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CANADA

National Report for Canada 2019

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Overview:

NEW or SPREAD

Other marine species that have already invaded Canadian waters continue to spread, including European green crab (*Carcinus maenas*), vase tunicate (*Ciona intestinalis*), carpet tunicate (*Didemnum vexillum)*, golden star tunicate (*Botryllus schlosseri*), violet tunicate (*Botrylloïdes violaceus*), clubbed tunicate (*Styela clava*), Japanese skeleton shrimp (*Caprella mutica*), coffin box (*Membranipora membranacea*), and oyster thief (*Codium fragile* subsup*. fragile*).

Canada's Ocean Protection Plan includes policies, funding and activities to address the issue of derelict vessels which have been found to be a source of pollution and of biofouling including Non-Indigenous Species (NIS). Transport Canada's program applies to larger commercial vessels and Fisheries and Oceans Canada (DFO) Small Craft Harbour (SCH) program applies to smaller fishing and recreational vessels. The goal is to remove these vessels as part of Canada's commitment to protecting the ocean environment.
Fisheries and Oceans Canada has added AIS Core Management to its activities and each region has several personnel working on areas of AIS management including working on control licences for green crab to working with groups including Indigenous groups to form citizen science teams to monitor for AIS in remote locations.

1. Regulations:
Fisheries and Oceans Canada has developed regulations to manage the threat of aquatic invasive species (AIS). The Aquatic Invasive Species Regulations for the *Fisheries Act* is now in force in Canada effective June 17, 2015. (http://gazette.gc.ca/rp-pr/p2/2015/2015-06-17/html/sor-dors121-eng.php). The new AIS Core Management group has been created to manage these regulations.

2. Intentional Introductions:
Prior to December 31, 2015, Fisheries and Oceans Canada, along with the provinces and territories, managed disease, genetic, and ecological risks associated with aquatic animal movements through a variety of federal, provincial, and territorial regulations under the

National Code on Introductions and Transfers of Aquatic Organisms. However, disease risk is now managed by the Canadian Food Inspection Agency (CFIA) through the National Aquatic Animal Health Program under the Health of Animals Regulations.

3. Unintentional Introductions:

New Sightings-

There were no sightings of new marine AIS reported in 2019

Spread of established AIS species-

Newly established

Established and Spreading

Diplosoma listerianum was found for the first time in Nova Scotia in Lunenburg Harbour in 2012. It was not observed again until 2016 where it was found at 9 locations in SW NB and 1 location in SW NS; after-which it spread rapidly to 14 locations throughout SW NB and 5 locations within SW NS by 2018. *Diplosoma listerianum* subsequently disappeared from SW NB in 2019 following a cold winter, but continues to persist in SW NS at 3 locations (Digby Neck, Digby, and Wedgeport) where it is now considered as established. In addition to these 3 locations, *Diplosoma listerianum* also spread to 5 additional locations within Nova Scotia during 2019.

Didemnum vexillum, confirmed for the first time in 2013 in Atlantic Canada in Minas Basin, in the upper Bay of Fundy, was also confirmed in 2017 by genetic analysis of samples collected within the Bay of Fundy (near Minas Channel) from colony attached to small rock.

Carcinus maenas is established in several areas along the shores of Prince Edward Island (PEI) and the Gulf of St. Lawrence (GSL) coast of New Brunswick (NB) and Nova Scotia (NS) with a new report in 2019, Chance Harbour, NS. The northern limit of its distribution along the eastern coast of NB remains Pokemouche harbour. Increased abundances observed in 2016-17 in several recently invaded bays of eastern NB and PEI, have been followed by significant decreases in the last two years, particularly in 2019Green crab continues to spread in Newfoundland in Placentia Bay, the west coast of NL, and Fortune Bay on the south coast, which is an area of high lobster productivity. In 2019 DFO received reports of the presence of green crab in St. Mary's Bay and confirmed its presence there following a focussed survey of the bay. Abundances of green crab in Magdalen Islands, Quebec have decreased since 2013 with only one crab found in 2019. Cold winters or control efforts are potential factors that could explain this important drop.

Ciona intestinalis is now well established on the eastern shore of Nova Scotia, in Chedabucto Bay, Cape Breton, along the south and southwest shores of mainland Nova Scotia and in SW New Brunswick and is found in isolated areas of the Burin Peninsula in Newfoundland and Labrador. This species is also well established along the eastern shore of Prince Edward Island and was confirmed on the southern shore in 2019 (Borden). It is sporadically distributed along the GSL shore of Nova Scotia where increasing occurrences have been observed (new reports in 2019: Mabou). *C. intestinalis* is only observed in one harbour in the Magdalen Islands, where control efforts have been put in place to minimize dispersal risks into aquacultures sites.

Botryllus schlosseri is now present in most bays and harbours along the south and SW coast of mainland Nova Scotia, as well as in coastal Cape Breton and the Bras D'Or lakes, the GSL shore of Nova Scotia, Prince Edward Island and the Magdalen Islands. It is well established in SW New Brunswick and continues to spread along the eastern shore of the province, where the northern limit has been extended to Miscou Island (first occurrence in 2017) In 2019, two new detections of *B. schlosseri* were reported in PEI: Egmont Bay and Basin Head (Marine Protected Area). It was detected for the first time in Gaspésie, Quebec on collector plates in 2012 but was never observed in that area since that time. In Newfoundland, *B. schlosseri* has been found in many coves throughout Placentia Bay. It has also been found in isolated areas along the south coast of Newfoundland, including Fortune Bay, Hermitage Bay, and since 2013 has been found on the southwest coast of the Island. It is present in only one harbour (Long Pond) in Conception Bay.

Botrylloides violaceus is well established and continued to spread to new locations in SW New Brunswick, while its occurrence in the NE portion of the province remains limited. *B. violaceus* has established in most bays on the northern shore of Prince Edward Island and several bays along the eastern and southern shores of the island (confirmed in Pinette in 2019;. *B. violaceus* is also present in the northern archipelago region of the Magdalen Islands and along the Atlantic and GSL coasts of Nova Scotia. In Belleoram, Newfoundland, where *B. violaceus* was originally detected in that province, abundances had decreased and rarely detected in 2019. Isolated populations have been discovered throughout Newfoundland, including the west coast (Codroy), Placentia Bay (Arnold's Cove), and Conception Bay (Long Pond).

Styela clava was reported in Prince Edward Island in 1998 and is mostly restricted to the eastern shore and a few bays on the northern and southern shores of this province (no new reports since 2017). *S. clava* was reported for the first time in Nova Scotia in 2012 at a few locations within Halifax Harbour and at Lunenburg harbour. In 2013 it was found at all these sites and in addition recorded at several sites within Chedabucto Bay and this species appears to be established within all these areas as they have been found at the same locations every year including 2017.

Caprella mutica is well established on the Atlantic coast of Canada since the 1990's. In 2016, *C. mutica* was observed for the first time in the Bay of Sept-Îles located on the West Coast of the GSL.It has been reported at several locations within the southern mostly along the shores of PEI and northern NB (confirmed in Foxley and Cape Egmont, PEI in 2019)_*C. mutica* was found for the second time in Bay of Sept- Îles in 2018, and now is considered to be established on the north coast of the GSL.

Membranipora membranacea is well established on the Atlantic coast of Canada since the 1990's. In Quebec, this invasive bryozoan is found in the Magdalen Islands, Gaspe Peninsula and on the West coast of the GSL. In 2018 *M. membranacea* was detected for the first time in the northern part of the GSL (close to the Labrador border). Low densities have been detected in eastern and western PEI (confirmed in Skinners Pond in 2019), the GSL and Atlantic coasts of Nova Scotia, and SW New Brunswick. *M. membranacea* is well established in Newfoundland and has been found in most coastal areas throughout the province, including southern Labrador.

Codium fragile subsp. *fragile* is established along the shores of the Northumberland Strait and in Malpeque Bay (northern shore of PEI) as well as in the Magdalen Islands. On the eastern shore

of NB, confirmed reports extend as far north as Lamèque, where it was first reported in 2002. In Newfoundland, it has been observed attached in Notre Dame Bay (near Pilley's Island) and within Fortune Bay (near Little Harbour East). A focussed survey was conducted in Notre Dame Bay in 2019 and it had not spread from the original location. In Nova Scotia, *C. fragile* was reported for the first time in 1991 and spread along coasts since that time.

4. Pathogens

None reported.

5. Research and Monitoring Programs This should also include sections on **Planned Research**, **Research Needs** and **Research Gaps**.

Research Needs

- Research is needed to develop better management practices for biofouling, such as remotely-operated devices for risk assessment and cleaning with particle retention.
- A baseline data set for Canadian Arctic plankton and benthos by marine ecoregions has been collated, but species records for different taxa should be incorporated into a consistent, standardized database format and ideally published/archived in a way that they can be made publicly available.

Research Gaps

- DNA barcode reference libraries to catalogue biodiversity of lower trophic level taxa and provide a basis for the use of new genetic tools for the detection of changes in biodiversity and detection of new species.
- Risk assessment for recreational boating as a vector of AIS to Arctic region
- Population genetics studies of cryptogenic species found in port surveys, to better understand origins (native versus introduced)

Research and Monitoring projects and programs

1) Fisheries and Oceans National AIS Monitoring Program – Atlantic Canada Zone (2005-ongoing)

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Fisheries and Oceans Canada (DFO) has included a monitoring component in its Aquatic Invasive species (AIS) framework since 2005. The Atlantic Zone (Nova Scotia, New Brunswick, Newfoundland and Labrador, Prince Edward Island, Quebec) Monitoring program has been conducting surveys, rapid response, and outreach projects for non-native and invasive species since that time using standardized

methods and protocols. Using a combination of harbour surveys (settling plates, video and SCUBA) for detection and spread of biofouling organisms and trapping for invasive green crab, a baseline distribution of AIS in the Atlantic zone has been compiled. Ongoing surveys and monitoring projects are aimed at prevention and early detection, mitigation strategies and providing advice for management of AIS in Canada. Data collected from these surveys are included in the ICES AQUANIS database.

2) In-transit survival and post-arrival performance of hull fouling aquatic invasive species (2017-2019)

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Ships may act as vectors of introduction for aquatic invasive species (AIS) through hull fouling. However, there is limited understanding of the survival of fouling species following short-term in-transit changes in environmental conditions. Normally, last port-of-call (LPoC) information is used to assess the relative risk of introduction of AIS. However, species present in hull fouling communities may be very different from those in the LPoC given that organisms may have accumulated over time through voyages to multiple destinations subjected to a variety of environmental conditions. Further, it is typically assumed that individuals from populations of a given hull fouling species across a range of latitudes have similar probabilities for survival in novel receiving environments, although studies of other organisms show that physiological performance and capacity for adaptation may vary substantially depending on population of origin. This study used a two-step approach for studying the environmental tolerances for survival and post-arrival performance of fouling organisms. The first will evaluate AIS survival and recovery following exposure to short-term changes in salinity and temperature simulating pathways with transitions between marine and freshwater and back to marine environments, or vice-versa. The second will evaluate the performance and acclimation capacity of fouling AIS populations from different latitudes to the full range of expected temperatures in Canadian waters (temperate-polar). The results of this project will provide a better understanding on fouling vectors and the response of species to changes in environmental conditions. This can contribute to the development of more complete and realistic hull fouling risk assessments.

3) DEVELOPING A RISK-BASED PATHWAY ANALYSIS TO PREVENT THE SPREAD OF THE HIGH IMPACT INVASIVE SOLITARY VASE TUNICATE (CIONA INTESTINALIS) (2019-2022).

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The objectives of this three year project are to document vectors and pathways associated with small harbours and marinas (< 25m vessels) for potential regional and zonal spread of invasive species, using the vase tunicate as a proxy for other biofouling organisms. The study will develop and evaluate effective prevention and early AIS detection strategies and best management practices that may be useful to stakeholders, regulators and policymakers with regard to small habours and marinas. A decisions tree type guidance document will be developed and tested for a preventative approach to the introduction of AIS and rapid response events as part of harbour management protocols

4) Development of community-based program for monitoring and early detection of aquatic invasive species in the Canadian Arctic – preparing for increased shipping related to resource development and climate change (2015-2019)

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Increased shipping in the Canadian Arctic associated with resource development and climate warming will inevitably result in unwanted species introductions. Preventative measures, such as ballast water exchange and treatment and reduction of vessel fouling, are key components for management of aquatic invasive species (AIS). However, these measures are not 100% effective. Thus, in addition to prevention, management should focus on strategies for monitoring and early detection, especially where AIS have not yet established or population levels are still low, as in the Canadian Arctic. Monitoring improves the likelihood of detecting invasions at early stages when there is a greater chance for successful eradication, containment, or to prepare to adapt to the presence of a new species. Through this project we are developing a foundation for the development of a monitoring and early detection system in the Canadian Arctic. This includes the following elements and is extending past research efforts by DFO and the Canadian Aquatic Invasive Species Network (CAISN): 1) Identification and ranking of key ship-mediated AIS for early detection and monitoring, and geographic locations with highest probability for establishment via Environmental Niche Modeling; 2) Development and trial of genetic early detection methodologies (e.g., environmental or eDNA) for AIS in high risk ports; 3) Establishment of a community based monitoring network/capacity; and

4) development of generic Risk Assessment models based on detailed shipping information

6. Meetings

2019

- National Aquatic Invasive Species Monitoring Meeting Ottawa, ON February, 2019
- Northeastern Aquatic Nuisance Species (NEANS) Panel spring meeting, Springfield, Massachusetts, United States, 3-5 June, 2019
- International Conference on Aquatic Invasive Species, October 27-31 2019, Montreal Canada
- Northeastern Aquatic Nuisance Species (NEANS) Panel fall meeting, Delmar, New York, United States, - 10-11 December, 2019

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DENMARK

National Report Denmark 2019

Prepared by Kathe R. Jensen, Natural History Museum of Denmark, with inputs from J. Møller, Danish Environmental Protection Agency and S. and M. Mikkelsen (leisure fishers).

Highlights:

The amphipod *Gammarus tigrinus* has been documented in Danish waters for the first time at the Baltic island Bornholm. The tanaid *Sinelobus vanhaareni* has been observed for the first time in Denmark in the harbour of Copenhagen. The Asiatic crab *Hemigrapsus takanoi* is now established in Dybsø Fjord, a lagoon connected to the southern part of the Great Belt. The Danish Environmental Protection Agency is now permanently established in Odense.

Content:

1. **Regulations:**

The major part of the Danish Environmental Protection Agency (EPA) moved to Odense during the spring and early summer of 2019. Many new staff had been hired to replace experienced staff who did not wish to move. This has somewhat slowed down progress of many areas of work. Furthermore, there was a change of government after a parliamentary election in June 2019. This caused some reorganizations in ministries and agencies. Thus, the Fisheries department was transferred from the Ministry of Foreign Affairs back to the Ministry of Environment and Food.

The second update of the EU list of alien species of union concern has been approved and entered into force in July 2019, and the amended list was made publicly available on the website of the Danish EPA on 12 August 2019 (https://mst.dk/media/177675/oversigt-arter-paa-eulisten-til-hjemmeside-opdateret-august-2019_1.pdf). The updated list still contains only one tropical marine fish and the Chinese mitten crab. The former Danish government (before June 2019) stated that it does not wish to place marine species on the EU list because management measures are not possible or too expensive. The present government has not made any comments to this. The list for the third update contains some marine species, but risk assessments have not yet been completed.

The second phase of implementing the EU Marine Strategy Framework Directive (MSFD) was initiated in 2019 (Consolidation Act 1161 of 25 November 2019) (all laws, consolidated acts, executive orders, etc. can be downloaded from https://www.retsinformation.dk/). Prior to this, a report on the marine strategy containing status and impacts on the marine environment, as well as establishment of environmental targets for the various descriptors of the MSFD (Miljø- og Fødevareministeriet, 2019a). For Descriptor 2 (NIS) they conclude that the existing monitoring program does not capture new introduced species and they do not expect good environmental status in 2020. There is a general lack of data, and they recommend targeted collection of data from leisure boats and marinas concerning fouling organisms. The inclusion of eDNA analyses for capturing NIS in the monitoring program is still in a preliminary phase (Hansen & Høgslund, 2019; Winding et al., 2019).

Concerning mariculture the Danish Environmental Protection Agency organized a thorough investigation of all existing operators and their compliance with legislation and regulations (Miljø- og Fødevareministeriet, 2019b). This was in response to several cases of illegal activities in previous years. No new permits have been issued and no existing operator has been permitted to expand or change their production during 2019. The report concluded that there is a general lack of documentation, a lack of compliance with habitat regulations and a lack of transparency of who is responsible for what – both for operators and authorities.

For the Ballast Water Convention and hull fouling, collaboration within the HELCOM/OSPAR framework has continued. An Executive Order (BEK 1000 of 18 September 2019) on treatment of ballast water and sediments from ships' ballast tanks has been approved by the minister of Environment and Food. It replaces BEK 968 of 24 July 2017.

2. Intentional:

Although the import of live American lobster remains high, there are no reports of catching them in the wild. For escapes of fish from mariculture, see below. There have been no reported cases of illegal import of fishes for mariculture in 2019.

Fisheries statistics are no longer published as annual reports, but only available as "dynamic tables" on the website https://fiskeristyrelsen.dk/fiskeristatistik/.

