crassirostris* was highly variable during the year, being present in the gulf only during October, November and December (representing 5.59%, 14.3% and 3.7% of the total zooplankton abundance respectively). Its total mean abundance during these three months was 9906 ind.m-3, ranging between 0 and 28,007 ind.m-3, with the highest value being recorded in the gulf in October, and the lowest at the station located in the open sea in December (Papantoniou & Fragopoulu in Eleftheriou *et al.*, 2011).

Parasites

A total of 54 specimens of the platyelminth ***Glyphidohaptor plectocirra*** (Paperna, 1972) were collected from host gill lamellae of *Siganus* spp (*S. luridus, S. rivulatus*) sampled in 2010 in Rodos island, Dodecanese. Despite evidence of a slight decrease in the genetic diversity of Mediterranean populations, a simulation analysis based on coalescent theory demonstrated the absence of significant bottlenecks, but there was directional selection along a cline moving further from the Suez canal. The absence of bottlenecks was congruent with that described for *G. plectocirra* hosts *Siganus rivulatus* and *Siganus luridus*, and reflected a common history of high propagule pressure during initial colonization, and constant or repeated gene flow from the Red Sea to the Mediterranean area (Stefani *et al*, 2012).

Fish

On the 25th of August 2011, eight specimens of ***Neogobius fluviatilis*** (Pallas, 1814) were caught on a one-bank 500 meter longitudinal transect of the main stem of the Evros using a Smith-Root 24 volt back-pack electrofisher (battery output voltage: 50 to 990V; 400W maximum continuous). The location of the sampling site (40o 58′ 35 N, 26o19′40 E) is 65 river kilometres from the Evros′ river-mouth between the villages of Tychero and Gemisti at an elevation of about 7 m above sea level. Eighteen fish species were caught at this site including the following aliens in descending order of abundance: *Carassius gibelio* (68 individuals), *Pseudorasbora parva* (13), *Lepomis gibbosus* (6), *Gambusia holbrooki* (5). *Neogobius fluviatilis* inhabited sand and fine gravel substrates in the main channel of the river near its shoreline at depths ranging from 30 to 60 cm. (Zogaris & Apostolou, 2011).

Previous Sightings

Botryocladia madagascariensis is a species recorded, to date, in the Mediterranean Sea from Italy, the Maltese Islands and Turkey. Its finding in Karpathos Island in 2006 by Catra & Giardina (2009) and later in Korinthiakos Gulf (Greek Ionian Sea) by Tsiamis & Verlaque (2011) suggests a broader distribution in the Mediterranean Sea of this species that can be confused with *Botryocladia botryoides.* Some sterile specimens of this species were collected in 2010 at Trachila (36° 46.089 N, 22°18.819 E) and Gerolimenas (36° 28.729 N, 22° 24.085 E) (Messiniakos Gulf) and at Porto Ageranos (36°41.969 N, 22°31.540 E) (Lakonikos Gulf) between 8 and 10 m depth (Catra & Alongi in Nikolaidou *et al*, 2012).

Range expansions

Table 1 summarises findings reported in 2009-2012 publication not considered in the Zenetos *et al.* (2011) update reporting the 2010 status.

Table 1. Range expansion of alien species reported in ELNAIS, 2010 & Zenetos *et al*,, 2011.

Species	Current occurrence	Source
Anotrichium okamurae	2009: Saronikos	Tsiamis et al., 2012
Aplysia dactylomela	2007: N. Schinoussa Isl.	Giakoumi S. In Nicolaidou et al., 2012
Asparagopsis armata	2010: Lakonikos, Messiniakos	Catra & Alongi, in Nicolaidou et al., 2012
Callinectes sapidus	2011: Ionian Sea	Kapiris et al. in Eleftheriou et al., 2011
Cassiopea andromeda	2011: Rodos isl	Kalogirou in Nicolaidou et al., 2012
Chondria coerulescens	2007: Saronikos	Tsiamis et al., 2012
Codium fragile subsp. fragile	2009-11: Saronikos Gulf	Issaris et al., 2012
Ganonema farinosum	2009: Saronikos	Tsiamis et al., 2012
Hypnea valentiae	2009: Rodos isl	Tsiamis & Verlaque, 2011
Laurencia caduciramulosa	2009: Saronikos 2009: Rodos isl	Tsiamis et al., 2011
Neosiphonia harveyi	2006: Karpathos	Catra & Giardina, 2009
Polysiphonia atlantica	2007: Saronikos	Tsiamis et al., 2012
Percnon gibbesi	2007: Sikinos isl.	Katsanevakis et al., 2011 Giakoumi S. In Nicolaidou et al., 2012
Stephanolepis diaspros	2008: Sikinos isl.	Giakoumi In Nicolaidou et al., 2012
Stypopodium schimperi	2007-2008: widely distributed in Kyklades 2009: Zakynthos isl.	Giakoumi. In: Nicolaidou et al., 2012 Tsiamis, 2012 (PhD)

Both gametophytic and sporophytic thalli of *Asparagopsis armata* Harvey were collected at two localities of the Messiniakos Gulf: Trachila (36° 46.089 N, 22° 18.819 E) and Gerolimenas (36° 28.729 N, 22° 24.085 E) from 0.5 to 10 m and at 8 m depth, respectively in 2010 (Catra & Alongi, in Nicolaidou *et al*, 2012).

The crab *Percnon gibbesi* (H. Milne Edwards, 1853), which is established in most Mediterranean coasts (Katsanevakis *et al.*, 2011), was recorded for the first time on rocky substrate in the south of Sikinos Island in 2008 (N 36 42 58.93 E 36 42 58.93). The fish *Stephanolepis diaspros* (Fraser-Brunner 1940), known to be well established in the South Aegean (Zenetos *et al.*, 2011) was recorded on sandy bottoms on the east of Sikinos Island in 2008 (N 36 40 26 E 25 08 35). The black spotted seahare, *Aplysia dactylomela* (Rang, 1928), was encountered north of Schinoussa Island in 2007, on rocky bottoms with patches of the seagrass *Posidonia oceanica*, (N 36 51 78 E 25 16 22). The macrophyte *Stypopodium schimperi* (Kützing) Verlaque & Boudouresque was recorded in rocky sites of several Kyklades islands (Amorgos, Koufonisi, Donousa, Folegandros, Naxos, Santorini) (Giakoumi : In Nicolaidou *et al.*, 2012).

The shallow seabed off the Greek islands Paros and Antiparos was surveyed for the presence of alien megabiota during July 2011. Fourteen sites were surveyed by snorkeling at depths between 0 and 10 m. Eight alien species were recorded: *Caulerpa racemosa* var. *cylindracea*, *Halophila stipulacea*, *Pinctada radiata*, *Percnon gibbesi*, *Cassiopea andromeda*, *Aplysia dactylomela*, *Siganus luridus* and *Fistularia commersonii*. The first four species are new records for the islands; all eight species established populations in the study area. *Siganus luridus* was present in high numbers in all sites and may be considered as highly invasive. *Cassiopea andromeda* reappeared in the Aegean Sea after a hiatus of 55 years, reaching densities >20 individuals/m2 at one site (Katsanevakis, 2011).

Not Seen Species Yet

Several Lessepsian macroalgae, already found in the Levantine coasts, are expected to expand their distribution range within the Greek coasts in the near future. For example the alien green algae *Caulerpa mexicana* and *C. scalpelliformis* have been recorded in the Levantine coasts of Turkey (Cinar *et al.* 2011). In addition, the alien alga *Codium arabicum* and the red alga *Galaxaura rugosa* have been successfully established along the Israel coasts (Hoffman *et al.* 2011) and further north-western expansion along the Levantine coasts would not be a surprise.

Alien fish species already recorded in the eastern Mediterranean Sea and which are expected to be found at Greek coasts in the near future are *Heniochus intermedius*, *Platycephalus indicus* and *Synanceia verrucosa* (Bilecenoglu, 2012).

4. Pathogens

Native oyster (*Ostrea edulis* L) beds of the gulf of Thessaloniki were totally extinct in the past 10 years. A cause for this extinction is the presence of the parasite *Marteilia* sp. (Virvilis. & Angelidis. 2006). *Marteilia refringens* Cavalier-Smith, 2002 has been reported in oyster cultures in Thessaloniki Gulf since 1997 (Angelidis *et al.*, 2001).

PHD theses

Tsiamis Kostas, 2012. Alien macroalgae in the sublittoral zone of the Greek coasts: PhD thesis : Department of Biology, University of Athens

The bulk of alien macroalgae has been introduced in Greece after the 1970s. Alien macroalgae introductions into a Greek area seem to be dependant mainly on its geographical location. Vectors, such as shipping, and the Suez Canal play an importand role on alien introductions. Thus, more alien macroalgae are expected to be found in areas neighboring harbors that host intense shipping. Fishing nets are also important for secondary alien introductions from one infested area to another. On the other hand, aquaculture and aquaria trade are not responsible for alien macroalgae introductions in Greece.

Alien macroalgal introductions into a native phyco-community are not dependant by the community native biodiversity, opposing the 'Biotic Resistance hypothesis', nor by the phyco-community type and the ecological quality of the area. Macroalgal invaders do not exhibit invasive behavior everywhere in Greece but only in some areas. Interesting is the case of 'Chora' station in Andros Isl. where the alien macroalgae *Codium fragile* subsp. *fragile* and *Asparagopsis taxiformis* presented simultaneously invasive behavior, exhibiting the synergistic process of 'Invasional Meltdown'.

Based on the Biological Pollution index, most alien macroalgae of Greece do not affect **the indigenous communities and generally the marine ecosystem. However, five (5)** alien species were noted to present occasionally severe impacts in the Greek seas. These are: *Caulerpa racemosa* var. *cylindracea, Codium fragile* subsp. *fragile, Stypopodium schimperi*, *Asparagopsis taxiformis* and *Womersleyella setacea. Caulerpa racemosa* var. *cylindracea* .

Kalogirou Stefanos (2011) PhD Thesis: Alien Fish Species in the Eastern Mediterranean Sea: Invasion Biology in Coastal Ecosystems, ***Department of marine ecology, University of Gothenburg, Sweden.*** **http://hdl.handle.net/2077/24869 ISBN: 91-89677-47-1**

This thesis aimed to increase the knowledge on the fish assemblage structure and function of *Posidonia oceanica* meadows and sandy habitats in a coastal area of the eastern Mediterranean Sea and give insight into invasion biology by investigating the potential impact of introduced fish species to the local ecology and food-web of the marine systems under study.

Posidonia oceanica was found to be a multifunctional habitat for fish species. It was found to be a highly important nursery habitat for several species during summer and a habitat that could under certain seasons concurrently be used by both adults and juveniles. Four functional guilds were created to describe the habitat use of *P. oceanica* meadows for each species encountered; juvenile migrants, seagrass residents, seasonal migrants and occasional visitors. Among the 88 species encountered, eleven were found to be non- indigenous of Indo-Pacific and Red Sea origin, three of them using segrass mainly as juveniles, and four as residents (Kalogirou *et al.* 2010).

In a comparison of fish assemblage structure between seagrass and sandy habitats quantitative sampling in combination with classification of fish species into six major feeding guilds revealed the position and contribution of non-indigenous species (NIS) in the food web of *Posidonia oceanica* and sandy habitats. In *P. oceanica* beds and on sandy bottoms 10 and five species, respectively, were non-indigenous of Indo-Pacific and Red Sea origin. The proportional contribution of NIS individuals on P. *oceanica* beds was lower than that of sandy bottoms (12.7 vs. 20.4 %) a pattern that also followed for biomass (13.6 vs. 23.4 %), indicating that low diverse systems may be more prone to introductions than species-rich communities. The two habitats had similar fish feeding guilds, but the biomass contribution from NIS varied within each guild, indicating different degrees of impact on the available resources. Two of the aspects considered in this study, the chance of establishing and the chance of being very dominant will depend upon competitive abilities strongly coupled to size and grounds for habitat shift. However, success of establishment will also depend on appropriate food resources in the recipient community as well as competitive abilities and level of competition in the food web within habitats. No support could be found for the theory that taxonomic affiliation could facilitate invasion success (Kalogirou *et al.,* 2012).

The non-indigenous bluespotted cornetfish *Fistularia commersonii* was found to be a strictly piscivore predator and the diet consisted of 96 % by number and >99 % by weight of fish. The diet of *F. commersonii* was related to time of year, and fish size. Size classification and habitat of prey groups (benthic, supra-benthic, and pelagic) showed that with increased body length it extended its diet to larger prey and more generalist feeding. *Fistularia commersonii* was found to prey on commercial important native species (e.g. *Spicara smaris, Boops boops, Mullus surmuletus*) and the absence of NIS from its diet was mainly attributed to the absence of NIS with elongated body shape (Kalogirou *et al.* 2007).

The feeding ecology of two common indigenous (*Sphyraena sphyraena* and *Sphyraena viridensis*) and one abundant non-indigenous barracuda, *Sphyraena chrysotaenia*, of Indo-Pacific origin, was investigated. Dietary analyses revealed that all three species examined were specialized piscivores with their diet consisting to more than 90 % of fish, both by number and weight. All three predators examined showed a significant selectivity towards *Atherina boyeri*. During winter, condition of the NIS was significantly lower than that of the indigenous species, indicating that winter temperature in the studied area may be a limiting factor for further population growth of this Indo-Pacific species. Additionally, congeneric affiliation of fish introductions was not found to be an important factor explaining successful establishment of NIS (Kalogirou *et al.* 2012).

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3.9 Ireland

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Legislative matters

National legislation has been introduced which further transposes aspects of the EU Birds and Habitats directive (SI No 477 of 2011). The legislation outlines a permitting system which evaluates the risks associated with the introduction of a range of non-native plants and animals associated with activities or the movement of vector material e.g. mussels for aquaculture. If such a risk presents, the applicant must apply to the relevant Minister for permission to introduce the product into Ireland.

Unintended introductions

The most recent account of aquatic aliens and cryptogens in Ireland was reported by Minchin (2007). Since then additional species have been recorded, several of which are of concern in relation to the management of the EC Water Framework Directive. While these additions will have been recorded since 2006, it is possible that some of these were already present by that date. Indeed it is likely that there are species yet to be revealed that are already present.

New NIS additions to Ireland since 2006

Bugula neritina : 2006 Malahide, 2008 Carlingford Lough (Ryland *et al.*, 2011). It most probably occurs elsewhere. It is likely to have arrived on the hulls of arriving leisure craft since it has commonly been found attached to fenders, floating pontoons and boat hulls. In 2008 was locally abundant attached to floating pontoons and fenders in Carlingford Lough. In 2008 in Malahide, following heavy rains, few specimens remained. A study of archived material indicates its presence in Ireland since 2006.

Carassius auratus: Found in the Raven River, Co Wexford. Found in May 2011 by Inland Fisheries staff (Joe Caffrey, pers. comm.). While there have been anecdotal records of goldfish from different regions within Ireland this is the first confirmed account.

Corbicula fluminea: It occurs in great abundance in the lower Barrow River in April 2010 first found by Pascal Sweeney (2010) and studied by Caffrey *et al*. (2011). Known from the upper Shannon River at Carrick-on-Shannon in August 2010 (Joe Caffrey (pers. comm.) and recorded by Brian Hayden, 2012). Locally abundant in Lough Derg, Shannon River, first recorded in January 2011 (Dan Minchin, in press)

Crepidula fornicata: The slipper limpet is established in Belfast Lough where it is widely distributed. (McNeil *et al*., 2010). Chains of individuals found on shores in 2009. Possibly dumped in the Lough with a consignment of mussels imported for relaying although the introduction associated with a large vessel, brought into the harbour for recycling, has not been fully discounted. Small individuals have been found associated with bottom mussel culture in Wexford Harbour in surveys conducted during 2010 and 2011 (F.X. O'Beirn).

Ferrisia wautieri: Is known only from the Grand Canal. This limpet was possibly introduced with the aquarists trade or associated with aquatic plants. (Evelyn Moorkens, pers. comm.).

Gracilaria vermicularis: Is known to occur in Carlingford Lough. It is unclear as to how this macroalga will have arrived, perhaps as natural drift from other colonised areas in Britain (Fred Mineur, pers. comm.)

Hemimysis anomala: First found in Lough Derg in 2007 (Minchin 2008); and elsewhere on the Shannon River (Minchin & Boelens 2010) and is locally abundant with up to 4,000 $1m^{-3}$. Known from Lough Key to Lough Derg from shallows of lakes, small numbers found on navigable rivers. It is locally abundant. The introduction mode is uncertain but will have been with water, possibly with imports of aquatic garden plants or a live food for captive fish. Almost exclusively a nocturnal species generally appearing at light levels below 10 lux. During winter its range can overlap with that of *Mysis salemaai*, as part of this population migrates from deep to shallow water (study in progress).

Ludwegia c.f. peploides: West Cork, one locality. Likely to have been introduced as an ornamental pond plant (Caffrey, pers. comm.)

Marenzellaria sp. Shannon Estuary. Small individuals not yet identified to species. (Eddie McCormack, of Aquafact, pers comm.)

Marsupenaeus japonicus: This prawn is likely to have been an escape from farms in the south of France. Further individuals have been collected from the English Channel (Declan Quigley, pers. comm.).

Stenopsis rufinasus: Found at Carrick on Shannon in July 2009 (Minchin pers. ob.) and elsewhere. This beetle was likely to have been introduced with the floating fern *Azolla filiculoides* as a contaminant imported with aquatic garden plants. Species confirmation was by Jan Baar-Roberts.

Tricellaria inopinata: It is likely to have been imported on the hulls of leisure craft. Often on boat keels. It's presence on craft in Ireland is likely to have been before 2007. Frequent on floating pontoons. Confirmed by John Ryland.

Watersipora subtorquata: Specimens found in Dublin, on marina jetty support, confirmed by John Ryland and collected by Antoinette Kelso of Trinity College Dublin.

Recognised NIS expansions since 2006:

Chelicorophium curvispinum: It has greatly increased its abundance in Lough Derg since 2007 and this amphipod is likely to have an impact on zebra mussel *Dreissena polymorpha* recruitment.

Crassula helmsii: the New Zealand pigmyweed has appeared in some midland localities and control measures in a canal have involved the lowering of water levels (J. Caffrey, pers. comm.).

Crassostrea gigas: the Pacific oyster has been recorded in 15 locations in and around the Irish coast. The presence of oysters appears to be mediated primarily by proximity to aquaculture operations, hydrology (residence time) and substrate availability (Kochman *et al*. 2009). In Lough Swilly, high abundances have been recorded (>20 indivduals/m^2) such that a fishery has developed for the species (F.O'Beirn pers. obs.).

Didemnum vexillum: isolated records of this tunicate are known from east and west coasts associated with marinas or aquaculture sites. May be more extensively distributed than is currently known.

Dreissena polymorpha: The zebra mussel continues to expand to small lakes most probably with fouled hulls of angling craft (Minchin and Zaiko, 2012).

Elodea nuttallii: is invasive in the lower Shannon River (Minchin and Boelens, 2011) ascending the Shannon River and now in Lough Ree (in 2011, Dan Minchin, pers. ob.), Nuttall's pondweed is abundant and hindering leisure craft navigation in Upper Lough Erne (Cormac McCarthy).

Hottonia palustris: The water violet continues to expand in Lough Derg (Minchin and Boelens, 2011) and is the only region in Europe where it is considered invasive. It is protected in Northern Ireland where it is considered to be native.

Lagarosiphon major: The South African pondweed occurs at great densities in some localities (Caffrey *et al*., 2011). Attempts to control it while reducing its numbers using jute matting have been tried with localised success (Caffrey *et al*., 2010) but the method is unlikely to ultimately succeed in large lakes but control methods have been successful in ponds.

Lemna minuta: This duckweed is very widely distributed throughout Ireland and is probably under recorded and is almost certainly spread by wildlife (Minchin and Boelens, 2011).

Styela clava: This tunicate is now found on all but west coasts of Ireland at multiple localities. In some culture activities on the south coast it is a significant fouling species (Nunn and Minchin, 2009).

Developments involving the biopollution index

The zebra mussel in the Shannon Navigation, an internal waterway used principally by leisure craft, was used to evaluate the impact within seventeen separate assessment units made up of lakes, rivers, canals and small lake and rivers sections. The data used was based on ten years of survey work. The impacts were highly variable ranging throughout the full scale of impacts (range 0-4) from 0 where there was no impact in acid lakes to massive (4) where the species dominated in alkaline lakes (Minchin and Zaiko, in press). A more rapid approach has been adopted for some smaller lake systems principally based upon the abundance and distribution range enabling an assessment within a few days. The Rapid Assessment method was used in marinas elsewhere in Europe using the abundance and distribution at three marina sites and provided results for a bryozoan invasion within hours for each marina. The method may be of value in general monitoring surveys for targeted species that are easily identified in the field.

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3.9 Israel[5]

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

On June 2010 the Ministry of Agriculture and Rural Development, the unit for Fishing and Aquaculture, has issued guidelines for applications for "Requests of introduction, raising and transfer of non-native fish and aquatic organisms" in Israel, and guidelines for "Judging requests of introduction, raising and transfer of non-native aquatic species" in Israel.

In 2012 the "white" list of live aquatic species (fish, invertebrates including stony corals) approved for importation by the Ministry of Agriculture and Rural Development for live import (farming, consumption, research and the pet trade) was updated.

2. Intentional introductions

No intentional introductions were reported in Israeli coastal waters in recent years.

3. Unintentional introductions

New Sightings

Algae & higher plants

In September 2007, the mat-forming chlorophyte *Codium arabicum* Kützing 1856 was found along the shore of Bat Galim, at the southern end of Haifa Bay (Hoffman *et al* 2011). It is commonly found in Haifa Bay and has since 2008 become the dominant in the wreck. It is found on rocks in sheltered sites and on vertical walls. The authors believe it was introduced by vessels frequenting Haifa port.

In May 2004, the chlorophyte *Codium parvulum* (Bory ex Audouin) P.C. Silva was collected off the Israeli coast (Israel *et al* 2010). Since then several blooms have been recorded off the northern shores of Israel. The species was originally described from the Red Sea but had not been previously reported from the Mediterranean. Although it may have been long present but overlooked, the authors believe it is a recent Erythrean introduction.

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[5] **Note:** This report does not reflect an official position or knowledge of the relevant Israeli Government bodies

Hydrozoa

In June 2009, the Indo-Pacific hydrozoan ***Campanularia morgansi*** Millard, 1957 was collected off Mikhmoret, on the Mediterranean coast of Israel (Piraino *et al* 2010).

In June 2009 and again in February 2010 the hydrozoan ***Dynamena quadridentata*** (Ellis & Solander, 1786) was collected off Haifa and Rosh HaNikra, on the Mediterranean coast of Israel, where it is abundant (Piraino *et al* 2010).

Scyphozoa

The first specimen of the alien cephid scyphozoan ***Marivagia stellata*** Galil and Gershwin 2010 was collected off Tel Shikmona, 32º49.3'N, 34º57'E, on the southern rim of Haifa Bay, in January 2006. On June 29, 2010, a larger specimen was collected nearby, off Bat Galim, 32º50'N, 34º57'E, and on July 7, 2010, a smaller specimen was collected off Beit Yannai, 32°22.6'N, 34°52'E. In June 2010, a specimen was photographed off Rosh Haniqra, 33º05'N, 35°01'E (Galil *et al* 2010).

Ctenophora

Several specimens of ***Beroe ovata*** Mayer, 1912 were recorded and photographed outside the main breakwater of the Port of Ashdod (31°49'00"N, 34°39'00"E), along the southern Mediterranean coast of Israel, on June 10th, 2011. It is suggested that *B. ovata,* like *M. leidyi,* indigenous to western Atlantic coastal waters, may have been transported to Israel in vessels arriving from ports in the Black Sea (Galil *et al* 2011).

Mollusca

Two specimens of ***Aplysia dactylomela*** Rang, 1828 (approximately 20 and 12 cm length alive) were recorded and photographed at the head of the Akhziv submarine canyon (Israel), 33°3'38"N 35°5'31"E, on 25 September, 2010, at a depth of 10 m on a rocky ledge sparsely covered with algae, next to specimens of *Conomurex persicus* Swainson, 1821 – a well established invasive strombid gastropod (Pasternak & Galil 2010).

A photograph of ***Chromodoris annulata*** Eliot, 1904 taken near Caesarea (32°31'34"N, 34°53'58"E) on October 1st 2009, constitutes the first record of the species off the Mediterranean coast of Israel (Lavi 2009). On May 14th 2011, two specimens were collected off Sedot Yam (32°29'29"N, 34°53'16"E), at 1–3 m depth. Five additional specimens were observed at the same site, at 1–5 m depth, on May 18–19th. On May 17th, 3 specimens were observed on the shallow reef near Mikhmoret (32°24'12"N, 34°51'56"E), and on the same date one specimen was found near Ma'agan Mikha'el (32°33'25"N, 34°54'23"E). Specimens of this conspicuously patterned opisthobranch were recorded and photographed on June 8th at the head of the Akhziv submarine canyon (33°03'38"N, 35°05'31"E), on a shallow rocky ledge sparsely covered with algae. On June 12th a single specimen was collected off Yafo (32°01'49"N, 34°44'23"E), 2 m depth. During July 2011 the nudibranch was sighted off HaBonim (32°38'32"N, 34°55'15"E), on the Carmel plain, south of Haifa Bay, and off Bat Yam (32°01'47"N, 34°44'25"E), on a rocky outcrop surrounded by sandy bottom. Four specimens (40 mm length) were collected at the latter site. The most probable pathway for *C. annulata* into the Mediterranean, like previously recorded Erythrean alien opisthobranchs, is through the Suez Canal (Yokeş and Rudman 2004). Nonetheless, the possibility of shipping as a vector does exist, as attested to by the specimen of *C. annulata* recorded from the Gulf of California (Bertsch and Kerstitch 1984).

The Erythrean alien neritid gastropod ***Smaragdia souverbiana*** (Montrouzier, 1863) was reported for the first time from the Mediterranean coast of Israel (Rothman &

Mienis 2011). A single shell was found in the intestines of *Callionymus filamentosus*, an Erythrean alien fish, which had been caught in Haifa Bay in 1987. This record predates the oldest published record of the species from Turkey by five years (Buzzurro & Greppi 1994).

Crustacea

10 female specimens of a newly described siphonostomatoid copepod, ***Lernanthropus callionymicola*** El Rashidy & Boxshall, 2012, were described from an Erythrean alien

population of the blotchfin dragonet *Callionymus filamentosus* Valenciennes. The specimens were collected off Ashdod, the Mediterranean coast of Israel on 6 July, 2008 by B. Galil, M. Goren and A. Diamant (El Rashidy & Boxshall, 2012). This is the first record of a member of the family Lernanthropidae parasitising a dragonet host.

Fish

A single specimen of the blacktail butterflyfish, ***Chaetodon austriacus*** Rüppell, 1836, one of the most common chaetodontid fishes in the Red Sea, was collected near the port of Ashdod, on the Mediterranean coast of Israel 31°49'10''N, 34°38'16''E, depth: 10m, on August 2011. A population of *C. austriacus* is known from a rocky reef off Nahsholim (about 90 km north to Ashdod). The recent records of Erythrean coral-reef inhabiting fishes in the Mediterranean demonstrate a higher than expected plasticity in habitat choice and feeding habits (Goren *et al* 2011).

A single specimen of the Orangeface Butterflyfish ***Chaetodon larvatus*** Cuvier, 1831, was collected on 15 January 2011 at a depth of 10 m off Tel Shiqmona, 32°49′27″N, 34°56′49″E, at the southern edge of Haifa Bay. The species is endemic to the Red Sea the Gulf of Aden and the Gulf of Oman. The specimen is an Erythrean introduction, whether ephemeral or established population exists will be determined by future records (Salameh *et al* 2011).

In May 2011, a single specimen of ***Champsodon nudivittis*** (Ogilby, 1895) was collected in southern Israel, off Ashdod, 31°45.414N, 34°24.893E, at depth of 100m (Goren *et al* 2011). The occurrence of *Ch. nudivittis* in Israel and Turkey (Çiçek and Bilecenoglu 2009) indicates the presence of a reproducing population in the Mediterranean of the Erythrean alien.

In June 2010, two specimens of the cardinal fish ***Cheilodipterus novemstriatus*** (Rüppell, 1838) was collected by divers at shipwreck off Tel Aviv, 32°05'24''N, 34°45'32''E, at a depth of 30 m (Goren *et al* 2010). The species is known from the Red Sea, Gulf of Oman, and Persian Gulf. It constitutes the fourth Erythrean alien cardinal fish species recorded within less than 5 years off the Israeli coastline.

In December 2009 a single specimen of ***Cyclichthys spilostylus*** (Leis and Randall, 1982) was collected near Haifa Bay. The specimen constitutes the second record of the widely distributed Indo-Pacific species in the Mediterranean. The specimen is an Erythrean introduction. A single specimen (under the generic name of *Chilomycterus*) was reported previously (Golani 1993). The time gap between the records could be due to ephemeral introduction, or an established population so small, specimens had not been captured and brought to the attention of scientists (Golani *et al* 2010).

In May 2011, a single specimen of the slender ponyfish ***Equulites elongatus*** (Günther, 1874) was collected from a nocturnal catch of a commercial trawler off Tel Aviv, from depth of ca. 35 m. The species is widely distributed in the Indo-Pacific, including the Red Sea (Golani *et al* 2011a). The specimen is an Erythrean introduction.

In March 2010 a single specimen of the island grouper ***Mycteroperca fusca*** (Lowe, 1838) was speared off Ga'ash (near Tel Aviv) 32813′38″N 34848′47″E, at 12 m depth. The species is known from the Azores, Madeira, Cape Verde, and the Canary Islands (Heemstra *et al* 2010). It is the first record of the species in the Mediterranean Sea. Its presence in the SE Levant, but unknown elsewhere in the Mediterranean raises questions as to its possible vector. It may have entered through the Strait of Gibraltar and dispersed along the North African coast where it may have been overlooked or confused with it cogener *M. rubra*, introduced with ballast water or an escapee from a mariculture farm.

In October 2010 a single specimen of ***Platax teira*** (Forsskål in Niebuhr, 1775) was collected off Ashdod, 31°45.4N, 34°24.83E, at 8 m depth. *Platax teira* has a wide Indo-Pacific distribution. It was first recorded from the Mediterranean by a single specimen from Bodrum, Turkey (Bilecenoglu and Kaya, 2006), who assumed that their record resulted from an aquarium release. However, the finding of a second specimen in the Levant indicates that it is most likely an Erythrean introduction that has established a small population in its new region (Golani *et al* 2011).

In November 2009 a single specimen of ***Pomacanthus imperator*** (Bloch, 1787) was speared at a depth of 5 m off Shiqmona, 32º49'N, 34º567'E, on the southern rim of Haifa Bay (Golani *et al* 2010). This is the first record of the widely distributed Indo-Pacific species in the Mediterranean. The specimen may be an aquarium release, since the species is a popular with aquarists, or it may be an Erythrean introduction.

In November 2009 a single specimen of ***Priacanthus sagittarius*** Starnes, 1988 was collected off Tel-Aviv, 32º09'55'' 34º47'09', at 40 m depth. This is the first record of this Indo West Pacific species from the Mediterranean and the first member of the Priacanthidae collected in the Levantine basin (Goren *et al* 2010). On October, 2010 another specimen was collected off the southern edge of Haifa Bay, at 50 m depth. The finding of a second specimen in the Mediterranean in less than a year from its previous record suggests that this Erythrean alien species is establishing a population in its new region (Golani *et al* 2011).

In April 2010, a single specimen of the stonefish, ***Synanceia verrucosa*** Bloch et Schneider, 1801, was collected off Palmakhim, 31.56.36ˈ N, 34.42.16ˈ E, at depth of 3 m. This is the first record of this widely distributed Indo Pacific species from the Mediterranean (Edelist *et al* 2011). The stonefish is a venomous fish and its presence warrants special attention to ascertain whether it establishes a population. It may have entered the Mediterranean through the Suez Canal (Erythrean introduction), either as larvae or adult. It may also be an aquarium release.

In December 2009 a single specimen of ***Trypauchen vagina*** (Bloch et Schneider, 1801) was collected on silty bottom at depth of 90 m between Atlit and Hadera. This is the first record of the widely distributed Indo West Pacific species in the Mediterranean (Salameh *et al* 2010). The species had not been reported from the Red Sea, but it is likely it occurs there but uncollected due to its cryptic habits (Salameh *et al* 2010). The specimen is an Erythrean introduction.

In May 2010 a single specimen of the widely distributed Indo-Pacific tetraodontid fish ***Tylerius spinosissimus*** (Regan, 1908) was collected off Ashdod- Tel Aviv, at 120-140 m. This is the first record of the species from the SE Levant and the third record in the Mediterranean- it was previously recorded off Rhodes (Corsini *et al*. 2005; Corsini-Foka 2010). Although there is no confirmed record from the Red Sea, it is probable that it occurs there; but due to its rarely sampled deepwater habits it may have gone undetected (Golani *et al* 2011).

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3.11 Italy[6]

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

To accomplish the requirements of the EU Marine Strategy Framework Directive (2008/56/EC), under the Legislative Decree 190 of 18/11/ 2010, the Ministry of the Environment has appointed a Technical Committee with representatives of other Ministries, of the Regions and of local administrations, in order to i) assess the initial state of the environment, ii) establish the requirements of good environmental status, iii) define the environmental targets. Within a contract work on the above items, ISPRA (Institute for Environmental Protection and Research – Rome) is currently organizing the available information and filling the gaps concerning non-indigenous introduced species.

2. Intentional introduction

No new intentional introductions have been reported.

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[6] **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 2011.

3. Unintentional introduction

New Sightings

<u>Algae & higher plants</u>

Wolf *et al*. (2011) report the first finding of *Hypnea flexicaulis* Yamagishi and Masuda in the Mediterranean Sea (Lagoon of Venice, Italy) identified through molecular analyses using the plastid ribulose-1,5-bisphosphate carboxylase/oxygenase (rbcL) and the mitochondrial protein-coding cytochrome c oxidase subunit I (cox1) genes. The phylogenetic reconstruction, showed that all specimens of *H. flexicaulis* from Venice, Korea, Philippines and Taiwan were included in a monophyletic group. It is highly probable that *H. flexicaulis* has been introduced by Indo-Pacific populations, in particular the Korean one, via ship traffic or shellfish transfers.

<u>Invertebrates</u>

During a survey conducted in October 2010 along the cost of Apulia (off Otranto, Ionian Sea) two specimens of the Phyllodocidae Polychaete *Hesionura serrata* were found. The species has been recorded previously from the Suez Canal and from the coast near Barcelona (Eleftheriou *et al*., 2011).

Previous Sightings

<u>Algae & higher plants</u>

Harmful benthic microalgae blooms are causing health and economic concern, especially in tourist areas of Italy. *Ostreopsis ovata* blooms occur in summer, with increasing regularity (Brescianini *et al*., 2006; Mangialajo *et al*., 2011; Pistocchi *et al*., 2011). *Ostreopsis* species produce palytoxin (PTX) and analogues, PTX is considered one of the most toxic molecules occurring in nature and can provoke severe and sometimes lethal intoxications in humans. So far in temperate areas, *O. ovata* blooms were reported to cause intoxications of humans by inhalation and irritations by contact. In addition, invertebrate mass mortalities have been reported, possibly linked to *O. ovata* blooms, although other causes cannot be ruled out, such as oxygen depletion or high seawater temperature.

A method has been developed (Perini *et al*., 2011) for improving abundance evaluations by means of molecular identification of *O. ovata* in water and on plant substrates.

An ecological study by Accoroni *et al*. (2011) investigated the *O.* cf. *ovata* bloom and its relationships with nutrient concentrations along the Conero Riviera (northern Adriatic Sea) during the summer of 2009. Furthermore, a molecular PCR-based analysis was applied to environmental samples to confirm the identity of *Ostreopsis* spp. genotypes throughout the study period. The toxin profile of epiphytic *O.* cf. *ovata* samples was evaluated both qualitatively and quantitatively with HR LC–MS analyses. In this study, the highest abundances were recorded with temperatures between 22.7 and 22.9 °C, i.e., after the maximum summer value; no clear relationship between the bloom trend and nutrient concentrations was apparent.

An ecotoxicological screening was performed by (Faimali *et al*., 2011) to investigate the toxic effects of different concentrations of *O. ovata* on crustaceans (*Artemia salina, Tigriopus fulvus, Balanus amphitrite*) and fish (*Dicentrarchus labrax*) as model organisms. Furthermore Caroppo and Pagliara (2011) studied toxic effects against both gametes and zygotes of *Paracentrotus lividus.*

The benthic microalga *Chrysophaeum taylorii* bloomed in 2007 in Sardinia, showing adverse effects; a survey, however, did not show statistical differences between benthic communities affected and non affected by the mass death caused by mucus suffocation one year before, nor was any effect noted between areas were the algae mucus was removed manually from control quadrats (Caronni *et al*., 2011a; Caronni *et al*., 2011b). Along the North-Eastern Sardinian coasts a high spatial and temporal variability has been observed (Michelet *et al*., 2011)

Two dinoflagellate *Alexandrium* species have also being studied, due to health concern.

High PST toxin levels are often found in mollusk rearing plants in Sardinia (Luglié 2011), following the introduction in Italy of *Alexandrium catenella* recorded by Luglié (2004).

Summer outbreaks of *Alexandrium taylorii* are recurrent events in nearshore waters producing dense yellowish-green patches; at present, toxicity has not been assessed in the Mediterranean strains, the impacts affect tourism and recreational uses of beaches. Biological, environmental, and molecular data are reported by Giacobbe *et al*. (2007) from a semi-closed bay of Sicily (Vulcano Island, Tyrrhenian Sea), showing high-biomass blooms and events of water discolouration. Analyses of the molecular diversity of geographically distinct isolates of *A. taylorii* from Italy, Spain, and Greece based on rDNA sequences showed a high level of similarity, indicating the existence of an unique Mediterranean population. Satta *et al*. (2010) report a new detection in three successive summers from Platamona Beach, Gulf of Asinara, Sardinia).

On the basis of morphological data and molecular analyses (rbcL and mitochondrial cox2-cox3 spacer sequences) Cecere *et al*. (2011a) confirmed the taxonomic identity (previously only hypothesized) of *Grateloupia turuturu* in both the Lagoon of Venice and the Mar Piccolo basin of Taranto, where it was most probably introduced by shellfish transfers. The encrusting bases of the alga act as resting structures, that are able to survive during unfavorable environmental conditions. In both the Lagoon of Venice and the Mar Piccolo of Taranto, *G. turuturu* does not yet exhibit invasive behaviour.

Several experimental studies have been published on the ecological relationships during the invasion of the green benthic alga *Caulerpa racemosa* var. *cylindracea.*

A study by Bulleri *et al*. (2009) was done along an exposed sandstone rocky shore about 5 km south of Leghorn, on the north-west coast of Italy, between February and September 2005. Resident turf algal assemblages facilitate *Caulerpa racemosa* by enhancing the anchoring of stolons and/or trapping fragments of the alga. Dominance of space by either algal turfs or encrusting corallines favoured *C. racemosa*. Urchins can feed on algal assemblages, in particular *Paracentrotus lividus* and *Arbacia lixula* have been reported to feed preferentially on erect and encrusting algae, respectively. Urchins can reduce the penetration of stolons, directly, through the consumption of *C. racemosa*, or indirectly, by feeding on algal assemblages; the effects of *A. lixula* on the penetration of stolons, in contrast to *P. lividus*, are limited to barren habitats. *P. lividus* can also directly favor the penetration of stolons, releasing nutrients through excretions.

Bulleri *et al*. (2010) evaluated whether *Caulerpa racemosa* is the primary cause of degradation (i.e., responsible for the loss of canopy-formers and the dominance by algal turfs) on shallow rocky reefs near Leghorn, by experimentally removing the invader alone or the entire invaded assemblage. They observed that the cover of *C. racemosa* was greatly enhanced by the removal of the canopy, and that the cover of erect algae was fostered by the removal of *C. racemosa* and, to a greater extent, by that of the entire assemblage. They concluded that invasive species have the potential to transform transient ecological effects, generated by a temporary deviation from the original regime of disturbance, into permanent changes. In other words, they can erode the resilience of natural communities to acute events of disturbance. These effects can persist beyond the disappearance of the invader.

Bulleri *et al*. (2011) tested the hypothesis that the occurrence and abundance of the seaweed *Caulerpa racemosa* in the north-western (NW) Mediterranean would increase with increasing levels of human disturbance. Their results along the coast of Tuscany and NW Sardinia and within the Marine Protected Area of Capraia Island (Tuscan Archipelago), further suggest that *C. racemosa* can take advantage of habitat degradation. They conclude that herbivores could influence the spread of exotic plants not only directly, but also indirectly, via the modification of the effects of resident assemblages of primary producers.

Pacciardi *et al*. (2011) evaluated the effects of *C. racemosa* spread on soft-bottom assemblages in the Tuscan Archipelago National Park (north-western Tyrrhenian Sea). The benthic assemblages colonized by *C. racemosa* were compared with non-invaded assemblages at multiple spatial scales. In addition, a manipulative experiment has been conducted over a one-year period in order to compare the structure of native assemblages invaded by the alga with others where the alga has been manually removed and others that were not invaded. The results of the study showed that the Mediterranean soft-bottom assemblages invaded by *C. racemosa* differed from non-invaded ones in terms of species composition, abundance and patterns of spatial variability.

The spread of *Caulerpa racemosa* modified the habitat also in the soft bottom of the Gulf of Salerno (Tyrrhenian Sea), which was largely unvegetated in its central part, since the first appearance of the alga in the mid-1990s. A long-term assessment of the macrofaunal assemblages from this area was conducted (Lorenti *et al*., 2011). They compared a historical dataset of macrofaunal species obtained in 1981, before the introduction of the alga, with datasets derived from sampling performed in 2006 and 2007 at the same stations. The most conspicuous changes were a decline in infaunal bivalve mollusks and an increase of mobile epibenthic forms (notably the mollusk *Nassarius pygmaeus*); these may be linked to the influence of *C.racemosa* on sediment properties.

<u>Invertebrates</u>

Genetic variability was investigated (Mura *et al*., 2011) at six microsatellite loci of the Manila clam *Ruditapes philippinarum* from the Gulf of Olbia (N-E Sardinia) and Sacca di Goro (N Adriatic Sea). No significant differentiation among Sardinian samples and between those and the Adriatic one was detected, suggesting the absence of a founder effect in Sardinian population.

Significant genetic divergence was found (Barbieri *et al*., 2011a) sequencing a portion of mitochondrial rDNA between individuals of *Mytilaster minimus* sampled from 6 marine sites located in Tuscany and Sardinia and 5 Tyrrhenian lagoon sites .

Limnoperna (= Xenostrobus) securis has been recorded (Barbieri *et al*., 2011b) in 3 more locations in the Tyrrhenian Sea (in the estuaries of the rivers Arno and Fiume Morto - Tuscany, and in the Gulf of Olbia - Sardinia).

A massive and repeated settlement of *Brachidontes pharaonis*, known from Sicily since 1969, has been reported in a large industrial plant in Siracusa (Garaventa *et al*., 2010). The proliferation of *B. pharaonis* inside intake structures, screens, seawater piping systems and heat exchanger tubes has become so severe, that the plant had to be periodically shut down, causing an overall decline in plant efficiency at great economic costs. Routine antifouling chemical treatments (hypochlorite and one booster biocide) designed for control of indigenous bivalve populations were totally ineffective against *B. pharaonis*, forcing managers to change their antifouling strategy and test new biocides.

