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

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ICES

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Executive Summary

In 2010 the ICES Working Group on Introductions and Transfers of Marine Organisms (WGITMO) met in Hamburg, Germany with Judith Pederson, U.S.A. serving as chair and Sophie Foster, Canada, serving as rapporteur. The meeting venue was the Bundesamt für Seeschifffahrt und Hydrographie (BSH) with Manfred Rolke from BSH, as our host. Representatives from ICES Countries: Belgium, Canada, Estonia, Denmark, Finland, France, Germany, Spain, Sweden, United Kingdom, and the United States of America and from the Mediterranean: Italy attended the meeting. See Appendix I for list of attendees and their addresses. \ \ \

Synopsis of WGITMO and WGBOSV combined meeting

Because the Working Group on Introductions and Transfers of Marine Organisms (WGITMO) and the Working Group on Ballast and Other Shipping Vectors (WGBOSV) share one half day of meetings, the following minutes cover the joint meeting first and the WGITMO meeting second reflecting the order of the meetings. The main issues for the 2010 WGITMO and WGBOSV meeting were (1) the joint effort with PICES WG 21 (the equivalent of both WGBOSV and WGITMO), and (2) issues related to hull and other hard surface vessel fouling where WGBOSV has taken the lead in drafting a Code of Practice.

Synopsis of highlights of the National Reports

This section highlights the new marine introductions of the National Reports and other important changes in the reporting ICES countries. Table 1 lists new marine species introductions reported in this year's annual reports. Table 2 lists some species that have expanded their ranges and Table 3 list some single species identifications that were reported this year that bear watching in future years to see if they are established and spreading. Two countries that provided annual reports, Belgium and the U.S. did not report new species introductions, although Belgium noted a highly successful spatfall of *Ensis directus*. One aquaculture release was reported by the U.S. Adults of the shrimp *Penaeus monodon* were observed off the coast of North Carolina, but no reproducing populations were found. This is the northern-most sighting for this species which is from Guyana. *Crassostrea gigas* is also an aquaculture escapee and is reported as range expansion in Ireland. More information is provided in the National Reports, Annex II, including references to species not seen in various countries and general information on range expansions.

Table 1. List of marine species identified as new reports in the 2009 ICES National Reports

Genus	Species	Common name	Country	Location notes
<i>Marteilia</i>	<i>refringens</i>	(Paramyxean parasite)	Sweden	Orust municipality (2009), E Skagerrak (N 58°04'90", E 11°33'25")
<i>Edwardsiella</i>	sp.	(Parasitic sea anemone)	Sweden	The Gullmar Fjord (2007), E Skagerrak (N 58°44', E 11°24')
<i>Lennoxia</i>	<i>faveolata</i>	diatom	Germany	Wadden Sea, Sylt
<i>Potogammaru</i>	<i>robustoides</i>	amphipod	Estonia	N54.4207, E27.92168, Narva Joesuu
<i>Chelicorophium</i>	<i>curvoispinum</i>	amphipod	Estonia	N54.4207, E27.92168, Narva Joesuu, N59.41101a, E27.74703, Sillamäe
<i>Gammarus</i>	<i>tigrinu</i>	amphipod	Estonia	N 58.2-59.5°, E 23-26.7°, multiple
<i>Neogobius</i>	<i>melanostomus</i>	roundgoby	Estonia	N59,605683, E25,07945, Harjumaa, Aksi Saar
Virus, new genotype	OsHV-1	virus	France	oyster beds
<i>Polyopes lancifolius</i> (= <i>Grateloupia okamurai</i>) red alga			France	Gulf of Morbihan in August 2008 (47°35 54 42 N; 2° 53 23 50 W)
<i>Blackfordia</i>	<i>virginica</i>	black jelly fish	Spain	Guadiana estuary, Spain, 37°15'30"N, 7°25'58"W
<i>Mnemiopsis</i>	<i>leidyi</i>	warty comb jelly or sea walnut	Spain	Cap de Creus, Spain, 42°19'05.78" N, 42°19'05.78" N
<i>Diadumene</i>	<i>lineata</i>	Sea anemone	Denmark	Læsø (Northern Kattegat)
<i>Palisada</i>	<i>maris-rubri</i>	red alga	Italy	Lachea island, Sicily, Ionian Sea
<i>Mnemiopsis</i>	<i>leidyi</i>	comb jelly	Italy	Ligurian, Tyrrhenian, and Ionian Seas
<i>Phyllorhiza</i>	<i>punctata</i>	jelly	Italy	NE coast of Sardinia
<i>Ophryotroca</i>	<i>diadema</i>	polychaetes	Italy	Porto Empedocle, Sicily, Ionian Sea
<i>Harmothoë</i>	<i>vesiculosa</i>	polychaetes	Italy	Capo Santa Maria di Leuca, Apulia
<i>Charybdis</i> (<i>Charybdis</i>)	<i>lucifer</i>	crustacean	Italy	Gulf of Venice
<i>Catenicella</i>	<i>paradoxa</i>	bryozoan	Italy	Capo Passero Island (Sicily, Tyrrhenian Sea)

Table 2. Range expansions reported from 2009 National Reports.

	Species	Common name	Country	Location notes
Genus	Species	Common name	Country	Location notes
<i>Carcinus</i>	<i>maenas</i>	Green crab	Canada	confirmed on the Newfoundland west coast in Bay St. George
<i>Carcinus</i>	<i>maenas</i>	Green crab	Canada	Îles-de-la-Madeleine - population density has expanded since first observation
<i>Carcinus</i>	<i>maenas</i>	Green crab	Canada	spread along the North Shore of New Brunswick.
<i>Diplosoma</i>	<i>listerianum</i>	Sea squirt	Canada	Îles-de-la-Madeleine - first observed in 2008 - no spread reported in 2009
<i>Caprella</i>	<i>mutica</i>	Japanese skeleton shrimp	Canada	Observed in new location - Bay des Chaleurs in Gaspé Peninsula, Qc
<i>Littorina</i>	<i>littorea</i>	Common periwinkle	Canada	detected in Vancouver Harbour
<i>Caprella</i>	<i>mutica</i>	Japanese Skeleton Shrimp	Canada	observed in several locations in British Columbia (Frey <i>et al.</i> 2009)
<i>Botrylloides</i>	<i>violaceus</i>	Violet tunicate	Canada	confirmed in Murray River on mussel sock
<i>Botrylloides</i>	<i>violaceus</i>	Violet tunicate	Canada	New sightings at Peakes Quay Marina, Charlottetown Harbour on October 1, 2009
<i>Styela</i>	<i>clava</i>	Clubbed tunicate	Canada	New sightings at Peakes Quay Marina, Charlottetown Harbour on October 1, 2009
<i>Ciona</i>	<i>intestinalis</i>	Vase Tunicate	Canada	
<i>Crassostrea</i>	<i>gigas</i>	Japanese oyster	Sweden, moved south	Hallands Väderö (2009), S Kattegat (N 56°27', E 12°33')
<i>Hemimysis</i>	<i>anomala</i>	Boody-red shrimp (mysid)	Sweden, moved north	Forsmark (2003), S Bothnian Sea (N 60°25'03", E 18°11'02")
<i>Marenzelleria</i>	<i>cf. viridis</i>	Red gilled mud worm (polychaete)	Sweden, moved north	Tjärnö (2009), NE Skagerrak (N 58°52'27", E 11°08'44")
<i>Gracilaria</i>	<i>vermiculophylla</i>	(red alga)	Sweden, moved north	Kungsvikshamn (2009), NE Skagerrak (N 58°21'14", E 11°07'30")
<i>Cyclope</i>	<i>neritea</i>	gastropod	Port Lazo, Eng. Chan	48°45'47.93"N, 2°57'56.84"W)
<i>Rapana</i>	<i>venosa</i>	gastropod	W English Channel	48°31'25N, 04°46'15"W So. Brittany; Carnac, Bay of Quiberon, approximately 47°34'6.58"N, 3° 6'12.15"W, St Philibert, approximately 47°35'0.21"N, 2°59'39.18"W
<i>Cephalopholi</i>	<i>taeniops</i>	Atlantic fish	Italy	
<i>Lutjanus</i>	<i>jocu</i>	Atlantic fish	Italy	

<i>Crassostrea</i>	<i>gigas</i>	Pacific cupped oyster	Denmark	Northern entrance to Great Belt
<i>Rhithropanopeus</i>	<i>harrisii</i>	Harris' mud crab	Denmark	Coast of Lolland (western Baltic)
<i>Marenzelleria</i>	<i>viridis</i>	Red gilled mud worm (polychaete)	Denmark	Odense Fjord; Isefjord (both in southern Kattegat)

Table 3. Single species or dead animal sightings from the 2009 National Reports.

Genus	Species	Common name	Country	Location notes
<i>Mytilicola</i>	<i>orientalis</i>	mussel	Germany	
<i>Paralithodes</i>	<i>camtschaticus</i>	king crab	Italy	Ionian Sea
<i>Ascophyllum</i>	<i>nodosum</i>	brown alga	Italy	Mar Grande di Taranto
<i>Kyphosus</i>	<i>incisor</i>	fish	Italy	Teiro Stream, Varazze, Ligurian Sea

Table 4. Species not yet seen based on 2009 National Reports.

Genus	Species	Common name	Country
<i>Urosalpinx</i>	<i>cinera</i>	predatory snail	Belgium
<i>Ocinebrellus</i>	<i>inornatus</i>	predatory snail	Belgium
<i>Fenestrulina</i>	<i>delicia</i>	bryozoan	Belgium
<i>Ruditapes</i>	<i>philippinarum</i>	Manila clam	Belgium
<i>Lennoxia</i>	<i>faveolata</i>	diatom	Germany
<i>Blackfordia</i>	<i>virginica</i>	black jelly fish	Spain
<i>Mnemiopsis</i>	<i>leidyi</i>	warty comb jelly or sea walnut	Spain
<i>Undaria</i>	<i>pinnatifida</i>	brown alga	Sweden
<i>Hemigrapsus</i>	spp.	Asian shore crabs	Sweden
<i>Carassius</i>	<i>gibelio</i>	fish	Sweden

1 Summary of WGITMO 2010 Meeting

1.1 Terms of Reference

1.2 Meeting Attendance

Participants:

Judith Pederson, Chair (USA); Manfred Rolke, Local Host (Germany); Francis Kerckhof (Belgium); Sophie Foster (Canada); Kathe R. Jensen (Denmark); Henn Ojaveer (Estonia); Lauri Urho (Finland); Laurence Miossec (France); Stephan Gollasch (Germany) Kai Trümpfer (Germany); Lisa Benfield (Germany); Anna Occhipinti-Ambrogi (Italy); Gemma Quilez-Badia (Spain); Malin Werner (Sweden); Tracy McCollin (UK); Gordon Copp (UK) and WGBOSV attendees: Daniel Masson (France); Argyro Zenetos (Greece); Allegra Cangelosi (USA); Lisa Drake (USA); Fred Dobbs (USA); Mario Tamburri (USA). Francis O'Biern, Justin McDonald, and Anna Szaniawska, participated by correspondence.

Progress with Terms of Reference

This section addresses the terms of reference discussed at the meeting and gives a brief overview of the highlights. Each Term of Reference (ToR) is discussed below in more detail and in the report appears in the order as discussed based on the Agenda (joint meeting and WGITMO meeting).

- a) Synthesize and evaluate national reports using the new format for reporting and contributions to the database that includes species, locations (latitude and longitude), status of invasions and other relevant species from other ICES member countries as appropriate), and develop an annual summary table of new occurrences/introductions of aquatic invasive species in Member Countries. We will add a section to our format on eradication methods undertaken by countries that have been used and whether or not they have been successful.
- b) Review options for utilizing existing databases and information resources (in ICES countries and elsewhere) to provide a more complete picture of introduced species distribution.
- c) Publish the *Crassostrea gigas* report. And explore the opportunities for the development of short communications materials on species of concern to be peer reviewed and published by ICES on the web or elsewhere.
- d) Continue to develop and discuss joint activities with PICES WG 21 during intersession that furthers cooperation and communication for resources sharing and information on introduced species (example: databases).
- e) Identify the criteria used by ICES countries to develop lists of high, moderate and low risk for intentional introductions and for those introduced species already established.
- f) Finalize the 5 year summary report (2003–2007) during intersession. Note: WGITMO has a draft five-year report, but it is missing a fisheries section including in this report.

- g) Prepare a draft of the 25-year report based on earlier National reports, literature, and other ICES country information, based on new discussions about how best to present this information to be most useful to ICES member countries. We will discuss how best to accomplish this with ICES.
- h) Finalize preparation of a draft report on the different approaches taken by ICES countries on targeted fisheries of nonindigenous species and the impact that these fisheries have had in reducing the spread and abundance of nonindigenous species. This will require intercessional preparation and editing of the report.

WGITMO will continue to meet with WGBOSV on areas of interest to both of Expert Groups. These will include hull fouling, monitoring (e.g. Port Sampling Protocol (a TOR of WGBOSV of interest to WGITMO as some aquaculture facilities are in close proximity to ports, e.g., ballast water discharge zones), data base development with ICES, data sharing, and joint collaboration with PICES WG 21.

The recommended venue for the next meeting in 2011 is Nantes, France during the week of March 14-18, 2011. WGITMO will meet Wednesday March 16, 2011 (jointly with WGBOSV) to Friday March 18, 2010.

2 WGITMO and WGBOSV combined Meeting Summary

Wednesday, March 10, 2010- combined with WGBOSV

Two presentations were made to both the WGITMO and WGBOSV because of the mutual interests, which have been included in discussions below. One presentation by Tracy McCollin (on behalf of Rohan Holt, Countryside Council for Wales) discussed the feasibility of eradication and/or control of *Didemnum vexillum* in Wales. The second presentation reviewed the rapid response approach adopted by Germany.

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

ICES PICES Joint Meeting Summary

An overview of PICES WG 21 and the rapid assessment survey that was held in Jeju, Korea in 2009 were discussed. Currently PICES is focused on two main issues: developing a database and a rapid assessment program (pilot project in China in 2008 and second effort in Korea in 2009).

Areas of possible interaction are: the ICES Code of Practice, which PICES is also working on with respect to prevention and mitigation; development of a taxonomic expert database; and possible joint meetings between ICES and PICES. Judith Pederson reviewed the U.S. experience with rapid assessment surveys and discussed her experience with the PICES rapid assessment pilot project in China and Korea. She noted that the Korean experience ran more smoothly than the first attempt in China where deployed sampling plates were lost prior to removal by Chinese scientists. In addition, some new protocols were instituted, additional taxonomic experts were enlisted to assist with identifications, and the laboratory was able to accommodate the large number of samples. The result was approximately 233 species were identified, but the number of non-native species was not identified, although at least five were identified as non-native.

The discussion of the PICES database was hampered, since neither of the two creators of the PICES database was able to attend the joint meeting. The PICES database is very detailed and in its current form is not easy to share with other users. Although WGITMO has not committed to developing this type of database, the excel-based one that we have started is similar, but lacks detail of species habitats, life histories, and multiple levels of distribution. It was suggested that ICES review the requirements of the PICES database and compare those to their own needs. WGITMO members agreed that the PICES approach has merit, with an adequate level of thought put into its development and structure. However, although there is much information to be gained from it, the amount of work required to accomplish this for each species is enormous. As of 2009, Judith Pederson noted that the database does not integrate information from country to country. For WGITMO and WGBOSV it is advisable to begin with a less ambitious approach with much less detail and construct a database that can be built upon at later date. Details of the proposed WGITMO database are discussed later.

The need for a database was also discussed in detail during the WGBOSV meeting and it was agreed to have follow-up discussion intersessionally.

Recommendations:

- One area for collaboration was to develop and share a database of taxonomic experts. WGITMO has begun to develop the taxonomic expert database with a general process for filtering requests for identification to minimize impacts on the experts.
- The recommendations were to continue with our approach to databases and work with ICES to have them maintain the information. Habitat information and biogeographic regions are to be added to the current information.
- Because the West PAC includes other Pacific countries than PICES does, ICES WGITMO will continue to communicate with them on marine invaders.
- Another area of mutual interest is Climate change. What is needed is a risk assessment of ballast water transportation in the Arctic, a particular concern as the seaways open to traffic. We need to link to PICES countries and Canada and the US and begin to develop a list of species that could survive in Canada. The idea is to conduct environmental matching for ports.

Preliminary List of Experts for Sharing with PICES WG21

Below is a preliminary list of taxonomic experts to share with PICES WG21. The intent is to provide Pacific scientists with names of North Atlantic individuals who are experts in various taxa. The caveat is to share this information among experts only and to establish a clearinghouse (or individual such as the Chair of WGITMO) to forward names to address specific requests. Each individual recommended would be asked if they want to participate.

Cyanobacteria

Phytoplankton - Tracy McCollin (UK)

Diatoms

Dinoflagellates

Macroalgae (Malin will ask Christine Maggs)

Sponges (Francis will check Van Soest)

Ctenophores (Henn will ask colleagues)

Cnidaria (Gemma will ask)

Hydroids

Polychaetes

Molluscs

Bivalves

Gastropods and Opisthobranchs- Kathe Jensen (Denmark)

Crustacea

Amphipods-isopods – Jonne Kotta

Decapods- (Gemma will ask)

Shrimps and Prawns

Cirripedes – Francis K. (Belgium)

Copepods - Gemma Q (Spain)

Bryozoans Anna O- (Italy)

Tunicates (Judy to contact Gretchen Lambert, Anna will contact Mastrotaro)

Echinoderms

Fish and lamprey Henn (Estonia)

A discussion on the issue of range expansion due to climate change led to several observations and needs for continued evaluation of this topic. The question posed was, “Is it a new introduction due to vectors or not when ice melts in the Arctic seaways and permits species moving between oceans?” Several observations were offered.

- Both native and invasive species moving northward
- Changes are occurring in life history traits, e.g. reproduction, recruitment rates
- Climate change not just temperature changes- also current, salinity, pH, etc.
- Basic knowledge on environmental tolerance is not sufficient to make predictions and leads to an inability to predict which species may invade
- The ability to invade under different climate scenarios needs to be examined.

Presentation

Harald Rosenthal, one of the original founders of the WGITMO presented a discussion on the proposed introductions of sturgeon into Germany. These species are threatened in most environments. He presented efforts to determine the genetic sources of the German sturgeons to responsibly identify potential stock. The finding that sturgeons from New Brunswick are genetically identical to European sturgeon has increased options for managing this threatened species. Juvenile sturgeons were shipped from New Brunswick to Germany in 2007. This multiyear effort has ad-

dressed scientific as well as political issues with the hope that over time the species will recover.

ToR a) Synthesize and evaluate national reports using the new format for reporting and contributions to the database that includes species, locations (latitude and longitude), status of invasions and other relevant species from other ICES member countries as appropriate), and develop an annual summary table of new occurrences/introductions of aquatic invasive species in Member Countries. We will add a section to our format on eradication methods undertaken by countries that have been used and whether or not they have been successful.

Summary of Annual Reports

The WGITMO continues to review the format of the annual reports and the data collected. In addition to the data collected, respondents provide references for the species identified providing documentation in the literature. This section briefly discusses the annual report findings and presents a table of new introductions and shifts in distribution for species already present. One of the issues that continues to be problematic is the renaming of species making it difficult to compare historical records with the present ones. Although no one source provides up-to-date information, the World Register of Marine Species (WoRMS), Algaebase, and Fishbase are recommended as useful databases. And although not as up-to-date as WoRMS, the Integrated Taxonomy Information System, also maintains taxonomic data. DAISIE is a database that covers non-native species and most of the ICES countries have a database as well.

The ongoing discussion about which species should be included in the reports resulted in a consensus that WGITMO will report primarily on species in marine and brackish water. Freshwater inland species are not included in the reports. The ICES countries reporting include: Belgium, Canada, Denmark, Estonia, Finland, France, Germany, Ireland, Poland, Spain, Sweden, UK, and USA and Italy and New Zealand have also provided reports.

Countries were also asked to comment on databases.

Belgium recorded no new invasive species during 2009. All introduced species that were reported during previous years are still present and seem to be well-established and thriving. During 2009, *Ensis directus* had an extremely successful spat fall, the most successful ever, and in autumn 2009 billions live specimens ended up on the beaches.

Canada did not report new invaders for the East Coast although new sightings were observed in some of the provinces (e.g., *Diplosoma listerianum* and one specimen of *Ciona intestinalis* in Madeleine Islands). Several tunicate species continued to spread around Prince Edward Island, Nova Scotia and New Brunswick. In addition, the green crab continues to spread throughout several provinces. A species still not observed in Canada is *Didemnum vexillum* even though it is present in the body of water on the US side.

Denmark highlighted the Chinese mitten crab *Eriocheir sinensis* of which a gravid female was found in an area suitable for establishment. The zebra mussel, *Dreissena polymorpha* is spreading into brackish water and the polychaete, *Marenzelleria viridis* is found extensively on sandy bottoms, suggesting an earlier presence. One red alga has not been previously reported, neither have two new sites for *Gracilaria vermiculophylla*. Several species are expanding their range, e.g. the red alga, *Dasya baillouviana* and new records of *Crassostrea gigas* were reported. Species in neighbouring coun-

tries not observed in Denmark include other species of *Marenzelleria* than *M. viridis*, *Mertensia ovum*, *Rapana venosa*, *Urosalpinx cinerea*, and *Ocinebrellus inornatus*.

Estonia noted an increase of the fresh water fish, Gibel carp *Carassius gibelio* in both distribution and abundance. The Chinese mitten crab *E. sinensis* was not detected in 2009 at the sampling station. A general observation was made that invertebrates were increasing in abundance regardless of when they had invaded. Some native species appear to be decreasing, other increasing.

In *Finland* a national strategy on marine bioinvasions is being established, the National Action Plan on Invasive Species was initiated in 2009.

The first record of the midge, *Telmatogeton japonicus* was first recorded in 2008 on the marine supra-tidal region. The salinity is too low for Chinese mitten crab for reproduction. The round goby *Neogobius melanostomus* was first reported in 2005, then none were observed until 2008, and detected near Helsinki in 2009. The gibel carp, *Carassius auratus* m. *gibelio* started to invade inland areas from the sea. Although frequently reported as *C. gibelio*, this species is a complex with the taxonomic status still under discussion. The Russian sturgeon *Acipenser gueldenstaedtii* was caught and probably were aquaculture escapees.

France reported that their database is in development but not yet available online. A Commission decisions (2009/177/EC) establishes surveillance and eradication programs and disease-free status declarations for approval for member states, zones and compartments. A new observation included the red alga, *Polyopes lancifolius* (*Grateloupia okamurai*) and spreading of *Cyclope neritea* and *Rapana venosa*. *Bonamia exitiosa* is spreading and the cause of *C. gigas* die off, the OsHV-1 virus has been sequenced and several species of *Vibrio* are thought to cause brown ring disease – both are widely distributed.

Germany has updated its law on non-native species that is applicable to entire country. There is an obligation to monitor and permission is needed to release species in German waters. Species of concern include the Pacific oyster, *Crassostrea gigas* which survived the severe winter in 2009/2010. There appeared to be no abnormal mortality during the 2009 surveys. A new parasite, *Mytilocola orientalis*, previously present in EU but not in Germany, was sighted in 2009. In addition the diatom *Lennoxia faveolata* is a new sighting. Adult *Amphibalanus amphitrite* are not found in Germany, but the cyprids are in the water column, but apparently it is too cold for metamorphosis.

Ireland reported the marine bryozoan *Bugula neritina* and *Tricellaria inopinata* for the first time in Ireland. *Crassostrea gigas*, *Didemnum vexillum*, and *Styela clava* have been confirmed at a number of sites.

Italy reports fourteen new sightings are described. Two species of algae (*Palisada maris-rubri* and *Ascophyllum nodosum*), two gelatinous macroplankters (*Mnemiopsis leidyi* and *Phyllorhiza punctata*), two polychaetes (*Ophryotroca diadema* and *Harmothoë vesiculosa*) one crustacean (*Charybdis* (*Charybdis*) *lucifera*), one bryozoan (*Catenicella paradoxa*) and one fish (*Kyphosus incisor*) were recorded for the first time in Italy. Moreover, a single large individual of the king crab *Paralithodes camtschaticus* was found in the Ionian Sea. The freshwater alien crab *Procambarus clarki* and the Tilapia *Oreochromis niloticus niloticus* were found for the first time in a marine coastal lake. Two Atlantic fishes expanding their range were found in Italy (*Cephalopholis taeniops* and *Lutjanus jocu*).

In 2009, a commission of experts were designated under new Regulations. There were no new intentional introductions. There were new sightings in new locations,

some as range expansion and several as non-intentional introductions. There is a citizen watch for jellyfish.

New Zealand has adopted a high-risk site surveillance program and added 2 more marine responses, the Mediterranean fan worm *Sabella spallanzanii* and the ascidian *Pyura praeputialis* for reporting range expansions and more. Over 40,000 specimens were collected, 1200 different species and from 13 ports, a 156 species collected of which 114 native.

Poland reported the presence of several amphipods and one isopod although the salinity tolerances of these species are uncertain.

Spain

No specific legislation was passed into law on invasive species, although it is mentioned in other regulations on biodiversity, protection of natural areas, and the criminal code. A new unintentional introduction was the cnidarian *Blackfordia virginica* was first observed in 2008, although the vector is unclear. *Mnemiopsis leidyi* was first reported in 2009 and is probably established in Mediterranean and the pathogen *Bonamia exitiosa* was reported in September 2006. In freshwater, *Dreissena polymorpha* continues to spread with minimal efforts to prevent its spread being undertaken.

Sweden has decided to ratify the Ballast Water Convention. The round goby was first found in 2008 in brackish water (salinity ca 7-8) and observed spreading in 2009 along with evidence of spawning. It was determined to have arrived in 2007. The Chinese mitten crab has decreased in abundance. Currently the laws state that only the owner of waters can harvest oysters. However, there is an effort to change the law so that anyone can harvest the introduced *Crassostrea gigas*. In a parasite monitoring programme for diseases in both blue mussels as well as oysters, *Marteilia refringens* was observed for the first time. The red alga *G. vermiculophylla* was observed expanding northward. In the northern Baltic proper all comb jellies were *Mertensia ovum*. Species not yet observed include e.g., *Undaria pinnatifida*, *Hemigrapsus* spp., and *C. gibelio*.

The *UK* reported finding *Botrylloides* cf. *diagense*. Another blue crab was found as part of a scanning for new invaders. Species that appear to be flourishing are *C. gigas* and the Manila clam. Species spreading include *C. fornicata*, *E. sinensis*, *D. vexillum*, and *C. mutica*, as well as *D. polymorpha*. Species not found are *Sinelobus stanfordi*, *H. sanguineus* and *H. takanoi*.

United States (East Coast) no new species were reported in 2009. The ascidian *Clavelina lepadiformis* and has survived its second winter in Long Island Sound (Connecticut). The Lionfish *Pterois* complex is spreading throughout south, probably from the aquarium trade releases or planted in snorkelling areas. Damselfish, blennies and other warm water species were reported in Florida. Two isopods found in Florida and Texas (appeared to originate from California) are cryptic. There is concern that the Chinese mitten crab, including gravid females is becoming established in the Chesapeake Bay and Hudson River areas. Reports of oriental shrimp and Asian tiger shrimp continue to occur.

Didemnum has expanded and growing in new habitats. *Gracilaria*, and garden escapes of mangrove species are invading wild areas. The nematode parasite of eels continues to spread.

In the US Pacific, kelp *Undaria pinnatifida* has not been eradicated.

See Appendix II for submitted National Reports.

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

The database issue was discussed with WGBOSV at the joint meeting (see above).

A new reporting form has been developed for each country to facilitate documentation of new invasions, and ultimately spreading of previous invasions. The mapping of spread of species requires more support than we currently have.

*ToR c) Publish the *Crassostrea gigas* report. And explore the opportunities for the development of short communications materials on species of concern to be peer reviewed and published by ICES on the web or elsewhere.*

The Alien Species Alert Report: *Crassostrea gigas* (Pacific oyster) was published as the Cooperative Research Report, number 299, 43 pages. Authors were Laurence Miossec, R-M LeDeuff, and Philippe Gouilletquer.

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

There is a need to develop criteria for determining high, medium, and low risks that are consistent across countries. Countries may have different criteria and thus introduce a species that may spread to other countries. There is a need to address this from the perspective of intentional introductions of species already established in some countries as well as those that may be introduced.

The European Union has some regulations to address this issue (see Appendix III.)

The regulations include a rank of Low risk for species that have been in aquaculture for a long time and have no reported impacts. High risk considers species problematic unless proven otherwise. Screening is required to determine if high risk. The issue of what to do with the medium risk remains the conundrum. The European Union needs to consider other EU states' concerns about species they want to use in aquaculture. For example, EU document, Paragraph 6 – provides guidance on risk assessment and notes the community should develop own framework but in the short excerpt there is no mention of ICES Code of Practices and risk assessment guidelines. In the EU regulations, veto power of neighbouring states is not addressed. The next several paragraphs describe criteria used by individual countries.

In Belgium a matrix of potential invasiveness and current distribution screening, particularly of black listed species exists. For freshwater invertebrates the result is a matrix more conservative than the EU.

Risk Assessment in the UK is based on Australia's pre-screening program. An EU scheme is developed from existing protocol and the approach is internationally accepted. Basically the system evaluates environmental impacts and invasions stages (e.g. not present, few populations, enclosed, locally established) for all groups – terrestrial, freshwater and marine. The scoring system is a sum of scores - 1. Spread, 2. Habitat, 3. Maximum value of impact of species (e.g., predation, herbivory etc.), 4. Ecosystem impacts (e.g. nutrient cycling, physical alteration, etc.). Examples of marine invertebrates are given. For the species a profile that provides brief information, risk status and category.

In the U.S. the proposed introduction of an oyster, *Crassostrea ariakensis*, was recommended to replace the native species *C. virginica*, which has done poorly in recent years for a variety of reasons. Virginia wanted the introduction, but other states did not, nonetheless they have no authority to block the introduction. After a lengthy

federal review period, the U.S. confirmed that there was too much risk involved. The process took several years and over 1500 pages of an Environmental Impact Statement (first as a Draft then as a Final EIS).

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

Rapid Assessment Surveys in Germany

A presentation by Christian Buchsbaum on the rapid assessment surveys in Germany provided an overview of their approach. The goal was to identify what is currently present and to describe current spatial distribution. The information is used to identify areas highly susceptible to infestations as well as to calculate invasion rates.

Rapid assessment of non-native species in German coastal waters

Christian Buschbaum, Karsten Reise, Dagmar Lackschewitz

Intensive international trade along the global water ways has caused a dramatic increase in the introduction of alien species in native coastal ecosystem with substantial effects on local species communities and ecosystems. Despite strong consequences of alien species on ecosystem goods and services, no comprehensive concept exists for German coastal waters with the objective of both detection and assessment of exotic organisms. Thus, the aim of our pilot project was to get an overview of benthic alien species along the German North Sea and Baltic Sea coast. Due to the high probability that alien species first establish at ports and marinas in a new environment, we selected eight ports at the North Sea coast and four sites at the Baltic Sea as our study sites. At each location, we studied the species communities of artificial structures such as pontoons and boulders that provide a suitable habitat for exotic organisms. Additionally, we took sediment samples and identified all organisms to species level. At the North Sea coast, we found a total number of 103 species, 26 of them alien species. At the Baltic Sea coast we identified a total number of 81 species. With a number of 7, the occurrence of exotic species was comparatively low here. Besides the high number of non-native organisms we also detected three new species at the North Sea coast which were not found there before (*Tricellaria inopinata*, Bryozoa; *Sinelobus stanfordi*, Tanaidacea; *Telmatogeton japonicas*, Diptera). The project enabled a first comprehensive overview on the occurrence and spatial distribution of non-native species in German coastal waters and, therefore, provides valuable information on the invasion status of single species and the arrival of new exotics. Additionally, it has the potential to serve as a first step for a long-term monitoring program on neobiota. This program would be an important tool to get significant information on the development and status of non-native species in German coastal waters.