3. Summary of sightings:

Unintentional, new sightings:

In 2019 the first occurrence of the amphipod *Gammarus tigrinus* Sexton, 1939, was recorded in the scientific literature. It has been found at two locations on the east coast of Bornholm in 2018, but was not published until 2019 (Rewicz et al., 2019). Ferries are suggested to be the most likely vector.

A student at the Natural History Museum of Denmark has collected the tanaid *Sinelobus vanhaareni* Bamber, 2014, in the harbour of Copenhagen during the summer of 2019. The ID has been confirmed by the Crustacea specialist at the museum, Dr. Jørgen Olesen. At this time it is unknown if there is an established population. This is the first record from Danish waters. It has been found previously along the German Baltic coast and most recently in the Gulf of Gdansk (Brzana et al., 2019).

Unintentional, species previously recorded, but new sightings:

Mnemiopsis leidyi A. Agassiz, 1865, continues to be abundant in Danish waters through summer months (when people go to the beach).

During April through July 2019, several specimens of *Hemigrapsus takanoi* Asakura & Watanabe, 2005, were found in Dybsø Fjord some of which were egg-bearing females. Also several *Rhithropanopeus harrisii* (Gould, 1841), were collected. Identification has been confirmed by photos and preserved specimens collected by S. & M. Mikkelsen and sent to the Natural History Museum of Denmark. Some of the *H. takanoi* specimens have been sent to NIVA Denmark for DNA-analysis. The occurrence of egg-bearing females means that *H. takanoi* is now established in the Danish part of the Baltic Sea. Dybsø Fjord is an enclosed lagoon-like estuary with a narrow

connection to the Baltic Sea south of the Great Belt. Another record, confirmed by photo, is from July 2019 in Guldborgsund, the strait between the islands of Falster and Lolland. Here *H. takanoi* was found with *Rhithropanopeus harrisii*, which has been recorded from this locality before. Further records of *H. takanoi* have been reported to the web-site of the Danish EPA (https://invasive-arter.dk/Menu.aspx) in June, July and August (when people go to the beach): at Als in the westernmost part of the Baltic, where they also occurred in 2018, and at the island Langeland, plus an unconfirmed record from the narrow strait between the islands of Falster and Møn (all in the Baltic Sea).

There have also been some sightings (recorded on the web-site of the EPA – see URL above) of *Hemigrapsus sanguineus* (De Haan, 1835) during the summer of 2019, mostly from the Baltic Sea, but one record from July 2019 from Ebeltoft, at the border between Kattegat and the Belt Sea, and a second record from near Helsingør in the northern Sound (southern Kattegat) in October 2019 stand out as expansions of the previously observed range (https://www.oresundsakvariet.ku.dk/nyheder/2019/invasiv-krabbe-fundet-i-oeresund/). None of these records mentions egg-bearing females, so it is uncertain if this species is established in the Danish part of the Baltic Sea and Kattegat.

Some cases of mass escapes of rainbow trout, *Oncorhynchus mykiss* (Walbaum, 1792) have been reported in Newsletters from anglers' associations, e.g. Nyborg Fjord in April 2019 and Lillebælt in December 2019.

The round goby, *Neogobius melanostomus* (Pallas, 1814), continues its spread through Danish waters. In 2019 it was found in Odense Fjord (Belt Sea) (Kuhn & Christoffersen, 2019).

Unintentional, not yet seen

A highly toxic species of Limnomedusae, *Gonionemus* sp. has been observed on the Swedish west-coast. *Gonionemus vertens* L. Agassiz, 1862, was reported from northern Kattegat, Denmark in 1960, a record which was identified by the then world expert, P. Kramp (Jensen & Knudsen, 2005), but it has not been seen since then. DNA sequencing of the Swedish specimens showed that they were identical to stinging populations from Japan and the NW Atlantic and genetically different from *G. vertens* from Iceland (Govindarajan et al., 2019).

The parasitic copepod *Mytilicola orientalis* Mori, 1935, was found parasitizing blue mussels in Kiel Bight in the western Baltic (Brenner et al., 2019). The authors conclude that it may be just a matter of time before it spreads to other parts of the Baltic, including mussels in the Danish part of the Baltic.

4. Pathogens

Nothing to report

5. Research and Monitoring Programs

The Danish Environmental Protection Agency has initiated a project to develop teaching materials about invasive species for 7-9th grade school children.

A cookbook has been published in collaboration between the EPA and the cooking school in Copenhagen. It features short descriptions of the species, their biology and spread, and then

some recipes; the only marine species included are *Crassostrea gigas* and *Neogobius melanostomus* (Dalsgård et al., 2019).

In relation to the EU Water Framework Directive (WFD), a research project has investigated the invasive seaweed *Sargassum muticum* on other vegetation (Stæhr et al., 2019). They concluded that *S. muticum* has a significant effect on macroalgal composition, decreasing especially other large brown algal species. They found no negative effects on eelgrass.

The bacterial composition of ectodermis and gastrodermis of *Mnemiopsis leidyi* has been compared for native and invasive populations of the comb jelly (Jaspers et al., 2019). Also, a dataset on biodiversity and abundance of gelatinous macro zooplankton, including *M. leidyi* from the North Sea in August 2018 has been published (Gawinski et al., 2019).

The population of Pacific oysters, *Crassostrea gigas*, in the Danish Wadden Sea has been estimated to about 72,000 t. Pacific oysters often occur mixed with blue mussels. In some places there are oyster reefs with many mussels on and between the oysters, in other places there are extensive mussel mounds with small oysters attached (Nielsen et al., 2019a).

There are two reports assessing the population of *Crassostrea gigas* in the Limfjord, one from Nissum Bredning, the westernmost part of the fjord, where an estimated population of 90 t was found in the areas where blue mussels are fished (Nielsen et al., 2018). The second assessment area was in Løgstør Bredning in the central part of the Limfjord, where a population of about 2450 t was estimated at depths greater than 3 m (Nielsen et al., 2019b).

There is also a Nordic report on harvesting Pacific oysters. This report summarizes knowledge about *Crassostrea gigas* in Nordic waters and presents suggestions for commercial exploitation (Mortensen et al., 2019b). In connection with this research, a Policy Brief has also been published (Mortensen et al., 2019a).

Movements in the sediment caused by activities of permanently buried *Mya arenaria* from the northernmost tip of Fyn (Funen island) (Camillini et al., 2019).

A paper analyzing the genetic composition on the alien barnacle *Amphibalanus improvises* has been overlooked in the previous report (Wrange et al., 2016).

Acoustic telemetry has been used to study behavior and seasonal migrations of *Neogobius melanostomus* in Karrebæk and Dybsø Fjords (Christoffersen et al., 2019).

In connection with the implementation of the MSFD a study on cumulative effects of human stressors has been published, which applies spatial modeling (Andersen et al., 2020). The model showed that NIS ranked second in impacts if climate anomalies were not included, and third when climate anomalies were included.

Also in connection with the implementation of the MSFD, a provisional EU-wide consolidated list of NIS has been assembled by experts from 16 EU countries (Tsiamis et al., 2019).

Future planned research:

The methodology for eDNA will be further developed; primers for more species will be developed.

The EPA has proposed monitoring of fouling organisms on leisure boats and in marinas should be included in national monitoring, but they are still seeking funding for a preliminary study.

The final report of MONIS 4 on the baseline of NIS in 16 Danish harbours has still not been published, but research results have been presented at meetings.

Knowledge gaps:

With the rapid expansion of various small crab species (*Hemigrapsus* spp., *Rhithropanopeus harrisii*) it would be nice to know whether the Baltic invasion is from the same genetic strains as the North Sea populations, and whether the Baltic is being invaded through Skagerrak, the Limfjord or maybe the Kiel Canal.

As mentioned several times over the past years, jelly plankton should be included in monitoring. *Beroe ovata* was reported from the Belt Sea (Baltic) in 2014, but has not been reported since – probably because nobody looked.

6. Meetings

The advisory group on invasive species have only held one meeting in 2019 due to the relocation of the Environmental Protection Agency from Copenhagen to Odense. The meeting was held on 8 May 2019 in Odense

Danish Society for Marine Biology held a meeting on 27 February 2019 with presentations on monitoring of non-indigenous species by eDNA, night-diving and fouling plates.

A Marine Science symposium in January 2019 at University of Southern Denmark in Odense featured some presentations and posters on NIS.

Jysk Naturhistorisk Forening held a meeting on invasive species 3 October 2019. This was related to the EU list and the problems of implementing the control measurements.

An ICES Shellfish Symposium: Shellfish – Resources and Invaders of the North was held in Tromsø, Norway 5-7 November 2019. Staff from Danish Shellfish Center presented data on expansion of *Crassostrea gigas* in Denmark (Freitas et al., 2019).

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FINLAND

National Report Finland

Compiled by Maiju Lehtiniemi[1], Okko Outinen[1] and Lauri Urho[2]

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Summary 2019-2021

Finland collected the needed information for the first reporting of the EU IAS Regulation and reported presence/absence of the EU listed species in Finland in June 2019. The only aquatic species that was on the reported species list is *Eriocheir sinensis*. The newest aquatic non-indigenous species found in Finnish territorial waters, *Sinelobus vanhaareni*, a small crustacean, which was found at the southern coast of Finland in 2016 (but identified in 2018), has been now found in various regions and occasionally in high densities. A proposal on non-native species monitoring framework to HELCOM (jointly with Lithuania and Estonia) was done. This work continues to more concrete actions in the Interreg project COMPLETE. Finland conducted NIS sampling events on 3 coastal marinas in 2018 (Southwestern Finland), while creating Biofouling survey protocol for leisure boats and marinas (task of the COMPLETE project).

Overview:

Highlights of the 2019 report

One of the COMPLETE project tasks was to estimate biofouling risk for leisure boats and this task included a marina sampling, which was conducted in 3 relatively populous marinas in Southwestern Finland (Kasnäs, Hanko and Raisio). Sampling included fouling plate samples and scrape samples from leisure boats and artificial structures. No new NIS were found from the samples, but overall, 7 NIS were found (*Amphibalanus improvisus, Cercopagis pengoi, Gammarus tigrinus, Mytilopsis leucophaeata, Palaemon elegans, Rhithropanopeus harrisii* and *Sinelobus vanhaareni*). Scrape samples from leisure boats also contained *Sinelobus vanhaareni* crustaceans, sometimes in high densities (133 individuals per approximately 0.5 m^2).

The round goby (*Neogobius melanostomus*) that was first recorded in Finland in 2005, has spread to almost entire Finnish coastal waters. The northernmost observation was made in 2019 in Oulu, Bothnian Bay.

Content:

1. **Regulations:**

Finland has been actively taking part to the expert groups of EU invasive species issues related to the implementation of the EU IAS Regulation (2014). The first reporting to the Commission was completed in June 2019.

2. **Intentional:**

Deliberate releases into the Baltic Sea continued (including rivers draining into the Baltic) for fisheries and fish stock enhancement purposes in 2019 with newly hatched and older salmon (*Salmo salar*), sea trout (*Salmo trutta* m. *trutta*), whitefish (*Coregonus lavaretus*).

3. **Summary of sighting.**

Unintentional:

No new sightings

Previous sightings:

General information

In 2019, the amount of pink salmon (*Oncorhynchus gorbuscha*) that ascended into northern rivers in Finland was the same than in 2017.

4. **Pathogens**

5. **Research and Monitoring Programs**

1. Completing management options in the Baltic Sea Region to reduce risk of invasive species introduction by shipping, COMPLETE (2017-2020).

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The project is led by Kotka Maritime Research Association, Finland and funded by INTERREG Baltic Sea Region Programme. There are 12 project partners from seven Baltic Sea countries. Finland is represented by five partner institutes (Kotka Maritime Research Association, Finnish Environment Institute, University of Helsinki: Dept of Environmental Sciences, Keep Archipelago Tidy and Kymenlaakso University of Applied Sciences). Project is tackling several knowledge gaps: the need to take into account rights and obligations of involved stakeholders; approaches for NIS monitoring and surveillance for EU Marine Strategy Framework Directive (MSFD) and Ballast Water Management Convention (BWMC); risk assessment based exemptions from ballast water management requirements; legal aspects; regional cooperation and information exchange. Project results will provide comprehensive knowledge for decision making to understand the different antifouling practices in maritime and leisure traffic. Based on this knowledge, recommendations will be compiled which enable the development of harmonized biofouling management strategies for the entire Baltic Sea region. The project aims at developing a roadmap for a harmonized approach by involving all relevant stakeholders from the beginning of the project. SYKE is leading the work package 2 in the project where the aim is to develop and test new methods for NIS monitoring that could be taken into routine use in the Baltic Sea countries and to complete the development of the harmonized monitoring program for the Baltic Sea area.

2. BONUS BLUEWEBS (2017-2020)

Laura Uusitalo, Finnish Environment Institute: Contact: laura.uusitalo@ymparisto.fi

BLUEWEBS is designed to deliver an assessment of the consequences of simultaneously achieving the good environmental status and providing blue growth (i.e. the capability of Baltic Sea food webs to sustainably produce ecosystem goods and services). Global climate change will likely result in novel climates, leading to combinations of physical oceanographic conditions never encountered before in the Baltic Sea. These will affect ecosystems in addition to the regional anthropogenic impacts of eutrophication, fisheries exploitation, invasions of non-indigenous species and accumulation of hazardous substances. These cumulative impacts have already (and will likely continue in the future) cause novel food webs that significantly differ in structure and function from historical predecessors. Novel food webs in concert with novel climates will likely render present management tools and measures unsuitable and hence challenge the ability of society to achieve GES while safeguarding BG potential.

6. **Meetings**

- Several national meetings (of the board on invasive species issues, the expert group on development of national NIS legislation, ad hoc group on BWMC implementation)

- project COMPLETE meetings

- HELCOM/OSPAR TG Ballast meeting in December 2019

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FRANCE

National Report France 2019

Compiled by Amelia Curd (Ifremer) & Frédérique Viard (CNRS – Station Biologique de Roscoff) with contributions from Emmanuelle Sarat (IUCN France), Aurore Raoux, Jean-Claude Dauvin & Jean-Philippe Pezy (CNRS – University of Caen), Sylvaine Giakoumi & Virginie Raybaud (ECOSEAS - University of Nice Sophia Antipolis), Laurent Guerin and Cécile Massé (UMS PatriNat – Stations marines de Dinard et d'Arcachon) , Marc Verlaque (CNRS - MIO Marseille) , Christine Pergent-Martini (Université de Corse Pasquale Paoli), Gabin Droual & Philippe Goulletquer (Ifremer).

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

Overview:

New introductions, all unintentional, were reported for the country or for new maritime region within France. This includes two algae (*Ulva ohnoi* and *Symphiocladia tanakae*), one isopod (*Synidotea laticauda*), one fish (*Holocentrus adscensionis)* and one tunicate (*Botrylloides diegensis*), as well as a novel mussel lineage (resulting from admixture between native mussels and the introduced Mediterranean mussel in North Atlantic commercial ports). The first review of NIS in the French overseas territories was carried out by the IUCN French committee. They reported 61 NIS, a third of which are ascidians, with the highest number (31) found in French Polynesia. In the absence of dedicated monitoring, these numbers are probably underestimated, as is likely to be the case in continental France. Several research programs targeted pathogens and diseases, notably the protist *Haplosporidium costale* responsible for an important die-off of the *Crassostrea gigas* oyster in one locality, and transmissible cancer in mussels (for which a new strain had been identified, which is shared by the blue mussel and the Chilean mussel suggesting international shipping as pathways). Other research projects aimed to1) examine the relationships between MPAs and invasive species, 2) analyze biofouling by NIS in ports and 3) develop molecular tools to support surveys and monitoring –including with eDNA and metabarcoding, tracing back introduction routes, and analyzing impacts on native species (hybridization).

Content:

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

Throughout 2019, the EU regulation on the prevention and management of the introduction and spread of IAS (EU 1143/2014) has been rolled out across Frances' five overseas departments. Through a series of decrees, the islands of la Réunion, Mayotte, Guadeloupe, Martinique and French Guiana are gradually banning all activities involving non-indigenous flora and fauna.

As part of the implementation of the second cycle (2014-2020) of the EU Marine Strategy Framework Directive (MSFD), the monitoring programs for France's four sub-regions have been revised and gradually implemented by regional authorities since February 2019. During a national workshop held in December 2019, it was agreed to focus monitoring efforts on a) hard substrates and 'high-risk' areas and b) the 'D2C2' criteria, which aims to quantify established NIS (abundance

and spatial distribution), based on a list of 68 priority species (drawn up in 2018) considered as being already or potentially invasive.

2. **Intentional:**

No statistics are presently available for 2019 live import/export of commercial NIS.

3. **Summary of sightings**

3.1 **Unintentional**

New sightings (2019): new country records or new sub-region records

Important note: the sightings reported below are for mainland France only. However, the first review of NIS in the French overseas territories was carried out by the IUCN French committee. A total of 61 NIS were reported, although it is difficult to determine the year of first observation in most cases. We therefore did not fill the table below with overseas NIS but recommend to read this report for further information: IUCN Comité Français (2019). Espèces exotiques envahissantes marines : risques et défis pour les écosystèmes marins et littoraux des collectivités françaises d'outre-mer. Etat des lieux et recommandations. Paris, France, 100p.