Anadara transversa is an Arcid bivalve first reported in the Mediterranean Sea in the early 1970s in Turkey. Since then, the species has been recorded in the Aegean Sea and in the Adriatic Sea, where it became invasive along the northern coasts. Its finding in the Olbia harbor (NE Sardinia) represents the westernmost record of this species (Lodola *et al*., 2011).

In mesocosm experiments (Munari *et al*., 2011), the three most common bivalve prey in northern Adriatic lagoons: the non-native ark shell (*Scapharca inaequivalvis*) , the Manila clam (*Ruditapes philippinarum*), and the native cockle (*Cerastoderma glaucum*) were offered to the non-native rapa whelk (*Rapana venosa*). The results suggest that hypoxia may facilitate the coexistence of the two non-native bivalves via predator switching and that the native cockle could be the net loser of the game.

Bello (2011) reexamines a previous work, giving the justifications for not terming as alien species 4 Cephalopods that are present in the Italian checklist (Bello, 2008).

<u>Fish</u>

A newly settled population of the Erythrean rabbitfish *Siganus luridus*, which arrived in Linosa Island (Sicily Strait) in 2000, was studied (Azzurro *et al*., 2011) to unveil the genetic variability of the early phase of invasion. Demographics and dynamic aspects of *S. luridus* in the Mediterranean were evaluated by using phylogeographic and demographic (coalescent) methods based on DNA sequences of the mitochondrial control region. Samples were collected in one locality in the Red Sea (Eilat) and three localities in the Mediterranean (Israel, Greece and Linosa, Italy). Data showed a lowering of the genetic diversity of the invading population (Mediterranean) compared to the parental one (Red Sea). Within the Mediterranean populations, there was no pattern of regional separation and mitochondrial diversity appeared to be preserved during the Linosa colonization, with no traces of founder events.

The additional records of the Atlantic fish *Seriola fasciata* from the Maltese coastal waters (Deidun, 2011b) reinforce the impression that the species should no longer be considered as rare in the Mediterranean Sea. This conclusion is further supported by a considerable range expansion within the Mediterranean since its appearance within the basin in 1989.

Not Seen Species Yet

In late autumn and early winter of 2004, two individuals of the Erythrean alien *Rhopilema nomadica* were sighted at two locations off the Maltese Islands, marking the westernmost records of this species in the Mediterranean Sea (Deidun *et al*., 2011a). This tropical scyphozoan purportedly first entered into the Mediterranean Sea via the Suez Canal since the late 1970's; since then, this planktotrophic jellyfish species has regularly formed swarms of considerable proportions (some stretching for 100km) along the Levantine coast. A footage, taken in 2004, had been made available to the

Authors only recently: the photos clearly record the first images of *Rhopilema nomadica* in the straits of Sicily.

The occurrence within Maltese coastal waters of *R. nomadica* follows the recording in 2009 of another alien jellyfish species, *Cassiopea andromeda* (Schembri *et al*., 2009).

The Amphipods, *Stenothoe gallensis* and *Hyale camptonyx,* were found in Southern Tunisia by Zakhama-Sraieb and CharW-Cheikhrouha (2010) and Zakhama-Sraieb *et al*. (2011). The decrease of abundance of *Amphitoe helleri* in one location suggests the substitution of indigenous species by the Erithrean ones. The structure of the meadow assemblage seems to be influenced by the presence of the lessepsian amphipods species, including *Elasmopus pectinicrus* and *Stenothoe gallensis*, recorded since 2006 in the *Posidonia* meadow of a station named Zarzis Sonia plage.

4. Pathogens

No data

5. Meetings and research projects

A review of vegetative reproduction by multicellular propagules in Rhodophyta has been published by Cecere *et al*. (2011b), highlighting the importance for long-distance dispersal and ecological fitness of many species belonging to this taxon.

Two reviews on alien mollusk distribution in Italy were produced by Crocetta (2011a, b), yet many changes of taxonomical nomenclature are still under debate among specialists.

The results of the research programme on *Ostreopsis* toxicity, financed by the Minisry of the Environment, have been published (Magaletti and Giani, 2010) and presented during a final workshop (Rome, ISPRA Auditorium, 30 april 2010)

A seminar organized by the University of Florence Dept. of Evolutionary Biology (Francesca Gherardi) was held in Florence on November 2011 entitled "Interactions between climatic change and invasive species: risks and opportunity".

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3.12 Lithuania

Compiled by Sergej Olenin, Coastal Research and Planning Institute, Klaipeda University, Lithuania

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

No new regulations since 2010.

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 marine and coastal waters in 2011.

5. Meetings and projects

Meetings

The Center for Coastal and Ocean Mapping/Joint Hydrographic Center Seminar Series. Center for Coastal and Ocean Mapping, Durham, NH, USA. March 28, 2011

- S. Olenin. Functional Ecology of Benthic Habitats and Marine Biological Invasions

Seminar at the Centre of Marine Sciences. University of Algarve, Faro, Portugal. April 6, 2011

- S. Olenin. Invasive species and environmental quality assessments.

Expert Meeting on Improving SEBI Indicators on IAS, 26-27 September, 2011, European Environmental Agency, Copenhagen, Denmark

- S. Olenin. Non-indigenous species and Good Environmental Status Indicators in the European Marine Strategy Framework Directive

2nd World Conference on Biological Invasions and Ecosystem Functioning. Mar del Plata, Argentina. November 21-24 2011.

- Anastasija Zaiko / Sergej Olenin. Water quality management and bioinvasion impacts: How to make practical assessments?
- Anastasia Zaiko. Assessing the bioinvasion impact of an aquatic habitat engineering species
- Aleksas Narščius. Bioinvasion impact assessment and alien species databases: Lessons learned

Projects:

- AUTOFITOMET. Automated method for identification and quantification of alien phytoplankton species. National project funded by the Research Council of Lithuania (2010-2011).

The phytoplankton sample treatment (species identification, counting, cell measuring and biovolume calculation) is a very time-consuming procedure. The work requires also highly skilled phytoplankton expert. In order to save time and to achieve a reasonable accuracy a system for automatic identification and counting of alien phytoplankton would be very useful. The project is aimed to develop digital image database of the alien phytoplankton species found in the Lithuanian waters of the Baltic Sea; categorize specific morphological features of that species which may be used for development of automated computerised alien phytoplankton identification and counting algorithms; and develop a prototype of a user friendly computerised system of phytoplankton identification and counting integrated with a microscope. Such a system may be a first step towards development in the future of an automatic phytoplankton detection system integrated with physical-chemical sensors.

- SATYRAS. Study on invasive potential of higher crustaceans: metabolism and trophic niche. National project funded by the Research Council of Lithuania (2010-2011).

The project is aimed at studies of isotopic niche partitioning among the most widely spread in Lithuanian waters invasive crustaceans (amphipod *Pontogammarus robustoides*, mysid *Paramysis lacustris*, shrimp *Palaemon elegans* and crayfish *Orconectes limosus*) and the local ecologically equivalent species. The results demonstrated the most severe niche overlap of the native noble crayfish *Astacus astacus* with spiny-cheek crayfish *O. limosus*, leading to the fastest exclusion rates of the native species. These findings contribute to strong recommendation to consider the conservation status of noble crayfish in Lithuania. The surveys also revealed that exotic species occupied larger isotopic niche space than their native counterparts. This implies that alien populations are more effective at the use of wider spectrum of available resources than native species and subsequent have more diverse trophic roles in the ecosystems.

- SVETIMI TINKLE. Impact of alien crustacean invasions on food web structure in lakes. National project funded by the Research Council of Lithuania (2010-2011).

Summarised the impact of non-indigenous Ponto-Caspian amphipods and mysids on the pattern of perch feeding. Provided comprehensive overview of the distribution of non-indigenous macroinvertebrate species in Lithuanian fresh waters and their dispersal patterns. Drawn predictions of future invasions in inland waters. Evaluated the biological contamination of macroinvertebrate assemblages in Lithuanian rivers and the impact of that on conventional macroinvertebrate indicators of the ecological status of lotic systems. Summarised the change of peracaridan assemblage in Lake Dusia since the introduction of Ponto-Caspian species. Established the method for evaluation of the ecological status and non-indigenous species–specific naturalness of Lithuanian lakes. In an attempt to reveal the impact of biological invasions on community-wide parameters of isotopic niche, the food webs of 16 Lithuanian lakes have been investigated.

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

Project is aimed at development of 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, in particular for development of BINPAS (Bioinvasion impact / biopollution assessent system) (http://www.meece.eu/).

- VECTORS. Vectors of Change in Oceans and Seas Marine Life, Impact on Economic Sectors (2011-2015)

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).

6. 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).

CORPI develops an Information system on marine alien and cryptogenic species of Europe and adjacent regions [working title: VECTORS database].which covers all Large Marine Ecosystems

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3.13 The Netherlands

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

1. Regulations:

- Import of mussels from Ireland and the UK into the Oosterschelde is permitted under licence. Mussels are imported mainly during the winter period. A strict monitoring protocol is applied to the imports to monitor the risks of introducing invasive species with the transports into the Oosterschelde.
- Permits are issued for small-scale fishery on wild Pacific oysters in the Wadden Sea.
- As part of the transition of the mussel aquaculture sector from seed fishery to collection of mussels through Seed Mussel Collectors (SMC's), a permit is issued to transfer mussels from the Oosterschelde to the Wadden Sea. The transfers will take place in a short period in Spring. Various mitigating measures have been implemented such as various treatments of the transport within the ships (mechanical, freshwater and dry), control, monitoring and restricted transport of seed mussels. The activities will be evaluated this summer.
- The fishery on razor clams (*Ensis directus*) is continuing. The stocks are still increasing. The razor clams are far the most important bivalve species along the Dutch coast. The market for razor clams, however, is limited.
- Non Indigenous Species are one of the 11 descriptors of the Marine Framework Directive. Discussions have been started on the indicators of this descriptor and how monitoring programs can be used to measure the indicators.

- A national Expertise Centre for Exotic species has been formed. The goal is to collect knowledge about exotic species. Also the centre will conduct fundamental research on exotic species

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. Specific species that are used for shellfish aquaculture on land are *Venerupis philippinarum*. This species is also recorded as present in the Oosterschelde.

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.

There are intentional translocations of invasive species. Wild Pacific oysters are translocated to locations in the Oosterschelde where they can have a function in coastal protection.

3. Unintentional introductions:

New Sightings

There are no new first observations of exotic species in the coastal waters of the Netherlands this year.

Previous Sightings

The lists of Wolff (2005) on exotic species in the Dutch coastal waters has been 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 and the transport of mussels from the Oosterschelde to the Wadden Sea 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 (Gittenberger *et al.*, 2010, Wijsman & De Mesel, 2009). 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 and the intertidal oysterbeds have been mapped. In the Wadden Sea the expansion of *Ensis directus* continued. At present it is by far 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 (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 pers comm.). 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, Faasse & Ligthart, 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.

During the alien species inventories in 2009 and 2011 in total 19 new species (resp. 11 and 8) were found, raising the number of known alien species in the Dutch Wadden Sea from 54 to 72 in three years time. Many of these species have probably been overlooked in previous years as the inventories of 2009 and 2011 were the first to specifically focus on finding all alien species in the Dutch Wadden Sea. In 2001 two of the eight 'new' alien species for The Wadden Sea, also concern 'new' alien species to The Netherlands: *Ceramium botryocarpum* and *Ceramium tenuicorne*. Although they had been found "washed ashore" in previous years, they were first recorded as settled/attached individuals in 2011. In 2011 one alien species (*Telmatogeton japonicas*) was discovered from the SETL project. This species is new to the Dutch Wadden Sea but not for the Netherlands.

In the Oosterschelde a survey has been executed on the distribution of Pacific oysters (*Crassostrea gigas*) in the Oosterschelde. All intertidal oyster beds have been mapped and measured. The population is still increasing.

Fenestrulina delicia has been found on the Borkumse stenen in the North Sea. This is the most northern observation of this species in Europe.

4. Pathogens

Shellfish from the Zeeland open water bodies is sampled twice per year in a monitoring program, to detect infections and diseases. The condition of the shellfish is determined by an autopsy, after which shellfish are sampled for histopathology and sometimes also bacteriology. Molecular techniques are also increasingly being used for diagnostic purposes. Surveillance on shellfish diseases and pathogens (*Bonamia Ostrea, Marteilia refringens*, etc) is continuing.

5. Meetings

- 8 December 2011: Mechanical and chemical elimination of exotic species. Tiel, The Netherlands
- Trilateral Conference on Neobiota in the Wadden Sea - Challenges for Nature Con-servation was held 26 August 2010 in Germany (Wilhelmshaven). Presentations were given on the Dutch situation by Hein Sas, Arjan Git-

tenberger and Jeroen Wijsman. (http://www.waddensea-secre-tariat.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

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3.14 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:

Polish regulations include:

CBD Convention (05 June 1992) – protection of native biodiversity on all levels: genetics, ecosystems, landscapes.

Act on Fishery (19 February 2004) - regulations for breeding and restocking of marine fish and other marine organisms, thus including IAS.

Nature Conservation Act (16 April 2004) – regulation for the introduction of alien fungi, plants and animals and on the import of alien species that pose a threat to native biodiversity.

The new decree of the Minister of Environment, issued on 9 September 2011, imposes restrictions on 52 invasive alien species of plants and animals. Import, keeping, breeding and selling these species requires obtaining permission from the General Director for Environmental Protection. Breaking the law is subject to a fine or jail. Negligence leading to escape of animals listed in the decree may result in similar consequences. The aim of the new regulation is to reduce the risk of introduction of the most invasive alien species that are either absent, or still restricted in their range in Poland. It will come into force in March 2012.

2. Intentional introductions:

In 2011 deliberate releases of salmon (*Salmo salar*), sea trout (*Salmo trutta morpha trutta*) and whitefish (*Coregonus lavaretus*) were conducted (Bartel and Kardela, in press).

3. Unintentional introductions:

Jaera istrii Veuille, 1979 (Isopoda) in 2011 was recorded for the first time in Poland, in the Oder River (Szlauer-Łukaszewska and Grabowski, under review). The native range of *Jaera istri* is the Ponto-Caspian region. In 1967, it was observed in the upper section of the Danube River (Kothe 1968), then it extended its range to Western Europe through the Main-Danube Canal (Tittitzer *et al*. 2000) and was found for the first time in the Elbe River in 1999 (Schöll & Hardt, 2000). In 2008 it was found for the first time in the River Elbe in the Czech Republic (Straka and Špaček 2009). Among Ponto-Caspian crustaceans colonizing European inland waters in recent decades, *J. istri* is the only isopod species (Bij de Vaate *et al*. 2002). It is relatively euryhaline species lives among stones and vegetation.

Hypania invalida (Grube, 1860) (Polychaeta) was recorded for the first time in the southern part of the River Odra estuary in 2010 (southern Baltic) (Woźniczka *et al*. 2011). It was the first record of this species in Poland or in any a Baltic estuary. *H. invalida* is one of the few polychaete species inhabiting fresh waters. In the native Ponto-Caspian range the polychaete settles in both fresh and brackish waters, tolerating a wide range of salinity, temperature and depth, but in Western and Central Europe, until now, *H. invalida* settles only fresh waters, mainly big rivers and dam reservoirs. Although in 2010 in the River Odra estuary the occurrence had locally a mass character (maximum abundance of 11 466 ind m^{-2}), in 2011 the individuals of this species probably disappeared from area settled at previous year – sampling done on 3 August 2011 does not confirm presence of *H. invalida* on any of sampled stations (Woźniczka *et al*. 2011 a, Woźniczka *et al*. 2011 b). The appereance of *H. invalida* in Szczecin Lagoon has a rapid character and was probably correlated with flood wave enter into the Lagoon.

Gammarus varsoviensis Jażdżewski, 1975 (Amphipoda) recognised until now as native to Central Europe is apparently an alien gammarid originated in the Pontic area (investigations on the base of 128 partial 16S r DNA sequences of *G. varsoviensis* from 19 localities) (Grabowski *et al*. 2012 a, in press). The first findings of *G. varsoviensis* (in 2009 and 2011) in Ukraine have confirmed the Ponto-Caspian origin of this species (Grabowski *et al*. 2012 b). Ukraine lies almost entirely within the Balck Sea drainage basin –a very important part of that region. Geographic range of *G. varsoviensis* includes Germany, Poland, Lithuania, Latvia, Belarus and Ukraine, and the distribution pattern indicate that this species have migrated to the Baltic basin through the Pripyat-Bug Canal. Its expansion in Central Europe apparently started soon after the opening of the artificial waterways joining the Black and the Baltic Sea drainage basins (Grabowski *et al*. 2012 a, in press).

Ameiurus nebulosus (Lesueur) (Ictaluridae) was recorded for the first time in the Łyna River drainage basin. In February 2010, 77 brown bullhead were collected in Lake Czarne, and one in July 2010 was caught by angling method in Lake Długie in Olsztyn (northeast Poland) (Kapusta *et al*. 2010). The brown bullhead, *Ameiurus nebulosus* (Lesueur), is native to eastern and central North America from Nova Scotia and New Brunswick to the Great Lakes region and south to Alabama. It has also been introduced throughout the United states (Scott and Crossman 1973). *A. nebulosus* is found in lakes, ponds, oxbow lakes, reservoirs, canals, and low-gradient streams with shallow water, dense aquatic vegetation, and muddy bottoms. The brown bullhead has been recorded in the middle and lower courses of the Oder and Vistula rivers, in the Warta, Bug and Wieprz tributaries, and in the lower course of the San River. It also inhabits the lakes of the Łęczyńsko-Włodawski Lake District, Western Pomerania, and the Masurian Lake District (Grabowska *et al*. 2010). Until recently, the inland waters of Poland were thought to be inhabited only by *A. nebulosus.* However recent reports indicate that also *A. melas* occurs in Polish waters. The currently location of *A. melas* has been described in central Poland (Nowak *et al*. 2010).

4. Pathogens

Parasites: *Diplostomum paracaudum* (Iles, 1959) (Digenea), *Eustrongylides tubifex* (Nitzsch, 1819) (Nematoda) and *Holostephanus luehei* Szidat, 1936 (Digenea) were recorded for the first time in Poland in the individuals of the Chinese (Amur) sleeper *Percottus glenii* Dybowski, 1877 (Perciformes: Odontobutidae) in the Włocławek Reservoir on the lower Vistula River (Mierzejewska *et al*. 2012). In total 168 seasonally caught individuals of *P. glenii* (collected from 2008 to 2010) were examined for parasites. Chinese sleeper *Percottus glenii* was unintentionally introduced from eastern Asia to the European part of Russia (near St. Petersburg) in 1916 and has since spread spontaneously throughout Asia and Europe. It is now a frequent component of the ichtyofauna in the Vistula River drainage. This species spreads naturally with floods and river currents or by anglers who often use this fish as live bait, and it had colonized the Włocławek Reservoir on the lower course of the Vistula River by 1998 (Kakareko 1999, Wiśniewolski *et al*. 2001, Kostrzewa *et al*. 2004).

Anquillicoloides crassus (Kuwahara, Niimi et Itagaki, 1974) (Anqullicoidae) is increasing its range of occurrence in Poland. This pathogenic nematode of the swim bladders of eel was recorded for the first time in lakes Żarnowieckie, Ostrzyckie, Raduńskie (Dolne and Górne), and in the Vistula River. The study material was collected during the 2005-2008 period (Rolbiecki 2011). It is highly probable, that the area of occurrence of this nematode in Poland corresponds to the distribution of its final host – the eel.

Actis hypoleucos (L., 1758) – is the new Polish host of trematodes: *Plagiorchis nanus* (Rudolphi, 1802) (Digenea) and *Leucochloridium perturbatum* Polmańska, 1969 (Digenea). The digeneans were collected during 2005-2008, during a study on the food composition of the common sandpiper. The research was conducted near Lisewo Malborskie (near Tczew, Żuławy Wiślane, Gdańsk sea-coast), at a resting site on the birds'migration route. *Actis hypoleucos* is the host for these new records in Poland (Rzad *et al*. 2011).

5. Meetings

International Carp Conference, 15th -16th of September 2011 in Kazimierz Dolny on the Vistula, Poland.

www.carpinternational.eu

Carp farming differs from aquaculture vision that existed in European Union so far. Nowadays many of carp farmers problems are not only their domestic but they are international matter. Fish diseases, predators, EU funds – those are only some issues in which carp farmers should find common position. That is why idea of International Carp Conference was born. It was interesting experience exchange and elaboration of common position for crucial issues. In the conference participated carp farmers, associations and governmental representatives, veterinary services, university and institutes representatives.

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3.15 Portugal

Compiled by Paula Chainho, Centro de Oceanografia, Faculdade de Ciências da Universidade de Lisboa, Portugal with contribtion from Ana Amorim, João Canning-Clode, João Castro, Ana Cristina Costa, Ricardo Melo, Mónica Sousa, Miriam Guerra and José Lino Costa.

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

Portaria n.º 85/2011, 25th February, forbids the capture of the native species *Ruditapes decussatus* and legalizes the capture of *Ruditapes philippinarum*, requiring a harvesting plan that cannot exceed the current number of licenses.

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

In order to accomplish the requirements of the EU Marine Strategy Framework Directive (2008/56/EC) IPIMAR contributes to the inventory, the description of spatial distribution, and the assessment of status and impacts of non-indigenous species, both on the seabed and the water column, in the marine environment (mainland Portugal).

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 81 aquatic non-indigenous species (NIS) is registered for the Portuguese estuarine and coastal aquatic systems. New additions to the 2011 list are listed in Table 1. New additions for Portuguese mainland and Azores and Madeira islands were considered separately. Species for which there corrections/changes on the possible introduction vectors, year of first record, current population status at locations where the species were registered and references were included. Possible introduction vectors were indicated based on the life cycle of the introduced species and the presence of known introduction vectors at locations where it was registered. The inventory of NIS did not include fish species and freshwater species.

Table 1. List of new NIS registered in Portuguese waters

Taxa	Year of first record	Location of first record	Possible introduction vector	Invasion Status	References
Ostreopsis cf. ovata	2011	South Coast of Portugal	Unknown	Unknown	David et al., 2012
Anotrichium furcellatum (J. Agardh) Baldock	1970	Madeira	Ballast water; Fouling	Unknown	Levring, 1974
Anotrichium cf. okamurae Baldock	2003	Portuguese coast	Unknown	Established	Berecibar, 2011
Antithamnion amphigeneum A.J.K.Millar	2003	Southern Portuguese coast	Unknown	Established	Berecibar 2011
Antithamnion diminuatum Wollaston	1994	Azores	Unknown	Established	Athanasiadis & Tittley, 1994
Antithamnion pectinatum (Montagne) J.Brauner	1994	Southern Portuguese coast	Unknown	Not established	Berecibar 2011
		Azores	Unknown	Established	Athanasiadis & Tittley, 1994
Antithamnionella spirographidis (Schiffner) E.M.	1987	Azores	Ballast water; Fouling	Unknown	Castro & Viegas, 1987
Asparagopsis armata Harvey (+ Falkenbergia rufolanosa)	1989	Azores	Unknown	Established	Neto, 1989
Asparagopsis taxiformis (Delile) Trevisan de Saint-Léon	1929	Azores (S. Miguel, Santa Maria, Flores)	Unknown	Established	Schmidt, 1929
Bonnemaisonia hamifera Hariot	1989	Azores (Faial, Graciosa and Flores)	Fouling	Established	Neto, 1989
Lomentaria hakodatensis Yendo	2003	Southern Portuguese coast	Unknown	Established	Berecibar, 2011
Scageliopsis patens Wollaston	2003	Southern Portuguese coast	Unknown	Unknown	Secilla et al. 2008
Symphyocladia marchantioides (Harvey) Falkenberg	2010	Tagus estuary coastal area	Unknown	Unknown	Inspect
	1994	Azores (Santa Maria, S. Miguel and Graciosa)	Unknown	Unknown	Neto, 1994
Codium fragile spp. fragile (Suringar) Hariot	1993	Azores (São Miguel ,Corvo, Flores, Santa Maria)	Fouling	Established	Titley & Neto, 2005
Ulva pertusa Kjellman	2003	Southern Portuguese coast	Unknown	Unknown	Berecibar, 2011
Endarachne binghamiae J. Agardh	1994	Azores (Faial, Pico, São Miguel and	Fouling	Established	Tittley & Neto, 1994

		Terceira)			
Desdemona ornata Banse, 1957	1993	Mainland Portugal (Ria Formosa)	Ballast water	Established	Machado & Cancela da Fonseca, 1997
Bugula neritina (Linnaeus, 1758)	2004	Mainland Portugal (Ria de Aveiro)	Fouling	Established	Marchini et al., 2007
Watersipora subtorquata (d'Orbigny, 1852)	2010	Mainland Portugal (Tagus estuary)	Fouling	Established	Inspect
Pteropurpura (Ocinebrellus) inornata (Récluz, 1851)	1999	Mainland Portugal (Sagres)	Aquaculture	Established	Afonso, 2011
Zoobotryon verticillatum Della Chiaje, 1828	2008	Madeira	Fouling	Unknown	Wirtz & Canning-Clode, 2009
Amphibalalus amphitrite (Darwin, 1854)	1920	Azores (S. Miguel and Faial)	Ballast water; Fouling	Established	Gruvel, 1920
Amphibalanus eburneus Gould, 1841	1998	Azores (Faial)	Fouling	Unknown	Southward, 1998
Perforatus perforatus Bruguiére, 1789	2011	Azores (S. Miguel)	Ballast water; Fouling	Established	Inspect

5. Meetings and projects

Meetings

Amorim, A., V. Veloso, C. Battochi & A. Penna. Occurence of *Ostreopsis* cf. *siamensis* in the upwelling coast of Portugal (NE Atlantic). ICOD, International Conference on *Ostreopsis* Development, Villefranche, France, April, 2011.

Amorim, A, V. Veloso, F. Rodrìguez & S. Fraga,. Life-cycle, morphology and phylogeny of species of *Fragilidium Balech* in west Iberia Peninsula. 9th International Conference on Modern and Fossil Dinoflagellates between the 28th August to 2nd September 2011.

Chainho, P., J.L. Costa J.P. Medeiros & M.J. Costa. The influence of non indigenous species in the assessment of ecological status based on estuarine benthic communities. VII Iberian Water Congress, Talavera de la Reina, Spain, February 2011.

Costa, A.C., P. Raposeiro, A. Cruz, P. Torres & C. Hipólito. Aquatic invasive alien species in the Azores islands. Workshop on prevention and control of invasive species, Angra do Heroísmo, Portugal, October 2011.

Cruz, T. & J.J. Castro. Distribution, abundance and size of the barnacle *Austrominius modestus* in its southern limit in continental Europe (Portugal). 9th International Temperate Reef Symposium. June-July 2011.

Hipólito, C., P. Torres & A.C. Costa 2011. Distribution of the invasive bryozoan *Zoobotryon verticillatum* in the Azores islands. Workshop on prevention and control of invasive species, Angra do Heroísmo, Portugal, October 2011.

Ribeiro, S., A. Amorim, T. J. Andersen, F. Abrantes & M. Ellegaard, Reconstructing the history of an invasion - the toxic phytoplankton species *Gymnodinium catenatum* in the NE Atlantic. 9th International Conference on Modern and Fossil Dinoflagellates, Liverpool, UK, August 2011.

Silva, T., V. Veloso, A. Amorim,. Caracterização dos bancos de quistos de *Gymnodinium catenatum* da costa NW de Portugal. XI Reunión Ibérica sobre microalgas nocivas y biotoxinas, Bilbao, Spain, May 2011.

Torres, P., A.C. Costa, M.A. Dionísio. Alien barnacles in the Azores and some remarks on the invasive potential of Balanidae. The Crustacean Society Summer Meeting, Honolulu, Hawai, June 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.

- Azores: Stop-over for Marine Alien Species? – ASMAS (M2.1.2/I/032/2011). In the Azores, studies on marine species introductions or invasions are rather recent. However, some alien species have already been identified. This project aims to study the occurrence of main marine alien species in the Azores and its invasion pathways (hull fouling and ballast water), evaluate the existence of environmental conditions that favour or difficult the establishment of potential invaders and promote monitoring and mitigation protocols. Sampling surveys on maritime traffic routes will be conducted at commercial and marina harbours of São Miguel and Santa Maria Islands, and neighbouring areas, for several different taxonomic groups, namely phytoplankton, zooplankton, macroalgae and invertebrates on soft and hard substrates. Also, some selected ship ballast water tanks arriving to the mentioned harbours will be sampled to assess the importance of this introduction vector. Proposals on the definition of priority areas and species will be done with the aim of supporting managers and decision makers on the allocation of resources to prevent and/or mitigate the invaders impacts. Also, it is intended to evaluate the exploitation potential of main identified marine alien species, to allow an alternative approach to address this problem. This project is also expected to increase the cooperation between the scientific community, administration representatives of different sectors and civil society, through cooperative actions and participation, meetings organization and through leaflet factsheets distribution to raise public awareness of the problem.
- Canning-Clode J. (2012-2015). Exploring fouling invasions in Portuguese waters: roles of artificial substrates and metal pollution. Postdoctoral FCT grant.

  Non-indigenous species (NIS) invasions occur on a global scale and can generate significant ecological, evolutionary, economic and social consequences. One of the major transfer mechanisms (vectors) for the redistribution of marine species around the world is shipping, primarily through ballast water and hull fouling. Estuarine are particularly vulnerable to invasions due to their use as harbors and ports, and are also often highly polluted due to years of human-induced degradation. In addition, the number of artificial structures such as docks and pilings is becoming increasingly frequent within bays and estuaries, representing a crucial source of space for newly established species. At IMAR-DOP and Centre of Oceanography at the University of Lisbon and also in close collaboration with the Smithsonian Environmental

Research Centre, I propose to make a pioneer contribution to marine invasions in Portugal. I will investigate whether artificial substrates facilitate marine invasions and will examine if marine invasive species are more tolerant to metal pollutants than native species.

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- Grazziotin-Soares, C. 2010. Macroalgae communities at Sines and Oeiras recreational harbours (Portugal): influence of diferent substrates and occurrence of non indigenous species. Master thesis. University of Lisbon.
- Lopes, C.H. 2010. Biology of the invasive species *Zoobotryon verticillatum* Della Chiaje, 1822 in São Miguel, Açores. Graduation thesis in Biology. University of Azores.
- Garaulet, L.L. 2011. Establishment of the non indigenous bivalve *Ruditapes philippinarum* (Adams & Reeve, 1850) in the Tagus estuary: population status and comparison with the native species *Ruditapes decussatus* (Linnaeus, 1758) and benthic community. Master thesis. University of Lisbon.
- Ribeiro, S. 2011. Marine protists resting stages as tracers of environmental change – linking past and present with living and subfossil dinoflagellate cysts. Ph.D. thesis. Faculty of Science, University of Copenhagen, Denmark.
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3.16 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)

Royal Decree 1628/2011, regulating the Spanish list and catalogue of invasive exotic species, was approved on 14th November, 2011. In the Catalogue are included "alien invasive species", whereas in the List are included "alien species with invasive potential".

This decree is not specific for marine or aquatic species, although the following marine species are included:

<u>In the Catalogue</u>:

<u>Algae</u>:

Asparagopsis armata (Harvey, 1855).

Asparagopsis taxiformis ((Delile) Trevisan de Saint-Léon, 1845).

Caulerpa racemosa ((Forssk.) J.Agardh, 1873).

Caulerpa taxifolia ((M.Vahl) C.Agardh, 1817).

Codium fragile ((Suringar) Hariot, 1889).

Grateloupia turuturu (Yamada, 1941).

Sargassum muticum ((Yendo) Fensholt, 1955).

Stypopodium schimperi ((Buchinger ex Kützing) Verlaque & Boudouresque, 1991).

Undaria pinnatifida ((Harvey) Suringar, 1873).

Mollusks:

Dreissena polymorpha (Pallas, 1771).

Cnidaria:

Cordylophora caspia (Pallas, 1771).

Crustaceans:

Carcinus maenas (Linnaeus, 1758). (For the Canary Islands)

Eriocheir sinensis (Milne-Edwards, 1853).

Fish:

Pterois volitans (Linnaeus, 1758).*

In the List:

Algae:

Acrothamnion preissii ((Sonder) E.M.Wollaston 1968).

Lophocladia lallemandi ((Montagne) F.Schmitz 1893).

Polysiphonia morrowi (Harvey, 1857).

Womersleyella setacea ((Hollenberg) R.E.Norris 1992).

Parasites:

Anguillicola crassus (Kuwahara, Niimi & Itagaki 1974).

Pseudodactylogyrus anguillae (Yin & Sproston, 1948).

Custaceans:

Balanus improvisus (Darwin, 1854).

Mollusks:

Crassostrea gigas (Thunberg, 1793).

Crepidula fornicata (Linnaeus, 1758).

Ruditapes philippinarum (Adams & Reeve, 1850).

Xenostrobus securis (Lamarck, 1819).

Annelida:

Ficopomatus enigmaticus (Fauvel, 1923).

Cnidarians:

Haliplanella lineata (Verrill, 1870).

Ctenophores:

Mnemiopsis leidy (A. Agassiz, 1865).

Crustaceans:

Callinectes sapidus (M. J. Rathbun, 1896).

Rhithropanopeus harrisii (Gould, 1841).

The species with * means that it is not present in the natural environment, but it existed (at least it should not be commercialized anymore) in the aquarium trade.

The main difference between the Catalogue and the List is that the inclusion in the **Catalogue** entails a "general prohibition of possession, transportation, traffic or trade of live or dead specimens, their remains or propagules, including foreign trade". And "this ban may be lifted upon administrative approval, when needed for research purposes, human health or safety". On the other hand the inclusion in the **List** entails "prohibiting their introduction into the wild, in all the national territory and in marine areas under Spanish sovereignty or jurisdiction. Where appropriate, exceptions to this prohibition, and after administrative control of the autonomous region, can be granted to those List species introduced in enclosures linked to human activities and which are isolated from the natural environment."

Nevertheless, since its entry into force, on December 13, the Royal Decree has already been appealed in the Supreme Court by the Spanish Fisheries Federation, among others. In addition, several autonomous regions, such as Castilla y León, Aragón and Catalonia, have submitted a request to the Ministry, asking for the nullity of the regulation. These autonomous regions state that the regulation, as well as containing important legal uncertainties, which hinder its application, includes a list of potentially invasive species, such as the carp (*Cyprinus carpio*) or the rainbow trout (*Oncorhynchus mykiss*), that have been integrated to our ecosystem for more than a century, and to which a highly restrictive regime is being applied.

After listening to the claims of all these autonomous communities that have expressed their strong opposition to this legislation, on February 24, the Cabinet approved to revise the Royal Decree of Invasive Alien Species.

2. Intentional:

Crassostrea gigas

Through its potential for rapid growth and its wide ranging tolerance to environmental conditions, the Pacific cupped oyster has become the oyster of choice for cultivation in many regions of the world, including Spain. While its origins are in Japan, it has been the subject of widespread introductions elsewhere, either to replace stocks of indigenous oysters severely depleted by over-fishing or disease, or to create an industry where none existed before. In Spain it was introduced in 1877.

Figure 1 shows the production (in Tn) in Spain since 2007 (Data from the Ministry of Agriculture, Food and Environment)

(http://www.magrama.es/app/jacumar/datos_produccion/datos_produccion.aspx).

In 2010 less than 700 Tn were produced (about 46% drop from 2009), which represented a value of 1.5 million €

(http://www.magrama.es/app/jacumar/datos_produccion/lista_datos_valor2.aspx?Id=es).

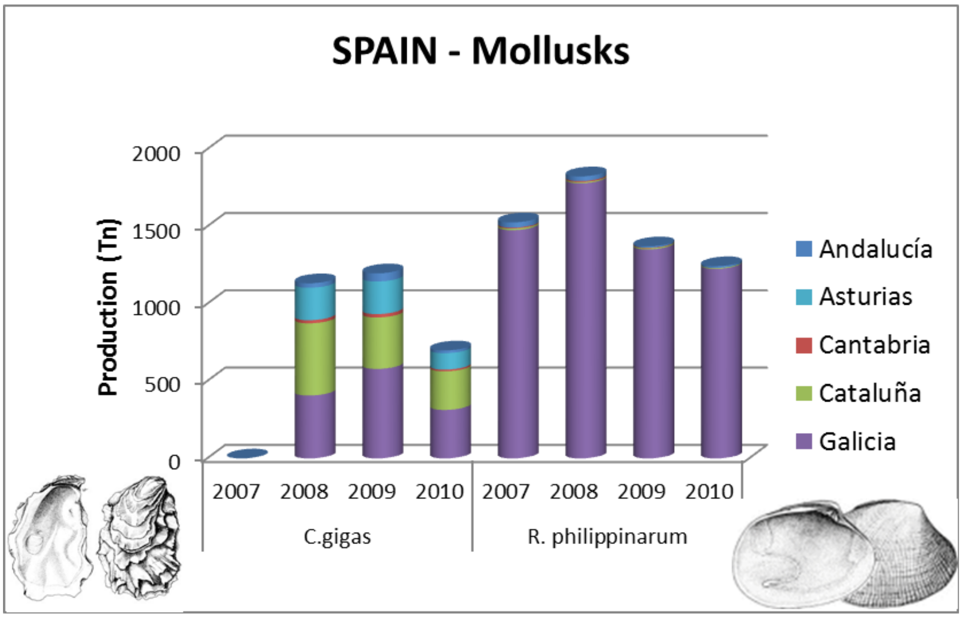

Figure 1. Production (Tn) of *Crassostrea gigas* and *Ruditapes philippinarum* in Spain, from 2007 to 2010. (Data from the Ministry of Agriculture, Food and Environment) (http://www.magrama.es)

Ruditapes philippinarum

In Spain, three main types of clams are cultured: *Venerupis pullastra*, *Ruditapes decussatus* and the introduced *R. philippinarum*.

The Manila clam (*R. philipinarum*) shares its habitat with *R. decussatus*, although it lives buried at shallower depths in the substrate. It has a fast growth, reaching the commercial minimum size of 40 mm after approximately 2 years. Originally from the NW Pacific Ocean, overfishing and irregular production of the native European clams, generated its import to European waters in the 70s. It was introduced in Spain (Galicia, Cantabria, Catalonia and Andalusia) in 1980. Nowadays, *R. philippinarum*, which is fairly resistant to dry periods, is the most common in the markets, with a more affordable price, as the quality of its meat is considered inferior to the other species

(http://www.magrama.es/app/jacumar/especies/Documentos/Almejas.pdf).

Last year (2011), Galicia (the maximum producer of *R. philippinarum* in Spain) sold 1.300 Tn for 8 million €

(http://www.farodevigo.es/portada-arousa/2012/01/08/dominio-absoluto-ventas-bivalvos-gracias-potencial-bancos-arousa/612396.html).

Figure 1 shows the production (in Tn) in Spain since 2007 (Data from the Ministry of Agriculture, Food and Environment)

(http://www.magrama.es/app/jacumar/datos_produccion/datos_produccion.aspx).

Undaria pinnatifida

U. pinnatifida was first reported for Spain in 1988 on Galician coasts, where it is now widely distributed and incorporated into the native community. The chronology of the introduction of this species and the types of habitat where it is currently integrated in Galician coasts clearly reveal that the presence and local expansion of this kelp is influenced largely by human activities, mainly shellfish aquaculture and maritime traffic.

It was officially cultured only in 2008, where 1.8 Tn were produced (Figure 2), representing €1.260

(http://www.magrama.es/app/jacumar/datos_produccion/lista_datos_valor2.aspx?Id=es)

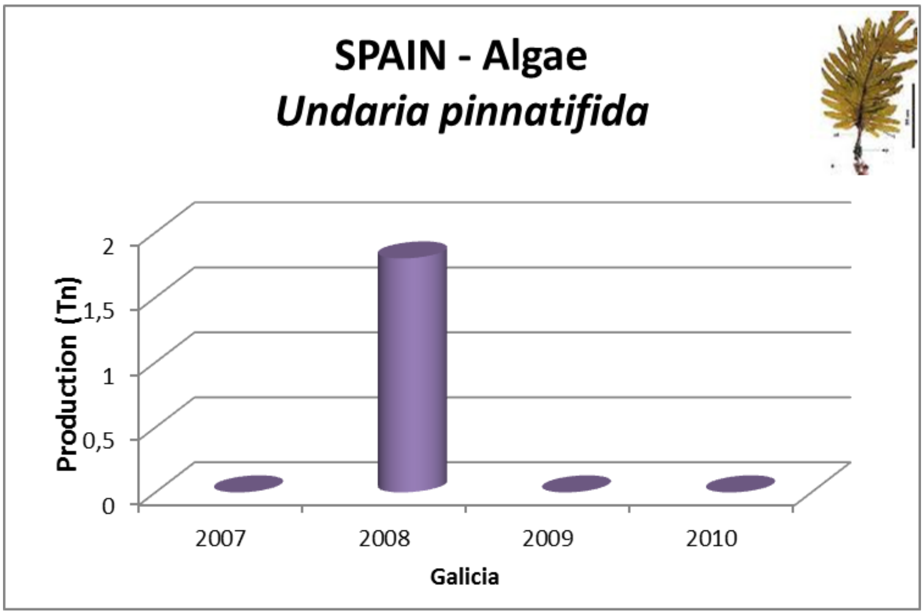

Figure 2. Production (Tn) of *Undaria pinnatifida* in Spain, from 2007 to 2010. (Data from the Ministry of Agriculture, Food and Environment) (http://www.magrama.es)

Marsupenaeus japonicus

Originally from the Western Pacific and Indian Oceans, it penetrated the eastern Mediterranean through the Suez Canal reaching the southern coast of Turkey. It was introduced in Spain in 1981 in the Ebro Delta and in the marshes of Huelva (E Spain).

There are currently three farms in Spain dedicated to the production of *M. japonicus*, two of which are located in the province of Huelva and one in the province of Cadiz (S Spain). Its consumption has increased in Spain significantly in recent years, being now the main importer at European level and the third worldwide. *M. japonicus* cultured in Spain, had in 2009, an average value at first sale of around 27 € per kilo

http://www.magrama.es/app/jacumar/especies/Documentos/Langostino_japones.pdf

Figure 3 shows the production (in Tn) in Spain since 2007 (Data from the Ministry of Agriculture, Food and Environment)

(http://www.magrama.es/app/jacumar/datos_produccion/datos_produccion.aspx).