In the US Rapid Assessment Surveys bring experts together to sample areas and report on native and non-native species. Students are recruited to participate and to train or encourage their continuation in taxonomy. The US program is not an annual program and is limited as an early detection approach. The methods used in Australian surveys were discussed.

There is an ongoing survey program, Rapid Assessment designed to be an early warning system that is in development in several countries. Information on similar monitoring programs from other countries are requested. The intent is to develop an early warning system and make it a formal process. A coalition of citizen-scientists and others informally go out one to two times a month. In smaller countries, contacts

with fishermen are valuable additions to the program. Volunteer programs are proving to be a good way to get information.

Several years ago, WGITMO began a Rapid Response Report. The topic has proven to be a moving target as several countries, the EU, and collaborative efforts such as IMPASSE have been developing. A Rapid Response document for evaluating options to contain or eradicate unwanted marine invaders has undergone significant revisions over the last two years. Thus, our Rapid Response Report is not yet finalized. We are expanding the topic to include *rapid response/risk analysis/successful eradication*.

The recent risk assessment approaches are being incorporated and significant progress was made at the WGITMO meeting. Participants worked on editing Rapid response document, but several risk assessments need to be incorporated, including the EU document. There is also a need for funds to be available for eradication efforts. It was suggested that evaluating existing field resources is a first step, e.g., how many boats, volunteers, personnel, etc. are available for a response.

Some options include the UK register for emergency response funding, the options of revolving fund where funds are “repaid”, and there may be other options. A section on funding will be added to the document. WGITMO plans to include successful eradication effort, if any examples are provided as well as unsuccessful eradication efforts and lessons learned.

Presentation – *Didemnum vexillum* Feasibility of Eradication and/or Control

Tracy McCollin (on behalf of Rohan Holt, Countryside Council for Wales) presented a summary of eradication efforts in Wales. A report was prepared on the potential for eradication and/or control of *Didemnum vexillum* in Wales by Sarah N. Kleeman based on efforts to manage infestations. The infestation appears to be relatively new, thus the impacts are based on observations from other areas. Economic costs will result from fouling of vessel surfaces and increased fuel costs associated with the fouling. In addition, aquaculture facilities are likely to be impacted and would need to be cleaned along with other associated activities that add costs to the industry. In addition, *Didemnum* may overgrow or foul shellfish with additional removal costs. Ecosystem and habitat changes are not well-documented but in other areas, the sea squirt overgrows most organisms. Associated costs are not available.

Prevention is an obvious way to control the organisms. Transport in the UK is primarily by leisure boats, specifically poorly maintained vessels that may include other vessels as well. Once established, species may go through a lag period before an “explosion” phase to a fully established phase. It can be difficult to identify, and may be confused with sponges and other encrusting ascidians.

Regulations often determine what can be done to control or eradicate a species. Recommendations to add compounds to the water must be approved by regulatory authorities. The process may result in a delay in control of the species.

One approach that was employed in attempting attempt eradication was to “bag” (use plastic wrapping to encapsulate) the organisms, leave the bags in place for 8 days allowing the contents to become anoxic and/or accelerating mortality with the use of chlorine (which takes about 2 days to extirpate the organisms).

A cost-benefit analysis estimated that it would cost 130 thousand pounds in first year in contrast with impacts that would cost 6 M pounds. However, eradication alone is not effective as the vector continues to bring new infestations. This would lead to additional costs associated with monitoring both in affected areas and beyond.

Other eradication attempts are included in the discussion on Targeted Fisheries.

ToR f) Finalize the 5 year summary report (2003–2007) during intersession. Note: WGITMO has a draft five-year report, but it is missing a fisheries section including in this report.

Five Year Report Status

A draft of the five year report is nearly finished. The fisheries section is complete, the invertebrate and disease and pathogen section needs to be reviewed, and the algal section needs additional work. This report has been delayed by retirement of key individuals.

FishBase is an example of a database that provides information on range expansion and contraction, some correlated with climate change. It is an option as a tool to predict invasive species distribution. The question of the legal level and its implementation remains unresolved.

ToR g) Prepare a draft of the 25-year report based on earlier National reports, literature, and other ICES country information, based on new discussions about how best to present this information to be most useful to ICES member countries. We will discuss how best to accomplish this with ICES.

A discussion on how best to address the 25 (perhaps more realistically it should be called the 30 year) report focused on issues not addressed in the five and 10 year reports. The purpose of the report is to identify the “bad actors”, and use the information to assist countries with decisions about control, eradication, and overall management of marine invasions. These concerns included: uncertainty about species establishment, lack of details on where species were identified and by whom, lack of data from several European and/or nearby countries which did not report, uneven reporting by some countries, uncertainty in vectors, and incomplete data from non-standardized reporting. In addition, decisions about whether to include fresh water species or not remains a challenge. It was decided to make the report as useful as possible to ICES and ICES countries. The challenge is to take the country by country and species by species reporting and balance a report that indicates spread, impacts and response to new drivers such as climate change. It was also recognized that it would take several years to complete.

A working outline was adopted.

The 30 (putative 25-year) year report

Foreword – Harald Rosenthal/Jim Carlton

Introduction-

Human pressures – all

Vectors

Physics, geologic, biologic oceanography

Climate Change

The problems of invasions - high, medium, and low risk species

By Region (this section describes marine invaders by regional seas and ocean basins with the person in bold being the Lead Author)

Northwest Atlantic – **Sophie and Judy**

North Sea – Tracy, Kathe, Manfred, **Stephan**, Francis

Kattegat – **Kathe**, Malin

Baltic – Henn, Lauri, Kathe, **Manfred**, Malin

Eastern Atlantic – Laurence, **Tracy** (others), Gemma, Ian, Jim Ellis, Francis O’B., Dan M.

Norwegian Sea – **Anders and Jan**

Mediterranean – Laurence, **Gemma**, Anna, Sophie,

The second section would focus on species

Introduction to species important species -spread, impacts, etc.

Species selected would highlight what is important, which areas, when they arrived and what are the impacts. Filter 10 year and 5 year reports, for one-time reports in the submissions of single reports, rare, and **established**

The challenge is to provide a record of how to deal with countries not represented and the species spread and distribution within these countries.

Summary and Recommendations

The 25-30 year report is a massive undertaking and will take several years to complete. Thus, a draft report will be worked on intersessionally and during the next meeting.

One of the challenges in presenting information about invasions and the impacts are questions that relate to whether species are impacting native communities and ecosystems. An Overview of Bio-pollution Index was presented by Henn Ojaveer.

This index relates to the EU Marine Framework Strategy directive- to assess environmental status of assessment units. The index is characterized by 11 qualitative descriptors including non-indigenous species. The objective of the Bio-pollution Index is to minimize the impact of alien species. The index contains 4 levels of assessment - individual/ community/ habitat/ ecosystem and five sublevels of impact from no impact to high impact. The assessments allow for comparison between different water bodies. More information is available online at;

<http://www.corpi.ku.lt/~biopollution>.

Discussion of the bio-pollution index included concerns there will be no “good habitats” because all habitats have aquatic invasive species. Hence, all mapped habitats will be designated as red or high within a range of possible impact at different levels. EU countries discussed their experience using the index, noting that application of the Index do not result in all areas being classified as seriously degraded from invaders. Recommendations from the WGITMO

- do not have enough information on impacts
- difficult to apply – even absence/ presence data lacking
- Viewed as one tool to identify impacts- cumulative assess

*ToR h) Finalize preparation of a draft report on the different approaches taken by ICES countries on targeted fisheries of nonindigenous species (i.e., *Ruditapes philippinarum* or *Crassostrea gigas*) and the impact that these fisheries have had in reducing the spread and abundance of nonindigenous species. This will require intercessional preparation and editing of the report.*

The request from ICES for information on targeted fisheries on nonindigenous species is summarized by country. Not all countries have information to report, either

reflecting a lack of effort to target nonindigenous species as a fishery or because efforts are small or localized and not a national effort. See Appendix IV for draft report.

The WGITMO discussed what should go in the report. Each country was asked to summarize the following information for their country.

- List of species- which ones targeted
- Economic impacts (+/ -)
- Ecological impacts- including hitch hikers
- Whether or not fisheries have been successful (identify as accidental and intentional, bycatch)

Create a Table of all ICES countries with all species suggested- identify where they occur and where targeted.

Case studies will also be included in the report- e. g. what should be taken into account when considering a targeted fishery on non-native species

Example provided of the River Thames- can't go ahead with fisheries because of bycatch of eels, and Toxins high- reports will be released shortly and distributed to the group.

Prepare final report during intersession.

Terms of Reference for 2011

The **ICES Working Group on Introduction and Transfers of Marine Organisms [WGITMO]** (Chair: Henn Ojaveer, Estonia) will meet in Nantes, France during the week of March 14-18, 2011.to:

- a) Synthesize and evaluate national reports using the adopted format for reporting and contributions to the database that includes species, locations (latitude and longitude), status of invasions from other ICES member countries as appropriate, status of eradication efforts, and habitat, and develop an annual summary table of new occurrences/introductions of aquatic invasive species in Member Countries.
- b) Review options for utilizing existing databases and information resources (in ICES countries and elsewhere) to provide a more complete picture of introduced species distribution and abundance and discuss verification of species identifications.
- c) Review and draft a compilation of existing monitoring activities and programs with the goal of avoiding duplications. A draft summary will be prepared for next year.
- d) Continue to develop and discuss joint activities with PICES WG 21 and CIESM during intersession that furthers cooperation and communication for resources sharing and information on introduced species.
- e) Identify the criteria used by ICES countries to develop lists of high, moderate and low risk for intentional introductions and for those introduced species already established and prepare a final report.
- f) Finalize the 5 year summary report (2003–2007) during intersession. Note: WGITMO has a draft five-year report, but needs to have reviews of the sections.

- g) Prepare a draft of the 25-30 year report based on earlier National reports, literature, and other ICES country information. An outline has been developed for a draft of the report. Given taxonomic name changes, status, and criteria for including species, the process will take several years.
- h) Finalize preparation of a draft report on the different approaches taken by ICES countries on targeted fisheries of nonindigenous species and the impact that these fisheries have had in reducing the spread and abundance of nonindigenous species. This will require intercessional preparation and editing of the report.
- i) WGMASC recommends that key persons of WGITMO dealing with the introduction of aquatic exotic species via shellfish transfers should be invited to the next WGMASC meeting to participate in preparing a joint report, identify information gaps and recommend specific research goals and management advice.

Material and data relevant for the meeting must be available to the group no later than 14 days prior to the starting date.

WGITMO will report by 25 March 2011 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:	<p>a) We want to document successful eradication efforts by ICES countries and identify those that were unsuccessful and why they failed. This information should be of use to developing rapid response plans.</p> <p>b) 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.</p> <p>c) We request that the Final <i>Crassostrea gigas</i> report be published by ICES. The draft is attached, final not yet received.</p> <p>d) We plan joint meetings with PICES at International Conferences and the chairs of the Working Group on Introductions and Transfers has attended PICES meetings. We propose to continue to explore options for collaboration, particularly focusing on database management options for introduced species.</p> <p>e) One of the issues raised is the ranking of invaders as high, moderate, and low risk for intentional introductions. Each country has its own criteria, but these are often contradictory between and among the ICES countries. There is a need to identify criteria used and to develop assessments that are consistent and/or identify a process for reconciling differences. Intersessionally we will compile these criteria and review them..</p> <p>f) We have not been able to finalize the 5-year report and would propose integrating the five year report into a more comprehensive report as discussed in ToR f.</p> <p>g) In reviewing the data from the first two ten year reports, we identified</p>

	<p>many gaps in the data from countries that did not report and data that was overlooked. In addition some species are identified once, but not further information on their establishment is discussed. We are proposing to request that we reorganize the report to include data from National databases, literature and the ICES Annual reports to provide a comprehensive, and list of species that reflects current nomenclature and addresses reports that remain unverified.</p> <p>h) Once species like the Chinese mitten crab are released and established, they may become a target for a fished species. Intersessionally, WGITMO will compile country records of nonindigenous species that have become targeted fisheries and report on the success of this effort next year.</p>
Resource requirements:	None required other than those provided by ICES Secretariat and national members
Participants:	<p>WGITMO members and invited experts from, e.g., Australia, New Zealand, Mediterranean countries that are not members of ICES, representatives of relevant PICES WGs.</p> <p>WGITMO recommends inviting experts with relevant expertise to contribute to the Aliens Species Alert reports and experts from countries which have developed/are developing rapid response plans.</p>
Secretariat facilities:	Meeting room provided 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, Mariculture Committee
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.

Appendix I. List and Addresses of Participants

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

10 – 12 March 2010

LIST OF PARTICIPANTS

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Appendix II. COMPILED NATIONAL REPORTS

ICES WORKING GROUP ON INTRODUCTIONS AND TRANSFERS OF MARINE ORGANISMS.

HAMBURG, MARCH 2010

National Report Belgium

2009

F. Kerckhof MUMM/BMM

Highlights

During 2009 no new invasive species have been recorded.

All introduced species that were reported during previous years are still present and seem to be well-established and thriving.

During 2009 *Ensis directus* had an extremely successful spat fall, the most successful ever, and in autumn 2009 billions live specimens ended up on the beaches.

1. Laws and regulations

There is no new legislation to report.

2. Intentional introductions

There is no information available on intentional introductions if any.

3. Unintentional introductions:

All introduced species that were reported during previous years are still present and seem to be well-established and thriving. An overview of the current status of alien species in Belgian marine waters can be found in Kerckhof *et al.* 2007.

During 2009 *Ensis directus* had an extremely successful spat fall, the most successful ever, and in autumn 2009 billions live specimens ended up on the beaches.

During 2008 six windmills were built on the Thornton Bank some 30 km offshore. The 6 concrete foundations for these wind mills were established on a line, 500 m from each other, between 27 April and 29 May 2008. A monitoring programme was set up to sample the new hard substrates associated with the windmills. After 3.5 months already, a high species richness was found, including four non-indigenous species: the slipper limpet *Crepidula fornicata*, the New Zealand barnacle *Elminius modestus*, the giant barnacle *Megabalanus coccopoma* and *T. japonicus*. (Kerckhof *et al.*, 2009). All four species, already known from the area, are opportunists and early colonisers after disturbance, taking advantage of man-made structures and disturbed conditions to settle.

Not Seen Species Yet

Several species associated with oysters and recently reported from surrounding countries (France & Dutch Oosterschelde) can be expected to turn up in the Spuikom in

Oostende. The Spuikom is a saline pond in connection with the harbour, where some aquaculture (including relaying of oysters) takes place. Examples are the predatory gastropods *Urosalpinx cinerea* (Say, 1822) and *Ocenebrellus inornatus* (Récluz, 1851) (Faasse, 2009), the alien bryozoan *Fenestrulina delicia* Winston, Hayward & Craig 2000 (De Blauwe, 2008) and the Manila clam *Ruditapes philippinarum* (Adams & Reeve, 1850) (Faasse, M., Ligthart, M. 2008). They have not been found yet, however *R. philippinarum* has already been relayed in the Spuikom in the past.

4. Pathogens

No information

5. Meetings

The second Belgian Conference on Biological Invasions entitled "Science facing Aliens" an initiative of the [Belgian Forum on Invasive Species](http://ias.biodiversity.be/conference_2009) has taken place on May 11th 2009 in Brussels. http://ias.biodiversity.be/conference_2009

6. Research projects:

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

7. References and bibliography

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1. Laws and regulations

Fisheries and Oceans Canada (DFO) is currently undertaking policy development work to develop an Aquatic Invasive Species regulation under the *Fisheries Act* and expects to proceed with formal consultations on the draft regulatory development package throughout the fall of 2010. The regulation is expected to be finalized in 2011 – 2012.

The New Brunswick Department of Agriculture and Aquaculture (NB-DAA) and DFO have approved the *Southwest New Brunswick Breach of Containment Governance Document*. The Code of Containment and the Governance Document will be supported by changes in 2010 to current regulations under the *New Brunswick Aquaculture Act*. Once these changes are made, the NB-DAA may take various actions if a site operation is shown to be in non-compliance with the aquaculture industry. The Minister may revoke or suspend an aquaculture license and aquaculture lease. As non-compliance would be considered an offence under the amended regulation, fines can be imposed.

2. Intentional releases and planned introductions

2.1. Synthesis of Domestic Introductions and Transfers

Province	Species	Number	Reason	Notes
British Columbia	Eel	10,000	Research	
	Sablefish (<i>A. fimbria</i>)	1,520	Aquaculture	
	Atlantic Salmon (<i>S. salar</i>)	10,987,900	Aquaculture	
	Chinook Salmon (<i>O. tshawytscha</i>)	751,100	Aquaculture	
	Sockeye Salmon (<i>O. nerka</i>)	1,591,200	Aquaculture	
	Chum Salmon (<i>O. keta</i>)	30,000	Aquaculture	
	Trout (<i>O. mykiss</i>)	200,000	Aquaculture	
	Coho Salmon (<i>O. kisutch</i>)	103,000	Enhancement	
	Chinook Salmon (<i>O. tshawytscha</i>)	90,000	Enhancement	
	White Sturgeon (<i>A. Transmontanus</i>)	1,070,066	Enhancement	
	Rainbow Trout (<i>O. mykiss</i>)	4,250	Enhancement	
	Chinook Salmon (<i>O. tshawytscha</i>)	63,500	Research	
	Sockeye Salmon (<i>O. nerka</i>)	1,505,400	Research	
	Coho Salmon (<i>O. kisutch</i>)	4,010	Research	
	Pink Salmon (<i>O. gorbuscha</i>)	15,050	Research	
Threespine Stickleback (<i>G. aculeatus</i>)	100,550	Research		

	White Sturgeon (<i>A. Transmontanus</i>)	50,000	Research	
	Trout (<i>O. mykiss</i>)	1,610	Research	
	Geoduck Clam (<i>P. Abrupta</i>)	4,000,500	Aquaculture (beach or sub-tidal seeding)	Juveniles
	Blue Mussel (<i>M. Edulis</i>)	10,000,000	Aquaculture	Larvae
	Gallo Mussel Seed (<i>M. galloprovincialis</i>)	97,000,000	Aquaculture	Seed
	M.C. Mussels (<i>M. Californianus</i>)	4,000	Aquaculture	Adult
	Japanese Scallop (<i>P. yessoensis</i>)	50,000	Aquaculture	Adult
	Abalone (<i>H. kamtschatkana</i>)	3,000	Enhancement	Adult
	Abalone (<i>H. kamtschatkana</i>)	6,000,000	Research	Larvae
	Cockles (<i>C. nuttali</i>)	19,510,000	Research	Seed
	Blue Mussel (<i>M. Edulis</i>)	26,500	Research	Seed
	M.C. Mussels (<i>M. californianus</i>)	1,050	Research	Adult
New Brunswick	Atlantic Salmon (<i>S. Salar</i>)	17.5 M	Aquaculture (all life stages)	
	Atlantic Salmon (<i>S. Salar</i>)	1.7 M	Enhancement	
	Atlantic Salmon (<i>S. Salar</i>)	14 K	Research	
	Landlock Salmon (<i>Salmo salar Sebago</i>)	200 K	Enhancement	
	Brook Trout (<i>Salvelinus fontinalis</i>)	275 K	Enhancement	
	Artic Char (<i>Salvelinus alpinus alpinus</i>)	8 K	Aquaculture	
	Halibut (<i>Hippoglossus hippoglossus</i>)	7 K	Aquaculture	
	Rainbow Trout (<i>Oncorhynchus mykiss</i>)	18K	Aquaculture	
	Shortnose Sturgeon (<i>Acipenser brevirostrum</i>)	11 K / 630	Aquaculture / Research	
	Atlantic Cod (<i>Gadus morhua</i>)	15 K	Aquaculture	
	American Oysters (<i>C. virginica</i>)	7 M	Aquaculture	
	Mussels (<i>Mytilus edulis</i>)	4500 kg	Aquaculture	
	Scallop (<i>Placopecten magellanicus</i>)	8000	Aquaculture	
	Lobster (<i>Homarus americanus</i>)	600 K	Enhancement	
Newfound land and	<i>Salvelinus fontinalis</i> (Brook trout)	100,000	Component of a habitat compensation agreement related to a	Origin:- a hatchery;

Labrador			hydroelectricity project	released to a lake Ongoing past few years
	<i>Salmo trutta</i> (brown trout)	4,000	Research PhD candidate – mark-recapture experiment involving reciprocal transfers of about 1K fry to each of the watersheds to evaluate growth, survival and adaptability.	Origin: - research facility reared fry from donor animals from each watershed.
	<i>Homarus americanus</i> (lobster larvae)	20,000	Lobster enhancement project	Origin – research facility from broodstock collected in same area.
Quebec	Giant Scallop (<i>Placopecten magellanicus</i>)	1,000,000	Aquaculture	
	Clam (<i>Mya arenaria</i>)	50 000	Aquaculture	
	American Oyster (<i>Crassostrea virginica</i>)	16 200	Development	
PEI	Brook Trout 1	50,000 yearling	Enhancement of public fisheries and resulting recreational angling opportunities	
	Rainbow Trout	225	200 yearlings stocked to provide angling opportunity in a community setting; other 25 were removed from one branch of a river and transferred to a holding pond as part of an Atlantic salmon restocking research project	Community pond is screened to prevent release of fish to waters d/s; fish transfer as part of research project have been present in the wild in the area in excess of 15 years
	Atlantic Salmon ¹	42,900	Stocked into a select number of river for enhancement purposes and in support of a restocking research project in Souris River	
	American Oyster ²	It is difficult to provide a number, because applications vary on this point; some indicate quantity in	Transfers to aquaculture leases and to public grounds in support of enhancing public fisheries	These transfers occur on an annual basis with stock acquired from provincial waters; they represent transfers from one estuary to another and are

		boxes, others in pans and still others in pounds.		covered by I&T because they originate in designated restricted waters because of the presence of one or more AIS tunicate species.
	Bay Scallops	125,000 spat	Grow-out on aquaculture leases; spat secured from hatcheries sources on mainland	Product stocked in June/July and harvested in December of the same year; product does not survive over winter in Island estuaries
	Blue Mussels ³	~2 million pounds of spat	Used to restock aquaculture leases within the province	It is difficult to provide a precise number because some requested relate to number of tanks and others to number of pounds.
Nova Scotia	Atlantic Salmon (<i>Salmo salar</i>)	>300	DFO stocking program and Nova Scotia Department of Fisheries and Aquaculture (NSDFA) -Provincial stocking program	Mainly juvenile fish DFO partners on an outreach program with the Atlantic Salmon Federation for educational purposes. NSDFA has a stocking program whereby 200 lakes are stocked in the spring and an additional 200 are stocked in the fall for the purposes of inland fisheries management.
		146,360	Research	Research being conducted by various by institutions
		10,405,000	Aquaculture	Transfers include eggs, fry and smolt.
	Rainbow Trout (<i>Oncorhynchus mykiss</i>)	Unknown	NSDFA-Provincial Stocking Program	NSDFA has a stocking program

				whereby 200 lakes are stocked in the spring and an additional 200 are stocked in the fall for the purposes of inland fisheries
		3,255,800	Aquaculture	Mainly eggs and fingerlings These numbers include transfers from the US and are captured below.
Brook Trout (<i>Salvelinus fontinalis</i>)		15,000	Aquaculture	Fry only
Arctic Char (<i>Salvinus alpinus</i>)		25,000	Aquaculture	Eyed eggs only
Speckled Trout (<i>Salvelinus fontinalis</i>)		Unknown	Enhancement - Provincial stocking program	NSDFA has a stocking program whereby 200 lakes are stocked in the spring and an additional 200 are stocked in the fall for the purposes of inland fisheries
Brown Trout (<i>Salmo trutta</i>)		Unknown	Enhancement - Provincial stocking program	NSDFA has a stocking program whereby 200 lakes are stocked in the spring and an additional 200 are stocked in the fall for the purposes of inland fisheries
Land Locked Salmon (<i>Salmo salar</i>)		Unknown	Enhancement - Provincial stocking program	NSDFA has a stocking program whereby 200 lakes are stocked in the spring and an additional 200 are stocked in the fall for the purposes of inland fisheries
Atlantic Halibut (<i>Hippoglossis hippoglossis</i>)		4,370	Aquaculture	Juvenile fish only
		500	Research	
Atlantic Cod		500	Research	Juvenile fish

	(<i>Gadus morhua</i>)			only
	Atlantic Whitefish (<i>Coregonus huntsmani</i>)	2,500	Enhancement	Juvenile fish only
	Striped Bass (<i>Morone saxatilis</i>)	20,000	Aquaculture	Juvenile fish only
	European oysters (<i>Ostrea edulis</i>)	2,040,000	Aquaculture	
	Soft shell clams (<i>Mya arenaria</i>)	100,000	Aquaculture	Seed were introduced from the USA.
	Bay Scallop (<i>Argopecten irradians</i>)	300,000	Aquaculture	
	Green Crab (<i>Carcinus maenas</i>)	75	Research	Moved into a land based, quarantine facility.
	American lobster (<i>Homarus americanus</i>)	100	Research	
		150,150	Enhancement	
	Blue Mussels (<i>Mytilus edulis</i>)	1,378,343 lbs	Aquaculture	Shellfish is generally transferred from PEI and requires treatment for AIS
		1,200	Research	
	American oysters (<i>Crassostrea virginica</i>)	454,000	Aquaculture	
		450	Research	
		50,000	Other	

¹⁾ All enhancement activities listed here involve progeny of adult fish collected from local waters.

²⁾ Oyster spat is transferred from Ellerslie Reserve to a number of estuaries within the province for purpose of enhancing public beds. In addition, lease holders transfer spat between estuaries. Where transfers involve movement between estuaries, I&T licence requirement applies due to the presence of AIS tunicates in the waters of origin.

³⁾ Mussel seed is used to restock mussel grow-out leases. Transfer of seed between estuaries does occur, but growers attempt to meet their needs from within the same body of water where grow-out occurs. Where transfers involve movement between estuaries, I&T licence requirement applies due to the presence of AIS tunicates in the waters of origin.

2.2 Imports into Canada

Province	Species	Country of Origin	End Use	Notes
British Columbia	Northern Anchovy (<i>E. mordax</i>)	Washington, USA	Research	
	Dace (<i>Phoxinus</i>)	Alberta, BC	Research	
	Atlantic Salmon (<i>S. salar</i>)	Iceland	Aquaculture	
	Rainbow Trout (<i>O. mykiss</i>)	Washington, USA	Aquaculture	
	Manila Clams (<i>V. philippinarum</i>)	Guangdong, China, Western USA incl. Hawaii	Aquaculture	Seed
	Geoduck Clam (<i>P. abrupta</i>)	Washington, USA	Broodstock	Adults
	Pacific Oyster (<i>C. gigas</i>)	Western USA incl. Hawaii	Aquaculture	Seed
	Kumamoto Oysters (<i>C. sikamea</i>)	Western USA incl. Hawaii	Aquaculture	Seed
New Brunswick	Atlantic Salmon (<i>S. Salar</i>)	USA	Aquaculture	
	Atlantic Cod (<i>Gadus morhua</i>)	USA	Aquaculture / Research	
	Soft Shell Clam (<i>Mya arenaria</i>),	USA	Research	
	Sea Urchin (<i>Strongylocentrotus droebachiensis</i>)	USA	Research	
Newfoundland and Labrador	Rainbow trout eggs (<i>Oncorhynchus mykiss</i>)	United States	commercial	Hatchery supplier
	Atlantic cod (<i>Gadus morhua</i>)	United States	commercial	Hatchery supplier
	Ghost shrimp (<i>Callinassa californiensis</i>)	United States	research	Destination: Closed containment facility only
	Mud shrimp (<i>Upogebia pugettensis</i>)	United States	research	Destination: Closed containment facility only
Nova Scotia	Mexican Tetra (<i>Astyanax mexicanus</i>)	USA	Research	Juveniles and embryos Fish were transferred to a land based, research facility whereby the fish would be contained in a closed circulation tank.

	Zebrafish (<i>Danio rerio</i>)	USA	Research	Adult pairs and embryos Fish were transferred to a land based, research facility whereby the fish would be contained in a closed circulation tank.
	European Sea Bass (<i>Dicentrachus Labrax</i>)	France	Aquaculture	Fish were transferred to a land based, quarantine facility.
	Rainbow Trout (<i>Oncorhynchus mykiss</i>)	USA	Aquaculture	Eyed eggs only
	Soft shell clams (<i>Mya arenaria</i>)	USA	Aquaculture	Seed only

3. Unintentional Releases

Newfoundland and Labrador:

- No new invasive species reported in Newfoundland and Labrador
- In 2009, *Carcinus maenas* presence was confirmed on the Newfoundland west coast in Bay St. George.
- Experimental control programs established for *Botrylloides violaceus* and *C. maenas* in 2008 continued into 2009.
- In 2009, 6 505 lbs of green crab were removed (899 trap hauls) during 9 days of the experimental control project between July 13 and July 29.

New Brunswick:

- No new species reported in New Brunswick.
- In 2009, *Carcinus maenas* was observed to have spread along the North Shore of New Brunswick.
- Monitoring efforts continued for tunicate species.
- A rapid assessment to search for *Didemnum vexillum* was conducted in Sept 2009 using divers, underwater camera systems and scallop drags. *Didemnum vexillum* colonies were not detected. *D. vexillum* has been detected on structures in Eastport, Maine, very close to Canada.

Prince Edward Island

- Monitoring confirmed presence and absence of vase *Ciona intestinalis*, clubbed *Styela clava*, violet *Botrylloides violaceus* and golden star *Botryllus schlosseri* tunicates, including spread of previously detected species throughout the province, and absence in previously detected areas, how-

ever, no new invasive species are reported in the province. The following information covers the years 2008 and 2009.

- Violet tunicate were confirmed in Murray River on mussel sock on lease SUR-0520-L October 8, 2008; coordinates -62.538, 46.02884
- Vase, clubbed, violet and golden star tunicates confirmed at Souris Marina, Souris Harbour. On September 22, 2008; vase tunicates were present on floating docks, while the other three species were observed on pleasure boats. A subsequent check in August and September re-affirmed presence of all four species; vase tunicate also detected on collector plate in 2009; coordinates -62.2488, 46.34723
- Golden star tunicate confirmed present on buoy at wharf in Nine Mile Creek in 'rapid response' exercise in 2008; species was observed present throughout the harbour on wharf structures in 2009 exercise; no vase tunicates were observed in the 'rapid response' exercises in 2008 and 2009; coordinates for golden star sighting -63.2180, 46.14818
- Vase, clubbed, violet and golden star tunicates confirmed present at Peakes Quay Marina, Charlottetown Harbour on October 1, 2009; the presence of clubbed and violet represent new sightings for the area; vase tunicate was not observed in a check in 2008 on structures where it was confirmed present in 2007; in 2009 colonials observed on floating docks, while vase, clubbed and golden star observed on pleasure boats present in marina; boats infested with clubbed tunicate had visited waters of Cardigan Bay earlier in the year; coordinates -63.1219, 46.23133
- Monitoring of mussel leases in this Hunter River estuary failed to detect the presence of violet tunicate in 2008 and 2009; thus, the restricted water designation for this estuary was lifted.
- Golden star tunicate were not present when floating docks removed and checked from the harbour at West Point on November 6, 2009. This species was detected on similar structures in 2006; the 2009 check represented the first re-check of the area; coordinates -64.0756, 46.77988

Nova Scotia:

- Currently in NS, there is a monitoring/surveillance program in place for aquatic invasive species (AIS). This program is being lead by Fisheries and Oceans Canada (DFO-Science) with assistance from the Nova Scotia Fisheries and Aquaculture (NSDFA) and various community groups. To date the species of tunicates found in coastal waters of NS include Golden Star (*Botryllus schlosseri*), Vase (*Ciona intestinalis*) and Violet (*Botrylloides violaceus*). The DFO AIS program also conducts surveillance for the presence of the clubbed tunicate, *Styela clava*, and the pancake-batter tunicate, *Didemnum vexillum*, neither of which has been recorded in Nova Scotia to date.
- In addition to the above, the monitoring and surveillance program examined the distribution of Lacy crust bryozoan (*Membranipora membranacea*) and Japanese skeleton shrimp (*Caprella mutica*). This information, in conjunction with the information on tunicates, was uploaded to the national AIS database.
- The AIS monitoring and surveillance program does not currently examine green crab distribution. However, the intent is to monitor the distribution of green crab within the province of Nova Scotia.