Molluscs –Mytilus spp.

Using a dataset of 4279 mussels genotyped at 77 SNPs, Simon et al. (2020) documented a very recent (<50 years) introduction of the Mediterreanean mussel *Mytilus galloprovincialis* into several Atlantic harbours. In each case, the introduced species shows extensive admixture with the local native *Mytilus* background (*i.e*., in all cases *M. edulis*, with one exception in the port in Brest where the native mussel is the Atlantic lineage of *M. galloprovincialis*). Interestingly, these "dock mussels" are so far confined to harbours, with sharp transitions at the port entrance.

Tunicates -*Botrylloides diegensis* and *Botrylloides spp.*

Based on COI sequencing of >750 colonies of *Botrylloides* spp. including reference samples identified by taxonomist experts, and sequences retrieved from BOLD and Genbank, Viard et al. (2019) showed database errors particularly regarding *B. diegensis* (introduced) which can thus be mistaken as *B. leachii* (native). This work provides evidences for new reports of *B. diegensis* in Italy (Venice), Spain (Delta of Ebro and Catalan coast) and France (Thau Lagoon). In addition, a particular unicolor morph of *B. diegensis* can easily be mistaken with *B. violaceus.* It is thus likely that the distribution of *B. diegensis* had been underestimated in European seas. The authors point the need to revise previous reports of *B. leachii*, as it may have been confused with *B. diegensis*. In the same study, colonies belonging to a new lineage of *Botrylloides* sp. have also been identified in the English Channel (in the UK only, so far). This lineage could be either a divergent lineage of *B. israeliense* (newly described in the Mediterranean Sea) or a sister species (possibly undescribed, and maybe introduced) of the latter.

Taxon	Phylum	References	MSFD sub-region, location	First country record?	Year of observation
Botrylloides diegensis	Chordata - tunicates	Viard et al., 2019	W. Med	No – previously in BoB (2007) and EC (2005)	2012
Holocentrus adscensionis	Chordata - squirrelfish	Raybaud – pers.comm.	W. Med	Yes	2019
Synidotea laticauda	Crustacea	Massé et al., 2019	EC (Seine Estuary)	Previously in BoB – Gironde Estuary (1993)	2017
Symphiocladia tanakae	Rhodophyta	Verlaque & Breton 2019	EC – ports of le Havre and Antifer	No – 1st European observation in Thau lagoon	2008
Ulva ohnoi	Chlorophyta	Verlaque & Breton 2019	EC – ports of le Havre and Antifer	No – previously observed in port of Sète	2015

Previous sightings (2019): new records within the same sub-region

Taxon	Phylum	References	MSFD sub-region, location	Year of most recent observation	Comments
Boccardia proboscidea	Annelida	Gully & Cochu, 2019	EC Northern Brittany (Trégor)	2018	Previously near Belgium border (Wimereux)
Mytilus galloprovincialis	Mollusca	Simon et al., 2020	EC & Bay of Biscay	2015-2017	Previously in Cherbourg (2003)

Rapana venosa	Gastropoda	Unpublished observations	Bay of Biscay	2019	Two large individuals identified (1 in Arcachon, 1 in La Rochelle)

After reaching the Italian and Spanish coasts of the Western Mediterranean Sea, the American blue crab *Callinectes sapidus* is now regularly observed in the lagoons along the French Mediterranean coast (Labrune et al., 2019). Its strong invasion capacities will probably lead to important changes in the structure and composition of French lagoon biota. A harvesting program is being envisaged to manage the population, as blue crabs are commercialized in their native range.

Not Seen Species Yet

A newly established population of the fouling polychaete *Spirobranchus cf. tetraceros* is reported from the western Mediterranean (Valencia Port). Despite previous intensive surveys, this is the first record for the taxon in the Iberian Peninsula (Palero et al., 2020). The compound ascidian *Symplegma brakenhielmi* is rapidly spreading across the Mediterranean and was observed in the NE of Sardinia in 2018 (Ramos-Epla et al., 2020). The probability this species will be, or is already, present in Corsica is therefore highly likely.

4. **Pathogens**

Protists: On the 8th of June 2019, after a massive mortality event in the farmed *Crassostrea gigas* oysters from the Ifremer Bouin marine station, the parasite *Haplosporidium costale* was detected, supposedly for the first time in France. This parasite is known to cause low mortality of *C. virginica* along the east coast of North America. As part of a risk prevention strategy, all oyster batches originating from Bouin were destroyed. A retroactive analysis revealed this parasite as already being present in the wild in France as early as 2009 and in the UK. On-going research is focusing on genome sequencing of the parasite and understanding what caused the sudden oyster mortality. A two-day workshop will be held with several members of WGPDMO this spring (cf. Events §). A newly described Haplosporidian endoparasite (*Haplosporidium pinnae*) is the most probable cause of a mass mortality event devastating the populations of the endemic bivalve *Pinna nobilis* in the Mediterranean Sea since 2016 (Cabanellas-Reboredo et al., 2019). Although the origin of this parasite is unknown, there is speculation it too may have been introduced through human activities.

Transmissible cancers are rogue cell lineages that spread between individuals (i.e., disseminated neoplasia). Such a transmissible cancer had been identified in bay mussels (*M. trossulus*) in the Northern hemisphere by the team led Michael Metzger at the Pacific Northwest Research Institute in Seattle, Washington. Tumour cells with genetic markers characteristic of bay mussels, although revealing a second strain of this disseminated neoplasia, had been then identified in both the Chilean mussel (*M. chilensis*) and the blue mussel (*M. edulis*) (Yonemitsu et al., 2019).

The transmissible cancer thus spread to South American and European mussel species — probably via international shipping vessels, the researchers suggest. Since 2014, the blue mussel (*Mytilus edulis*) has experienced mass die-offs in France. After showing initial signs of being caused by a transmissible cancer, the most probable cause of the mass mortality event is likely to be a pathogen and/or non-transmissible tumour (Burioli et al. 2019, Charles, et al. 2020).

5. **Research and Monitoring Programs**

5.1. **AQUANIS 2.0 (2016-2021)**

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Supported by the Fondation TOTAL, the AQUANIS 2.0 project aims to develop new tools based on environmental DNA studies and metabarcoding to detect, monitor and study non-indigenous species in marine coastal habitats, with a particular focus on biofouling assemblages in marinas/ports. It has a two-fold objective: 1) to address important questions regarding biological introduction processes, e.g. processes limiting or enhancing the spread from artificial habitats to natural habitats, and 2) deliver effective tools in support of policies and regulations, incl. MSFD. Besides developing DNA-based tools, this project continues to support surveys of NIS in marinas from Brittany. For instance, in July 2019, Rapid Assessment surveys had been carried out in 10 marinas, repeating previous surveys carried in 2013 and 2016. Regarding DNA-based tools, a first study, based on the metabarcoding of larval samples obtained over 22 months had been published (Couton et al. 2019), showing the efficiency of the approach to detect NIS (12 were recovered). A new manuscript is in preparation to demonstrate the usefulness of High-Throughput Sequencing to identify native vs. introduced species together with intra-specific analyses. The case study is the genus *Botrylloides* because these colonial tunicates exemplify both the difficulty to use external characters to identify species and show cryptic lineages (Viard et al. 2019).

5.2 **IDEALG (2011-2020)**

Philippe Potin, CNRS Roscoff Biological Station : potin@sb-roscoff.fr

The IDEALG project aims to develop sustainable aquaculture of seaweeds in Brittany. Several studies were carried out on *Undaria pinnatifida*, an edible seaweed native to Asia and cultivated in Brittany for more than 40 years. Studies based on the use of surveys and DNA-based analyses (Guzinski et al. 2018, Salamon et al. 2020) showed that 1) populations in the wild are self-sustaining, 2) marinas are the primary vectors of spread in natural habitats, 3) that novel marinas are quickly colonized by this species. More specifically, Salamon et al. (2020) carried out, over three years, field surveys (>20 000 individuals geo-localized) and genetic analyses (10 microsatellite loci, N=890 individuals) of *Undaria pinnatifida* to study the real-time colonization dynamics of a newly-built marina in Brittany (France). They showed a remarkable snow-ball effect over time, with local density reaching locally up to 50 individuals per m² after two years. Genetic assignment showed that the founders mainly came from neighboring populations (established in natural rocky reefs). Spill-over effects (i.e., spread from marinas to the wild) have been previously documented to explain the expansion of this seaweed. The authors here showed that the on-going ocean sprawl also offers a perfect arena for spill-back events (*i.e.,* spread from natural

habitats to artificial structures), highlighting the need for careful surveillance of newly built infrastructures.

5.3. EMBIMANOR (ENrichissement de la BIodiversité MArine Littorale en NORmandie) (2017-2021)

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This ongoing project aims to understand the evolution in biodiversity of the Normandy coastline and marinas, encompasses two actions targeting non-native species. The first is a monitoring of the populations of crab of asian origin *Hemigrapsus sanguineus* and *Hemigrapsus takanoi*, which will be jointly carried out by researchers and environmental NGOs. The second action will study the fixed hard-substrate fauna present in marinas and will test the hypothesis that the ports of Normandy with high numbers of cross-Channel and international traffic (Cherbourg, Ouistreham, Le Havre et Dieppe) are the main pathway of introduction of non-native (but rarely invasive) species. The chosen protocol is similar to that develop by the Interreg project Marinexus: 40 alveolated polyethylene plates will be immersed at 1.5m depth in 20 marinas between Granville and Tréport. Plates will be removed and analysed after 3, 6, 9, 12 and 24 months, in order to view the entire colonisation sequence. Species which colonised the plates will be identified to the lowest taxonomic level possible.

5.4 ROME (Réseau d'Observatoires pour la recherche en Microbiologie Environnementale intégrée (2019-2025)

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The ROME project aims to develop an integrated observatory of the microbiology of mainland France's coastal waters. It has a twofold purpose of developing new approaches and data (-omics data) for scientific research and of strengthening support to public policies. Batch environmental DNA and RNA analyses will be carried out, with a view to assess whether these tools can be used for "routine" monitoring purposes. In 2019, four sampling sites were designated and the sampling protocol defined; fieldwork will commence before June 2020.

5.5 ASSEMBLE + - JRA1 (2018-2021)

As part of the AssemblePlus project (http://www.assembleplus.eu/), coordinated by EMBRC-France, Autonomous Reef Monitoring Structures (ARMS) have been deployed across a network of 20 observatories in European coastal waters and in the polar regions. This action is coordinated as part of JRA1 'Genomic observatories' by Mathias Obst (Sweden). The Station Biologique of Roscoff is one of the 17 research institutes involved in this network. One of the initial scientific goals of the network is to report novel Non-Indigenous Species (NIS) and track the spread of already known NIS in European continental waters, which is achieved with short-term (3-months) deployments. Pilot studies had been carried out in 2019, and materials scrapped from ARMS had been prepared for High-Throughput Sequencing by HCMR, with the aim to make taxonomic assignment through metabarcoding.

5.6 PAVIS (Assessing the relationships between marine protected areas and invasive species) (2016-2018)

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The PAVIS ANR project investigated the following hypotheses: 1) whether MPAs influence the expansion of invasive species and mitigate their effects on native assemblages, 2) whether the ecological effects of such species could alter, reduce, or nullify ecosystem responses to protection in MPAs, and 3) whether local economic activities, such as artisanal fisheries, carried out in MPAs and adjacent areas, have been impacted by the presence of invasive fish. The main findings from this project are presented in Giakoumi et al. (2019a and b), with a key result being that MPAs had no impact on non-indigenous fish (Giakoumi et al. 2019a).

5.7 Réseau Alien Corse (2015-)

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Since 2015, the dedicated '*Caulerpa* alert network' in Corsica has expanded to monitor a broader list of non-native species. In the first half of 2019, 32 non-native species were reported around the island, mainly via SCUBA-diving club observations (Viel et al., 2019).

Additional Information

1. Research on Climate Change Impacts (ToR b)

Chefaoui et al. (2019) used an ENM to predict the future range of the invasive seaweed *Sargassum muticum* under different scenarios of climatic change. Under the most severe scenario (RCP 8.6), the ENM predicted northward expansion with putative substantial ecological consequences for subarctic coastal ecosystems. However, after filtering to take into account thermal constraints on the reproductive phenology, they showed a reduced northward expansion, as compared to a non-filtered ENM. In particular, the total range area was expected to increase by 61.75% by 2100, but only by 1.63% when the reproductive temperature window was considered. Although this study points to substantial changes under climate change, it also shows the need to better integrate phenology and physiological constraints in ENMs.

A review paper by Drobetsov et al. (2019) provides an overview of knowledge about the effects of climate change, in particular the effect of elevated temperature and ocean acidification on microfouling communities and bioactive molecules. The authors point out that the existing studies suggest different categories of impact such as changes in the production of bioactive compounds or composition of biofouling communities.

2. Research on Biofouling – Marinas & ports (ToR c)

As part of a collaborative project between French and Chilean researchers, settlement plates were deployed upon two types of artificial habitats (floating and non-floating hard substrates) at a total of ten ports, associated either with local or international shipping traffic, along the Central Chilean coastline. After colonization periods of 3 and 13 months, fouling sessile assemblages were examined. A total of 78 taxa were identified across all sites and sampling times, among which 25 were non-indigenous or cryptogenic. While shipping traffic categories had no discernable effect

on the assemblages, there were strong differences between the two habitats. These differences were driven by non-indigenous species which contributed 10 times more to the assemblages in floating habitat than in their non-floating counterparts (Leclerc et al., 2020). More attention should be paid to the type of habitats, regardless of the intensity of ship traffic.

In a complementary study, using an exclusion experiment to examine predator effect on the early establishment (4 months) of new assemblages on settlement panels, Leclerc et al. (2019) showed that the community structure was significantly influenced by the exclusion treatments. Altogether, predators reduced the abundance of most NIS and cryptogenic species, some of them being only observed when the two categories of predators were excluded. Similar findings were obtained when examining more mature assemblages (26 months). This study shows an effective consumptive biotic resistance.

3. Molecular approaches to provide science-based tools for strategic planning, policy development, and operational processes (ToR e)

See also IDEALG and AquaNIS2.0 projects

Based on microsatellite markers, Le Cam et al. (2020) did not detect any genetic variation over >1200 individuals sampled from 46 locations over the Pacific-Atlantic introduction range of the invasive seaweed *Sargassum muticum*. Thanks to high-throughput genotyping (ddRAD-sequencing), they then confirmed severe founder events in both the Pacific and Atlantic introduction ranges. These markers also revealed two unexpected additional distinct genetic origins of introductions, and suggest that conversely to scenarios based on historical records, southern rather than northern NE Pacific populations could have seeded most of the European populations. Altogether, this study exemplifies the usefulness of new sequencing technologies to uncover introduction routes, and also underline the need for extreme caution in interpreting neutral genetic diversity as a proxy for invasive potential.

6. **Meetings**

In 2019

- Franco-English exchanges on IAS Biosecurity in Aquatic Environments (Concarneau, France, 16th May 2019)
- "Ballast Water and Invasive Species: the IMO BWMC status, questions ad solutions". European Maritime Day (Lisbon, Portugal, 16-17th May 2019)
- Biological Invasions: how can scientists respond to scientific denialism and social unawareness? CNRS Conference organized ahead of the 7th IPBES Session, (Paris, France, 25-26th April 2019)
- National MSFD **'Descriptor D2' monitoring** workshop – (Paris, France, 3rd December 2019)

Future meetings *(scheduled prior to Covid-19 outbreak)*

- Workshop on **parasites of the *Haplosporidium* genus** (Nantes, France, 18-19 March 2020)
- The **Réseau Alien Corse** will host a three-day "Bio et Alien" seminar (Calvi, France, 10-12 April 2020)

- The **National Resource Center for Invasive Exotic Species** is holding a stakeholder NIS prevention and surveillance training course (Sète, France, 27-30 April 2020)
- **IUCN World Conservation Congress** with a dedicated workshop on Marine Non-indigenous Species (Marseille, France, 11-19 June 2020)
- COP 15 of the UN Convention on Biological Diversity (Kunming, China, 15-28 October 2020)

On the 14th of June 2020, a thematic stream session (Stopping the tide: Best practices and solutions to tackle marine invasive alien species (IAS)), co-organized by the IUCN French committee and the IUCN secretariat, will focus on the management of key pathways of introduction. Using concrete case studies from around the world and by sharing ideas and lessons learned, this session will identify current challenges, areas for priority action and collaboration, present best practices, and tools to support decision-making that effectively manage the major pathways of introduction of IAS. This event will bring together 200 participants from the diverse community of stakeholders associated with the use of marine waters, including environmental protection, tourism and recreation, education, transport. The expected outputs of the session are a list of ranked priority actions and partnership opportunities for future projects that will adress the identified issues. The session will involve IMO, ICES WG ITMO and WG BOSV, World Sailing as well as French organizations (Ministry of ecology, UMS PatriNat, Ifremer, CNRS, etc.) and marine protected areas managers.