Specifically, in 2010 47.51 Tn were produced, representing a value of 1.11 million €

(http://www.magrama.es/app/jacumar/datos_produccion/lista_datos_valor2.aspx?Id=es)

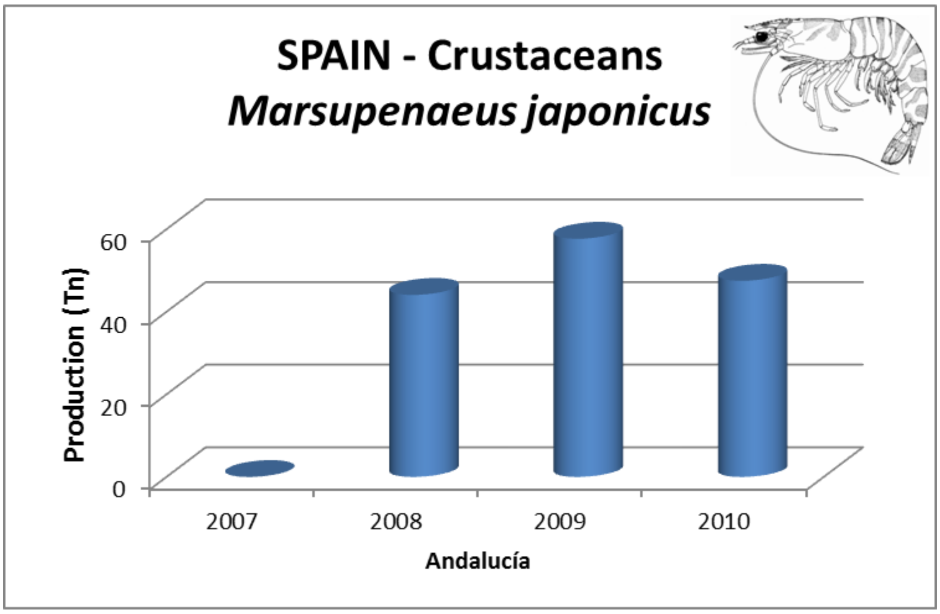

Figure 3. Production (Tn) of *Marsupenaeus japonicus* in Spain, from 2007 to 2010. (Data from the Ministry of Agriculture, Food and Environment) (http://www.magrama.es)

3. Unintentional:

New Sightings

Paracaprella pusilla (see "SPAIN National Data Report 2012")

The skeleton shrimp, *P. pusilla*, was recorded for the first time in European waters in summer of 2010 in Cádiz harbor (36º 31'N, 6º 17'W) (Ros and Guerra-García, (in press)). Caprellid amphipods, commonly called skeleton shrimps, are abundant in many littoral habitats of the marine environment (Gerra-García and Thiel, 2001). They can be found clinging on to seaweeds, hydrozoans, bryozoans, mussels and sometimes inanimate objects (Bhave and Deshmukh, 2009). In particular, *P. pusilla*, from tropical and temperate seas, has traditionally been collected from mangrove roots, seagrasses, hydroids and ascidians (McCain, 1968), but also on gravel bottoms, ropes, mussels and oysters (Díaz *et al*., 2005). In Cádiz harbor it was only present on the native bryozoan *Zoobotryon verticillatum* and the native hydroid *Eudendrium racemosum* in summer months, probably due to the higher water temperature during that season. The authors of the study (Ros and Guerra-García) suggested that the presence of this species in Southern Spain (temperate area) could be related to climate change, being ship fouling the most probable vector for its introduction.

4. Pathogens

5. Meetings

Past year

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3.17 Sweden

Prepared by Malin Werner, Swedish University of Agricultural Sciences, Dep. of Aquatic Resources, Institute of Marine Research, Lysekil, Sweden

Contributions from:

Inger Wallentinus (University of Gothenburg), Björn Fagerholm (Swedish University of Agricultural Sciences), Åsa Strand (University of Gothenburg), Jan Albertsson (Umeå University), Lars-Ove Loo (University of Gothenburg), Sture Nellbring (County Administrative Board of Stockholm), Anders Hellström (National Veterinary Institute), Kennet Lundin (Göteborg Natural History Museum), Gunnar Karltorp (Swedish EPA), Lena Kautsky (Stockholm University), Lars Johan Hansson (University of Gothenburg), Lena Granhag (Chalmers University of Technology), Ullrika Sahlin (Linnaeus University) as well as many colleagues that said that there was nothing to report.

1. Regulations:

The EU strategy for Invasive Alien Species, IAS, has been further developed in 2011 e.g. at expert meetings, and will hopefully be presented in early autumn 2012. When the EU strategy is ready, work with the Swedish national strategy is planned to continue, as there will probably be directives or regulations from the Commission on how to prevent, manage or eradicate IAS. A suggestion for a national strategy was published in 2008, but it is not yet implemented.

The regulations about oysters, claiming that the land owner also owns the oysters in the adjacent sea area, are still under investigation. This means that by the current law it is forbidden for the general public to collect the Pacific oyster, *Crassostrea gigas*, as well as the European oyster, *Ostrea edulis.* Probably the proposition of a change in the legislation can be presented during autumn 2012 and permit public collection of *C. gigas*.

Sweden has been active in the work to develop indicators for the Marine Strategy Framework Directive within both HELCOM and OSPAR e.g. for non-indigenous species.

2. Intentional introductions:

No numbers are available this time of the year.

3. Unintentional introductions:

New Sightings

There have been three new sightings during 2011;

Conrad's false mussel, *Mytilopsis leucophaeata*, was found in spring and summer 2011, in the artificial ”Biotest Basin” outside Forsmark nuclear power plant, in the southern Bothnian Sea, (Anon. 2011a). The basin receives cooling water from the power plant and has a higher temperature than ambient water. Also in the central part of the Gulf of Finland it occurs preferably close to discharges of cooling water.

Both adults and larvae of the comb jelly, *Euplokamis dunlapae,* native in the American north Pacific, was found in April-June in the Gullmar fjord, the southern Skagerrak by the marine scientists Lene Friis-Møller and Lena Granhag (both then at University of Gothenburg. Manuscript in review on this discovery together with Sanna Markkula, pers. Comm. Lena G). During April and May 2011 it mainly occurred in more shallow water, while in June it was found also deeper than 100 m, as was a single animal in August. The species has also lately been found in fjords on the Norwegian west coast, while it has been known from the Mediterranean Sea since long. (Anon. 2011b).

The Japanese skeleton shrimp, *Caprella mutica*, was found in June 2011 in the Koster area, south west of Strömstad in the Skagerrak (Appelqvist & Kilströmer 2011). It has for many years been expected to turn up on the Swedish west coast, since it has been found in increasing numbers in e.g. Ireland, UK, Scotland, Belgium, Germany and Norway.

It can also be mentioned that the fish reticulated dragonet (*Callionymus reticulatus*) is confirmed in Sweden, for the first time, in 2011 (Lars-Ove Loo, University of Gothenburg, pers. comm.), but it is considered, most probably, as a range expansion (pers. comm. Tomas Carlberg, Swedish University of Agricultural Sciences). A photograph of the fish, taken at Väderöarna ("Weather islands", because there are often severe storms there) can be seen here:

http://mugga.se/photo/1115/callionymus_reticulatus).

Previous Sightings

The results from the monitoring programs for the the Bothnian Sea and the Bothnian Bay on the northern part of the Swedish east coast are not ready for 2011 yet. Jan Albertsson, Umeå University, reported that until 2010 *Cercopagis pengoi* has been found every year since 2006, but scarcely. In 2006 and 2007 the abundance was a little higher but lower after that. *Marenzelleria* sp. is established in all investigated areas in the Bothnian Sea, in offshore areas in the northernmost parts of the Bothnian Bay, and a few near the coast. The abundance has decreased in most areas for a few years, but it has not disappeared anywhere. The species concept of *Marenzelleria* spp. is being investigated molecularly in a research project. In the waters outside Helsingborg, in south westerns Sweden, *Marenzelleria viridis* is found since 2002. The species had a peak in abundance and distribution in 2008, but both abundance and the number of stations where it is found have decreased in 2009 and 2010 (Göransson *et al.* 2011).

Round goby, *Neogobius melanostomus*, that was found in Visby and Gothenburg in 2010 were in Visby found again in 2011, at least 30 specimens were caught in recreational fishery. (Sture Nellbring, County Administrative Board of Stockholm pers. comm.)

A study in September 2011 outside the nuclear power plant Ringhals on the Swedish west coast also included a special search for sessile introduced species. The study found no new ones but noted four earlier found species, the algae *Sargassum muticum, Dasya baillouviana, Bonnemaisonia hamifera* and the oyster *Crassostrea gigas*. The first and last last were more common closer to the cooling water discharge from the power plant (Jansson *et al.* 2012).

The efficiency in gathering more information for regulatory decisions on preventing potentially invasive species depends not only on the accuracy of prediction species invasiveness if introduced, but also on the context of the decision to be made. The use of value-of-information analysis as a tool to evaluate the usefulness of a predictive model of invasiveness and the efficiency of increasing accuracy in predictions were demonstrated by Sahlin *et al.* (2011). They showed that the value of a predictive model was influenced by the base rate of invasiveness (proportion of invasive species among those introduced) and its uncertainty in the system to be regulated, and the relation between the cost of not stopping an invasive species and cost of being too careful and not make use of a non-invasive species.

Species not Seen Yet

There is an Alert-list at www.frammandearter.se (page in Swedish) with 92 species with an expected potential to arrive, but so far without a risk analysis of the chances of arrival.

Two species of many that could come to Swedish waters are:

The snails *Ocinebrellus inornatus,* which is now found in Limfjorden (Lützen *et al*. 2012).

The crab *Rhithropanopeus harrisii* that was first found in 2009 and now considered established in Finnish coastal waters (WGITMO report 2011).

4. Pathogens

No new pathogens are reported in 2011. No information of spread or extra problems with previous sightings.

5. Meetings

Past year

A workshop on *C. gigas* was held in Arendal 19-20/4 2012 within the Nordic oyster network (SNOK).

Future meetings

The newly started Swedish Agency for Marine and Water Management (SWAM), that has taken over the responsibility for aquatic non-indigenous species, will gather expertise within different areas for a general discussion this year on how to proceed with national work.

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3.18 United Kingdom

Compiled by Ian Laing (Cefas-Weymouth) with contributions from Lyndsay Brown (Marine Scotland-Science), Elizabeth Cook (SAMS), Gordon H. Copp (Cefas-Lowestoft), Tracy McCollin (Marine Scotland-Science), Gabrielle Wyn (CCW).

1. Regulations

Council Regulation 708/2007/EC (on use of alien and locally absent species in aquaculture) has been transposed into national legislation in England and Wales (The Alien and Locally Absent Species in Aquaculture (England and Wales) Regulations 2011.

In Scotland, the Wildlife and Natural Environment (Scotland) Act 2011, which covers various alien species issues, came into force.

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 stands at a little over 1,300 tonnes. Stock for on growing was imported from Guernsey (only). Movement restrictions to prevent the spread of a new and highly pathogenic strain of oyster herpes virus (OsHV-1 µvar) remain in place.

Imports of non-native species of live bivalve molluscs and crustaceans for human consumption continue. Just less than 600 tonnes of live Canadian/ American lobsters were brought in to the UK in 2011, representing a slight increase in trade compared with 2010. There were further reports of Canadian/American lobsters being captured in pots set in the wild.

3. Unintentional introductions

New sightings

No new non-native species have been reported for either marine or inland waters in 2011, however a new species to science of purple *Hymedesmia* sponge was found off the Norfolk coast during a routine survey in October 2011. The record of this, as yet un-named, species is available at: http://www.mcsuk.org/what_we_do/Wildlife%20protection/Conservation%20in%20action/MCS%20Seasearch%20divers%20discover%20new%20sponge%20species

A number of other similar discoveries of new marine species have been reported in Scotland in December 2011: http://www.scotland.gov.uk/News/Releases/2011/12/22105642

Previous sightings

Invertebrates

The predatory shrimp (*Dikerogammarus villosus*) has not been found in any new locations in 2011, suggesting that measures taken to contain the species at the three known sites are being successful. Further information on these measures is available at: https://secure.fera.defra.gov.uk/nonnativespecies/alerts/index.cfm?id=3

North American signal crayfish in the River Lee in southern England are being fitted with small radio tracking transmitters by the Environment Agency. Preliminary results showing that these crayfish move upstream at a rate of 500 metres per month.

The Northern Ireland Department of the Environment (DOE) has confirmed that zebra mussels are present at an additional seven lakes in the Fermanagh area. Following this, a report was received from Angling First Ltd who alerted authorities to their discovery of these invasive mussels in Loughgall Country Park Lake in Co. Armagh. Officials from the Northern Ireland Environment Agency (NIEA) confirmed the discovery, bringing the total number of known sites in Northern Ireland to 13.

The invasive Carpet Sea-squirt (*Didemnum vexillum*) was found in a new area, along the north Kent coast, where it occurs in the low inter-tidal zone. This is one of the areas to which it was predicted that the organism might spread (Laing *et al.*, 2010). In Wales, plans to re-attempt eradication in Holyhead harbour have been approved. The work, started in January 2012, will be carried out by volunteers and diving contractors using a variety of methods including wrapping the chains and floating pontoons and removing and cleaning some of the swinging moorings and buoys. The marina structures will then be monitored to check for any re-growth of the ascidian. In Scotland, consideration is being given to eradication from Largs marina and the surrounding area.

There was a great deal of discussion at the 14th International Conference on Shellfish Restoration, which was held in the UK in August, around the topic of naturalisation of Pacific oysters in northern Europe, where it had not initially been expected to spawn. Dai Roberts of Queen's University Belfast presented data from Ireland on the spread of these oysters and measures being considered for its eradication. A different approach was taken in the Netherlands, where there is little discussion of restoring the native oyster population but rather of capitalising on the spread of Pacific oyster reefs. Lively debate ensued about the relative benefits of native versus Pacific oyster reefs and associated epibiota, as the evidence suggested that the associated species assemblages were quite different between the two though overall ecosystem benefits appeared to be similar. Bob Rheault from the East Coast Shellfish Growers Association, USA provided a stimulating and thought provoking talk on the important ecosystems services provided by aquacultured shellfish and encouraged attendees to think beyond natural beds.

SEAFISH is funding the Shellfish Association of Great Britain (SAGB) to produce a report detailing the issues pertaining to Pacific oyster cultivation and the status of this species in the UK. The final report is due in March 2012.

The mitten crab (*Eriochier sinensis*) has been reported in a new area in the Duddon estuary, north-west England.

Fish

No new species of non-native fish have been reported for either marine or inland waters in 2011.

Species not yet reported or observed

Three species of Bryozoa recorded from Belgium and/or the Netherlands: *Smittoidea prolifica*, *Pacifincola perforata* (also in W. France) and *Fenestrulina delicia* (also in N. France) might all be easily introduced. Identification requires microscopical examination but none of these species would be expected to give particular cause for concern.

In addition, there are three crabs: *Hemigrapsus sanguineus* and *H. takanoi*, both established just the other side of the English Channel, and *Callinectes sapidus* (the Blue Crab, with a few scattered records). *Pachygrapsus marmoratus*, for which there are just a small handful of GB records so far, could also be considered, but there is some debate whether establishment would represent a range extension or an introduction.

There has been rapid geographical expansion of the alien amphipod *Caprella scaura* to the East Atlantic coast (Guerra-Garcia *et al.*, 2011), possibly increasing the risk of spread to the UK.

4. Pathogens

Sightings/records

One European flat oyster (*Ostrea edulis*) in a sample of 27 taken from the River Fal, Cornwall in December 2010 was found to be infected with *Bonamia exitiosa*. This followed reports that oysters were not thriving in the area. The sample was taken from an area already subject to longstanding controls due to the presence of *Bonamia ostreae* and high levels of this disease were found in the sample. However, this is the first record of *Bonamia exitiosa* in the UK. The disease is currently listed in legislation as exotic to the European Union. *B. exitiosa* has however also been reported in Spain, France and Italy. Further sampling and testing have failed to detect the parasite. Movement controls have been put in place to prevent further spread.

Presence of the notifiable disease *Bonamia ostreae* was confirmed in European oysters in a new area in the UK (Menai Strait, North Wales).

Following reports from an earlier study on the use of mussels as indicator organisms of environmental change of the presence of *Marteilia* species, a sample of blue mussels (*Mytilus edulis*) was taken from the Tamar estuary, Cornwall.in August. Diagnostic tests confirmed *Marteilia refringens* in four individuals from a sample of 150 mussels. However there was no evidence of morbidity or mortality in the mussels. This is the first record of *M. refringens* in the UK. The disease is listed in legislation as non-exotic to the European Union and has been previously found in native oysters and in mussels in the coastal waters of a number of member states including France, Spain, Portugal and Greece. Movement controls have been put in place to prevent further spread of the parasite.

A microsporidian parasite infecting non-native Chinese mitten crabs (*Eriochier sinensis*) from Europe has been described (Stentiford *et al*., 2011). It is assumed that the parasite was introduced during initial invasions of this crab to Europe during the early 20th Century.

General information

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

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

The GBNNSS is developing Invasive Species Action Plans (ISAPs). For the aquatic environment, plans for non-native crayfish and for *D. vexillum* are under development.

Scientists from Swansea University are asking fishermen for information on crab and lobster shell disease and the locations of American/Canadian lobster. The work is part of a collaborative project (SUSFISH) between Welsh and Irish universities investigating the impacts of climate change on commercial shellfish productivity within the Irish Sea. The aim is to map records of American/Canadian lobsters caught or seen by commercial fishermen around UK and Irish coasts. This will enable them to identify any hot spots of the aliens and to assess the level of risk to European lobster populations.

Sample analysis from a Scottish Government funded project to assess the risk of transporting non native species to Scotland via biofouling on vessels is on-going (ends 2012). To date, no new non-native species have been detected. The biological analysis will be combined with information on vessel type and voyage pattern to assess whether it is possible to assign levels of risk for introducing non native species.

A project "Protecting marine biodiversity and industries by managing non-native species pathways" is currently being put together in order to bid for LIFE+ funding from the EU. There will be several organisations involved and the project will be led by the Countryside Council for Wales. The project aims to reduce the risk posed to native marine biodiversity and marine industries from invasive non-native species by: Reducing the introduction and spread of INNS in ecologically sensitive areas through improved biosecurity; Improving communication with key stakeholders in priority areas to raise awareness, achieve behaviour change and encourage early detection and rapid reporting; Improving our ability and capacity to rapidly respond to new non-native species threats in the marine environment; Delivering innovative demonstration projects relating to improved bio-security and rapid response. Stakeholders expected to be included within this project are: the recreational boating sector, marina and port operators, aquaculture and fishing sectors, shipping sector, those undertaking ship recycling and marine relevant NGOs.

A collaborative project between Cefas, Defra, Marine Scotland Science, Invasive Species Ireland and the Non-Native Species Secretariat has been put together to carry out work to identify the highest risk vectors/pathways for the introduction and subsequent spread of marine invasive species in GB and to recognise 'hot spot' areas or nodes that are at most risk of invasion. The study will also include a case study of the invasive tunicate *Didemnum vexillum* to validate the tool and to aid in the management of this species.

A further study to carry out a genetic analysis of the *Didemnum* populations in the United Kingdom will run for about two months from April 2012. This will aim to obtain samples from as many populations around the UK as possible and use genetic techniques to confirm that they are all the same species.

A study on colonisation of offshore marine renewable energy structures is being undertaken at the Scottish Association for Marine Science (SAMS), in collaboration with the Northern Lighthouse Board. A network of 43 navigation buoys throughout Scotland was used to study epibenthic communities typical of artificial structures in tidal and wave exposed areas proposed for marine renewable energy generation. The presence and abundance of non-native species have been assessed to determine the importance of these off-shore artificial habitats for the maintenance of marine non-native populations. Many non-native species were identified in different geographical regions. Most notably large numbers of *Caprella mutica*, a non-native amphipod, were found on many navigation buoys. A PhD has started recently with joint supervision from SAMS and the Environmental Research Institute in Thurso (Northern

Scotland), and working closely with Pelamis (a wave renewables company). Non-native and native species associated with the Pelamis structure and with vessels and service hubs associated with the offshore renewables industry will be studied.

A Scottish Aquaculture Research Forum (SARF) funded project that will run from Feb - July 2012 will review existing published guidance on the recognition and eradication of marine invasive and non-native species, with particular relevance to species that could potentially negatively impact the Scottish aquaculture industry. It will make recommendations for the production of new identification material, if deemed necessary and recommend how such guidance could be better disseminated throughout the industry.

A scoping study is being carried out on behalf of Defra that will review the evidence underpinning national and international advice on biosecurity in the marine and freshwater aquatic environments and provide evidence based advice on what biosecurity measures should be employed to minimise the risk posed by non-native species and diseases, such as crayfish plague, which are transmitted by non-native species.

In 2011, Cefas has begun a literature review and risk assessment for Defra of non-native species invasion pathways with a view to the preparation of a 'Pathway Management Plan' (PMP) for organisms of Ponto-Caspian origin that pose a potential risk of invading Great Britain.

A review of issues associated with the management of non-native fishes was published in 2011 (Britton *et al*. 2011), along with a dedicated issue of the French publication *Sciences Eaux & Territoires*, which included papers presented at the workshop "*Gestion des espèces invasives en milieu aquatique*" (issue 6, 2011), which took place in Paris on 12–14 October 2010. A summary of the GB non-native risk analysis scheme was presented by Booy *et al*. (2011).

5. Meetings

Past year (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" was held in London on 10 February 2011. Presentations from the meeting are available online at: http://www.marlin.ac.uk/marine_aliens/symposium.php

International measures to address bio-fouling from ships, to minimize the transfer of aquatic species, was agreed in draft form by the Sub-Committee on Bulk Liquids and Gases (BLG) when it met for its 15th session at IMO from 7–11 February, 2011. These guidelines were adopted by MEPC in July 2011, and represent the first set of international measures for minimizing the translocation of invasive aquatic species through bio-fouling of ships adopted by IMO and will fill a gap by addressing the risks of introduction of invasive aquatic species through bio-fouling of ships. The resolution can be found at http://www.imo.org/blast/blastDataHelper.asp?data_id=30766&filename=207(62).pdf

The Institute of Ecology and Environmental Management held a meeting on "*Invasive Species*: *New natives in a Changing Climate*?" on 23 March 2011, in London. Copies of the presentations can be found at: http://www.ieem.net/ieemspringconference2011.asp

The annual conference of the Fisheries Society of the British Isles, 18–22 July 2010, "*Fish Diversity and Conservation: Current state of knowledge*", included a themed session on "The role of introduced species in the decline of fish diversity" (www.fsbi.org.uk/2011/index.html).

Meetings in 2012

The following meetings have non-native species sessions as part of their programme:

Canadian Conference for Fisheries Research (Moncton, Canada, 5-7 January 2012)

Sixth World Fisheries Congress (Edinburgh, Scotland, 7-11 May 2012)

International Conference on Ecology & Conservation of Freshwater Fish (Vila Nova de Cerveira, Portugal, 28 May – 2 June 2012)

European Pond Conservation Network 5th Workshop (Luxembourg, 4-8 June 2012)

First International Conference on Integrative Sciences and Sustainable Development of Rivers (Lyon, France 26-28 June 2012)

NEOBIOTA 2012 (Pontevedra, Spain, 12-14 September 2012)

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3.19 United States

Prepared by Judith Pederson, James Carlton, Paul Fofonoff, Matthew Bracken, Collins Johnson, and Greg Ruiz.

1. Regulations

Federal: US Coast Guard

From John Morris, US Coast Guard

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

We are not at liberty to discuss details of the rule until it is actually published, but wanted to clear up confusion about its status. A copy of OMB's summary is attached,

with the second entry at top, and is also available on its website at <http://www.reginfo.gov/public/do/eoPackageMain>
http://www.reginfo.gov/public/do/eoPackageMain

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

http://www.gpo.gov/fdsys/pkg/FR-2011-12-09/pdf/2011-31595.pdf"

Federal: US Environmental Protection Agency

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

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

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

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

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

States:

The states of California, Washington, Oregon, Alaska and Hawaii have ballast water management regulations and management coast-wise traffic as well. Michigan has strict standards, but New York State has dropped their proposed standards to be compliant with the federal agencies.

Although many states address issues of moving invaders from fresh water to fresh water, few have marine hull fouling regulations. Massachusetts has passed a bill to manage transport of freshwater organisms by vessels and trailers but has not addressed other issues.

The potential for Asian carp to enter the Great Lakes has not led to any regulations, however management plans and actions have been undertaken.

2. Intentional introductions

No new intentional introductions are reported.

3. Accidental introductions and transfers.

3.1. Fish

Atlantic/Gulf Coasts

Lionfishes (*Pterois* spp.) continued to expand their range in the Western Atlantic. The two introduced species are usually lumped as *Pterois miles/volitans*. A recent genetic study by Betancur-R *et al*. (2011) found that specimens of *P. miles* (native to the Indian Ocean) were limited to North Carolina and Bermuda, where they were greatly outnumbered (21 to 329 *P. miles* vs. *P. volitans*. specimens), by the mostly Pacific species *P. volitans* which now is established from North Carolina to Venezuela, east to Bermuda and most of the Caribbean Islands. Another genetic study found only *P. volitans* in the Bahamas, and indicated that these populations were established by dispersal form the East Coast of the US (Freshwater *et al*. 2011). In the Gulf of Mexico, the range of presumed *P. volitans* is expanding westward. In 2010, specimens were seen or caught from Alabama to Louisiana, and in 2011, they were found in the Flower Garden Banks National Marine Sanctuary off Louisiana and Texas, and off South Padre Island, Texas, near the Mexican border (9/25/2011, USGS Nonindigenous Species Program 2011). Lionfish were found well inside the Loxahatchee River estuary, Florida (part of the Indian River Lagoon system), associated with man-made structures. They sometimes occurred in waters with low surface salinities, but could have stayed in deeper, higher-salinity waters (Jud *et al*. 2011). Salinity tolerances of *Pterois* spp. are not well-known, but they are presumed to have a strong preference for marine conditions.

Johnston and Purkis (2011) developed a regional scale model, including oceanographic and life history features which duplicates most of the present distribution, and predicts further spread into the Gulf and western Caribbean. Another modeling effort, by Morris *et al*. (2011a) used a stage-based model of local populations, and indicated that ~27% of adult lionfish would have to be removed monthly, in order to cause populations to decrease. Including juveniles in removal efforts would increased the effectiveness of sustained removal efforts. Reproductive studies in North Carolina and the Bahamas indicate that both species spawn asynchronously, year-round, releasing eggs in hollow, buoyant, gelatinous masses (Morris *et al*. 2011b). Although populations of lionfish have been established for two decades, the first capture of a *Pterois* larva in the western Atlantic was only made in 2010, in the Yucatan Current, off Mexico (Vasquez-Yeomans 2011). Feeding studies in North Carolina indicate that juvenile and adult lionfish are generalist carnivores, feeding almost exclusively on smaller fishes, and with prey varying according to local and seasonal abundance (Muñoz *et al*. 2011). Overall, densities of invasive populations of lionfishes in the Atlantic appear to be up to eight times higher than native populations in the Indo-Pacific (Kulbicki *et al*. 2011).

A variety of other exotic fish records have occurred in US East and Gulf Coast estuarine waters in 2011. Two species of Indo-Pacific marine aquarium fishes were captured in Florida East Coast waters. A specimen of the Spotted Scat, *Scatophagus argus,* was captured in the Indian River Lagoon, and a specimen of *Zebrasoma veliferum* (Sailfin Tang) was found near Boca Raton. The Spotted Scat is known from one previous Florida record, from the Gulf Coast in 1992, while there have been at least 12 sightings of the Sailfin Tang in the Boca Raton area since 2000. However, neither species is known to be established (USGS Nonindigenous Aquatic Species Program 2012). The Nile Tilapia (*Oreochromis niloticus*) has maintained populations in Mississippi estuaries since 2000. While establishment of the population may have been aided by thermal effluents, otolith studies indicate that these populations are showing growth and reproduction similar to that of African populations (Grammer *et al*. 2011). In laboratory studies, this fish tolerated temperatures as low as 14° C, and with gradual transfer, at higher temperatures, salinities as high as 60 PSU (Schofield *et al*. 2011). One specimen of Nile Tilapia was captured in Sarasota Bay, Florida in 2011 (USGS Nonindigenous Aquatic Species Program 2012).

In Chesapeake Bay, the Northern Snakehead (*Channa argus*), native to Asian freshwaters, and first discovered in the Potomac River in 2004, has apparently spread out of the Potomac, through the open waters of the Bay, possibly as the result of heavy rains and river discharges in the winter and spring of 2010 and 2011, which greatly lowered salinities. Specimens of this large predatory fish were caught near the mouth of the Potomac, in the Nanticoke River, and in the Rhode River. The Rhode River specimen was caught at a salinity of 6 PSU (USGS Nonindigenous Aquatic Species Program 2012, Thomson 2012, Ruiz *et al*., unpublished data). However, it is not clear if this dispersal will lead to established populations outside the Potomac.

3.2 Invertebrates

Atlantic/Gulf Coasts

New Sightings

The tubeworm (Polychaeta: Serpulidae) *Hydroides elegans* (identification confirmed by Rolando Bastida-Zavala, Universidad del Mar, Puerto Angel, Oaxaca) was discovered in the summer of 2011 to be thriving in small reef-like masses in a warm brackish lagoon (Eel Pond, in Woods Hole) on Cape Cod, Massachusetts (41.526209 -70.670381). An Indo-Pacific species previously known only as far north as Florida, it was introduced to the Pond in hull fouling via coastal vessel traffic. While not likely to survive the winter of 2011-12, surveys are planned for May 2012 to determine the status of the populations.

Previous Sightings

Two species of apparently non-native sponges (Porifera) collected in 2011 on southern Cape Cod remain unidentified. One species (similar to a tetillid (craniellid)) was found in coastal shellfishery operations; material is with Dr. Manuel Maldonado (Spain) for identification. A second species (*Halisarca*-like), detected in Woods Hole aquarium facilities, and said to be present for some years, awaits further taxonomic workup.

A small isopod (Isopoda: Janiridae) in the genus *Ianiropsis*, common to abundant in fouling communities in New England (since the 1990s), the Netherlands, possibly southern Britain, and along the U.S. Pacific coast, has been identified as a Japanese species (Niels-Viggo Hobbs, Eric Lazo-Wasem, Jeff Cordell, Marco Faasse, James Carlton, John Chapman, and Andrew Cohen, 2012, in preparation).

The Japanese isopod (Isopoda: Idoteidae) *Synidotea laevidorsalis* remains established in the New York City region (and presumably also remains established further south along the Atlantic coast in Delaware, Chesapeake Bay, and South Carolina, where it was first reported). Last detected in New York in the summer of 2003 in fouling communities, it was found in hull fouling on a vessel (resident solely in New York City) towed to Mystic, Connecticut in November 2011.

The tiger shrimp, *Penaeus monodon*, native to the Indo-Pacific, was widely reared in aquaculture operations worldwide, but has been largely supplanted by the Pacific White Shrimp, *Litopenaeus vannamei*. Nonetheless, *P. monodon* continues to appear in increasing numbers on the southeastern and Gulf coasts of the US. More than 200 specimens were reported in 2011, caught between North Carolina and Texas (USGS Nonindigenous Aquatic Species Program 2011). In 2010, 27 records were reported over this range. These records appear to be mostly single captures of adult shrimp. Reproduction has not yet been reported in US waters. These shrimp become inactive at temperatures below 17°C (Food and Agricultural Organization 2011), so that overwintering may be unlikely. According to people in the shrimp industry, tiger shrimp are no longer commercially raised in the US, so *P. monodon* appearing in US waters may be coming from established populations near ongoing or abandoned rearing operations in the Caribbean (Pam Fuller, personal communication).

Palaemon macrodactylus the oriental 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 and Nijta 2009). In 2001 it was discovered on the Atlantic coast but its present was not announced until 2010. It is well-established from Narragansett Bay to New York City. It is expected to expand along the North American Atlantic seaboard. Several specimens are known from Chesapeake Bay, but the presence of an established population here has not yet been confirmed (Ruiz *et al*., unpublished data).

The European rockpool prawn (Caridea: Palaemonidae) *Palaemon elegans*, first discovered in the summer of 2010 in the Gulf of Maine, is now well-established along the Massachusetts coast north of Cape Cod as well as in southern Maine (Carlton *et al*., 2012, in preparation). It is a ballast water introduction which may have been present for some years before detection. It is likely to expand along the Atlantic seaboard.

The green porcelain crab *Petrolisthes armatus*, native to Gulf of Mexico and Tropical Atlantic, was absent from the Atlantic Coast before 1930, and after 1991, rapidly extended its range northward, reaching Cape Fear Sound, North Carolina by 2005. (Canning-Clode *et al*. 2011). Severe winter cold in 2009-2010 caused a sharp population decline in Georgia, from 790-11,200 to 0-12 crabs/m^2 (Canning-Clode *et al*. 2011). Similar recent declines have been reported in other invaders of tropical/subtropical origins on the southeastern and Gulf coasts of the US.

Surprisingly, in 2011, there was only two new reports of Chinese mitten crabs (*Eriocheir sinensis*) in East Coast estuaries, both adult male crabs, in Delaware Bay, and Baltimore Harbor, Chesapeake Bay (Darrick Sparks, personal communication). However, previous collections indicate that this crab is established in the Hudson River estuary. A modeling study (Tillburg *et al*. 2011) indicates that this crab could complete its life cycle in the Delaware Bay-River estuary, and suggests that this is likely in other estuaries in the mid-Atlantic region.

The Indo-Pacific green mussel (*Perna viridis*) appeared in the US in 1999 in Tampa Bay, Florida, and invaded the East Coast in 2002, becoming well-established up to Florida-Georgia border and occurring sporadically to North Carolina. During the severe winter of 2009-2010, abundance of this mussel decreased sharply in Tampa Bay (Canning-Clode, pers. comm.) and in St. Augustine, Florida (Edwards 2011). Observations of its population biology and survival in Tampa Bay indicate that this intertidal mussel is sensitive to low air temperatures (Baker *et al*. 2011; Firth *et al*. 2011), probably slowing its northward invasion.

The Spaghetti Bryozoan (Bryozoa: Ctenostomata) (*Zoobotryon verticillatum*) a species of unknown subtropical-tropical origin but now widespread due to centuries of global shipping, continues to appear in summer New England waters, but fails (so far) to survive the winter. It appeared in 2005 and 2010 in Long Island Sound (as previously reported to ICES) and in 2011 in Narragansett Bay. Populations are brought north in hull fouling on coastal vessel traffic from more southern waters along the U.S. Atlantic coast or Caribbean.

Tricellaria inopinata colonies were first found on several floating docks in Eel Pond, Woods Hole, MA (41.526209 -70.670381) in September 2010. These sites were tracked throughout 2011 to determine the success of this initial introduction, and to assess the impact of the introduction on previously established bryozoan assemblages. *Tricellaria inopinata* colonies not only persisted in Eel Pond throughout 2011, but have negatively impacted other Eel Pond arborescent bryozoans. The results from this study have recently been submitted for publication, and the establishment of *T. inopinata* in Eel Pond continues to be monitored.

The European lightbulb seasquirt (Ascidiacea: Clavelinidae) *Clavelina lepadiformis*, first detected in Long Island Sound in 2009, remains locally established in at least two harbors (41.334545,-72.095718; 41.330098,-71.907578) (R. Whitlatch, personal communication, 2011). It was introduced in vessel hull fouling from Europe.

Didemnum vexillum did not appear to expand significantly along the northwest Atlantic coast.

Pacific Coast-

Didemnum vexillum has been reported in Alaska (57.04554, -135.3715) (Cohen *et al*. 2011), and Oregon (43.346466, -124.319444; 43.6773387, -124.17955). It had previous been reported in California and Washington state. Eradication efforts in Washington did not succeed.

3.3. Algae and higher plants

Atlantic Coast-

Previous Sightings

First described from drift algae in Rhode Island in the summer of 2009, the range of "*Heterosiphonia*" *japonica* in the western Atlantic now spans over 250 km, from at least the mouth of the Connecticut River at the eastern end of Long Island Sound to Cape Ann, Massachusetts, crossing the Cape Cod biogeographic boundary. Surveys indicate that *Heterosiphonia* can be very abundant, comprising up to 50-90% of total algal biomass) in locations where it has invaded (M. Bracken, Northeastern University, pers. Comm. This species occurs in shallow subtidal habitats in both its native and European invaded ranges, and has been observed to similar depths (down to ~10 m below mean lower-low water) in the US. Experiments suggest that *Heterosiphonia* grows more rapidly, is more efficient at nitrate uptake, and is less susceptible to herbivores than co-occurring native nitrate uptake, and is less susceptible to herbivores than co-occurring native seaweeds, indicating that rapid growth, nutrient competition, and release from grazing may be potential mechanisms for its success in invading New England coastal waters. *Heterosiphonia* is originally from western Pacific rocky reefs but has recently become widespread on European coastlines, where it has spread from its original introduction point in France (1984) to a current range from Italy to Norway. Based on its European distribution and thermal tolerances, *Heterosiphonia* has the potential to become established from Florida to Newfoundland.

Pacific Coast

3.4 Parasites, pathogens, and other disease agents

East Coast

The oyster disease-causing protozoan parasite MSX (*Haplosporidium nelsoni*), since its appearance on the East Coast in the 1950s, has caused massive mortalities of the native Eastern oyster (*Crassostrea virginica*), particularly in higher-salinity areas of Chesapeake and Delaware Bays. In recent years, Eastern oysters in these regions of Chesapeake and Delaware Bays have shown decreased prevalence of the parasite, indicating the occurrence of disease-resistance. Oysters from low-salinity tributaries, normally not exposed to the parasite, remain very susceptible to MSX (Carnegie and Burreson 2011).

A rhizocephalan barnacle parasite, *Loxothylacus panopaei*, infecting mud crabs of the families Xanthidae and Panopeidae, was described from the Gulf of Mexico in 1884. This parasite was discovered in Chesapeake Bay in 1964, on the crabs *Eurypanopeus depressus* and *Rhithropanopeus harrisii* probably transported with oysters planted to restore beds, after die-offs due to MSX. Subsequently, by 2005, this parasite appeared on mud crabs in estuaries from North Carolina to Florida. A genetic study (Kruse *et al*. 2011) indicates that '*L. panopaei*'is a species complex, of which the invasive form is one, while one or two other species infect crabs of the genus *Panopeus*. The invasive form is possibly native to the western Gulf of Mexico, and is capable of infecting *E. depressus* and *R. harrisii* in the eastern Gulf, and southern Florida, where it is now absent (Kruse *et al*. 2011). The ecological impact of this parasite is difficult to determine, because populations of these small crevice-loving crabs are difficult to count. However, mud crabs are important as scavengers, predators, and prey.

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Annex 4. List of new species and range expansions of alien species as reported in National Reports

Date	Genus	Species	Namer and date	Taxon	Country	Location	Lat	Lon	Population status	Region of 1st record	Date of 1st record	References
2011	Caulerpa	racemosa	(Forsskål) J.Agardh 1873	algae (Chlorophyta)	Croatia	Middle and Southern Adriatic			Established	Middle Adriatic, Pakleni otoci (Marinkovac islet)	2000	Žuljević et al. 2003
2011	Caulerpa	taxifolia	(M.Vahl) C.Agardh 1817	algae (Chlorophyta)	Croatia	Middle and Southern Adriatic			Established	Middle Adriatic, Stari Grad (Island of Hvar)	1994	Žuljević et al. 1998
2006	Botryocladia	madagascariensis	Feldmann-Mazoyer	Rhodophyta	Greece	Karpathos isl., Dodekanesos	35° 34 45N	27° 11 14E	unknown			Catra & Giardina, 2009
2009	Botryocladia	madagascariensis	Feldmann-Mazoyer	Rhodophyta	Greece	Porto Germeno, Korinthiakos Gulf	38° 08, 47,8 N	23° 13, 23,1 E	a single thallus from trawling fishing nets			Tsiamis & Verlaque, 2011
2010	Botryocladia	madagascariensis	Feldmann-Mazoyer	Rhodophyta	Greece	Messiniakos Gulf	36° 28.729 N	22° 24.085 E	Some sterile specimens			Catra & Alongi, in Nikolaidou et al, 2012
2010	Botryocladia	madagascariensis	Feldmann-Mazoyer	Rhodophyta	Greece	Lakonikos Gulf	36°41.969 N	22°31.540 E	Some sterile specimens			Catra & Alongi, in Nikolaidou et al, 2012
2010	Codium	parvulum	(Bory ex Audouin) P.C. Silva	algae	Israel	Haifa Bay	32.816144°	35.016625°	Common		2004	Israel et al., 2010
2011	Codium	arabicum	Kutzing 1856	algae	Israel	Bat-Galim, Haifa Bay	32.836669°	34.978855°	Local		2007	Hoffman et al 2011

2003	Ceratoperidinium	yeye	Margalef 1969	algae (Dinophyta)	Croatia	Northern Adriatic	45°15′N	13°34′E		Northern and Southern Adriatic	2003	Ninčević Gladan et al. 2006
2003	Ceratoperidinium	yeye	Margalef 1969	algae (Dinophyta)	Croatia	Southern Adriatic	43°45′N	15°51′E		Northern and Southern Adriatic	2003	Ninčević Gladan et al. 2006
2011 Nov 02	Claviceps	purpurea	Fries	Fungi	Germany	on common cord-grass Spartina anglica, a two localities on the German North Sea coast in the Wadden Sea			well established	Wadden Sea of Lower Saxony near Wilhelmshaven	2011 November	Nehring et al. 2012
2004	Cladocora	debilis	Milne Edwards & Haime, 1849	Cnidaria, Anthozoa	Croatia	Eastern Adriatic			Spreading	South Adriatic, Island of Lastovo	2002	Kružić et al. 2005
2010	Marivagia	stellata	Galil & Gershwin, 2010	jellyfish	Israel	Shikmona	32.825253°	34.955622°	Sporadic		2006	Galil et al., 2010
2010	Campanularia	morgansi	Millard, 1957	hydrozoan	Israel	Haifa Bay, Rosh Hanikra	32.921650°	35.052445°	Common		2009	Piraino et al., 2010
2010	Dynamena	quadridentata	(Ellis & Solander, 1786)	hydrozoan	Israel	Haifa Bay, Rosh Hanikra	32.921650°	35.052445°	Common		2009	Piraino et al., 2010
2011	Beroe	ovata	Mayer 1912	comb jelly	Israel	Ashdod	31.843082°	31.843082°	Rare		2011	Galil et al 2011
2010	Glyphidohaptor	plectocirra	(Paperna, 1972)	Platyhelminthes	Greece	Rhodes isl, Dodekanesos	36° 06'39''N	28°04'44''E	54 specimens			Stefani et al, 2012

2011 June	Anadara	transversa	(Say, 1822)	Bivalvia	Croatia	Lim Bay	45º08'N	13º42'E	Six specimens	Northern Adriatic, Lim Bay		Nerlović et al. 2012
2001 Oct	Melibe	viridis	(Kelaart, 1858)	Gastropoda, Nudibranchia	Croatia	Stari Grad Bay (Island of Hvar)	43º11'N	16º34'E		Middle Adriatic, Stari Grad (Island of Hvar)	2001	Despalatović et al. 2002
2009	Siphonaria	pectinata	(Linnaeus, 1758)	Gastropoda, Heterobranchia	Croatia	Middle Adriatic coastline	43º30'N	16º24'E		Middle Adriatic, Split	2003	Despalatović et al. 2009
2010	Allolepidapedon	fistulariae	Yamaguti, 1940	parasite	Israel	Ashdod	31.843082°	31.843082°	Expanding		2008	Diamant et al., 2010
2006 May - 2010 July	Diplostomum	paracaudum	(Iles, 1959)	parasite	Poland	Włocławek Reservoir	52º32'58"N	19º34'29"E	Few specimens	on the lower course of the Vistula River	May 2006- July 2010	Mierzejewska et al.. 2012
2006 May - 2010 July	Holostephanus	luehei	Szidat, 1936	parasite	Poland							Mierzejewska et al.. 2012
2010	Aplysia	dactylomela	Rang, 1828	mollusc	Israel	Akhziv	33.077224°	35.097252°	Single Record		2010	Pasternak & Galil, 2010
2010	Septifer	forskali	Dunker, 1855	mollusc	Israel	Mikhmoret	32.403000°	34.865674°	Rare		2007	Mienis, 2010
2010	Melibe	viridis	Alder & Hancock, 1864	mollusc	Israel	Atlit	32.704082°	34.929686°	Single Record		2008	Mienis, 2010
2011	Flabellina	rubrolineata	(O'Donoghue, 1929)	Mollusca	Greece	Syros isl, Kyklades	37°.424444° N,	22.970556° E	1 specimen			Poursanidis in Eleftheriou et al, 2011
2010	Philinopsis	cyanea	(Martens, 1879)	mollusc	Israel	Atlit	32.704082°	34.929686°	Single Record		2009	Mienis, 2010

2011 June 06	Rapana	venosa		mollusc	France	Anse de la Malconche	46° 00.5649 N	1° 15.8846	single	Bay of Quiberon		
2011	Smaragdia	souverbiana	(Montrouzier, 1863)	mollusc	Israel	Haifa Bay	32.816144°	35.016625°	Single record		1987	Rothman & Mienis 2011
2012	Pseudorhaphitoma	cf. iodolabiata	(Hornung & Mermod, 1928)	mollusc	Israel	Haifa port	32.816144°	35.016625°	Single Record		2010	Bogi & Galil, 2012
2009-2010	Jaera	istri	Veuille, 1979	Isopoda	Poland	Oder River	between 51.2484ºN and 53.0599ºN; and 52.0532º and 53.3804º	between 16.8465ºE and ca 14.3542º; and 14.9540º and 14.5356º	70 individuals	Between Uraz and Ognica, and between Krosno Odrzańskie and Szczecin	2009-2010	Szlauer-Łukaszewska and Grabowski, under revision
2008	Peniculus	fistula	von Nordmann	Crustacea, Copepoda	Croatia	Eastern Adriatic Sea				Eastern Adriatic	2008	Vidjak et al. 2008
2002	Hippolyte	prideauxiana	Leach, 1817	Crustacea, Decapoda	Croatia	Kostrena, Northern Adriatic	45°18′N	14°30′E		Northern Adriatic, Kostrena	2002	Kirinčić 2006
2010	Callinectes	sapidus	Rathbun, 1896	Crustacea, Decapoda	Croatia	Neretva River Delta	43º02′N	17º25′E	Established	Southern Adriatic, Ston	2004	Onofri et al. 2008, Dulčić et al. 2011 b
2012	Lernanthropus	callionymicola	El Rashidy & Boxshall, 2012	Copepod	Israel	Ashdod	31.843082°	31.843082°	Rare		2008	El Rashidy & Boxshall, 2012
2011 Aug	Rhithropanopeus	harrisii	Gould, 1841	crab	Estonia	Pärnu Bay (Gulf of Riga, Baltic Sea)	58,36958	24,47842	unknown	Estonia and Gulf of Riga: first record	2011	Henn Ojaveer, unpubl.