Quebec:

- Suite à la découverte de *Diplosoma listerianum* en octobre 2008 aux Îles-de-la-Madeleine, une évaluation de la situation (*Rapid Assessment*) a été réalisée en août 2009 au même site à l'aide de plongeurs et de caméras submersibles. Aucun autre spécimen n'a été observé en 2009. Pour l'instant, nous ne pouvons pas confirmer que cette espèce est établie. Nous continuerons de suivre cette espèce.
- Un spécimen de *Ciona intestinalis* a été observé en août 2009 sur une plaque de détection faisant partie du programme de monitoring des EAE (protocole standard pour toutes les provinces atlantiques). Il s'agit de la troisième observation de cette espèce aux Îles-de-la-Madeleine depuis 2006.
- Le crabe vert est maintenant clairement établi aux Îles-de-la-Madeleine et la population est en expansion, passant de seulement 47 crabes en 2007, à 457 en 2008 et 1200 crabes en 2009. Des crabes de très petites tailles (juvéniles) ont aussi été capturés depuis 2008.
- One specimen of *Caprella mutica* has been observed in one location in the Bay des Chaleurs in Gaspe Peninsula, Qc. We cannot confirm that this species is established in this area for the moment.

Ontario:

- The Great Lakes is under threat of invasion from Asian carps (particularly from Bighead Carp (*Hypophthalmichthys nobilis*) and Silver Carp (*H. molitrix*)). A risk assessment conducted by DFO's Centre of Expertise of Aquatic Risk Assessment found the likelihood of introduction and magnitude of the consequences to be high for Canadian water, especially the Great Lakes. Canada participated in massive control efforts (rotenone) of the Chicago Sanitary and Ship Canal to minimize risk of introduction in December 2009.

Manitoba:

- Canadian prairie watersheds, particularly Lake Winnipeg, Manitoba, are under threat of invasion from zebra mussels (*Dreissena polymorpha*).
- Zebra mussels are in the Red River basin (Pelican Lake MN). Curly leaf pondweed is in SW Manitoba in Lake Metigoshe that borders North Dakota (USA). Latitude (DMS) 48° 58' 60 N, Longitude 100° 20' 60 W

British Columbia:

- In B.C. two new species were detected in 2009 including *Caprella mutica* and *Littorina littorea*. *Caprella mutica* was previously reported in the adjacent waters of B.C. and observed in several locations (Frey *et al.* 2009). *Littorina littorea* was detected in Vancouver Harbour and the pathway is unknown at this time.
- Monitoring in British Columbia has focused on biofouling agents, such as, tunicates, and Bryozoans, and inter-tidal species such as, non native bivalves and Green Crab.
- A control experiment took place on *Didemnum vexillum*., an invasive species associated with Oyster aquaculture. The experiment explored chemical (eg. concentration), biological treatments (eg. grazing by sea urchins) and manual treatments (eg. cleaning).

4. Pathogens

- In 2008, Malpeque disease was detected in the North Denys Basin area, Nova Scotia of the Bras d'Or Lakes. Malpeque was not previously detected in the Bras d'Or Lakes prior to 2008. Additionally, MSX continues to pose a problem for aquaculturists in Eastern Nova Scotia.

5. Meetings, conferences, symposia or workshop on Introductions and Transfers

AIS Regulatory Workshop, January 27-28, 2009, Vancouver, BC.

International Conference on Aquatic Invasive Species. April 19-23, 2009. Montreal, QC. B. Cudmore organized and moderated a session on risk assessment, and was a keynote speaker for the conference.

I&T National Meeting (Regulatory consultations) May 22, 2009. Ottawa, ON

AIS National Rapid Response Workshop, June 9-10, 2009, Vancouver, BC

National Aquatic Animal Health Program (NAAHP) - Domestic Disease Control Program Meeting

Atelier sur la gestion des tuniciers envahissants, 14-15 décembre 2009 Cap-aux-Meules, Îles-de-la-Madeleine, QC

Canadian Aquatic Invasive Species Network Annual General Meeting, May 3-5, 2009 Halifax, NS

Formation sur l'identification et la biologie des tuniciers, 5-9 octobre 2009 IML.

Industry Workshop on Shellfish and Biosecurity and Aquatic Invasive Species September 24-30 Grand Falls/Windsor, NL.

Upcoming 2010:

- Aquatic Invasive Species Workshop, St. John's, Newfoundland. March 2010
- Canadian Science Advisory Secretariat (CSAS) Newfoundland and Labrador Region green crab peer review meeting. March 2010.
- Canadian Science Advisory Secretariat (CSAS). Biological risk assessment of New Zealand mudsnail in Canada (Centre of Expertise for Aquatic Risk Assessment - CEARA) March 2010.

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National Report, Denmark 2009

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Regulations:

The National Action Plan on Invasive Species is now in the implementation phase and plans for management of individual species are under construction; though there are none for marine species so far. The new base-line studies for Natura2000 areas now include marine invasive species, as listed in the "Black-list" of the Action Plan, among threats to ecological status.

Intentional introductions:

None reported.

Live imports and exports:

Danish fisheries' statistics do not permit separation into amounts for consumption, industrial purposes or release for aquaculture (see National Report 2008).

Unintentional introductions:

Invertebrates:

The orange-striped sea anemone, *Diadumene lineata* (Verrill, 1869) (= *Haliplanella l.*) has been found at the small island Læsø in northern Kattegat. It was first found in September 2008 in Bover Bugt, a small shallow bay, and again in August 2009 at the same locality. The identity has been confirmed by experts and the report was accompanied by photos.

Mnemiopsis leidyi (A. Agassiz, 1865) has been monitored in the Limfjord during a cruise on 14-17 September 2009 and it was concluded that many specimens were present (see http://www.blst.dk/Vandmiljoeet/Hav/DanskeFarvande/Limfjorden/Limfj_uge_3809.htm?WBCMODE=pres). DTU-Aqua monitored *M. leidyi* in the Danish part of the Baltic Sea in November 2009 and concluded that there were fewer specimens than last year (see <http://www.aqua.dtu.dk/Nyheder.aspx?guid=56601C37-3BE0-4317-82EA-365717205F08>).

The North American Harris' mud crab, *Rhithropanopeus harrisi* (Gould, 1841), which has only been observed twice before (see National report 2008), was reported to environmental authorities in March 2009. About 50 specimens had been collected by a fisherman in 2008, at several places along the coast of the island Lolland in southern Denmark (Olesen & Tendal, 2009). No egg-bearing females have been caught, so it is unknown if a reproducing population exists in Danish waters. Also it is unknown whether the crab migrated from places along the south coast of the Baltic Sea, e.g. Poland, where it has been established for several years, or if it has been introduced by human activities, e.g. ballast water or hull fouling.

There have been no new reports of mitten crabs, *Eriocheir sinensis* (Milne-Edwards, 1853) in 2009, but one fisherman reported egg-carrying females in Ribe Å in 2009 (Tendal, 2009). As this stream enters the Wadden Sea, which has high salinity, there is

a chance that reproduction may be successful for this population. This would mean that *E. sinensis* may be considered established in Denmark.

There were a few new records of *Crassostrea gigas* (Thunberg, 1793) in 2009: Near Kalundborg, in north-eastern Storebælt (Great Belt) several large live specimens were observed in the summer of 2009. Some live specimens were reported in the narrow strait between Langeland and Fyn. Also, density and area covered are increasing in the Wadden Sea as well as in the western Limfjord. *C. gigas* is one of the focus species of the MARINVA project (see below).

The zebra mussel, *Dreissena polymorpha* (Pallas, 1771), until now, occurred only in freshwater. It has spread through most of the Gudenå river system up to Randers Fjord, which is brackish. Hence, the inner part of this fjord should be monitored. It was first reported from the Gudenå river system in 2006. A folder has been prepared on how to clean pleasure craft (mostly canoes and kayaks) and fishing gear when leaving the Gudenå to avoid further spreading (available at: <http://www.skanderborg.dk/Default.aspx?ID=28135>).

The spionid polychaete *Marenzelleria viridis* (Verrill, 1873) has now been found, and is dominating, in most coastal waters in Denmark, e.g. Odense Fjord (Dr. E. Kristensen, SDU, pers. comm.). It has been noticed that the species seems to occur only in sandy bottoms and it seems to displace the native *Hediste diversicolor* (O.F. Müller, 1776). *M. viridis* is one of the focus species of the MARINVA project (see below). Other species of *Marenzelleria* have not been collected.

Fish:

Neogobius melanostomus (Pallas, 1914) has been caught at Bornholm in May 2009 (see <http://snm.ku.dk/forskning/projekter/fiskeatlas/nyheder/2008009/>) and at Guldborgsund in October 2009 (see <http://snm.ku.dk/forskning/projekter/fiskeatlas/nyheder/sortkutlingguldborgsund/>).

Acipenser oxyrinchus (Mitchill, 1815) were caught near Hasle, Bornholm on 4 May 2009 (see <http://snm.ku.dk/forskning/projekter/fiskeatlas/nyheder/2008010/>) and at the southern tip of the island, Langeland, in Storebælt (Great Belt) 31 October 2009 (see <http://snm.ku.dk/forskning/projekter/fiskeatlas/nyheder/2008017/>). Both were recaptures of marked specimens released by researchers from University of Rostock.

Macroalgae:

Dasya baillouvia (Gmelin) (Montagne, 1841) has extended its distribution in Danish waters. It has been found in the harbor of Copenhagen (Nielsen, 2008).

Gracilaria vermiculophylla (Ohmi; Papenfuss, 1967) observations from 2008 not reported previously. (Avnø Fjord, juni 2008) (See http://www2.blst.dk/publikationer/naturplanforslag/169_HavKystKar.pdf); (Fyns Hoved, November 2009; Grandorf *et al.*, 2009).

Fucus evanescens (C. Agardh, 1820) is now a dominant species in the harbor of Copenhagen (Nielsen, 2008).

Sargassum muticum (Yendo; Fensholt, 1955) continues to be a nuisance for mussel farmers in the Limfjord (J.K. Petersen, pers. comm.).

Species not yet observed:

The Arctic ctenophore, *Mertensia ovum*, (Fabricius, 1780) has not been observed in Danish waters.

The presatory gastropods, *Rapana venosa* (Valenciennes, 1846), *Urosalpinx cinerea* (Say, 1822) and *Ocenebrellus inornatus* (Récluz, 1851) have not been observed in Danish waters. All may be associated with oysters, and particularly the Wadden Sea and western Limfjord should be monitored for the appearance of either one of these species.

Pathogens:

No new records

Meetings:

The National Marine Scientists' meeting was held in Helsingør, 27-29 January 2009. One session was dedicated to invasive species. Six oral presentations and several posters were presented. (Unfortunately the book of abstracts has not been made available electronically).

DTU-Aqua organized a "Jelly Day" on 26 November 2009. There were 10 presentations on *Mnemiopsis* and two on other jelly-plankton. Abstracts available at: <http://www.dfu.dtu.dk/upload/dfu/kalender/Jelly%20Day%2026%20November%2009%20Abstracts.pdf>.

The Centre for Invasive Species, University of Copenhagen, organized a workshop on 25 January 2010 on the topic of Practical aspects: Prevention, Mitigation and Eradication. Thirteen oral presentations (only one marine) were given and 8 posters (only one marine) were presented.

The 6th NEOBIOTA Conference will be held in Copenhagen 14-17 September 2010 (see <http://cis.danbif.dk/neobiota2010>).

Research projects:

MARINVA - Marine Invasive Arter i Danmark [Marine invasive species in Denmark] – Research project over three years (2009-2011) to study the ecosystem impacts of marine invasive species. Grant from Danish Research Council for Nature and Universe to Dr. Benni Winding Hansen, Institute for Environment, Society and Spatial Change, Roskilde University (RUC).

Acknowledgements:

I would like to thank many colleagues at universities, regional environmental agencies and consulting companies for contributing unpublished material for inclusion in the report.

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ICES Working Group on Introductions & Transfers of Marine Organisms

National Report for Estonia 2010

Compiled by Henn Ojaveer

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Regulations

In 2009 an amendment was drafted of the Nature Protection Act (2004) including a list of species whose import into Estonia is forbidden. According to the amendment, the regime of complete ban will be replaced by a system of permits of different restrictions. No new fish species will be added to the list. This amendment is still being processed within the Ministry of the Environment and will be adopted during 2010.

In 2009, the Environment Agency was designated as the competent authority for issuing permits according to the EC regulation No 708/2007 concerning use of alien and locally absent species in aquaculture.

The Nature Protection Development Plan (NPDP) was drafted and published for comments during 2009, but it is not yet finished. Fisheries and aquaculture is one part of the plan. It will be finished and approved during 2010.

In the fisheries sector, annual amendments to fishing restrictions were established. No new acts or regulations were drafted or adopted.

Intentional Introductions

Estonia continues live fish imports from various countries. The statistical nomenclature categories do not always allow identification of the species, but gives fish by origin or taxonomic group. During the past two years only salmonids (salmon and sea trout) have been released into natural water bodies in order to enhance fishery resources.

LIVE IMPORTS

2008

Country	Fish	Quantity (kg)
Indonesia	Ornamental freshwater fish	630
Latvia	Ornamental freshwater fish	1
Peru	Ornamental freshwater fish	105
Singapore	Ornamental freshwater fish	2108
Sri Lanka	Ornamental freshwater fish	266
Indonesia	Ornamental marine fish	794
Lithuania	Ornamental marine fish	56
Singapore	Ornamental marine fish	15
Sri Lanka	Ornamental marine fish	144
Lithuania	<i>Oncorhynchus apache</i> and <i>O. chrysogaster</i>	1700
Latvia	<i>Oncorhynchus apache</i> and <i>O. chrysogaster</i>	1232
Latvia	Unidentified salmon	136801
Holland	<i>Anguilla anguilla</i>	75

Latvia	cyprinids	11135
Lithuania	<i>Thunnus maccoyii</i>	217
Latvia	<i>Thunnus maccoyii</i>	207
Lithuania	<i>Oncorhynchus nerka</i> , <i>O. gorbuscha</i> , <i>O. keta</i> , <i>O. tschawytscha</i> , <i>O. kisutch</i> , <i>O. masou</i> , <i>O. rhodurus</i> , <i>Salmo salar</i> , <i>Hucho hucho</i>	385
Unknown	<i>Oncorhynchus nerka</i> , <i>O. gorbuscha</i> , <i>O. keta</i> , <i>O. tschawytscha</i> , <i>O. kisutch</i> , <i>O. masou</i> , <i>O. rhodurus</i> , <i>Salmo salar</i> , <i>Hucho hucho</i>	21542
Israel	Unidentified fish	720
Latvia	Unidentified fish	269
Finland	Unidentified fish	2080

2009 (January-October)

Country	Fish	Quantity (kg)
Colombia	Ornamental freshwater fish	113
Germany	Ornamental freshwater fish	238
Singapore	Ornamental freshwater fish	1368
Czech Republic	Ornamental freshwater fish	330
Indonesia	Ornamental marine fish	80
Singapore	Ornamental marine fish	24
Finland	Ornamental marine fish	2779
Sri Lanka	Ornamental marine fish	200
Lithuania	<i>Oncorhynchus apache</i> and <i>O. chrysogaster</i>	1023
Latvia	<i>Oncorhynchus apache</i> and <i>O. chrysogaster</i>	546
Norway	<i>Oncorhynchus apache</i> and <i>O. chrysogaster</i>	92795
Lithuania	Unidentified salmon	129
Latvia	Unidentified salmon	155071
Holland	<i>Anguilla anguilla</i>	28
Latvia	cyprinids	6589
Lithuania	<i>Thunnus maccoyii</i>	51
Latvia	<i>Thunnus maccoyii</i>	25
Lithuania	<i>Oncorhynchus nerka</i> , <i>O. gorbuscha</i> , <i>O. keta</i> , <i>O. tschawytscha</i> , <i>O. kisutch</i> , <i>O. masou</i> , <i>O. rhodurus</i> , <i>Salmo salar</i> , <i>Hucho hucho</i>	377
Norway	<i>Oncorhynchus nerka</i> , <i>O. gorbuscha</i> , <i>O. keta</i> , <i>O. tschawytscha</i> , <i>O. kisutch</i> , <i>O. masou</i> , <i>O. rhodurus</i> , <i>Salmo salar</i> , <i>Hucho hucho</i>	38823
Israel	Unidentified fish	390
Latvia	Unidentified fish	104

LIVE EXPORTS

2008

<i>Country</i>	<i>Fish</i>	<i>Quantity (kg)</i>
Latvia	<i>Oncorhynchus nerka</i> , <i>O. gorbusha</i> , <i>O. keta</i> , <i>O. tshawytscha</i> , <i>O. kisutch</i> , <i>O. masou</i> , <i>O. rhodurus</i> , <i>Salmo salar</i> , <i>Hucho hucho</i>	17150
Holland	<i>Anguilla anguilla</i>	23498
Russian Federation	Unidentified fish	5000

2009 (January-October)

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

Official data on fish releases of Estonia for 2008 and 2009 (in thousands)

Species/year	2008	2009
Salmon (<i>Salmo salar</i>)	294,300	190,710
Sea trout (<i>Salmo trutta trutta</i>)	81,140	97,380

Unintentional Introductions

No new alien species were found in Estonian waters in 2009.

Abundance of the predatory cladoceran *Cercopagis pengoi* reached high levels both in the Gulf of Finland and the Gulf of Riga, which were comparable to the registered record high levels in the 1990s. The mean annual abundance of the species in the Gulf of Riga exceeded 600 ind/m³ with the absolute maximum value of 1800 ind/m³ in Tallinn Bay (Gulf of Finland).

The alien cladoceran *Evadne anonyx* is continuously present in zooplankton samples taken from the Gulf of Finland with abundances around one order of magnitude lower than the native *Evadne nordmanni*.

Taxonomic identification (in cooperation with Finland) of collected ctenophore samples evidenced that in Estonian marine waters, there is no *Mnemiopsis leidyi* but instead *Mertensia ovum*.

Abundance of polychaeta larvae, as a measure of larval *Marenzelleria* spp. averaged about 900 ind/m³ in 2009. This should be considered relatively low abundance compared with several previous years (e.g., 1998, 1999 ja 2007) when polychaeta larvae were present at abundances of around 4000 ind/m³.

The mysid shrimp *Paramysis intermedia* (Czerniavsky) was recorded first time in the Baltic Sea in 2008. The species was recorded in the eastern Gulf of Finland and in the central Gulf of Riga (Herkül *et al.* 2009). The species was not found in 2009.

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

The amphipod *Chelicorophium curvispinum* (Sars) was found for the first time in the Estonian coastal sea near Sillamäe in Narva Bay, the eastern Gulf of Finland, in 2005 (Herkül & Kotta 2007). Similarly to 2008, *C. curvispinum* was found in Sillamäe and Narva-Jõesuu area, eastern Gulf of Finland, in 2009.

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

The catch index of the Chinese mitten crab *Eriocheir sinensis* has been monitored in gillnet fishing nets in Muuga Bay (Gulf of Finland) since 1991. Until 2002, the species was relatively rarely reported, but since has a significantly elevated catch level. However, no crabs were found in 2009.

The round goby *Neogobius melanostomus* continues to colonize new areas and increase in population abundance in the Gulf of Finland. The center of the distribution area is the Port of Tallinn in Muuga Bay where the species has increased exponentially since 2005. In 2009 the species (5 specimen) was observed near island Aksi (southern coast of Gulf of Finland). In 2008, one specimen of the species was found in the coastal area of the NE Baltic Proper (Väinameri Archipelago area).

Meetings

Attendance of the 6th Marine Bioinvasions Conference (Portland, Oregon, August, 2009) and involvement in the conference SSC (H. Ojaveer).

Co-organising Euro-CoML alien species workshop in 2009 (Mallorca, Spain) and in 2010 (by S. Olenin and H. Ojaveer) planning to write EuroCoML paper on marine bioinvasions (lead author: S. Olenin).

Co-chairing the ICES ASC 2010 Theme Session on 'Global change and aquatic bio-invasions' (H. Ojaveer, S. Gollasch, H. MacIsaac).

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National Report, Finland 2009

Lauri Urho & Maiju Lehtiniemi

Regulations:

The National Action Plan on Invasive Species was started in 2009 and should be finalized at the end of 2010. National strategy on invasive alien species aims to list all harmful and potentially harmful alien species in Finland as well as to determine which management options are most important and which authorities are responsible for the management.

Intentional Introductions:

Deliberate releases into the Baltic Sea were (including rivers draining into the Baltic) for fisheries and fish stock enhancement purposes in 2009 (for whitefish year 2008) as follows

0.8 million newly hatched and 2.0 million older salmon (*Salmo salar*), and

1.4 million newly hatched and 1.4 million older sea trout (*Salmo trutta m. trutta*),

something around 20 million newly hatched and 6.0 million older whitefish (*Coregonus lavaretus*).

Unintentional Introductions:

Invertebrates:

Pupal exuviae of marine intertidal midge *Telmatogeton japonicus* Tokunaga (Diptera: Chironomidae) were found in September 2008 for the first time from the Gulf of Finland, Baltic Sea. Previous records of the species in the Baltic Sea were from Sweden, Denmark, Germany and Poland. There have been several reports of individual mitten crabs, *Eriocheir sinensis*, also in 2009.

Fish:

Neogobius melanostomus Pallas, 1914 was caught off Helsinki in May 2009 (http://www.rktl.fi/kala/elinymparistot/kalasto_ilmaston_muuttuessa/) and also in the eastern Gulf of Finland in October 2009 (Laine 2010). Several round goby individuals of different sizes were caught by recreational fishermen near the harbor area in Helsinki.

Some new findings of *Carassius auratus m. gibelio* were recorded in the Gulf of Finland and for the first time it was observed to have ascended several kilometers up into a river system.

In 2009 some Russian sturgeons, *Acipenser gueldenstaedtii*, probably escapers from an Estonian fish farm, were caught along the coast of Finland.

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.

Meetings:

2009 ICAIS 16th conference on aquatic invasive species, Montreal, Canada

2009 Jelly Day-seminar, Copenhagen, Denmark

2009 Nordic Workshop on Economic Analysis of the State of the Baltic Sea, Helsinki, Finland

Research projects:

A research project on climate change, fish fauna and alien fish species has been funded by the Ministry of Agriculture and Forestry, Finland.

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

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Publications:

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Leppäkoski E, Laine AO (2009) Alien species. In: HELCOM (2009) *Biodiversity in the Baltic Sea – An integrated thematic assessment on biodiversity and nature conservation in the Baltic Sea*. Baltic Sea Environ. Proc. 116B, 118-124

Raunio J, Paasivirta L, Brodin Y (2009) Marine midge *Telmatogeton japonicus* Tokunaga (Diptera: Chironomidae) exploiting brackish water in Finland. *Aquatic Invasions* 4, 405-408.

ICES Working Group on Introductions & Transfers of Marine Organisms

Hamburg – Germany 10 – 12 March 2010

NATIONAL REPORT FRANCE 2010

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Audience: (ICES, Member Countries & Observers, and Scientists)

Overview:

In 2009, a new event of mass mortalities of Pacific oysters (*Crassostrea gigas*) was recorded in France. Mortalities are affecting diploid and triploid oyster spat and juvenile, irrespective of their origin (natural or hatcheries) in most French oyster production areas. Several infective agents were detected in moribund oysters including OsHV-1 virus and several species of *Vibrio*. A new viral genotype of OsHV-1, the OsHV-1 μ var, detected in France for the first time during episodes of mortality in 2008, was found in the 100% of the samples sequenced. Its origin is still unknown.

The OsHV-1 μ var was also detected in oysters affected by mass mortality in 2009 in several European countries ([Ireland and the Channel Islands](#)). Consequently, a EU commission regulation, giving recommendations for sampling, testing the presence of OsHV-1 μ var and establishment of containment areas in case of increased mortality in oysters of the species *Crassostrea gigas*, will be published soon.

1. Regulations:

A Commission Decision (2009/177/EC) was published on the 31th October 2008 implementing Council Directive 2006/88/EC as regards surveillance and eradication programmes and disease-free status of Member States, zones and compartments. This decision emphasizes conditions for submission of surveillance programmes and disease-free status declarations for approval. A list of member states, zones and compartments declared disease free is detailed in Annex I, part C. The following diseases are concerned: Viral haemorrhagic septicaemia (VHS), Infectious haematopoietic necrosis (IHN), Koi herpes virus (KHV) disease, Infectious salmon anaemia (ISA), Infection with *Marteilia refringens*, Infection with *Bonamia ostreae*, White spot disease.

The commission decision (2009/975/EU), published on the 14th December 2009, modified the Annex I, parts B and C of the Commission Decision 2009/177/EC, providing a

list of member states subject to approved eradication programmes and an updated list of member states, zones and compartments declared disease-free.

These documents are available at the following web address: <http://eur-lex.europa.eu/>

Following high mortality of Pacific oysters (*Crassostrea gigas*) observed in several European countries (*France, Ireland and the Channel Islands*) in 2008 and 2009, a commission regulation implementing Council Directive 2006/88/EC as regards measures to control increased mortality in oysters of the species *Crassostrea gigas* in connection with the detection of Ostreid herpesvirus 1 μ var (OsHV-1 μ var) was recently adopted and will be soon published. This regulation will provide recommendations for sampling, testing the presence of OsHV-1 μ var and establishment of containment areas in case of increased mortality in oysters of the species *Crassostrea gigas*.

2. Intentional:

No information

3. Unintentional:

Algae:

Polyopes lancifolius (= *Grateloupia okamurai*) originated from Japan, was observed for the first time in the Gulf of Morbihan in August 2008 (47°35'54.42"N; 2°53'23.50"W).

Molluscs:

Cyclope neritea (Linné, 1758) was observed in Port Lazo (English Channel, 48°45'47.93"N, 2°57'56.84"W) in April 2008. This species has been recorded in Arcahon Bay (South Atlantic sea) since 1976 and in the Gulf of Morbihan (North Atlantic sea) since 1984. In 2001, it was detected in the bay of Morlaix (West English Channel). All these areas are oyster leases and natural banks of clams. This gastropod is suspected to have been introduced with oysters batches. Only one specimen was observed in Port Lazo which does not mean that a population could be established (Le Quément, 2008).

A first record of *Rapana venosa* (19 cm apical length, 9 cm diameter and 990 g weight) was observed in Porspoder (Western English Channel, in northern Brittany, 48°31'25"N, 04°46'15"W) in July 2009. This species has been observed regularly since 1997 southward, in the Bay of Quiberon and the Gulf of Morbihan (South Brittany), two coastal areas of the bay of Biscay. So far 26 snails have been captured and discarded in those two locations. A new specimen was captured in the same area (Carnac, Bay of Quiberon, approximately 47°34'6.58"N, 3°6'12.15"W) in September 2009 (weight 1.3 kg, total length 165 mm, width 135 mm, diameter 105 mm). In a location nearby (St Philibert, approximately 47°35'0.21"N, 2°59'39.18"W) spawns of *Rapana venosa* were collected attached to oysters bags placed on iron tables during the summer 2009.

A programme, funded by the Regional Council of Poitou-Charente, was launched by Ifremer in November 2008 in order to evaluate the update biomass of *Crepidula fornicata* in Marennes Oleron Bay. The survey, carried out in 2008-2009, estimated the surface covered by this invasive species using an interferometric side-scan sonar. The first results underlined a large expansion of banks previously recorded in 1980 and 1995, in some areas of the Bay (for example, the surface of the banks of the slipper limpets was multiplied by 3 between 1994 and 2008 in the sectors Current of Oléron and Lamouroux. However, an equivalent reduction was observed in areas which

were cleaned in 2008 by a barge, specially equipped to eliminate this invasive species. A campaign is planned in 2010 to evaluate the biomass of this species in the same area.

4. Pathogens

Following the detection of *Bonamia exitiosa* in Spain (2007) then in Manfredonia Gulf (Adriatic sea, Italy), a working programme was proposed by the Community Reference Laboratory for Mollusc Diseases of Ifremer (La Tremblade, France) to the European National Reference Laboratories for Mollusc Diseases with the support of the European Commission. This working programme, carried out in 2008, aimed at characterizing parasites looking like *Bonamia* usually detected in Europe and at collecting epidemiological information on *Bonamia exitiosa* to find out the actual spread of the parasite in the EU. Analyses were realised in flat oysters collected in UK (Scotland, Northern Ireland, Wales and England), Portugal, Italy, Ireland, The Netherlands, Belgium, Spain and France. *Bonamia exitiosa* was detected and confirmed in 3 Member States: France, Italy and Spain. In France, it was detected in three zones: Corsica and outside Thau lagoon in the Mediterranean sea and in the Bourgneuf bay in the Atlantic coast. Results were presented at the Annual Meeting of the National Reference Laboratories for Mollusc Diseases held in La Tremblade on 16-19 March 2009.

General information

In 2009, as in 2008, a new event of mass mortalities of Pacific oysters (*Crassostrea gigas*) was recorded in most French oyster production areas from South to North of the country. First outbreaks were reported in South of France at the end of April, then in Arcachon Bay, Marennes Oléron, Vendée and latter in Brittany and Normandy. Mortalities are affecting diploid and triploid oyster spat and juvenile, irrespective of their origin (natural or hatcheries). Mortalities were severe, between 60 and 100% of young culture oysters. No officially notifiable infective agents were detected in the samples subjected to histological examination. The OsHV-1 virus was detected in 96% of samples tested. Sequencing studies were carried out on the positive samples to look for the presence of a specific viral genotype (detected in France for the first time during episodes of mortality in 2008). The OsHV-1 μ var was found in the 100% of the samples sequenced. Its origin is still unknown ; however, retrospective analyses are in progress on samples collected in several countries before 2007. Moreover several species of *Vibrio* were detected too in moribund oysters (*Vibrio splendidus*, *Vibrio aestuarianus*, *Vibrio harveyi* and *Vibrio tapetis*, the causative agent of brown ring disease of clams).

Several risk factors are associated with these mortality events, including detection of the OsHV-1 μ var and *Vibrio*, environmental parameters, genetic factors and cultural practices.

http://www.oie.int/wahis/public.php?page=event_summary&reportid=8265

5. Meetings

France

Several projects were initiated in France in 2009 in order to collect data and relevant information on aquatic invasive species in France. There is no clear relationship between these projects.

A project called "Marine Invasive Species in Brittany" was launched in October 2009. It is financed by the State and the Regional Council of Brittany and is carried out by a consortium called Bretagne-Environment. The objective of the project is to establish a list of detected marine invasive species in Brittany since a century. For some target species, a leaflet will be produced with relevant information on biology, origin, habitat, and impact. These documents, when written, will be available on-line at the following address <http://www.bretagne-environnement.org/especes-invasives/>. Information on terrestrial invasive flora and fauna are already available on this web site.

A working group on Aquatic Invasive Species was formed by the National Agency for water and aquatic environments (ONEMA) at the beginning of 2009. The objectives are to establish guidelines for management of aquatic biological invasions, to propose operational tools for stakeholders and to identify prospective scientific issues related to the subject. The group is mainly constituted with freshwater specialists. A workshop will be organised in Spring 2010 in order to establish the state of the art regarding the introduction and management of aquatic invasive species in France.

Europe

The European Commission has commissioned the Joint Research Centre (JRC) and the International Council for the Exploration of the Sea (ICES) to facilitate the preparation of the scientific basis for the development of criteria and methodological standards in relation to 8 of the 11 Good Environmental Status (GES) descriptors in the EU Marine Strategy Framework Directive (MSFD) during the course of 2009. With this purpose, the JRC and ICES were requested to establish Task Groups (TGs) for each of these 8 descriptors, among which a TG on Non Indigenous Species (TG2). Each TGs consisted of experts with specific regional expertises. The objectives of the group were to give an initial interpretation of the descriptor, to review the scientific literature underlining existing methods, to identify relevant temporal and spatial scales for the descriptor, to propose the general framework for describing environmental status including monitoring and research. The TG2 was lead by Serguej Olenin from the Klaipeda University (Lithuania). It meets twice in 2009 (May and November) and worked too by e-mail. The report was finalized at the end of December including answers to the main issues and sent to the Commission by the end of January 2010. The key attributes of the descriptor are the number of non-indigenous species (NIS) recorded in an area, abundance and distribution range of NIS, NIS impact on native communities, NIS impact on habitats and NIS impact on ecosystem functioning. The group recommended to apply the Biopollution level index (BPL, Olenin *et al.*, 2007) to assess the GES for the descriptor. This index takes into account the abundance and distribution range of NIS in relation to native biota in the invaded area and aggregates data on the magnitude of the impacts these species have on. This work will contribute to a decision of the Commission which is expected by July 2010.