For more information on this session:
https://www.iucncongress2020.org/programme/official-programme/session-43188

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GERMANY

National Report

Reporting period (2019-2021)

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Audience: ICES, Member Countries & Observers, and Scientists

Overview:

Highlights of the National Report

New species records were observed in both, Baltic (2 NIS) and North Seas (6 NIS). Regular and NIS targeted monitoring programmes occur along the German coast, now with more than 20 sampling sites. Activities took place in form of extended rapid assessments (e-RAS) at hot spots like harbours, marinas and aquaculture sites with a sampling frequency of at least one event annually.

We note that our coastal neighboring countries The Netherlands, Denmark and Poland documented NIS, which were not yet known from German coasts and we assume that some of those may also spread to our waters.

Intentional living species introductions remain at similar levels as in the last years and include predominantly sturgeons, salmonid species, rainbow trouts, carps, *Crassostrea gigas (seed mussels and adults)*, scallops, *Mytilus* sp., *Homarus americanus* and other decapods, cephalopods as well as the red alga *Palmaria palmata*. Imports are predominnatly from Ireland, United Kingdom and the Netherlands. In addition a substantial amount of various living ornamental fish are imported.

For activities where shipping stands in the focus, please consult the WGBOSV report.

Content:

1. **Regulations:** An update on new regulations and policies

No new German regulation, but see below for an update on the EU Regulation 1143/2014 on Invasive Alien Species.

2. **Intentional:**

Synthesis of introductions

Intentional living species introductions remain at similar levels as in the last years and include predominantly sturgeons, salmonid species, rainbow trouts, carps, *Crassostrea gigas (seed mussels and adults)*, scallops, *Mytilus* sp., *Homarus americanus* and other decapods, cephalopods as well as the red alga *Palmaria palmata*. Imports are predominnatly from Ireland,

United Kingdom and the Netherlands. In addition 170 tonnes of various living ornamental fish are imported (FactFish 2020).

Statistics in Germany are not precise enough to deliver more meaningful results in WGITMO needs. The German trade statistics for 2019 list that fish and fisheries products (includes invertebrates and algae) in the value of 271 million Euro of were exported and 746 million Euro were imported. The amount of living organisms in trade is not specified (Statistisches Bundesamt 2020). Other statistics document, e.g., the global trade of aquatic invertebrates shipped alive and here Germany is on 19th place with ca. 450 tonnes imported in 2017. It is not specified if this is marine or freshwater species and neither if they were imported for human consumption or if this includes ornamental trade. In some other cases this database is remarkable precise, e.g., Germany imported in 2017 ca. 350 tonnes of scallops of the genera *Pecten*, *Chlamys* or *Placopecten* live, fresh or chilled. Some datasets include the value, weight and number of individuals shipped (Figure 1) (FactFish 2020).

It should further be noted that native species seedmussels (e.g., *Mytilus edulis*) were imported from European sources and that this method results in a risk to unintentionally introduce species. As an example, *Undaria pinnatifida* was first recorded near Hörnum (Sylt Island) in close proximity to a *M. edulis* aquafarm, which introduced seedmussels, including sources where *U. pinnatifida* was previously recorded (Buschbaum pers. comm.).

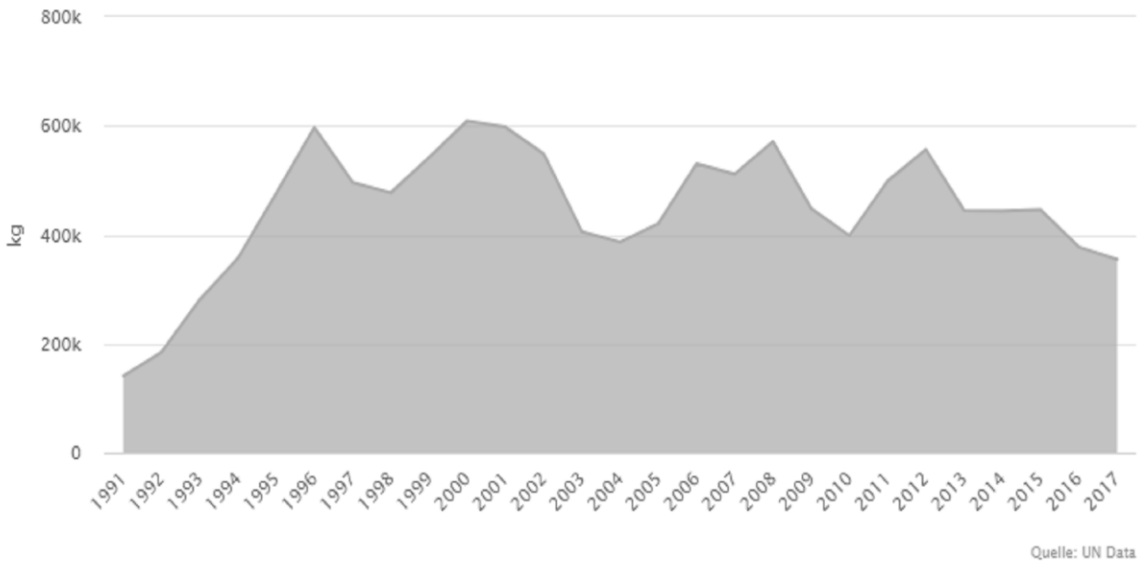

Fig. 1. UN dataset of historical imports of living scallops to Germany (FactFish 2020).

3. **Summary of sightings**

Unintentional:

New sightings

New unintentionally introduced species were found (Table 1).

North Sea

The 1st record of the stalked jellyfish *Haliclystus tenuis* Kishinouye in Atlantic waters was made at Helgoland Island, Germany, attached to seaweed already in 2010. The occurrence of *H. tenuis* on European coasts may have been overlooked or the collected specimens were confused with the similar-looking *H. octoradiatus*. In a study morphological analysis paired with molecular genetic species identification resulted in this taxonomic species identification. *H. tenuis* was never reported out of Japan and China and its geographical range was suggested to be limited to the Northwest Pacific (Holst & Laakmann 2018).

Mulinia lateralis (Bivalvia) was found first found in 2017 in the German part of the Wadden Sea as 1st Euroepan record. Now it occurs also in the Westerschelde estuary, in densities of up to almost 6000 individuals per square meter, and in the Ems estuary, which is the border between The Netherlands and Germany.

Five individuals of *Hypereteone* cf. *lighti* were found in August 2019, at Trischendamm. However, the taxonomy is not yet confirmed (Hoffmann pers. comm.) (so that this species is not yet registered in AquaNIS).

Table 1 New unintentionally introduced and cryptogenic species along the German North and Baltic Seas coasts. Please note that the species reporting year is not always also the year of first record.

Reporting year	**North Sea**	**Reference**	**Baltic Sea**	**Reference**	**Total**
2019	*Haliclystus tenuis* in sample of 2010 (!)	Holst & Laakmann (2018)	*Fucus distichus*	Schanz et al. 2018	8
	Mulinia lateralis in sample of 2017	Klunder et al. 2019			
	Hypereteone cf. *lighti*	Hoffmann pers. comm.	*Nippoleucon hinumensis*	IFAÖ pers. comm..	
	Pacificincola perforate	IFAÖ pers. comm.			
	Corambe obscura	IFAÖ pers. comm.			
	Plagiolemma distortum sp. nov.	Schanz et al. 2020			
2020					
2021					
Total	**6**		**2**		**8**

Two colonies of the bryozoan *Pacificincola perforate* were found in offshore samples taken in the German Bight in 2019. This species is also known from The Netherlands with findings in 2005 (IFAÖ pers. comm.).

The nudibranch *Corambe obscura* was found in offshore samples taken 2019 in the North Sea. The species is known to occur in The Netherlands, France and the Black Sea (IFAÖ pers. comm.).

The Bacillariophyceae *Plagiolemma distortum* sp. nov. was recorded in 2018 samples from the Jade-Weser-Port (Schanz et al. 2020). This new diatom species was formally described by Nezan et al. (2018). Before its taxonomic identification it was named "pringle" (after the potato crisps) due to its characteristic shape. Investigating plankton photos it was in retrospect found with the earliest record documented by an image from the English Channel in 1992. Further material confirmed records in the North Sea (The Netherlands and Germany - with many records near or in ports) since 2001 and after 2010 in the eastern and western British Channel (Kraberg et al 2018). As a result, this species occurred in Europe long before it was described as new species. As this newly described species has a characteristic shape it is assumed that this would not have been overlooked in earlier samples. However, due to its uncertain introduction status it is registered as cryptogenic.

Baltic Sea

In the Port of Kiel, at three sampling sites, *Fucus distichus* (listed as *F. edentatus*) was found (Schanz et al. 2018). This species is widely distributed in the northern hemisphere along Pacific and Atlantic shores, including the North Sea (www.algaebase.org), but this seems to be the first record in the Baltic Sea (AquaNIS, last checked February 2020).

The cumacean *Nippoleucon hinumensis* was found in Stralsund and Rostock in 2019. This is a new record for Europe. Its native area is the Northwest Pacific and it was previously introduced to the west coast of North America where it was first reported from Coos Bay, Oregon in 1977. Its non-native range now stretches from Puget Sound, Washington to Port Hueneme, California. (IFAÖ pers. comm., Fofonoff et al. 2018).

Previous Sightings

An interesting case, which is not yet included in AquaNIS due to its unclear status (introduction vs secondary spread) is the sun- or moon fish *Mola mola* with its German Baltic records. (Moritz et al. 2017). Twenty-three records of *Mola mola* have been recorded since 1860 in German waters of the Baltic Sea with nineteen of them since 1978. Figure 2 shows the findings along the German Baltic coast.

Fig. 2 *Mola mola* records along the German Baltic Sea coast (taken from Moritz et al. 2017).

The authors report that the specimen findings are not correlated to salt water inflow from the North Sea (Fig. 3).

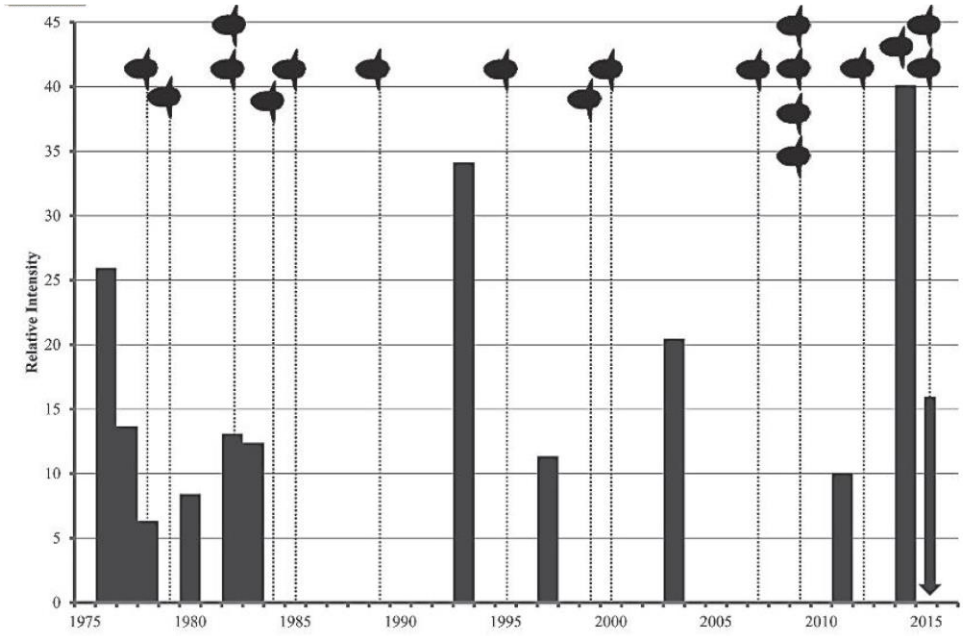

Fig. 3 Major inflow events into the Baltic (modified, after MOHRHOLZ et al. 2015) and records of *Mola mola* in German waters of the Baltic Sea; arrow – inflow event without detailed intensity data available (taken from Moritz et al. 2017).

Please note also additional information on the taxonomic unclarity of *Sinelobus vanhaareni* "vs" *S. stanfordi*. The German *Sinelobus* specimens found in several North Sea ports are all *Sinelobus vanhaareni*, i.e., not *S. stanfordi*, neither *Sinelobus cf. vanhaareni* (Lackschewitz pers. comm.).

Taxonomic analysis further revealed that there is no *S. stanfordi* in Europe until there is further evidence proving otherwise (van Haaren pers. comm.).

In Thedinghausen, near Bremen on the Weser River, hundreds of Chinese Mitten Crabs were reported as crossing streets and warning signs were put up to alert car drivers (DPA 2019, various newspaper publications).

In summer 2018 a mass development of *Diadumene lineata* was observed in Kiel, Marinehafen (Hoffmann pers. comm.).

Additional findings of *Hemimysis anomala* in Stralsund 2019 confirmed its presence in the Baltic (IFAÖ pers. comm.).

The since 2013 on Helgoland Island recorded polychaete *Pileolaria berkeleyana* was now also found in Hörnum (Sylt Island) (Lackschewitz pers. comm.).

Not Seen Species Yet

We searched AquaNIS in February 2020 and other resources (see reference list) for new introduction events since 2015 in our neighboring countries The Netherlands, Denmark and Poland.

Baltic Sea

No new introduction events are included in AquaNIS along the Danish Baltic coast since 2015.

In total 4 introduction events are included in AquaNIS for Poland since 2015. The species not yet known from the German Baltic coastal waters are:

- the decapod *Callinectes sapidus* found as single specimen in 2018 in Polish waters (but found in Germany on the North Sea shores),
- the amphipod *Chelicorophium robustum* was not found elsewhere in the Baltic, but was found in Poland in 2018 (but found in Germany in the rivers Main and Rhine which drain into the North Sea).
-

North Sea No new introduction events are included in AquaNIS along the Danish North Sea coast since 2015.When comparing the six recent new NIS/CS records of The Netherlands we note that all were not (yet) found in Germany:

- the bryozoan *Biflustra grandicella* was found in the Westerschelde in 2016,
- the goby *Tridentiger barbatus,* Oosterschelde in 2016,
- another goby *Gobiosoma bosc* in the North Sea Canal in 2017,
- 2018 record of the alga *Ulvaria splendens.* this species is probably native to western Europe so that a range expansion may also be considered.
- *Caulacanthus okamurae* and *Dasya sessilis* concern two alien algal species from the NW Pacific, which are already known in the Netherlands from records in 2018.

4. **Pathogens Sightings/records**

No new findings were reported since last year's meeting.

5. **Research and Monitoring Programs**

Project Title: COMPLETE

Contact: Katja Broeg, Federal Maritime and Hydrographic Agency (BSH), Katja.Broeg@bsh.de
Short description: This Interreg Baltic funded project addresses various aspects of ballast water and biofouling related issues. The projects title is "Completing management options in the Baltic Sea Region to reduce risk of invasive species introduction by shipping" (COMPLETE). This project will include all Baltic countries, including the Russian Federation who will participate as associated organization. COMPLETE is tackling several gaps in ballast water and biofouling knowledge and will result in the development of operational frameworks and actual tools, e.g., measures on how to take into account rights and obligations of involved stakeholders; developing effective risk assessment procedures for ballast water management exemptions; ensuring active regional cooperation and information exchange of harmful aquatic organisms and pathogens (HAOP) findings; proposing an integrated regional NIS monitoring system and surveillance for compliance control with ballast water management standards. The target groups are national ministries and agencies of transport and environment; ship owners and their associations; Baltic Sea ports and coastal municipalities; shipyards; marinas and boating associations; as well as HELCOM and its contracting parties. For an update on the work progress please visit https://www.balticcomplete.com/.
A practical workshop on ballast water sampling and analysis was be conducted in May 2019 in Hamburg, Germany.

Project Title: Rapid-assessment of non-native species in German Coastal Waters including further development of the trend indicator

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Short description: The German alien species monitoring programmes continue with several sampling stations in ports along the Baltic and North Seas as presented last year. The samplings are conducted annually between August and October with a focus on benthos and to a lesser degree on plankton. Recent monitoring activities in Germany filled geographical gaps in the network of coastal monitoring stations. The monitoring activities took place in form of extended rapid assessments (e-RAS) at hot spots like harbours, marinas and aquaculture as routine monitoring programme as Germany considers it important to perform NIS monitoring frequently (at least once a year). This allows for a higher probability of early NIS detection. Since a yearly survey of all hot spots following the HELCOM/OSPAR Join Harmonized Procedure (JHP) sampling approach would be too cumbersome and expensive, e-RAS has been chosen as a cheaper but

still adequate alternative. The NIS monitoring programme of the German North Sea and Baltic coast included 17 locations. Results of the rapid assessments indicate that the rate of newly recorded NIS is lower in the Baltic Sea compared to the North Sea. In 2019 additional Baltic ports were sampled using e-RAS, i.e., Wismar-Wendorf, Rostock-Schmarl, Stralsund-Dänholm, Oderhaff-Kamminke, Sassnitz-Mukran and Sassnitz-Stadthafen (Zettler & Zettler 2020).

Project Title: Hamburg and Kiel Port sampling
Contact: Mariusz Zabrocki, Federal Maritime and Hydrographic Agency (BSH), mariusz.zabrocki@bsh.de
Short description: The ports of Hamburg and Kiel have been surveyed for non-indigenous species according to the HELCOM/OSPAR Joint Harmonized Procedure port survey protocol (Schanz et al 2018). In the Port of Hamburg overall, 179 species were found, of these 16 NIS occurred. In the Port of Kiel, 205 species were found, of which 13 NIS species were identified. The “only” new NIS reported for Germany was *Fucus distichus* (listed as *F. edentatus*) found in Kiel.