2011 Aug	Rhithropanopeus	harrisii	Gould, 1841	crab	Estonia	Pärnu Bay (Gulf of Riga, Baltic Sea)	58,37771	24,39308	unknown	Estonia and Gulf of Riga: first record	2011	Henn Ojaveer, unpubl.
2009	Parvocalanus	crassirostris	Dahl, 1894	Arthropoda	Greece	Lesvos isl,, NE Aegean			3.7-14.3% of zooplankton abundance			Papantoniou & Fragopoulu in Eleftheriou et al., 2011
2010 July	Paracaprella	pusilla	Mayer, 1890	crustacean	Spain	Harbour of Cádiz	36º 31′N	6º 17′W	Rare	SE Atlantic coast of Spain	July 2010	Ros and Guerra-García, 2011
2011 July	Palaemon	elegans	Rathke, 1834	shrimp	Estonia	Whole Estonian coastline			established	Gulf of Riga, Kõiguste Bay	2011 July	Kotta & Kuprijanov, 2012
2009	Ficopomatus	enigmaticus	(Fauvel, 1923)	Annelida, Polychaeta	Croatia	Krka River Estuary	43º44′N	15º52′E		Middle and Southern Adriatic, Krka River Estuary and Neretva River Delta	2009	Cukrov et al. 2010
2009	Ficopomatus	enigmaticus	(Fauvel, 1923)	Annelida, Polychaeta	Croatia	Neretva River Delta	43º02′N	17º25′E		Middle and Southern Adriatic, Krka River Estuary and Neretva River Delta	2009	Cukrov et al. 2010
2006 May - 2010 July	Eustrongylides	tubifex	Jägerskiöld, 1909	parasite	Poland							Mierzejewska et al.. 2012

2008 Aug	Caranx	crysos	(Mitchill, 1815)	Pisces	Croatia	Peninsula Istra, Northern Adriatic	45°16′N	13°34′E	First record	Northern Adriatic, Peninsula Istra	2008	Dulčić et al. 2009
2010 Mar	Elates	ransonnettii	(Steindachner, 1876)	Pisces	Croatia	Eastern Adriatic			First single record	Eastern Adriatic	2010	Dulčić et al. 2010
2006 Nov-Dec	Fistularia	commersonii	Rüppell, 1838	Pisces	Croatia	Islet of Sveti Andrija, Southern Adriatic	42°39′N	17°57′E	Spreading	Southern Adriatic, Islet of Sveti Andrija	2006	Dulčić et al. 2008, Joksimović et al. 2008
2011	Holacanthus	ciliaris	(Linnaeus, 1758)	Pisces	Croatia	Bay of Trogir	43°29′N	16°11′E	First record	Middle Adriatic, Bay of Trogir	2011	Dulčić (personal communication)
2010 June	Lobotes	surinamensis	(Bloch, 1790)	Pisces	Croatia	Biševo Island	42º56′N	16º00′E	First record	Middle Adriatic, Biševo Island	2010	Dulčić & Dragičević, 2011
2011	Paranthias	furcifer	(Valenciennes, 1828)	Pisces	Croatia	Marina Bay	43º30′N	16º09′E	First record	Middle Adriatic, Marina Bay	2011	Dulčić (personal communication)
2008	Polyacanthonotu s	rissoanus	(De Filippi & Verany, 1857)	Pisces	Croatia	Southern Adriatic Pit	42°05′N	17°38′E	First record	South Adriatic, open sea	2008	Isajlović et al. 2009
2010 Nov	Siganus	luridus	(Rüppell, 1829)	Pisces	Croatia	Mljet Channel	42º48′N	17º30′E	Second single record	Northern Adriatic		Dulčić et al. 2011 a
2003	Sphyraena	viridensis	(Cuvier, 1829)	Pisces	Croatia	Dubrovnik	42º41′N	17º57′E	First single record	South Adriatic, Dubrovnik	2003	Kožul et al. 2005
2011	Neogobius	fluviatilis	(Pallas, 1814)	Fish	Greece	65 river kilometers from the Evros' river-mouth	40o 58′ 35 N	26°19′40 E	8 specimens			Zogaris & Apostolou, 2011

2010	Terapon	jarbua	(Forsskål, 1775)	fish	Israel	Dor	32.607202°	34.916493°	Single Record		2009	Golani & Appelbaum Golani, 2010
2010	Trypauchen	vagina	(Bloch & Schneider, 1801)	fish	Israel	Atlit-Hadera	32.607202°	34.916493°	Single Record		2009	Salameh et al., 2010
2010	Pomacanthus	imperator	(Bloch, 1787)	fish	Israel	Shiqmona	32.825253°	34.955622°	Single Record		2009	Golani et al., 2010
2010	Priacanthus	sagittarius	Starnes, 1988	fish	Israel	Ashdod	31.843082°	31.843082°	Rare		2009	Goren et al., 2010a; Golani et al, 2011
2010	Mycteroperca	fusca	(Lowe, 1838)	fish	Israel	off Ga'ash (near Tel Aviv)	32.230269°	34.815761°	Single Record		2010	Heemstra et al., 2010
2010	Cheilodipterus	novemstriatus	(Rüppell, 1838)	fish	Israel	Tel Aviv	32.087131°	34.767627°	Single Record		2010	Goren et al., 2010b
2011	Synanceia	verrucosa	Bloch & Schneider, 1801	fish	Israel	Palmahim	31.932156°	34.698577°	Single Record		2010	Edelist et al 2011
2011	Tylerius	spinosissimus	(Regan, 1908)	fish	Israel	Ashdod-Tel Aviv	31.932156°	34.698577°	Single Record		2010	Golani et al, 2011
2011	Platax	teira	Forsskål, 1775	fish	Israel	Ashdod	31.843082°	31.843082°	Single Record		2010	Golani et al, 2011
2011	Equuilites	elongatus	(Günther, 1874)	fish	Israel	Tel Aviv	32.087131°	34.767627°	Single Record		2011	Golani et al 2011
2011	Chaetodon	austriacus	Rüppell, 1836	fish	Israel	Ashdod port	31.843082°	31.843082°	Single Record		2011	Goren et al, 2011
2011	Chaetodon	larvatus	Cuvier, 1831	fish	Israel	Shiqmona	32.825253°	34.955622°	Single Record		2011	Salameh et al., 2011
2011	Champsodon	nudivittis	(Ogilby, 1895)	fish	Israel	Ashdod	31.843082°	31.843082°	Single Record		2011	Goren et al, 2011
2010 Feb	Ameiurus	nebulosus	Lesueur	fish	Poland	Łyna drainage basin			Few specimens	northeast Poland	February 2010	Kapusta et al.. 2010

Annex 5. Information on the ongoing monitoring activities and programs in different countries either specifically directed on alien species or those from where information on non-indigenous species can be obtained by: presence/absence monitoring, spatial distribution monitoring, abundance-biomass monitoring, port monitoring and ecological impact monitoring.

Annex 5.1. Presence/absence monitoring

Country	Presence/absence monitoring	Does not exist (X)	Exists (X)	Name of sampling area/region/locations (give information by all organism groups, if different)	Number of sampled stations/localities	Since when (or which years)	Which organism group(s) (add these groups to the rows on Column B)	Sampling design and – frequency (give information by all investigated organism groups separately)	Sampling methods (by all investigated organism groups separately)	Habitat surveyed (incl. artifical habitat)	List of environmental parameters measured during the monitoring surveys	Status of data availability (i.e., are data available and if yes, under which conditions)
Sweden	Phytoplankton		x	All along the Swedish coast and in the open sea	20	1983	phytoplankton	14 stn 9-12 times per year, 6 stn 18-25 times per year, (+ approx. 80 stn once a year)	plankton trawl (do not know the mesh size yet)	pelagic	salinity, temp, light, secci depth, oxygen, alkalinity, pH, phosphorus, nitrogen, silicon, chlorophyll, primary production, sedimentation, DOC, humus, bacteria, cyanobacteria	Available from SMHI on line, in Swedish (but they are not very easy to retrieve unless you know how)
Sweden	Zooplankton		x	All along the Swedish coast and in the open sea	20	1979	zooplankton	14 stn 9-12 times per year, 6 stn 18-25 times per year, (+ approx. 80 stn once a year)	plankton trawl (do not know the mesh size yet)	pelagic	salinity, temp, light, secci depth, oxygen, alkalinity, pH, phosphorus, nitrogen,	Available from SMHI on line, in Swedish

											silicon, chlorophyll, primary production, sedimentation, DOC, humus, bacteria, cyanobacteria	
Sweden	Macrophytes		x	Gullmarsfjorden, Askö, Gotland, Höga kusten, Torhamn, Tärnö, Onsalahalvön = both west and east coast of Sweden	7	1993	macrophytes	diving once a year	sampling on the east coast, photo on the west coast	rocky bottom, undewater rock walls	?	Available from SMHI on line, in Swedish
Sweden	Invertebrates		x	All along the Swedish coast and in the open sea	more than 68, see to the right	1978	all macroskopic inverebrates	once a year, April-June. 42 stations on the west coast, 26 different locations (with more than one sampling per location) in the Baltic Sea	some kind of sediment grabber, generally 0,1m2, sieve: 1mm	soft bottom	in some stations: sediment samples (water content, organic content, redox) water temp., salinity and oxygen.	Available from SMHI on line, in Swedish
Sweden	Fish (coastal)		x	Nets at Fjällbacka, Hakefjorden, Kullen, Torhamn, Kvädöfjorden, Lagnö, Långvindsfjärden, Gaviksfjärden, Örefjärden, Holmöarna,	12 nets + 28-33 trawling (+ regional studies)	Nets since 1991 (some older with variable methods). Trawling on the west coast since 2001.	coastal fish	often once a year in July_august	Nordic nets (mostly) and bottom trawl	coastal areas, nets often in shallow bays. Trawling in trawlable depths and conditions	water temperature,	Newer net fishing data available online, in Swedish. Trawling data available on demand.

				Kinnbäcksfjärden, Rånefjärden + trawling on west coast								
Sweden	Fish (open sea)		x	Swedish west coast (IBTS) and Baltic Sea (BITS, BIAS)	30-50 hauls/IBTS/BITS tour	1970-ies (trawling)/ 1978 (acoustics= BIAS)	fish, focus on commercial, but all are considered	Trawling twice a year in the Baltic & twice a year in Skagerack-Kattegatt. Once a year acoustic survey in the Baltic.	see left	Trawling for bottom dwelling fish. Acoustics is for pelagic fish (including pelagic trawling)	SMHI takes watersamples, oxygen, temperature, salinity (more?) at the same time.	Fish data available if asked for, but not on line. Soon at the Swedish University of Agricultural Sciences, department of Aquatic Resorces.
Estonia	Chinese mitten crab		X	Gulf of Finland (Muuga Bay)	1 station	1991		ice-free season, 7-20 times per month	gillnets (1.5-1.8 m height, mesh size 40-55 mm)	Coastal near-shore habitat.	temperature	free
Estonia	Round goby		X	Gulf of Finland (Muuga Bay)	1 station	2005		ice-free season, 7-20 times per month	gillnets (1.5-1.8 m height, mesh size 18-22 mm)	Coastal near-shore habitat.	temperature	free
Canada	Phytoplankton		x	Maritimes (Bay of Fundy NB)	5	1987	all phytoplankton species detected - new specied to the area are noted	weekly during bloom periods, biweekly - monthly during winter	net hauls, whole water samples (50 mls settled and cvounted with inverted microscope	water column	CTD depth profiles (Temperature, salinity, fluorescence, turbidity, Oxygen	ICES Database WGHABD
Canada	Macrophytes											

Canada	Codium fragile		x	Newfoundland and Labrador (NL)	5 to 15	2006	Codium fragile (not present)	annually	diver survey	Harbours and associated natural and artifical habitats)	Temperature, salinity, chl a, turbidity, Oxygen	AIS National Database
Canada			x	Maritimes (Mar - NS)	40-60	2006	Codium fragile present	Province-wide, Atlantic coast, annually	visual survey	Harbours, marinas, aquaculture sites and associated natural habitats and artificial structures	Temperature, salinity, chl a, oxygen	AIS National Database
Canada		x		Maritimes (Bay of Fundy NB)			Codium fragile present	periodically	visual survey	harbours, beaches		
Canada				Gulf								
Canada		x		Quebec	10 to 36	2004	Codium fragile present	periodically	diver survey, beaches	Harbours, marinas, beaches, eelgras beds, aquaculture sites and associated natural habitats and artificial structures		AIS National Database
Canada												

Canada	Invertebrates		x	NL	5 to 15	2005		Province-wide based on priority, annual	collector plates, dive surveys, video survey	Wharf structures, docks, other associated natural and artificial habitats, aquaculture s sites surveyed by provincial DFA	Temperature, salinity, chl a, turbidity and Oyxgen	AIS National Database
Canada			x	Maritimes (Mar - NS)	40 to 60	2005	Botrylloides violaceus, Botryllus scholsseri, Ciona intestinalis present	Province-wide, Atlantic coast, annually	collector plates, visual and video survey, anecdotal reports	Wharf structures, docks, other associated natural and artificial habitats, aquaculture s sites, some locations monitored by NSDFA and industry partners	Temperature, salinity, chl a, oxygen	AIS National Database

Canada			x	Maritimes (Bay of Fundy NB)	20	2005	Botrylloides violaceus, Botryllus scholsseri, Ciona intestinalis present	Bay ofFundy, southwest New Brunswick	collector plates, visual and video survey, anecdotal reports	Wharf structures, docks, other associated natural and artificial habitats, aquaculture s sites, some locations monitored by NB DAAF and Huntsman Marine Science Center	Temperature, salinity, fluorescence, turbidity and Oyxgen	AIS National Database
Canada				Gulf								
Canada	Botrylloides violaceus		x	Quebec	4 to 31	2006	Botrylloides violaceus present in Magdalen Islands	Province-wide. Based on priority (most risky sites). From June to October (3 sampling points)	collector plates, dive surveys, video survey, molecular probes	Wharf structures, docks, marinas, other associated natural and artificial habitats, aquaculture s sites	Temperature and salinity	AIS National Database
Canada	Botryllus schlosseri		x	Quebec	4 to 31	2006	Botryllus schlosseri present in Magdalen Islands	Province-wide. Based on priority (most risky sites). From June to	collector plates, dive surveys, video survey, molecular probes	Wharf structures, docks, marinas, other	Temperature and salinity	AIS National Database

								October (3 sampling points)		associated natural and artificial habitats, aquaculture s sites		
Canada	Didemnum vexillum		x	Quebec	4 to 31	2006	Didemnum vexillum not present	Province-wide. Based on priority (most risky sites). From June to October (3 sampling points)	collector plates, dive surveys, video survey, molecular probes	Wharf structures, docks, marinas, other associated natural and artificial habitats, aquaculture s sites	Temperature and salinity	AIS National Database
Canada	Diplosoma listerianum		x	Quebec	4 to 31	2008	Diplosoma listerianum present in Magdalen Islands	Province-wide. Based on priority (most risky sites). From June to October (3 sampling points)	collector plates, dive surveys, video survey, molecular probes	Wharf structures, docks, marinas, other associated natural and artificial habitats, aquaculture s sites	Temperature and salinity	AIS National Database
Canada	Cioana intestinales		x	Quebec	4 to 31	2006	Ciona intestinalis present in Magdalen Islands	Province-wide. Based on priority (most risky sites). From June to October (3	collector plates, dive surveys, video survey, molecular probes	Wharf structures, docks, marinas, other associated	Temperature and salinity	AIS National Database

								sampling points)		natural and artificial habitats, aquacultures sites		
Canada	Styla clava		x	Quebec	4 to 31	2006	Styla clava not present	Province-wide. Based on priority (most risky sites). From June to October (3 sampling points)	collector plates, dive surveys, video survey, molecular probes	Wharf structures, docks, marinas, other associated natural and artificial habitats, aquacultures sites	Temperature and salinity	AIS National Database
Canada	Tunicates include (all are not present in all regions)											
Canada	Botrylloides violaceus						Botrylloides violaceus					
Canada	Botryllus schlosseri						Botryllus schlosseri					
Canada	Didemnum vexillum						Didemnum vexillum					
Canada	Diplosoma listerianum						Diplosoma listerianum					
Canada	Ciona intestinalis						Ciona intestinalis					
Canada	Styla clava						Styla clava					

Canada	Bryozoans		x	NL	5 to 15	2006		south and west coast	dive surveys, harbour surveys	Harbour and docks, kelp beds near survey sites	Temperature, salinity, chl a, turbidity and Oyxgen	AIS National Database
Canada			x	Maritimes (Mar - NS)	40 to 60	2006	Membranipora membranacea present	Province-wide, Atlantic coast, annual	collector plates, video surveys, visual surveys	Wharf structures, docks, other associated natural and artificial habitats, aquaculture s sites, some locations monitored by NSDFA and industry partners	Temperature, salinity, chl a, oxygen	AIS National Database
Canada			x	Maritimes (Bay of Fundy NB)	20	2006		Bay of Fundy	collector plates, video surveys, visual surveys, dive surveys	Wharf structures, docks, other associated natural and artificial habitats, aquaculture s sites, some locations monitored by NSDFA and industry partners	CTD depth profiles (Temperature, salinity, fluorescence, turbidity, Oxygen)	AIS National Database

Canada				Gulf								
Canada			x	Quebec	4 to 31	2006	Membranipora membranacea present	Province-wide. Based on priority (most risky sites). From June to October (3 sampling points)	collector plates, dive surveys	Wharf structures, docks, marinas, other associated natural and artificial habitats, aquaculture s sites	Temperature and salinity	AIS National Database
Canada	Crustaceans include (separate due to differences in sampling)											
Canada	Caprella mutica		x	NL	5 to 15	2006	Caprella mutica	south coast	collector plates, dive surveys, video surveys	Wharf structures, docks, other associated natural and artificial habitats, aquaculture s sites, some locations monitored by NSDFA and industry partners	Temperature, salinity, chl a, turbidity and Oyxgen	AIS National Database

Canada			x	Maritimes (Mar - NS)	40 to 60	2006	Caprella mutica present	Province-wide, Atlantic coast	collector plates, video surveys, visual surveys	Wharf structures, docks, other associated natural and artificial habitats, aquacultures sites, some locations monitored by NSDFA and industry partners	Temperature, salinity, chl a, oxygen	AIS National Database
Canada		x		Maritimes (Bay of Fundy NB)			Caprella mutica present	Bay ofFundy	collector plates, video surveys, visual surveys	Wharf structures, docks, other associated natural and artificial habitats, aquacultures sites, some locations monitored by NB DAAFand industry partners		
Canada				Gulf								

Canada			x	Quebec	4 to 31	2006	Caprella mutica	Province-wide. Based on priority (most risky sites). From June to October (3 sampling points)	collector plates, dive surveys	Wharf structures, docks, marinas, other associated natural and artificial habitats, aquaculture s sites	Temperature and salinity	AIS National Database
Canada	Carcinus maenas		x	NL	15 to 35	2006	Carcinus maenas	Province wide frequency varies from annually to monthly based on risk	trapping, shore surveys, dive surveys, includes bicatch and biodiversity data	Harbours, eelgrass beds, known and suspected habitats	Temperature, salinity, chl a, oxygen	AIS National Database
Canada			x	Maritimes (Mar - NS)	40 to 60	2008	Carcinus maenas present	Province-wide, Atlantic coast	anecdotal reports, trapping, shore surveys, includes bicatch and biodiversity data	Harbours, marinas, eelgrass beds, known and suspected habitats	Temperature, salinity, chl a, oxygen	AIS National Database
Canada			x	Maritimes (Bay of Fundy NB)	10 to 15	2007	Carcinus maenas present	Bay of Fundy	anecdotal reports, trapping, shore surveys, includes bicatch and biodiversity data	Harbours, marinas, eelgrass beds, known and suspected habitats	Temperature, salinity, chl a, oxygen	AIS National Database
Canada				Gulf								

Canada			x	Quebec	4 (2004) to 27 (2011)	2004	Carcinus maenas present in Magdalen since 2004. Observed for the first time in Bay des Chaleurs in 2011.	Magdalen Islands and Gaspe Peninsula. Zonal standard monitoring protocol (June and September)	trapping, shore surveys, dive surveys, bicatch (eel fishermen), anecdotal reports	Harbours, eelgrass beds, lagoons, known and suspected habitats	Temperature and salinity	AIS National Database
UK Scotland - MSS (Marine Scotland Science)	Phytoplankton		X	Scottish coast (Stonehaven, Loch Ewe, Millport); Western Isles (Loch Maddy); Orkney (Scapa); Shetland (Scalloway)	6	Stonehave n: 1997; Scapa, Scalloway and Loch Ewe: 2001; Loch Maddy: 2003; Millport: 2005.	Phytoplankton	Weekly water samples collected at 6 sites to monitor phytoplankton communities in Scotland to assess if/how they are responding to changing environmetal conditions and if they are being affected by climate change. ???	10m Lund tube collects integrated water sample which is decanted into a bucket and mixed well. A 1l subsample is collected and from this 50ml is analysed at x200 magnification with an inverted microscope using the utermohl method.	Inshore coastal waters, sea lochs, harbour waters	Stonehaven and Loch Ewe: temperature, salinity, nutrients, chlorophyll, zooplankton. Scapa, Scalloway and Loch Maddy: temperature, salinity, nutrients. Millport: temperature.	Marine Scotland Science hold these data. Are they available?? CHECK
UK Scotland - MSS (Marine Scotland Science)	Zooplankton		X	Scottish coast (Stonehaven and Loch Ewe)	2	Stonehave n: 1997; Loch Ewe: 2002	Zooplankton	Duplicate weekly mesozooplankt on samples at 2 sites in Scotland to assess if/how they are responding to changing	Collected by vertical hauls using a Bongo net (diameter 40 cm, mesh sizes 68 and 200 µm) to near sea bed (45m at Stonehaven, 35 m at Loch Ewe).	Inshore coastal waters and a sea loch	Temperature, salinity, nutrients, chlorophyll	Data available from Marine Scotland Science.

								environmetal conditions and if they are being affected by climate change.	Samples are fixed in 4% buffered formaldehyde. Only the 200 μm samples are routinely analysed.			
UK Scotland - MSS (Marine Scotland Science)	Settling fauna including ascidians, bryozoans, molluscs, barnacles, anemones, hydroids, sponges, polychates		X	Scottish east coast (Lossiemouth, Peterhead, Port Edgar)	3	2009 only (for all 3 sites)	Ascidians, bryozoans, barnacles, anemones, hydroids, sponges, polychaetes	Settling panels hung in inner and outer areas of marinas to investigate whether sheltered or exposed areas affect settling ability and success of organisms. Panels hung for 2 and 8 weeks before removal.	Horizontal and vertcal corex panels hung in inner and outer locations within marinas for sets of 2 and 8 weeks. Removed after time period and scored for presence/absence of setted fauna.	Sheltered (inner) and exposed (outer) areas of water within marinas	Salinity and temperature (water flow roughly estimated)	Plymouth Marine Laboratory hold these data. Checking availability
UK Scotland - SEPA (Scottish Environment Protection Agency)	Presence/absence specifically for Crepidula fomicata, Styela clava, Sargassum muticum and Crassostrea gigas		X	Scottish east and west coasts	Unknown - checking with SEPA	West coast: 2010; east coast: 2011	Specifically for Crepidula fornicata, Styela clava, Sargassum muticum and Crassostrea gigas	Unknown - checking with SEPA	Suspected presence/absence recorded at specific (repeated) sampling locations	Areas where SEPA undertake bathing water and chemical sampling - checking particular habitats with SEPA	Checking with SEPA	Data will be available as fact sheets on SEPA website and loaded onto the SEPA NEMS database. Also available through

												DASSH (Data Archive for Seabed Species and Habitats) (Not currently available)
UK Scotland - SAMS (Scottish Association for Marine Science)	presence/absence specifically for Caprella mutica, Eriocheir sinensis, Perophora japonica, Styela clava, Codium fragile subsp. Tomentosoides, Sargassum muticum and Undaria pinnatifida		X	East and west coasts of Scotland	10	August 2006 - 2008 and November 2009	Crustaceans Caprella mutica and Eriocheir sinensis; ascidians Perophora japonica and Styela clava; green algae Codium fragile subsp. Tomentosoides; brown algae Sargassum muticum and Undaria pinnatifida	Basic description in Ashton et al. (2006) and based on method of Pederson et al. (2003) and Minchin et al. (2006). Checking with SAMS for sampling design for 2007-2009 surveys	Basic description in Ashton et al. (2006) and based on method of Pederson et al. (2003) and Minchin et al. (2006). Checking with SAMS for sampling methods for 2007-2009 surveys	Marinas including all structures	Unknown - checking with SAMS	2006 survey - data presented in Ashton et al. (2009). 2007 and 2008 surveys - data unpublished, currently held by SAMS. 2009 data - report can be found here http://www.snh.org.uk/pdfs/publications/commissioned_reports/413.pdf
UK	Macrophytes		X	Wales - mainly selected marinas	12	2008	Invertebrates and Macrophytes	Annual	Visual examination by divers	Mainly marinas	None	From CCW
Belgium	Phytoplankton		?									

Belgium	Macrophytes	x										
Belgium	Epibenthos		x	Belgian Part of the North Sea (BPNS)	3-12	since 1978 (more in recent years)	Epibenthos	twice a year	beam trawl	soft sediment	salinity, temperature	on request
Belgium	Demersal fish		x	Belgian Part of the North Sea (BPNS)	3-12	since 1978 (more in recent years)	Demersal fish	twice a year	beam trawl	soft sediment	salinity, temperature	on request
Belgium	Jellyfish (with focus on Mnemiopsis leidyi)		x	Belgian Part of the North Sea (BPNS)	3	2011-2012	JELLYFISH	monthly sampling	WP2 and WP3 net	pelagic habitat	secchi depth, CTD, fluorimetry, O2 level	on request
Belgium	Pelagic fish		x	Belgian Part of the North Sea (BPNS)	3-10	2009-2012	pelagic fish	monthly sampling	otter trawl	pelagic/benthic habitat	CTD	on request
Belgium	Zooplankton		x	Belgian Part of the North Sea (BPNS)	3-10	2009-2012	zooplankton	monthly sampling	WP2 net	pelagic habitat	CTD	on request
Belgium	Macrobenthos (soft sediment)		x	Belgian Part of the North Sea (BPNS)	3-12	since 1978 (more in recent years)	Macrobenthos (soft sediment)	twice a year	Van Veen grab	soft sediment	salinity, temperature and sediment fractions, …	on request
Belgium	Macrobenthos (hard sediment)		x	Belgian Part of the North Sea (BPNS) - windmill parks	1-3	since 2008	Macrobenthos - fouling (marine growth)	thrice a year	Quadrant crapings, removal of stones	artificial hard subtrate; windmill foundations and scour protection	CTD	on request
Belgium	Sea mammals		x (N/A)									
Belgium	Sea birds		x (N/A)									
Belgium	Meiobenthos		x	Belgian Part of the North Sea (BPNS)	9-11	since 1997	meiobenthos	autumn	Reineck boxcorer	soft sediment	CTD, grains size	samples available, data not

												elaborated
Belgium	hyperbenthos		x	Belgian Part of the North Sea (BPNS)	9-11	since 1997	hyperbenthos		hyperbenthic sledge	lower m of water column	CTD, grains size	samples available, data not elaborated
Italy	Phytoplankton		X	Emilia-Romagna Region	14	1982	Bacillariophiceae, Dinophyceae, Chriptophyceae, Chlorophyceae, Chrysophyceae, Raphydophyceae,	dephth sampling -0.5 m weekly/ fornightly	UNI CEN 15204, Magaletti et al. 2001	inshore coastal sea water	Temp., Salinity, O2, pH, Chlorophyll, Conductivity, Transparency	public property, available upon request
Italy	Phytoplankton		X	Mar Piccolo and Mar Grande basins in Taranto (Apulia, Ionian Sea)	from 4 to 20 (according to the different studies)	1996	Phytoplankton	From bi-weekly to seasonal according to the different studies	Depending on the group and the aims	Water column, soft bottoms	Temp., Salin., O2, pH, Chlor., PAR, Trasp., Particulate matter, Nutrients, ETS	From scientific publications and on written demand for lists of unpublished and raw data with the duty to quote the source of the data themselves

Italy	Zooplankton		X	Mar Piccolo and Mar Grande basins in Taranto (Apulia, Ionian Sea)	from 4 to 20 (according to the different studies)	1996	Zooplankton	From bi-weekly to seasonal according to the different studies	Depending on the group and the aims	Water column, soft bottoms	Temp., Salin., O2, pH, Chlor., PAR, Trasp., Particulate matter, Nutrients, ETS	From scientific publications and on written demand for lists of unpublished and raw data with the duty to quote the source of the data themselves
Italy	Macroalgae		X	Emilia-Romagna Region	4	2007	Rhodophyta, Chromophyta, Chlorophyta	fornightly (from June to September)	in-house method	artificial substrates (artificial breakwaters)	Temp., Salinity. O2, Chlorophyll, Conductivity	public property, available upon request
Italy	Macroalgae		X	Mar Piccolo and Mar Grande basins in Taranto (Apulia, Ionian Sea)	from 4 to 20 (according to the different studies)	1986	Rhodophyta, Chlorophyta, Ochrophyta	from monthly to seasonal according to the different studies	Depending on the group and the aims	soft bottom, natural and artificial hard bottom	Temp., Salin., O2, pH, Chlor., PAR, Trasp., Particulate matter, Nutrients, ETS	From scientific publications and on written demand for lists of unpublished and raw data with the duty to quote the source of the data

Italy	Angiosperms		X	Mar Piccolo and Mar Grande basins in Taranto (Apulia, Ionian Sea)	from 4 to 20 (according to the different studies)	1987	Rhodophyta, Chlorophyta, Ochrophyta	from monthly to seasonal according to the different studies	Depending on the group and the aims	soft bottom, natural and artificial hard bottom	Temp., Salin., O2, pH, Chlor., PAR, Trasp., Particulate matter, Nutrients, ETS	From scientific publications and on written demand for lists of unpublished and raw data with the duty to quote the source of the data themselves
Italy	Invertebrates		X	Emilia-Romagna Region	8	2002	Hydrozoa, Anthozoa, Crustacea, Mollusca, Annelida, Echinoderma, Sipuncula	seasonally (SFBC) bi-annual (VTC)	Gambi et al. 2003	soft bottom (SFBC, VTC)	Temp., Salinity, O2, pH, Chlorophyll, Conductivity, Transparency	public property, available upon request
Italy	Invertebrates, this monitoring has been continued under the supervision of ISPRA, but I could get no information up to now		X	Italy - pilot zones	50	2002-2006	Crustacea, Mollusca, Annelida, Echinoderma	annually	grab samples	soft bottom (SFBC, VTC)	none	public property, available upon request

Italy	Invertebrates		X	Mar Piccolo and Mar Grande basins in Taranto (Apulia, Ionian Sea)	from 4 to 20 (according to the different studies)	1970	Crustacea, mollusca	from monthly to seasonal according to the different studies	Depending on the group and the aims	soft bottom, natural and artificial hard bottom	Temp., Salin., O2, pH, Chlor., PAR, Trasp., Particulate matter, Nutrients, ETS	From scientific publications and on written demand for lists of unpublished and raw data with the duty to quote the source of the data themselves
Italy	Fish		X	Italy	7 GSAs	1994	Ostyeichties (bony fishes), Elasmobranchs, + Crustaceans, Cephalopods, large invertebrates	Annually	Random/ stratified sampling. Otter trawl towed by professional trawler	All habitats present between 50 and 800 m in tawlable bottoms	Temperature (during the haul)	Results collected each year in a report. Row data are available from each GSA coordinator
Finland	Phytoplankton		x	Gulf of Finland, Gulf of Bothnia, Archipelago Sea, Åland Sea, northern Baltic Proper	12	1979	phytoplankton	annually, in August	net (10 um)	open sea	Temp, sal, oxygen, nutrients, chl	public property, available upon request
Finland	Phytoplankton		x	Gulf of Finland, Gulf of Bothnia, Archipelago Sea, Åland Sea, northern Baltic Proper	17	1979	Phytoplankton	once every three years	water sample	coastal areas	Temp, sal	public property, available upon request

Finland	Zooplankton		x	Gulf of Finland, Gulf of Bothnia, Archipelago Sea, Åland Sea, northern Baltic Proper	12	1979	zooplankton	annually, in August	WP2-net (100 um)	open sea	Temp, sal, oxygen, nutrients, chl	public property, available upon request
Finland	Zooplankton		x	Gulf of Finland, Archipelago Sea	3	2 of the stations started 1960's, 1 station 2010	Zooplankton	once a month during ice-free period	WP2-net (100 um)	coastal areas	temp, sal	partly public property, available upon request
Finland	Benthos		x	Gulf of Finland, Gulf of Bothnia, Archipelago Sea, Åland Sea, northern Baltic Proper	80	1960's	macrozoobenthos	annually, in May/June	Van Veen grab	open sea, soft bottoms	Temp, sal, oxygen, nutrients, chl	public property, available upon request
Finland	Benthos		x	Gulf of Finland, Gulf of Bothnia, Archipelago Sea, Åland Sea, northern Baltic Proper	17		macrozoobenthos	annually during summer	Van Veen grab or Ekman sampler	coastal, soft bottom habitats	temp, sal	public property, available upon request
Finland	fish		x	Gulf of Finland, Archipelago Sea	3 areas	early 1990's	fish	annually July/August	coastal fishing nets	coastal habitats		public property, available upon request
Finland	macrophytes		x	Gulf of Finland, Bothnian Sea, Archipelago Sea	5 diving lines every year, 3 areas once per 3 years	1999	macrophytes	from once a year to once every 3 years	by diving	coastal habitats		public property, available upon request
Finland	invertebrates	x								hard bottoms		
Finland	fish, invertebrates	x								shallow waters,		

										among vegetation		
France	Protozoan parasite		X called REPAMO (active surveillance)	all around the French coast including North Sea, English Channel, Atlantic coast and Mediterranean coast	150 individuals of Flat oysters (Ostrea edulis) collected over the studied zone, individuals over 2 years of age	since 2003	Bonamia ostreae and Marteilia refringens	on non infected zones where action has been taken for approval - frequency: twice a year, in spring and autumn.	flat oyster collection by fishermen	Flat oyster wild and cultured beds	none	data collected in the Ifremer database called REPAMO
France			X called REPAMO (passive surveillance)	all around the French coast including North Sea, English Channel, Atlantic coast and Mediterranean coast	numbers depending of the mortality event	90's	notifiable diseases (EU directive 2006/88/CE)	in case of shellfish mass mortality sampling is done	moribund molluscs	shellfish areas (culture and wild)	none	data available in the Ifremer database called REPAMO
France	e.g. Phytoplankton		X called REPHY (active surveillance)	active surveillance ; all around the French coast including North Sea, English Channel, Atlantic coast and Mediterranean coast	55	since 1984	all phytoplanctonic species > 20 µm or less if species with colonies (i e list)	monthly or bi-monthly ; at high tide (more or less 2 h)	water sampling using a Niskin bottle	coastal waters, estuaries and lagoons	Temperature, salinity, turbidity, nutrients, oxygen	data collected in the Ifremer database called QUADRIGE[2]

France	Macrophytes		X called REBENT	mainly developped around the Brittany coast and done in the context of water framework directive monitoring program around the French coast including North Sea, English Channel, Atlantic coast and Mediterranean coast	data not communicated	since 2000 in Brittany and since 2006 for the Water Framework mornitoring network	Zostera noltii, Zostera marinus, Posidonia oceanica for phanerogames ; list of macroalgae according to latitude	according to WFD ; every 3 years or once a year depending of the group	recording on intertidal (by foot) and subtidal (by scuba diving) zones	coastal waters, estuaries and lagoons	data non communicated	data available in the Ifremer database called QUADRIGE[2]
France	Invertebrates		X called REBENT	mainly developped around the Brittany coast and done in the context of water framework directive monitoring program around the French coast including North Sea, English Channel, Atlantic coast and Mediterranean coast	data not communicated	since 2000 in Brittany and since 2006 for the Water Framework mornitoring network	list of species	according to WFD ; every 3 years or once a year depending of sampling points	dredge or grabe	coastal waters, estuaries and lagoons	data non communicated	data available in the Ifremer database called QUADRIGE[2]

Annex 5.2 Spatial distribution monitoring

Country	Spatial distribution monitoring	Does not exist (X)	Exists (X)	Name of sampling area/region/locations (give information by all organism groups, if different)	Number of sampled stations /localities	Since when (or which years)	Which organism group(s) (add these groups to the rows on Column B)	Sampling design and – frequency (give information by all investigated organism groups separately)	Sampling methods (by all investigated organism groups separately)	Habitat surveyed (incl. artifical habitat)	List of environmental parameters measured during the monitoring surveys	Status of data availability (i.e., are data available and if yes, under which conditions)
Sweden	Zooplankton (taken with phytoplankton)											
Sweden	Macrophytes							depth distribution				
Sweden	Invertebrates											
Sweden	Fish (coastal) national											
Sweden	Fish (open sea)											
Sweden	All these are as in Presence-absence.											
Estonia	All data obtained from abundance-biomass monitoring are also applicable in spatial distribution monitoring											

Estonia	Phytoplankton, zooplankton, macrozoobenthos		X	Gulf of Finland	up to 12 stations	since 1993		up to 3 times per year	HELCOM methodology	open basin; pelagic and benthic realm	CTD, water transparency, nutrients	free
Estonia	Phytoplankton, zooplankton, macrozoobenthos		X	Gulf of Riga	up to 6 stations	since 1993		up to 3 times per year	HELCOM methodology	open basin; pelagic and benthic realm	CTD, water transparency, nutrients	free
Estonia	Phytoplankton, zooplankton, macrozoobenthos		X	Northern Baltic Proper	up to 6 stations	since 1993		up to 3 times per year	HELCOM methodology	open basin; pelagic and benthic realm	CTD, water transparency, nutrients	free
Canada	Phytoplankton		x	Maritimes (Bay of Fundy NB)	5 to 17	1987	all phytoplankton species	weekly during bloom periods, biweekly - monthly during winter	net hauls, whole water samples	water column	CTD depth profiles (temperature, salinity, turbidity, fluorescence, oxygen) nutrients	ICES Database WGHABD
Canada	Macrophytes											
Canada	Codium fragile		x	Newfoundland and Labrador (NL)	5 to 15	2006	Codium fragile (not present)	annually	diver survey	Harbours and associated natural and artifical habitats)	Temperature, salinity, chl a, turbidity, Oxygen	AIS National Database
Canada			x	Maritimes (Mar - NS)	40-60	2006	Codium fragile present on south shore	Province-wide, Atlantic coast, annually	visual survey	Harbours, marinas, aquaculture sites and associated natural habitats and artificial structures	Temperature, salinity, chl a, oxygen	AIS National Database
Canada		x		Maritimes (Bay of Fundy NB)			Codium fragile only observed at one location		visual survey	harbours, beaches		

							near St. Andrews					
Canada				Gulf								
Canada		x		Quebec	10 to 36	2004	Codium fragile present	periodically	diver survey, beaches	Harbours, marinas, beaches, eelgras beds, aquaculture sites and associated natural habitats and artificial structures		AIS National Database
Canada												
Canada	Invertebrates		x	NL	5 to 15	2005		Province-wide based on priority, annual	collector plates, dive surveys, video survey	Wharf structures, docks, other associated natural and artificial habitats, aquacultures sites surveyed by provincial DFA	Temperature, salinity, chl a, turbidity and Oyxgen	AIS National Database
Canada			x	Maritimes (Mar - NS)	40 to 60	2005	Botrylloides violaceus, Botryllus scholsseri, Ciona intestinalis present south-southwest shore, coastal Cape Breton	Province-wide, Atlantic coast, annually	collector plates, visual and video survey, anecdotal reports	Wharf structures, docks, other associated natural and artificial habitats, aquacultures sites, some locations monitored by NSDFA and industry partners	Temperature, salinity, chl a, oxygen	AIS National Database