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Report prepared by Laurence Miossec Ifremer, Nantes, with:

Jean-François Bouget, Patrick Camus and Joseph Mazurié, Ifremer La Trinité sur mer

Michel Blanchard and Dominique Hamon, Ifremer Brest

Marianne Alunno-Bruscia, Ifremer Argenton

Pierre-Guy Sauriau, Ifremer – CNRS La Rochelle

Patrick Le Mao, Ifremer Dinard

Cyrille François, Ifremer La Tremblade

Auguste Le Roux, former Professor of marine biology from the Université de Bretagne sud, Vannes (France)

National Report Germany

prepared by S. Gollasch and M. Rolke

Audience: ICES, Member Countries & Observers, and Scientists

Overview:

The Federal German Nature Protection Law (BNatSchG) was amended and covers now non-native species nationwide. Unauthorized release of intentional introductions into the wild is prohibited.

Mytilicola orientalis is now also found near the oyster farm in the Wadden Sea, Sylt Island.

Content:

1. Regulations:

Amendment of Federal German Nature Protection Law (BNatSchG)

The Amendment of the BNatschG from 29. July 2009 entered into force 1. March 2010. The amendments referred to here concern "non-native, foreign and invasive species". The new version of BNatSchG paragraph 40 addresses non-native species.

In addition to preventive measures, the obligation to monitor and eradicate or control as well as requirements to get permission to release plants or animals into the wild, the liability measures against the unauthorized release of plants and animals taken by several German Federal States is now applicable to the entire country as long as invasive species are concerned.

The new version of the BNatschG is available as PDF file at:

http://www.bmu.de/naturschutz_biologische_vielfalt/downloads/doc/44597.php

2. Intentional:

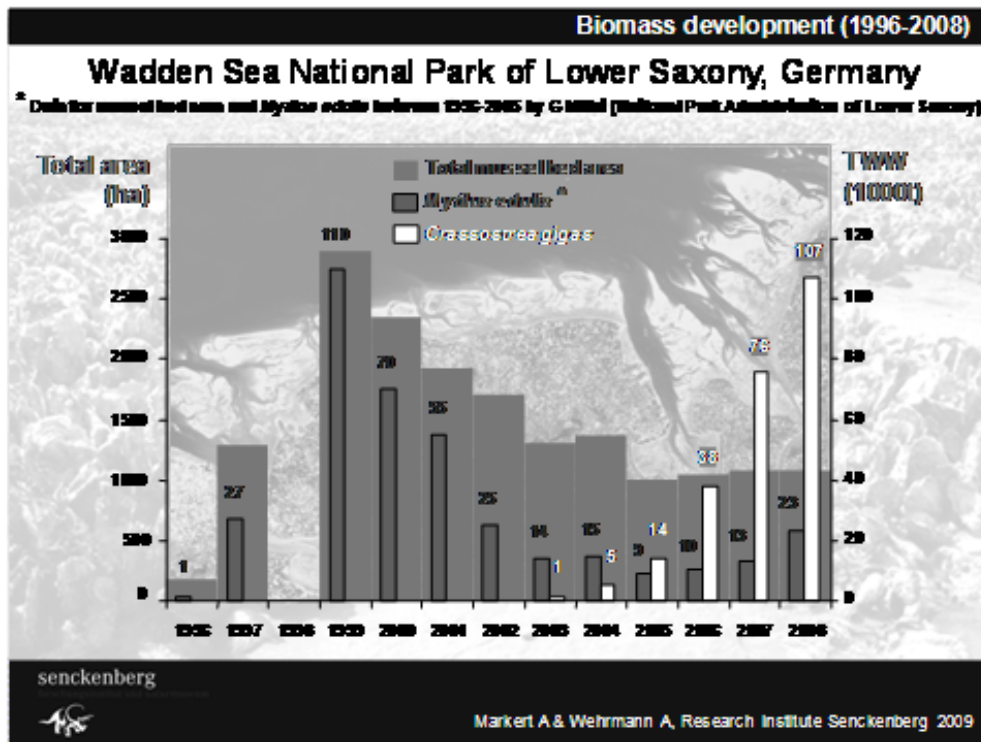
No major changes since last years National Report. The species which were reported earlier include Sturgeons, salmonid species, rainbow trouts, carps, *Crassostrea gigas*, *Homarus americanus* and *Palmaria palmata*.

The following information on *C. gigas* was provided by Dr. Achim Wehrmann (awehrmann@senckenberg.de) and Alexandra Markert (amarkert@senckenberg.de), Senckenberg am Meer, Abteilung für Meeresforschung, Südstrand 40, 26382 Wilhelmshaven.

Large-scale survey of Pacific oysters (*Crassostrea gigas*) in Lower Saxony takes place since 2003. 144 sampling stations at 12 sites, which are distributed from the Ems estuary to the Außenelbe estuary within the area of the National Park of Lower Saxony, are investigated yearly.

All intertidal mussel beds in Lower Saxony are mixed beds with increasing densities of Pacific oysters as well as blue mussels. Blue mussels on sites densely colonized by oysters may show higher abundances than oysters, but oysters are dominant in forming the shared habitat. Therefore, blue mussels are included in the monitoring program since 2006. Between 2005 and 2008, blue mussel stocks recovered while at the same time oyster biomass increased dramatically and mussel bed size remained unchanged (see Fig.). With increasing densities, the engineering effect of Pacific oysters

leads to an increase in aggregation and subsequently to the formation of oyster reefs (in contrast to blue mussel beds).



The exponential increase observed over the last 5 years (see Fig.) seems to have slowed down in 2009. During a first field trip in February 2010, we could not observe unexpected high mortalities in Pacific oysters nor in blue mussels due to strong winter conditions but monitoring season has not started yet.

Actual projects besides the regular monitoring are the investigation of microbial and chemical risks for consumers as a consequence of the massive spread of the Pacific oyster (INTERREG IVa, Project SafeGuard) and the investigation of the variability of macrobenthic communities related to the spread of the Pacific oyster and to climate change (BIK-F).

Publications in preparation include,

1. Reef formation and ecosystem engineering of the Pacific oyster *Crassostrea gigas*.
2. Recovery of native *Mytilus* stocks after the establishment of oyster reefs by non-indigenous *Crassostrea gigas*.
3. Habitat use of non-indigenous Pacific oyster reefs (*Crassostrea gigas*) by waders and shore birds in the Wadden Sea of Lower Saxony, Germany.
4. Indirect introduction facilitated by the establishment of *Crassostrea gigas* reefs: morphological and molecular identification of *Hemigrapsus penicillatus / takanoi* and its spread.
5. Population dynamic of non-indigenous *Crassostrea gigas* 10 years after its first record in the Wadden Sea of Lower Saxony, Germany.

3. Unintentional:

New Sightings

[A new parasite species was found, but is included below under the section "pathogens".]

The diatom *Lennoxia faveolata* was first recorded for the Southern Baltic in 2009. Only few specimens were found by the Leibniz Institute for Baltic Sea Research Warnemuende, Germany. The vector of introduction is unknown (Norbert Wasmund pers.comm.).

Previous Sightings

Hemigrapsus penicillatus. was in 2007 found for the first time in German waters (southwestern Wadden Sea) (Gehrmann *et al.* 2007, Markert & Wehrmann in prep.¹). Other studies in 2007 also documented the presence of *H. takanoi* and *H. sanguineus* from the area (Obert *et al.* 2007²).

As reported before, in October 2006 the invasive ctenophore *Mnemiopsis leidyi* was first recorded in the Kiel Bight and is today found in all Baltic countries. *M. leidyi* also invaded the North Sea. However, this invasion may have been overlooked as the species was misidentified as a native comb jelly (Faasse & Bayha 2006)³.

Gracilaria vermiculophylla, first recorded along the German North Sea coast in 2002 and along the German Baltic coast in 2005, continues to spread. Preliminary results from the Baltic show that *G. vermiculophylla* may have a potential to compete with the native *Fucus vesiculosus* in shallower and less exposed areas.

Styela clava occurs in the German Bight since 1997 and continues to spread as documented by recent records on Helgoland Island (in 2007).

A particular interesting case is the findings of *Balanus amphitrite* which has not been recorded along the German coast yet. However, harbour water from the East Frisian Island Norderney contained cyprids identified as *B. amphitrite* in 2002. Although searched for adults have not been recorded in the area indicating the unsuitability of the region for larval settlement. In contrast, wild cyprids settled and metamorphosed spontaneously within one day after water transfer into the laboratory, where the water temperature was raised from 18 to 27°C. It was assumed that for successful recruitment the local water temperature is currently too cold (Wiegemann 2008⁴). However, one question remains... Where do the cypris larvae originate, which settled in the laboratory? Could it be possible that the water collected was "contaminated" with *B. amphitrite* larvae from a vessel passing by? It is more likely that the larvae reached the German Island Norderney with currents from the nearby distribution limit of the species in the Dutch Delta area, which is a distance of ca. 300 km

¹ Markert, A & Wehrmann, A. (in prep.) The Asian crab *Hemigrapsus penicillatus* (de Haan 1835) invades new established Pacific oyster reefs in the Wadden Sea, German Bight (North Sea).

² Obert B, Herlyn M, Grotjahn M (2007) First Records of two crabs from the North West Pacific *Hemigrapsus sanguineus* and *H. takanoi* at the coast of Lower Saxony, Germany. Waddensea Newsl 33: 21-22

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

⁴ Wiegemann, M. 2008. Wild cyprids metamorphosing in vitro reveal the presence of *Balanus amphitrite* Darwin, 1854 in the German Bight basin. Aquatic Invasions (2008) Volume 3, Issue 2: 235-238

4. Pathogens

No new records of pathogens are known, but one of the most impacting parasites is the eel nematode *Anguillicola crassus*.

Mytilicola orientalis is now also found near the oyster farm in the Wadden Sea, Sylt Island. Its presence was proven by morphological taxonomy and DNA analysis (Reise pers. comm.).

5. Meetings

Past year

- 12th International Scientific Wadden Sea Symposium 2009, Wilhelmshaven, 30.03.-03.04.2009 (included talks on bioinvasions)
- Workop on Tackling the emerging crisis of invasion biology. Zentrum für Umwelt und Kultur Benediktbeuren. 08-10.03.2010 (focus on terrestrial and freshwater environments)
- 3rd International Symposium – Treatment of Wastewater and Waste on Ships. SOWOS 2009. Hamburg, 13.11.2010 (included session on ballast water)
- Biological invasions and phytodiversity – Impact and actions. Deutsche Bundesstiftung Umwelt gGmbH, Osnabrück, 26-27.11.2010 (focus on terrestrial environments)

Future meetings

- ESCA Conference 46. The Wadden Sea: Changes and Challenges in a World Heritage Site. AWI-Wadden Sea Station, List, Sylt Island, Germany, 03-06.05.2010
- The 38th IAD Conference. Large River Basins: Danube meets Elbe. Dresden, 22-25.06.2010 (also including alien species in freshwater environments)
- Invasive Species and their impact on biodiversity. NNA, Alfred Töpfer Akademie für Naturschutz. Camp Reinsehlen, 23.11.2010 (focus is on terrestrial and freshwater environments)

6. References and bibliography

The output of the EU-funded Research project "Environmental impacts of alien species in aquaculture" project acronym: IMPASSE, coordinated by Ian Cowx, International Fisheries Institute, The University of Hull was approved by the funding source and several project reports are now available at

<http://www.hull.ac.uk/hifi/IMPASSE/IMPASSEdocs.html>

A brief outline of all reports is attached as Appendix 1.

Fey, F., Dankers, N., Meijboom, A., Leeuwen, P.W. van, Verdaat, H., Jong, M. de., Heusinkveld, J., Dijkman, E. and Cremer, J., 2009c. Ontwikkeling van enkele mosselbanken in de Nederlandse Waddenzee; situatie 2008; IMARES (Rapport C047/09) - p. 52.

Fey, F., Dankers, N., Steenbergen, J. and Goudswaard, K., 2009a. Development and distribution of the non-indigenous Pacific Oyster (*Crassostrea gigas*) in the Dutch Wadden Sea. ICSR-2007 symposium proceedings. Aquacult. Int. DOI 10.1007/s10499-009-9268-0.

Fey-Hofstede, F.E., Cremer, J.S.M., Dijkman, E.M., Jansen, J.M., Roupioz, L.F.S. and Schmidt, A.M., 2009b. Development of analysis techniques for the use of aerial photography in the monitoring of intertidal mussel beds and oyster beds Texel: IMARES, (Report C004/09) - p. 27.

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- Nehring, S., Reise, K., Dankers, N. & Kristensen, P.S. (2009): Alien species. – In: Marencic, H. & Vlas, J. de (Eds.), Quality Status Report 2009. Wadden Sea Ecosystem 25(7): 1-28.
- Nehring, S. & Meer, U. van der (in press): First record of a fertilized female blue crab, *Callinectes sapidus* Rathbun, 1896 (Crustacea: Decapoda: Brachyura), from the German Wadden Sea and subsequent secondary prevention measures. – Aquatic Invasions 5.
- Nehring, S. (in press): Invasion history and success of the American blue crab *Callinectes sapidus* Rathbun, 1896 in European and adjacent waters. – In: Clark, P. & Galil, B. (Eds.), In the wrong place: Alien marine crustaceans - Distribution, biology and impacts. Ecological Studies Vol. xx, Springer, Berlin
- Nehls, G. and Büttger, H., 2009. Miesmuschelmonitoring 2006 und 2007 im Nationalpark Schleswig-Holsteinisches Wattenmeer: Ein Projekt im Rahmen des Trilateral Monitoring and Assessment Program (TMAP). Husum, BioConsult SH: 49.
- Nehls, Georg, Sophia Witte, Heike Büttger, Norbert Dankers, Jeroen Jansen, Gerald Millat, Mark Herlyn, Alexandra Markert, Per Sand Kristensen, Maarten Ruth, Christian Buschbaum and Achim Wehrmann, 2009. Beds of blue mussels and Pacific oysters. Thematic Report No. 11. In: Marencic, H. & Vlas, J. de (Eds.), 2009. Quality Status Report 2009. WaddenSea Ecosystem No. 25. Common Wadden Sea Secretariat, Trilateral Monitoring and Assessment Group, Wilhelmshaven, Germany.
- Panov, V.E., Alexandrov, B., Arbaciauskas, K., Binimelis, R., Copp, G.H., Grabowski, M., Lucy, F., Leuven, R.S.E.W., Nehring, S., Paunović, M., Semenchenko, V. & Son, M.O. (2009): Assessing the risks of aquatic species invasions via European inland waterways: From concepts to environmental indicators. – Integrated Environmental Assessment and Management 5: 110-126.
- Schmidt, A., Wehrmann, A. & Dittmann, S. 2009. Low mortality rates of juvenile Pacific oysters in the German Wadden Sea are characteristic for invasive species: a reply to Beukema and Dekker. Helgol Mar Res. DOI 10.1007/s10152-009-0170-y
- Wehrmann, A., Esser, W., Markert, A., Narkus, S. and Rabe, K., 2009. Management der Bioinvasion der Pazifischen Auster (*Crassostrea gigas*). Abschlussbericht Projekt 25/05 der Niedersächsischen Wattenmeer-Stiftung.

Appendix 1 II Summary of the EU-funded FP6 Project No. 044142

Environmental impacts of alien species in aquaculture

Project acronym: IMPASSE

Coordinator: Ian Cowx, International Fisheries Institute, The University of Hull

Project type: COORDINATION ACTION

Priority FP6 2005-SSP-5A, Sustainable management of Europe's natural resources

The IMPASSE documents are now available on-line:

<http://www.hull.ac.uk/hifi/IMPASSE/IMPASSEdocs.html>

Angelopoulos, N., Cowx, I. G. & Nunn, A. D. (2008). *Review of existing guidelines: advantages and constraints*. Report to EC, 46 pp.

Britton, J. R., Midtlyng, P. J., Persson, G., Joly, J. P., Gherardi, F., Nunn, A. D. & Cowx, I. G. (2009). *Assessment of mitigation and remediation procedures, and of contingency plans*. Report to EC, 54 pp.

Copp, G. H., Areikin, E., Benabdelmouna, A., Britton, J. R., Cowx, I. G., Gollasch, S., Gozlan, R. E., Jones, G., Lapègue, S., MacLeod, A., Midtlyng, P. J., Miossec, L., Nunn, A. D., Occhipinti-Ambrogi, A., Olenin, S., Russell, I. C., Peeler, E. & Savini, D. (2008). *Review of risk assessment protocols associated with aquaculture, including the environmental, disease, genetic and economic issues of operations concerned with the introduction and translocation of species*. Report to EC, 91 pp.

Copp, G. H., Britton, J. R., Jeney, G., Joly, J. P., Gherardi, F., Gollasch, S., Gozlan, R. E., Jones, G., MacLeod, A., Midtlyng, P. J., Miossec, L., Nunn, A. D., Occhipinti-Ambrogi, A., Oidtmann, B., Olenin, S., Peeler, E., Russell, I. C., Savini, D., Tricarico, E. & Thrush, M. (2008). *Risk assessment protocols and decision making tools for use of alien species in aquaculture and stock enhancement*. Report to EC, 85 pp.

Cowx, I. G., Angelopoulos, N. & Nunn, A. D. (2009). *Quarantining procedures*. Report to EC, 40 pp.

Cowx, I. G., Angelopoulos, N., Nunn, A. D., Britton, J. R. & Copp, G. H. (2009). *Guidelines for environmentally-sound practices for introductions and translocations in aquaculture*. Report to EC, 64 pp.

Cowx, I. G., Miossec, L., Lapègue, S. & Nunn, A. D. (2008). *Analysis of changes in genetic integrity of indigenous populations resulting from alien species introduction and genetically-modified organisms*. Report to EC, 27 pp.

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Gollasch, S., Cowx, I. G. & Nunn, A. D. (2008). *Analysis of the impacts of alien species on aquatic ecosystems*. Report to EC, 148 pp.

Gollasch, S., Miossec, L., Peeler, E. & Cowx, I. G. (2008). *Spread of novel pathogens and diseases caused by the introduction of alien species*. Report to EC, 69 pp.

- Gozlan, R. E., Nunn, A. D., Britton, J. R. & Cowx, I. G. (2008). [Review of the impacts of introductions on the aquatic environment and ecosystem services](#). Report to EC, 23 pp.
- Jones, J. & Kasamba, E. (2008). [Social and economic impacts of alien species introductions: decision tools for aquaculture](#). Report to EC, 27 pp.
- Occhipinti-Ambrogi, A., Savini, D., Cowx, I. G., Copp, G. H. & Nunn, A. D. (2008). [Analysis of drivers of the use of introduced species and dispersal mechanisms from aquaculture related activities](#). Report to EC, 26 pp.
- Olenin, S., Didžiulis, V., Ovčarenko, I., Olenina, I., Nunn, A. D. & Cowx, I. G. (2008). [Review of introductions of aquatic species in Europe](#). Report to EC, 41 pp.
- Angelopoulos, N., Cowx, I. G. & Nunn, A. D. (2008). [Review of existing guidelines: advantages and constraints](#). Report to EC, 46 pp.

SUMMARY

Growth of the aquaculture sector has resulted in an increased use of alien species to raise production, leading to increased spread of alien species as a result of intentional and unintentional introductions. As a consequence, there is an increasing need to control the introduction of species, and develop strategies to minimise or mitigate the impacts of alien species in the aquaculture sector. The extent to which non-native species and their impacts are covered by existing legislations was examined and found to be limited. There are no comprehensive instruments at an EU level to tackle alien species; existing legislation suffers from incomplete coverage, legal uncertainty, variation in the level of response among Member States and insufficient coordination. For that reason, there is a requirement for an all-encompassing directive or legislation to cover the use of alien species in aquaculture, and the European Council Regulation (No 535/2008) is designed to part meet that requirement. However, strategies to implement the regulation are needed.

Britton, J. R., Midtlyng, P. J., Persson, G., Joly, J. P., Gherardi, F., Nunn, A. D. & Cowx, I. G. (2009). [Assessment of mitigation and remediation procedures, and of contingency plans](#). Report to EC, 54 pp.

Executive summary

This report provides a review of the mitigation and remediation programmes against aquatic invasive species that have been carried out across Europe. It is not intended as a technical guide; rather it provides a series of case studies highlighting where mitigation and remediation have been achieved against particular species and where they have been unsuccessful. There is much focus on examples from the UK and Scandinavia; this is an unintentional bias that relates to where most work has been completed to date. In managing aquatic invasive species, a hierarchical approach is preferred, with preventing introduction the first step. However, once introduced, the remediation action of eradication, where the entire population of the invading species is eliminated, is considered the most effective and least expensive option in the long term. Promptness and decisiveness are key for successful remediation. However, except for the parasite *Gyrodactylus salaris* in Norway, there have been few genuine eradication attempts against aquatic invasive species in Europe. The reasons for this include opposition, expense, and the difficulty of achieving a 'zero' population and confirming success. In England and Wales, small-scale eradications have been used to control the invasive Asian cyprinid fish *Pseudorasbora parva*, mainly through applica-

tion of the piscicide rotenone. All the operations that have been initiated have, to date, been successful. However, *P. parva* is still present in England and Wales, including in a number of waters where alternative approaches may be necessary. Other local eradication attempts include minnow (*Phoxinus phoxinus*) from a watershed in the Hardangervidda mountains and a recent case of introduced signal crayfish, both in southern Norway. The introduction of the Pacific oyster *Crassostrea gigas* into French coastal waters in the early 1970s was a deliberate attempt to rejuvenate the ailing oyster-aquaculture industry following the collapse of *Crassostrea angulata* stocks due to a pathogen. It proved very successful and enabled industry recovery in a relatively short space of time. However, the presence of *C. gigas* in the wild has resulted in the uncontrolled formation of oyster reefs, which are hazardous to other water users, and adversely impact local hydrodynamics and siltation rates. Given that *C. gigas* is a valuable species for aquaculture, remediation activities are not necessarily viable. Instead, mitigation activities have used mechanical removal of wild *C. gigas* beds and the clean-up of abandoned culture areas where discarded equipment provides areas for rapid colonisation. This approach has proved relatively successful in enabling the industry to continue, whilst mitigating some negative impacts of wild *C. gigas*. Invasive crayfish populations in Europe have provided water managers with a major problem in that no mitigation or remediation methodology has, to date, proved effective in larger water bodies. Yet some of these populations have had severe consequences for native crayfish, through the transmission of crayfish plague, a disease against which native species have no immunity, and being out-competed by the larger and more aggressive invading species. Arguably, one of the worst impacts arising from species introductions by humans is the transmission of disease-causing organisms (i.e. pathogens). An example is *G. salaris*, which has had severe impacts on native stocks of Atlantic salmon *Salmo salar* in Norway, resulting in a concerted eradication programme, which is still on-going. Contingency plans are in place in countries such as England and Scotland, with responsibilities, funding and activities all detailed to allow immediate action should *G. salaris* be detected. It is recommended that contingency plans for the management of non-native species from aquaculture in the wild are adopted across Europe. These case studies suggest that prevention remains the most effective, and certainly the most cost-effective, method to avoid any negative effects of species introductions. Most of the invasive species originally introduced from aquaculture that are now present in the wild across Europe are likely to remain. The examples discussed here may, however, provide an empirical knowledge base for future mitigation and remediation activities, serving to support the conservation of threatened species and populations, and the longterm maintenance of European aquatic biodiversity.

Copp, G. H., Areikin, E., Benabdelmouna, A., Britton, J. R., Cowx, I. G., Gollasch, S., Gozlan, R. E., Jones, G., Lapègue, S., MacLeod, A., Midtlyng, P. J., Miossec, L., Nunn, A. D., Occhipinti-Ambrogi, A., Olenin, S., Russell, I. C., Peeler, E. & Savini, D. (2008). [Review of risk assessment protocols associated with aquaculture, including the environmental, disease, genetic and economic issues of operations concerned with the introduction and translocation of species](#). Report to EC, 91 pp.

Executive summary

With increased trade within the expanded EU and between the EU and the rest of the world, species translocations introductions are a growing concern to national governments and international organisations. The European Union has recognised the proliferation of nonnative and locally absent species as an emerging issue. The EC Coordination Action project IMPASSE (environmental IMPacts of Alien Species in aquaculturE) was initiated to inform this piece of legislation. The current report forms part of this project's work package 3, which aims to develop risk assessment protocols for future aquatic species introductions and aquaculture, with specific models and sub-routine assessments to consider economic issues, the potential environmental and economic impacts of diseases in wild aquatic organisms and ecosystems, genetic interactions with wild populations, and the disruption of ecosystem structure and function. The present report is a review of key risk assessment protocols and guidelines relevant to the assessment of risks and impacts associated with the use of alien species in aquaculture.

The national and international dispersal of pathogens is known to occur mainly via the movement of live fish, leading to the exposure of fish to new pathogens or more virulent strains (transboundary diseases). Once introduced into a new country or region, local movements (between aquaculture facilities, or for stocking into the wild) will in general be the main route of further dissemination. The introduction of new diseases to a naïve population, through the movement of non-native species, has resulted in significant reduction, if not elimination, of several wild aquatic animal species from river catchments or regions (e.g. crayfish plague: *Anguillicola crassus*, *Gyrodactylus salaris*). Once widespread into larger water bodies, elimination of disease in wild fish proves extremely difficult if not impossible.

The international movement of viruses of penaeid shrimps, mainly through the movement of non-native species, has temporarily devastated aquaculture production in many countries. A number of risk assessment and risk management protocols and risk analysis frameworks has been suggested for aquatic organisms. Along with these developments have evolved guidelines and codes of practice (CoP) for fisheries, in particular the 1988 ICES CoP, which formed the basis of the 1995 CoP from the FAO and subsequent CoPs from ICES in 1994, 1995, 2003 and 2004. In overview, these CoPs advocate mainly qualitative or semiquantitative assessment protocols, using schemes derived from the environmental toxicology risk assessments. Whereas, zoonosanitary import risk assessments use Covello-Merkhofer models with the construction of more detailed pathways and scenario trees, though based on quantitative estimations of each step of the pathway, as well as of the overall risk estimate.

Thus, apart from the disease assessment schemes, many of the non-native species protocols are mainly qualitative in character and most have undergone little or no testing or validation. A notable exception is a weed risk assessment scoring sheet of Pheloung, Halloy & Williams, which has been tested for plants at various locations around the world. There are a number of constraints associated with the assessments. For many species, there is inadequate information on their physiological tolerances, either for specific life stages or over the entire life cycle. In some cases, information on habitat, tropic status, growth, reproductive preferences, movements or migratory behaviour may be limited. Therefore, the estimation of ecological risks proves difficult, as does the assessment of genetic impacts (hybridisation, inbreeding, loss of genetic integrity) potentially associated with species introductions. Even in pathogen risk assessments, consequence assessment is clearly an underdeveloped part of most pro-

ocols, suggesting a general need for strengthening this aspect of alien species risk assessment on a broad scale.

The analysis of economic impacts for risk assessments are complex and multi-faceted, with a number of common, complicating issues, including the limitations on accurate accounting of environmental costs due to insufficient data as well as the issues of uncertainty and inequity. Information is required on the highly complex interactions involved in order to measure and predict the impacts of biological invasions, not just the direct effects on aquaculture businesses and industry (production) but also on consumer demands, loss of important biodiversity, disruption of ecosystem functions, effects on human health and increased spread of pathogens and diseases. Therefore, a key component for informed risk management is evidence-based risk assessments that incorporate the assessment of both likelihood and consequence.

Copp, G. H., Britton, J. R., Jeney, G., Joly, J. P., Gherardi, F., Gollasch, S., Gozlan, R. E., Jones, G., MacLeod, A., Midtlyng, P. J., Miossec, L., Nunn, A. D., Occhipinti-Ambrogi, A., Oidtmann, B., Olenin, S., Peeler, E., Russell, I. C., Savini, D., Tricarico, E. & Thrush, M. (2008). *Risk assessment protocols and decision making tools for use of alien species in aquaculture and stock enhancement*. Report to EC, 85 pp.

Executive summary

In response to the European 'Council Regulation No. 708/2007 of 11 June 2007 concerning use of alien and locally-absent species in aquaculture', and responding directly to Task 12, priority area 8.1. B.1.3, a scheme has been developed that seeks to provide 'Guidelines for environmentally sound practices for introductions and translocations in aquaculture, guidelines on quarantine procedures, and risk assessment protocols and procedures for assessing the potential impacts of invasive alien species in aquaculture'. Development of the European Non-native Species in Aquaculture Risk Assessment Scheme (ENSARS) has benefited from the unique breadth of expertise available from consortium members, enabling the direct utilisation of state of the art national and international research and practical experience in the assessment and management of non-native organisms. The ENSARS is modular in structure and is an adapted form of the pest risk analysis decision support scheme of the European and Mediterranean Plant Protection Organisation (EPPO), which was developed using the guidelines of the International Plant Protection Convention (IPPC) International Standards for Phytosanitary Measures on pest risk analysis, which are recognized by the Sanitary and Phytosanitary Agreement of the World Trade Organization (WTO, 1995). The questions (or types of questions) used in the ENSARS have been developed in conjunction with recent improvements to the GB Non-native Species Risk Assessment Scheme (<http://www.defra.gov.uk/wildlife-countryside/resprog/findings/nonnative-risks/index.htm>) with which the ENSARS is closely related. The ENSARS has been developed with full consideration of the Aquatic Animal Health Code (OIE, 2006).

The ENSARS provides a structured framework for evaluating the risks of escape, introduction to and establishment in open waters, of any non-native aquatic organism being used (or associated with those used) in aquaculture. In addition, it provides evaluation of potential risks posed by transport pathways, rearing facilities, non-target infectious agents, and the potential organism, ecosystem and socio-economic impacts. The ENSARS consists of seven modules. The first six modules comprise the 'risk assessment' protocols (Entry, Invasiveness, Organism, Facility, Pathway, Socio-economic Impact) and these lead into a Risk Summary & Risk Management Module. The Invasiveness component consists of a suite of generic and taxon-specific modules

used to assess the potential invasiveness of Amphibia and of freshwater and marine fishes and invertebrates. The various modules have been constructed using a common format and provide general guidance in the assessment of potential risks of introduction, establishment, dispersal and impacts by non-native organisms (NNO) for native species and ecosystems. Because a single person is unlikely to have the necessary expertise to complete all modules of this risk assessment scheme, it is assumed that a multi-disciplinary team of recognised experts will be required to complete the assessment of any given organism.

The assessor, a recognised expert, is required to respond to a sequence of questions, with each answer accompanied by appropriate bibliographic justification or other information (e.g. use of expert opinion) to justify the response and by a ranking (by the assessor) of his/her level of confidence/certainty regarding that response, using the confidence rankings recommended by the International Programme on Climate Change (IPCC): Low confidence (2 out of 10 chance), Medium confidence (5 out of 10 chance), High confidence (8 out of 10 chance), Very high confidence (9 out of 10 chance). These modules can also be used in stand-alone mode, and they could easily be adapted for incorporation into the web-based (electronic) risk modules currently being developed by the EPPO.

Cowx, I. G., Angelopoulos, N. & Nunn, A. D. (2009). *Quarantining procedures*. Report to EC, 40 pp.