Project Title: Port of Cuxhaven and Jade-Weser-Port sampling
Contact: Mariusz Zabrocki, Federal Maritime and Hydrographic Agency (BSH), mariusz.zabrocki@bsh.de
Short description: The ports of Port of Cuxhaven and the Jade-Weser-Port were surveyed for non-indigenous species according to the HELCOM/OSPAR Joint Harmonized Procedure port survey protocol (Schanz et al. 2020). In the Port of Cuxhaven 246 species were found, of which 24 were identified as NIS. In the Jade-Weser-Port 272 distinct species were found, including 28 NIS. One species listed as NIS in the Jade-Weser-Port is a species new to science (see above).

Project Title: e-DNA and metabarcoding
Contact: Pedro Martinez, Senckenberg, pmartinez@senckenberg.de
A project is ongoing analysing Dogger Bank and German Bight samples with e-DNA and metabarcoding approaches for non-indigenous species. First results indicate the presence of non-indigenous species which have not been found during the monitoring campaigns. Further analysis suggests that , e.g., *Hemigrapsus penicillatus* and *H. takanoi* should be considered as one species (Martinez pers. comm.).

Planned Research

Project Title: Begleitende Untersuchung zur Experience Building Phase (BU-EBP)
Contact: Dennis Binge, Federal Maritime and Hydrographic Agency (BSH), Dennis.Binge@bsh.de

Short description: The project, focusing on development and testing of sampling devices and instruments for analyses and their practical application by water police and port state control started in 2018 and is launched as another contribution to the IMO Experience Building Phase. This effort will be related to the earlier reported, and completed BSH project entitled “Ballast Water Test Quality Assurance (BAQUA)”. The project BAQUA, i.e., the development of a prototype of a round robin test facility to compare sampling and analysis of various test facilities or methods, has been finalised in 2017. Both projects are considered as part of the experience

building phase of the Ballast Water Management Convention to support its proper implementation.

Project Title: BMVI Network of experts
Contact: Mariusz Zabrocki, Federal Maritime and Hydrographic Agency (BSH), mariusz.zabrocki@bsh.de
Short description: The German Federal Ministry of Transport and Digital Infrastructure (BMVI) initiated a coordinated research effort to address early detection methods and management concepts for non-indigenous species introduction and spread by transport vectors. Further tasks are, e.g., expanding the knowledge base for future exemptions from ballast water management requirements, identification of species introduction hot spots and introduction vectors as well as an improvement of the German authority network regarding NIS. Focus will be on the relationship and mechanisms between primary introduction of species by international transport and the secondary spread by inland waterway transportation and leisure boating considering both, ballast water and biofouling.

Research Needs and **Research Gaps**

A comparison of performance test results of ballast water management systems is difficult as various test teams are using different test methods and approaches. Therefore, a kind of a ring test is planned inviting relevant researchers to take and process samples of a water body spiked with a known concentration of beads and/or organisms (see BU-EBP project above). We look forward to see the different results when applying all these different methods for ballast water sampling and sample processing.

We reported earlier (see also WGITMO reports) on the EU Regulation 1143/2014 on Invasive Alien Species. This regulation comprises the compilation of lists of “critical species” as species of Union-wide concern, species of regional concern, and species of national concern. In the beginning, only one marine (catadromous) species, i.e. the Chinese mitten crab, was added to the list. Based on the IAS Regulation each Member State needs to report the presence and distribution of the species on this list also providing options for management and/or eradication. However, some species on the lists are so widely distributed that eradication efforts are meaningless. Only species which are non-indigenous in the entire EU can be added to the list. Species which are suggested for addition will be reviewed by an expert forum. We see a possible research gap to, in detail, identify species selection criteria for these lists. The second update of the Union list entered into force on 15 August 2019. Further, it may be considered to add marine species to the list of species of Union concern and activities to update the list are ongoing. New candidate species are in evaluation for a possible addition to the list, including these aquatic species (data provided by Stefan Nehring): the fishes *Fundulus heteroclitus*, *Lagocephalus sceleratus*, *Micropterus dolomieu*, *Morone americana*, the crab *Hemigrapsus sanguineus*, the bivalve *Perna viridis*, the gastropod *Rapana venosa*, the frog *Xenopus laevis* and the cordgrass *Spartina pectinata*. It was agreed that the list is reviewed and the addition of species will be considered in a biannual rhythm. The progress of these updates may be followed here: https://ec.europa.eu/environment/nature/invasivealien/list/index_en.htm.

6. **Meetings**

Past year

During the 12th Trilateral Governmental Wadden Sea Conference (Tønder, Denmark, 6 February 2014) it was decided to develop a Strategic Framework for Alien Species for the trilateral Wadden Sea. The Working Group on Alien Species (WG-AS) initiated a project to develop a proposal for a common Trilateral Monitoring and Assessment Program for Alien Species (TMAP-AS) in the trilateral Wadden Sea area to identify possible areas for cross-border approaches and collaboration (van der Have & Lensink 2016). Based on this report and a workshop on this subject conducted in 2017, the Alien Species Management and Action Plan (MAPAS) was adopted in 2019 (WG-AS & Gittenberger 2019). The overall objective of MAPAS is to prevent threats from alien species in the Wadden Sea Area and to sustain the Outstanding Universal Value (OUV) and integrity of the Wadden Sea World Heritage property by preventing, managing or controlling alien species through a coordinated effort, in line with international conventions and treaties, the EU directive on invasive alien species (EU-IAS), the Marine Strategy Framework Directive (MSFD) and other relevant policies. Specific strategic goals for MAPAS are:

- Prevent the introduction of invasive alien species in the Wadden Sea Area,
- Monitor alien species' introduction and presence,
- Assess risks related to alien species´ introduction, invasive potential and possible impact,
- Manage or control invasive alien species that entered the Wadden Sea Area,
- Assess the effectiveness of measures, and
- Raise awareness on alien species prevention, presence and mitigation.

A one-day symposium about alien species has been held in Flintbeck, Schleswig-Holstein. Issues were alien species monitoring in North and Baltic Sea and in limnic waters and presentations about specific alien species like *Neogobius melanostomus* (Round goby) and *Crassula hemsii* (Swamp stonecrop).

Future meetings

To develop and coordinate German monitoring efforts and other non-indigenous species related aspects, meetings of the national neobiota expert working group (Meeresschutz der Bund/Länder-Arbeitsgemeinschaft Nord- und Ostsee (BLANO)) are anticipated, at least twice a year.

Germany is actively contributing to ballast water and other maritime transport related panels and meetings at IMO, HELCOM, OSPAR, TWSC and regional as well as international meetings related to the implementation of the EU-MSFD.

HELCOM/OSPAR TG Ballast continues its work on the amendment of the Joint Harmonised Procedure for the Contracting Parties of HELCOM and OSPAR on the granting of exemptions under International Convention for the Control and Management of Ships' Ballast Water and Sediments, Regulation A-4. This work is done in close cooperation with the COMPLETE project (see below).

GlobalTestNet - A formal group of test organizations involved in certification tests of BWMS was established in 2010 under the umbrella of GloBallast Partnership to facilitate increased standardization and harmonization of test procedures and information exchange. As biofouling became more and more into focus, the members voted in 2017 in favour of expanding the network beyond BWMS testing, and into biofouling to further support the shipping industry and its numerous stakeholders in managing the risk of bio-invasions and harmful species introductions into aquatic environments. Meetings are held approximately annually, with the most recent one in February 2020. The minutes of the meetings were published on the homepage http://www.globaltestnet.org/home.

In September 2020 the 1st In-Port Inspection & Cleaning Conference (PortPIC) will be held in Hamburg. Topic to address include aquatic invasive species, diver operations in ports, next-generation antifouling technologies, operator perspective on cleaning, performance-based cleaning, regulations and guidelines, robotic cleaning and inspection.

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GREECE

GREECE National Report 2019-2021

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OVERVIEW

Analysis of the pathway transport-stowaway (shipping) for the period 1970-2019, as an indicator (number of new non-indigenous species (NIS) per 6 years) for Good Environmental Status (GES) under the Marine Strategy Framework Directive (MSFD), revealed a strong positive correlation (increasing trend) for the Levantine and the South Aegean Seas, and no correlation for ship-transferred NIS in the Ionian and the North Aegean Seas (Zenetos et al., submitted). This seems odd, considering that the Hellenic Levantine coasts have no big ports, as opposed to the North Aegean and the Ionian Seas that host some of the biggest Hellenic ports (e.g. Thessaloniki, Patras, and Kalamata). However, the Levantine and South Aegean islands constitute major tourist destinations for sailing boats and large cruise ships which cover long distances across the entire Mediterranean Sea and beyond. For instance, within only a single sampling trip at the marina of Mandraki port, in Rhodes Island, Ulman et al. (2017) discovered nine NIS new for the Hellenic Levantine Sea, most of which were also first records for Greece.

A total of 10 alien species have been reported/observed within 2019 (Table 1). The majority of them are fishes (5 species) that have spread unaided from neighbouring seas (Lessepsian immigrants). The presence of two more fishes is attributed to careless release from domestic aquaria.

The tropical seagrass species *Halophila decipiens* Ostenfeld is reported for the first time in the Mediterranean Sea (Salamina island, Saronikos Gulf, Aegean Sea, Greece). A survey conducted in October 2018 identified the occurrence of a *H. decipiens* population, forming multiple mono-specific stands (1–10 m^2 in size) on a sandy area with a surface of about 5000 m^2, at depths between 3 and 4 m. The substantial distance (more than 1000 km) between the recorded *H. decipiens* population in the Mediterranean Sea and the nearest regions where the species occurs (at the Canary islands or the east coasts of Egypt in the Red Sea), as well as, the species' main dispersal mechanism (i.e. seed transport), suggests that *H. decipiens* has most likely been introduced in the area through shipping (i.e. ships' ballast water discharges). That is unsurprising, given the heavy shipping traffic that occurs around the wider area of Piraeus port, a well-documented hotspot for non-indigenous species (Tsiamis et al., 2010).

A single specimen of a Pelagiidae jellyfish (Scyphozoa) referable to the genus *Chrysaora* Péron and Lesueur, 1810 is reported from the port of Elefsina (Saronikos Gulf, Greece) on the basis of photographic evidence. Despite the uncertain identification, *Chrysaora* cf. *achlyos* may represent the tenth large scyphozoan recorded as NIS in the Mediterranean Sea. So far, no species of the genus *Chrysaora* is known to occur in the Red Sea, and therefore the possibility of an arrival through the Suez Canal should be dismissed. In this line, the most likely possibility is represented

by the arrival of propagules through ballast waters or with polyps attached to aquacultured molluscs or to ship hulls.

Female individuals of the species *Oithona davisae* have been found in Thermaikos Bay, a eutrophic coastal basin of Thermaikos Gulf. It is the first time that this species is reported from the North Aegean Sea. Its widespread in the neighbouring Black Sea raises doubts on its mode of introduction in Hellenic waters: Unaided spread via the Marmara Sea or vessel transferred (Ballasts).

Table 1. New records of non-indigenous species reported/observed in Greece, 2019.

Species	**Pathway**	**Source**
Sillago suezensis (FISH)	Unaided: Via Suez-Spreading	Tiralongo & Doumpas in Kousteni et al., 2019
Pomadasys stridens (FISH)	Unaided: Via Suez-Spreading	Kalogirou & Giovos in Kousteni et al., 2019
Vanderhorstia mertensi (FISH)	Unaided: Via Suez-Spreading	Tiralongo & Pillon, in Dragičević et al., 2019
Lutjanus argentimaculatus (FISH)	Unaided: Via Suez-Spreading	Tiralongo et al., 2019
Nemipterus randallii (FISH)	Unaided: Via Suez-Spreading	Kampouris et al., 2019
Chaetodipterus faber (FISH)	Aquaria release	Karachle et al., in press; Giovos et al., in press
Acanthurus cfr *gahhm* (FISH)	Aquaria release	Karachle et al., in press
Chrysaora cf. *achlyos* (CNIDARIA)	Ballast water	Langeneck et al., 2019
Oithona davisae (COPEPODA*)*	Unaided or Ballasts	Anadoli & Michaloudi, in Dragičević et al., 2019
Halophila decipiens (PHYTOBENTHOS)	Fouling	Gerakaris et al. in press (2020)

PLANNED RESEARCH

Ph.D. in progress:

Tsirintanis Kostas "Alien species in the Aegean Sea". University of Aegean, Lesvos isl. Greece 2019-to date

Gratsia Eirini "Application of ecological and molecular methods in the study of invasive species of Eastern Mediterranean, with emphasis on benthic Macroinvertebrates" University of Crete, Department of Biology, 2019 -to date

Maria Protopappa "Study of the antifouling properties of secondary metabolites by marine organisms" University of Athens. Biology Department 2013-2020. [The subject of this

doctoral thesis is the study of the antifouling properties of chemical compounds isolated and identified by marine organisms, as well as the analysis of the toxicity of these chemicals in target organisms, non-target organisms along with fish and human cell lines].

BSc dissertations in progress:

Papadimitriou Evangelos, BSc thesis in progress. Study of the herbivory effect by native and alien herbivores on the composition and biomass of macrophytic communities, through herbivore exclusion experiments. University of Aegean, Lesvos isl. Greece 2019- to date

Stragga Giolanta, BSc thesis in progress. Trends in global monitoring of alien species through a literature analysis of BioInvasions Records between 2012-2019. University of Aegean, Lesvos isl. Greece 2019- to date

Andriotis Manos, BSc thesis in progress. Effect of native and alien herbivores on the invasiveness of the alien alga *Caulerpa cylindracea*. University of Aegean, Lesvos isl. Greece 2019- to date

RESEARCH NEEDS AND GAPS

Fouling organisms in marinas across Greek seas.

MEETINGS

Past year

- 1st Mediterranean Symposium on the Non-Indigenous Species, UNEP/MAP – SPA/RAC, 18 January 2019, Antalya, Turkey
- Dahlem type workshop: Current and future challenges of Non-indigenous species (NIS) in Europe, LifeWatch ERIC, 14-18 October 2019
- Joint ESENIAS and DIAS Scientific Conference and 9th ESENIAS Workshop "Species, ecosystems and areas of conservation concern under threat from the invasive alien species", 03-06 September 2019, Ohrid, Republic of North Macedonia
- Workshop on "Addressing drivers of ecological change in Lake Akrotiri: Assessing and mitigating impacts of invasive non-native species", CEH, JSHU and the AEEC, 27-29 November 2019, Akrotiri, Cyprus

2020

- Seventh session of the Sub-Committee to be held at IMO Headquarters, 4 Albert Embankment, London, SE1 7SR, 17 to 21 February 2020

Upcoming meetings

- "Engaging Citizen Scientists into spotting, reporting and understanding Marine Alien Species", in the framework of COST Action CA17122 "AlienCSI: Increasing understanding of alien species through citizen science", 1-3 April 2020, Heraklion, Greece
- Joint ESENIAS and DIAS Scientific Conference and 10th ESENIAS Workshop, 27-31 July 2020, Demre, Antalya, Turkey

PROJECT INFORMATION

1. **PROJECT TITLE:** *ESTABLISHMENT OF A MONITORING NETWORK AND A WEB-BASED PLATFORM OF NON-INDIGENOUS SPECIES IN MAJOR PORTS OF GREECE (ALIENPORT)*

Contact Name: Georgios Chatzigeorgiou
Research Institutions: Hellenic Centre for Marine Research
Contact email: chatzigeorgiou@hcmr.gr
Short description: AlienPort project aims to create a monitoring network among the major Ports of Greece (Piraeus, Heraklion, Patras, Rhodes) based on a web platform that includes data, software and network of scientists. The web platform, taking advantage of the LifeWatchGreece Research Infrastructure (ESFRI), will include information and data on species lists of NIS and their distribution in the ports studied by the project. In addition, AlienPort will propose a sampling protocol specially focused on NIS species in ports and a management action plan for the Port Authorities to use in order to minimize the impact of the NIS in their ports. The results of the project will be available to the port and management authorities and will be potentially used as a base for developing management tools.
Project duration: 2018-2021

2. **PROJECT TITLE:** *ECOHULLCLEAN*

Coordinator: Diving Status: g.giazlas@divingstatus.com
Contact Name: Argyro Zenetos
Research Institution: Hellenic Centre for Marine Research
Contact email: zenetos@hcmr.gr
Short description: The project aims at designing, building and testing of an innovative underwater ecological hull cleaning system. The system will comply with all International Maritime Organization (IMO) Guidelines for the Control and Management of Ship hull fouling. It will also comply with all local guidelines for underwater reef cleaning by the Ministry of Shipping and other local regulations.
The proposal includes the development of a revolutionary new ship fouling instrument that will include complete collection of detached bio-fouling. The System will allow collection of soft and hard silicon-based antifouling paints containing pesticides such as Copper Oxide. This system will be designed to be portable and capable of operating at remote locations or directly on a maritime transport (landing barge). In detail the proposal will include:
-Design, manufacture and operation of CART hull cleaning system (underwater vehicle)
-Design, manufacture and operation of filtration system
- Testing the performance of this hull cleaning system through a) *Study of planktonic organisms discharged into the environment after filtration of the fouling biomass; b) feasibility study for managing the bulk of the filtered biofouling, c) Environmental impact assessment.*
- Design of waste sorting, treatment and disposal / recovery processes
Project duration: 2020-2022