Canada				Maritimes (Bay of Fundy NB)	20	2005	Botrylloides violaceus, Botryllus scholsseri, Ciona intestinalis presentBay of Fundy	anually, Bay ofFundy, southwest New Brunswick	collector plates, visual and video survey, anecdotal reports, dive surveys	Wharf structures, docks, other associated natural and artificial habitats, aquacultures sites, some locations monitored by NSDFA and industry partners	Temperature, salinity, fluorescence, turbidity and Oyxgen	AIS National Database
Canada	Botrylloides violaceus		x	Quebec	4 to 31	2006	Botrylloides violaceus present in Magdalen Islands	Province-wide. Based on priority (most risky sites). From June to October (3 sampling points)	collector plates, dive surveys, video survey, molecular probes	Wharf structures, docks, marinas, other associated natural and artificial habitats, aquacultures sites	Temperature and salinity	AIS National Database
Canada	Botryllus schlosseri		x	Quebec	4 to 31	2006	Botryllus schlosseri present in Magdalen Islands	Province-wide. Based on priority (most risky sites). From June to October (3 sampling points)	collector plates, dive surveys, video survey, molecular probes	Wharf structures, docks, marinas, other associated natural and artificial habitats, aquacultures sites	Temperature and salinity	AIS National Database
Canada	Didemnum vexillum		x	Quebec	4 to 31	2006	Didemnum vexillum not present	Province-wide. Based on priority (most risky sites). From June to October (3 sampling points)	collector plates, dive surveys, video survey, molecular probes	Wharf structures, docks, marinas, other associated natural and artificial habitats, aquacultures sites	Temperature and salinity	AIS National Database

Canada	Diplosoma listerianum		x	Quebec	4 to 31	2008	Diplosoma listerianum present in Magdalen Islands	Province-wide. Based on priority (most risky sites). From June to October (3 sampling points)	collector plates, dive surveys, video survey, molecular probes	Wharf structures, docks, marinas, other associated natural and artificial habitats, aquacultures sites	Temperature and salinity	AIS National Database
Canada	Cioana intestinales		x	Quebec	4 to 31	2006	Ciona intestinalis present in Magdalen Islands	Province-wide. Based on priority (most risky sites). From June to October (3 sampling points)	collector plates, dive surveys, video survey, molecular probes	Wharf structures, docks, marinas, other associated natural and artificial habitats, aquacultures sites	Temperature and salinity	AIS National Database
Canada	Styla clava		x	Quebec	4 to 31	2006	Styla clava not present	Province-wide. Based on priority (most risky sites). From June to October (3 sampling points)	collector plates, dive surveys, video survey, molecular probes	Wharf structures, docks, marinas, other associated natural and artificial habitats, aquacultures sites	Temperature and salinity	AIS National Database
Canada	Tunicates include (all are not present in all regions)											
Canada	Botrylloides violaceus						Botrylloides violaceus					
Canada	Botryllus schlosseri						Botryllus schlosseri					
Canada	Didemnum vexillum						Didemnum vexillum					
Canada	Diplosoma listerianum						Diplosoma listerianum					
Canada	Ciona intestinalis						Ciona intestinalis					

Canada	Styla clava						Styla clava					
Canada												
Canada	Bryozoans			NL	5 to 15	2006		south and west coast	dive surveys, harbour surveys	Harbour and docks, kelp beds near survey sites	Temperature, salinity, chl a, turbidity and Oyxgen	AIS National Database
Canada			x	Maritimes (Mar - NS)	40 to 60	2006	Membranipora membranacea present province wide	Province-wide, Atlantic coast, annual	collector plates, video surveys, visual surveys	Wharf structures, docks, other associated natural and artificial habitats, aquacultures sites, some locations monitored by NSDFA and industry partners	Temperature, salinity, chl a, oxygen	AIS National Database
Canada			x	Maritimes (Bay of Fundy NB)	20	2006	Membranipora membranacea present Bay of Fundy	annual sampling Bay ofFundy	collector plates, video surveys, visual surveys	Wharf structures, docks, other associated natural and artificial habitats, aquacultures sites, some locations monitored by NB DAAF	Temperature, salinity, fluorescence, turbidity and Oyxgen	
Canada			x	Quebec	4 to 31	2006	Membranipora membranacea present	Province-wide. Based on priority (most risky sites). From June to October (3 sampling points)	collector plates, dive surveys	Wharf structures, docks, marinas, other associated natural and artificial habitats, aquacultures sites	Temperature and salinity	AIS National Database

Canada	Membranipora membranacea						Membranipora membranacea					
Canada	Crustaceans include (separate due to differences in sampling)										
Canada	Caprella mutica			NL	5 to 15	2006	Caprella mutica	south coast	collector plates	as opportunity presents	Temperature, salinity, chl a, turbidity and Oyxgen	AIS National Database
Canada			x	Maritimes (Mar - NS)	40 to 60	2006	Caprella mutica present province wide	Province-wide, Atlantic coast	collector plates, video surveys, visual surveys	Wharf structures, docks, other associated natural and artificial habitats, aquacultures sites, some locations monitored by NSDFA and industry partners	Temperature, salinity, chl a, oxygen	AIS National Database
Canada			x	Maritimes (Bay of Fundy NB)	20	2006	Caprella mutica present Bay of Fundy	Bay of Fundy	collector plates, video surveys, visual surveys	Wharf structures, docks, other associated natural and artificial habitats, aquacultures sites, some locations monitored by NB DAAF	Temperature, salinity, fluorescence, turbidity and Oyxgen	

Canada			x	Quebec	4 to 31	2006	Caprella mutica	Province-wide. Based on priority (most risky sites). From June to October (3 sampling points)	collector plates, dive surveys	Wharf structures, docks, marinas, other associated natural and artificial habitats, aquacultures sites	Temperature and salinity	AIS National Database
Canada	Carcinus maenas			NL	15 to 35	2006	Carcinus maenas	Province wide frequency varies from annually to monthly based on risk	trapping, shore surveys, dive surveys, includes bicatch and biodiversity data	Harbours, eelgrass beds, known and suspected habitats	Temperature, salinity, chl a, turbidity and Oyxgen	AIS National Database
Canada			x	Maritimes (Mar - NS)	40 to 60	2008	Carcinus maenas present province wide	Province-wide, Atlantic coast	anecdotal reports, trapping, shore surveys, includes bicatch and biodiversity data	Harbours, marinas, eelgrass beds, known and suspected habitats	Temperature, salinity, chl a, oxygen	AIS National Database
Canada				Maritimes (Bay of Fundy NB)	10 to 15	2007	Carcinus maenas present throughout bay of Fundy	throughout Bay of Fundy	anecdotal reports, trapping, shore surveys, includes bicatch and biodiversity data	Harbours, marinas, eelgrass beds, known and suspected habitats	Temperature, salinity, fluorescence, turbidity and Oyxgen	AIS National Database
Canada			x	Quebec	4 (2004) to 27 (2011)	2004	Carcinus maenas present in Magdalen since 2004. Observed for the first time in Bay des Chaleurs in 2011.	Magdalen Islands and Gaspe Peninsula. Zonal standard monitoring protocol (June and September)	trapping, shore surveys, dive surveys, bicatch (eel fishermen), anecdotal reports	Harbours, eelgrass beds, lagoons, known and suspected habitats	Temperature and salinity	AIS National Database

UK Scotland	Phytoplankton		X	Scottish coast (Stonehaven, Loch Ewe, Millport); Western Isles (Loch Maddy); Orkney (Scapa); Shetland (Scalloway)	6	Stonehaven : 1997; Scapa, Scalloway and Loch Ewe: 2001; Loch Maddy: 2003; Millport: 2005.	Phytoplankton		10m Lund tube collects integrated water sample which is decanted into a bucket and mixed well. A 1l subsample is collected and from this 50ml is analysed at x200 magnification with an inverted microscope using the utermohl method.	Waters (up to 10m depth) of inshore coastal areas, sea lochs and harbours.	Stonehaven and Loch Ewe: temperature, salinity, nutrients, chlorophyll, zooplankton. Scapa, Scalloway and Loch Maddy: temperature, salinity, nutrients. Millport: temperature.	
UK Scotland - MSS (Marine Scotland Science)	Zooplankton		X	Scottish coast (Stonehaven and Loch Ewe)	2	Stonehaven : 1997; Loch Ewe: 2002	Zooplankton	Duplicate weekly mesozooplankton samples at 2 sites in Scotland to assess if/how they are responding to changing environmetal conditions and if they are being affected by climate change.	Collected by vertical hauls using a Bongo net (diameter 40 cm, mesh sizes 68 and 200 µm) to near sea bed (45m at Stonehaven, 35 m at Loch Ewe). Samples are fixed in 4% buffered formaldehyde. Only the 200 µm samples are routinely analysed.	Inshore coastal waters and a sea loch	Temperature, salinity, nutrients, chlorophyll	Data available from Marine Scotland Science.

UK Scotland - MSS (Marine Scotland Science)	Settling fauna including ascidians, bryozoans, molluscs, barnacles, anemones, hydroids, sponges, polychaetes		X	Scottish east coast (Lossiemouth, Peterhead, Port Edgar)	3	2009 only (for all 3 sites)	Ascidians, bryozoans, barnacles, anemones, hydroids, sponges, ploychaetes	Settling panels hung in inner and outer areas of marinas to investigate whether sheltered or exposed areas affect settling ability/success (??) of organisms. Panels hung for 2 and 8 weeks before removal.	Horizontal and vertcal corex panels hung in inner and outer locations within marinas for sets of 2 and 8 weeks. Removed after time period and scored for presence/absence of setted fauna.	Sheltered and exposed areas of water within marinas ???	Salinity, temperature	Plymouth Marine Laboratory hold these data
UK Scotland - SAMS (Scottish Association for Marine Science)	Phytoplankton		X	Dumfries and Galloway; Argyll and Bute; Highland; Fife; Scottish Borders; Lewis and Harris; Orkney Isles; Shetland Isles	46 location s within these 8 regions	2005	Toxin-producing phytoplankton			Coastal waters and sea lochs		SAMS/SFS A (Scottish Food Standards Association) hold these data
UK Scotland - SAMS (Scottish Association for Marine Science)	Distributions of Caprella mutica, Eriocheir sinensis, Perophora japonica, Styela clava, Codium fragile subsp. Tomentosoides, Sargassum muticum and Undaria pinnatifida		X	East and west coasts of Scotland	10	August 2006 - 2008 and November 2009	Crustaceans Caprella mutica and Eriocheir sinensis; ascidians Perophora japonica and Styela clava; green algae Codium fragile subsp. Tomentosoides; brown algae	Basic description in Ashton et al. (2006) and based on method of Pederson et al. (2003) and Minchin et al. (2006).	Basic description in Ashton et al. (2006) and based on method of Pederson et al. (2003) and Minchin et al. (2006).	Marinas including all structures		2006 survey - data presented in Ashton et al. (2009). 2007 and 2008 surveys - data unpublishe d, currently held by SAMS. 2009

							Sargassum muticum and Undaria pinnatifida					data - report can be found here http://www.snh.org.uk/pdfs/publications/commissioned_reports/413.pdf
Belgium	Phytoplankton											
Belgium	Macrophytes											
Belgium	Epibenthos		x	Belgian Part of the North Sea (BPNS)	3-12	since 1978	Epibenthos	twice a year	beam trawl	soft sediment	salinity, temperature	on request
Belgium	Demersal fish		x	Belgian Part of the North Sea (BPNS)	3-12	since 1978	Demersal fish	twice a year	beam trawl	soft sediment	salinity, temperature	on request
Belgium	Jellyfish (with focus on Mnemiopsis leidyi)		x	Belgian Part of the North Sea (BPNS)	3	2011-2012	JELLYFISH	monthly sampling	WP2 and WP3 net	pelagic habitat	secchi depth, CTD, fluorimetry, O2 level	on request
Belgium	Pelagic fish		x	Belgian Part of the North Sea (BPNS)	3-10	2009-2012	pelagic fish	monthly sampling	otter trawl	pelagic/benthic habitat	CTD	on request
Belgium	Zooplankton		x	Belgian Part of the North Sea (BPNS)	3-10	2009-2012	zooplankton	monthly sampling	WP2 net	pelagic habitat	CTD	on request
Belgium	Macrobenthos (soft sediment)		x	Belgian Part of the North Sea (BPNS)	3-12	since 1978	Macrobenthos (soft sediment)	twice a year	Van Veen grab	soft sediment	salinity, temperature and sediment fractions, …	on request
Belgium	Macrobenthos (hard sediment)		x	Belgian Part of the North Sea (BPNS) - windmill parks	1-3	since 2008	Macrobenthos - fouling (marine growth)	thrice a year	Quadrant crapings, removal of stones	artificial hard subtrate; windmill	CTD	on request

										foundations and scour protection		
Belgium	Sea mammals		x (N/A)									
Belgium	Sea birds		x (N/A)									
Belgium	Meiobenthos		x	Belgian Part of the North Sea (BPNS)	9.nov	since 1997	meiobenthos	autupn	Reineck boxcorer	soft sediment	CTD, grains size	samples available, data not elaborated
Belgium	hyperbenthos		x	Belgian Part of the North Sea (BPNS)	9-11	since 1997	hyperbenthos		hyperbenthic sledge	lower m of water column	CTD, grains size	samples available, data not elaborated
Finland	Phytoplankton		x	Gulf of Finland, Gulf of Bothnia, Archipelago Sea, Åland Sea, northern Baltic Proper	12	1979	phytoplankton	annually, in August	net (10 um)	open sea	Temp, sal, oxygen, nutrients, chl	public property, available upon request
Finland	Phytoplankton		x	Gulf of Finland, Gulf of Bothnia, Archipelago Sea, Åland Sea, northern Baltic Proper	17	1979	Phytoplankton	once every three years	water sample	coastal areas	Temp, sal	public property, available upon request
Finland	Zooplankton		x	Gulf of Finland, Gulf of Bothnia, Archipelago Sea, Åland Sea, northern Baltic Proper	12	1979	zooplankton	annually, in August	WP2-net (100 um)	open sea	Temp, sal, oxygen, nutrients, chl	public property, available upon request

Finland	Zooplankton		x	Gulf of Finland, Archipelago Sea	3	2 of the stations started 1960's, 1 station 2010	Zooplankton	once a month during ice-free period	WP2-net (100 um)	coastal areas	temp, sal	partly public property, available upon request
Finland	Benthos		x	Gulf of Finland, Gulf of Bothnia, Archipelago Sea, Åland Sea, northern Baltic Proper	80	1960's	macrozoobenth os	annually, in May/June	Van Veen grab	open sea, soft bottoms	Temp, sal, oxygen, nutrients, chl	public property, available upon request
Finland	Benthos		x	Gulf of Finland, Gulf of Bothnia, Archipelago Sea, Åland Sea, northern Baltic Proper	17		macrozoobenth os	annually during summer	Van Veen grab or Ekman sampler	coastal, soft bottom habitats	temp, sal	public property, available upon request
Finland	fish		x	Gulf of Finland, Archipelago Sea	3 areas	early 1990's	fish	annually July/August	coastal fishing nets	coastal habitats		public property, available upon request
Finland	macrophytes		x	Gulf of Finland, Bothnian Sea, Archipelago Sea	5 diving lines every year, 3 areas once per 3 years	1999	macrophytes	from once a year to once every 3 years	by diving	coastal habitats		public property, available upon request

France	Protozoan parasite		X called REPAMO (active surveillance)	all around the French coast including North Sea, English Channel, Atlantic coast and Mediterranean coast	150 individuals of Flat oysters (Ostrea edulis) collected over the studied zone, individuals over 2 years of age	since 2003	Bonamia ostreae and Marteilia refringens	on non infected zones where action has been taken for approval - frequency: twice a year, in spring and autumn.	flat oyster collection by fishermen	Flat oyster wild and cultured beds	none	data collected in the Ifremer database called REPAMO
France	e.g. Phytoplankton		X called REPHY (active surveillance)	active surveillance ; all around the French coast including North Sea, English Channel, Atlantic coast and Mediterranean coast	55	since 1984	all phytoplanctonic species > 20 µm or less if species with colonies (i e list)	monthly or bi-monthly ; at high tide (more or less 2 h)	water sampling using a Niskin bottle	coastal waters, estuaries and lagoons	Temperature, salinity, turbidity, nutrients, oxygen	data collected in the Ifremer database called QUADRIGE²

France	Macrophytes		X called REBENT	mainly developped around the Brittany coast and done in the context of water framework directive monitoring program around the French coast including North Sea, English Channel, Atlantic coast and Mediterranean coast	data not commu nicated	since 2000 in Brittany and since 2006 for the Water Framework mornitorin g network	Zostera noltii, Zostera marinus, Posidonia oceanica for phanerogames ; list of macroalgae according to latitude	according to WFD ; every 3 years or once a year depending of the group	recording on intertidal (by foot) and subtidal (by scuba diving) zones	coastal waters, estuaries and lagoons	data non communicated	data available in the Ifremer database called QUADRIG E²
France	Invertebrates		X called REBENT	mainly developped around the Brittany coast and done in the context of water framework directive monitoring program around the French coast including North Sea, English Channel, Atlantic coast and Mediterranean coast	data not commu nicated	since 2000 in Brittany and since 2006 for the Water Framework mornitorin g network	list of species	according to WFD ; every 3 years or once a year depending of sampling points	dredge or grabe	coastal waters, estuaries and lagoons	data non communicated	data available in the Ifremer database called QUADRIG E²

France	Macrophytes		X called REBENT	mainly developped around the Brittany coast and done in the context of water framework directive monitoring program around the French coast including North Sea, English Channel, Atlantic coast and Mediterranean coast	data not communicated	since 2000 in Brittany and since 2006 for the Water Framework mornitoring network	Zostera noltii, Zostera marinus, Posidonia oceanica for phanerogames ; list of macroalgae according to latitude	according to WFD ; every 3 years or once a year depending of the group	recording on intertidal (by foot) and subtidal (by scuba diving) zones	coastal waters, estuaries and lagoons	data non communicated	data available in the Ifremer database called QUADRIGE^2
Spain	Bivalve:											
Spain	Xenostrobus securis		X	Ria de Vigo (Galicia, NW Spain)	11		Bivalves	From the inner part to the middle part of the ria, 11 locations were sampled.	30 quadrants of 20 x 20 cm equidistantly spaced on a 30 m long transect line parallel to the coastline and located on the middle shore.	Natural and artificial rocky shores.	Temperature, Salinity and pH.	
Spain	Ascidian											

Spain	Styela plicata		X	Arenys de mar (41º 34'36"N/2º 33' 32"E), Jávea (38º 47' 52"N/0º11'06"E), San Fernando (36º 27' 36" N/6º 12' 13" W), Ferrol (43º 29' 00" N/8º 14' 00" W) and Tenerife (28º 00' 24" N/16º 39' 38" W)	5	In 2009 and 2010	Ascidians		All specimens were collected from depths that ranged between 0 and 2 m by pulling up harbour ropes, removing specimens from submersed docks and pilings, or pulling individuals from rocky assemblages (natural population). Samples were dissected in situ and a piece of muscular tissue from the mantle or the siphon was immediately preserved in absolute ethanol. Ethanol was changed after a few hours, and samples were then stored at -20 oC until DNA extraction.	All specimens were collected from artificial substrata (harbours, marinas or decks)		
Spain	Decapod											

Spain	Percnon gibbesi		X	Observation sites in Murcia (SE Spain) comprise Cabo de Palos region and Isla Grosa, including the Cabo de Palos–Islas Hormigas Marine Reserve (37º 38 ′N 0º 42′ W) which includes a no-take zone. Also in Cabo Tiñoso and Cabo Cope rocky coasts.	4	2009	Decapod	During spring and summer 2009	Snorkelling and dive assessments.	Mainly on rock boulders hideouts, at 1–3 m deep.		
Spain	Algae			Two localities (a steep upper foreshore zone and a wide flat low-tide terrace) on an estuarine beach (Mañóns) of the NW coast of Spain (Galicia).	2	2009-2010	Algae	Wrack samples were collected at one month interval from January 2009 to January 2010 during spring low tides.	All wrack present along six one-meter wide transects perpendicular to the shore was collected to assess specific composition and biomass.	Estuarine beach		
Spain	Sargassum muticum		X									
Spain	Gracilaria vermiculophylla		X									

Annex 5.3. Abundance-biomass monitoring

Country	Abundance-Biomass monitoring	Does not exist (X)	Exists (X)	Name of sampling area/region/locations (give information by all organism groups, if different)	Number of sampled stations/localities	Since when (or which years)	Which organism group(s) (add these groups to the rows on Column B)	Sampling design and – frequency (give information by all investigated organism groups separately)	Sampling methods (by all investigated organism groups separately)	Habitat surveyed (incl. artifical habitat)	List of environmental parameters measured during the monitoring surveys	Status of data availability (i.e., are data available and if yes, under which conditions)
Sweden	Phytoplankton		x									
Sweden	Zooplankton (taken with phytoplankton)		x									
Sweden	Macrophytes		x	Baltic Sea side of Sweden								
Sweden	Invertebrates		x									
Sweden	Fish (coastal) national		x									
Sweden	Fish (open sea)		x									
Sweden	All these are as in "Presence-absence", except macrophytes, that are not sampled, only photographed, on the Swedish west coast.											

Estonia	Phytoplankton		X	Gulf of Riga	3 stations	since 1993		April-October, twice per month	HELCOM methodology	Coastal near-shore habitat.	Chlorophyll, nutrients, temperature, salinity, secchi	free
Estonia	Phytoplankton		X	Gulf of Finland	6 stations	since 1993		May-September, twice per month	HELCOM methodology	Coastal near-shore habitat.	Chlorophyll, nutrients, temperature, salinity, secchi	free
Estonia	Macrophytes		X	Gulf of Riga	3 stations	since 1993		summer	HELCOM methodology	Coastal near-shore habitat.	Oxygen, temperature, water tranparency, bottom morphology, amount of suspended sediments	free
Estonia	Macrophytes		X	Gulf of Finland	6 stations	since 1993		summer	HELCOM methodology	Coastal near-shore habitat.	Oxygen, temperature, water tranparency, bottom morphology, mount of suspended sediments	free
Estonia	Zooplankton		X	Gulf of Riga	6 stations	since 1957		Ice free period, 1x week or 2x month	Juday or WP2 closing plankton net	Coastal near-shore habitat.	Oxygen, temperature, salinity, water transparency	free 1993-2011

Estonia	Zooplankton		X	Gulf of Finland	6 stations	since 1993		May-September, twice per month	Juday or WP2 closing plankton net	Coastal near-shore habitat.	Oxygen, temperature, salinity, water transparency	free
Estonia	Macrozoobenthos		X	Gulf of Riga	3 stations	since 1993		May-June, once per year	van Veen or Ekman sampler	Coastal near-shore habitat.	Oxygen,surface /bottom temperature, salinity, water transparency	free
Estonia	Macrozoobenthos		X	Gulf of Finland	6 stations	since 1993		May-June, once per year	van Veen or Ekman sampler	Coastal near-shore habitat.	Oxygen,surface /bottom temperature, salinity, water transparency	free
Estonia	Fish			Väinameri Archipelago area (west coast of Estonia)	4 localities	1992		30-72 stations per locality, below 5m (one area 14-20m), fished for several nights.	HELCOM guidelines; gillnet mesh size 17(14)-30(60)mm.	Coastal near-shore habitat.	wind direction and speed, water temperature and transparency	free
Estonia	Fish			Gulf of Riga	2 localities	1997 and 2005		7&30 stations per locality, depth below 6m, fished for several nights	HELCOM guidelines. Gillnet mesh size 17(14)-60mm.	Coastal near-shore habitat.	wind direction and speed, water temperature and transparency	free

Estonia	Fish			Gulf of Finland	2 localities	1997		6&36 stations per locality, depth up to 6&25m.	HELCOM guidelines. Gillnet mesh size 17(14)-38(60)mm.	Coastal near-shore habitat.	wind direction and speed, water temperature and transparency	free
Canada	Phytoplankton		x	Maritimes (Bay of Fundy NB)	5 to 17	1987	all phytoplankton species detected	weekly during the high biomass periods, biweekly - monthly during winter	net hauls, whole water samples settled, enumerated and counted with inverted microscope	water column	CTD depth profiles (oxygen, fluorescence, temperature, turbidity, salinity	ICES Database WGHABD
Canada	Macrophytes											
Canada	Codium fragile	x		NL								
Canada		x		Maritimes (Mar - NS)								
Canada		x		Maritimes (Bay of Fundy NB)								
Canada				Gulf								
Canada		x		Quebec	10 to 36	2004	Codium fragile present	periodically	diver survey, beaches	Harbours, marinas, beaches, eelgras beds, aquaculture sites and associated natural habitats and artificial structures		AIS National Database
Canada	Invertebrates	x		NL								

Canada			x	Maritimes (Mar - NS)	40 to 60	2005	Botrylloides violaceus, Botryllus scholsseri, Ciona intestinalis present	Province-wide, Atlantic coast, annually, assess degree of coverage on collector plates to determine heavy, moderate and light infestations	collector plates, visual and video survey, anecdotal reports	Wharf structures, docks, other associated natural and artificial habitats, aquacultures sites, some locations monitored by NSDFA and industry partners	Temperature, salinity, chl a, oxygen	AIS National Database
Canada		x		Maritimes (Bay of Fundy NB)								
Canada	Botrylloides violaceus		x	Quebec	4 to 31	2006	Botrylloides violaceus present in Magdalen Islands	Province-wide. Based on priority (most risky sites). From June to October (3 sampling points)	collector plates, dive surveys, video survey, molecular probes	Wharf structures, docks, marinas, other associated natural and artificial habitats, aquacultures sites	Temperature and salinity	AIS National Database
Canada	Botryllus schlosseri		x	Quebec	4 to 31	2006	Botryllus schlosseri present in Magdalen Islands	Province-wide. Based on priority (most risky sites). From June to October (3 sampling points)	collector plates, dive surveys, video survey, molecular probes	Wharf structures, docks, marinas, other associated natural and artificial habitats, aquacultures sites	Temperature and salinity	AIS National Database

Canada	Didemnum vexillum		x	Quebec	4 to 31	2006	Didemnum vexillum not present	Province-wide. Based on priority (most risky sites). From June to October (3 sampling points)	collector plates, dive surveys, video survey, molecular probes	Wharf structures, docks, marinas, other associated natural and artificial habitats, aquacultures sites	Temperature and salinity	AIS National Database
Canada	Diplosoma listerianum		x	Quebec	4 to 31	2008	Diplosoma listerianum present in Magdalen Islands	Province-wide. Based on priority (most risky sites). From June to October (3 sampling points)	collector plates, dive surveys, video survey, molecular probes	Wharf structures, docks, marinas, other associated natural and artificial habitats, aquacultures sites	Temperature and salinity	AIS National Database
Canada	Cioana intestinales		x	Quebec	4 to 31	2006	Ciona intestinalis present in Magdalen Islands	Province-wide. Based on priority (most risky sites). From June to October (3 sampling points)	collector plates, dive surveys, video survey, molecular probes	Wharf structures, docks, marinas, other associated natural and artificial habitats, aquacultures sites	Temperature and salinity	AIS National Database
Canada	Styla clava		x	Quebec	4 to 31	2006	Styla clava not present	Province-wide. Based on priority (most risky sites). From June to October (3 sampling points)	collector plates, dive surveys, video survey, molecular probes	Wharf structures, docks, marinas, other associated natural and artificial habitats, aquacultures sites	Temperature and salinity	AIS National Database

Canada	Tunicates include (all are not present in all regions)											
Canada	Botrylloides violaceus						Botrylloides violaceus					
Canada	Botryllus schlosseri						Botryllus schlosseri					
Canada	Didemnum vexillum						Didemnum vexillum					
Canada	Diplosoma listerianum						Diplosoma listerianum					
Canada	Ciona intestinalis						Ciona intestinalis					
Canada	Styla clava						Styla clava					
Canada												
Canada	Bryozoans	x		NL								
Canada		x		Maritimes (Mar - NS)								
Canada				Maritimes (Bay of Fundy NB)								
Canada			x	Quebec	4 to 31	2006	Membranipora membranacea present	Province-wide. Based on priority (most risky sites). From June to October (3 sampling points)	collector plates, dive surveys	Wharf structures, docks, marinas, other associated natural and artificial habitats, aquacultures sites	Temperature and salinity	AIS National Database

Canada	Membranipora membranacea						Membranipora membranacea					
Canada												
Canada	Crustaceans include (separate due to differences in sampling)											
Canada	Caprella mutica	x		NL								
Canada		x		Maritimes (Mar - NS)								
Canada		x		Maritimes (Bay of Fundy NB)								
Canada			x	Quebec	4 to 31	2006	Caprella mutica	Province-wide. Based on priority (most risky sites). From June to October (3 sampling points)	collector plates, dive surveys	Wharf structures, docks, marinas, other associated natural and artificial habitats, aquacultures sites	Temperature and salinity	AIS National Database
Canada	Carcinus maenas		x	NL	15 to 35	2006	Carcinus maenas	Province wide frequency varies from annually to monthly based on risk	trapping, shore surveys, dive surveys, includes bicatch and biodiversity data	Harbours, eelgrass beds, known and suspected habitats	Temperature, salinity, chl a, turbidity and Oyxgen	AIS National Database

Canada			x	Maritimes (Mar - NS)	30 to 35	2011	Carcinus maenas	eastern and south shore, single, 24-hour trapping event to compare abundance between locations	trapping survey, includes bycatch and biodiveristy data	Harbours, eelgrass beds, known and suspected habitats	Temperature, salinity, chl a, oxygen	AIS National Database
Canada			x	Maritimes (Bay of Fundy NB)	10 to 15	2008	Carcinus maenas	Bay of Fundy, southwest NB	trapping survey, beach walks, includes bycatch and biodiveristy data	Harbours, eelgrass beds, known and suspected habitats	Temperature, salinity, fluorescence, oxygen	AIS National Database
Canada			x	Quebec	4 (2004) to 27 (2011)	2004	Carcinus maenas present in Magdalen since 2004. Observed for the first time in Bay des Chaleurs in 2011.	Magdalen Islands and Gaspe Peninsula. Zonal standard monitoring protocol (June and September)	trapping, shore surveys, dive surveys, bicatch (eel fishermen), anecdotal reports	Harbours, eelgrass beds, lagoons, known and suspected habitats	Temperature and salinity	AIS National Database
UK Scotland - MSS (Marine Scotland Science)	Phytoplankton - data as 'cells L^{-1}'		X	Scottish coast (Stonehaven, Loch Ewe, Millport); Western Isles (Loch Maddy); Orkney (Scapa); Shetland (Scalloway)	6	Stonehaven: 1997; Scapa, Scalloway and Loch Ewe: 2001; Loch Maddy: 2003; Millport: 2005.	Phytoplankton	Weekly water samples collected at 6 sites to monitor phytoplankton communities in Scotland to assess if/how they are responding to changing environmetal	10m Lund tube collects integrated water sample which is decanted into a bucket and mixed well. A 1l subsample is collected and from this 50ml is analysed at x200 magnification with an inverted	Inshore coastal waters, sea lochs, harbour waters	Stonehaven and Loch Ewe: temperature, salinity, nutrients, chlorophyll, zooplankton. Scapa, Scalloway and Loch Maddy: temperature, salinity,	Marine Scotland Science hold these data. (?)

								conditions and if they are being affected by climate change.	microscope using the utermohl method.		nutrients. Millport: temperature.	
UK Scotland - MSS (Marine Scotland Science)	Zooplankton		X	Scottish coast (Stonehaven and Loch Ewe)	2	Stonehaven: 1997; Loch Ewe: 2002	Zooplankton	Duplicate weekly mesozooplankt on samples at 2 sites in Scotland to assess if/how they are responding to changing environmetal conditions and if they are being affected by climate change.	Collected by vertical hauls using a Bongo net (diameter 40 cm, mesh sizes 68 and 200 µm) to near sea bed (45m at Stonehaven, 35 m at Loch Ewe). Samples are fixed in 4% buffered formaldehyde. Only the 200 µm samples are routinely analysed.	Inshore coastal waters and a sea loch	Temperature, salinity, nutrients, chlorophyll	Data available from Marine Scotland Science.
Belgium	Phytoplankton											
Belgium	Macrophytes											
Belgium	Epibenthos		x	Belgian Part of the North Sea (BPNS)	3-12	since 1978	Epibenthos	twice a year	beam trawl	soft sediment	salinity, temperature	on request

Belgium	Demersal fish		x	Belgian Part of the North Sea (BPNS)	3-12	since 1978	Demersal fish	twice a year	beam trawl	soft sediment	salinity, temperature	on request
Belgium	Jellyfish (with focus on Mnemiopsis leidyi)		x	Belgian Part of the North Sea (BPNS)	3	2011-2012	JELLYFISH	monthly sampling	WP2 and WP3 net	pelagic habitat	secchi depth, CTD, fluorimetry, O2 level	on request
Belgium	Pelagic fish		x	Belgian Part of the North Sea (BPNS)	3-10	2009-2012	pelagic fish	monthly sampling	otter trawl	pelagic/benthic habitat	CTD	on request
Belgium	Zooplankton		x	Belgian Part of the North Sea (BPNS)	3-10	2009-2012	zooplankton	monthly sampling	WP2 net	pelagic habitat	CTD	on request
Belgium	Macrobenthos (soft sediment)		x	Belgian Part of the North Sea (BPNS)	3-12	since 1978	Macrobenthos (soft sediment)	twice a year	Van Veen grab	soft sediment	salinity, temperature and sediment fractions, …	on request
Belgium	Macrobenthos (hard sediment)		x	Belgian Part of the North Sea (BPNS) - windmill parks	1-3	since 2008	Macrobenthos - fouling (marine growth)	thrice a year	Quadrant crapings, removal of stones	artificial hard subtrate; windmill foundations and scour protection	CTD	on request
Belgium	Sea mammals											
Belgium	Sea birds											
Belgium	Meiobenthos		x	Belgian Part of the North Sea (BPNS)	9.nov	since 1997	meiobenthos	autupn	Reineck boxcorer	soft sediment	CTD, grains size	samples available, data not elaborated

Belgium	hyperbenthos		x	Belgian Part of the North Sea (BPNS)	9-11	since 1997	hyperbenthos		hyperbenthic sledge	lower m of water column	CTD, grains size	samples available, data not elaborated
Italy	Fish		x	Italy	7 GSAs	1994	Ostyeichties (bony fishes), Elasmobranchs, + Crustaceans, Cephalopods, large invertebrates	Annually	Random/ stratified sampling. Otter trawl towed by professional trawler	All habitats present between 50 and 800 m in tawlable bottoms	Temperature (during the haul)	Results collected each year in a report. Row data are available from each GSA coordinator
Finland	Phytoplankton		x	Gulf of Finland, Gulf of Bothnia, Archipelago Sea, Åland Sea, northern Baltic Proper	12	1979	phytoplankton	annually, in August	net (10 um)	open sea	Temp, sal, oxygen, nutrients, chl	public property, available upon request
Finland	Phytoplankton		x	Gulf of Finland, Gulf of Bothnia, Archipelago Sea, Åland Sea, northern Baltic Proper	17	1979	Phytoplankton	once every three years	water sample	coastal areas	Temp, sal	public property, available upon request
Finland	Zooplankton		x	Gulf of Finland, Gulf of Bothnia, Archipelago Sea, Åland Sea, northern Baltic Proper	12	1979	zooplankton	annually, in August	WP2-net (100 um)	open sea	Temp, sal, oxygen, nutrients, chl	public property, available upon request

Finland	Zooplankton		x	Gulf of Finland, Archipelago Sea	3	2 of the stations started 1960's, 1 station 2010	Zooplankton	once a month during ice-free period	WP2-net (100 um)	coastal areas	temp, sal	partly public property, available upon request
Finland	Benthos		x	Gulf of Finland, Gulf of Bothnia, Archipelago Sea, Åland Sea, northern Baltic Proper	80	1960's	macrozoobenth os	annually, in May/June	Van Veen grab	open sea, soft bottoms	Temp, sal, oxygen, nutrients, chl	public property, available upon request
Finland	Benthos		x	Gulf of Finland, Gulf of Bothnia, Archipelago Sea, Åland Sea, northern Baltic Proper	17		macrozoobenth os	annually during summer	Van Veen grab or Ekman sampler	coastal, soft bottom habitats	temp, sal	public property, available upon request
Finland	fish		x	Gulf of Finland, Archipelago Sea	3 areas	early 1990's	fish	annually July/August	coastal fishing nets	coastal habitats		public property, available upon request

France	Phytoplankton		X called REPHY (active surveillance)	active surveillance ; all around the French coast including North Sea, English Channel, Atlantic coast and Mediterranean coast	55	since 1984	all phytoplanctonic species > 20 µm or less if species with colonies (i e list)	monthly or bi-monthly ; at high tide (more or less 2 h)	water sampling using a Niskin bottle	coastal waters, estuaries and lagoons	Temperature, salinity, turbidity, nutrients, oxygen	data collected in the Ifremer database called QUADRIGE^2
France	Invertebrates		X called REBENT	mainly developped around the Brittany coast and done in the context of water framework directive monitoring program around the French coast including North Sea, English Channel, Atlantic coast and Mediterranean coast	data not communicated	since 2000 in Brittany and since 2006 for the Water Framework mornitoring network	list of species	according to WFD ; every 3 years or once a year depending of sampling points	dredge or grabe	coastal waters, estuaries and lagoons	data non communicated	data available in the Ifremer database called QUADRIGE^2

Spain	Crustacean caprellid:			Harbour of Cádiz (36º 31’N 6º 17’W)		summer 2010-spring 2011	Crustacean caprellid					
Spain	Caprella scaura		X									
Spain	Paracaprella pusilla		X									
Spain	Bryozoan:						Bryozoan					
Spain	Tricellaria inopinata		X									
Spain												
Spain	Scleractinian coral											
Spain	Oculina patagonica		X	Along the 400 km coastline of the Catalan coast (NE Spain) (40º 31’N - 42º 26’N; latitude)	223 locations	2008	Scleractinian coral	Field surveys included the annotation of each colony depth to examine variation on abundance of the species with depth. Random transects were conducted on each location in order to determine presence-absence of the species.		Rocky shores and port jettys.		