Summary

Growth of the aquaculture sector has resulted in an increased use of alien species to raise production, leading to increased spread of alien species as a result of intentional and unintentional introductions. As a consequence, there is an increasing need to control the introduction of species, and develop strategies to minimise or mitigate the impacts of alien species in the aquaculture sector, but existing legislation was found to be limited. This report provides guidelines on quarantine procedures and requirements for appropriate health checks to account for phylum-specific peculiarities, developmental stage, and risk level (including considering potential pathogen and parasite carriage). Procedures, controls and mechanisms to minimise potential risks and regulate movement of potentially invasive species are provided. This report builds on the review of Angelopoulos *et al.* (2008) and provides recommendations for quarantine procedures, in the broadest sense, for a range of organisms for use in aquaculture operations. Information on technical characteristics of facilities (open versus closed facilities), effluent and waste treatment and disposal, physical containment, biosecurity and personnel is provided.

Cowx, I. G., Angelopoulos, N., Nunn, A. D., Britton, J. R. & Copp, G. H. (2009). *Guidelines for environmentally-sound practices for introductions and translocations in aquaculture*. Report to EC, 64 pp.

Executive summary

Council Regulation 708/2008 provides a decision framework for assessing the suitability of introducing a non-native species for aquaculture purposes in European Union countries (Figure 1.1). This framework requires input and decisions at various steps on whether a new species introduction is acceptable or whether measures have to be taken to regulate such an introduction. This report provides support for these various steps in the form of guidelines for environmentally sound practices for intro-

ductions and translocations in aquaculture and stock enhancement activities. They effectively guide the proposer through the information that must be acquired and the issues that must be addressed if a proposal to introduce a species is to be considered. The guidelines contain a series of modules relevant to managing alien species in aquaculture, including: (I) a strategy for implementation; (II) the steps to take prior to introducing a new species, including application of the risk assessment strategy; (III) the steps to take after deciding to proceed with an introduction; (IV) policies for quarantining should an introduction proceed; (V) policies for ongoing introductions or transfers that have been an established part of commercial practice; (VI) the steps taken should an invasive organism be released into the wild; (VII) the steps to take prior to releasing genetically modified organisms and releasing polyploidy animals. The guidelines have been prepared noting already existing guidelines and recommendations such as the ICES and EIFAC Codes, in collaboration with potential end users and stakeholders based on the information collated by the IMPASSE project.

Implicit within the procedure defined, is the need for a comprehensive risk assessment before a proposal is considered acceptable. This refers, explicitly to non-routine movements of organisms that particularly carry a potential high risk. Where appropriate, reference is made to quarantining procedures should the risk from the proposed introduction be deemed unacceptable.

This report also provides a rapid response framework should a species or a non-target organism becomes invasive. This includes the components and procedures for eradication plans and contingency plans for the control of non-target organisms if eradication is impractical.

Cowx, I. G., Miossec, L., Lapègue, S. & Nunn, A. D. (2008). [*Analysis of changes in genetic integrity of indigenous populations resulting from alien species introduction and genetically-modified organisms*](#). Report to EC, 27 pp.

Executive summary

Assessment of the genetic impacts of introduced species on native taxa is a relatively new field of research, as it has only been possible to detect genetic changes at the level of single genes, by enzyme electrophoresis, since the 1960s. Consequently, the least studied aspect of species introductions may be the genetic impacts they have on native species. Knowledge on changes in the genetic integrity of indigenous populations resulting from species introductions and genetically-modified organisms is mainly limited to hybridization events. Hybridization was cited as the most common impact, with the highest occurrences from Germany, Latvia and Russia. By contrast, 25 countries/regions considered there were no known hybridization impacts, although this is probably due more to lack of awareness and an absence of studies to detect genetic interactions than no impacts. This is particularly true for Atlantic salmon where concern has been expressed about hybridization between wild and farm-reared fish, possibly leading to the demise of salmon stocks across its distribution range. Hybridization events are mostly known from fishes. The species most frequently noted regarding hybridization impacts is *Oncorhynchus mykiss* (8 cases), followed by *Acipenser ruthenus* (7) and *Acipenser baerii* (7). Two cases were cited for molluscs and one crustaceans. In molluscs, the genetic impact of the introduction of the Pacific oyster on the Portuguese oyster populations is well documented. Species extinctions resulting from the complete loss of genes or gene combinations are unknown in Europe, although declines in wild stocks have been implicated with the stocking (and escape) of farmed-reared Atlantic salmon (*Salmo salar*). The disappear-

ance of species and local populations related to stock enhancement are primarily caused by competition with, or predation on, the wild stocks. Triploids are of interest to aquaculture because they are expected to be sterile, to grow faster than diploids when they reach the age of sexual maturity, and to exhibit higher survival rates than diploids because of the reduced biological costs associated with reproduction. Information on the impacts of triploids is equivocal. Potential hazards from triploids arise from interference with spawning activities of wild stocks, increased competition and subsequent loss of growth performance of wild stocks, alteration of fish community structure, suppression of recruitment processes in wild populations and increased fishing pressure and mortality of wild stocks. Each of these hazards needs thorough evaluation, both individually and synergistically, to determine if there any long-term, relative risks from triploid fishes.

Cowx, I. G., Nunn, A. D. & Angelopoulos, N. (2008). [*Role of alien species in European aquaculture, with linkages to fisheries*](#). Report to EC, 30 pp.

Introduction

The introduction of species beyond their natural range is expanding rapidly, due to increased transport, trade, travel and tourism, and the unprecedented accessibility of goods resulting from globalisation (Leppäkoski *et al.* 2002; Copp *et al.* 2005). Biological invasions by nonnative (also called alien, non-indigenous, exotic, or introduced) species are widely recognised as a significant component of human-caused global environment change (IUCN 2000), and aquatic habitats are no exception in this regard (Moyle & Leidy 1992). Non-native species encompass a diverse range of taxa that threaten a wide range of aquatic and terrestrial environments. The introduction of such species can have far-reaching and often harmful effects upon the biological diversity and the function of invaded ecosystems, and cause significant losses in economic values (Pimentel 2000). For example, non-native species can act as vectors for novel diseases, alter ecosystem processes, reduce biodiversity, disrupt the cultural landscape, reduce the value of land and water for human activities, and cause other socioeconomic consequences for humans (McGinnity *et al.* 2003). As such, non-native species are now considered to be the second most important cause of global biodiversity loss after direct habitat destruction, and they can have adverse environmental, economic and social impacts from the local level upwards.

One area of major concern regarding the spread of IASs is through aquaculture practices. To continue to be active in the market, as well as increase the annual growth rate, the aquaculture industry needs to be innovative and develop new and cost-effective production methods. Novel species production is one area that is being considered, with a perpetual search for fish, shellfish (e.g. Mollusca, Crustacea and Echinodermata) and plant species whose biology is well known and that have already achieved or could achieve success in extensive/intensive cultivation. Once identified, such species are potential candidates for movement to new locations for the purpose of establishing new fisheries and new aquaculture resources. This presents several major challenges. The first is the ecological, environmental and economic impacts of introduced and translocated species, especially those that could become established in the receiving environment should they escape the confines of cultivation. Such new populations can have adverse impacts on native species and ecosystems. The second challenge concerns the potential genetic impacts of introduced and translocated species, relative to their mixing with farmed and wild stocks, and the release of genetically modified organisms. The third challenge concerns the inadvertent move-

ment of organisms associated with the target (host) species; this includes both pathogens and other organisms that are transferred with the target species. The mass transfer of animals and plants without inspection, quarantine, or other management procedures, has inevitably led to the simultaneous introduction of pathogenic or parasitic agents, causing harm to the development and growth of new fishery resources and to native fisheries. These problems are further highlighted in the Second Report of the European Community to the Convention on Biological Diversity – Thematic Report on Alien Invasive Species, October 2002¹, and the Bern Convention². The latter listed aquaculture (fish, molluscs and crustaceans introduced for production, and disease organisms accompanying introduced species) as one of 15 pathways for intentional and unintentional species introductions.

Although non-native species are becoming the backbone of production in many parts of the world (De Silva *et al.* 2006; Nguyen and De Silva 2007), few studies have attempted to evaluate the contribution of non-native species in aquaculture as a potential driver for their dispersion and the consequent impacts on biodiversity. This report reviews the extent of use of non-native aquatic species in aquaculture and assesses their importance to aquaculture in Europe. The main outputs of the review are information to underpin assessment of the impacts of non-native species on natural aquatic ecosystems if the species escapes and become invasive.

Gollasch, S., Cowx, I. G. & Nunn, A. D. (2008). [*Analysis of the impacts of alien species on aquatic ecosystems*](#). Report to EC, 148 pp.

Introduction

Council Regulation (EC) No 708/2007 of 11 June 2007 concerning use of alien and locally absent species in aquaculture includes a list of species as Annex IV that are exempted from the application of the principles in this Council Regulation. This refers to species already introduced into the Community, e.g. species imported in current commercial practice. For a species to be exempt, it must have been used in aquaculture for a long time (with reference to its life cycle). At the same time it should be documented that the species show no adverse effects, i.e. introductions and translocations of such species must avoid unintentional movements of potentially harmful non-target species, such as disease agents and other "fellow travellers". Annex IV of this EU instrument provides a list of such species and Member States may request the Commission to add species to this list.

The current Annex IV contains 12 species that are already exempt because they have been used in aquaculture in the EU for considerable time and represent important species for production. A further 30 species have been proposed for inclusion in Annex IV but these require assessment of their importance in European aquaculture as well as whether they are likely to have any significant impacts if given exemption to the principles of Council Regulation 708/2007.

The criteria against which species were assessed are:

(a) The aquatic organism must have been used in aquaculture for a long time (with reference to its life cycle) in certain parts of the Community with no adverse effects in the wild.

Long time means a minimum period of 10 years after two production cycles are completed. This time period is considered the minimum period necessary to observe any adverse effects on ecological goods and services and ecosystem functioning.

Adverse ecological effect on the recipient ecosystem is defined as where evidence shows that an aquatic species, after its introduction in a particular country, has caused inter alia habitat degradation, competition with native species for spawning habitat, or hybridization with native species threatening species integrity, or predation on native species' population resulting in their decline, or depletion of native food resources.

(b) Introductions and translocations must be able to take place, without the coincident movement of potentially harmful non target species (having regard to the fact that diseases-causing organisms are covered by Directive 2006/88/EC).

As part of the actions to evaluate whether a species should be included for exemption, a series of fact sheets were prepared for discussion at expert workshops held in Brussels and subsequent decision on their inclusion. This document provides a summary of the fact sheets and the conclusions from the deliberations.

More than 30 species fact sheets were prepared, which summarise information on diagnostic features, geographical distribution, habitat and biology, aquaculture production (with an emphasis on the European industry), impacts of introduction, factors likely to influence spread and distribution. The fact sheets may be consulted for further details. These documents also provide extensive case studies of the negative (and beneficial) impacts of selected alien species, thereby contributing to the outputs of WP2. As such they represent a major output of IMPASSE WP1 (Task 1.2 - aquaculture production) and WP2.

Gollasch, S., Miossec, L., Peeler, E. & Cowx, I. G. (2008). [*Spread of novel pathogens and diseases caused by the introduction of alien species*](#). Report to EC, 69 pp.

Executive summary

The movement of fish for aquaculture and in ornamental trade has resulted in rapid national and international spread of disease and also exposed potentially highly susceptible populations to new diseases.

More than 400 non-target species introduction events are included in the database prepared by IMPASSE, of which approximately 50% are unintentional introductions of disease agents and pathogens. The other non-target species refer to associated organisms, such as fouling species on, for example, bivalve shells. The main source is import of contaminated/infected target species (primary introductions). Secondary spread between aquaculture sites in Europe is also of serious concern as non-target species were frequently moved unintentionally.

Existing guidelines on quarantine measures and risk assessment should be followed (e.g. ICES Code of Practice on the Introductions and Transfers of Marine Organisms (ICES 2005), IUCN Guideline on alien species in aquaculture (Hewitt *et al.* 2006), EU Council Regulation (EC) No 708/2007 of 11 June 2007 concerning use of alien and locally absent species in aquaculture).

The most impacting disease agents and pathogens in Europe include:

- Infectious Haematopoietic Necrosis Virus, IHNV (impact on trout),
- Viral Haemorrhagic Septicaemia Virus, VHSV (impact on salmon),
- Spring Viraemia of Carp Virus, SVCV (impact on cyprinids),
- *Aeromonas salmonicida*, Furunculosis (impact on salmon),

- *Lepeophtheirus salmonis*, Salmon louse (impact on salmon),
- *Bonamia ostreae*, Bonamiosis (impact on oysters),
- Withering Syndrome (impact on abalone),
- *Anguillicola crassus*, Eel nematode (impact on eels), and
- *Gyrodactylus salaris* (impact on salmon).

Gozlan, R. E., Nunn, A. D., Britton, J. R. & Cowx, I. G. (2008). [Review of the impacts of introductions on the aquatic environment and ecosystem services](#). Report to EC, 23 pp.

Introduction

The public view towards species introductions reflects societal values (Sagoff, 2005, 2007) and is often a matter of risk perception rather than actual risk analysis (Llewellyn, 1998). The judgements that people make when asked to characterise and evaluate potential ecological risks are influenced by the scientific consensus (Hunziker & Kienast, 2003; Brown, 2007; Sagoff, 2007; Simberloff, 2007; Wallner *et al.* 2003). Whilst risk perceptions are important to the policy process, there is often a well-established pattern of comparatively small risks being over-assessed (Andersen *et al.*, 2004; Brown, 2007; Copp, Garthwaite & Gozlan, 2005b; Holt, 2006; Kolar, 2004; Llewellyn, 1998; Ricciardi & Rasmussen, 1998; Wallner *et al.*, 2003).

This is reflected in the issue of freshwater fish introductions, where the great majority of research has focused on a small number of genuinely negative cases (Gozlan, 2008). As risk perception is an important part of the evaluation of ecosystem functioning and ecological impact in general, this aspect will be discussed in the light of hard evidence from the scientific literature.

Furthermore, the environmental changes that aquatic ecosystems are likely to encounter in the future may have implications on the distribution of native species, and an increased reliance on non-native species to supplement existing stocks may occur as a consequence (Alcamo, Florke & Marker, 2007; Balirwa, 2007; Cowx, 1997; Finnoff *et al.*, 2005; Kaliba *et al.*, 2006; Leung *et al.*, 2002; Lovell, 2006). Aquaculture production is increasing, as is our dependence upon this activity as it provides an important substitute for the declining output of capture fisheries. As a result, it is likely that the number of introductions will increase, and so a more pragmatic, albeit controversial, attitude will be outlined.

Jones, J. & Kasamba, E. (2008). [Social and economic impacts of alien species introductions: decision tools for aquaculture](#). Report to EC, 27 pp.

Executive Summary

The impacts of invasive alien species (IAS) can be negative and costly. The nature of the impact can vary greatly from the obvious affects on industry finances to the less obvious economic effects on supply and demand. In addition, some of the impacts can have effects for which there are no markets to assess values, such as the loss of species or ecosystem function. These latter impacts require very different techniques for their assessment and there are a number of objections to their use.

The impacts of IAS relating to aquaculture can be seen at three broad levels. The most common and easiest to assess are those impacts that affect the industry and associated businesses itself; i.e. the effects of the IAS are felt within relatively narrow and

well-defined boundaries. The second level reflects the situation whereby an IAS impacts on businesses and industries outside that of the aquaculture sector, such as tourism. These first two levels broadly comprise what economists term use values. Use values relate to direct use of a good or service as well as indirect use. Indirect use relates to special functions of some ecosystems. For example, lakes, oceans and rivers assimilate waste, and provide habitats for wildlife; forests act as carbon sinks and so on. Use value may or may not be reflected in market prices. The third level impacts affect non-market goods and services, which may have use or non-use values. Non-use values are derived independently of any use, present or future, which people might make of those non-market goods and services. The methods commonly used to estimate non-market values are briefly described, as are the critiques. This three-level classification of the impacts implies different techniques to estimate values as part of a cost benefit type appraisal. However, it is argued that as the scale of the impacts increases in time and space, these more “standard” economic techniques become less appropriate and that other more participatory methods need to be considered. Such methods require input from different stakeholder groups to better reflect society’s preferences. This is a relatively new area in the field of environmental valuation and has not been applied widely. Given very few examples on calculating economic impacts from IAS resulting from aquaculture are available in the literature, it is possible that standard techniques, such as costs benefit analysis, will suffice for the majority of cases. The pest risk analysis procedures that have been adopted in other sectors allow for a form of participatory input, albeit from the perspective of experts rather than a broader coalition of stakeholders, and may be applicable for aquaculture.

One final point needs to be made with respect to socio-economic analysis of the impacts of invasive alien species. The process can be expensive, particularly when surveys or focus groups need to be incorporated into the analysis. The need for the use of such methods needs to be assessed at an early stage.

Occhipinti-Ambrogi, A., Savini, D., Cowx, I. G., Copp, G. H. & Nunn, A. D. (2008). *Analysis of drivers of the use of introduced species and dispersal mechanisms from aquaculture related activities.* Report to EC, 26 pp.

Executive summary

This report provides a review of the reasons behind the introductions of non native aquatic species in Europe for aquaculture and related activities, together with indications on dispersal mechanisms through which non native species can establish populations into the wild during the stages of import, farming and delivery to the market.

The information on the use of non-native organisms for aquaculture purposes showed a high degree of uncertainty about the major reasons for introductions in Europe (still unknown in 30% of cases). Notwithstanding, the most important driver of use for the introduction of new species is “broad commercial reasons” (about 30% both in inland and marine waters). Commercial/economic reasons are based on the use of most cost-efficient species in terms of production costs to output revenues, resistance to environmental stressors (e.g. pollution or parasites), pre-existing knowledge of rearing methodologies and technologies. The majority of introduction events have been driven by these reasons; the search for new food resources following a general collapse of fisheries in the 1970s and the subsequent development of aquaculture to meet the European demand for fishery products. Other important reasons for species introduction are connected with trade of species for recreational reasons

(stocking, sport fishing), ornamental (species for public and private aquaria), biocontrol, research issues and social religious reasons.

Dispersal mechanisms refer to any route by which non native species from the aquaculture processes can enter natural aquatic environments. Aquaculture involves a highly clustered and complex productive chain; each step has an associated risk of dispersal of alien organisms in the wild. A deep knowledge of all steps, from import to larval rearing and adult growing, and finally, delivery to the market, is a fundamental prerequisite for an effective evaluation of the environmental risk posed by alien cultured species. A general model of a production chain is described, and the main “gates” through which dispersal can take place are identified, along the steps of transport, hatching and larval production, adult rearing and delivery of products to the market.

Two main steps are discussed in more detail (adult rearing facilities and delivery to the market), giving examples of European case histories having caused, or threatening, the most important introductions of non indigenous species in natural environments. Aquaculture facility types range along an axis of increasing risk of dispersal: through intensive-closed - intensive-open - extensive gated - extensive open.

Data gathered from IMPASSE database indicate that the major farming typology in Europe is that one bearing the higher associated risk of dispersal into the wild: 20% of non native cultured species are farmed in extensive open systems, while < 10% are farmed in intensive closed systems. Destinations for aquaculture products can be highly variable and include: live or frozen/ chilled/ fresh food market; ornamental (aquarium) species; stocking for mitigation, restoration, enhancement, ranching or creation of new fisheries; rehabilitation and conservation of the environment; biocontrol and research. The results of the study show that aquaculture processes in Europe are currently expanding and that they offer great opportunities for the establishment into the wild environment not only for alien species used for aquaculture purposes, but also for associated and accompanying (non-target) species.

Olenin, S., Didžiulis, V., Ovčarenko, I., Olenina, I., Nunn, A. D. & Cowx, I. G. (2008). [*Review of introductions of aquatic species in Europe*](#). Report to EC, 41 pp.

Executive summary

The main objective of this report was to assess the scale of introductions and translocations in aquaculture and for aquaculture-based stocking in the 27 EU Member States and wider European countries over the past four decades. The review comprises analyses of intentional introductions divided into species groups, environments and regions, their temporal trends, general spatial patterns and processes that lead to the need to introduce aquatic organisms for aquaculture-related purposes.

The report is largely based on literature reviews collated in the IMPASSE database on introductions of species related to aquaculture and stock-enhancement activities. The database contains over 1000 references, documenting the introduction of 651 species to European marine and freshwater ecosystems as a result of aquaculture and stocking activities, of which 317 were target species and 265 were non-target species, with the status of 248 species unknown.

The main groups used for aquaculture and stocking activities are bony fishes, crustaceans and molluscs. While the number of target species introductions is declining, the relative number of non-target species introductions is increasing. Thus, the category that causes greatest concern is accidental introductions. Nearly 36% of introductions

are accredited to this mode. Although not specified in all cases, escape from aquaculture installations is suspected as a main cause, with such introductions mostly relating to bony fishes (61%), e.g. the nematode *Anguillicollosa crassus* is the most frequently introduced non-target species in Europe.

Most introductions, both deliberate and accidental, have had negative effects on indigenous fish communities and other fauna through predation, competition, introduction of pathogens and changes in ecosystem dynamics. Although many introductions have been economically successful, the impacts on the recipient ecosystems have not always been fully evaluated. The primary reasons for deliberate introductions are generally based on short-term benefits in controlled (aquaculture) or natural (commercial and recreational fisheries) systems. Crosssectoral impacts, particularly conservation status and social and cultural aspects in fishing communities, which are difficult to quantify, are generally not considered. Council Regulation 708/2007 makes a positive contribution towards a reasoned examination of all the potential consequences, not on only pressures from economically-motivated sources.

WGITMO 2009: National Report - Ireland

(Compiled by Francis O'Beirn with input from Dan Minchin, Marine Organism Investigations and John Kelly, Invasive Species Ireland).

Highlights

Freshwater systems: Reproductive swarms of *Hemimysis anomala* were found in a sheltered inlet of a 114km² lake, Lough Derg, the lowest lake on the Shannon River in April 2008. They were recovered from the same locality in October and December 2008. It was also found associated with *Mysis relicta* over depths of 36m. In March 2009 it was found in abundance in the lower region of Lough Ree (also on the Shannon River system but upstream of Lough Derg). Presently there is no explanation for its arrival.

In this same lake the amphipod *Gammarus tigrinus* was found to depths of 36m, and occurs in varying abundance at all depths, and *Crangonyx pseudogracilis* and *Chelicorophium curvispinum* to 20m.

The North American pondweed *Elodea nuttallii* is invasive in Lough Derg is expanding its range upriver but has not as yet been found in the next upstream lake, Lough Ree. This plant has become invasive in a shallow water area on the River Lee that drains into Cork Harbour.

The South African pondweed *Lagarosiphon major* was eliminated from a pond of ~0.4 hectare near the Shannon River but continues to expand its range in one large lake, Lough Corrib on the west coast of Ireland.

The freshwater snail *Ferrisia wauteri* has been found for the first time in Ireland. Further details will be available for next years report.

Marine Systems: The marine bryozoa *Bugula neritina* and *Tricellaria inopinata*, have been found for the first time in Ireland. Further details will be available for next years report. Recruitment of the Pacific oyster, *Crassostrea gigas*, has been confirmed in a number of sites in Ireland. A series of studies are currently being conducted by the Marine Institute, Galway, University College, Dublin and Queens University, Belfast to investigate the dynamics of *C. gigas* recruitment reproduction and ecological interactions. The presence of tunicate *Didemnum vexillum*, has been confirmed at a wide

range of sites (predominantly marina sites) on both the east and west coasts of Ireland. Additional sightings of *Styela clava* have also been confirmed at a number of locations in Ireland throughout 2008. The presence of *S. clava*, appears to coincide with shellfish culture operations or significant boat movements.

The Pacific oyster, *Crassostrea gigas*: Settlement of the Pacific oyster, *Crassostrea gigas*, which has been cultured in Ireland since 1974, has recently been confirmed from a number of bays in Ireland. These bays include, Strangford Lough, Loughs Foyle and Swilly, Inner-Donegal Bay and Inner Galway Bay. Varying levels of recruitment have been observed with multiple year classes being observed in Strangford – Lough and in Loughs Swilly (see Figure 1) and Foyle.

Crassostrea gigas – Reports 2008					
Identified By	Collector	Date	Locality	Longitude	Latitude
Francis O'Beirn	Francis O'Beirn, Judith Kochman, Ciaran McGonnigle	November 27, 2008	Lough Foyle	7 12.643	55 6.274
Francis O'Beirn	Francis O'Beirn, Judith Kochman	November 27, 2008	Lough Swilly	07 33.742	55 2.875
Francis O'Beirn	Francis O'Beirn, Judith Kochman	November 28, 2008	Lough Swilly	7 33.549	55 02.611
Francis O'Beirn	Francis O'Beirn, Judith Kochman	November 28, 2008	Lough Swilly	7 34.953	55 01.283

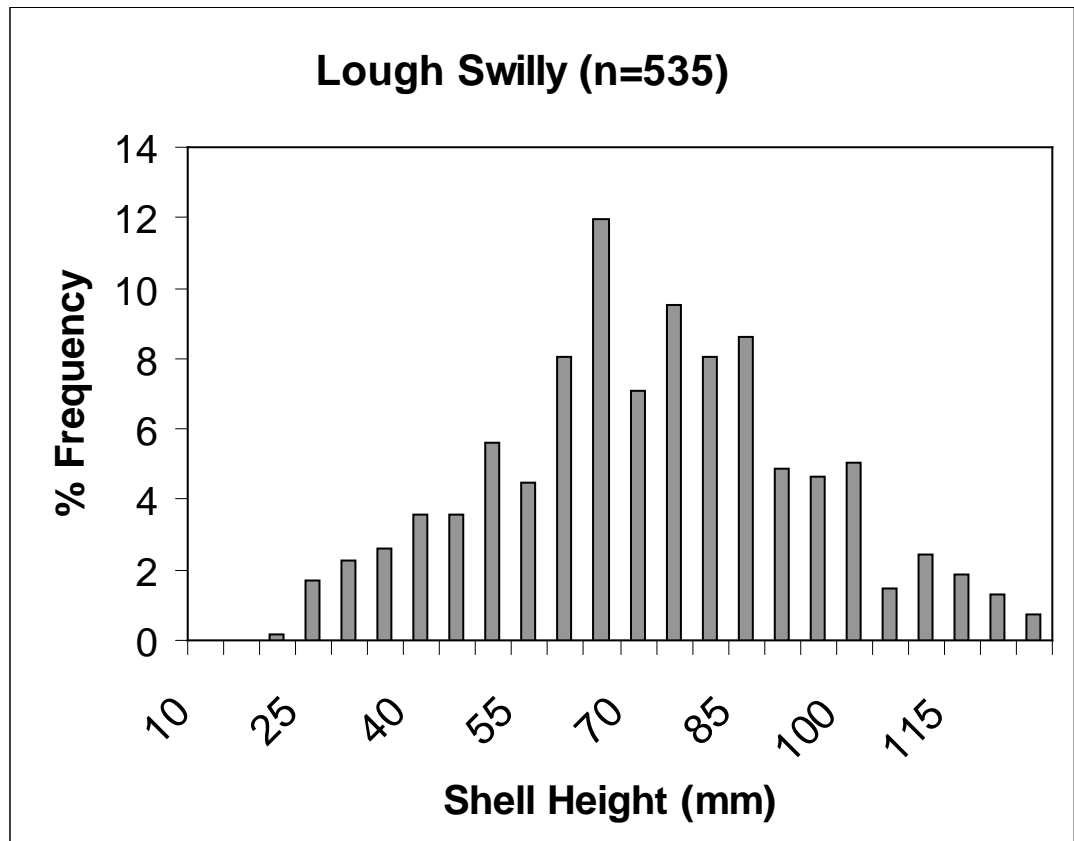


Figure 1: *Crassostrea gigas*, shell height frequency distribution from Lough Swilly, Ireland (November 2008).

C. gigas Research

Current research will focus upon documenting the extent of recruitment around Ireland (focusing upon areas where culture is concentrated). A standardised sampling protocol is currently being developed whereby multiple survey teams can increase the geographic area surveyed with a view to surveying much of the country in 2009.

Recruitment studies are also being conducted in Lough Swilly and Foyle in order to document extent and identify habitat preference. Genetic analysis will be conducted comparing culture stock with wild stock in order to determine if there is any differentiation between the two. Quantitative reproductive (histological) analysis is also being conducted to identify difference in culture methods and to differentiate between triploid and diploid stocks- with a view to recommending risk mitigation measures

***Didemnum vexillum* Current Known Distribution in Ireland:** The colonial tunicate *Didemnum* sp., following recent genetic studies may now be referred to as *Didemnum vexillum*. This species has been reported from Westport Bay on the west coast of Ireland, kindly identified by Gretchen Lambert. This makes for three known localities in Ireland. However, the marina pontoons at Malahide were devoid of *D. vexillum*. It appears that these may have been purged by reduced salinity. The species still remains in Carlingford but was not found to be abundant.

Marina Sites (Carlingford Lough and Malahide)

In 2008 there were further reports of the occurrence of *Didemnum vexillum* colonies on boat hulls, pontoons, and other substrates in two marinas in eastern Ireland.

Clew Bay

Tunicate colonies of *Didemnum vexillum* overgrowing bottom of oyster bag; note long tendrils lying on bag surface. Clew Bay at Murrisk, County Mayo, Ireland (53 deg 47.43 min N, 09 deg 37.02 min W). Water depth, low intertidal oyster trestles. Nov 9, 2007. Identified by J. Kelly (QUB).

South Galway Bay

Tunicate colonies of *Didemnum vexillum* (pale orange color) hanging from two middle bars of oyster bag trestle above the seabed. South Galway Bay at Carrowmore, Shanmullen Channel, County Galway, Ireland (53 deg 12.75 min N, 08 deg 58.25 min W). Water depth, low intertidal. Sep 30, 2007. Identified by J. Nunn (NMNI).

<i>Styela clava</i> – historical reports					
Identified By	Collector	Date	Locality	Longitude	Latitude
John Bishop	John Bishop	21/09/2004	Dingle Marina	-10.337247	52.129189
Olwen Ager	Olwen Ager	06/2002	Fenit Harbour	-9.903271	52.226873
John Bishop	John Bishop	15/11/2005	Dun Laoghaire marina	-6.204307	53.217129

<i>Styela clava</i> – new records since 2008					
Identified By	Collector	Date	Locality	Longitude	Latitude
Joe Breen/ Hugh Edwards	Joe Breen/ Hugh Edwards	Unknown	Larne Lough	n/a	n/a

Julia Nunn	Julia Nunn	25 May 2008	North Water Mulroy Bay 14 m	7°42.20'	55°12.7'
Ascidian Workshop	Ascidian Workshop	03 Aug 2008	North Water Mulroy Bay 6 – 14m Approx	7°42.20'	55°12.7'

Current Known Distribution of <i>Botrylloides violaceous</i> in Ireland					
Identified By	Collector	Date	Locality	Longitude	Latitude
Dan Minchin	Dan Minchin	2006	Malahide marina	06°09.21'	53°27.26'
Dan Minchin	Dan Minchin	2006	Carlingford Marina	06°11.27'	54°03.01'

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Training and Public Understanding of Science

http://news.bbc.co.uk/2/hi/uk_news/northern_ireland/7544157.stm

Didemnum report a sighting leaflet. "Have you seen this invader? Report all sightings"

Poster guidelines for boat owners. "[Protect against Invasive Alien Species](#)"

- Ascidian taxonomy workshop. August 4-8, 2008. Portaferry, Strangford Lough, Northern Ireland, Queen's University Marine Biology Station
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Meetings

2008 Second Annual Invasive Species in Ireland Forum. National Botanic Gardens, Dublin.

National Report for Italy - 2009

(Submitted to the ICES Working Group on Introductions and Transfers of Marine Organisms, meeting in Hamburg, Germany, March 2010)

Overview:

Fourteen new sightings are described. Two species of algae (*Palisada maris-rubri* and *Ascophyllum nodosum*), two gelatinous macroplankters (*Mnemiopsis leidyi* and *Phyllorhiza punctata*), two polychaetes (*Ophryotroca diadema* and *Harmothoë vesiculosa*) one crustacean (*Charybdis (Charybdis) lucifera*), one bryozoan (*Catenicella paradoxa*) and one fish (*Kyphosus incisor*) were recorded for the first time in Italy. Moreover, a single large individual of the king crab *Paralithodes camtschaticus* was found in the Ionian Sea. The freshwater alien crab *Procambarus clarki* and the Tilapia *Oreochromis niloticus niloticus* were found for the first time in a marine coastal lake. Two Atlantic fishes expanding their range were found in Italy (*Cephalopholis taeniops* and *Lutjanus jocu*).