3. **PROJECT TITLE:** *MSFD – MONITORING FOR DESCRIPTOR D2*

Contact Name: Argyro Zenetos
Research Institutions: Hellenic Centre for Marine Research and Hellenic Agricultural Organization-DEMETER / Fisheries Research Institute of Kavala
Contact email: zenetos@hcmr.gr

Short description: Eight monitoring sites which cover the main marinas and harbours of Greece, and adjacent natural habitats, will be sampled every two years for the detection of NIS. The sampling process will involve qualitative and quantitative samples, using conventional and photographic/visual methods, as well as samples for molecular analyses. Furthermore, questionnaires & citizen science data.
Project duration: 2017-2023

4. PROJECT TITLE: *ALIENS IN THE AEGEAN – A SEA UNDER SIEGE (ALAS)*

Contact Name: Stelios Katsanevakis
Research Institutions: Department of Marine Science, University of the Aegean
Contact email: Katsanevakis@marine.aegean.gr
Short description: ALAS aims to fill knowledge gaps on the impacts of marine alien species in the Aegean Sea, and support marine managers and policy makers in prioritizing mitigation actions. The project focuses on under-studied alien-native interactions, priority and vulnerable habitats (such as underwater caves and shallow forests of canopy algae), and applies a multitude of approaches (such as field experiments, large-scale surveys, satellite imaging and remote sensing, species distribution modelling, cumulative impacts assessments). It will apply a standardized, quantitative method for mapping Cumulative IMpacts of invasive Alien species on marine ecosystems (CIMPAL), according to which cumulative impact scores are estimated on the basis of the distributions of invasive species and ecosystems, and both the reported magnitude of ecological impacts and the strength of such evidence. Towards that direction, ALAS will improve our knowledge base and compile the needed information to estimate CIMPAL by (1) conducting a series of field experiments and surveys to investigate the impacts of selected invasive alien species on marine habitats, (2) producing high-resolution habitat maps in the coastal zone, refining the results of previous research efforts through fieldwork, remote sensing and satellite imaging, (3) producing species distribution models for all invasive species, based on extensive underwater surveys for the collection of new data and integrating all existing information.
Project duration: 2020-2023

5. PROJECT TITLE: *ASSEMBLE PLUS*

Contact Name: Antonios Magoulas / WP leader Georgios Kotoulas
Research Institutions: Hellenic Centre for Marine Research
Contact email: magoulas@hcmr.gr and kotoulas@hcmr.gr
Short description: The Joint Research Activity 1 (JRA1) of ASSEMBLE Plus (http://www.assembleplus.eu/) fosters the application of genomics technologies at Long Term Ecological Research Network sites. Within JRA1, a Marine Biodiversity Observation network (MBON) has been deployed and tested, consisting of Autonomous Reef Monitoring Structures (ARMS). ARMS are three-dimensional units consisting of stacked settlement plates which are attached to the sea floor. The network consists of 20 observatories in European coastal waters and in the polar regions, which are maintained by 17 research institutes. The aim of the ARMS-MBON is to assess the status and changes of hard-bottom communities in near-coast environments with genomic-based methods, notably metabarcoding in combination with the conventional community analysis. One of the initial scientific goals of the network is to report not known Non-Indigenous Species (NIS) and to track the spread of already known NIS in European continental waters, which is achieved with the short-term deployments. Sampling takes place

either as short-term deployments during summer (4 months) or long-term deployments (12 months) starting in spring.
Project duration: 2018-2021

6. PROJECT TITLE: *RECONNECT (INTERREG V-B)*

Contact Name: Christina Pavloudi
Research Institutions: Hellenic Centre for Marine Research
Contact email: cpavloud@hcmr.gr
Short description: RECONNECT aims to tackle global threats such as the impact of invasive species and the loss of biodiversity which can be inadequately dealt with only at an international level and under a transnational approach. WP4: A database (TraitBank) with functional traits of selected and invasive species identified during habitat mapping will be created.
Project duration: 2017-2020

7. PROJECT TITLE: *MODERN UNIFYING TRENDS IN MARINE BIOLOGY (MOUNT)*

Contact Name: Antonios Magoulas
Research Institutions: Hellenic Centre for Marine Research
Contact email: magoulas@hcmr.gr
Short description: WP1.1 Population genomics of fish (Task 1.1.1: Invasion genomics of Lessepsian migrants).
Project duration: 2014-2020

RECENT PUBLICATIONS AND PRODUCTS

Peer-reviewed publications
Published

1. Blakeslee A.M.H., Manousaki T., Vasileiadou K., Tepolt C.K., 2019. An evolutionary perspective on marine invasions. *Evolutionary Applications*; 00, 1–7. https://doi.org/10.1111/eva.12906
2. Danis T., Tsakogiannis A., Kristoffersen J.B., Golani D., Tsaparis D., Kasapidis P., Kotoulas G., Magoulas A., Tsigenopoulos C.S., Manousaki, T., 2020 Building a high-quality reference genome assembly for the eastern Mediterranean Sea invasive sprinter *Lagocephalus sceleratus* (Tetraodontiformes, Tetraodontidae). *bioRxiv* 2020.02.17.952580; doi: https://doi.org/10.1101/2020.02.17.952580
3. Dimitriadis Ch, Fournari – Konstantinidou I., Di Franco A., Corsini-Foka M., 2019. First record of the Red Sea Mantis Shrimp *Erugosquilla massavensis* (Kossmann, 1880) in the Greek Ionian Sea. *Acta Adriatica*, 60 (2), 187-192.
4. Dragičević B., Anadoli O., Angel D., Benabdi M., Bitar G., Castriota L., Crocetta F., Deidun A., Dulčić J., Edelist D., Gerovasileiou V., Giacobbe S., Goruppi A., Guy-Haim T., Konstantinidis E., Kuplik Z., Langeneck J., Macali A., Manitaras I., Michailidis N., Michaloudi E., Ovalis P., Perdikaris C., Pillon R., Piraino S., Renda W., Rizgalla J., Spinelli A., Tempesti J., Tiralongo F., Tirelli, V., Tsiamis K., Turan C., Uygur N., Zava B., & Zenetos A., 2019. New Mediterranean Biodiversity Records (Dec. 2019). *Mediterranean Marine Science*, 20, 645-656.

5. Galanos CJ., Kritikos S., 2019. *Diadema setosum* (Leske, 1778) (Echinodermata, Echinoidea, Diadematidae), first record for Simi Island, Hellas, Eastern Mediterranean. *Parnassiana Archives*, 7, 15-19
6. Giakoumi S., Arda Y., Pey A., Huseyinoglu M.F., 2019. Assessing the state of Invasive fishes in two Mediterranean marine protected areas and adjacent unprotected areas. *1st Mediterranean Symposium on the Non-Indigenous Species* (Antalya, Turkey, 17-18 January 2019).
7. Giakoumi S., Pey A., Franco A.D., Francour P., Kizilkaya Z., Arda Y., Raybaud V., Guidetti P., 2019. Exploring the relationships between marine protected areas and invasive fish in the world's most invaded sea. *Ecological Applications* 29(1), e01809.
8. Giovos I., Kleitou P., Poursanidis D., Batjakas I. , Bernardi G., Crocetta F., Doumpas N., Kalogirou S., Kampouris TE, Keramidas I., Langeneck J., Maximiadi M., Mitsou E., Stoilas VO., Tiralongo F., Romanidis-Kyriakidis G., Xentidis NJ., Zenetos A., Katsanevakis S., 2019. The importance of citizen-science in monitoring marine invasions and stimulating public engagement – A case project from the Eastern Mediterranean. *Biological Invasions*, 21, 3707-3721.
9. Kampouris T.E., Doumpas N., Giovos I. &. Batjakas I.E., 2019. First record of the Lessepsian *Nemipterus randalli* Russell, 1986 (Perciformes, Nemipteridae) in Greece. *Cahiers de Biologie Marine*, 60 (6), 559-561
10. Kampouris T. E., Porter J. S. & Sanderson W. G., 2019. *Callinectes sapidus* Rathbun, 1896 (Brachyura: Portunidae): An assessment on its diet and foraging behaviour, Thermaikos Gulf, NW Aegean Sea, Greece: Evidence for ecological and economic impacts. *Crustacean Research*, 48, 23-37
11. Katsanevakis S., Tsirintanis K., Tsaparis D., Doukas D., Sini M., Athanassopoulou F., Kolygas M.N., Tontis D., Koutsoubas D., Bakopoulos V., 2019. The cryptogenic parasite *Haplosporidium pinnae* invades the Aegean Sea and causes the collapse of *Pinna nobilis* populations. *Aquatic Invasions*, 14(2), 150-164
12. Kevrekidis K., 2019. Relative growth of the blue crab *Callinectes sapidus* in Thermaikos Gulf (Methoni Bay), northern Aegean Sea. *Cahiers de Biologie Marine*, 60, 395-397.
13. Kleitou P., Giovos I., Tiralongo F., Doumpas N., & Bernardi G., 2019. Westernmost record of the diamondback puffer, *Lagocephalus guentheri* (Tetraodontiformes: Tetraodontidae) in the Mediterranean Sea: First record from Greek waters. *Journal of Applied Ichthyology*, 35(2), 576-579.
14. Kousteni V., Christidis G., 2019. Westward range expansion of the Indo-Pacific nakedband gaper *Champsodon nudivittis* (Ogilby, 1895) in Saronikos Gulf, Greece. *BioInvasions Records*, 8 (1), 167-174.
15. Kousteni, V., Bakiu, R., Benhmida, A., Crocetta, F., Di Martino, V., Dogrammatzi, A., Doumpas, N., Durmishaj, S., Giovos, I., Gökoğlu, M., Huseyinoglu, M., Jimenez, C., Kalogirou, S., Kleitou, P., Lipej, L.,Macali, A., Petani, A., Petović, S., Prato, E., Fernando, R., Sghaier, Y., Stancanelli, B., Teker, S., Tiralongo, F., Trkov, D., 2019. New Mediterranean Biodiversity Records (April, 2019). *Mediterranean Marine Science*, 20(1), 230-246.
16. Küpper F. C., Tsiamis K., Johansson N. R., Peters A. F., Salomidi M., Manousakis L., … & Žuljević A., 2019. New records of the rare deep-water alga *Sebdenia monnardiana* (Rhodophyta) and the alien *Dictyota cyanoloma* (Phaeophyceae) and the unresolved case of deep-water kelp in the Ionian and Aegean Seas (Greece). *Botanica Marina*, 62(6), 577-586.

17. Langeneck J, Crocetta F, Doumpas N, Giovos I, Piraino S, Boero F., 2019. First record of the non-native jellyfish *Chrysaora* cf. *achlyos* (Cnidaria: Pelagiidae) in the Mediterranean Sea. *BioInvasions Records* 8 (3), 608–613.
18. Sedano F, Florido M, Rallis I, Espinosa F, Gerovasileiou V., 2019. Comparing sessile benthos on shallow artificial versus natural hard substrates in Crete Island, Greece (Eastern Mediterranean Sea). *Mediterranean Marine Science,* 20, 688-702.
19. Theodorou J.A., Perdikaris C., Spinos E., 2019. On the occurrence of rayed pearl oyster *Pinctada imbricata radiata* (Leach, 1814) in Western Greece (Ionian Sea) and its biofouling potential. *Biharean Biologist*, 13(1), 4-7.
20. Tiralongo F, Giovos I, Doumpas N, Langeneck J, Kleitou P, Crocetta F., 2019. Is the mangrove red snapper *Lutjanus argentimaculatus* (Forsskål, 1775) established in the eastern Mediterranean Sea? First records from Greece through a citizen science project. *BioInvasions Records* 8 (4), 911–916.
21. Tsiamis K. & Panayotidis P., 2019. Seaweeds of the Greek coasts: Rhodophyta excluding Ceramiales. *Acta Adriatica*., 60(1): 3 – 24
22. Vavasis C., Simotas, G., Spinos, E. et al., 2019. Occurrence of *Pterois miles* in the Island of Kefalonia (Greece): the Northernmost Dispersal Record in the Mediterranean Sea *Thalassas*. https://doi.org/10.1007/s41208-019-00175-x.
23. Zannaki K., Corsini-Foka M., Kampouris Th.E., Batjakas I.E., 2019. First results on the diet of the invasive *Pterois miles* (Actinopterygii: Scorpaeniformes: Scorpaenidae) In the Hellenic Waters. *Acta Ichthyologica et Piscatoria*, 49 (3), 311–317.
24. Zenetos A., 2019. Mediterranean Sea: 30 Years of Biological Invasions (1988-2017). *1st Mediterranean Symposium on the Non-Indigenous Species* (Antalya, Turkey, 17-18 January 2019).
25. WGEUROBUS – Working Group "Towards a EURopean OBservatory of the non-indigenous calanoid copepod *Pseudodiaptomus marinus*" *Biological Invasions*, 22(3), 885-906.

Accepted for publication

1. Bariche M, et al. (2020) New Mediterranean Biodiversity Records (December, 2019). *Mediterranean Marine Science*. in press
2. Dimitriadis C, Galanidi M, Zenetos A, Corsini-Foka M, Giovos I, Karachle PK, Fournari–Konstantinidoy I, Kytinou E, Issaris Y, Azzurro E, Castriota L, Falautano M, Kalimeris A, Katsanevakis S. 2020. Updating the occurrences of *Pterois miles* in the Mediterranean Sea, with considerations on thermal boundaries and future range expansion. *Mediterranean Marine Science* in press
1. Gerakaris V., Lardi P. L., Issaris Y., 2020. First record of the tropical seagrass species
3. *Halophila decipiens* Ostenfeld in the Mediterranean Sea. *Aquatic Botany*, 160, 103151. in press
4. Giovos I, Tiralongo F, Langeneck J, Kaminas A, Kleitou P, Crocetta F, Doumpas N., 2020. First record of the Atlantic spadefish *Chaetodipterus faber* (Broussonet, 1782) in the Mediterranean Sea: is it a new aquarium release? *Bioinvasions Records*, in press

Other reports

1. Galanidi Bingkiol M., 2019. Developing a protocol for marine IAS impacts reporting by citizen scientists. Short Term Scientific Mission (STSM), Scientific Report, COST CA 17122 "Alien CSI", 33 p.
2. Galanidi M, Zenetos A, Gavriil E, Karachle PK., 2019. Stakeholder perceptions on marine alien species impacts towards the preparation of citizen science campaigns. 9th ESENIAS Workshop and Conference, 9: 50.

ICELAND

National Report 2019

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

Submitted by:

Sindri Gíslason: sindri@natturustofa.is

Overview: Highlights of the National Report

Six new introduced species are reported from Iceland. These species are all ascidians and reported at the southwest coast. The number of NIS in Iceland is now 23 confirmed species. Updated information on the colonization by NIS in selected locations and/or environments (like marinas and harbours) is provided.

Content:

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

No new regulations.

2. Intentional introduction:

One new intentional introductions was reported in 2019, *Litopenaeus vannamei*, for research purpose.

The Icelandic Food and Veterinary Authority (MAST) allowed introduction of 3 species for aquacultures in 2019–2020. Information about intentional introductions of aquatic species can be found in the annual reports of the Icelandic Food and Veterinary Authority (under the heading *Eldisfiskur*): http://mast.is/matvaelastofnun/utgafa/skyrslur/

Table 1. Intentionally introduced aquatic NIS to Iceland.

Species	First indroduced	Aquaculture	Ind.imported in 2019-20	Total number of individuals imported
Onchorhyncus mykiss	1951	Land- and sea-based	2.083.000	13.308.000
Salmo salar	1984	Land- and sea-based		7.425.000
Haliotis rufescens	1988	Land-based		1.600
Dicentrarchus labrax	1994	Land-based		10.752.300
Haliotis discus hannai	1996	Land-based		4.393
Stichopus japonicus	2010	Land-based		761
Solea senegalensis	2011	Land-based	3.122.000	22.575.000
Haliotis discus discus	2012	Land-based		750
Magallana gigas	2013	Sea-based/cages		4.300.000
Acipenser transmontanus	2014	Land-based		300
Homarus gammarus	2014	Land-based		360
Litopenaeus vannamei	2019	Land-based	15.000	15.000

The Environment Agency declined applications and banned further import of *Magallana gigas* in March 2019 with reference to negative review from expert committee on NIS.

3. Summary of sighting.

Six new ascidian species were reported in Iceland in 2019. Samples were taken in 2018 and 2019, but processed in 2019. All species are reported on the southwest coast of Iceland.

Ciona cf. *robusta* Hoshino and Tokioka, 1967; first observed on floating dock in Sandgerði harbour (N 64º02.19' W 22º43.13') in 2018. Has not been reported elsewhere (Ramos-Esplá 2020).

Diplosoma listerianum (Milne Edwards, 1841) first observed on floating dock in Sandgerði harbour (N64º02.19' W22º43.13'). Has not been reported elsewhere (Ramos-Esplá 2020).