Annex 5.4. Port monitoring

Country	Port monitoring	Does not exist (X)	Exists (X)	Name of sampling area/region/locations (give information by all organism groups, if different)	Number of sampled stations/localities	Since when (or which years)	Which organism group(s) (add these groups to the rows on Column B)	Sampling design and – frequency (give information by all investigated organism groups separately)	Sampling methods (by all investigated organism groups separately)	Habitat surveyed (incl. artifical habitat)	List of environmental parameters measured during the monitoring surveys	Status of data availability (i.e., are data available and if yes, under which conditions)
Sweden	All	x										
Estonia	Zooplankton		X	Muuga Bay (adjacent to Port of Tallinn)	2 main stations	1996	zooplankton	Sampled 1-2 times per month (Apr-Oct)	Juday net. Analysis according to HELCOM methodology	Pelagic	CTD, water transparency, nutrients	Free
Estonia	Macrozoobenthos		X	Muuga Bay (adjacent to Port of Tallinn)	2 main stations	1996	macrozoobenthos	Sampled 1-2 times per month (Apr-Oct)	Ekman, van Veen samplers. Analysis according to HELCOM methodology	Benthic	CTD, water transparency, nutrients	Free
Canada	Phytoplankton	x										
Canada	Macrophytes											
Canada	Codium fragile		x	Newfoundland and Labrador (NL)	5 to 15	2006	Codium fragile (not present)	annually	diver survey	Harbours and associated natural and artifical habitats)	Temperature, salinity, chl a, turbidity, Oxygen	AIS National Database

Canada			x	Maritimes (Mar - NS)	40-60	2006	Codium fragile present	Province-wide, Atlantic coast, annually	visual survey	Harbours, marinas, aquaculture sites and associated natural habitats and artificial structures	Temperature, salinity, chl a, oxygen	AIS National Database
Canada		x		Maritimes (Bay of Fundy NB)			Codium fragile ouly detected at one location by Huntsman Marine Science Center					
Canada				Gulf								
Canada		x		Quebec	10 to 36	2004	Codium fragile present	periodically	diver survey, beaches	Harbours, marinas, beaches, eelgras beds, aquaculture sites and associated natural habitats and artificial structures		AIS National Database
Canada												

Canada	Invertebrates		x	NL	5 to 15	2005		Province-wide based on priority, annual	collector plates, dive surveys, video survey	Wharf structures, docks, other associated natural and artificial habitats, aquacultures sites surveyed by provincial DFA	Temperature, salinity, chl a, turbidity and Oyxgen	AIS National Database
Canada			x	Maritimes (Mar - NS)	40 to 60	2005	Botrylloides violaceus, Botryllus scholsseri, Ciona intestinalis present	Province-wide, Atlantic coast, annually	collector plates, visual and video survey, anecdotal reports	Wharf structures, docks, other associated natural and artificial habitats, aquacultures sites, some locations monitored by NSDFA and industry partners	Temperature, salinity, chl a, oxygen	AIS National Database
Canada			x	Maritimes (Bay of Fundy NB)	20	2005	Botrylloides violaceus, Botryllus scholsseri, Ciona intestinalis present	Bay of Fundy, southwest NB	collector plates, visual and video survey, anecdotal reports, dive surveys	Wharf structures, docks, other associated natural and artificial habitats, aquacultures sites, some	Temperature, salinity, fluorescence, oxygen	AIS National Database

										locations monitored by NB DAAF		
Canada	Botrylloides violaceus		x	Quebec	4 to 31	2006	Botrylloides violaceus present in Magdalen Islands	Province-wide. Based on priority (most risky sites). From June to October (3 sampling points)	collector plates, dive surveys, video survey, molecular probes	Wharf structures, docks, marinas, other associated natural and artificial habitats, aquacultures sites	Temperature and salinity	AIS National Database
Canada	Botryllus schlosseri		x	Quebec	4 to 31	2006	Botryllus schlosseri present in Magdalen Islands	Province-wide. Based on priority (most risky sites). From June to October (3 sampling points)	collector plates, dive surveys, video survey, molecular probes	Wharf structures, docks, marinas, other associated natural and artificial habitats, aquacultures sites	Temperature and salinity	AIS National Database

Canada	Didemnum vexillum		x	Quebec	4 to 31	2006	Didemnum vexillum not present	Province-wide. Based on priority (most risky sites). From June to October (3 sampling points)	collector plates, dive surveys, video survey, molecular probes	Wharf structures, docks, marinas, other associated natural and artificial habitats, aquacultures sites	Temperature and salinity	AIS National Database
Canada	Diplosoma listerianum		x	Quebec	4 to 31	2008	Diplosoma listerianum present in Magdalen Islands	Province-wide. Based on priority (most risky sites). From June to October (3 sampling points)	collector plates, dive surveys, video survey, molecular probes	Wharf structures, docks, marinas, other associated natural and artificial habitats, aquacultures sites	Temperature and salinity	AIS National Database
Canada	Cioana intestinales		x	Quebec	4 to 31	2006	Ciona intestinalis present in Magdalen Islands	Province-wide. Based on priority (most risky sites). From June to October (3 sampling points)	collector plates, dive surveys, video survey, molecular probes	Wharf structures, docks, marinas, other associated natural and artificial habitats, aquacultures sites	Temperature and salinity	AIS National Database

Canada	Styla clava		x	Quebec	4 to 31	2006	Styla clava not present	Province-wide. Based on priority (most risky sites). From June to October (3 sampling points)	collector plates, dive surveys, video survey, molecular probes	Wharf structures, docks, marinas, other associated natural and artificial habitats, aquacultures sites	Temperature and salinity	AIS National Database
Canada	Tunicates include (all are not present in all regions)											
Canada	Botrylloides violaceus						Botrylloides violaceus					
Canada	Botryllus schlosseri						Botryllus schlosseri					
Canada	Didemnum vexillum						Didemnum vexillum					
Canada	Diplosoma listerianum						Diplosoma listerianum					
Canada	Ciona intestinalis						Ciona intestinalis					
Canada	Styla clava						Styla clava					
Canada												
Canada	Bryozoans		x	NL	5 to 15	2006		south and west coast	dive surveys, harbour surveys	Harbour and docks, kelp beds near survey sites	Temperature, salinity, chl a, turbidity and Oyxgen	AIS National Database

Canada			x	Maritimes (Mar - NS)	40 to 60	2006	Membranipora membranacea present	Province-wide, Atlantic coast, annual	collector plates, video surveys, visual surveys	Wharf structures, docks, other associated natural and artificial habitats, aquacultures sites, some locations monitored by NSDFA and industry partners	Temperature, salinity, chl a, oxygen	AIS National Database
Canada			x	Maritimes (Bay of Fundy NB)	20	2006	Membranipora membranacea present	Bay of Fundy, Southwest NB	collector plates, video surveys, visual surveys	Wharf structures, docks, other associated natural and artificial habitats, aquacultures sites, some locations monitored by NSDFA and industry partners	Temperature, salinity, fluorescence, oxygen	
Canada			x	Quebec	4 to 31	2006	Membranipora membranacea present	Province-wide. Based on priority (most risky sites). From June to	collector plates, dive surveys	Wharf structures, docks, marinas, other associated natural and	Temperature and salinity	AIS National Database

								October (3 sampling points)		artificial habitats, aquacultures sites		
Canada	Membranipora membranacea						Membranipora membranacea					
Canada												
Canada	Crustaceans include (separate due to differences in sampling)											
Canada	Caprella mutica	x		NL								
Canada			x	Maritimes (Mar - NS)	40 to 60	2006	Caprella mutica present	Province-wide, Atlantic coast	collector plates, video surveys, visual surveys	Wharf structures, docks, other associated natural and artificial habitats, aquacultures sites, some locations monitored by NSDFA and industry partners	Temperature, salinity, chl a, oxygen	AIS National Database
Canada		x		Maritimes (Bay of Fundy NB)			Caprella mutica present					

Canada			x	Quebec	4 to 31	2006	Caprella mutica	Province-wide. Based on priority (most risky sites). From June to October (3 sampling points)	collector plates, dive surveys	Wharf structures, docks, marinas, other associated natural and artificial habitats, aquacultures sites	Temperature and salinity	AIS National Database
Canada	Carcinus maenas		x	NL	15 to 35	2006	Carcinus maenas	Province wide frequency varies from annually to monthly based on risk	trapping, shore surveys, dive surveys, includes bicatch and biodiversity data	Harbours, eelgrass beds, known and suspected habitats	Temperature, salinity, chl a, turbidity and Oyxgen	AIS National Database
Canada			x	Maritimes (Mar - NS)	40 to 60	2008	Carcinus maenas present	Province-wide, Atlantic coast	anecdotal reports, trapping, shore surveys, includes bicatch and biodiversity data	Harbours, marinas, eelgrass beds, known and suspected habitats	Temperature, salinity, chl a, oxygen	AIS National Database

Canada			x	Maritimes (Bay of Fundy NB)	10 to 15	2008	Carcinus maenas present	Bay of Fundy	anecdotal reports, trapping, shore surveys, includes bicatch and biodiversity data	Harbours, marinas, eelgrass beds, known and suspected habitats		AIS National Database
Canada			x	Quebec	4 (2004) to 27 (2011)	2004	Carcinus maenas present in Magdalen since 2004. Observed for the first time in Bay des Chaleurs in 2011.	Magdalen Islands and Gaspe Peninsula. Zonal standard monitoring protocol (June and September)	trapping, shore surveys, dive surveys, bicatch (eel fishermen), anecdotal reports	Harbours, eelgrass beds, lagoons, known and suspected habitats	Temperature and salinity	AIS National Database
UK Scotland - MSS (Marine Scotland Science)	Hull fouling spp including barnalces, mussels, macroalgae, amphipods, bryozoans, isopods, oysters, polychaetes,		X	Scottish ports (Telford Dock, Aberdeen harbour; Imperial dock, Leith; Garvel Clyde, Greenock)	3	2009 - 2011	Barnacles, mussels, macroalgae, amphipods, bryozoans, isopods, oysters, polychaetes	Biofouling samples are collected from vessels during dry dockings to assess the risk that vessels pose of transporting non native	Scrapings of bio fouling samples are collected from vessels while in dry dock and fixed in 4% formalin. Fouling coverage is estimated	Vessel hulls and associated structures (propellers, bow thrusters, sea chests/gratings, rudders, bilge keels etc)	Not applicable	Marine Scotland Science hold these data.

								species to Scottish waters. As many vessels as possible will be sampled.	using a quadrat			
Belgium	Macrobenthos (hard sediment)		x	Port of Zeebrugge								on request
Belgium	Jellyfish (with focus on Mnemiopsis leidyi)		x	Spuikom, Oostende	1	2011-2012	JELLYFISH	qualitative sampling	hand net gathering	pelagic habitat		on request
Belgium	Zooplankton		x	Spuikom, Oostende	1	2011-2012	zooplankton	qualitative sampling	hand net gathering	pelagic habitat		on request
Italy		X										
Finland		X										
France		X										
Spain		X										

Annex 5.5. Ecological impact monitoring

Country	Ecological impact monitoring	Does not exist (X)	Exists (X)	Name of sampling area/region/locations (give information by all organism groups, if different)	Number of sampled stations/localities	Since when (or which years)	Which organism group(s) (add these groups to the rows on Column B)	Sampling design and – frequency (give information by all investigated organism groups separately)	Sampling methods (by all investigated organism groups separately)	Habitat surveyed (incl. artifical habitat)	List of environmental parameters measured during the monitoring surveys	Status of data availability (i.e., are data available and if yes, under which conditions)
Sweden		X										
Estonia		X										
Canada	Phytoplankton		x	Maritimes (Bay of Fundy NB)	5 to 17	1987	all phytoplankton species	weekly, biweekly and monthly during non-bloom periods (winter)	net hauls, whole water	water column	Temperature, salinity, fluorescence turbidity, oyxgen, nutrients	ICES Database WGHABD
Canada	Macrophytes											
Canada	Codium fragile	x		Newfoundland and Labrador (NL)								
Canada		x		Maritimes (Mar - NS)								
Canada		x		Maritimes (Bay of Fundy NB)								
Canada				Gulf								

Canada		x		Quebec	10 to 36	2004	Codium fragile present	periodically	diver survey, beaches	Harbours, marinas, beaches, eelgras beds, aquaculture sites and associated natural habitats and artificial structures		AIS National Database
Canada	Invertebrates		x	NL	5 to 15	2005		Province-wide based on priority, annual	collector plates, dive surveys, video survey	Wharf structures, docks, other associated natural and artificial habitats, aquacultures sites surveyed by provincial DFA	Temperature, salinity, chl a, turbidity and Oyxgen	AIS National Database
Canada			x	Maritimes (Mar - NS)	40 to 60	2005	Botrylloides violaceus, Botryllus scholsseri, Ciona intestinalis present, record information on other species present on collector plates	Province-wide, Atlantic coast, annually. Bi-weekly monitoring (Ciona	collector plates, visual and video survey, biweekly monitoring (Ciona	Wharf structures, docks, other associated natural and artificial habitats, aquacultures	Temperature, salinity, chl a, oxygen, CTD profiles, nutrients, Ciona intestinalis larval	AIS National Database

								intestinalis) at one shellfish aquaculture site	intestinalis) at one shellfish aquaculture site	sites, some locations monitored by NSDFA and industry partners	settlement and growth rates	
Canada			x	Maritimes (Bay of Fundy NB)	20	2005	Botrylloides violaceus, Botryllus scholsseri, Ciona intestinalis present, record information on other species present on collector plates	Bay of Fundy, southwest New Brunswick (annual)	collector plates, visual and video surveys	Wharf structures, docks, floating docks, other associated natural and artificial habitats, aquacultures sites surveyed by provincial DAAF	Temperature, salinity, fluorescence, turbidity, oxygen	AIS National database
Canada	Botrylloides violaceus		x	Quebec	4 to 31	2006	Botrylloides violaceus present in Magdalen Islands	Province-wide. Based on priority (most risky sites). From June to October (3 sampling points)	collector plates, dive surveys, video survey, molecular probes	Wharf structures, docks, marinas, other associated natural and artificial habitats, aquacultures sites	Temperature and salinity	AIS National Database
Canada	Botryllus schlosseri		x	Quebec	4 to 31	2006	Botryllus schlosseri present in Magdalen Islands	Province-wide. Based on priority	collector plates, dive surveys,	Wharf structures, docks,	Temperature and salinity	AIS National Database

								(most risky sites). From June to October (3 sampling points)	video survey, molecular probes	marinas, other associated natural and artificial habitats, aquacultures sites		
Canada	Didemnum vexillum		x	Quebec	4 to 31	2006	Didemnum vexillum not present	Province-wide. Based on priority (most risky sites). From June to October (3 sampling points)	collector plates, dive surveys, video survey, molecular probes	Wharf structures, docks, marinas, other associated natural and artificial habitats, aquacultures sites	Temperature and salinity	AIS National Database
Canada	Diplosoma listerianum		x	Quebec	4 to 31	2008	Diplosoma listerianum present in Magdalen Islands	Province-wide. Based on priority (most risky sites). From June to October (3 sampling points)	collector plates, dive surveys, video survey, molecular probes	Wharf structures, docks, marinas, other associated natural and artificial habitats, aquacultures sites	Temperature and salinity	AIS National Database
Canada	Cioana intestinales		x	Quebec	4 to 31	2006	Ciona intestinalis present in Magdalen Islands	Province-wide. Based on priority (most risky	collector plates, dive surveys, video	Wharf structures, docks, marinas,	Temperature and salinity	AIS National Database

								sites). From June to October (3 sampling points)	survey, molecular probes	other associated natural and artificial habitats, aquacultures sites		
Canada	Styla clava		x	Quebec	4 to 31	2006	Styla clava not present	Province-wide. Based on priority (most risky sites). From June to October (3 sampling points)	collector plates, dive surveys, video survey, molecular probes	Wharf structures, docks, marinas, other associated natural and artificial habitats, aquacultures sites	Temperature and salinity	AIS National Database
Canada	Tunicates include (all are not present in all regions)											
Canada	Botrylloides violaceus						Botrylloides violaceus					
Canada	Botryllus schlosseri						Botryllus schlosseri					
Canada	Didemnum vexillum						Didemnum vexillum					
Canada	Diplosoma listerianum						Diplosoma listerianum					
Canada	Ciona intestinalis						Ciona intestinalis					

Canada	Styla clava						Styla clava					
Canada	Bryozoans		x	NL	5 to 15	2006		south and west coast	dive surveys, harbour surveys	Harbour and docks, kelp beds near survey sites	Temperature, salinity, chl a, turbidity and Oyxgen	AIS National Database
Canada			x	Maritimes (Mar - NS)	40 to 60	2006	Membranipora membranacea present, information on other species present	Province-wide, Atlantic coast, annual	collector plates, video surveys, visual surveys	Wharf structures, docks, other associated natural and artificial habitats, aquacultures sites, some locations monitored by NSDFA and industry partners	Temperature, salinity, chl a, oxygen	AIS National Database
Canada			x	Maritimes (Bay of Fundy NB)	20	2006		Bay of Fundy, southwest New Brunswick	collector plates, video surveys, visual surveys	wharves, docks aquaculture sites	Temperature, salinity, fluorescence, turbidity and Oyxgen	AIS National database

Canada			x	Quebec	4 to 31	2006	Membranipora membranacea present	Province-wide. Based on priority (most risky sites). From June to October (3 sampling points)	collector plates, dive surveys	Wharf structures, docks, marinas, other associated natural and artificial habitats, aquacultures sites	Temperature and salinity	AIS National Database
Canada	Membranipora membranacea						Membranipora membranacea					
Canada	Crustaceans include (separate due to differences in sampling)											
Canada	Caprella mutica	x		NL								
Canada		x		Maritimes (Mar - NS)								
Canada		x		Maritimes (Bay of Fundy NB)								

Canada			x	Quebec	4 to 31	2006	Caprella mutica	Province-wide. Based on priority (most risky sites). From June to October (3 sampling points)	collector plates, dive surveys	Wharf structures, docks, marinas, other associated natural and artificial habitats, aquacultures sites	Temperature and salinity	AIS National Database
Canada	Carcinus maenas		x	NL	15 to 35	2006	Carcinus maenas	Province wide frequency varies from annually to monthly based on risk	trapping, shore surveys, dive surveys, includes bicatch and biodiversity data	Harbours, eelgrass beds, known and suspected habitats, biodiversity impact and shellfish impact	Temperature, salinity, chl a, turbidity and Oyxgen	AIS National Database
Canada			x	Maritimes (Mar - NS)	30 to 35	2011	Carcinus maenas	eastern and south shore, single, 24-hour trapping event to compare abundance between locations	trapping survey, includes bycatch and biodiveristy data	Harbours, eelgrass beds, known and suspected habitats	Temperature, salinity, chl a, oxygen, bottom type and eel-grass coverage	AIS National Database

Canada		x		Maritimes (Bay of Fundy NB)	10 to 15	2007	Carcinus maenas	Bay of Fundy, southwest New Brunswick	trapping, beach walks	harbours, shoreline	Temperature, salinity, chl a, turbidity and Oyxgen	AIS national database
Canada			x	Quebec	4 (2004) to 27 (2011)	2004	Carcinus maenas present in Magdalen since 2004. Observed for the first time in Bay des Chaleurs in 2011.	Magdalen Islands and Gaspe Peninsula. Zonal standard monitoring protocol (June and September)	trapping, beach walks, dive surveys, bicatch (eel fishermen), anecdotal reports	Harbours, eelgrass beds, lagoons, known and suspected habitats	Temperature and salinity	AIS National Database
UK		X										
Belgium	Epibenthos	Dredge disposal	x	Belgian Part of the North Sea (BPNS)	+/- 10	since 2004	Epibenthos	twice a year	beam trawl	soft sediment	salinity, temperature	on request
Belgium	Epibenthos	Sand extraction	x	Belgian Part of the North Sea (BPNS)	10-20	since 2004	Epibenthos	twice a year	beam trawl	soft sediment	salinity, temperature	on request
Belgium	Epibenthos	Wind farms	x	Belgian Part of the North Sea (BPNS)	10-25	since 2005	Epibenthos	twice a year	beam trawl	soft sediment	salinity, temperature	on request
Belgium	Demersal fish	Dredge disposal	x	Belgian Part of the North Sea (BPNS)	+/- 10	since 2004	Demersal fish	twice a year	beam trawl	soft sediment	salinity, temperature	on request
Belgium	Demersal fish	Sand extraction	x	Belgian Part of the North Sea (BPNS)	10-20	since 2004	Demersal fish	twice a year	beam trawl	soft sediment	salinity, temperature	on request
Belgium	Demersal fish	Wind farms	x	Belgian Part of the North Sea (BPNS)	10-25	since 2005	Demersal fish	twice a year	beam trawl	soft sediment	salinity, temperature	on request

Belgium	Jellyfish (with focus on Mnemiopsis leidyi)		x	Belgian Part of the North Sea (BPNS)	3	2011-2012	JELLYFISH	monthly sampling	WP2 and WP3 net	pelagic habitat	secchi depth, CTD, fluorimetry, O2 level	on request
Belgium	Macrobenthos (soft sediment)	Dredge disposal	x	Belgian Part of the North Sea (BPNS)	60-90	since 2004	Macrobenthos (soft sediment)	twice a year (since 2010 only autumn)	Van Veen grab	soft sediment	salinity, temperature and sediment fractions, …	on request
Belgium	Macrobenthos (soft sediment)	Sand extraction	x	Belgian Part of the North Sea (BPNS)	40-200	since 2004	Macrobenthos (soft sediment)	twice a year (since 2010 only autumn)	Van Veen grab	soft sediment	salinity, temperature and sediment fractions, …	on request
Italy		x										
Finland		x										
France		x										
Spain				Harbour of Cádiz (36º 31’N 6º 17’W)		summer 2010-spring 2011	Crustacean caprellid					
Spain	Crustacean caprellid:						Bryozoan					
Spain	Caprella scaura		X									
Spain	Paracaprella pusilla		X									
Spain	Bryozoan:											
Spain	Tricellaria inopinata		X									
Spain												

Spain	Ctenophore											
Spain	Mnemiopsis leidyi		X	Ebro River Delta (E coast of Spain)		2010-2011	Ctenophore	Monthly samples taken during 2010 and 2011				
Spain	Algae											
Spain	Sargassum muticum		X	Beaches from NW Spain: Balieiros, Ladeira, Samil, Toralla, Abra and America	6	2007-2008	Algae	Monthy samples taken between December 2007 and November 2008.	Sampling during low spring tides from base of dune to lowest swash level along 6 transects randomly spaced over a 100 m-long stretch.	These beaches encompass an exposure range from very exposed to sheltered.	The following 6 environmental variables were recorded at each site: beach slope; beach length; beach width; wave height; wave period; and beach area.	
Spain	Invasive species			Along all the Catalan coast	123	Since 2006		During 2 years	126 stations that are sampled for two years and 60 transects.	Algal communities along the bathymetric gradient on areas particularly susceptible to introductions.		
Spain	Algae											

Spain	Acrothamnion preissii		1 single record found in 2010				Algae					
Spain	Caulerpa racemosa var. cylindracea		X				Algae					
Spain	Womersleyella setacea		X				Algae					
Spain	Invertebrates											
Spain	Mnemiopsis leidyi		X				Ctenophore					
Spain	Carybdea marsupialis		X				Cnidarian					
Spain	Phyllorhiza punctata		X				Cnidarian					
Spain	Bursatella leachii		X				Mollusk					
Spain	Microcosmus squamiger		X				Ascidian					
Spain	Paraleucilla magna		X				Porifera					

Annex 6. Appendices to the ICES Code of Practice (CoP) on the Introductions and Transfers of Marine Organisms (2005)

Appendices A to D will be applied to all new introductions and transfers as required. The Appendices outline the details required for the Prospectus (Appendix A), Risk Review (Appendix B), Quarantine (Appendix C) and Monitoring (Appendix D). Appendix E shows a flowchart of all stakeholders involved and Appendix F presents a case study of the application of an older version of the ICES Code of Practice.

Note: The following three EC Regulations may also be consulted in combination with this document.

- **COUNCIL REGULATION (EC) No 708/2007 of 11 June 2007 concerning use of alien and locally absent species in aquaculture,**
- **COMMISSION REGULATION (EC) No 506/2008 of 6 June 2008 amending Annex IV to Council Regulation (EC) No 708/2007 concerning use of alien and locally absent species in aquaculture,**
- **COMMISSION REGULATION (EC) No 535/2008 of 13 June 2008 laying down detailed rules for the implementation of Council Regulation (EC) No 708/2007 concerning use of alien and locally absent species in aquaculture.**

The content of these CoP Appendices are not meant to replace the requirements as set forth in the EC Regulations, but to represent the ICES/WGITMO views on this subject. Many European WGITMO members contributed to the development of these EC Regulations.

APPENDIX A - PROSPECTUS

The information provided with the Prospectus will be used to conduct the biological risk review (see Appendix B). To be scientifically valid, the information provided needs to be based on a thorough literature review. The prospectus also needs to include a contingency plan in case immediate eradication of the introduced species needs to be carried out. The proponent has to design an appropriate monitoring programme that will document impacts in the receiving environment.

Wherever possible, information is to be supported with references from the scientific literature, and notations to personal communications with scientific authorities and fisheries experts. Applications lacking detail may be returned to the proponent for additional material, resulting in a delay in assessing the proposal.

For some proposals, e.g. routine introductions/transfers, the information requirement may be reduced significantly. WGITMO should be consulted in such cases. It is possible that there may be concurrent proposals taking place or knowledge of a previous attempt in which case this information can be provided and so reduce the time and cost of this part of the project. As introductions are intended to cover a wide range of situations (aquaculture, fisheries, restoration of habitat, re-introductions of a similar population/species to replace expired populations, genetically modified organisms, biological control) all of the requirements made below will not necessarily apply and additional requirements may be necessary so as to reduce the risk of an unwanted impact and to protect the proposer from not having acted appropriately.

A) Executive Summary:

Provide a brief summary of the document including a description of the proposal, the potential impacts on native species and their habitats and mitigation steps to minimize the potential impacts on native species.

B) Introduction

1) Name (common and scientific and commonly used synonyms [genus and species]) of the organism proposed for introduction or transfer.

2) Describe the distinguishing characteristics of the organism and how it may be distinguished from similar species in its area of origin and proposed area of introduction. Include a scientific drawing or photograph.

3) Describe the history in aquaculture, enhancement or other introductions (if appropriate) and the nature of the planned activities using the candidate species.

4) Describe the objectives and rationale for the proposed introduction, including an explanation as to why such an objective cannot be met through the utilization of an indigenous species.

5) What alternate strategies have been considered in order to meet the objectives of the proposal? What are the implications of a "do nothing" option?

6) What is the geographic area of the proposed introduction? Include a map.

7) Describe the numbers of organisms proposed for introduction (initially, ultimately). Can the project be broken down into different sub-components; if so, how many organisms are involved in each sub-component?

8) Describe the source(s) of the stock (facility) and genetic stock (if known).

9) Describe the frequency of the planned species movement for e.g. aquaculture purposes (is it planned to e.g. annually import this species from this source?)

10) Does the proposed quarantine facility require to be modified to an acceptable standard for the purpose of completing the introduction? Are there other holding facilities where the species may be held should this be necessary?

C) Life History Information of the Species to be Introduced or Transferred - For Each Life History Stage

1) Describe the native range and range changes due to introductions.

2) Record where the species was introduced previously and describe the ecological effects on the environment of the receiving area (predator, prey, competitor, and/or structural/functional elements of the habitat).

3) What factors limit the species in its native range.

4) Describe the physiological tolerances (water quality, temperature including, turbidity, oxygen, and salinity) at each life history stage (from early life history stages to adult, and for reproductive development) including any resting stages).

5) Describe the habitat preferences for each life history stage including water depth, substrate types and adaptability to different habitats.

6) Describe the mode(s) of reproduction (including any asexual stages i.e. fission) and natural triggers and artificial means for conditioning and spawning. Duration of the larval phase?

7) Describe how the species becomes dispersed and is there any evidence of local or larger scale seasonal or reproductive migration(s).

8) Describe the feeding methods and food preferences for each life history stage. In case of algae describe the light and nutrient preferences.

9) Describe the growth rate and lifespan and extrapolate likely rates of growth in the introduced area based on information from its native range and where it has become introduced.

10) Describe the known pathogens and parasites of the species or stock including epibionts and endobionts. Are there specific taxonomic groups that pose a risk? Is it a known carrier of pathogens or life history stages of harmful stages? Will it act, in its new environment, as an intermediate host for unwanted species?

11) Describe the behavioural activities that result in modifications to habitat and that may result in interactions with other species. Are any other species required for the presence of the introduced species to be successful?

12) Describe the occurrence of the taxon in other regions (native and introduced): In what densities is the taxon found? Are mass occurrences reported? How frequently are findings of the taxon reported?

13) List nearest populations and indicate why the potential source population is being considered over other sources that may have disease free stock, for example.

D) Interaction with Native Species

1) What is the potential for survival and establishment of the non-native species should it escape? (This question applies to species intended for closed culture systems)

2) What habitat(s) will the introduced species be likely to occupy in the proposed area of introduction and compromise the existence of any protected species/species population? Indicate if the proposed area of introduction also includes contiguous waters).

3) With which equivalent native species will/could there be a niche overlap? Are there any unused ecological resources of which the species would take advantage?

4) What will the introduced species eat/consume in the receiving environment?

5) Will this predation/consumption cause any adverse impacts on the receiving ecosystem?

6) Will the introduced species survive and successfully reproduce in the proposed area of introduction or will annual stocking be required? (This question applies to species not in closed culture systems)

7) Can the introduced species hybridize with native species? Is local extinction of any native species or stocks possible as a result of the proposed introduction? Are there any possible impacts of the introduced species on the spawning substrata of local species?

8) Are there any potential impacts on habitat or water quality as a result of the proposed introduction?

E) Receiving Environment and Contiguous Watershed

1) Provide physical information on the receiving environment and contiguous water bodies such as seasonal water temperatures, salinity, and turbidity, dissolved oxygen, pH, nutrients and metals. Do those parameters

match the tolerances/preferences of the species to be introduced, including conditions required for reproduction.

2) List species composition (the principal aquatic vertebrates, invertebrates and plants) of the receiving waters. Which of these are competitors with, or predators of the species to be introduced. Which of the species have a similar ecological function? Are any of these species known to be susceptible to the diseases and parasites found to affect the introduced species within its native range, the region from where the introduction will take place or elsewhere in its range?

3) Are any of the species in the receiving environment known to be susceptible to the diseases and parasites found to affect the introduced species in its native range?

4) Provide information on habitat in the area of introduction, including contiguous waters, and identify critical habitat. Which of those parameters match the tolerances/preferences of the species to be introduced? Is the introduced species capable of modifying any of the habitats described?

5) Describe the natural and/or man-made barriers relied upon to prevent the movement of the introduced organisms to adjacent waters. . Include flow rates and direction of flow that might distribute the introduced species.

6) 5 Describe the substrate and bottom characteristics in the receiving area and compare with the preferred and tolerated environment in the area of origin.

7) Indicate what native or other already introduced species may be likely to compromise development of the proposed species introduction to native waters.

F) Precautions and Management Plan

1) Describe the management plan for the proposed introduction or transfer. This should include but not be restricted to the following information:

a) details of the disease certification status of stock to be imported;

b) Setting-up of an independent national scientific advisory team.

c) disease monitoring plan proposed for the introduced stocks following introduction or transfer;

d) precautions taken to ensure that no unnecessary associated biota accompany the shipment;

e) who will be permitted to use the proposed species and under what terms and conditions;

f) The nature of the pilot and pre-commercial phases including a contingency withdrawal plan;

g) description of the quality assurance plan for the proposal;

h) other legislative requirements and precautionary measures that need to be met for each phase of development.

2) Describe the chemical, biophysical and management precautions being taken to prevent accidental escape of any target as well as non-target taxa to recipient ecosystems. Provide details of the water source, effluent destination, effluent treatments, local drainage and proximity to storm sewers, predator control, site security, precautions to prevent escapes.

3) Describe contingency plans to be followed in the event of an unintentional, accidental or unauthorized liberation of the species from rearing and hatchery facilities or an accidental or unexpected expansion of the range deduced at the pilot or later stages. Also, describe a contingency plan to address the finding of a disease agent of significance (e.g., exotic disease agent to the area of introduction) and the disposal of fish mortalities in case of a disease outbreak.

4) If this proposal is intended to create a fishery, give details of the objective. Who would benefit from such a fishery? Give details of a management plan, and, if appropriate, include changes in management plan for species, which will be impacted.

G) Business Data

1) Provide the legal name of the owner and company, the aquaculture licence number and the business licence (if applicable) or the name of the government agency or department with a contact name, telephone, fax and email information.

2) Provide realistic indication as to the economic viability of the proposed project, having studied other similar projects.

H) References

1) Provide a detailed bibliography of all references cited in the course of the preparation of the risk assessment.

2) Provide a list of names, including addresses, of scientific authorities and fisheries experts consulted and listed in the information provided.

3) Include taxonomic identification literature.

4) Refer to web-pages and other sources of information for further information (further reading).

APPENDIX B: RISK REVIEW

INTRODUCTION

To evaluate risks associated with the introduction or transfer of aquatic organisms, it is necessary to assess the probability that a species will become established and the consequences of that establishment. The process addresses the major environmental components. It provides a standardised approach for evaluating the risk of genetic, ecological and disease impacts as well as the potential for introducing a "fellow traveller" or parasite that might impact the native species of the proposed receiving waters. This approach has been adapted from "Final Draft - Report to the Aquatic Nuisance Task Force - Generic Non-indigenous Aquatic Organisms Risk Analysis Review Process, Washington, DC, February 9, 1996 by the Risk Assessment and Management Committee of the U.S. Aquatic Nuisance Species Task Force".

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

At each of Steps 1, 2 and 3, 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.

<u>Note</u>: For the High and Medium category of risks, application of appropriate mitigation measures are required to lessen the risk to a Low rating. However, it is recognized that this may not be possible for all proposals.

<u>Note</u>: Proposals will be approved only if the Organism Risk Potential is LOW or can be reduced to LOW through mitigation procedures.

The strength of the review process is not in the ratings but in the detailed biological and other relevant information statements that motivate them.

<u>Part I – Aquatic Organism Ecological and Genetic Risk Assessment Process</u>

<u>Step 1 Determining the Probability of Establishment</u>

Complete the following table and provide a brief rationale with appropriate references to support the rating given.

Element Rating	Probability of Establishment (H, M, L)1	Level of Certainty (VC to VU)2
Estimate of probability of the organism successfully colonizing and maintaining a population in the intended area of introduction3		
If the organism escapes from the area of introduction, estimate the probability of its spreading4		
Final Rating5,6		

Explanatory Notes

1) H = High, M = Medium, L = Low. Element ratings should be supported with data and references, including a rationale for the rating given.

2) VC = Very certain, RC = Reasonably certain, RU = Reasonably uncertain, VU = Very uncertain.

3) 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.

4) Characteristics within this element include: the organism coming in contact with an adequate food resource; suitability of habitat, encountering appreciable biotic and abiotic environmental resistance; and the ability to reproduce in the new environment.

5) Characteristics within this element include: ability for natural dispersion; estimated range of the probable spread; ability to use human intervention/activity as a means of dispersal, likely areas of further colonization. The areas of likely further colonization should be described, especially if they contain species of special interest (e.g., endangered species) or areas of concern (Marine Protected Areas).

6) The final rating for the **Probability of Establishment** is assigned the value of the element with the lowest risk rating (example: **High** and **Low** ratings for the above elements would result in a final **Low** rating).

7) The final rating for the **Level of Certainty** is assigned the value of the element with the **Lowest** level of certainty (e.g**. Very Certain** and **Reasonably Certain** ratings would result in a final **Reasonably Certain** rating).

Part 1 – Step 2 Determining the Consequence of Establishment of an Aquatic Organism

The "**Consequence of Establishment**" is assigned a single rating based on environmental impacts.

Element Rating: Estimate of magnitude of environmental impacts, if established.	Consequences of Establishment(H, M, L)7	Level of Certainty (VC to VU) 8
Ecological impact on native ecosystems both locally and within the drainage basin.9		
Genetic impacts on local self-sustaining stocks or populations.10		
Final Rating11,12		

Explanatory Notes

8) See Note 1.

9) See Note 2

10) Ecological impacts that can affect the distribution or abundance of native species resulting from alterations in relationships such as predation, prey availability, and habitat availability. In assessing the ecological impacts of establishment, the assessors should take into consideration whether the non-indigenous stock i) enters or alters the habitat of indigenous species, ii) displaces indigenous species from optimal habitat, iii) affects the quantity, quality, and availability of food supply of indigenous species, iv) prey on other species of concern.

11) Genetic impacts which can affect the capacity of native species to maintain and transfer to successive generations its current identity and diversity. In assessing the genetic impacts, the assessors should take into consideration whether the non-indigenous stock i) encounters or interacts with species of concern, ii) affects the survival of local species, iii) affects the reproductive success of local species, or iv) affects the genetic characteristics of native stocks or species.

12) The final rating for the **Consequences of Establishment** is assigned the value of the element with the **highest** rating (example: **High a**nd **Medium** ratings for the above elements would result in a final **High** rating).

13) See Note 6.

Part 1 – Step 3 Estimating Aquatic Organism Risk Potential

The overall Risk is assigned a single value based on the **Probability of Establishment** and the **Consequences of Establishment.**

Component Rating	Element Rating (H,M,L)	Level of Certainty (VC to VU)
Probability of Establishment estimate13		
Consequences of Establishment estimate14		
FINAL RISK ESTIMATE 15, 16		

Explanatory Notes:

14) As estimated in Step 1 - Use the "final rating level" and "final level of certainty", respectively

15) As estimated in Step 2 - Use the "final rating level" and "final level of certainty", respectively

16) Under "element rating " – The table above provides a guide for categorizing the final risk estimate

17) Under "level of certainty" - the final level of certainty for the **Final risk estimate** is assigned the value of the element with the **lowest** certainty level (e.g. a **Very Certain** and **Reasonably Uncertain** estimate for the probability of establishment and consequences of establishment, respectively, would result in an overall **Reasonably Uncertain** level of certainty).

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. It is advised that the proposal be approved. Mitigation is not needed.

Note: It is advised that the proposal be approved as presented (no mitigating measures required) only if the overall estimated risk potential is LOW

Note: It is advised that the proposal be approved only if the overall confidence level for which the overall risk was estimated is VERY CERTAIN or REASONABLY CERTAIN.

Note: For an overall HIGH or MEDIUM risk, a second risk assessment needs to be conducted to determine whether the proposed mitigation procedures are adequate to reduce the overall risk to LOW.

Part 1 – Step 4 Completion of Risk Assessment Documentation

Specific Management Questions (Mitigation Factors or Measures)

Additional Factors and Notes

1. Mitigation measures could reduce risks to a low rating. Mitigation measures include but are not limited to the following:

   Reducing risk of genetic impact on local stock:

   - hold in containment facilities to prevent escape
   - use stocks genetically similar to stocks in receiving waters
   - sterilize organisms to prevent interbreeding with local populations

   Reducing risk of ecological impact on local ecosystems:

   - use local stock only
   - sterilize organisms to prevent natural reproduction and increase in population size
   - use species that cannot reproduce naturally in receiving waters
   - hold in containment facilities to prevent escapes

2 Are there any neighbouring jurisdictions to consult?

   If Yes – Has this been done?

   Is the neighbouring jurisdiction concerned?

   If Yes – Has the dispute avoidance mechanism outlined in Appendix II been applied?

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

Step 1 Determining the Probability of Establishment

Complete the following table and provide a brief rationale with appropriate references to support the rating given.

Steps 1 to 3 must be carried out for each **hazard** identified in the hazard identification step (Appendix V).

Element Rating	Probability of Establishment (H,M,L) 17	Level of Certainty (VC to VU)18
Estimate the probability that a pathogen, parasite or fellow traveller may be introduced along with the species proposed for introduction. Note that several pathways may exist through which pathogens or accompanying species can enter fish habitat. Each must be evaluated.		
Estimate the probability that the pathogen, parasite or fellow traveller will encounter susceptible organisms or suitable habitat.		
Final Rating 19, 20		

Explanatory notes:

18) See Note 1

19) See Note 2

20) The final rating for the **Probability of Establishment** is assigned the value of the element with the **lowest** risk rating (e.g., a **Medium** and **Low** estimate for the above elements would result in an overall **Medium** rating). Note that the calculation of the final rating follows the multiplication rule of probabilities (i.e., the probability that a given event will occur corresponds to the product of the individual probabilities). Thus the final risk of establishment is assigned the value of the lowest individual probability estimate.

21) The final rating for the **level of certainty** for the Probability of Establishment is assigned the value of the element with the **lowest** level of certainty (e.g. a **Very Certain** and **Reasonably Uncertain** ratings for the above elements would result in a final **Reasonably Uncertain** rating).

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

Complete the following table and provide a brief rationale with appropriate references to support the rating given. The final rating of the Consequences of Establishment is assigned a single rating based on environmental impacts.

Element Rating – Impacts of establishment of a parasite, pathogen or fellow traveller on native species and/or aquaculture in the watershed.	Consequences of Establishment (H, M, L) 21	Level of Certainty (VC to VU) 22
Ecological impacts on native ecosystems both locally and within the drainage basin including disease outbreak, reduction in reproductive capacity, habitat changes, etc.		
Genetic impacts on local self-sustaining stocks or populations (i.e. whether the pathogen, parasite or fellow traveller affects the genetic characteristics of native stocks or species).		
Final Rating23, 24		

Explanatory notes:

21. See Note 1
22. See Note 2.
23. The final rating for the **Consequences of Establishment** is assigned the value of the element with highest risk rating (e.g. **High** and **Medium** ratings for the above elements would result in a final **High** rating)
24. See Note 20.

Part 2 – Step 3 Estimating Pathogen, Parasite or Fellow Traveller Risk Potential

The overall Risk is assigned a single value based on the **Probability of Establishment** and the **Consequences of Establishment.**

Component Rating	Element Rating (H, M, L)	Level of Certainty (VC to VU)
Probability of Establishment estimate25		
Consequence of Establishment estimate26		
FINAL RISK ESTIMATE 27, 28		

Explanatory notes:

22) As estimated in Step 1 - Use " final rating for probability of establishment" and "final rating for the level of certainty", respectively.

23) As estimated in Step 2 – Use "final rating for consequences of establishment" and "final rating for the level of certainty", respectively.

24) Under "element rating" – refer to Table 1, which provides an outline for categorizing the final risk estimate.

25) See Note 20.

Definition of **"Pathogen, Parasite, Fellow Traveller 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. Mitigation is justified. It is advised that the proposal be rejected unless mitigation procedures can be developed to reduce the risk to Low.
LOW	=	Acceptable risk - organism(s) of little concern. It is advised that the proposal be approved as presented. Mitigation is not needed.

Note: It is advised that the proposal be approved as presented only if all potential hazards (as defined in Step 1) for which the overall risk was estimated is LOW.

Note: It is advised that the proposal be approved as presented only if the overall confidence level for which the overall risk is VERY CERTAIN OR REASONABLY CERTAIN

Note: For an overall HIGH or MEDIUM risk, a second risk assessment needs to be conducted to determine whether the proposed mitigation procedures are adequate to reduce the overall risk to LOW

Part 2 – Step 4 Completion of Risk Assessment Documentation

Specific Management Questions (Mitigation Factors or Measures)

Additional Factors and Notes

Mitigation measures could reduce risks to a low rating. Examples of mitigation measures include the following:

Reducing risk of transferring accompanying pathogens, parasites and/or fellow travellers

- health inspection and certification
- pre-treatment for pathogens, diseases and parasites
- inspection for fellow travellers
- disinfection prior to discarding water in which the organisms arrived
- vaccination
- disinfection of eggs
- importation as milt or fertilized eggs only
- quarantine incoming organisms and use as broodstock, release F_1 progeny only if no pathogens, parasites or fellow travellers appear.

Table 1. How to Categorize the Final Risk Estimate[29]

Probability of Establishment	Consequences of Establishment	Final Risk Estimate
High	High	High
High	Medium	High
High	Low	Medium
Medium	High	High
Medium	Medium	Medium
Medium	Low	Medium
Low	High	Medium
Low	Medium	Medium
Low	Low	Low

Explanatory Notes

26) If there is no increment between the two estimates, the final risk estimate takes the value of the highest of the two probabilities (precautionary approach). For example, if the Probability of Establishment is High and the Consequence of Establishment is Medium, the Final Risk Estimate will be High. If the Probability of Establishment is Low and the Consequence of Establishment is High, the Final Risk Estimate will be Medium.

APPENDIX C: QUARANTINE

QUARANTINE

Quarantine is the separate holding, rearing, or both, of taxa in a facility or site, under conditions which prevent the escape or other movement of these taxa and associated organisms (i.e. disease agents, pathogens, epibionts) out of the location. Different periods of quarantine and security level may be required depending on the risk of introducing reportable disease agents or previously undetected disease agents of concern.

During the quarantine period, the taxon is held in a quarantine unit. To accomplish this, general principles which apply to all quarantine units for aquatic species are given below. The individual construction and approval of the unit and the length of the quarantine period. Further is there a need to build quarantine systems according to the species considered as some might have peculiarities remains with the operator and the jurisdiction into which the introduction or transfer takes place.

For the operation of an effective quarantine unit, the operators will need to take the topics below into account when constructing and maintaining the quarantine unit

Effluent and Waste Disposal

All effluent and wastes generated within a quarantine facility[7] should be treated in a manner that effectively destroys all disease agents, parasites, fouling organisms on oysters etc.

To ensure continuous operation and complete containment, quarantine effluent treatment systems should be equipped with fail-safe backup mechanisms to ensure continuous operation and complete containment

Treated effluent and waste may contain substances deleterious to the environment (e.g. active disinfectants). The discharge should therefore be disposed of in a manner that minimizes environmental impact.

Further information on disinfecting effluent and solid wastes are presented below (under heading of Disinfection).

Discharge of treated effluent and waste must comply with all other restrictions and regulations applicable to the facility (e.g., federal, provincial, municipal or other environmental legislation with respect to quarantine effluent discharge and waste disposal).

A detailed log of effluent and solid waste treatment should be prepared, listing the operational personnel responsible for treatments, timing and monitoring of the system is useful to monitor effective operation and act as a early warning system for possible failures. Details of the information that should be monitored are provided below (under heading of Record Keeping).

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[7] A quarantine facility is defined as land based facility or portion of a facility approved by the ITC where shellfish can be held in a manner which prevents the movement of shellfish or shellfish disease agents from the facility.

Physical Separation

Aquatic organisms held in quarantine must be separated from other organisms in a system to ensure containment of animals and disease agents, to prevent entry by birds and other animals, to prevent entry by unauthorised personnel and to prevent spills from contaminating surrounding areas. Water lines must be constructed such that there is no possibility of backflow from the quarantine areas to other animals or the environment.

Personnel

Access to a quarantine facility must be restricted to authorised personnel. Personnel working in the quarantine facility must ensure that footwear, hands, and any material used within the facility are disinfected before exit from the facility.

Equipment

Upon receipt all life-stages, tanks, water, shipping containers and equipment in contact with the taxon— including the transport vehicles — should be handled to ensure that there is no escape of the taxon or associated disease agents from the facility. All shipping and packing material must be disinfected or burned.

All equipment and supplies used within a quarantine facility must be disinfected in a manner that will effectively destroy disease agents before removal from quarantine. Protocols for effective management and disinfection must be approved by the WGITMO.

Mortalities and Disposal

Daily records of mortalities must be maintained and be available for inspection, where required.

All mortalities must be kept on site. No mortalities, body parts or shells, bones etc. can be discarded without approved treatment to ensure complete disinfection so that no body parts etc. may re-enter the aquatic environment. Where autoclave access is outside the quarantine facility, the organisms and associated solid waste can be chemically sterilised, or frozen prior to transport to the autoclave. Alternately, materials can be formalin fixed and then discarded in e.g. a landfill site.

The cause of mortalities must be determined in a timely manner. Mortalities should be reported immediately to the WGITMO in order to expedite protocols for examination of the affected animals. This may require that samples be collected or preserved for transportation to a laboratory in an approved manner.

Inspection and Testing

Regular inspections for reportable disease agents must be carried out as specified under the conditions of the licence for introductions or transfers.

If a reportable disease agent, or previously undetected disease agent, is identified in any life-history stage of animals in a quarantine facility, actions necessary to control the disease will be required. These actions may include destruction of all animals in the facility and disinfection of the facility.

If no reportable disease agent is detected in the animals during quarantine, a pathogen status report will be provided to terminate the quarantine requirement.

Following removal of all life stages of the taxon from the quarantine facility, further monitoring and testing of the taxon for reportable disease agents and imposition of additional restrictions may be required.

Duration

The required duration of quarantine will vary according to the aquatic taxon, seasonality of pathogens of concern, rearing conditions and reason for quarantine containment. The quarantine period will be specified on the licence for introductions or transfers that specifies quarantine as a condition.