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

The Italian Ministry of Agriculture and Fishery through the coordination of ISPRA (Institute for Environmental Protection and Research) has designated a commission of experts as the competent body for ensuring compliance with the requirements of the EC regulation N°708/2700 concerning the use of alien and locally absent species in aquaculture. As required by the article 23rd of the Council Regulation, a public register of introductions and translocations will be soon available.

2. Intentional introduction

No new intentional introductions have been reported.

3. Unintentional introduction

New Sightings

Algae & higher plants

The first occurrence of red alga *Palisada maris-rubri* (Ceramiales, Rhodomelaceae) in the Mediterranean Sea, is reported from Lachea island (Sicily, Ionian Sea) (Serio *et al.*, 2010). To date the species, belonging to the *Laurencia* complex, was reported only from tetrasporic specimens from the type locality (Ras Muhammed, Sinai, Egypt, Red Sea), collected in 1967, whereas the specimens were collected in Lachea island since 1991.

A few floating thalli of the brown algae *Ascophyllum nodosum* (Ochrophyta, Fucales), have been collected in July 2009 in the Mar Grande di Taranto no far from a mollusc processing plant (Ester Cecere and Antonella Petrocelli, pers.comm). This species is distributed along the eastern Atlantic coast from Svalbard to Portugal and had never been found in the Mediterranean Sea before. It is very likely that *A. nodosum* was used as packaging material for a large quantity of *Crassostrea gigas*, which had arrived a few days earlier from France and had been dumped in the sea once the oysters were put in the cleaning system. This finding is of special concern in the light of what happened with *Undaria pinnatifida*, which is now one the commonest species in the area, not to mention the failure of all the efforts made to raise awareness on the dangers of such practices.

Invertebrates

The gelatinous macroplankters *Mnemiopsis leidyi* and *Phyllorhiza punctata* have been recorded for the first time from the Italian coasts of the Western Mediterranean. In the framework of the CIESM Jellywatch campaign in the summer of 2009, *M. leidyi* was recorded from the Ligurian, Tyrrhenian, and Ionian Seas, suggesting a great success of the species in the Western Mediterranean (Boero *et al.*, 2009). Within the same program, a single specimen of *P. punctata* has been recorded in a marine protected area in the North-East coast of Sardinia. Both species do not sting or harm humans and no impact on tourism is expected, but they might harm fisheries by preying on fish eggs and larvae and their prey, zooplankton. The large distribution area of *M. leidyi* suggests that the species invaded the Western Mediterranean during the summer of 2009, but its establishment is still uncertain, since the populations might not withstand winter conditions. The isolated record of *P. punctata* just indicates that this thermophilic species can reach this part of the Mediterranean.

The Polychaete *Ophryotroca diadema*, known from temperate Northern Pacific (South California) was reported for the first time in the Mediterranean Sea and also in the European coast. It was found within the fouling communities of Porto Empedocle (Sicily, Ionian Sea) in September 2006, July 2007 and June 2008 (Simonini *et al.*, 2009) with an estimated density of 7 ind./kg of fouling (Simonini pers.comm.).

Another Polychaete (*Harmothoe vesiculosa*) was collected on living coral colonies off the Capo Santa Maria di Leuca (Apulia) at a depth of 500-700 m. It is the first Mediterranean record for this rare species that is known from Ireland and the Bay of Biscay (Mastrototaro *et al.*, 2010).

A single male adult specimen of the Indo-Pacific portunid crab *Charybdis* (*Charybdis*) *lucifera* (Fabricius, 1798) has been recorded 6 miles off the Venetian coast. This represents the first record for the Mediterranean Sea (Gulf of Venice) (Mizzan *et al.*, 2009). It's very likely that, the species was unintentionally introduced by passive transportation of the planktonic larva in ballast water.

A single large (4 kg) individual of the red king crab *Paralithodes camtschaticus*, was caught in August 2008 by a gill net in the Ionian Sea (Faccia *et al.*, 2009). Considering the boreal origin of this species, the finding is rather puzzling.

The presence of the Louisiana crayfish or red swamp crayfish, *Procambarus clarkii*, already known only from freshwater habitats in Italy, has been registered in the brackish coastal lagoon of Lesina (Apulia) (Florio *et al.*, 2008). *Procambarus clarkii* was also found in large quantities (over 1000 individuals) in a relict coastal brackish Mediterranean biotope directly connected to the Tyrrhenian Sea on the western coast of Italy. The salinity values registered in the 5 sampling occasions carried out in 2006 varied from 16.2 to 29.6 part per thousand (Scalici *et al.*, in press).

The Bryozoan *Catenicella paradoxa* sp. nov. is described from Mediterranean shallow bottoms (Rosso, 2009), along the northern coast of the Capo Passero Island (Sicily, Tyrrhenian Sea). The species represents the first known Mediterranean catenicellid, a family taxon with a warm, mostly Australasian present-day distribution.

Fishes

A few *Tilapia* individuals, *Oreochromis niloticus niloticus*, has been recorded by Florio *et al.* (2008) in the brackish lagoon of Lesina, together with the Louisiana crayfish quoted above. They are likely linked to the accidental release from fresh water aquaculture activities present in the surrounding land based facilities. A previous caught of 176 individuals found at the lagoon opening to the sea had already been described in 1999 by Scordella *et al.* (2003).

Two specimens of sea chub *Kyphosus incisor* (Cuvier, 1831) were caught at Camogli (eastern Ligurian Riviera) by an artisanal gear -the 'mugginara' -which is a small net trap fixed to the rocks that form the south-western corner of the Portofino promontory (Relini Orsi *et al.*, 2010). This finding might be interpreted both as a case of natural range expansion through the strait of Gibraltar of a species distributed in east Atlantic from Madera to Angola or as a man mediated introduction. In fact the species displays a particular behavior, during juvenile phase uses to find shelter under the ships, and during the adult stage has a demersal, free swimming habit.

We also quote here a typical case of range expansion by a fish known from the eastern Atlantic coasts of Africa, from Angola to Morocco, the African hind *Cephalopholis taeniops* (Valenciennes, 1828) (Serranidae: Epinephelinae) that was recorded for the first time in Mediterranean in 2002 off the Libyan coasts and on July 2009 was observed also at Lampedusa Island (Guidetti *et al.*, 2010).

Also the dog snapper *Lutjanus jocu* (Bloch & Schneider) was caught in 2005 by gillnet at a depth of 10 m at the mouth of Teiro Stream, Varazze, Ligurian Sea (Vacchi *et al.*, 2010). The species is principally known from the tropical western Atlantic Ocean where it occurs from Massachusetts (rare north of Florida) to northern Brazil, including the Gulf of Mexico and the Caribbean Sea.

Previous Sightings

Algae & higher plants

The potentially toxic microalga *Fibrocapsa japonica*, that had caused intense blooms in the Adriatic Sea in past years, has been investigated testing the conditions under which the cysts are formed. A survey for cyst recovery has been performed in the sediments of the coast of the region Marche (Cucchiari *et al.*, 2009). *Ostreopsis ovata* has been found (together with *Fibrocapsa japonica*) in phytoplankton samples collected in the summer of 2008 along the Adriatic coast of the region Abruzzo (Ingarao *et al.*, 2009).

The effects of the green macroalga *Caulerpa racemosa* var. *cylindracea* (Bryopsidales, Chlorophyta) have been studied on the benthic diversity of the rocky coast of Tuscany, where *C. racemosa* was introduced in 1993 and is now colonizing large areas. Both alpha and beta diversity were lower in areas invaded by *C. racemosa* than in non-invaded areas. The low alpha diversity was related to lower mean number of taxa and evenness per sample. At invaded locations, 19 and 23 taxa were not present at -5 and -25 m, respectively, compared to non-invaded locations. Furthermore, assemblages at -5 and -25 m habitats were more similar in invaded than non-invaded areas, and variability in taxa composition was lower in invaded than non-invaded areas at both depths. The reduction of differences between deep and shallow assemblages in areas invaded by *C. racemosa* was related to the lack of several species unique to the two habitats and to the increased abundance of few opportunistic species (Piazzi and Balata, 2008).

Modifications induced by *C. racemosa* spread on the sponge assemblage of coralligenous concretions (Ionian Sea –Torre Ovo, Apulia) were reported by Baldacconi and Corriero (2009). The green alga extends its stolons on the sponge specimens, anchored through numerous rhizoidal pillars that penetrate the sponge tissue to a depth of several millimeters; although sponges are known to withstand overgrowth, the sediment trapped by the algal stolons of *C. racemosa* may affect sponge pumping activity. The sponge assemblage showed a significant decrease in percentage cover, concomitant with the alga colonization; after two years, however, the algal spread has not produced a loss of sponge species richness.

A study on the feeding habits of some zoobenthic taxa inhabiting the upper infralittoral rocky shores in NW Sardinia has evaluated the effects of *C. racemosa* by comparison of isotopic ratio in both invaded and not-invaded areas. Results by Casu *et al.* (2009) suggest that *C. racemosa* detritus was a significant food source for the following native species: the polychaete *Syllis prolifera*, the gammarid *Corophium sextonae* and the gastropods *Cerithium rupestre* and *Pisinna glabrata*.

Invertebrates

A number of intensive surveys were performed from 2002 to 2008 to update the distribution of the Polychaete genus *Ophryotrocha* in Italian harbours and lagoons. Among the three most abundant species, the occurrence of *O. japonica* was confirmed in several locations, and the first record of *O. diadema* in Europe were documented as quoted above (Simonini *et al.*, 2009).

In the brackish lagoon complex of Lesina and Varano (Apulia), connected with the Adriatic Sea, the presence of the molluscs *Musculista senhousia* and *Rapana venosa*, together with the decapods *Dyspanopeus sayi* and *Callinectes sapidus* was registered (Florio *et al.*, 2008).

Fishes

The Atlantic fish *Halosaurus ovenii* expanded its distribution in Italy according to the records in Sardinia (Pais *et al.*, 2009).

A review of the distribution of Mediterranean fishes has been published by Relini-Orsi (2010), including the Italian coasts.

4. Pathogens

No data

5. Meetings and research projects

A new research project (PROGETTO ISPRA) was launched in 2009. It comprises the preparation of updated taxonomic files of non-indigenous algal and plant taxa in the Mediterranean and Italian seas, including a critical appraisal of the literature.

To acquire a more precise picture of the occurrence of gelatinous plankton aggregations, the Mediterranean Commission (CIESM), launched a citizen science initiative, the Jellywatch Programme, in the summer of 2009. Citizen science is becoming a common practice, especially to record the presence of species that are not easily sampled by traditional methods such as gelatinous plankters. The pilot phase took place in Italian waters. A poster with the main gelatinous plankters of the Mediterranean Sea was distributed nationwide with great media coverage helped by the environmentalist association “Marevivo” (<http://www.marevivo.it>). The 8000 km of the Italian coastline are intensively frequented by tourists throughout the summer and these citizens, together with beach authorities and the Coast Guard, provided hundreds of

records of gelatinous plankters, including alien species. Records were often documented by pictures and were assembled in a database.

A cooperation project is under way supported by CMCC (Centro Euromediterraneo per i Cambiamenti Climatici) and the Italian Ministry of Environment (MATTM) in the framework of the Italy-Israel collaboration programme "The impacts of biological invasions and climate change on the biodiversity of the Mediterranean sea".

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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 to the new guidelines for ICES WGITMO National Reports; it updates the Italian status appeared in 2009.

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2009 New Zealand National Report to ICES

Prepared by: Dr Justin McDonald
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1. Regulations

No new regulations or policies for the control and management of invasive aquatic species (including the management of international vectors) were adopted by the New Zealand government in 2009.

MAFBNZ is working through the International Maritime Organisation (IMO) to develop international measures for minimising the transfer of invasive aquatic species through ballast water transfer and biofouling of ships.

The New Zealand Government has agreed to develop legislation to manage the environmental effects of economic activities in New Zealand's Exclusive Economic Zone. The proposed legislation will include amendments to the Biosecurity Act to extend its jurisdiction to the EEZ. This will ultimately enable the biosecurity risks from craft operating in the EEZ to be managed.

Synthesis of introductions

2. Intentional:

There were no known intentional introductions to New Zealand.

3. Unintentional:

All non-indigenous species detected in New Zealand are assumed to have been unintentional that have arrived through vessel fouling, ballast water or a combination of both these pathways.

General information on New Zealand's Biosecurity surveillance.

MAFBNZ's marine surveillance team has completed baseline surveillance for non-indigenous marine species at 24 major ports and marinas (Figure 1) of international entry. These baseline surveys were to characterize marine flora and fauna that exists in these locations from which we may detect any change.

MAFBNZ has a regular high risk site surveillance program which has surveyed 10 high risk locations twice yearly in winter and summer for a suite of target organisms since 2002. In 2009 two extra high risk sites were added to this surveillance program.

The high risk site surveillance has two primary aims, these are:

1. Detect incursions of non-target non-indigenous or cryptogenic species not previously recorded in New Zealand.
2. Detect incursions of established non-indigenous or cryptogenic species that are exhibiting invasive characteristics (i.e. range extensions of established organisms).

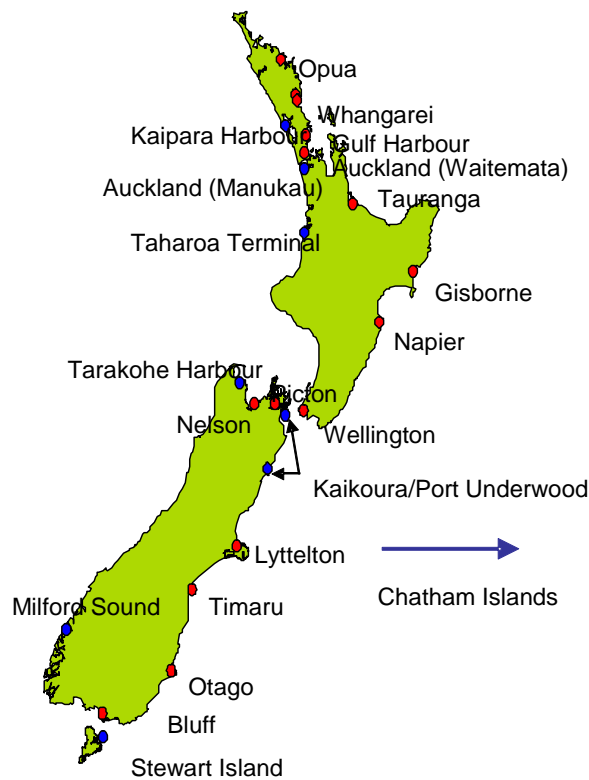


Figure 1. Location of ports and marinas targeted in baseline surveys from 2002 to 2008.

The taxonomic identification of collected material is carried out through The Marine Invasives Taxonomic Service (MITS). MITS is the facilitation and provision of taxonomic identification/diagnosis and validation of marine organisms (indigenous, cryptogenic, or introduced) of relevance to marine biosecurity management in New Zealand, and other supporting services. The Marine Invasives Taxonomic Service (MITS) was implemented in 2005, following exploration of the concept between MAFBNZ and the Contractor (NIWA). Since implementation the development of this service has largely been a joint effort (or alliance) between MAFBNZ and the Contractor, who have both invested significant time, effort, resources and, in the Contractor's case, infrastructure, into ensuring an effective service is delivered to meet MAFBNZ's needs. The service is aimed at gaining and maintaining access to the best available marine taxonomists (whether in New Zealand or internationally) and their taxonomic networks, tracking sample ID progress and managing all information relating to submitted samples (including the samples themselves).

To date approximately 40,000 specimens have been collected and processed as part of the MAFBNZ surveillance and baseline programs. These 40,000 specimens equates to approximately 1200 different species from around NZ ports and marinas. Of those 1200, about 218 (eighteen percent) were found to be non indigenous.

Most of the non indigenous species are believed to have arrived in association with international vessel movements into and around New Zealand. Biofouling has been identified as the most likely means of introduction for the majority of these species (~81 percent), followed by ballast water.

Surveillance status - 2009

In 2009 marine Biosecurity surveillance was conducted in 13 ports and marinas around New Zealand (figure 2). There were a total of 156 species collected through this surveillance program. This 156 was comprised 21 species (16 genera) of algae and 135 animal species (86 genera). There were 36 non-indigenous, 6 cryptogenic and the remaining 114 species were native. For more comprehensive taxonomic information relating to the material collected during 2009 surveillance activities please refer to the attached excel spreadsheet.

Response status - 2009

There are currently two ongoing marine responses in New Zealand. These are for the Mediterranean fan worm *Sabella spallanzanii* and the ascidian *Pyura praeputialis*. For further details refer to website:

Sabella spallanzanii: <http://www.biosecurity.govt.nz/pests/mediterranean-fanworm>
Pyura praeputialis: www.biosecurity.govt.nz/pests/pyura

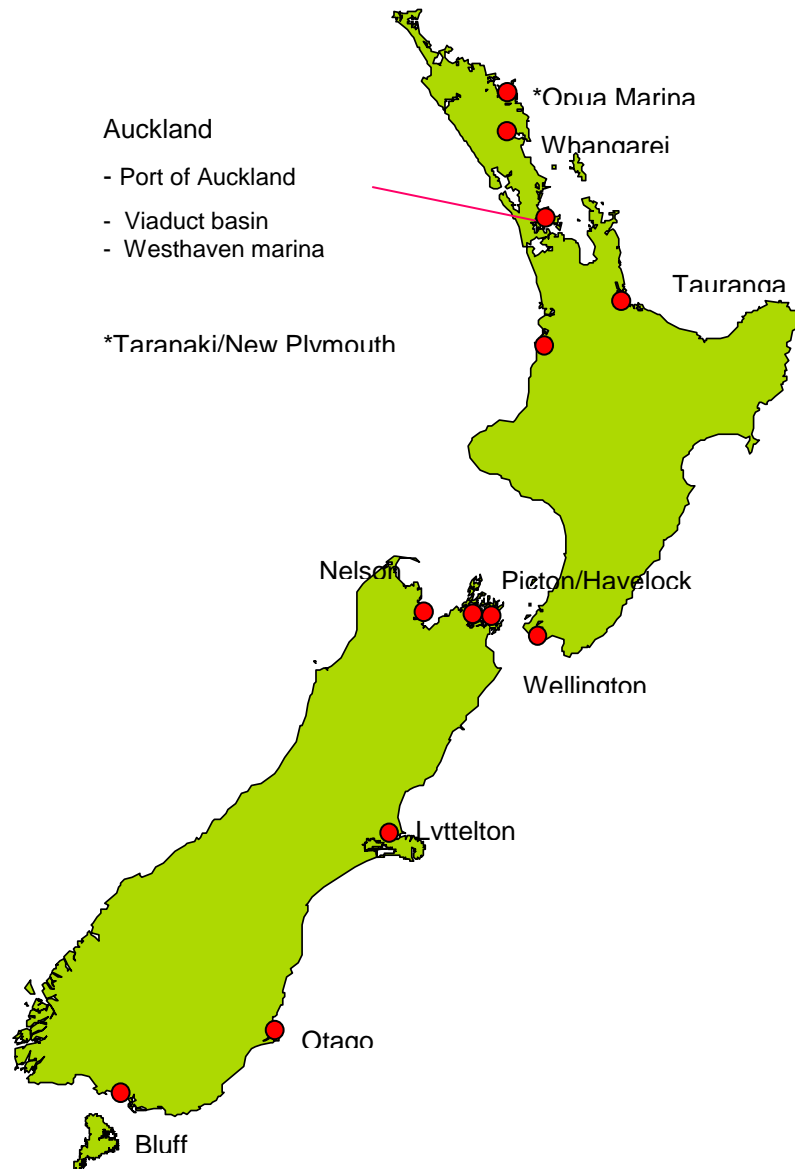


Figure 2. Location of ports and marinas targeted in 2009 marine high risk site surveillance.

ICES WGITMO Report 2009 POLAND

Audience: ICES, Member Countries & Observers, and Scientists

Prepared by: Aldona Dobrzycka-Kraheil and Anna Szaniawska

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1. Regulations:

Nothing new recorded, still in force: CBD Convention (05 June 1992), Act on Fishery (19 February 2004) and Nature Conservation Act (16 April 2004).

2. Intentional:

In 2008 deliberate releases of salmon (*Salmo salar*), sea trout (*Salmo trutta morpha trutta*), eel (*Anguilla anguilla*) and whitefish (*Coregonus lavaretus*) were conducted (Bartel & Kardela, 2009).

In 2009 deliberate releases of salmon (*Salmo salar*), sea trout (*Salmo trutta morpha trutta*), vimba (*Vimba vimba*) and whitefish (*Coregonus lavaretus*) were consistent. Additionally reintroduction of *Acipenser oxyrinchus* were conducted (Bartel & Kardela, in press).

3. Unintentional

Invertebrates

Orchestia cavimana (Heller, 1865) (Amphipoda: Talitridae) was recorded for the first time on the water-edge of the Vistula River at Świbno (8th October 2009, 54.333417°N 18.935980°E - in freshwater inland habitats in the Vistula River (Konopacka at el. 2009).

O. cavimana is generally considered as alien in the basin, however neither the reason nor the vectors of their spread is known. It is the species originating presumably from Mediterranean/Ponto-Caspian regions or even from Asia. Now it has a rather wide distribution range including the Black Sea, Mediterranean, Red Sea, Atlantic coasts of North Africa and Europe. The species has been previously found only in a few sites on the coasts of Poland, in damp habitats, beneath stones and decaying vegetation close to fresh or brackish water (Spicer & Janas, 2006). It is a 'freshwater' beach flea common in the Szczecin Lagoon, at the mouth of the River Oder (Odra), from where it has reached the Polish Island of Wolin (Urbański, 1948); it has also been observed in the Vistula Lagoon and in the Dead Vistula River (Żmudziński, 1990).

Jaera sarsi (Valkanov, 1936) was recorded for the first time in the River Odra estuary. *Gammarus tigrinus*, *Pontogammarus robustoides*, *Dikerogammarus haemobaphes*, *D.villosus* and *Chelicorophium curvispinum* are alien species still occurring in the River Odra estuary (Gruszka & Cupak, 2009).

Pontogammarus robustoides (Amphipoda), *Dikerogammarus haemobaphes* (Amphipoda), *Obesogammarus crassus* (Amphipoda) and *Gammarus tigrinus* (Amphipoda) represent alien species still occurring in Vistula Delta. *Gammarus tigrinus* (Am-

phipoda), *Pontogammarus robustoides* (Amphipoda), *Dikerogammarus haemobaphes* (Amphipoda) and *Obesogammarus crassus* (Amphipoda) occur in the Vistula Lagoon (Surowiec & Dobrzycka-Kraheil 2008; Dobrzycka-Kraheil & Chabowska A., submitted)

Fish

527 *Percottus glenii* individuals were collected in four sites in the Włocławski Reservoir (the Vistula River, Baltic basin, Poland) (Grabowska *et al.* 2009).

Earlier, in the 1990s a rapid expansion of *P. glenii* was observed in the Vistula River system in Poland (Terlecki & Pałka, 1999, Kostrzewa *et al.*, 2004).

4. Pathogens

Gregarines : *Uradiophora ramosa*, *Uradiophora longissima*, *Cephaloidophora similis*, *Cephaloidophora mucronata* and microsporidians : *Nosema dikerogammari*, *Nosema pontogammari*, *Thelohania sp. 2*, *Thelohania sp. 5* were recorded in gammarids inhabiting Polish inland and coastal waters including Vistula, Oder and Bug Rivers, Vistula Lagoon, Gosławskie Lake, littoral of the Baltic Sea, as well as small rivers draining directly to the sea. All the above microparasites were new to Poland. *Cephaloidophora sp. 1* and *Uradiophora sp. 1* were registered only in North-American *Gammarus tigrinus*. *Uradiophora ramosa* infects Ponto-Caspian (*Pontogammarus robustoides*, *Dikerogammarus villosus*) and North-American hosts (*G. tigrinus*) (Ovcharenko *et al.*, 2009 a).

Taxonomic verification of *Nosema dikerogammari* (Ovcharenko and Kurandina 1987) to a new genus *Cucumispora* was noted. *Dikerogammarus villosus* is an invasive amphipod that has two frequent microsporidian parasites. The taxonomic status of these parasites was unclear. Phylogenetic analysis based on the complete sequence of SSU rDNA places the parasite outside the genus *Nosema* and it is therefore ascribed to a new genus *Cucumispora*. The key features characteristic to this genus are: presence of a very well-developed, umbrella-shaped anchoring disk covering the anterior part of polaroplast; arrangement of isofilar polar filament into 6-8 coils convoluted with different angles, voluminous diplokaryon, thin spore wall and relatively small posterior vacuole containing posterosome. The parasite infects most host tissues but mainly muscles. It showed high rates of horizontal trophic transmission and lower rates of vertical transmission (Ovcharenko *et al.*, 2009 b).

List of non-indigenous marine species in Polish Baltic coastal environment

Alien species name
1. <i>Mnemiopsis leidyi</i> (Ctenophora)
2. <i>Acartia tonsa</i> (Crustacea)
3. <i>Atyaephyra desmaresti</i> (Crustacea)
4. <i>Balanus improvisus</i> (Crustacea)
5. <i>Cercopagis pengoi</i> (Crustacea)
6. <i>Chaetogammarus ischnus</i> (Crustacea)
7. <i>Chelicorophium curvispinum</i> (Crustacea)
8. <i>Dikerogammarus haemobaphes</i> (Crustacea)
9. <i>Dikerogammarus villosus</i> (Crustacea)
10. <i>Dyopetos monocanthus</i> (Crustacea)

11. <i>Eriocheir sinensis</i> (Crustacea)
12. <i>Gammarus tigrinus</i> (Crustacea)
13. <i>Hemimysis anomala</i> (Crustacea)
14. <i>Obesogammarus crassus</i> (Crustacea)
15. <i>Orconectes limosus</i> (Crustacea)
16. <i>Palaemon elegans</i> (Crustacea)
17. <i>Platorchestia platensis</i> (Crustacea)
18. <i>Orchestia cavimana</i> (Crustacea)
19. <i>Pontogammarus robustoides</i> (Crustacea)
20. <i>Rhithropanopeus harrisi tridentatus</i> (Crustacea)
21. <i>Jaera sarsi</i> (crustacean)
22. <i>Cordylophora caspia</i> (Hydrozoa)
23. <i>Dreissena polymorpha</i> (Mollusca)
24. <i>Mya arenaria</i> (Mollusca)
25. <i>Potamopyrgus antipodarum</i> (Mollusca)
26. <i>Branchiura sowerbyi</i> (Oligochaeta)
27. <i>Anguillicola crassus</i> (Nematoda)
28. <i>Acipenser baerii</i> (Pisces)
29. <i>Acipenser gueldenstaedti</i> (Pisces)
30. <i>Acipenser ruthenus</i> (Pisces)
31. <i>Aristichthys nobilis</i> (Pisces)
32. <i>Coregonus peled</i> (Pisces)
33. <i>Ctenopharyngodon idella</i> (Pisces)
34. <i>Cyprinus carpio</i> (Pisces)
35. <i>Hypophthalmichthys molitrix</i> (Pisces)
36. <i>Lepomis gibbosus</i> (Pisces)
37. <i>Neogobius gymnotrachelus</i> (Pisces)
38. <i>Neogobius melanostomus</i> (Pisces)
39. <i>Oncorhynchus mykiss</i> (Pisces)
40. <i>Percottus glenii</i> (Pisces)
41. <i>Marenzelleria cf. viridis</i> (Polychaeta)
42. <i>Pseudodactylus anquillae</i> (Monogenea)
43. <i>Pseudodactylogyrus bini</i> (Monogenea)
44. <i>Parateniusentis ambiguous</i> (Acanthocephala)
45. <i>Uradiophora ramosa</i> (Apicomplexa)
46. <i>Uradiophora longissima</i> (Apicomplexa)
47. <i>Cephaloidophora mucronata</i> (Apicomplexa)
48. <i>Cephaloidophora similis</i> (Apicomplexa)
49. <i>Cucumisphora dikerogammari</i> (Microsporidia)
50. <i>Nosema pontogammari</i> (Microsporidia)
51. <i>Thelania sp. 2</i> (Microsporidia)
52. <i>Thelania sp. 5</i> (Microsporidia)

5..Meetings

Past year:

- 24-25.09.2009 was the NOBANIS group meeting in Krakow.

NOBANIS (European Network on Invasive Alien Species <http://www.nobanis.org>) has developed a network of common databases on alien and invasive species in 18 countries of central and northern Europe. Polish data are provided by the "Alien Species in Poland" database.

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Spain National Report

Prepared by Gemma Quilez-Badia

Regulations

There currently is no specific legislation regarding the prevention and control of NIS in Spain. There are, however, some mentions of existing rules regarding The Conservation and Use of Biodiversity, The Planning and Management of Protected Natural Areas, Animal and Plant Health and the Criminal Code.

Conservation and Use of the Biodiversity:

- Ley 42/2007, de 13 de diciembre, de Patrimonio Natural y de la Biodiversidad. Capítulo III. Artículo 61 sobre creación del Catálogo Español de EEI (Law 42/2007, December 13, for the Spanish Natural Heritage and Biodiversity. Chapter III Prevention and Control of Alien Invasive Species. Art. 61 on the creation of the NIS Spanish Inventory).
- Real Decreto 1997/1995, de 7 de diciembre, por el que se establecen medidas para contribuir a garantizar la Biodiversidad mediante la Conservación de los Hábitats Naturales y de la Fauna y Flora Silvestres (Royal Decree 1997/1995, December 7, by which measures were established to guarantee the Biodiversity by Conserving Natural Habitats of Wild Fauna and Flora).
- Ley 26/2007, de 23 de octubre, de Responsabilidad Medioambiental (Law 26/2007, October 23, on the Environmental Responsibility).
- Estrategia Española de Conservación y Uso Sostenible de la Biodiversidad Biológica (Spanish Strategy for the Conservation and Sustainable Use of the Biological Biodiversity).

Management of Protected Natural Areas

- Real Decreto 1803/1999, de 26 de noviembre, por el que se aprueba el Plan Director de la Red de Parques Nacionales (Royal Decree 1803/1999, November 26, by which the Director Plan for the Network of National Parks is approved).

Animal and Plant Health

- Ley 43/2002, de 20 de noviembre de Sanidad Vegetal (Law 43/2002, November 20, on Plant Health)
- Ley 8/2003, de 24 de abril, de Sanidad Animal (Law 8/2003, April 24, on Animal Health)
- Real Decreto 1190/1998, de 12 de junio, por el que se regulan los Programas Nacionales de Erradicación o Control de organismos nocivos de los vegetales aún no establecidos en el territorio nacional (Royal Decree 1190/1998, June 12, by which National Programs for the Eradication or Control of Plant's Harmful Organisms, not yet established in the country, are regulated).

Criminal Code

- Ley Orgánica 10/95 de 23 de noviembre del Código penal. Artículos del 325 al 340 (Organic Law 10/95, November 23, on Criminal Code. Articles 325-340).
- Ley Orgánica 15/2003, de 25 de noviembre, por la que se modifica la Ley Orgánica 10/1995, de 23 de noviembre, del Código Penal (Organic Law 15/2003, November 25, by which Organic Law 10/1995, November 23, on Criminal Code, is modified).

Intentional Introductions

Crassostrea gigas

Spain exported 653 t between January and June 2009 (http://www.icex.es/icex/cda/controller/pageICEX/0,6558,5518394_5519005_6366453_4282633_0_-1,00.html)

Unintentional Introductions

New Sightings:

Blackfordia virginica and *Mnemiopsis leidyi* (see Species_list_Spain_2009).