Botryllus schlosseri (Pallas, 1766) was first observed in 2011 in front of Vogar (N63º58.08'W22º24.59') on *Mytilus edulis* in a long-lines aquaculture facility, at approximately 3m depth (Ramos-Esplá 2016, 2020). Was observed on floating dock in the harbours of Sandgerði and Grindavík for the first time in 2018 (Ramos-Esplá 2020).

Ascidiella aspersa (Müller, 1776), first observed on floating dock in Sandgerði harbour (N64º02.19' W22º43.13') in 2018. Was also observed on floating dock in the harbour of Hafnarfjörður in 2018 (Ramos-Esplá 2020).

Botrylloides violaceus Oka, 1927, only been observed on floating dock in the harbour of Hafnarfjörður (64º03.51' W21º57.81'). First record in 2018 (Ramos-Esplá 2020).

Molgula manhattensis (De Kay, 1843), observed on floating dock in Sandgerði harbour in 2018 (N64º02.19' W22º43.13'), also observed in Reykjavík harbour the same year (Ramos-Esplá 2020).

Table 2. New marine NIS in Icelandic waters

Taxa	*First recorded*	*Invasive*	*References*
Tunicata			
Botryllus schlosseri	2011, SW-Iceland	*Potentially*	Ramos-Esplá et al. 2020 (in press)
Ciona cf. *robusta*	2018, SW-Iceland	*Potentially*	Ramos-Esplá et al. 2020 (in press)
Diplosoma listerianum	2018, SW-Iceland	*Potentially*	Ramos-Esplá et al. 2020 (in press)
Ascidiella aspersa	2018, SW-Iceland	*Potentially*	Ramos-Esplá et al. 2020 (in press)
Botrylloides violaceus	2018, SW-Iceland	*Potentially*	Ramos-Esplá et al. 2020 (in press)
Molgula manhattensis	2018, SW-Iceland	*Potentially*	Ramos-Esplá et al. 2020 (in press)

The distribution of *Ciona intestinalis* in Iceland was documented in 2018. The species was only found on the SW coast of Iceland, in dense aggregations reaching up to 876 ind/m^2 in all harbours from Grindavík to Akranes (Micael et al. 2020).

Oncorhynchus gorbuscha was reported in over 60 rivers in 2019 (33 in 2017) and spent adults found in several rivers (Þórðardóttir and Guðbergsson, 2020).

The most up to date information about alien species in Iceland coastal and marine waters is found at the Southwest Iceland Nature Research Centre website: http://www.natturustofa.is/mnis.html.

4. Pathogens (Sightings/records, General information, Add links and references)

No findings have been reported.

5. Research and Monitoring Programs

The addition of this section was recommended at the previous WGITMO meeting in 2017. It will allow us to better review and coordinate research and monitoring programs. This should also include sections on **Planned Research**, **Research Needs** and **Research Gaps**.

No governmental research or monitoring programs are ongoing on marine alien species in Icelandic waters.

CRAB-ICE is a research and monitoring project that started in 2007. The focus of the project has been on the alien crab species *Cancer irroratus*. Research have e.g. been done on its genetic variation (Gíslason et al. 2013), moulting, and density (Gíslason et al. 2017). Annually both larvae and crab abundance is monitored at several sampling stations in Faxaflói, SW-Iceland, and information about its distribution along the coastline is updated. The project was started on the initiative of the University of Iceland, it has been carried out in collaboration by the University of Iceland's Research Centre in Suðurnes and the Southwest Iceland Nature Research Centre. It is not a governmental project and not funded specially and so far only been financed with funding from competitive funds.

BF-ICE is a research and monitoring program on biofouling in Icelandic marinas. The program started in 2018 and its aim is to monitor selected floating docs in selected marinas around the Iceland for NIS. The project was started on the initiative of the Southwest Iceland Nature Research Centre, is not a governmental project and not funded specially and so far only been financed with funding from competitive funds.

6. Meetings

No meetings attended.

7. References and bibliography (Should include literature on sightings (not just a personal bibliography. Peer-reviewed or equivalent reports that include ecology, changes in invasive status, etc., unsubstantiated reports are not acceptable (or at a minimum should be noted).

Gíslason ÓS, Jónasson JP, Pálsson S, Svavarsson J, and Halldórsson HP (2017) Population density and growth of the newly introduced Atlantic rock crab Cancer irroratus Say, 1817 (Decapoda, Brachyura) in Iceland: A four-year mark-recapture study. Marine Biology Research 13 (2) 198-209. doi: 10.1080/17451000.2016.1240875

Gíslason ÓS, Pálsson S, Mckeown NJ, Halldórsson HP, Shaw PW and Svavarsson J (2013) Genetic variation in a newly established population of the Atlantic rock crab Cancer irroratus in Iceland. Marine Ecology Progress Series 494: 219–230 doi: 10.3354/meps10537

Jónsson G. 2020. Ársskýrsla dýralæknis fisksjúkdóma 2019. MAST. 1–52. (in Icelandic).

Micael J, Rodrigues P, Halldórsson HP, and Gíslason S. 2020. Distribution and abundance of the invasive tunicate *Ciona intestinalis* (Linnaeus, 1767) in Icelandic harbours. Regional Studies in Marine Science 34. doi: 10.1016/j.rsma.2020.101039

Ramos-Esplá AA, Micael J, Halldórsson HP, and Gíslason S. 2020. Iceland: a laboratory for non-indigenous ascidians. BioInvasions Records (in press).

Ramos-Esplá AA 2016. Iceland, between boreal and arctic waters: Benthic Tunicata (Chordata: Ascidiacea). Proceedings of Mares Conference: Marine Ecosystems Health and Conservation, February 1–5, 2016, Olhao, Portugal, pp 131

Þórðardóttir GB, Guðbergsson G. 2020. Lax- og silungsveiði 2019. Marine and Freshwater Institute. National report. (In preperation). (In Icelandic).

ITALY

National Report for Italy - 2019

(Extended version for the ICES Working Group on Introductions and Transfers of Marine Organisms, meeting in Gdynia, Poland, 2020)

Overview 2019

Six new introduced species are reported from Italian coasts. These include: one polychaete, three mollusks, one crustacean and one fish. In addition, five cryptogenic species of foraminiferans have been recorded from the Sicily straits. Significant ecological studies on various species of already known NIS have been published, while a recent review (2017) of the number of introduced species in Italy totals 205 species. Updated information on the colonization by NIS in selected locations and/or environments (like marinas and harbours) is provided. Finally, Italian researchers participated in some collaborative papers encompassing the analysis of NIS in a wider international context.

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

No new regulations

2. Intentional introduction

No new intentional introductions have been reported.

3. Summary of sightings

Unintentional introduction

List of New Sightings 2019

POLYCHAETA

Dorvillea similis (Crossland, 1924)

MOLLUSCA

Isognomon legumen (Gmelin,1791)

Malleus regula (Forsskål in Niebuhr, 1775)

Mitrella psilla (Duclos, 1846)

MALACOSTRACA

Parametopella cypris (Holmes 1905)

ACTINOPTERYGII

Neogobius melanostomus (Pallas 1811)

<u>Invertebrates</u>

Six specimens of the Erythrean polychaete *Dorvillea similis*, known until now only from the Eastern basin, were collected in fouling assemblages sampled with a scraping net at 1 m depth on concrete docks in the marina of Capraia Island, Tyrrhenian Sea (43.0513° N, 9.8367° E) on 14th May 2019 (Langeneck and Tempesti, 2019).
The stenothoid amphipod *Parametopella cypris*, known from the US East coast, has been recorded with a few specimens from experimental recruitment panel deployed in the Pialassa Baiona, a microtidal lagoon, connected to the port of Ravenna (Northern Adriatic) (Desiderato et al., 2018). It is the first record of this genus for the Mediterranean.
The occurrence of the bivalve mollusc *Isognomon legumen* has been ascertained only recently in the Mediterranean Sea; Giacobbe and Renda (2019) report the first record of this taxon from Italian seas and the westernmost locality in the Mediterranean Sea. Six *I. legumen* specimens from the Strait of Messina (38.259819° N, 15.628871° E) were collected on the 9th of September 2019, from a scraping of about 0.25m^2 of vegetated rocky surface dominated by *Lithophyllum* algae at 1m depth.
The well-established Mediterranean alien bivalve *Malleus regula,* native to the Western Indian Ocean, Persian Gulf, and Red Sea, is first reported from Italy, based on field observations carried out since 2016 in Mar Piccolo, a semi-enclosed marine basin in the Gulf of Taranto (Ionian Sea, Central Mediterranean). In particular, during a visual survey in August 2018, several specimens of *M. regula* were noticed on the poles of mussel farms and rocky substrata at about 2 m depth in the first inlet of Mar Piccolo (40.484809N; 17.249412E). A single individual was collected and deposited (Prato and Rubino, 2019).
Mitrella psilla (Duclos, 1846) is a Western African species, occurring from Angola to Mauritania, only recorded in the Mediterranean Sea from the Gulf of Tunis. 213 living specimens were collected (Nappo et al., 2019) from 1 to 7 meters in depth, in the Civitavecchia harbor, Central Tyrrhenian Sea (N 42°5' 17" E 11° 47' 17"), on 14th December 2016.

Fishes

Two specimens of the Round Goby, *Neogobius melanostomus,* were found in the northernmost branch of the river Po Delta in 2012 (Busatto et al., 2016), but this sighting had been overlooked until now. No further findings have been reported yet. The two fishes had been captured on May 8th, 2012 during a sampling campaign using electrofishing in the Po di Levante near Porto Viro (45°02'18.4"N; 12°11'42.1"E), in the Veneto Region.

Cryptogenic species

The study of Guastella et al. (2019), besides giving an update of the fora-NIS *Amphistegina lobifera* in the Sicily Channel, also provides new information on the current distribution of other Indo-Pacific foraminiferal species, considered as cryptogenic, namely *Amphistegina lessonii, Amphisorus hemprichii, Coscinospira arietina, Coscinospira hemprichii* and *Sorites orbiculus,* that were also recorded from the same area.

Previous Sightings

Algae & higher plants

Harmful Algal Blooms (HABs) along the Emilia Romagna coast (from Goro to Cattolica) have been reviewed by Pompei et al. (2018), for the period 1975-2017, including the identification of species and of the produced toxins (yessotoxins produced by Dynophiceae and others responsible for

Diarrhetic Shellfis Poisoning - PSP. The only case of saxitoxin contamination (responsible for Paralytic Shellfish Poisoning – PSP) was recorded in 1994.

A new record of the microalga *Chrysopheum taylorii* along the coast of Ortona has been added in August 2016 (Grechi et al, 2018), in 3 out of 6 sampled stations. This represents the second location in the Adriatic Sea after the Tremiti Island. A short manipulative experiment was carried out at the Tavolara-Punta Coda Cavallo Marine Protected Area (NE Sardinia) to study the interactive effect of mucilage produced by *Chrysopheum taylorii* on encrusting coralline algae (Caronni et al., 2018).

In the summer of 2015, in a small artificial lagoon in western Sicily (Locality Tonnarella, near Mazara del Vallo) a red tide episode was observed (Cangini et al., 2018), due to a bloom of *Bysmatrum subsalsum* (Dinophyceae). This species is known from tropical and sub-tropical regions and only recently recorded in the Mediterranean Sea. No biotoxins have been isolated.

After a disturbance to a rocky subtidal macroalgal assemblage in the Mediterranean Sea (Italy) by a shipwreck (Costa Concordia), Piazzi et al. (2020) compared native and nonnative seaweed community structure at the disturbed site and two reference sites using traditional abundance measures, in addition to employment of the ALien Biotic IndEX (ALEX). In January 2012, the ship Costa Concordia collided with a submerged natural rocky reef near Giglio Island, west Mediterranean, off Tuscany. In July 2014, the wreck was extracted and the remaining parbuckling structures were removed by spring 2017. In each area, three independent samples were collected at two times (July 2017 and November 2017), in order to collect species with different seasonal life cycles. Macroalgal NIS were initially more abundant at the disturbed site, but four months later were decreased and there were no difference with the reference sites. Native macroalgal cover at the disturbed site was lower than at reference sites in the initial survey, but unexpectedly decreased significantly four months later. Overall, a total of four non-indigenous species were found: the Chlorophyta *Caulerpa cylindracea* and the Rhodophyta *Asparagopsis* spp. (sporophyte stadium), *Acrothamnion preissii* and *Womersleyella setacea*. The nonnative macroalgae *C. cylindracea* and the grouped non-indigenous filamentous species (*W. setacea* and *A. preissii*) contributed to moderate levels of cover at the sites, particularly in comparison to most native taxa. In this study, the decline in NIS cover at the disturbed site to undisturbed levels, suggests a quite quick recovery of the native algal assemblage.

A revision of algal taxa in the Lagoon of Venice (Sfriso et al., 2018) has shown that the number of algal introductions is 31 species and this number has been growing steadily. On the basis of macrophyte distribution assessed during the last five years, the total NIS standing crop is approximately 147 ktonnes (corresponding to one third of the total algal biomass measured in spring 2014). The most abundant species are *Gracilaria vermiculophylla* (66 ktonnes), *Agardhiella subulata* (37 ktonnes), and *Hypnea flexicaulis* (28 ktonnes). These species grow mainly free-floating and colonise soft substrata. Other two invasive species (*Sargassum muticum* and *Undaria pinnatifida*) grow attached to hard substrata and show a significantly lower biomass. The Authors observe a positive effect on the environment of the massive growth of e.g. *Gracilaria vermiculophilla* (recorded for the first time in May 2008), that replaces Ulvaceae in confined areas, avoiding or reducing rapid biomass collapses and triggering of hypo/an-oxic crises.

Morri et al. (2019) tested the assumption that NIS expanding into different habitats reduce the dissimilarity among the recipient communities. They used a simulation experiment, analyzing a comprehensive database (78 species x 229 samples) collected between 2012 and 2017 in the marine protected area of Portofino (NW Italy), where the green alga *Caulerpa cylindracea* exhibits high substratum cover at depths between 1 m and 45 m. Apparently *C. cylindracea* did not replace any native species, most of them having already disappeared or got rarer due to climatic and local human impacts during the 1980–90s ecosystem shift at Portofino reefs; the simulation however, evidenced that *C. cylindracea* is cause of homogenization in the recipient ecosystem. In particular, the depth gradient was better defined, with a greater multivariate dispersion (considered a measure of β diversity), when the invader was excluded from the analysis.
Mannino and Balistreri (2019) reported first observations on the effects of *Caulerpa cylindracea* on the communities living along the coasts of the Island of Favignana (Egadi Islands MPA, Western Sicily). According to the study performed in the Northern part of the island, at Cala San Giuseppe (37°56'07.00''N, 12°20'02.59''E), *C. cylindracea* may have negative effects on the habitat where it settles in two different ways: a) affecting the structure of the native algal community that presents a low diversity, and b) favouring the settlement of other alien species such as the Sabellid Polychaete *Branchiomma bairdi*.
Mannino et al. 2019 updated the current distribution of *Caulerpa taxifolia* var. *distichophylla* in the Mediterranean Sea, based on relevant scientific publications, grey literature and personal observations. Three new records of the algae are reported for Sicily: along the southern coast in Concerie-Pachino and Punta delle Formiche-Pachino, and along the Northern coast in Cefalù. The species was found over a wide range of environmental conditions (depth, light and substratum), suggesting a broad ecological plasticity of this alga making it a potential threat for the Mediterranean benthic communities.

Unicellular species

The benthic foraminiferal species *Amphistegina lobifera*, native to the Red Sea has been reported (Guastella et al., 2018; 2019) from the southern coast of Sicily, very abundant on the soft bottom sediments and as epiphyte on algae. The sampling period was August November 2017 in 12 sites (from Marzameni to Capo Passero and Pozzallo; and in the small islands of Pantelleria and Favignana). *Amphistegina lobifera*, which has an invasive behaviour in the Eastern Mediterranean, was already known for Italy from a previous record in the Pelagian islands (Caruso & Cosentino, 2014), but the present findings extend its distribution range in the Central Mediterranean Sea, and update the predicted species distribution models for the years 2040–2050 and 2090–2100, indicating that the warming trend will facilitate north-westward migration of amphisteginids.

Invertebrates

In the area of the Gulf of Genoa (Ligurian Sea) two new records were added to previously known species: the SW Atlantic sponge *Paraleucilla magna*, and the Red Sea polychaete *Branchiomma luctuosum*, and the presence of the cryptogenic amphi-American and amphi-Atlantic crab *Percnon gibbesi* was confirmed in the area (Bianchi et al., 2018).

The upside-down jellyfish *Cassiopea* sp. is a benthic scyphozoan, considered a non-indigenous invasive species in the Mediterranean, forming large blooms in eutrophic areas. Taxonomy of the genus *Cassiopea* is extremely difficult because morphological/meristic characters used are variable within the same species, overlapping among different species. The first documented record of *Cassiopea* in northern Sicily dates back to 2014 and has since resulted in an abundant

population. An analysis of the main morphological characters of the sampled *Cassiopea* jellyfish from Palermo harbour (Tyrrhenian Sea 38°07.22'N 13°22.09'E) was carried out and subsequently, molecular analyses were performed by using COI barcode (Maggio et al., 2019). *Cassiopea* specimens were found to belong to *andromeda* species. Moreover, high values of sequence divergence were found between Mediterranean *Cassiopea* and the other *C. andromeda* from the Red Sea, Hawaii and Florida. Different hypotheses on the origin of the Palermo population have been discussed.