RECORD KEEPING

All quarantine and isolation facilities and sites must maintain accurate records of the following:

- entry /exit times of personnel, all of whom should have authorization for access
- numbers of mortalities and method of storage or disposal
- effluent and/or influent treatments and monitoring of residuals
- any abnormal conditions affecting quarantine / isolation operations (power outages, building damage, serious weather conditions, etc.)

DISINFECTION

The general principles pertaining to disinfection of aquaculture facilities (hatcheries, holding facilities, land-based ponds, etc.) involve the application of treatments in sufficient concentrations, and for sufficient periods of time, to kill all harmful organisms which otherwise would gain access to surrounding aquatic ecosystems. Since the inherent toxicity of disinfectants prohibits safe use in open-water, or in flow-through systems, disinfection can only be applied with reasonable control within hatcheries, tank or isolated pond-holding facilities. All disinfectants should be neutralised before release into the surrounding environment and facilities based on seawater should deal with the residual oxidants produced during chemical disinfection.

A log of neutralisation of disinfection procedures and monitoring results is highly recommended for ensuring that neutralisation is adequate to prevent negative environmental impacts.

There is a wealth of detailed information on disinfection available from official and commercial organisations. New and improved products and protocols are being continuously developed and so it is not appropriate to provide detailed guidance here.

For example, The World Animal Health Organization (Office International des Epizooties) has provided information on the disinfection of aquaculture establishments (see: International Aquatic Animal Health Code, 2002, Office International des Epizooties 2002 - http://www.oie.int/fileadmin/Home/eng/Health_standards/aahm/2010/1.1.3_DISINFECTION.pdf). A list of some commercially available disinfectants approved for use in Australia by AQIS can be found on their website. (http://www.daff.gov.au/aqis/import/general-info/qap/aqis_approved_disinfectants_for_all_classes).

APPENDIX D: MONITORING

The purpose of the monitoring program is to verify that the introduction is performing according to the proposed prospectus for release of the organism. Thus, the monitoring needs to address issues related to three separate levels during the introduction process: 1) a "pre-baseline" review, 2) monitoring during pilot release phase, and 3) subsequent monitoring.

The following is adapted from Managing Troubled Waters, the Role of Marine Environmental Monitoring, National Research Council, Washington, D.C. published in 1990.

The monitoring report must identify resources at risk.This information should have been included in the Prospectus (Appendix A). Information on select species most likely to be impacted (prey, competitors, potential species for hybridization) and/or physical alterations (changes in current light etc.) must be part of the pre-baseline review and must be re-visited in the subsequent two reports to ensure that the impacts were accurately predicted or if there were additional or different impacts.

The proponent should develop a conceptual model appropriate to each pilot project (e.g. use the *Patinopecten yessoensis* in Appendix F as an example) and highlight the issues of concern with an endpoint of acceptability or unacceptability, see Box 1 for some examples. The monitoring will result in caution levels and warning levels depending on the findings/results of the studies undertaken.

A caution level recognized during the monitoring phase may result in the need for additional studies to be carried out, with acceptable results, before the next stage of the introduction into the environment is acceptable.

A warning level: a decision from the regulatory agencies in the importing country is required before the project can proceed to the next step (e.g., further releases, or expansion of the project) or if the project is to be discontinued.

1) Establishment in nearby areas: the requirement is to monitor nearby areas at appropriate time frame after spawning.
2) Competition with other species for food/habitat: Laboratory studies are needed (e.g., re-circulating tank studies to examine behaviour, stomach contents and habitat preferences as juveniles and adults).
3) Spread of pests and diseases: The information on the presence of pathogens in the source population, the initial introduction phase, and/or the population investigated during the pilot release phase may lead to a caution level or a warning level, depending on the type of pathogen detected and the stage of the introduction.
4) Mass mortalities: Because the use of mass mortalities may be related to cultivation practices, the culture practice itself should be self-monitoring and part of the pilot project proposal. If mass mortalities occur, they should be examined for pathogens, pest, and diseases to elucidate whether a) there was an escape of a pathogen or whether b) it was a native causative organism likely to endanger the project. The caution level is an occurrence of a mass mortality in the field (and triggers an analysis of the reasons both environmental and potential surveys of pathogens). A warning level is the presence of pathogens (native or not) that would require a delay in continued culture until satisfied that the disease/pathogen was not

released. Thus no additional monitoring is needed if there are no mass mortalities.

The warning level comes into effect at any significant mortality event.

1) Potential for hybridization: Monitoring of spawning periods of native and introduced species. The caution level is (a) evidence of spawning outside the predicted range during the pilot project or (b) that there is evidence of hybridization with local species in lab studies. If there was hybridization in the lab then there is a warning level and a decision would be required before proceeding.

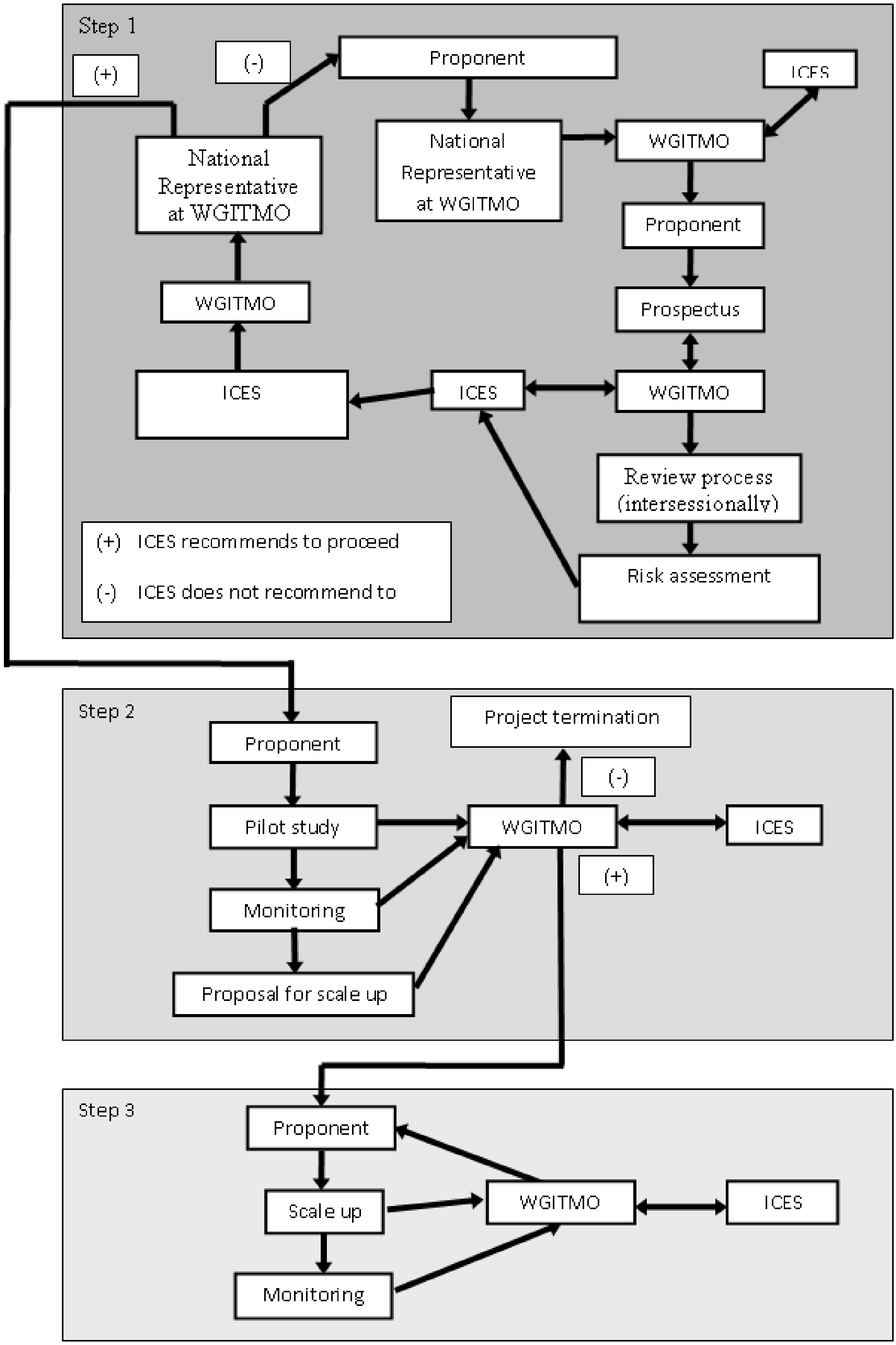
2) Ability to live in conditions of the receiving environment: this is based on known physiological information (taken from initial prospectus). Also, there should be water quality monitoring on a regular basis that examines (1) dissolved oxygen, (2) changes to benthos outside acceptable zone. The caution levels come into effect when a given level is exceeded (e.g., dissolved oxygen at the country level of acceptability (5-6 mg/L in MA), no shift to pollution tolerant species (e.g. capitellids, spionids etc.) outside modelled zone of impact as the caution level and additional monitoring to see if it is a transient occurrence or long term occurrence.

The monitoring will be increased in scale to accommodate future expansion.

Box 1: Negative hypotheses that may aid direction for monitoring of an introduction.

1. The expected growth is not realised and so the species is unlikely to be profitably used.
2. The species appears outside intended area of introduction
3. The species will significantly alter normal trophic pathways
4. The substratum will be altered
5. The species becomes elusive to capture
6. The species is susceptible to native parasites, pests or/and diseases
7. The species is readily consumed by native predators
8. Reproductive development is not synchronised
9. Species is prone to translocation by natural vectors (i.e. storms)
10. The species acts as an intermediary host for a pathogen/pest
11. Consumers do not wish to purchase the intended product
12. Others?

APPENDIX E: FLOW CHART OF APPLICATION AND REVIEW PROCESS



APPENDIX F: A CASE HISTORY OF THE INTRODUCTION OF THE JAPANESE SCALLOP *PATINOPECTEN YESSOENSIS* FROM JAPAN TO IRELAND USING THE ICES CODE OF PRACTICE ON THE INTRODUCTIONS AND TRANSFERS OF MARINE ORGANISMS

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and the

ICES Working Group on Introduction and Transfers of Marine Organisms

Introduction

The Japanese scallop, *Patinopecten yessoensis* (Jay) was introduced to Ireland following requests by an Irish fish and shellfish processor, the promoter, to cultivate the species on the south-east coast of Ireland. The earliest discussions took place in late 1988 at which time it was agreed to follow the procedure set forth in the revised ICES Code of Practice of 1988. Essentially the principles followed in this version of the Code appear in the 2002 version. The use of the Code was rigorously tested and was subsequently modified based on the experience of this introduction. Two meetings of the Working Group on the Introductions and Transfers of Marine Organisms (WGITMO) in 1989 and 1990 were required before the modified project was approved. Progress reports were submitted at following annual meetings of the WGITMO and continued until 1994.

In this account the case history is covered in two main parts:

1. Historical summary of the management of the introduction.
2. Response to concerns raised by the members of the ICES Working Group on the Introductions and Transfers of Marine Organisms.

Part I HISTORICAL SUMMARY OF MANAGEMENT OF THE INTRODUCTION OF THE JAPANESE SCALLOP FROM JAPAN TO IRELAND.

1988 –1989: Initial Discussions

In early 1989 a leading processor of fish and shellfish, the promoter, made a formal request for developing a Japanese scallop (*Patinopecten yessoensis*) aquaculture business on the Irish Coast. The project was first discussed with scientists of the Irish Department of the Marine (DOM), in November, 1988 at which time the ICES Code of Practice was adopted as the protocol for proceeding with the proposed introduction. The promoter's initial plan was to introduce spat for direct release into the sea at a later stage following clearance from pathogens and parasites. However, the Code does not permit the release of the original broodstock imported. The spat would need to be cultured to maturity to produce an F1 progeny, which then could be released, and only if no parasites or pathogens were associated with this generation. Thus, based on the Code, the initial proposal to introduce spat following a short period of quarantine was rejected by the Irish Minister for the Marine, on the advice of the management team.

A further proposal based on the introduction of hatchery reared eyed umbonate larvae to quarantine, which at a subsequent time could be released to culture in the sea, was discussed. There was uncertainty about whether this would be permissible, because the larvae could be classified as the original import (i.e. comparable to brood stock) being released to the sea. This proposal was based on what had become at this time standard practice for the international transmission of the eyed unbonate larvae (the stage before settlement) of the Japanese oyster, *Crassostrea gigas*. Thus, the principle of transferring eyed oysters had already been established but the Irish DOM considered this an unacceptable approach for *P. yessoensis* unless these were to be used as broodstock. The ICES Secretary General was informed about the intended project to introduce the Japanese scallop to Ireland and the DOM sought the advice on this matter through the Working Group on Introductions and Transfers of Marine Organisms (WGITMO).

1989

At the WGITMO in Dublin during May 1989, the planned introduction of *P. yessoensis* to Ireland was described. A presentation was made by the proposer as to the reason for the introduction, based on economic projections and known ease of culture. The following documents were provided in advance of the meeting:

- Status report on the Japanese scallop, *Patinopecten yessoensis* (Jay) with reference to Proposal for introduction into Irish waters: with a review of its biology, culture techniques and possible consequences of introduction (17 pp) by William Crowe, Shellfish Research Laboratory, University College Galway.
- Status report on the Japanese scallop, *Patinopecten yessoensis* (Jay). Information relating to the biology, fisheries and cultivation of scallops, together with supporting documentation on:

i) *Patinopecten yessoensis* (39 pp) by William Crowe

ii) *Pecten maximus* (16 pp) by William Crowe

iii) Inspection and Certification (7 pp) by John McArdle, Fisheries Research Centre.

The WG members wished to discuss the project further with their national experts before comment, but did not oppose the introduction of adult broodstock to Irish waters provided that the correct quarantine measures were adhered to. A number of questions were raised:

1. Unexplained mass mortalities of scallops in culture in Japan
2. Genetic risk
3. Possible competition with other scallops
4. Possible introduction of other organisms with the scallops
5. Would Japanese scallops thrive in Irish waters?
6. Would Japanese scallops become established outside Irish waters?

These required further consideration and the DOM endeavoured to answer these questions for the 1990 WGITMO meeting. The subject was tabled as a special discussion topic for the 1990 meeting in Halifax, Canada. The advice provided by ICES, following the recommendations of the WGITMO, in the meantime was as follows:

The Department of the Marine of Ireland submitted to the ICES General Secretary a proposal for introduction of the Japanese scallop, Patinopecten yessoensis, *for consideration by the Working Group on Introductions and Transfers of Marine Organisms. The review determined that further information is needed before definitive advice can be developed on this proposed fisheries management measure.*

<u>Background</u>

The Working Group summarises relative information and points of concern, as follows:

1) The introduction is being proposed principally because the native species are not as suitable as the proposed species for cultivation and local stocks are at low levels.

2) The introduced species is expected to establish viable populations in Ireland.

3) Small numbers of this species have been introduced to Denmark and to France on the Atlantic coast and on the Mediterranean coast, and the species is being used in laboratory studies in Newfoundland, Canada.

4) Available information on environmental data and on inter-specific competition with native species is inadequate to enable full evaluation of the proposal.

5) Greatest detrimental impact is likely to occur mainly in ecological interactions; pathological problems via unwanted disease movements are possible; and genetic risks through hybridisation are expected to be low.

6) Late receipt of the proposal prevented consultative meetings within member countries.

7) Additional ecological and pathological information on this species in the native habitat is necessary, as required by the ICES Code of Practice.

<u>Preliminary Advice</u>

On the basis of the foregoing points of concern, the Working Group offers the following preliminary advice and comment:

1) The dominant issue is that of ecological impact, e.g., recruitment success in the British Isles is probable and spread of the species from Ireland would be expected and thus competition with valuable local species may occur.

2) Several disease problems with scallops are known, mass mortalities of unknown causes are frequent, and high losses of this species occur in Japan; thus significant effort is required to prevent disease introduction to Ireland.

3) If Ireland wishes to establish a broodstock, adult scallops should be held in quarantine following the ICES Code of Practice. All scallops, including the F1 generation, should be held in quarantine pending definitive advice.

4) The Working Group does not support the introduction of eyed scallop larvae unless they are destined only for use as broodstock and held in quarantine.

5) To improve international communication in the matter of Introductions of Patinopecten yessoensis *in ICES member countries, the Secretary General should query all member countries requesting summaries of past, present and future actions related to introduction and culture of Japanese scallops, to be provided by May 1990.*

1990 Assessing Information

In January-March 1990, letters of concern relating to the introduction were published in Irish national newspapers. A United Kingdom agency sought further clarification about the importation.. The DOM endeavoured to collate further relevant literature and carry out a risk assessment of such an introduction which included a study visit in Japan in March-April 1990. At the same time a quarantine facility was constructed under the supervision of the DOM by the promoter.

At the ICES WGITMO June 1990 Meeting in Halifax, Canada, additional support of information already presented in 1989 and from the study-visit in Japan to address the concerns endorsed by the ICES Council were made (see - Part II).

In addition further presentations included statements on the layout of the quarantine facility, procedures to be employed at this facility, health certification, histological studies and administrative matters and policy.

Following two days of discussion, WGITMO reported to the ICES Council:

The Department of the Marine, Ireland, has submitted to the Council a request for advice on the introduction of Japanese scallops, Patinopecten yessoensis, *to open waters of Ireland. Steps outlined in the ICES Revised Code of Practice have been followed meticulously by the Department. The following advice is offered by the Working Group to go forward to Council:*

The Working Group,

(1) does not oppose the continued development of Patinopecten *culture in Ireland, in the form of field trials that would assess their survival, growth, and gametogenesis in open waters pending verification of a pathogen-free F1 progeny and hatchery brood, including the stock destined for open release.*

(2) finds that upon careful examination of available scientific evidence assembled by Ireland, commercial-scale development of Patinopecten yessoensis *populations in the open sea will very likely lead to the establishment of natural (wild) populations and possibly their eventual (albeit slow) spread,*

(3) urges that Ireland should provide to the Working Group annual records of release sites, dates, and numbers as part of their national report, and carefully monitor the occurrence, extent, micro habitats, health and concomitant ecological relationships, if any, with native biota, of wild populations if such become established (with a particular focus on any competitive interactions with the native scallops).

While the appraisal of the proposal was in progress the DOM permitted the importation of the first broodstock consignment to the quarantine facility in April 1990 on the understanding that these, and their progeny, would remain in quarantine until such time as definitive advice on the overall proposal was received from ICES. It was necessary to import the broodstock at this time (their normal reproductive period), so that larvae could be produced at the quaratine facility because otherwise the project would be delayed a year. ICES, following the 1990 Statutory Meeting, informed DOM that they did not oppose the development of field trials subject to the condition that there would be status reports of the project presented to the WGITMO for review.

1991 Summary of Report to WGITMO

The main points in the following status report submitted to the WGITMO in June 1991 were:

- Histological studies, using 150 Japanese scallops produced in each batch of scallops at the quarantine facility, in the spring of 1990, showed no indication of disease or parasitic organisms. The scallops in quarantine were then released to the wild in pearl nets on longlines.
- Comparative growth between the native scallop *Pecten maximus* and the Japanese scallop, *P. yessoensis* of the 1990 year-class took place in pearl nets at the longline site at varying densities 20:40:80:160 per pearl net. Both species suffered shell distortions and interrupted growth and had high mortalities (*ca* 90%). There was poor growth with dense fouling of pearl nets from hydroids, tube-building amphipods, sponges and bryozoa. Some native scallop *Aequipecten opercularis* had settled on the outside of the pearl nets.
- Japanese scallops of the 1990 spawning, released to the sea did not show any indication of reproductive development.
- Twenty males and 51 female broodstock of *P. yessoensis* were imported in March 1991 from the same source as previous broodstock. These spawned and produced a settlement after 20-28 days, the higher survival and reduced larval period indicated a better condition than in 1990.

1992 Summary of Report to WGITMO

The 1992 report was as follows:

Three introductions of adult broodstock were brought into quarantine under the supervision of the Department of the Marine. Scallops were released from quarantine in September 1990 and were held in hanging culture near Carnsore Point on the south-east coast alongside native scallops (Pecten maximus). *Of this year class, 118 remain. Samples of these animals taken in April did not show any pathological condition or parasite loading.*

In March 1991 the quarantine facility was re-opened in advance of receiving 20 male and 51 female broodstock. The adults came from Utatsu Bay in Miyagi Prefecture, Japan - the same source as the 1990 introduction. There were five spawnings over a twenty-day period during March and April. All adults, after spawnings, were destroyed. Settlement of larvae took place 20-28 days after spawnings. In June there were noticeable mortalities of spat following strong south-easterly winds that caused large amounts of algal debris to accumulate on the shore close to the sea water intake. At this time scallop mortalities were high and the rate of growth declined. There was a vibrio infection of the mantle margin and all spat were then destroyed. On no occasion did scallops from the 1991 year-class leave quarantine.

There will be no importation of broodstock in 1992.

1993 Summary of Status Report to WGITMO

In 1993 the status report of the project to the ICES WGITMO was as follows:

Japanese scallops that survived their importation from Japan were introduced to a quarantine facility in Ireland during April 1990. Following spawnings all adult broodstock were destroyed. The surviving F1 generation, which cleared quarantine in September 1990, was expected to spawn during the spring of 1993. It will appear that spawning will now take place during spring 1994. The surviving 75 scallops are held in lantern nets off the Wexford coast, SE coast of Ireland.

There were no further importations in 1992 and none are planned for 1993 or 1994.

1994 Summary of Status Report to WGITMO

In 1994 the project was terminated, the longline holding the F1 broodstock was torn from its moorings in a storm. The longline was recovered but all of the scallops were dead.

Although the project ultimately failed, given different circumstances it could have been successful. The onshore quarantine laboratory was made secure in advance of any consignments and adult broodstock were imported close to breeding condition. Sufficient numbers of F1 individuals were produced but their subsequent culture in the sea on completion of quarantine requirements took place in an exposed area on the insistence of the promoter. On account of the exposed culture site there was entanglement and fouling of the long-line system and shell overlapping that resulted in high mortality. Servicing of the cultures could only take place when the sea-state was suitable, limiting the possibilities for practical management. Despite these difficulties, the procedure adopting the ICES Code of Practice was successfully carried out.

Part II RISK ASSESSMENT ON THE INTRODUCTION OF THE JAPANESE SCALLOP (*Patinopecten yessoensis*) TO IRISH WATERS

Introduction

The ultimate objective of introducing the Japanese scallop *Patinopecten yessoensis* to Irish waters was to develop commercial hanging culture. Initially its survival and growth in a pilot culture scheme would be compared with that of *Pecten maximus*, the main commercial scallop species in Ireland, to determine whether it was suitable for large-scale culture. Sites on the south and west coasts were selected for possible ongrowing following quarantine. All parent *P. yessoensis* were introduced to a quarantine facility on the SE coast of Ireland, under the supervision of the Irish Department of the Marine.

Introductions of larvae from Japan, intended to eventually act as broodstock, did not survive. Importations of adults took place in April 1990 and March 1991. These were spawned and the subsequent F1 generations settled. All adults were destroyed following spawning. The young scallops remained in quarantine until the F1 generation of the 1990 importation was released to the sea in September 1990. Those spat produced in the quarantine laboratory in 1991 were destroyed following a large mortality during a period of poor water quality. The surviving 2,500 spat of the 1990 spawning were to form the basis of a parental broodstock on which the project would depend.

The main contents of this document were presented to address concerns raised by the Working Group on Introductions and Transfers of Marine Organisms and subsequently by the Mariculture Committee of the International Council for the Exploration of the Sea (ICES) at 1989 meetings, and was reported in the following year. The preparation of the report is based on studies of the literature, a visit to Japan (to meet with biologists, oceanographers, pathologists and fishermen) and correspondence with internationally recognised scallop biologists, affiliated with the International Pectinid Workshop.

SUMMARY OF IMPACT HYPOTHESES

1. THAT JAPANESE SCALLOPS COULD BECOME ESTABLISHED OUTSIDE IRISH WATERS.

The scallops are to be cultivated in intensive hanging culture. Their growth and reproductive development will be monitored using spat released from quarantine. The project will proceed on a pilot programme in advance of becoming a commercial production with an option of withdrawing all cultivated scallops should any significant and negative effect be predicted or determined.

Japanese scallops once mature have the capability of spawning and small initial releases would provide a small inoculum with a low probability of the species becoming established. Increased production of scallops would undoubtedly increase this risk. In tandem ecological studies, including dredging of areas near the culture site should provide sufficient information on the extension of the cultured population to the wild. Because the conditions in Ireland are suitable for growth and reproduction, it is likely that the species will eventually become established in the wild. It is probable that a large source population is required before the establishment of a wild self-reproducing population becomes likely. The critical size of the source population required is not known, but will depend on local hydrographic conditions. For this reason a small adult biomass is recommended in pilot studies so that a full evaluation of scallop growth and reproductive development can be undertaken, to ensure that its expectations for culture can be realised.

In Japan the establishment of cultivation in new areas is thought to have produced some recruitment to the natural populations in nearby regions, but this has not been quantified. Larval numbers will clearly be dependent on population size, and in Mutsu Bay a direct relationship between spawning stock biomass and settlement onto collectors has been found to exist. Annual settlements are known to be highly variable in most scallop species, however.

2. THAT JAPANESE SCALLOPS MAY COMPETE WITH NATIVE SCALLOP SPECIES

It is not possible to determine the full interaction with other species in advance of an introduction; however, the study of scallop shell morphology does provide some basis for a reasoned argument in advance of an introduction. *P. yessoensis* has features intermediate between *Pecten maximus* and *Aequipecten opercularis.* For this reason it is considered that the range of *P. yessoensis,* once established in the wild in Europe, are unlikely to coincide with those of native scallops. Although there is some overlap with the ranges of other scallop species in Japanese waters there is no apparent competition. The Japanese *Pecten albicans*, which resembles *P. maximus*, has a geographical range just overlapping that of *P. yessoensis*, and has a preference for finer sediment.

It can be deduced from the Japanese literature that the larvae or settled spat of *P. yessoensis* are unlikely to compete with those of Irish pectinids, because spawning takes place in the early spring. However, there may be competition as juveniles or adults, where its distribution overlaps with that of other scallops, but this is not seen in Japan. Studies in tanks, and in the field, of *P. yessoensis* with European native scallop species would be required to determine the interactions, behaviour and sediment preferences as juveniles and adults.

3. THAT THE INTRODUCTION OF JAPANESE SCALLOPS MAY RESULT IN A SPREAD OF PESTS, PARASITES OR DISEASES.

Prior to introductions, *P. yessoensis* adults were selected by size and condition, and their shells scrubbed. The consignment was met on arrival at customs by an officer of the Irish Department of the Marine who brought the scallops directly to the awaiting and supervised quarantine facility. Following unpacking, all waste was burned and dead tissues buried in lime. Living scallops, and their remaining epibionts, remained in quarantine. Wastewater was treated by chlorination at 250 ppm with a minimum treatment holding time of 4.5 hours.

Following spawning all eggs were sieved, washed and separated from adults and their water. The original broodstock was then destroyed and the quaratine facility was operated until such time as the F1 or subsequent generations were devoid of known pathogens and parasites, determined by histology, and were in a healthy condition. These measures were considered sufficient to control and eliminate the risk of an introduction of known pathogens or parasites to the sea.

4. THERE WAS CONCERN OVER THE MASS MORTALITIES OF JAPANESE SCALLOPS IN CULTURE IN JAPAN.

There was no evidence of any direct pathological implication in scallop mortalities in Japan. Causes appear to have been one or more of the following, most of which arose from over-intensive cultivation:

a) Physiological stress arising from premature development or high sea temperatures,

b) Wave action, resulting in soft tissue damage from shell overlapping,

c) Oxygen depletion.

5. THAT JAPANESE SCALLOPS MAY HYBRIDISE WITH COMMERCIALLY IMPORTANT EUROPEAN SCALLOPS

In Japanese waters there are no known examples of hybridisation of *P. yessoensis* with any other pectinids with overlapping ranges. This scallop has a different shell morphology and is dioecious and is unlike European commercial species.

Further, hybridisation is unlikely because *P. yessoensis* spawns at lower temperatures (in the early spring) than *P. maximus*, which spawns from May to August. *A. opercularis,* which has a different chromosome number, has three periods of spawning - a small peak in January/February (in the Irish Sea), summer and autumn. *Chlamys varia* occurs within shallow bays and spawns at temperatures above 14°C.

For these reasons it was concluded that there was no predictable genetic risk.

6. THAT JAPANESE SCALLOPS ARE UNLIKELY TO THRIVE IN IRISH CONDITIONS

All indications are that conditions in Ireland are favourable, sea temperature ranges fall within the optimum range for the species, and all likely cultivation areas have appropriate salinities.

Main Account of the Risk Assessment of the Introduction of the Japanese Scallop, *Patinopecten yessoensis,* to Irish Waters.

Scallops were introduced to Ireland following strict adherence to the ICES Code of Practice in effect at that time. The 1988 Code was updated during the course of the introduction of Japanese scallops. Recommendations for some changes were made and subsequently contributed to the 1994 Code of Practice.

Species summaries of the three main scallop species in Irish waters are provided. These are distilled accounts of lengthy submissions made to the Working Group (Boxes 1-3) to enable comparison with the biology of the Japanese scallop (Box 4).

Following the study visit to Japan in March 1990 the following responses (below) in relation to the concerns expressed by the ICES Council in 1989 were addressed at the WGITMO meeting in Halifax, Canada in June 1990. In addition a description of culture methods and general conditions at the donor site was included. During this time adult *P. yessoensis* broodstock were imported to the prepared quarantine reception facility in Ireland (to produce spawnings in March/April – their normal spawning time) so that a years work was not lost.

CULTIVATION TECHNIQUES ON THE SANRIKU COAST, JAPAN.

Scallops were sourced from Utatsu Bay on the southern Sanriku coast in Miyagi Prefecture (Figure 1). In this region of intensive cultivation, the main species utilised from the sheltered shore to more open bay is generally in the following sequence:

Oysters Þ Ascidians Þ Undaria Þ Salmon Þ Scallops

Scallops are normally cultivated at the most open end of these bays sometimes 5-6km offshore over depths of 40-60m. Scallops are held on submerged longlines with marker floats that extend to the surface. The majority of the floatation is from subsurface floats; most of these were glass. As scallops grow and become heavier additional floatation is added. The longlines are arranged in rows, with corridors of 50-100m between them. Cultivation is extensive and activities in the production provide employment for most of the year.

Environmental conditions

Onagawa Bay lies adjacent to the area where the Irish consignments of scallops were sourced. Much of the environmental data from this area is based on studies made by students at the University of Sendai. Annual sea temperatures range from *ca* 6°-22°C, however, temperatures at the depths of culture range from 6°-20°C, with cooler and warmer temperatures inshore in winter and summer respectively (Misu, 1990; Arimoto, 1977). In Onagawa Bay, which gradually deepens to almost 50m at its entrance, sediments range from sandy mud to sand (Misu, 1990). Seasonal transects passing through the centre of Onagawa Bay were made to determine the distribution of nitrogen, silicates, phosphates and chlorophyll α together with temperature and salinity (Shibakuki, 1990). In spring silicates and phosphates are concentrated below 20m. Levels are low in summer but are well mixed throughout the water column in autumn and winter. Chlorophyll α levels were highest close inshore in spring and summer. The tidal range within this region is 1.8m (Uno, 1990).

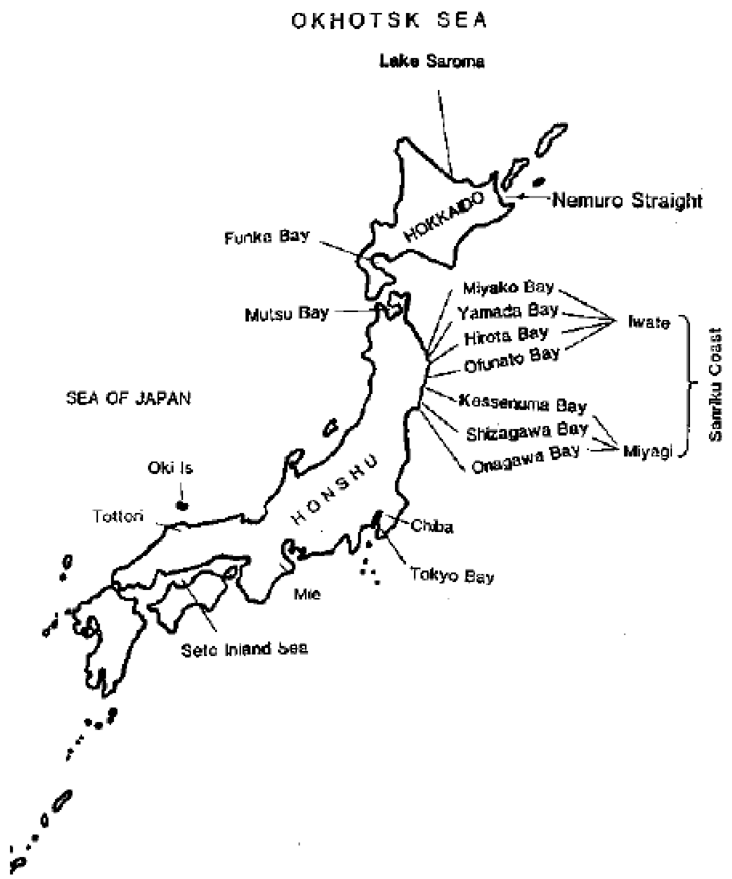

Figure 1. Location of Japanese localities referred to in the text.

Japanese scallop cultivation

The industry in Japan is totally based on natural spat settlements. The main areas of cultivation are Mutsu, Funka, Saroma, Tenora and Sanriku districts (Figure 1). No laboratories currently rear *P. yessoensis* larvae apart from some small experimental studies on the Sanriku coast, although efforts were made to produce hatchery reared spat to stabilise production in the 1960's and early 1970's when there were large fluctuations of natural settlements (Imai, 1967). Hatchery production was expensive and was discontinued when natural settlements became more reliable (Sanders, 1973).

In Miyagi Prefecture more than 70% of the seed used in culture is obtained by placing collectors locally. Larval occurrence and spat production have been studied by Sasaki *et al.* (1984). Settlement takes place over the period May-June and the spat are removed from the collectors in July-August once they are *ca* 10mm shell height. At some localities on the Sanriku coast there are two separate appearances of larvae in the plankton (end of May-first week of June, last week of June first week of July in 1984 (Sasaki *et al.,* 1984)). The source of these settlements is not known. There is a local and natural unexploited population below the longline culture areas. It is not clear whether both cultured and natural scallops provide larvae that settle within these areas, but it is considered likely. Scallops in culture may spawn in advance of those on the sea-floor and this could account for the two peaks of larval abundance appearing in the plankton.

Scallops spat when removed from collectors are transferred to pearl nets at densities ranging from 40-100 per net. A second grading to a larger meshed pearl net takes place when scallops are 30mm+ shell height, when densities are reduced to 15 *per* net. The mesh floors of these pearl nets were not as fouled as their upper surfaces. In was noticed that *Polydora* can be found on shells of this size (pers. obs.).

Importations of scallops from Northern Hokkaido to the Sanriku coastline have not taken place. However, scallops for hanging culture, once about 6cm, are imported from Funka and Mutsu bays. The exact quantities imported are not known because fishermen do not wish to disclose their suppliers. Transfers normally take place in December, six months following settlement. Scallops are transported in boxes lined with sacking soaked in seawater. The consignments are held at 2°to 4°C in temperature controlled containers. Transportation times are usually planned so that scallops are not held out of water more than 10 to11 hours. Funka Bay scallops, that are not used in hanging culture, normally go for sowing culture in the Othotsk Sea and the Nemura Straight. The majority of the Mutsu Bay scallops are transferred to Iwate Prefecture. Here scallop production is greater than in Miyagi Prefecture.

After nine months scallops can be large enough for sale. This market for small scallops has developed as a result of the large quantities being reared with insufficient capacity for growing them on to a larger size. These small scallops tend to be slower growing or may have sustained some damage while handling and are usually sold entire. The better quality and larger scallops continue to be ongrown, those that exceed 6cm in shell height are ear (auricle) drilled and hung in vertical arrays from longlines. Ear hanging culture takes place at depths of 10-39m, on dropper lines spaced approximately 1m apart suspended from a subsurface buoyed horizontal line. Scallops are fixed to the dropper lines in pairs using 1mm diameter monofilament line, or barbed plastic tabs. In the more exposed areas shells can be lost due to wear of the monofilament. Scallops using this system normally develop with a greater shell volume (are more globose) with thin shells.

Those not cultured in this way are held within subsurface lantern nets at stocking densities of about 10 per level until they reach a size of 100mm shell height. However, fishermen are inclined to overstock using 13-15 individuals per level. Scallops generally grow more rapidly when held in suspended culture (Figure 2). In the Sanriku region there are few areas where scallops are sown on the sea floor.

Scallops are normally marketed following two years of culture, although some may require to be ongrown a further year. This depends on local conditions and cultivation densities. Growth in the Miyagi district (Figure 1) is the fastest known in Japan. This is due to the extensive period of warmer sea temperatures resulting in optimal growth. Mortalities do, however, take place once temperatures exceed 21°C.

The method of cultivation is intensive; many longline systems are installed within suitable ongrowing areas. Fishing vessels in these areas use hydrojet propulsion to avoid entanglement with the surface marker floats. The equipment used for working the longlines is highly specialised and consists of rollers and lifting gear on shallow drafted, low gunwhale vessels.

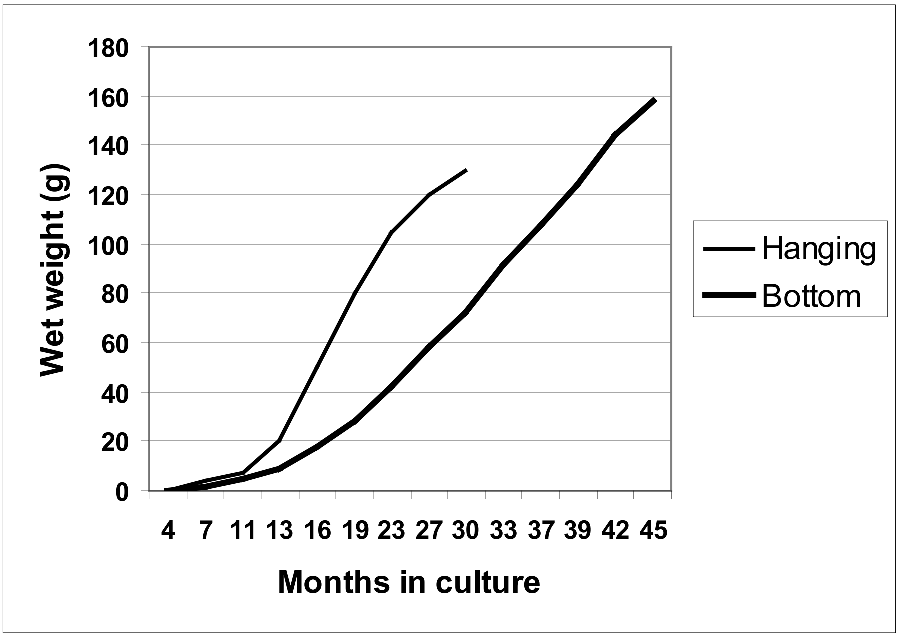

Figure 2. Comparison of growth for scallops held in hanging culture with those sown on the sea floor (based on Imai, 1967).

MASS MORTALITIES OF SCALLOPS IN CULTURE

In Japan scallop losses have taken place at most production sites, and also in the warmer water areas outside of their natural range where experimental cultivation trials took place. Extensive histological studies at main cultivation sites (when there have been high mortalities) have not indicated any pathological cause. The most likely explanation for these mortalities would appear to have been physiological stress due to over intensive cultivation. Saito (1984) suggested diseases as being one of a number of possible contributory causes of decreased production in Hokkaido following the dramatic twelve-fold expansion in production over the years 1971 to 1977. During this period annual production rose from less that 6,000 metric tonnes to 70,000 metric tonnes. No evidence is adduced, however, to support this hypothesis. No further information relating to diseases was available during the 1990 visit to Hokkaido. Although mortalities still occur from time to time, the levels of losses that took place since 1972 have not been repeated. The following possible explanations for high mortality were offered.

Cultivation technique

Long exposure to air:

Scallops, as they grow larger, need to have their cultivation density reduced and placed in containers with progressively larger mesh sizes. This reduces fouling, enhances water flow and thereby promotes growth. During this grading process the scallops are exposed to the air. There is a apparently a great variability in stock survival between different family units who cultivate scallops in close proximity to each other according to the handling they receive. For example, in Saroma Lake adjacent units have had >50% mortality and <10% mortality (Hayashi, 1988). Some cultivators handle their stock at sea to reduce aerial exposure and return them to the water as soon as possible. Survival under these circumstances is greater. Those who bring their stock ashore to grade expose the scallops for longer periods and these scallops have higher mortalities (Hayashi, pers. comm.)

Exposure to sun and rain:

Scallops handled in the early morning in the warmer months avoid being exposed to high solar radiation and at a time with cooler air temperatures. Scallops handled in this way have a lower mortality (Anon., 1980). Survival is greater when tarpaulins are used as a sunshade or as a shelter to deflect rain. Once sea temperatures are high, >20°C, handling is normally avoided.

High density cultivation:

High-density cultivation has continued to result in high mortality. In Funka Bay large interconnected longlines are owned by a fishermen's co-operative, and sections of this are allocated to family units. Because of the limited space available each family produces as much as possible from the apportioned area. Ear hung scallops are usually hung in groups of three, where optimally there should be one or two, and correct densities in lantern nets are exceeded. Such overstocking results in reduced growth requiring a longer cultivation cycle, poorer quality scallops with significant losses (Hayashi, pers, comm.).

High-density culture in pearl and lantern nets may result in deformed shells, more importantly this can lead to additional mortality. Many die from shells overlapping ('biting'). The ventral (leading) edges of the overlapping shells may penetrate and cut the soft tissues within the shell cavity. Small scallops of 15 to 30mm shell height are particularly vulnerable; because at this size they can gape widely. This was a serious problem 15-16 years ago in Hokkaido when densities of 300-600 scallops were held within each pearl net, when normally two hundred 3mm shell height individuals would be stocked (Hayashi, 1988). The effects of density on growth have been well described by Querellou (1975) and Ventilla (1982.). The optimum density for cultivation is considered to be 50%-66% shell surface area to cage floor area (Anon., 1980).

Incorrect drilling of cultured shells:

Scallops can be drilled through the shell auricles ('ears') to take a monofilament which is then attached to a vertically arrays of hanging dropper lines suspended from a horizontal subsurface longline. Incorrectly drilled shells often perish. Mortalities of 10% are frequent. Losses from this source are accepted because of the lower overall capital cost of this method of cultivation. Higher losses occur in areas of wave exposure. Currently there is about 2% shell distortion among drilled shells (Sasaki, pers. comm.).

Physiological Stress

Abnormal sexual development:

Scallops grown in the Miyagi and Iwate Prefectures grow more rapidly, and females can mature during their first year, unlike the populations in Mutsu Bay and Hokkaido. In warmer waters abnormal sexual development in scallops of less than one year can take place (Osanai, 1975). Development may be incomplete and so result in only partial spawnings at the normal time of spawning. This is followed by partial adsorption of the remaining sexual products.