The cnidarian *Blackfordia virginica*, native to the Black Sea, was first reported in July 2008 in the Guadiana estuary (SW Spain, 37°15'30"N, 7°25'58"W) (Chícharo *et al.*, 2009). The authors found specimens of both sexes, over a wide range of sizes (6-19 mm) and maturation stages and in such large numbers that would suggest local reproduction. The results from this study showed that stations where *B. virginica* was present had reduced densities of all zooplanktonic organisms, including eggs of European anchovy *Engraulis encrasicolus* (Linnaeus, 1758). Elsewhere, similar populations of alien ctenophores have been recorded to grow so large that they consume most of the summer zooplankton production (up to 80%). This depletion of food supply occurred so quickly and devastated the populations of small pelagic fish. Commercial catches were also severely affected (Studenikina *et al.* 1991). If similar reductions of planktonic biomass can be caused by *B. virginica*, this could have severe implications for organisms at upper trophic levels. *E. encrasicolus*, for example, use the Guadiana estuary as a nursery area (Chícharo *et al.* 2002) and feed mostly on small planktonic crustaceans. Moreover, the potential consumption of eggs by *B. virginica* could potentially increase the impact on the nursery function of the estuary (Chícharo *et al.*, 2009).

The vectors of introduction of *Blackfordia virginica* in the Guadiana estuary are still unclear. It may have been introduced to the Guadiana estuary in either the medusa or the polyp stage (or both), most likely by nautical activities (Chícharo *et al.*, 2009).

The ctenophore *Mnemiopsis leidyi*, native from the West Atlantic, was first reported in July 2009 in Cap de Creus (NE Spain, 42°19'05.78"N, 3°19'31.40"E) Subsequently it was reported along the entire length of the Catalan coast (NE Spain) and in some other locations along the Mediterranean coast of Spain. *M. leidyi* occurred throughout the summer (last report 26 September 2009) (Fuentes *et al.*, 2009). The authors suggest that due to the high concentrations of *M. leidyi* along the Spanish coast, together with its blooms earlier that year in Israel (Galil *et al.* 2009) and Italy (Boero *et al.* 2009), *M. leidyi* is already established in the Mediterranean Sea.

The success of *M. leidy* and the consequences for the environment have not yet been studied in Mediterranean waters. The presence and possible establishment of *M. leidy* populations, however, is of great concern because it could have serious consequences for the Mediterranean ecosystem and fisheries as in other previously-invaded regions (e.g., Purcell *et al.* 2001; Shiganova *et al.* 2001a).

The presence of large numbers of *M. leidy* at several locations off the Spanish Mediterranean coast suggests there may have been more than one point of origin. It is unclear whether *M. leidy* was transported by currents or ships from other areas of the Mediterranean Sea (Fuentes *et al.*, 2009).

Pathogens

Bonamia exitiosa was first recorded in Ria de Arousa, Galicia (Atlantic Ocean) (42° 30' 26.49" N, 08° 49' 15.27" W) in September 2006 (Abollo *et al.*, 2008). *Bonamia* spp, including *B. exitiosa*, are protists (intrahaemocytic protozoa) of the phylum Haplosporidia (Carnegie and Cochenec-Laureaun, 2004) that cause lethal infection of the haemocytes of certain oysters (Cranfield *et al.*, 2005; Dinamini *et al.*, 1987) (e.g. *Ostrea chilensis* (in New Zealand) or *Ostrea angasi* (in Australia) (MAPA, 2007)). *B. exitiosa* appears to be endemic from New Zealand (Cranfield *et al.*, 2005) and in Galicia it has been identified infecting another oyster species (*Ostrea edulis*).

B. exitiosa could have been introduced in Galicia through ballast water and outer hulls of ships. Although, *B. exitiosa* could also have been inadvertently introduced through (1) the illegal importation of oysters from areas endemic for *B. exitiosa*; or (2) the legal importation of oysters from hypothetical European countries where *B. exitiosa* may occur, but have not yet been detected (Abollo *et al.*, 2008).

Meetings

Past year:

Quilez-Badia, G. and Ruiz, G.M. (2009) 'Synthesis of marine invasion history for the Iberian Peninsula: Patterns and predictions'. Poster presentation at BIOLIEF: World Conference on Biological Invasions and Ecosystem Functioning, Porto, Portugal (27-30 October, 2009)

Future meetings:

Quilez-Badia, G. and Ruiz G.M. (2010) 'Iberian Peninsula marine and estuarine invasions: Past, present and future'. Presentation at 39th CIESM Congress, Venice, Italy, 10 - 14 May 2010.

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ICES Working Group on Introductions and Transfers of Marine Organisms, Hamburg, Germany, March 10-12, 2010

National report, Sweden 2009

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Highlights of the National Report

The parasite *Marteilia refringens* was found in Sweden for the first time, in blue mussels (*Mytilus edulis*) on the Swedish west coast.

Mature individuals of round goby, *Neogobius melanostomus*, ready for reproduction were found in Karlskrona archipelago. They probably arrived as larvae in 2007, because the oldest individual was 2 years old. (First record in July 2008.)

The Chinese mitten crab, *Eriocheir sinensis*, was found in decreased numbers during the latest years, in the lakes Vänern and Mälaren, compared to peak abundances in 2005 and 2006.

The Swedish parliament has decided to ratify the Ballast Water Convention.

The Japanese oyster, *Crassostrea gigas*, is now very common on the Swedish west coast and is also found to reproduce at some locations. A proposed bill to make them available to anyone, not only the owner of the water area, is presented to the parliament.

The red alga *Gracilaria vermiculophylla* was found at five new localities on the Swedish west coast in summer 2009, two of which were north but none south of the range, in which it had been previously found.

The American comb jelly *Mnemiopsis leidyi* was found in higher numbers than previous years in the Gullmarfjord on the Swedish west coast. Genetic analysis of ctenophores (comb jellies) from the northern part of the Baltic proper was found to be *Mertensia ovum*, not *Mnemiopsis leidyi*.

Added to the report is a map of salinity in the waters around Sweden.

1. Laws and regulations

The government and Swedish parliament have decided to ratify the Ballast Water Convention (decision 2009/10:23, 4th of November 2009, and a new law: 2009:1165, that will come in force when the convention comes into effect).

A proposed bill is given to the parliament about *Crassostrea gigas*. Today "oysters" belong to the water owner, according to the law. But there is no species name of the "oyster" in the law text and the proposition is to clarify ownership of *Ostrea edulis*, but not of *Crassostrea gigas*, to make the Japanese oyster free for anyone to collect. (Proposition 2009/10:MJ245 in September 2009. It will be handled in spring 2010.)

2. Intentional releases and transfers

No data

3. Unintentional introductions

3.1 New sightings

No new sightings for 2009 except for a new parasite (see 4, pathogens.)

A sludge worm (Annelida, Oligochaeta, Naididae), probably not reported before, though it is not found very recently, is *Potamothrix heuscheri* (Bretscher, 1900) that was found in lake Mälaren in 1915-1916 but it was also found, in the 1990s, in brackish waters in the inner archipelago of Stockholm (N 59° 20", E 18° 10"), (Millbrink 1999).

3.2 Previous Sightings

Fish

A correction of *Neogobius melanostomus* that was first reported for 2008 (Fig. 1), but is now calculated to have arrived in 2007, due to the age of the specimens (Florin 2009). The investigation in 2009 of *Neogobius melanostomus* in Karlskrona archipelago (N 56° 9", E 15° 33") found 9 individuals, the largest a spawning dressed male 2 years of age. Some females had ripe gonads and the population was considered able to reproduce (Florin 2009). As the oldest individuals were 2 years of age, they probably arrived in 2007.

Invertebrates

The distribution of the Japanese oyster *Crassostrea gigas* on the Swedish west coast has been investigated further by Nyberg (2010). In 2006 there was an invasion of oyster larvae that have grown up since then. New recruits in 2008 and 2009 are possibly from local reproduction. *Crassostrea gigas* is now found from Hallands Väderö (N 56° 27", E 12° 33") in the south, ca 50 km further south than previously reported, to Svinesund in the north, i.e. most of the Swedish west coast. A few new localities have been colonized in 2009 compared to investigations in 2008. At least two control/eradication attempts have been made locally, one at Ringhals' power plant (at the intake water supply) and one at a public beach in Bohuslän (Nyberg 2010).

Information about the Chinese mitten crab *Eriocheir sinensis* in Sweden is compiled and submitted to "Aquatic invasions" (Drotz *et al.* submitted). There are peaks of abundances, but since 2007 the abundance in Lake Vänern and Lake Mälaren have been rather low. The number of reports from the east coast is about the same as before (Marcus Drotz pers. com.).

A genetic investigation of ctenophores in the northern Baltic Sea (Gorokhova *et al.* 2009, see also Gorokhova and Lehtinemi 2010) showed that all specimens there were *Mertensia ovum*. The abundance was high, up to 4500 individuals m⁻² and positively correlated with salinity.

On the west coast of Sweden, and as far into the Baltic Sea as Bornholm, adult specimens of *Mnemiopsis leidyi* were collected by scientists from University of Gothenburg. Larvae collected from the Baltic Sea will be genetically analyzed. The same group of scientists monitored the abundance of *Mnemiopsis leidyi* in the Gullmar Fjord near Lysekil, the SE Skagerrak, approximately every week for more than a full year (August 2007-December 2008, see WGITMO 2009). In 2009 the monitoring was conducted less frequently, but the results showed that the highest abundances occurred at the same time in 2007, 2008 and 2009, but with increasing numbers every year. The high abundances of *M. leidyi* have coincided with a reduction in zooplankton and the additional abundance peak in October/November 2009, that was 3 times as high as ever reported before in the area is expected to cause a severe reduction in zooplankton (Lene Friis Möller pers. com.). Parasitic larvae of the sea anemone *Edwardsiella* sp., infecting *M. leidyi*, were recorded in the Gullmar Fjord on the Swedish west coast (N 58° 24' E 11° 24'") from September to November in 2007 and 2008 (Selander *et al.* 2009). The highest density was observed in September 2008 when *Edwardsiidae* larvae reached 2.3 ind. m⁻³. In 2008 total density of the parasite occasionally exceeded 40% of the host density.

Old unreported distributions:

Hemimysis anomala was found in "Biotestsjön" at Forsmark (N 60° 25' 3", E 18° 11' 2"), the southern Bothnian Sea, in 2003, September 2005, May and August 2006 and August 2007 (Kerstin Mo pers. com.). (It has reported from other locations before e.g. in the Trosa and Stockholm archipelagos in the northern Baltic proper.)

Marenzelleria spp. were found near Forsmark in 1997 (previously unreported finding), the southern Bothnian Sea. Now they have increased and are dominating deeper samples (Sandström *et al.* 2002, Agrenius *et al.* 2009). In February 2009 *Marenzelleria* cf. *viridis* was found (Hansson 2009) in the small shallow channel between Tjärnö and Saltö in northern Bohuslän (N 58° 52' 27", E 11° 08' 44"), which is the northernmost record for the Swedish west coast.

Specimens of the bivalve *Macoma balthica*, originating from the North Sea, were found in the southern part of the Baltic Sea in the mid 1990s. Since these are genetically different in terms of morphology, behaviour and evolutionary history from the Baltic populations, it was tested if predator-prey interactions varied for the two groups (Ejdung *et al.* 2009). They also discussed that if the thinner and more fast-growing North Sea individuals would replace the Baltic, more globular, ones, the food web structure could be affected.

Macroalgae

In August-September 2009, slightly more than 100 different marinas and shallow sand/soft bottoms along the Swedish west coast, from the Norwegian border to the northern part of the Sound, were surveyed for the presence of the red alga *Gracilaria vermiculophylla* (Wallentinus in prep.). It was found at five new localities from where it has not been reported before, two outside the range where it previously had been found. At the new northernmost locality a single drifting specimen was seen at Kungsvikshamn, a marina north of Strömstad (N 58° 59' 47", E 11° 07' 30"), very close to the Norwegian border and the new MPA "Kosterhavet". This was ca 80 km

north of the previous northernmost record. At the other, the inner harbour at Smögen (N 58° 21' 14", E 11° 13' 00"), ca 15 km west of the previous northernmost site, a few single specimens were raked from a jetty. The other three localities were within the previous range, being found at a sheltered bay east of Hälleviksstrand, Bohuslän, in quite large amounts (N 58° 07' 35", E 11° 26' 38"), in a marina at Stråvallastrand, Halland, in quite large amounts (N 57° 17' 58", E 12° 09' 50") and two specimens in a marina at Getterön, Halland, (N 57° 06' 51", E 12° 13' 37"). Since none of the sites had been visited before, it is not known for how long they had been there. The species was not found south of its previous range and only one new site was not in a marina, pointing to leisure/fishing boats being the main vectors.

3.3 Species not seen yet

There is an Alert-list, with Latin names, on the Swedish Introduced Species web page where there is a list of expected, but not yet seen species. Some examples of species not seen yet are the brown alga *Undaria pinnatifida*, the crabs *Hemigrapsus sanguineus* and *H. tankanoi/penicillatus*, and the fish *Carassius gibelio*.

The web page is in Swedish but choose "Nya arter" in the menu to the left and then "alertlista!" at <http://www.frammandearter.se/>.

The species on the alert-list was presented in the National report from Sweden in 2009. A number of species have been added to the list since last year and it now contains almost 40 species that are considered probable future introductions. Two fish species mentioned in the 2009 report have been removed from the list as they have been reported on single occasions in Sweden; *Cyprinus carpio* (1952 and 1992) and *Onchorhynchus kisutch* (1984). A bryozoan, *Victorella pavida*, has also been removed from the list, due to a note that it has been found in 1948 at Barsebäck harbour, the Sound (N 55° 44' 34", E 12° 55' 7") (Brattström 1954).

4. Pathogens

The paramyxean unicellular parasite *Marteilia refringens* was recently for the first time found in blue mussels (*Mytilus edulis*) in a mussel farm in Orust municipality, SE Skagerrak (N 58° 04' 90", E 11° 33' 25", Fig. 1). The parasite was found due to a new sampling program, where they started sampling in 2009 (The Swedish Board of Agriculture, see web page in reference list). The way of introduction is not known.

In Norway some kind of shell disease is found on a few specimens of American and European lobsters (Mats Ulmestrand pers com.). Species identification is on its way.

A pathogen that recently got attention in Swedish media as a potential threat is the shellfish virus white spot disease (or WSSV, White Spot Syndrome Virus). It could arrive with e.g. imported raw shrimps and could cause much damage if it ends up in the sea or a lake (as discarded shells).

5. Meetings

Workshop on risk analyses and introduced species. Swedish Board of Fisheries, 6 March 2009.

There have been two meetings in 2009 with the Target Group 2, on Non-indigenous species in connections with how they can be monitored for EUs Marine Strategic Framework Directive. Inger Wallentinus was part of this TG2, and also presented the Group's Report at the WG GES meeting in Brussels February 1-2, 2010.

She also was invited to the the International Workshop on "Indicator based methods to assess and map biological pollution in the coastal waters of Norway", Bergen May 27-29, 2009 (Wallentinus 2009)

Research project

A current research project, Wreck Protect, are studying *Teredo navalis*, that are spreading eastward in the south Baltic Sea. Earlier reports are from Warnemünde, but in 1993-1996 it has spread to Hiddensee (N 54° 42" E 13° 6", Christine Appelquist pers com.).

<http://www.wreckprotect.eu/>

Papers from the national research program AquAliens (2002-2007) are still coming out concerning introduced species in Sweden, from both marine and fresh water habitats (Berglund *et al.* 2009, Gren *et al.* 2009a, 2009b, Järemo 2009, Lindberg *et al.* 2009, Nyberg & Wallentinus 2009, Nyberg *et al.* 2009).

Doctoral thesis

Berglund H (2009) The treat from non indigenous species - ecosystem vulnerability, global distribution and co-occurrence with other major threats. Doctoral thesis. Department of Chemical Ecology and Ecotoxicology. Lund University. 23 pp and 5 papers.

Andersen Borg M (2009). Non-indigenous zooplankton - the role of predatory cladocerans and copepods in trophic dynamics. Doctoral thesis. Stockholm University. 53 pp and 5 papers.

Acknowledgement

We thank all our colleagues at universities, museums, municipalities and other authorities for their kind help especially with unpublished information.

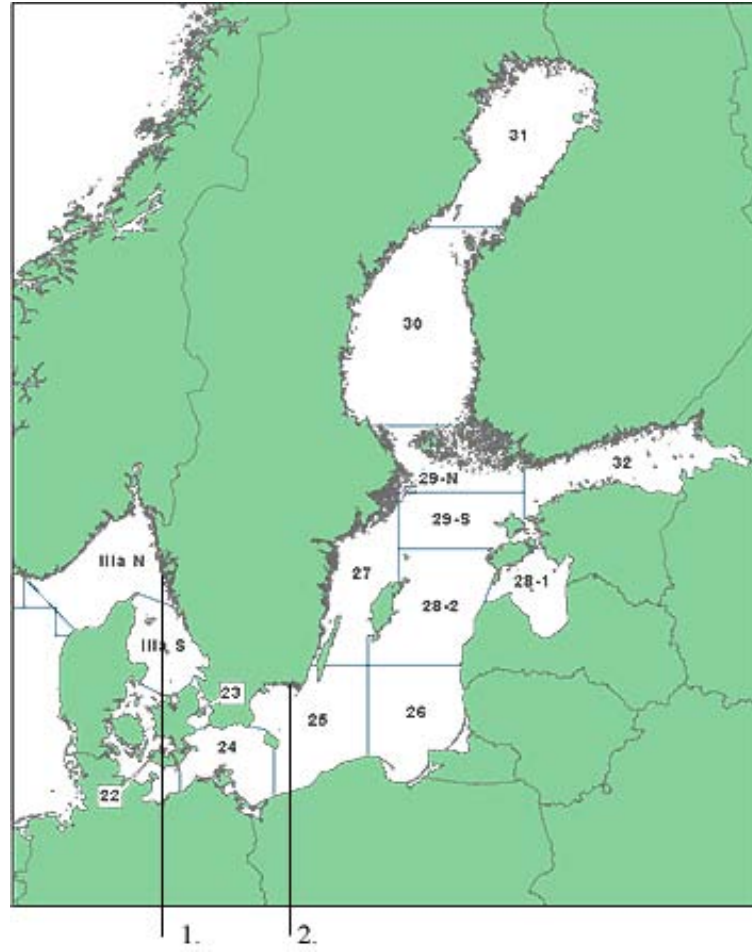
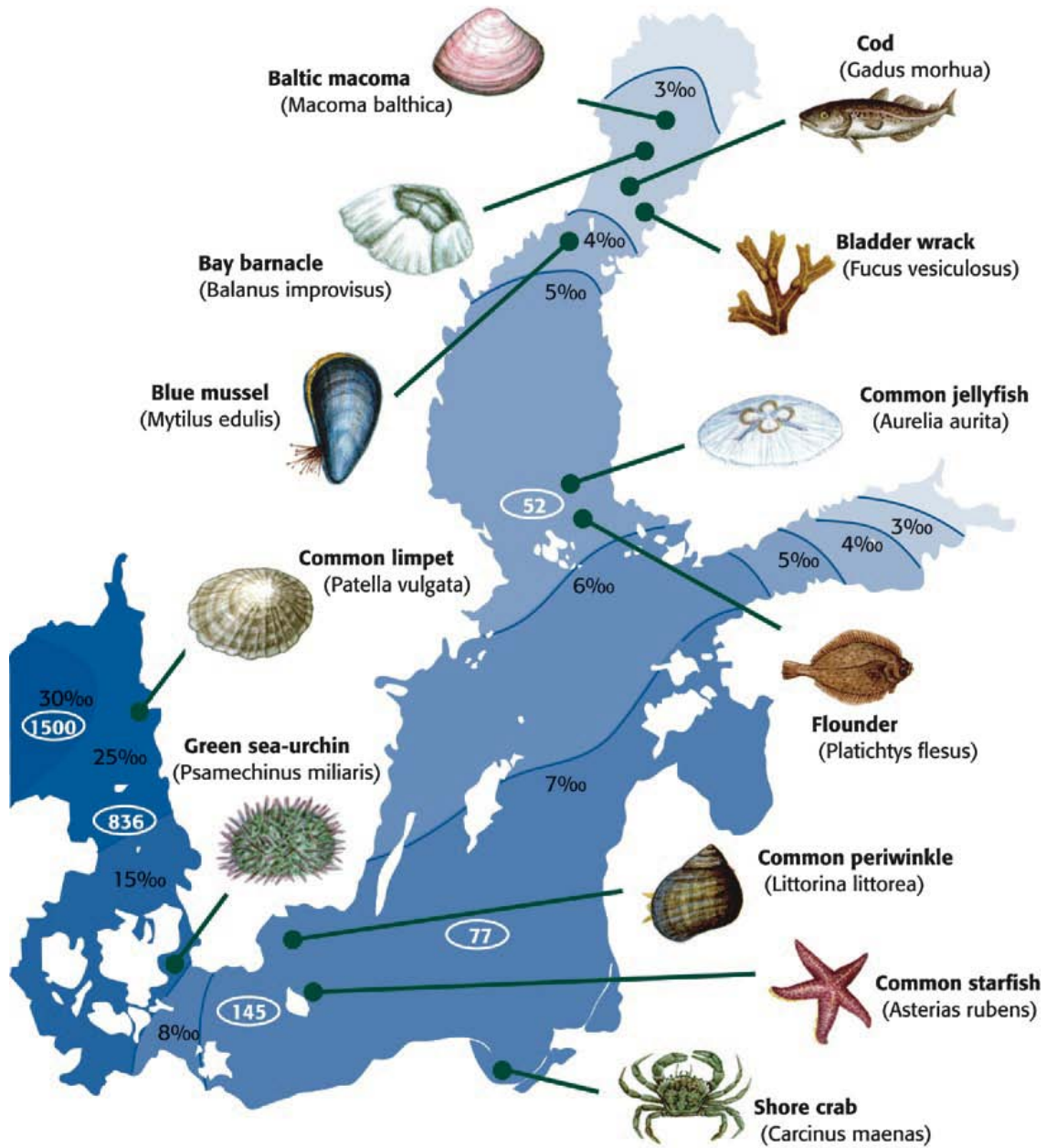


Figure 1. Arrows indicate the area where reports of 1) *Marteilia refringens*, the mollusc parasite was found for the first time in Swedish waters in 2009 and 2) round goby, *Neogobius melanostomus*, reported for the first time in 2008.

Salinity affects diversity



Numbers within circles indicate amount of marine macrofauna found in the area.

By Stockholm Marine Research Centre, reference: professor B-O Jansson, Stockholm University

Figure 2. Map of the seas around Sweden, (the Skagerrak, the Kattegat and the Baltic Sea *sensu lato*) with the surface salinity in black, and the limit for different species (native but also introduced) to live there. Courtesy to Stockholm Marine Research Centre. (N.B. The map is a quite old and several species have arrived since then).

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Web links (Visited early February 2009)

The Swedish Board of Agriculture, information about *Marteilia refringens*, in Swedish:

<http://www.jordbruksverket.se/formedier/nyheter/nyheter2010/parasitsjukdompavisadpasvenskablammusslor.5.7caa00cc126738ac4e880003345.html>

A fact sheet about the sludge worms *Potamothrix* spp.:
http://www.frammandearter.se/5arter/pdf/Potamothrix_sp.pdf

Information about the project to protect wrecks from the shipworm:

a) <http://www.wreckprotect.eu/>

b) http://www.science.gu.se/english/News/News_detail/?languageId=100001&contentId=911209&disableRedirect=true&returnUrl=http%3A%2F%2Fwww.science.gu.se%2Faktuellt%2Fnyheter%2FNyheter%2BDetalj%2F%2FSkeppsmaskens_spridning_hotar_arkeologiska_fynd.cid911209

A fact sheet about the shipworm *Teredo navalis*:

http://www.frammandearter.se/0/2english/pdf/Teredo_navalis.pdf

United Kingdom, 2009

Prepared by: Ian Laing, Gordon Copp (Cefas) and Victoria Appleyard (JNCC).

Regulations

The UK Government has been carrying out an impact assessment of proposed amendments to the Import of Live Fish Act 1980 (ILFA) Order, with the public consultation opening in early 2010.

In Northern Ireland, The Wildlife Order (NI) 1985 is nearing the end of its review process following a period of public consultation. Several amendments are proposed to Article 15 and Schedule 9, which specifically deal with the introduction of non-native species. It is anticipated that the new legislation titled 'The Wildlife and Natural Environment Act 2010' will be brought through in mid 2010.

As part of its non-native species strategy, the UK Non Native Species Secretariat (www.nonnativespecies.org) has been coordinating the development of a rapid response strategy. The final report of the working group was completed at the end of 2009 and is due to be published in early 2010.

A Spanish language version of the Fish Invasiveness Scoring Kit (FISK; Copp *et al.* 2009) is now available for free download (<http://www.cefas.co.uk/4200.aspx>) and a similar pre-screening for freshwater invertebrates has been calibrated (Tricarico *et al.* 2009).

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/news-and-events/finfish-news.aspx>) and Marine Scotland Science publications (for Scotland, <http://www.marlab.ac.uk/>). UK export statistics are also presented in these publications.

Invertebrates

Deliberate releases of Pacific oysters for cultivation continue at a similar level to that of previous years. Annual production of market-sized oysters remains at about 1,000 tonnes. Stock for on growing was imported from France, Ireland and the Channel Islands. A temporary ban was imposed on trade from France, Jersey and Ireland following exceptionally high summer mortality in these countries, attributed to a new variant of the oyster herpes virus. The EU is developing legislation to control and prevent the spread of this potential pathogen. The UK Non Native Species Secretariat (NNSS) has published a risk assessment for Pacific oysters. The industry trade body, Shellfish Association of Great Britain (SAGB), has challenged this document and there is an on-going debate on the status (naturalised or invasive non-native) of Pacific oysters as they are a commercially valuable cultivated species. Naturally recruited seed is being harvested and re-laid for cultivation in southeast England.

Reports from fishermen suggest that the Manila clam is flourishing in the Solent. The clams allegedly do not grow to the EU minimum landing size of 40 mm and the fishermen have been lobbying for a reduction, claiming that the species is mature at a much smaller size. There are proposals for a reduction in this MLS, possibly to 30 mm. Imports of non-native species of live bivalve molluscs and crustaceans for human consumption continues. About 670 tonnes of live Canadian/American lobsters were brought in to the UK. There were no reports from fishermen finding these lobsters in their pots.

Unintentional Introductions

New Sightings

Botrylloides cf. diagenes, a colonial sea squirt, was found at Burry Port in South Wales in 2009, a new record for the UK. No new sightings have been received for any algae or fish species.

Previous Sightings

Algae

Heterosiphonia japonica (a red alga) was found off North Anglesey in 2009. It seems to be growing fast and out-competing native species. This is the first record for Wales. The species was reported from Scotland in 2008, having been found to be common in both Loch Sunart and Loch Creran (Moore and Harries, 2009). This species was first reported from the UK in 2005, from the English south coast.

Invertebrates

The slipper limpet (*Crepidula fornicata*) was recently found for the first time in Belfast Lough. The provenance of this population is unknown although it was possibly introduced with seed mussel movements. A sample will be aged.

It was established that the Chinese Mitten crab (*Eriocheir sinensis*) in the Thames is safe for consumption. A subsequent decision was taken however not to allow a fishery to exploit the species, due to concerns on by-catch of eels and the risk of deliberate spread to enhance the fishery. It nevertheless continues to show range expansion, now being detected in the Conwy Estuary in North Wales.

A survey of selected marinas in England has detected further populations of *Didemnum vexillum* in the Dart estuary, Lymington and Gosport. In Scotland a population has been identified in the Clyde. This was discovered during a routine survey in Largs marina in October 2009. Further survey work is planned and a response is urgently being considered in each case. Eradication of the species is already being attempted at the one known site in Wales (Holyhead Harbour).

The Japanese skeleton shrimp, *Caprella mutica*, was found in Wales for the first time in 2009 in the Milford Haven. In Northern Ireland it was recorded in July 2009 for the first time in Bangor Marina. Previously from here it was only recorded from Carlingford Marina.

Six tonnes of freshwater zebra mussel shells were discovered during a routine clean at the Champion Hills Water Treatment Works, which is owned by Severn Trent Water. They had to be removed with industrial vacuum pumps and by hand. Contractors were faced with a similar scenario a few years previously, involving a water treatment works in the Severn Trent region where around 12 tonnes of mussels had simply washed in and collected over the years.

Fish

There have been no new confirmed records in 2009 of previously reported species, but there has been mention made on angling internet blogs of sturgeon/sterlet specimens, either in angling lakes, including those near rivers, or in water courses (e.g. www.wildaboutbritain.co.uk; www.anglersnet.co.uk).

Species Not Yet Reported or Observed

A small crustacean, *Sinelobus stanfordi* has been recorded from five different water bodies in the Dutch coastal area and in the docks of the Belgian harbour of Antwerp. It is likely to have been introduced through shipping vectors, with a high risk of further spread (van Haaren & Soors, 2009) from this busy port.

The range of the two Asian crab species, *Hemigrapsus sanguineus* and *H. takanoi*, is expanding in Europe and both have been reported at many sites across the English Channel (Dauvin, J-C. *et al.* 2009).

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ICES National Report on Marine Invasions in US waters, 2009

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1. No new regulations, although some are pending (see WGBOSV annual report)

2. Intentional introductions

No new intentional introductions.

3. Accidental introductions and transfers.

3.1. Fish

Atlantic/Gulf Coasts

Lionfish of the *Pterois miles/volitans* complex, native to the Indo-Pacific, are well-established on the southern Atlantic coast of the US, and are continuing to expand their range through the Caribbean Sea. [Both species have been identified in US waters by molecular methods, but are not easily separated morphologically (Freshwater *et al.* 2009)]. Lionfish were first seen in Biscayne Bay, Florida, in 1993, probably released from aquaria, and were discovered to be well-established in waters off North Carolina in 2000. In 2009, no major range extensions were reported in mainland US waters, but four sightings were made in the Florida Keys, in 2009, suggesting that this species may be becoming established in the northeast Gulf of Mexico. There was only one previous record in the Gulf, in 2006, in Pinellas County, Florida. Lionfish do seem to be spreading in the south Gulf and Caribbean, with first records on the Yucatan Peninsula, and on the Caribbean coasts of Honduras, Nicaragua, Colombia, Panama, Curacao, and Bonaire (González *et al.* 2009; Schofield *et al.* 2009; Aguilar-Perera and Tuz-Sulub 2010; USGS Nonindigenous Aquatic Species Program 2010).

A single specimen of another marine aquarium fish, Whitetail Damsel, *Dascyllus aruanus*, was collected off Palm Beach, Florida (USGS Nonindigenous Aquatic Species Program 2010). This is one of at least 25 exotic marine aquarium species, mostly Indo-Pacific natives, which have been seen in Florida waters (Semmens *et al.* 2004; USGS Nonindigenous Aquatic Species Program 2010) in the last two decades. Most of these records are single specimens. So far, only three species of stenohaline marine fishes are known to have established populations in US Atlantic/Gulf of Mexico/Caribbean waters. These are the two Lionfish species and the South American Tessellated Blenny (*Hypsoblennius invemar*). The latter species may have entered US waters on offshore oil platforms. It was described from a platform off Louisiana in 1975, and has a disjunct distribution, on the South American Caribbean coast (the presumed native region), and the northern coast of the Gulf of Mexico, where most of its records are from man-made structures (Sheehy and Vik 2009; USGS Nonindigenous Aquatic Species Program 2010).

Pacific Coast-

3.2 Invertebrates

Atlantic/Gulf Coasts

*Paradella diana*e and *Paracerceis sculpta*- These two isopods, of the family Sphaeromatiidae, are native to the Eastern Pacific, from southern California and Mexico, but have been widely successful invaders in warm-water ports around the world (Hawaii, Brazil, South Africa, the Mediterranean, Atlantic Spain, Hong Kong, etc.). Both species have been established for some time in Atlantic US waters, but their occurrence or introduced status was overlooked. *Paradella diana*e was described from specimens collected in Mexico in 1952, and then collected in Florida in 1965, and Puerto Rico in 1966. Recent studies of the genus support an Eastern Pacific origin of this species (Wetzer and Bruce 2007; James T. Carlton, personal communication to Paul Fofonoff), and therefore an introduced status in the Western Atlantic. On the Atlantic Coast, this isopod is abundant in Texas, Florida, and Bermuda, and has been collected in 2000-2002 near Charleston (Clark and Robertson 1982; Kensley and Schotte 1999; US National Museum of Natural History 2009-2010; David Knott, personal communication to Paul Fofonoff). *Paracerceis sculpta* was described from southern California in 1904. In 1996, 2 collections, totaling 29 individuals, were made in the Indian River Lagoon, Florida (US National Museum of Natural History 2010). The extent of the range of *P. sculpta* on the US Atlantic and Gulf coasts is unknown. Marilyn Schotte, of the US National Museum of Natural History, confirmed the identity of these specimens (personal communication to Paul Fofonoff). Both of these isopods inhabit crevices in rocks and wood, and are well adapted to ship transport.

Eriocheir sinensis, Chinese Mitten Crab- Since the first capture in Chesapeake Bay in 2006, 145 Chinese Mitten Crabs have been caught in US Atlantic Coast waters, 83 in 2009 alone. 70 of these 2009 captures were in the Hudson-Raritan watershed-estuarine system, including nontidal streams, and in the estuary from New York Harbor and Raritan Bay as far upstream as Coxsackie, New York, about 150 km upstream, about 30 km below the head of tide at Albany. The crabs captured in Hudson-Raritan estuary include juveniles, mature adults, and gravid females (Sparks, Ruiz, and Ferrante, unpublished data). Juvenile crabs in nontidal streams are difficult to sample, but the collection of exuviae in Saw Kill, a small upland Hudson tributary, indicates a growing population of juveniles there (Schmidt *et al.* 2009). In January 2010, 17 gravid female crabs and 2 males were dredged in New York Harbors (Sparks, Ruiz, and Ferrante, unpublished data). Together, these observations strongly support the existence of an established population of *E. sinensis* in the Hudson-Raritan system. In other Atlantic coast estuarine systems in 2009, 5 crabs were caught in coastal New Jersey bay-river systems, including Barnegat Bay, 7 in the Delaware system, and one in Chesapeake Bay (Sparks, Ruiz, and Ferrante, unpublished data). The occurrence of breeding populations in these other estuaries is not yet established.

Palaemon macrodactylus Oriental Shrimp- This shrimp, native to the coasts of China, Korea, and Japan, has become established on the Pacific coast of the US, Europe (Germany-UK, Spain, Black Sea), and Argentina (Spivak 2006; González-Ortegón *et al.* 2007; Micu 2009). In June 2009, a specimen was collected in the brackish James River estuary. Later that summer, a second specimen was collected in the York River estuary. These are the first records of this shrimp on the Atlantic coast of North America (Roberto Llanso, personal communication). Ballast water is the most likely mode of introduction. This shrimp closely resembles native *Palaemonetes* spp. Sur-

veys are planned for Virginia waters in 2010 (Roberto Llanso, personal communication), and biologists working in estuaries along the Atlantic coast of the US should keep an eye out for this shrimp..

Penaeus monodon, Asian Tiger Shrimp- This Indo-Pacific shrimp is widely reared in tropical waters. In 1988, there was a mass escape of *P. monodon* from an aquaculture operation in South Carolina, which led to captures of more than 1000 Tiger Shrimp from North Carolina to Florida. However, there were no further captures until 2006 and 2007, when at least 9 specimens were caught from Louisiana to Pamlico Sound, North Carolina. In 2008, at least 15 Tiger Shrimp were reported over this range, and in 2009, at least 9 more adult shrimp were caught from Vermillion Bay, Louisiana to the Cape Fear River, North Carolina (USGS Nonindigenous Aquatic Species Program 2010). While this shrimp is no longer widely cultured in the tropical Atlantic, breeding populations may occur in the Caribbean (Perez *et al.* 2007). So far, there is no evidence for reproduction in US waters.

Clavelina lepadiformis (Light Bulb Tunicate)- This colonial tunicate, native to the coast of Europe, from Norway to Spain, was discovered in October, 2009, by Jamie Rheinhardt, a graduate student, in the Thames River (tributary of Long Island Sound), New London, Connecticut. To our knowledge, no further collections have been made. Rheinhardt has posted a Facebook page (<http://www.facebook.com/pages/Clavelina-Lepadiformis-New-Invasive-species-in-New-England/198247856822?ref=mf>), in order to publicize the species and collect information on further discoveries.

Didemnum vexillum- We are not aware of significant range expansions of this tunicate in US Atlantic waters in 2009. However, Carman and Grunden (2010) reported this species' occurrence on a novel substrate and habitat, the blades of Eelgrass (*Zostera marina*) in Lake Tashmoo, Martha's Vineyard (Massachusetts). *Didemnum vexillum* is well-known as a fouler of artificial structures, and other fouling organisms, but it had not previously been reported from Eelgrass. Eelgrass meadows are an important habitat for fishes and shellfish, so that overgrowth of the habitat has potential economic and ecological impacts (Carman and Grunden (2010). A methodological development in the study of *D. vexillum* is the development of multiple DNA marker sequences, which enable the study of genetic diversity, and the tracing of invasion routes in this organism (Hess *et al.* 2009).

Pacific Coast-

3.3. Algae and higher plants

Atlantic Coast-

Gracilaria vermiculophylla- This invasive red alga, native to the coast of Asia, from China to Vietnam, has previously been reported from the Atlantic coastal bays of Virginia, and from North Carolina. This alga has also invaded European waters from Spain to Denmark (Thomsen *et al.* 2009). A sample from Warwick, Rhode Island, on Narragansett Bay, collected in 2007, was identified as this species by molecular methods (Saunders 2009). *Gracilaria* is a difficult genus, so that it is likely that many populations of this seaweed are overlooked.

Exotic Mangroves- On the Atlantic Coast of Florida, two exotic species of Indo-Pacific mangrove trees, *Bruguiera gymnorhiza* and *Lumnitzera racemosa* have escaped from a botanical garden near and colonized adjacent mangrove swamps. Eradication efforts are underway- however control of invasive mangroves is difficult because of their persistent routes and water-dispersal of seedlings (Fourqurean *et al.* 2009).

Pacific Coast

Undaria pinnatifida (Wakame)- This northwest Pacific Kelp was first found growing near Los Angeles in 2000. It has spread southward into Baja California, Mexico, and northward to Monterey Bay by 2003. In 2009, it was discovered growing in two marinas in San Francisco Bay, and in Half Moon Bay, on the outer coast of California. Methods for controlling the spread of this invasive kelp are being considered (Zabin *et al.* 2009).

3.4 Parasites, pathogens, and other disease agents

East Coast

Anguillicoloides crassus .- *Anguillicoloides* (= *Anguillicola*) *crassus* is a nematode swim-bladder parasite of freshwater eels, whose native host is the Japanese Eel (*Anguilla japonica*). This parasite spread through populations of the European Eel (*A. anguilla*), and appeared in North American waters, affecting American Eels (*A. rostrata*) in 1995. Previous surveys had established that this parasite was prevalent in eel populations from North Carolina to the Hudson River. Aieta and Olivera (2009) undertook an extensive survey of northeastern waters from the Pawcatuck River (Rhode Island-Connecticut) to the St. Johns River, New Brunswick, and found that this parasite was present in 20 of the 26 streams sampled from Rhode Island through Maine. The parasite was also found in eels captured in two streams in Cape Breton Nova Scotia, but was not found in other Canadian locations, including the St. Lawrence River, in Quebec. From Rhode Island through central Maine (Kennebec River), the prevalence of the parasite did not show strong geographical trends, but it was rare or absent in eastern Maine. The pattern of occurrence suggests multiple transport mechanisms, including ballast water, use as bait, and transport of live eels for food (Aieta and Olivera 2009).

Pacific Coast

Orthione griffenis- The bopyrid amphipod, *O. griffenis*, is a parasite which inhabits the gill chambers of the burrowing mud shrimps of the genus *Upogebia*. It is apparently native to China and Japan, and was first collected in U.S. waters in 1985. It now infests *U. pugettensis* from Santa Barbara, California, north to British Columbia. The parasite sucks the mud shrimp's blood, greatly reducing the shrimp's reproductive potential (Griffen 2009). The metabolic costs of parasitism are likely to reduce the abundance of this species in the upper intertidal parts of its range, where feeding time is limited, while animals in the lower intertidal have more food, but also more exposure to the planktonic stages of the parasites (Griffen 2009). A decline in abundance of *U. pugettensis* has been observed throughout its range, coinciding with the arrival of the parasite but the role of the parasite in mortality and reproduction of the shrimp is not clear. Griffen (2009) uses a model to predict how parasitism could affect the shrimp's metabolism and population dynamics, and suggest testable hypotheses on the parasite's impacts. The mud shrimp *U. pugettensis* is economically important as bait, and is an important ecosystem engineer on wetlands.(Griffen 2009).

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Appendix IV. EU Regulation 708 Concerning use of non-native species in aquaculture

COUNCIL REGULATION (EC) No 708/2007 of 11 June 2007 concerning use of alien and locally absent species in aquaculture

Article 9

Non-routine movement

1. In the case of non-routine movements, an environmental risk assessment shall be carried...

Article 3

Definitions

16. 'routine movement' means the movement of aquatic organisms from a source which has a low risk of transferring non-target species and which, on account of the characteristics of the aquatic organisms and/or the method of aquaculture to be used, for example closed systems as defined in 3, does not give rise to adverse ecological effects;

17. 'non-routine movement' shall mean any movement of aquatic organisms which does not fulfil the criteria for routine movement;

Procedures and minimum elements to be addressed in an environmental risk assessment as foreseen under Article 9

The result of the assessment will be expressed in terms of the following risk levels:

A high-risk movement:

- (a) has a high risk of damaging biodiversity from spreading and other ecological consequences;
- (b) operates under farming conditions which would increase the risk of such damage;
- (c) involves an aquaculture facility which sells live aquatic animals for further farming or restocking;
- (d) as a consequence, the movement is 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.

A medium-risk movement:

- (a) has a medium risk of damaging biodiversity from spreading and other ecological consequences;
- (b) operates under farming conditions which would not necessarily increase the risk of such damage, taking account of the species and the containment conditions;
- (c) involves an aquaculture facility which sells its products mainly for human consumption;

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- (d) as a consequence the movement is of moderate concern. It is advised that the proposal be rejected unless mitigation procedures can be developed to reduce the risk to low.

A low-risk movement:

(a) has a low risk of damaging biodiversity from spreading and other ecological consequences.

(b) operates under farming conditions which would not increase the risk of such damage;

(c) involves an aquaculture facility which sells its products for human consumption only;

(d) as a consequence the movement is of negligible concern. It is advised that the proposal be approved. Mitigation is not needed.

Appendix IV Targeted Non-Native Fisheries – Draft report

Targeted Non-Native Fisheries

The request from ICES for information on targeted fisheries on nonindigenous species is summarized by country. Not all countries have information to report, either reflecting a lack of effort to target nonindigenous species as a fishery or because efforts are small or localized and not a national effort.

Targeted fisheries in Germany

Crassostrea gigas

Pacific oysters are collected for consumption by visitors of the Waddensea (pers. comm. Markert, A.). An oyster fishery would be not be a suitable option for the Wadden Sea ecosystem. Seed oysters might be collected but very few are suitable for further culturing because most are attached firmly to clusters being cumbersome to detach. Removal of entire reefs with bulldozers or by dredging from a ship is not feasible on the large scale required for control without harming all other organisms including natives, and the success is likely to be only short term (Stefan Nehring, Karsten Reise, Norbert Dankers, Per Sand Kristensen WADDEN SEA ECOSYSTEM No. 25 Quality Status Report 2009 Thematic Report No. 7 Alien Species).

Alien species bring both costs and benefits which may accrue to different sectors of society. Benefits are wide-ranging and examples in the aquatic environment include stocking and re-stocking operations, new aquaculture opportunities and tools in coastal protection and reclamation schemes (*a.o.* Minchin and Rosenthal, 2002).

Ecologically, the *Crassostrea gigas* spread in the Wadden Sea started with a paradox. In spite of strong crowding between *Mytilus edulis* on mussel beds, oyster larvae successfully attached to individual mussels, grew faster and larger, soon smothered their basibionts and began to dominate the beds. Mussels have not reversed this hostile takeover by settling on top of the oysters and smothering them in turn. Instead, mussels settled in the understory between the much larger oysters, escaping predators. Oyster larvae, by contrast, settled preferentially on top of their older conspecifics, which gives rise to reef formation (Diederich, 2005).

There are probably no more mussel beds without any oysters in the entire Wadden Sea. Will the Pacific oysters eventually displace the native mussels? Up to now, the observations are inconclusive (Nehls *et al.*, 2006; Nehls and Büttger, 2007). Within and between mussel beds, all combinations of high and low abundances have been encountered.

In particular, the Pacific oysters are still poorly integrated into the food web of the Wadden Sea. Birds like eider duck, oystercatcher and herring gull which particularly feed on mussels may run into a shortage of food because most oysters are too large for consumption or fused into clusters, and shells are too strong for the birds to break them open (Blew and Südbeck, 2005; but see also Cadée, 2008 a,b) .

Economic and societal effects (positive/negative)

In historic times, beds of the native European oyster (*Ostrea edulis*) were of widespread occurrence in the Wadden Sea and an important fisheries resource. However, overexploitation by oyster fishery since the 18th century exterminated these populations. Several attempts to revive the former oyster stock in the Wadden Sea have failed (Drinkwaard 1999, Nehring 1999). The cultivation of Pacific oysters in recent

years in a culture plot near Sylt gave a new and rising production. Fishery on wild Pacific oyster stocks is at present not allowed due to nature conservation directives. However, in July 2005 a first licence was given by German authorities for collecting of wild oyster spat in a small area of the Wadden Sea near Sylt. Whether such exploitation will be profitable compared to the importations of seed oysters is not yet known. However, collection of wild oyster spat instead of importing seed oysters may reduce the possible introduction of new invaders, like epibionts or parasites and pathogens. It may be that in the near future harvesting of adult oysters will also be allowed. However, once the oysters have developed reefs the product quality for the consumers decreases dramatically due to clumping, increase of shell size and decrease of meat content. Harvesting wild Pacific oysters is unlikely to be effective and profitable.

The actual records imply that the Pacific oyster has achieved a continuous distribution throughout the entire Wadden Sea (Reise *et al.* 2005). Spat settle on any hard substrate, but preferentially upon conspecifics and wild banks of the native Blue mussel (*Mytilus edulis*) (Diederich 2005b, Nehls *et al.* 2006). However, there is evidence that the recently observed decline of blue mussel beds near Sylt is mainly caused by failing spatfall possibly due to mild winters, whereas the increase in oysters is facilitated by mild winters and warm summers, respectively (Nehls *et al.* 2006). But it is to be expected that in the near future the traditional Blue mussel fishery might be even more hampered because still existing seed mussels and mussel beds become overgrown by oysters. This is estimated to result in a maximum loss in the German blue mussel fishery of about 25 million Euro per annum (Nehring in press).

Solid calcareous reefs of Pacific oysters are a completely new biogenic structure for the intertidal area of the Wadden Sea. Whether or not oyster reefs may facilitate coastal protection is not yet investigated and estimated. In this context, Pacific oysters in northern Europe may benefit from global warming and may become more abundant than mussel beds have ever been (Nehring 2003b).

Due to a further increase of the oyster population Pacific oysters will interfere with the recreational use of the Wadden Sea because of their razor-sharp shells. Analyses about the potential economic effects are needed.

Chinese mitten crab, Eriocheir sinensis

The Chinese Mitten Crab was introduced to Germany by shipping. The first sighting of an adult crab was reported from the Aller River in 1912. The impact of this invader became especially clear during the mass occurrences in German waters in the 1930s, 1940s, 1950s, 1980s and 1990s (Tab. 1). In total mass developments were reported for approximately 30 years (Fladung pers. comm.). During the four severe mass developments of the crab in the last century up to 140 t of juvenile crabs were caught annually. A single fishing net collected 50-60 kg of crabs per day (Fladung pers. comm.).

Especially in the 1930s, 1940s and 1990s, attempts were undertaken to catch and destroy as many crabs as possible. This implied labour costs and some catchment gear production at the German Rivers Elbe and Havel.

It was calculated that the the monetary impact caused by this invader in German waters totals to approximetaly 80 million Euro since its first appearance in 1912 (Tab. 1).

Table 1. Tentative calculation of cost since the first findings of the Chinese mitten crab in German waters (modified after Gollasch, unpublished).

Cost item (data adjusted from Fladung pers. comm.) costs from 1930s and 1940s calculated to today's value	Estimated sub-total [in €] conservative calculation	Estimated sub-total [in €] maximum calculation
<u>Costs of catchment gear installation</u> During 1935-1945 in total 35 catchment installations, i.e. barriers, ramps, collection buckets were in use. The average cost per installation was 750 € During 1996-1998 four catchment systems were in use, capital costs total to	26,250 10,000	26,250 10,000
<u>Labour to clean and maintain catchment gear</u> During the 1935-1945 the catchment season lasted for 8 to 10 weeks with 1 or 2 employees (estimated salary per week 300 €) During 1996-1998 labour costs totalled to	24,000 40,000	60,000 40,000
The <u>impact on bank erosion and feeding</u> on native species are very difficult to quantify. The assumption results in several 10,000s €	20,000	50,000
<u>Loss in commercial fisheries (estuaries and rivers)</u> Assuming that 250 fishermen were affected during 1930-1950 costs are estimated as 70,000,000 € (for 20 years annually ca. 14,000 € per fisherman) including repair of nets as crabs tend to cut net ropes. 60 fishermen were affected during the period 1994-2004 costs are estimated as 8,400,000 € (annually ca. 14,000 € per fisherman).	65,000,000 8,000,000	75,000,000 9,000,000
<u>Loss in commercial fisheries (pond fisheries)</u> , estimated for 1994-2004. Impacts include predation of fish food and cultured pond fish	75,000	100,000
Loss in commercial fisheries due to the <u>predatory impact of the crabs on macrozoobenthos</u> (fish food) resulting in e.g. poor growth of fish is calculated as 10,000 to 20,000 € annually during the 30 year duration of mass occurrences.	300,000	600,000
Estimated total	73,495,250	84,886,250

Other cost implications

Additional negative impacts are known, but cannot be quantified:

- impacts on biodiversity,
- impacts on recruitment of commercial species,
- increased erosion rate due to crab burrowing activities in river banks.

It should also be noted that a positive effect was documented. During mass occurrences crabs were and continue to be sold for 1 to 3 € /kg to the industry e.g. for industrial use and for direct human consumption (Asian markets and restaurants). During 1994-2004 crabs in the value of approximately 3,000,000 to 4,500,000 € were

sold. This amount needs to be deducted from the impact cost figures above to take account of "beneficial" effects (Gollasch & Rosenthal 2006).

Fished non-native species report, Denmark

Commercial shell-fishing in Denmark is almost exclusively for blue mussel (*Mytilus edulis*), and there is also a considerable line-culture as well as "stock-enhancement" of natural mussel-beds. This means that seed-mussels are transplanted between different places in Denmark and may carry parasites and epifauna/flora between sites. This is something that has not been quantified.

There is some fishery on European flat oyster, *Ostrea edulis* in the Limfjord. Between 1992 and 2001 annual catches were below 100 tonnes, but in 2002 the catch was 528 tonnes, increasing to 940 tonnes in 2005 (Kristensen & Hoffmann, 2006). The Limfjord presently is declared *Marteilia* and *Bonamia* free, but it is uncertain whether the *Crassostrea gigas* have also been tested, and the fact that mussels are transplanted from other places in Denmark could also threaten the disease-free status. But, again, this has not been studied. Presently there is no commercial fishery for Pacific oysters, *C. gigas*, but there is a considerable population of this species in the western Limfjord (Christensen & Elmedal, 2007; Davids *et al.*, 2007). There is also a small population of *C. gigas* in the Isefjord (Wang *et al.*, 2007). Culture of *C. gigas* was attempted in the Limfjord (1970s-1980s) as well as in the Isefjord (1986-1998), but it was not economically feasible at the time. As far as native vs. non-native species, flat-oysters are problematic in Danish waters. It was a native species since the stone-age, but apparently it was heavily overfished in the early 20th century, and stocks were enhanced with imported spat, mostly from France and Ireland (Hoffmann, 2005).

The Danish Wadden Sea is a protected area, both under the European Bird Directive and the Habitat Directive and it will probably be declared a National Park shortly. There is a large population of *C. gigas* which has been locally reproducing since 2004 (Kristensen & Pihl, 2006). Commercial mussel fishery is strictly controlled, and fishery can only be permitted when stocks exceed what is necessary for the huge amounts of birds that use the Wadden Sea for feeding grounds. The Wadden Sea is resting area for huge flocks of migratory birds as well as feeding grounds for many local bird species. There has been an impact and feasibility study for a targeted fishery of *C. gigas* (Christensen *et al.*, 2008). The results showed that use of commercial mussel-dredges would have a significant impact on benthic fauna, whereas use of light-weight oyster-dredges had little impact. However, so far no licenses for commercial fishery have been issued. The local tourist organisations as well as nature guides organize tours for hand-collecting *C. gigas* for personal consumption. This has little impact on the population of oysters.

Ensis directus (= *E. americanus*) is abundant in Danish waters but there is no fishery. Shells of *E. directus* make up a considerable proportion of beach-washed shells. Because they bury deeply into the sediment, hydraulic dredges would be needed, and these are not presently permitted in Danish waters.

Mya arenaria is present in all Danish waters, but there is no targeted fishery (to my knowledge). They probably will be by-catch in cockle-fishery (*Cerastoderma edule*), but the fishery for this species is small. It is not listed separately in fishery statistics, but a report from DTU-Aqua lists a catch of 3,610 tonnes for 2004 (Hoffmann, 2005).

Chinese mitten crabs, *Eriocheir sinensis*, are often found in traps set for eel-fishing in Danish waters. A large proportion of the Danish records of this species is from fish-

ermen who have found the crabs in the traps. This also the case for other crab species, native as well as non-native.

American lobster, *Homarus americanus*, has only been caught once, and it was obviously a specimen escaped from somewhere (elastic bands on chelae).

A few specimens of blue crabs, *Callinectes sapidus* have been found in Danish waters. It is unknown whether they are escapees from imported food or they have been swimming from other places in Europe, where this species is known to occur.

Targeted Fisheries of Estonia

Three alien species are exploited in the Estonian waters. These are Chinese mitten crab *Eriocheir sinensis*, and the fresh water (low brackish water) species Gibel carp *Carassius gibelio* and round goby *Neogobius melanostomus*. While the Chinese mitten crab is caught as a by-catch species in relatively low numbers only (nowadays probably no more than a few hundred individuals annually) and generally not used for human consumption, gibel carp and round goby are targeted by commercial and leisure fishermen, respectively. Except for the round goby, which is present in a few localities only, the Chinese mitten crab and gibel carp are distributed all over the Estonian coast (Vetemaa *et al.* 2005, Ojaveer *et al.* 2007).

Previous studies carried out elsewhere suggest that the round goby is a very aggressive species being able to cause declines in native fish species populations, reduce hatching success of native species and compete for the same food resource with several commercial fish (like flatfishes) (Corkum *et al.* 2004, Karlson *et al.* 2007). This is also very likely to occur in some localities in the Estonian coastal sea where this alien species may reach high abundances (e.g., Muuga Bay in the Gulf of Finland). Because of low abundances, several ecological impacts caused by the Chinese mitten crab documented elsewhere (e.g., Panning 1938, Gollasch 1999) are in Estonian waters probably insignificant. In contrast, gibel carp may dominate in commercial catches in some sheltered and shallow areas (like NE Gulf of Riga). However, ecological impact of this species is unknown.

Impact of fishery on these three alien species is unknown. Likely, there are no economic estimates on the impact of these species neither on the ecosystem nor to the fisheries.

Targeted fishery of non-native species in Sweden

Only one marine species has been deliberately, legally introduced into Sweden (known by contributor) for the purpose of exploration. It was the Japanese oyster *Crassostrea gigas* that was introduced in the 1970s for culturing. At that time it was not successful and the project was terminated.

Fishery in Sweden is rather restricted to common commercial species and the abundance of non-native species has often not reached fishable numbers (except in fresh-water). This will perhaps change if the recently arrived *C. gigas* continues to thrive on the west coast of Sweden, especially if the general public will be allowed to harvest it. At least two attempts have been made locally to eradicate the species (See Swedish National report).

Most catches of non-native species have been by accident or they show up as by-catch if they appear in some number. Bivalves like *Ensis directus* and *Mya arenaria* may be collected by the general public and it is possible that the round goby, *Neogobius melanostomus*, recently found in Karlskrona archipelago, may become a recreational fishery if they increase in number. There is probably no substantial positive eco-

nomical gain of the unintentionally introduced non-native species in Sweden yet, though they may be profitable in other countries. There is no targeted fishery that regulates the populations of non-native species either.

A species that may cause economical loss to existing fishery is perhaps the Chinese mitten crab *Eriocheir sinensis* if it appears in high numbers locally and destroy fishery nets, although there are no known reports of problems with nets.

Other non-native species that may be negative to local fishery are the eel nematode, *Anguillicola crassus*, effecting eels, and perhaps also *Cercopagis pengoi* the predatory water flea, that on a few occasions have been said to cause problems locally and temporarily to fishermen by clogging their nets and making them visible to fish. But these are species that are very difficult to target as a by-fisheries.

The ecological impacts of most introduced species in Swedish waters are poorly known. It has been suggested that *E. directus* competes with *E. ensis*. The possible effects of *C. gigas* as competitor to the blue mussel, *Mytilus edulis*, are briefly studied in Sweden (Nyberg 2010) and perhaps, at least initially, local abundances of *M. edulis* may go down as *C. gigas* settles on them and also filter mussel larvae effectively. The *C. gigas* that has appeared in recent year on the Swedish west coast probably came as larvae, but if juvenile or adult specimens are moved it is known from other countries that there could be a lot of other organisms on the shells, also moved at the same time.

Targeted non-native species fished in the UK

The efforts described in this section focus primarily on attempts to eradicate non-native species.

Sargassum muticum

The eradication of this species in British waters has been attempted but has failed. Studies carried out at the time showed that removing *Sargassum* by hand is extremely time-consuming and needs to be repeated, probably indefinitely (Farnham 1980). Removal by trawling, cutting and suction have also been tried. Chemical methods using herbicide have been tried but failed due to lack of selectivity and the large doses needed. Small germlings can be consumed by molluscs and amphipods but this has no restrictive effect on *S. muticum*. Whatever method is used the alga always quickly re-grows and effective methods for its permanent removal have not been found, although cutting and suction is the preferred method applied (Farnham *et al.* 1981; Critchley *et al.* 1986).

Spartina anglica

This was extensively planted in the past as an aid to stabilisation of inter-tidal mudflats and a stimulus to enclosure and land-claim. It also readily colonises open mudflats and consequently has spread rapidly around the coast. Monoculture swards of either *S. anglica* or *S. x townsendii* are of little intrinsic value to wildlife, and in many areas *S. anglica* is considered a threat to the inter-tidal mudflats used as feeding-grounds by large populations of waders and wildfowl. As a result, attempts have been made to control *S. anglica* at several sites over many years, but these have largely been unsuccessful in eliminating it. *S. anglica* is generally considered to be a negative conservation feature of the sites where it occurs.

Spraying with chemicals was the preferred method and this had some, limited, success in some areas in preventing further spread.

Bonamia ostreae

There was a government-sponsored attempt in the early 1990s to eradicate *Bonamia* from the Beaulieu River, Hampshire by dredging out all the oyster stocks in the river. The aim was to prevent a focus of infection of this disease spreading and thus to protect the valuable native oyster fishery in the Solent. Several thousand pounds were spent. Following this, recruitment to the fished stocks in the western Solent have declined and it is now believed that these stocks provided much of the larvae/spat for the fishery in the wider area. The Beaulieu River was restocked several years later and it was not long before the parasite was found in samples of oysters there. We know from recent studies that the disease can reside in benthic invertebrates and eradication is therefore not usually a viable option.

Crepidula fornicata

This species was recently detected in a new area (Menai Strait, North Wales) in the UK for the first time. It was introduced with a consignment of re-laid seed mussels for aquaculture. Wildlife conservation designations at the newly infected site dictated that an attempt at eradication should be made. It is also not in the interest of the mussel fishery that this alien species becomes established. The re-laid mussels were removed by fishing and another consignment, from an area free of *Crepidula*, was deposited over the area, in an attempt to smother the *Crepidula*. This work was carried out by the industry. The situation is being monitored by both industry and conservation organisation staff.

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Table 2. Non-native species found in ICES countries that may be targeted as a fisheries. Blanks indicate no data given;

Countries not listed either did not report or did not have a targeted fisheries of non-native species. Abbreviations; A=Absent, P = Present, SS = single specimen, NE = not established, CF= Commercial fisheries, NF = No fisheries, RF = recreational fishery, N = native, B-C = bycatch, E = Expanding,

Species	Canada East Coast	Denmark	Estonia	Finland	France	Germany	Italy	Nether- lands	Sweden	UK	US-East Coast	Spain
Undaria pinnatifida	A	A	A	A	P, no CF	A	P, no F	A	A	P no F	A	P, , E, 0.8 €/kg
Porphyra sp.	N	A	A	A	A	A	A	A	N	A, hybrids	P, NF	A
Eriocheir sinensis	A	P, B-C	P, B-C	P, B-C	P, B-C	P, B-C; ca. 300.000 €/a		P, B-C; RF; (3 a 7 EURO/ kg)	P, B-C	RF	NE	P
Crassostrea gigas	A	P, RF	A	A	P,RF	P, RF	P, RF	A	P, RF	P, C and RF	A	P,CF
Ensis directus	A	P, NP	A	A	A	A	A	RF, license needed	P, RF	P, RF	N	A
Ostrea edulis	A	A	A	A	N	A	A	A	N,CF	A	P, RF	N, diseases, CF
Neogobius sp.	A	P, NF	P, CF, RF	RF, B-C	A	A	A	A	P, B-C, RF	A	A	A
Carassius gibelio	A	A	P, RF	B-C, RF	P, CF,RF	A	P, CF	A	A	A, hybrid	A	A

Homarus americanus	N	SS)	A	A	single SS;B-C	A	A	A	SS, B-C	CF	N	A
Callinectes sapidus	A	NE, B-C	A	A	NE, B-C	SS, B-C	B-C, NF	A	A	B-C	N	A
Mya arenaria	A	P, RF?)	A	A	P,RF	A	A	A	P, RF?	P	N	A
Mercenaria mercenaria	A	A	A	A	P, CF	A	A	A	A	P, some CF	N	A
Rapana venosa	A	A	A	A	SS, B-C	A	A	A	A	NE, NF	NE, A	SS, NF

Rapid assessment of non-native species in German coastal waters

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Intensive international trade along the global water ways has caused a dramatic increase in the introduction of alien species in native coastal ecosystem with substantial effects on local species communities and ecosystems. Despite strong consequences of alien species on ecosystem goods and services, no comprehensive concept exists for German coastal waters with the objective of both detection and assessment of exotic organisms. Thus, the aim of our pilot project was to get an overview of benthic alien species along the German North Sea and Baltic Sea coast. Due to the high probability that alien species first establish at ports and marinas in a new environment, we selected eight ports at the North Sea coast and four sites at the Baltic Sea as our study sites. At each location, we studied the species communities of artificial structures such as pontoons and boulders that provide a suitable habitat for exotic organisms. Additionally, we took sediment samples and identified all organisms to species level. At the North Sea coast, we found a total number of 103 species, 26 of them alien species. At the Baltic Sea coast we identified a total number of 81 species. With a number of 7, the occurrence of exotic species was comparatively low here. Besides the high number of non-native organisms we also detected three new species at the North Sea coast which were not found detected before (*Tricellaria inopinata*, Bryozoa; *Sinelobus stanfordi*, Tanaidacea; *Telmatogeton japonicas*, Diptera). The project enabled a first comprehensive overview on the occurrence and spatial distribution of non-native species in German coastal waters and, therefore, provides valuable information on the invasion status of single species and the arrival of new exotics. Additionally, it has the potential to serve as a first step for a long-term monitoring program on neobiota. This program would be an important tool to get significant information on the development and status of non-native species in German coastal waters.