Reproductive cells are formed during a decline of sea temperature in the autumn. Throughout the coldest period maturation takes place and spawning occurs with a sea temperature rise, usually in March-April in Iwate and Miyagi Prefectures. Should scallops be held at a low temperature for insufficient time they will enter the spawning period without full maturation, and this may explain the presence of sexual products found during summer months, as was found in Yamada Bay, Iwate Prefecture (Mori & Osanai, 1977). At higher temperatures the maintenance of gonadal tissue is greater (Mori, 1975). These conditions impose stresses that may result in mortality, particularly if exposed to additional handling.

Mortalities of 30 million scallops (>50%) were recorded in Yamada Bay in 1972, and similar mortalities were recorded for Ofunato and Hirota bays (Figure 1). The following year mortalities in these bays in Miyako Bay, all in Iwate Prefecture, were as high as 90%. In Miyagi Prefecture high mortalities were recorded during 1972 and 1973 in Kessenuma and Shizagawa bays. Scallops that were dying usually had a deformity and browning of the shell margin and pallial atrophy (Mori, 1975). Mortalities occurred in other years but this was not quantified. More recently mortalities have declined considerably as a result of modified longline systems and reduced culture densities.

Stress arising from high sea temperatures:

P. yessoensis is a cold water species tolerating temperatures from -2° to 21°C. Once temperatures exceed 21°to 24°C physiological stress results in reduced growth and often death. Mortality increases in those cases where scallops become exposed to additional stress, such as high-density cultivation.

Trial cultivation in Chiba and Mie Prefectures and the Seto Inland Sea (Yamamoto, 1977) showed high losses once summer temperatures attained 23°C (Koike, pers. comm.). In Mutsu Bay once temperatures attain 23°C, mortalities were normally noted. In many areas, at the southern end of this scallops range, mortality could be reduced by suspending them in deeper water to avoid those periods when there were high temperatures in the near-surface water.

Effects of high density:

High densities result in poor growth, competition for food, and greater fouling. Slow growing scallops may become overgrown by fouling organisms; this may lead to distorted growth of the shell and death.

The effect of wave action on scallops in hanging culture.

Scallops ongrown on longlines may be subject to strong vertical movements, particularly near the sea surface at exposed localities. Under these conditions, when scallops tap each other, shell margins and mantle tissues can become damaged, commonly resulting in shell chipping, mantle retraction and death. Mortality from this source has been significantly reduced with a redesign of longlines and culture of scallops at greater depth. There is also some indication that poor food availability as well as effects of wave action, termed "vibration", result in high mortalities (Mori *et al.*, 1974).

Oxygen depletion of the water column

Pseudofeces, waste matter and fouling organisms that descend to the seabed in areas of intensive off-bottom cultivation can result in a high organic loading, particularly in those areas where there is low dispersion. Locally the redox-discontinuity layer can appear at the sediment surface and the bacterial flora can produce sulphurous gases causing environmental deterioration (Anon., 1980). These conditions are also known to occur beneath both mussel rafts, in the rias of Spain, and salmon farms, in northern Europe (Pearson & Gowan, 1990).

Local events, such as the collapse of an algal bloom, may result in oxygen depletion causing mortality in the benthos. In Japan, sheltered areas with large accumulations of detritus can have poor growth and high mortalities. This can be controlled, in part, by moving in rotation the position of the cultivation units, to avoid continuous accumulation of waste so providing an opportunity for recolonisation of the sediments by benthic organisms (Anon., 1980).

GENETIC RISK

Absence of hybrids in Japanese waters:

There are no known hybrids between *P. yessoensis* and other scallop species found within its range. These include *Pecten albicans, P. sinensis, Chlamys swiftii, C. farreri nipponensis* (Kijima pers, comm.).

Different chromosome numbers:

P. yessoensis has 19 chromosome pairs, three of which are acrocentric, whereas in *P. maximus* there are the same number of chromosomes but 14 of these are acrocentric (Beaumont & Zouros, 1991). *A.. opercularis* has 14 chromosome pairs (Rasotto *et al.*, 1981) or 13 (Beaumont & Gryffydd, 1975). Recombination with European species is very unlikely. In Japan both *P. albicans* and *Chlamys farerri* have 19 chromosome pairs.

Scallops morphologically different:

P. yessoensis is morphologically different from other European pectinids. In addition this species is dioecious unlike the two main northern European commercial species *P. maximus* and *A. opercularis*.

Different spawning periods:

The expected spawning period of *P. yessoensis* in Irish waters (March and April) is unlikely to overlap that of *P. maximus*. In many coastal areas of Ireland spawning of *P. maximus* occurs form May to August (Gibson, 1956), except perhaps on occasions within the Irish Sea where spawning has been recorded over a sea temperature range of 7.2° - 13.7° C (Mason, 1958). *A. opercularis* spawn predominantly in the autumn, with smaller spawning peaks in the early spring and summer (Paul, 1978), mainly outside the anticipated spawning time of *P. yessoensis*. The opportunity to hybridise, should this for some reason be possible, is thereby considerably reduced.

COMPETITION WITH OTHER SPECIES IN JAPAN

Scallops that overlap the range of P. yessoensis:

The range of *P. yessoensis* overlaps other pectinid species, but only at the edge of its range or habitat (Figure 3). *Chlamys swiftii, C. nobilis, and C. farrei nipponesis* are normally found attached to stones and usually in shallower water, and here *P. yessoensis* is seldom encountered. *P. albicans and P. sinensis* infrequently overlap the range of *P. yessoensis*.

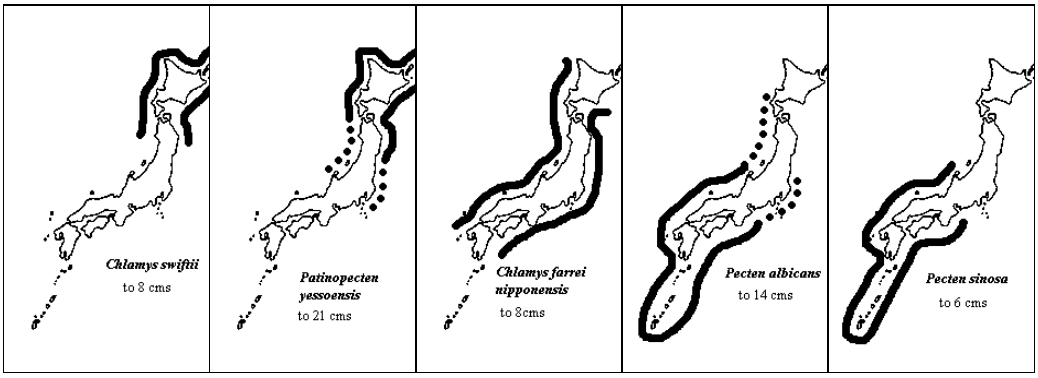

Figure 3. Distribution of the principal scallop species that overlap the distribution of *Patinopecten yessoensis.*

Patinopecten yessoensis in Japan*:*

P. yessoensis is found naturally in Northern Honshu and Hokkaido. Off Hokkaido it is found to depths of 60m, mainly on gravels (0.5-4mm diameter) in areas of swift water movement. The gravels in these areas are often well polished. These same areas are also sown in rotation, using scallops from culture, (Hayashi, 1988) with densities of up to 6-7 scallops per square metre.

In the partially enclosed Mutsu Bay, scallops occur on finer sediments. The chosen sowing areas consist of a community which includes *Echinocardium cordatum* and *Lepidopleurus assimilis*, both of which are used as biological indicators for sediment suitability. These sediments of sand, silt and gravel must have a silt (<0.1mm diameter) composition of less than 30% (Yamamoto, 1968). Higher levels of silt are unsuitable and in such areas scallop growth and survival are reduced. Settlement in muddy or silty areas normally result in high mortalities of spat, and so explain the absence or low numbers of scallops in these areas, Densities of less than six per square meter are needed to obtain 200g scallops in 3-4 years (Aoyama, 1989).

Pecten albicans in Japan:

P. albicans , a commercial species in the Sea of Japan on the west coast of Honshu, has a preference for sand and sandy mud. It normally occurs at depths of 30-80m (Ayama, 1986). It is cultivated in Tottori Prefecture and the Oki Island. Landings have been variable depending on recruitment of good year classes. Currently, production is stabilising as a result of cultivation. Attaining 100mm in its third year (maximum size, 140mm), it is cultivated in a similar way to *P. yessoensis* (Kunizou, 1986). *P. albicans* is very occasionally found on the east coast of Japan where it occurs northward to Tokyo Bay, where occasional sporadic year classes recruit. Overlapping of its range with *P. yessoensis* is not known on this coast (Koike, pers comm.).

Pecten sinensis in Japan:

P. sinensis attains 60 mm shell height, and has a similar geographic distribution to *P. albicans* within Japan, occurring in shallows where there is fine sand.

COMPETITION WITH OTHER SPECIES IN NORTHERN EUROPE

Likely range overlap with main European species:

Pecten maximus ranges from Norway to the Canaries (Figure 4) but is exploited from Spain to Norway from the lowest tidal level to depths of 180m. It is found on all Irish coasts particularly within shallow bays (Figure 5). *P. maximus* is found on a wide range of sediments, from soft mud to coarse gravels, although there would appear to be a preference for sandy mud (Minchin, 1984). These substrata and greater depth range represent a wider distribution than has been described for the Japanese scallop. Should *P. yessoensis* become established in Irish waters, it is expected that it will overlap the range of *P. maximus*. However, it is unlikely that their ranges would coincide. *A. opercularis* is also found over a wide range of substrata, but is more frequently associated with muds and sands to depths of 46m (Mason, 1983).

Figure 4. Distribution of *Pecten maximus* in Europe (Minchin, 1984).

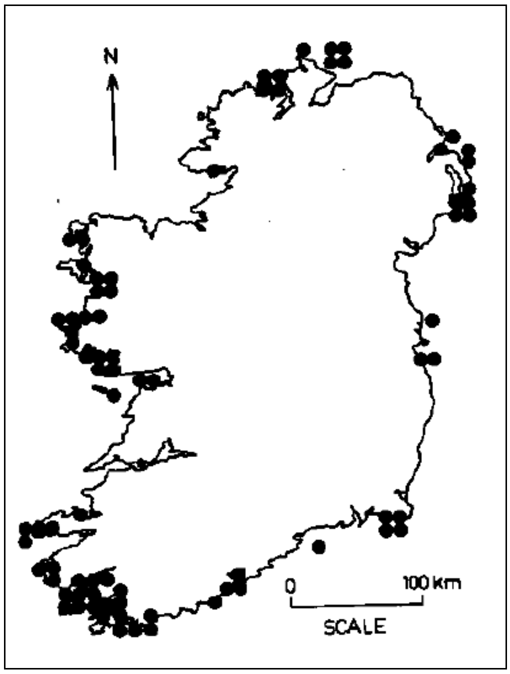

Figure 5. Distribution of *Pecten maximus* in Irish water (Minchin, 1984).

<u>*Likely behaviour in European waters:*</u>

Shell shape provides some indication of behaviour among pectinids (Gould, 1971). The shell of *P. yessoensis* differs from that of *P. maximus* and *A. opercularis*, yet has some similarities. *P. maximus* recesses within a pit in the sediment, and normally has a thick layer of sediment covering the upper (left) flat valve so that the upper surface of the shell lies flush with the level of the surrounding sediment. In *P. yessoensis* recessing also take place, but within shallow pits and some sediment can cover the left valve. *P. maximus* has an overlapping lower curved (right) valve, an adaptation for a deeper recessed mode.

A. opercularis has a biconvex shell without shell overlap, and, like *P. yessoensis*, is an active swimmer. The Japanese scallop has characteristics common to both of the aforementioned species and lives for a similar length of time. For these reasons *P. yessoensis* may be expected to become dispersed over a similar depth range with a preference for coarser sediments.

Chlamys varia is principally found in shallow water bays. It attaches with a byssus throughout its life and like the Japanese *Chlamys* species is unlikely to be found in areas where free swimming scallop species are found. It is capable of detaching the byssal mass and then swimming and subsequently secreting new byssal threads. Swimming seldom takes place, and then usually as an escape response to sea-stars.

P. maximus and *A. opercularis* coexist in European waters with overlapping ranges without apparent detriment. It is expected that *P. yessoensis* would behave in a similar manner should it become established. The only likely competition is expected to be for food, and this may not be significant when compared with the biomass of other filter feeding organisms present.

POSSIBLE INTRODUCTION OF OTHER ORGANISMS

Introduction of algal cysts

Distribution of algal blooms in Japan:

In Onagawa Bay and the Sanriku coast, close to the region of the source population of scallops to be introduced to Ireland, movements of coastal and oceanic water masses into the Bay determine the phytoplankton successions. The dominant species were diatoms, mainly composed of *Chaetoceros radicans* and *Thalassiosira decipiens* in May changing to *Nitzschia seriata* (now *Pseudonitzschia seriata*) and *Rhizosolenia fragilissima* in July. In October *Asterionella glacialis* and *Skeletonema costatum* predominated (Hashimoto, 1990). In Hashimoto's study in 1989 dinoflagellates did not consist of more than 1.5% of the marine algal counts. Arimoto (1977) who examined the same bay in 1974 and 1975 did find small numbers of *Prorocentrum micans* in the late summer, and recorded the presence of *Dinophysis ovum* and *D. homunculus var. tripos* during the summer and autumn.

On the Sanriku coast DSP has occurred close inshore, and scallops (as well as other species) sampled in the summer of 1976 and 1977 were found to be contaminated (Yasumoto *et al.*, 1978). The organism responsible is thought to be a *Dinophysis* species. Seed collection areas that supply Miyagi Prefecture with some of the scallops used in the suspended cultivation to the adults do have problems with DSP contamination. Species found associated with this problem are *Dinophysis fortii* and *D. acuminata*, although *D. norvegica, D. rotundata* and *D. mitra* were all recorded in Funka Bay, Hokkaido, in 1989 (Hayashi, 1989). In Mutsu Bay, Honshu, DSP contamination is also known (Yasumoto *et al.*, 1978); principally caused by *D. fortii*, which can be present from March to October/November (Satoh, pers. comm.). DSP is known to have occurred in this area since 1976, and there were serious outbreaks over the period 1978-1980 (Ventilla, 1982). This species does not appear to interfere with the growth of scallops, and sales can take place provided the hepatopancreas, in which the toxin accumulates, is removed. PSP contamination is not known from the Miyagi Prefecture, but is known in Funka Bay, an area that has sent scallops for adult cultivation on the Sanriku coast. The problems in Funka Bay are serious and sales of scallops can be restricted for most of the year. The causative organisms are *Alexandrium (Protogonyaulax) tamarense*, which was first recorded in the autumn of 1988, and *A. catenella* (Hayashi, 1989). Scallops are contaminated from May to October, and restrictions on sales of fresh meat for some localities can extend for as much as 290 days.

Treatment of used water in the Irish quarantine facility:

All water was filtered in stages down to 5µm and then treated with ultra-violet light before being used within the quarantine facility. All water introduced to the quarantine area was contained. In the unlikely event of all tanks being damaged the quarantine area had a bund to contain all spilt water so that it could then be treated in the way intended. Sterilisation of all used water was by means of an injected solution of sodium hypochlorite. Wastewater was contained within a 500 gallon drainage tank which when filled to a predetermined level activated a pump. The pump was linked to the hypochlorite injection system. The treated water was then held within a series of tanks at 250ppm chlorine before being neutralised at the point of discharge. The required treatment to destroy algal cysts is not presently known, but the precautions were considered to be adequate at the time for treatment. The tanks also acted as settlement traps and will have contained particles for longer than the minimum residence time of 40 hours. Procedures to ensure correct management of the quarantine area are laid down in Table 1.

Control of the introduction of non-native organisms

Shell fouling organisms:

There is considerable fouling of the shell surface of scallops held in hanging culture. Arakawa (1990) describes fouling in the hanging culture of the Pacific oyster, *Crassostrea gigas*, in Japanese waters. He describes 45 species that attach to the shell; the same species are likely to be found on the shell surface of scallops. In Utatsu Bay, colonial and solitary tunicates, hydroids, bryozoa and mussels were the principal fouling organisms seen. Scrubbing the shells prior to transportation can control the majority of these species.

Parasites and diseases of scallops;

First described in 1971 in Mutsu Bay in sown scallops was a rhizocephalan-like parasite to become known as *Pectenophilus ornatus* (Nagasawa *et al.*, 1988). This parasite attaches in the region of the gill or adductor muscle and is claimed to impede growth. It is presently widely distributed in Mutsu Bay and is also found on the Sanriku coast. It can infest all scallops in a locality and can result in marketing problems (Elston *et al.*, 1985). This species cannot be transferred to the F1 generation using standard quarantine procedures; all scallop parent stock will be destroyed following spawnings.

Branchial rickettsiales-like infections are known in *P. yessoensis* and *Tapes japonica* and have been implicated in myodegeneration and mortality (Elston, 1986).

Table 1. Procedure used for operating quarantine area:

1. The quarantine area was clearly indicated with a notice. Restricted regions within the compound were indicated, a health and safety statement was on display and included the following matters:
    - *Labelling of electrical switches and fuses according to function.*
    - *Low level warning alarm for chlorination injection system.*
    - *Spring closures on hatchery doors*
    - *Handwashing facilities at entry/exit point of hatchery*
    - *Separate broodstock and larval culture areas*
    - *Separate equipment for use with each tank*
    - *Intruder alarm system*
    - *An established daily opening up and closing procedure*
    - *Identification and notification of trip points, wet areas, obstructions, and unguarded equipment, hazardous chemicals and sharps.*
2. Only authorised personnel were permitted entry to the hatchery, all non-operatives signed a logbook on arrival. Visitors wishing to gain access to the

facility required prior approval from the proposer and the Irish Department of the Marine.

3. White coats (regularly laundered as for hospital clothing) were worn by all entering the hatchery.

4. Boots were provided for on site use in the hatchery and compound area. Separate footwear was

used for work outside of the compound area.

5. Both boots were bathed in a disinfectant solution (with a colour indicator) within the footbath before entry/leaving the hatchery area.

6. Hands were washed frequently with disinfectant soap, especially after handling broodstock, or between working separate scallop bins.

7. Equipment entering or leaving the hatchery was disinfected using absolute alcohol, in a 100ppm solution of chlorine, or by being autoclaved.

8. All rubbish was regularly removed to the compound and burnt.

9. Non flammable materials were soaked in chlorine and buried.

10. All organic material (dead broodstock, larval cultures) was soaked in chlorine and buried in lime.

11. Smoking and eating within the hatchery area was not permitted.

12. The main gate to the compound perimeter fence was either kept locked or overseen.

13. Regular inspections of:

- *all running pumps*
- *Sea-water pump house for flooding*
- *chlorine and metabisulphite tanks for levels*
- *sandfilter tanks*
- *flowmeters and UV indicator lights*
- *temperature, salinity and pH in larval and broodstock tanks*

14. Working procedures:

- *Chlorine levels in the waste treatment system were measured thrice daily at points of entry to the waste tanks and at the point of discharge.*
- *Assist in the hatchery practice, under the supervision of the hatchery manager, and be familiar with the hatchery purpose and routine.*
- *A diary of observations, measurement and hatchery operations.*
- *Aquire and prepare samples of material for histological study.*

LIKELY PHYSIOLOGICAL EXPECTATIONS FOLLOWING TRANSFER

Time of spawning in Irish waters:

In Japan development of the gonad begins once sea temperatures fall below 10°C, and it is important that at least two months of temperatures below 10°C are maintained (Matsutani, pers. comm.). Sea temperatures below 10°C are found about Irish Coastal areas (Figures 6 & 7, from Irish lightship records), and those regions within shallow bays may be expected to have lower and higher temperatures, more closely corresponding to air temperatures. With a rise in sea temperature spawning commences, and lasts approximately one month with no further subsequent spawning until the following year. This is unlike the native European species, which in Irish waters have a number of spawning periods throughout the year, but principally over the period late spring to autumn. In *P. yessoensis* the time of spawning depends on the geographical locality, those farther north spawning later. Spawning at the southern end of the range, in Miyagi Prefecture, takes place in March/April (Sasaki, pers comm.) and in Posjet Bay in the Soviet Union in late May to August (Golikov & Scarlato, 1970). Expectations of spawning in Ireland would coincide with a steady rise in sea temperature in March/April.

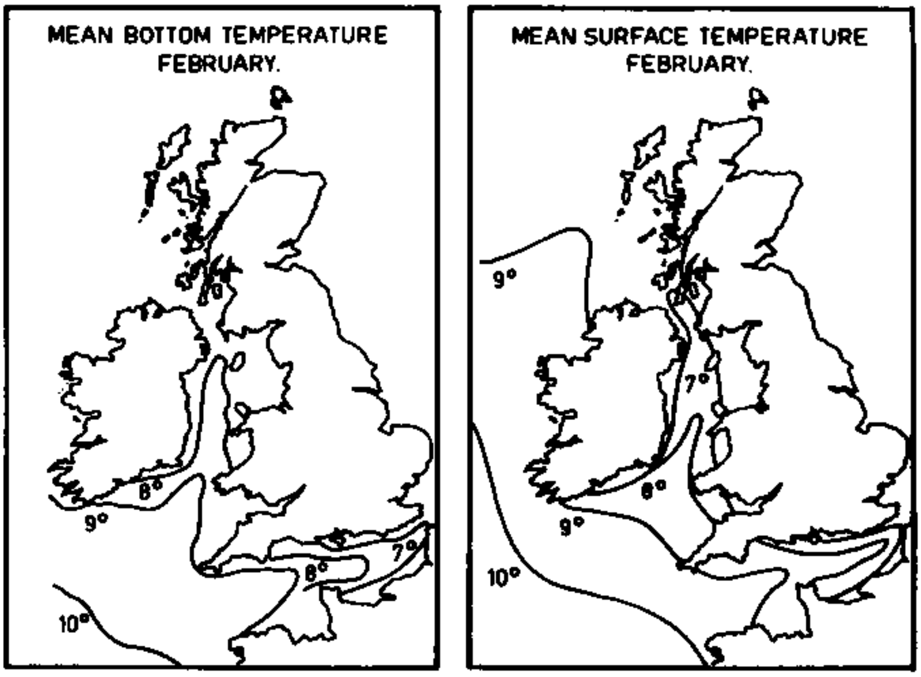

Figure 6. Mean bottom and surface sea temperatures for February about the Irish coast.

<u>*Growth of scallops in Irish waters.*</u>

The temperature for optimal growth in *P. yessoensis* is 15°C (Figure 8) and at some localities in Japan the depth of cultivation is adjusted to coincide with these temperatures (Sanders, 1973). Hanging culture on the Sanriku coast for most of the year is well suited for the growth of this species (Figure 9). Throughout the range of *P. yessoensis* in Japan there is a greater range of sea temperature, -2° to 24°C, but scallops are probably very seldom exposed to a full temperature range this great (Figure 10). It is very unlikely that sea temperatures will rise as high in Irish waters even inshore. The highest bay temperatures at the sea surface that have been measured in Ireland have been 21°C in August (Minchin, 1984). Lowest sea temperatures in Ireland are probably about 2°C in shallow bays during periods of sustained cold in late winter, and *P. yessoensis* can clearly function in Japan at these temperatures. Conditions in Irish waters would appear to be optimal for good growth rates for *P. yessoensis*.

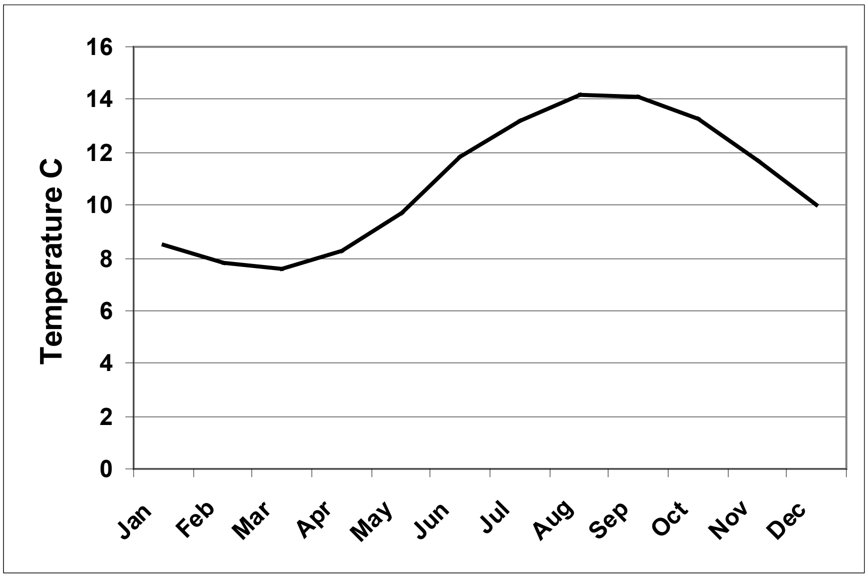

Figure 7. Mean sea surface temperature for the SE coast of Ireland close to the quarantine station at Carne, Co Wexford.

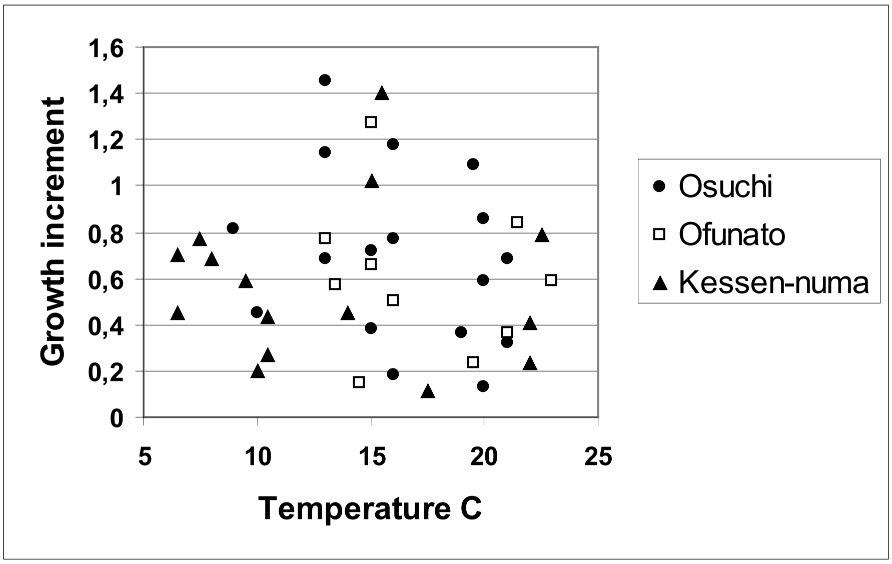

Figure 8. Optimal temperatures for the growth of *P. yessoensis* over a wide range of environmental conditions (based on Muller-Fuega & Querellou, 1973).

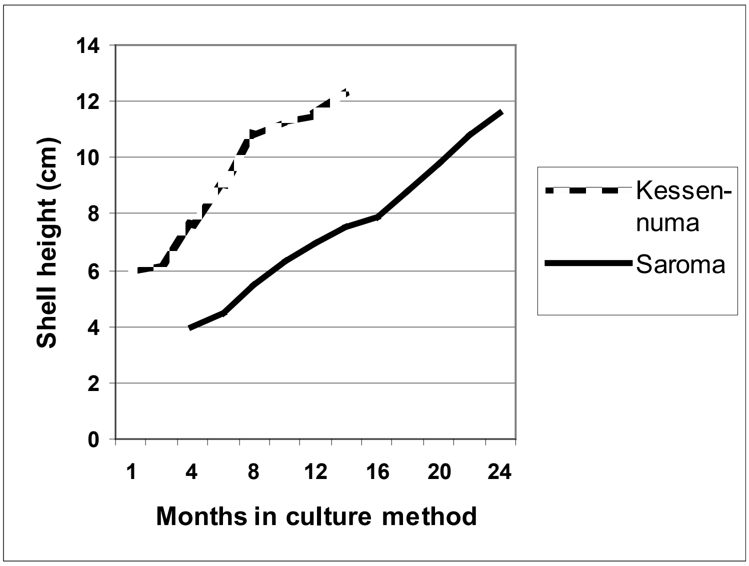

Figure 9. Full known range of growth, from ear-hanging culture (Kessen-numa Bay in Honshu – to the south) to pocket-net culture (Saroma Lake a shallow water lagoon on the north coast of Hokkaido – to the north) (provided by R. Sasaki).

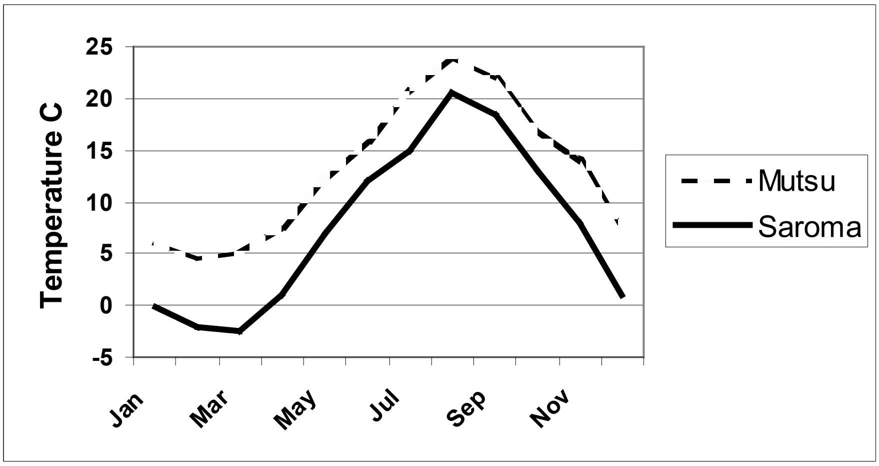

Figure 10. Sea surface temperature ranges for Mutsu Bay and Saroma Lake covering the range of the main production areas (based on Ventilla, 1982).

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BOX 1. *Pecten maximus* (L.), the great scallop, escallop, coquille Saint Jacques

Distribution: Northern Norway to the Azores, Madeira, West Africa and the western Mediterranean. Principally in areas of sandy mud to muddy sand but also occurs on muds to coarse gravels. Experimental introductions to Japan and Chile.

Depth range: Known to be exposed at low water spring tides to depths of 180m, most usually at depths of 3-45m.

Habit: Attaches at settlement with byssal threads, which can remain until about 4-13mm. Capable of swimming/recessing once 6mm. Adult scallops lie within depressions on the sea floor with sediment covering the upper valve. Can orientate to current flow.

Reproduction: A protandrous hermaphrodite spawning from late spring to early autumn. In Irish bays this is normally over the period May to September at temperatures of >13°C. A number of spawnings can take place within the same population during the year.

Larval Development: Larvae occur from April to September. Laboratory studies indicate a planktonic duration of 16-33 days at 15-20°C. Settle at 190-260μm, depending on temperature.
.

Settlement: Commercial settlements known from Mulroy Bay and the West coast of Scotland. Collected on onion bag type collectors, settlement time is predicted by examining the size of larvae in the plankton. Settlement takes place June to September principally on hydroids and algae.

Growth: Exceptionally attains 215mm shell length, however, those of 180mm are considered large. Commercial size is 100mm, normally exceeding this size within three to four years. Depth, food available, sea temperature and density influence growth.

Longevity: Known to live to 22 years, most fished populations have some specimens exceeding 10 years.

Diseases and parasites: Diseased animals are seldom encountered. The coccidian, *Pseudoklossina pectinis*, has been found in scallop kidneys in France. Copepod symbionts frequent. *Odostomia* frequently associated with scallops in some populations.

Predators: The blenny *Blennius gattorugine*, anenome *Anthopleura ballii* and small sea stars feed on '0' group scallops. Green crabs (*Carcinus maenas*); swimming crabs (*Liocarcinus spp.*), hermit crabs in shallow water feed on juveniles. The edible crab (*Cancer pagurus*), crawfish (*Palinurus elephas*), sea stars (*Asterias rubens, Marthasterias glacialis*) feed on adults. There is a swimming response to sea stars.

Competition and other interactions: Organotin leachates have resulted in settlement failures in some areas. Occasionally during prolonged cold winters scallops become torpid and die. Scallops can concentrate a toxin resulting in amnesic shellfish poisoning (ASP) if eaten.

Fisheries: Range from shallow bays to offshore areas. In depths of less than 5m they may be collected using a pole-net. Dredges of different designs either single light frames (in shallow water) or in gangs with heavy chain bags and sprung teeth (in deep water) are used. In some bays, where regulations permit, scallops are collected to depths of 25-30m by diving. Densities of up to $2.33m^{-2}$ are known but seldom exceed $0.6m^{-2}$ within established fisheries. Fisheries inshore normally take place during the winter and offshore during the spring and summer.

Aquaculture: Currently under development, limited by available natural spat collections. Hatchery production is small, except in France and Norway. Intensive cultivation of all later stages in cages, nets, ear hanging culture and ranching. Extensive ranching is possible but there can be extensive predation due in part to thinner shells arising from their earlier intermediate culture.

Main references: Brand *et al.* (1980); Gruffydd & Beaumont (1972); Minchin (1992); Mason (1983); Le Gall *et al.* (1988); Paul *et al.* (1981).

BOX 2. *Chlamys (Aequipecten) opercularis* (L.), the queen scallop, princess scallop, petoncle blanc.

Distribution: Northern Norway to the Mediterranean and Adriatic seas, generally ranges on the western coast of Europe from 30-70°N. Found over a wide range of sediments from muds to coarse gravels, may be found on coarser sediments than *Pecten maximus.*

Depth range: From 2 -180m, more usually 3-45m.

Habit: Can remain bysally attached to 2cm. Readily swims when disturbed. Not normally known to recess but has been found within shallow depressions, lies on the less convex valve. Can occur in large concentrations.

Reproduction: A hermaphrodite with a proximal white testis and a distal red ovary. About the Isle of Man there would appear to be two main spawnings in spring and autumn, but spawning spans over the period January to October. Spawns at temperatures 7-11°C. Probably a 'dribble' spawner.

Larval Development: Little is known of larval duration as the species is difficult to culture. Spawning requires careful management and in relation to its precise sexual cycle.

Settlement: Commercial settlements known from the west coast of Scotland. Collected on onion bag type collectors, settlement is monitored by examining plankton samples. Settlement takes place February to October principally on hydroids and algae. Settles at 210-260µm.

Growth: Attains 95mm shell height. acceptable to the market once 55mm, attaining this size in culture after 14-18 months.

Longevity: Known to live to 11 years.

Diseases and parasites: Diseased animals seldom encountered. The ciliate *Licnophora auerbachi,* has been found attached to the eyes.

Predators: Young individuals are consumed by plaice and cod, swimming crabs (*Liocarcinus spp.*), hermit crabs in shallow water; edible crab *(Cancer pagurus*). It has a swimming response to sea stars *Asterias rubens, Marthasterias glacialis*.

Competition and other interactions: Byssogenesis can be influenced by the insecticide

Endosulphan. Can occur as a significant fouling organism on fish netting resulting in hand laceration. Presence of amnesic shellfish (ASP) poisoning can influence fishing effort.

Fisheries: Principal fisheries are in The Faroes, western Scotland, Irish Sea and La Manche. Exploitation varies because sporadic recruitments can result in pulse fisheries in some regions. Can exceptionally attain densities of up to $1000m^{-2}$ on the Scottish west coast, precise measurements of 5.7^{-2} have been made. A variety of gear is used in their capture including beam trawls, spring dredges, rock hopper trawls.

Aquaculture: Cultivated in Scotland under the name 'princess scallop'. It grows rapidly to consumer size when held within suspended cages. The market is limited as the species has a relatively small meat and reproductive organ. Cultivations have been dependent on natural settlements.

Main references: Mason (1983); Paul (1980 & 1981); Broom (1976).

BOX 3. *Chlamys (Mimachlamys) varia*, variegated scallop, black scallop, petoncle noire.

Distribution: Ranges from North Sea (Denmark to Britain), Ireland, Mediterranean Sea to Senegal in west Africa. Found on coarse sediments attaching to shell, gravel, stones and bedrock.

Depth range: Attains greatest densities in shallow waters of fully marine sheltered inlets. Exposed at low water spring tides to depths of 40m, more usually occurring at depths of less than 20m.

Habit: Attaches at settlement with byssal threads, which remain throughout life. May be found within crevices, beneath stones and inside paired shell remains, often on shell banks, frequently where oysters *Ostrea edulis* naturally occur. Juveniles often cryptic.

Reproduction: A successive hermaphrodite functioning either as males or females can change sex following spawning. Spawns during May to September. Spawning is triggered by 1-2°C fluctuations, associated with spring tidal movements or prolonged periods of sunshine at temperatures exceeding 15°C. Requires 318-359 day degrees to the first spawning and 271-308 to the second spawning on the west coast of Ireland.

Larval Development: At 18°C settles after 25 days. .

Settlement: Commercial settlements of up to 50,000 spat per collector have been obtained in the Rade de Brest, France and several thousands in Lough Hyne, Ireland, in onion bag type collectors. Natural settlement takes place June to September on shells, stones and algae.

Growth: Exceptionally attains 105mm shell length, specimens of 70mm are considered large. French commercial size is 35mm, normally attained in two years.

Longevity: Known to live six years.

Diseases and parasites: Diseased animals seldom encountered. Some *Odostomia* sp. have been seen associated with adults. The ciliate *Licnophora auerbachi* is rarely found on the eyes.

Predators: Small scallops preyed upon by the blenny *Blennius gattorugine*. Juveniles fed upon by green crabs (*Carcinus maenas*) and swimming crabs (*Liocarcinus spp.*). Adults fed on by sea stars (*Marthasterias glacialis* and *Asterias rubens*) to which it has a swimming response.

Competition and other interactions: Organotin antifouling leachates have influenced larval survival in some areas.

Fisheries: Occur within shallow bays, none are known in deep water. Collected by hand picking at lowest tides or by dredges. Densities of up to 28^{-2} in Ireland and 3.2^{-2} in France.

Aquaculture: Cultivation to the adult does not presently take place due to the relatively low value of the market product. Collected spat on collectors are ranched in Rade de Brest. It is tolerant of a wide range of conditions and handling. Only experimentally produced in the hatchery.

Main references: Burnell (1991); Conan & Shafee (1978); Shafee (1980).

BOX 4. ***Patinopecten (Mihuzopecten) yessoensis*** (Jay), Japanese scallop, Hotategai.

Distribution: From the south Kurile Islands and southern part of the Sea of Othotsk to Sakhalin Island, North Korea, northern Japan south to Tokyo Bay and China north of 39°N. Found on a wide range of sediments but most frequent on coarse sands and fine gravels. Introductions to: Canadian Pacific and Atlantic coasts (in culture); Denmark (failed); France (in storage); Ireland (discontinued).

Depth range: 0.5 to over 50m.

Habit: Attaches at settlement with byssal threads to algae and hydroids until 6-10mm. Juveniles and adults recess in shallow depressions.

Reproduction: It is a dioecious species, spawning coincides with a rise in sea temperature following the lowest winter temperatures in Mutsu Bay. This is between March and May at temperatures of 6-8.5°C.

Larval Development: Larvae exist within the plankton 15 days at 17-19°C, 22-35 days at 7-13°C and may remain for 40 days. Larvae concentrate at different horizons at varying states of the tide and time of day. Larvae appear late March to the end of June in Mutsu Bay reaching densities of 4,600m^{-3}. They attain 230-286µm at settlement.

Settlement: Settlements greater in coastal gyres and in regions with slow flow rates. In Mutsu Bay optimum settlements in March-June, in Hokkaido from May-June, in Posyet Bay in June-July and Vostock Bay in July-September. Optimum settlements normally at 6-16m.

Growth: Sown scallops attain commercial size in 2.5-3.5 years in Mutsu Bay, longer in cooler northern regions. Can attain 6cm within a year in hanging culture and 10cm in two years. Sown scallops attain 150g in three years.

Longevity: Known to live to ten years.

Diseases and parasites: The shell boring worm *Polydora ciliata* can weaken the shell and result in severe mortalities. The copepod *Pectinophilus ornatus* infects the gills and adductor muscle and impairs growth.

Predators: In bottom culture and fisheries *Asterias amurensis* can result in up to 90% mortality. Crabs, cottid and hexagrammid fishes are predators.

Competition and other interactions: Unexplained mortalities may be due to oxygen depletion in relation to stratification of the water column, poor husbandry and high-density cultivation. Algal blooms influence the marketing of scallops due to DSP and PSP. Mortalities are known arising from sudden temperature changes and high temperatures, high turbidity, prolonged exposure in air and from storms causing strandings.

Fisheries: In Mutsu Bay the fishery was subject to pulses of abundance probably due to local hydrographic conditions. Presently most fisheries are under management by enhancement. Maximum production is 1200gm^{-2} with up to 6 scallops m^{-2} from sowings of 50-250 spat m^{-2}.

Aquaculture: Developed in 1963-64 using mesh bag collectors in Mutsu Bay and landings resulting from this rose to 47,000mt in 1974, but declined to 16,000 in 1977 due to high mortalities. With guidance from state laboratories 35,000mt were produced in 1982. This form of culture is also practised on Hokkaido, in Korea and Federated Union of Soviet States.

Main references: Aoyama (1989); Ito *et al.*, (1991); Kasyonov (1991); Ventilla (1982); Yamamoto (1977).

Annex 7 Proposed Terms of Reference for 2013

The **ICES Working Group on Introduction and Transfers of Marine Organisms** (WGITMO), chaired by Henn Ojaveer, Estonia, will meet in Montreal, Canada, from 20-22 March 2013, 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 as appropriate, region of origin, status of eradication efforts, and habitat, and develop an annual summary table of new occurrences/introductions of aquatic non-indigenous species.

b) Continue verifying 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.

c) Continue identification and evaluation of climate change impacts on the establishment and spread of non-indigenous species. This activity will mostly be carried out intersessionally and take several years (ToR of joint interest with WGBOSV).

d) Investigate and report on non-native species issues associated with artificial structures in marine environment (ToR of joint interest with WGBOSV).

e) Continue work to address MSFD D2, incl. by developing generic criteria and proposing guidance for alien species monitoring approaches to assist EC member states in designing their national alien species monitoring programs.

f) Coordinate reporting of nonindigenous pathogens affecting mariculture with the relevant ICES expert group(s) and establish a mechanisms for annually exchanging relevant information.

g) Produce the draft alien species alert report on *Ensis directus*.

WGITMO will report by 15 April 2013 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 have been developing a simple excel database on new introductions or expanding introductions and will be requesting that ICES adopt the data and maintain the database for the Working Group and ICES countries to access. b) The group will contribute to MSFD Descriptor 2 issues, incl. providing guidance and generic suggestions for designing future alien species moni-

	toring programs. c) We are planning 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. d) We plan to identify and evaluate climate change impacts on the establishment and spread of alien spoecies; this activity will result in scientific publication. e) We'll start coordinating reporting on pathogens affecting mariculture and involve relevant ICES expert group(s). f) We'll investigate and report increasingly important issue of various artificial structures for alien species spread and invasions. g) We'll produce next alien specia aleret report (on *Ensis directus*).
Resource requirements:	None required other than those provided by ICES Secretariat and national members
Participants:	WGITMO nominated members and invited experts from, e.g., Australia and Mediterranean Sea countries that are not members of ICES.
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, WGBIODIV
Linkages to other organizations:	WGITMO urges ICES to encourage and support a continued dialogue with PICES, CIESM, IMO, HELCOM, OSPAR and EIFAC.