Giangrande et al. (2018) proposed the exploitation of polychaete filter-feeder biomass derived from integrated multi-trophic aquaculture (IMTA) in various sectors such as sport fishing, ornamental aquarium and feed production: *Branchiomma boholense* and *B. luctuosum* are reared in the Maricoltura plant at Taranto.

In the Lesina and Varano coastal lagoons (Apulia, Central Adriatic Sea), during the period 2000-2016, 9 species of Bivalve molluscs have been recorded, of which 4 are NIS: *Arcuatula senhousia, Anadara transversa, A. inaequivalvis, Ruditapes philippinarum* (Scirocco et al., 2018).

A citizen science campaign in the harbor of Palermo (Sicily) was carried out in May 2017 (Lo Brutto et al. 2018) to collect Amphipods from fouling assemblages. Among the 325 Amphipod specimens, belonging to 5 species, *Elasmopus rapax*, *Erichtonius brasiliensis* and *Monocorophium acherusicum* are considered cryptogenic while *Caprella scaura* and *Stenothoe georgiana* are NIS.

The geographic distribution and population dynamics of *Procambarus clarkii* were studied for the first time in inland waters in the eastern Po Valley and its Delta, an area for which such information was absent Mistri et al. (2019). *P. clarkii*, in summer 2017, was present in all sampling sites, 12 geographically distant water bodies representative of an area of 3,000 km^2. Population dynamics was studied on total of 773 crayfish, 377 males and 396 females from 2017 to 2018, collected during the sampling sessions in Gramicia, a canal running through the town of Ferrara.

Two specimen of the brown shrimp, *Penaeus aztecus,* native to the eastern coast of North America, were collected in December 2018 off Augusta, SE Sicily (37.240° N 15.270°E) with a trammel net on a sandy-muddy bottom at about 70 m depth (Pipitone and Lombardo, 2018).

A flourishing population of the Massawan mantis shrimp, *Erugosquilla massavensis*, an Erythraean species, is recorded (Gianguzza et al., 2019) off Sicily, Italy, one year after the very first specimen was collected off the eastern coast of the island (Corsini-Foka et al., 2017) . The species is already established as a minor, albeit valuable, fishery resource. Once its population increases, however, it may compete with the native Mediterranean spot-tail mantis shrimp, *Squilla mantis*.

The native distribution of the blue crab *Callinectes sapidus* in the western Atlantic extends from Nova Scotia to Argentina. Introduced to Europe at the beginning of the 20th century, it is currently recorded almost ubiquitously in the Mediterranean and in the Black Sea. The capture of a male specimen of blue crab *Callinectes sapidus* in the coastal waters of Matzaccara, Sardinia, 39°11'N; 8°43'E, was reported with morphometric data by Piras et al. (2019). The ongoing expansion of *C. sapidus* in marine, transitional and freshwater sites in Sardinia in the period 2017–2018, adding this species to the seven non-indigenous decapod species reported from the island in the last decades has been provided by Culurgioni et al. (2020). An overview of the occurrence, abundance,

and ecological impact of *C. sapidus* in southern European waters had been given by Mancinelli et al. (2017a; 2017b); additionally, they present a pragmatic assessment of its management scenarios, explicitly considering the dual nature of *C. sapidus* as both an invasive species and a fishery resource. The trophic role and feeding flexibility in invaded benthic food webs have been addressed by Mancinelli et al. (2017c): they conducted field samplings in winter and summer in five coastal systems of the Apulia region (SE Italy), three located on the Ionian Sea (Mar Piccolo, Torre Colimena, and Spunderati) and two on the Adriatic Sea (Acquatina and Alimini Grande). Captured blue crabs were weighed and had their $d^{13}C$ and $d^{15}N$ isotopic signatures measured; their trophic level (TL) was estimated using the mussel *Mytilus galloprovincialis* as isotopic baseline.

The Indo-Pacific blue swimming crab, *Portunus segnis* entered the Mediterranean Sea a few decades ago through the Suez Canal, and more recently (2014) reached Tunisia, where it started to increase enormously in number (Hamida et al., 2019), was recorded in 2019 in the Island of Lampedusa. An alert communicate was issued by ISPRA, the Italian Institute for the Protection of the Environment (http://www.isprambiente.gov.it/it/evidenza/ispra/no-homepage/il-granchio-blu-del-mar-rosso-arriva-a-lampedusa).

The Pycnogonid *Ammothea hilgendorfi* was recorded for the first time in Venice in 1983; since then, the presence of this species has no longer been reported neither in the Venice lagoon nor in other sites of the Mediterranean sea. However this species is actually present and quite widespread in the Venice lagoon, as indicated by a number of individuals we caught between 1991 and 2017, totalling 29 specimens (Mizzan, 2018).

Colonies of the non-indigenous colonial ascidian *Symplegma brakenhielmi* were collected (Mastrototaro et al., 2019) in 2014 and 2018 along the North-eastern Sardinia coasts (Olbia). Further colonies were observed in 2016 in the Mar Piccolo basin (Gulf of Taranto). Synergistic analyses of morphological and molecular type are provided.

Not seen species yet

Ferrario et al. (2019) reported on fouling species in the harbor of Piran (Slovenia); among others, they found two NIS, whose presence has been firstly reported in the Mediterranean (including the Italian Tyrrhenian coast) only very recently: *Stenothoe georgiana* and *Watersipora arcuata*. The record in the Northern Adriatic Sea notably extends their colonization range and suggests these species may further spread elsewhere in the Adriatic Sea.

The alien gastropod *Biuve fulvipunctata* has been reported for the first time from Croatia, also representing the first record for the Adriatic Sea (Petani and Crocetta, 2019). The species had been recorded only once in Sicily (under the name of *Chelidonura fulvipunctata,* Malaquias et al., 2016) but never before along the Italian coasts of the Adriatic Sea.

4. Pathogens

No new information

5. Research and Monitoring Programs

A literature survey was performed (Cardeccia et al., 2018) in order to check the occurrence of marine and brackish-water **non-indigenous species in each Italian region**. The updated (2017) total count is of 613 regional records, referred to 205 NIS.

A re-examination of marine Non Indigenous Species (NIS) reported in Italian Seas until December 2018, has been compiled (Servello et al., 2019) in order to comply with the requirements of **Descriptor D2 of the Marine Strategy Framework Directive**, focusing on establishment success, year of first record, origin, potential invasiveness, and likely pathways, in particular.

A review of the **seaweed distribution** along the Italian seas has included an update on the presence and abundance of NIS (Petrocelli and Cecere, 2019).

Results obtained in 2018 from the **AlienFish project**– monitoring and study of rare and non-indigenous fish species in Italian waters collected through citizen science – have been reported by Tiralongo et al. (2019). Overall, 36 observations of 21 fish species belonging to 17 families were provided from the central and southern sectors of Italian seas. Nonindigenous fishes were sighted in 5 locations out of 18 sites: *Fistularia commersonii* (in Sabaudia)*, Lagocephalus sceleratus* (in Tropea)*, Siganus luridus* (in Catania and Avola) and *Stephanolepis diaspros* (in Avola) were reported. In particular, *S. diaspros* and *S. luridus* were recorded for the first time along the Ionian coast of Sicily. A targeted study within the AlienFish project on *Fistularia commersonii* reported it as established along the southeastern coast of Sicily, Ionian Sea (Tiralongo et al., 2018).

In the **Lagoon of Venice**, the Natural History Museum surveys the alien species benthic populations, reporting interesting observations on their fluctuations (L. Mizzan, personal communication):among crabs, *Callinectes sapidus* is caught regularly but no juveniles or small individuals are reported; similarly stable is *Dyspanopeus sayi* with moderate densities in all areas of the Lagoon, whereas *Rhithropanopeus harrisii* is rare in a few areas of low salinity in Northern part of the Lagoon. *Paracerceis sculpta* and *Xenostrobus* cfr. *securis* are well established. Within the phylum mollusca, *Arcuatula senhousia* is less abundant but still present. *Bursatella leachii* is present only during the summer; while less frequent are *Rapana venosa* and *Anadara transversa* (*Anadara inaequivalvis* has almost disappeared). The assessment of the taxonomic and biogeographic status of the ascidian *Clavelina oblonga* or *flegrea*, invasive since a few years ago, is still under study. The ctenophore *Mnemiopsis leidyi* is a stable component of macrozooplankton in the Lagoon and gives rise to large summer blooms: interestingly, in winter the specimen are double in size compared to summer ones.

The presence of NIS has been updated also in the **Sacca di Goro**, an enclosed bay in the Po River delta (Infantini et al., 2018). During 3 sampling campaigns (January 2015, June and October 2017) 16 NIS have been recorded out of a total of 93 taxa. Four species have been found in all of the three sampling occasions: *Arcuatula senhousia, Ruditapes philippinarum, Ficopomatus enigmaticus, Grandidierella japonica*.

A comprehensive compilation of recent data on the **Genoa Gulf** was complemented by regular monitoring by snorkelling at two sites near Genoa city (Lido and Quarto) between 2009 and 2015: a total of 20 southern species (11 NIS and 9 Warm Water Natives) were found (Bianchi et al., 2018). The monitoring exercise with a standardized protocol for 7 years in Genoa allowed

inventorying 18 southern species, 8 Warm Water Native and 10 NIS, in relation with the recorded temperature data. NIS have been found on artificial substrates and/or in degraded habitats, confirming their greater susceptibility to invasion. Global warming is facilitating the poleward range expansion of plant and animal species. In the Mediterranean Sea, the concurrent temperature increase and abundance of (sub)tropical non-indigenous species (NIS) is leading to the so-called 'tropicalization', which is dramatically evident in the south-eastern sectors of the basin. At the same time, the colder north-western sectors of the basin have been said to undergo a process of 'meridionalization', that is the establishment of warm-water native species (WWN) previously restricted to the southern sectors.

Macrozoobenthic fouling assemblages were studied (Tempesti et al., 2020) in the **port area of Leghorn**, focusing on the occurrence of non-indigenous species (NIS). Sampling was carried out at ten sites characterised by different anthropic impacts related to their use destination. Among the 262 species identified, 26 were alien or cryptogenic, 17 of which were new records for the study area, confirming the role of the port of Livorno as a hotspot of NIS introduction. The distribution of NIS showed a clear segregation depending on sampling sites; however, some species were more widespread than others. Even though the majority of transoceanic maritime traffic from and to Livorno pertains to the commercial harbour, the touristic harbour hosted the highest number of NIS, possibly because of secondary spread from other Mediterranean ports. The ALien Biotic IndEX (ALEX) identified all sites as high or good environmental status, but the large number of NIS detected suggests caution about their impact and further spread.

Gambi et al. (2019) updated the list of NIS from the **island of Ischia** (off Naples, Tyrrhenian Sea) presenting 7 additional alien species, together with a taxonomic emendation (*Branchiomma boholensis* instead of *B. bairdi*). Among the 7 species, the red alga *Lophocladia lallemandi,* first recorded in 2009 showing a massive coverage, might have also shown massive outburst in previous years (1998/1999), that went neglected. At present, large areas of the northern part of the island have been found densely populated by the alga.

The phytobenthic assemblages of the **Mar Piccolo of Taranto** (southern Italy, Ionian Sea), a lagoon like semi-enclosed coastal basin, have been analysed (Petrocelli et al., 2019), thanks to the availability of quantitative long term datasets describing changes occurred in the structure of the community over about thirty years. The total number of taxa and the dominant taxa differed over the years. Thirteen non-indigenous species in total were found, their number varied over the years, reaching its highest value in 2017.

The results of a large-scale study on **recreational boating** as vector of spreading in the Mediterranean Sea were published in three distinct papers (Martinez-Laiz et al., 2019; Ulman et al., 2019a,b). The work involved the analysis of biofouling in 50 Mediterranean marinas spanning 7 countries from Spain to Turkey, and from about 600 boat hulls, also interviewing their owners. The surveyed marinas had between 2 and 27 NIS, hence their role as 'hotspots of introduction' is comparable to the role of larger commercial harbours. NIS richness was related to sea surface temperature, number of berths, proximity to Suez Canal, aquaculture sites or commercial harbours, absence of pontoons, biogeographic sector and climate type (Ulman et al., 2019a). Interestingly, 71% of sampled hulls, including those that had recently been cleaned professionally, hosted from 1 to 11 NIS. Boats with high NIS richness strongly correlated to home marinas with high NIS richness. The surveyed boaters travelled considerably (on average, 67 travel days and 7.5

visited marinas per year), showing high potential for spreading NIS (Ulman et al., 2019b). The levels of awareness of Mediterranean boaters regarding the issue of marine bioinvasions was often low (Martinez-Laiz et al., 2019).

The **local ecological knowledge** (LEK) of small-scale and recreational fishers was accessed in order to reconstruct the dynamics of fish perceived as "new" or increasing in different fishing areas of the Mediterranean (Azzurro et al., 2019). Over 500 fishers across 95 locations and nine different countries were interviewed, and semiquantitative information on yearly changes in species abundance was collected. Overall, 75 species were mentioned by the respondents, mostly warm-adapted species of both native and exotic origin. Interviews were realized between 2009 and 2016 by local researchers in local languages (Albanian, Arabic, Croatian, Greek, Italian, Montenegrin, and Turkish). The LEK protocol is currently applied in other Mediterranean countries, such as Libya, Spain, and France and adopted by five Mediterranean marine protected areas generating new data.

A collaborative paper (Giakoumi et al., 2019) was prepared to guide the evaluation of **management options** for marine invaders at an early stage of invasion when reducing managers' response time is crucial. It could also guide decision-making in subsequent invasion stages, without requiring detailed species-specific information. Expert knowledge was elicited to prioritize 11 management actions for controlling 12 model species, distinguished by differences in dispersion capacity, distribution in the area to be managed, and taxonomic identity. Unlike previous studies, the aim was not to prioritize the invasive species for which management should be applied but to prioritize management actions for groups of invasive species that share similar traits.

6. Meetings

The University of Pavia, in collaboration with the Smithsonian Environmental Research Center (SERC, USA) organised in September 2019 a Summer School entitled 'Monitoring marine alien species in ports with the SERC protocol'. This Summer School, attended by professionals, public/private employees, researchers, master/PhD students, instructed to monitor ports in the Mediterranean Sea, using the method conceived and successfully applied for over 25 years in the United States by the SERC. Moreover, experts of different taxonomic groups provided lectures and laboratory activities on the identification of the most common fouling species of port habitats, with a focus on cryptogenic and alien invertebrate species.

The Summer School will be also replicated in 2020, from July 13th to July 17th

The Joint Research Center of the European Commission (Ispra, Varese, Italy) organised in October 2018 an horizon scanning workshop for marine IAS where several experts from Europe and neighbouring countries contributed to identify "top priority" species, to be considered for inclusion in the EU Regulation on IAS (1143/2014), where marine IAS are currently underrepresented. The exercise resulted in the identification of 26 top-priority species, illustrated in a publication that has been submitted and is currently under revision (Tsiamis et al, 2020 in press).

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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 with the guidelines for ICES WGITMO National Reports; it updates the Italian status up to 2019.

Prepared by Anna Occhipinti-Ambrogi and Agnese Marchini, Department of Earth and Environmental Sciences, University of Pavia, Via S. Epifanio,14 - I-27100 Pavia, Italy, March 2020.

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LITHUANIA

National Report for Lithuania 2019

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Overview:

No new arrivals were recorded in 2019.

Content:

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

The IMO BWMC was ratified in 2017-12-30 (http://www.infolex.lt/ta/442497:str1)

2. **Intentional:**

No new intentional introductions recorded.

3. **Summary of sighting.**

Unintentional:

No new unintentional introductions

The gulf wedge clam, common rangia *Rangia cuneata* (first found in 2013) continues its spread in the Lithuanian waters, however not as successfully as in the neighboring southern area, the Vistula Lagoon (Solovjeva et al. 2019).

An amphipod of Ponto-Caspian origin, *Dikerogammarus villosus,* has recently and rapidly spread along Baltic coastal lagoons and estuaries. By 2016 it had invaded Russian (Kaliningrad region), Lithuanian and Latvian waters (Minchin et al., 2019).

The Ponto-Caspian round goby (first found in 2002) is still abundant in the Lithuanian coastal waters, where it caused significant decline in the blue mussel population.

4. **Pathogens**

Not reported.

5. **Research and Monitoring Programs**

6. **Meetings**

- Marine Alliance for Science and Technology for Scotland.
  MASTS Annual Science Meeting 2019. 2-4 October 2019 at the Technology & Innovation Centre, Glasgow, Scotland, UK.

- SUT/MASTS Workshop Decommissioning & Wreck Removal Influence, educate and unlock opportunities: Informing key decommissioning and wreck removal challenges. Technology & Innovation Centre, Glasgow, 3-4 October 2019.
- The COMPLETE project Stakeholders' Conference, December 4-5, Jurmala, Latvia.
- International Scientific and Practical Conference MARINE RESEARCH AND EDUCATION MARESEDU - 2019 October 28-31, 2019, Moscow
- National ad hoc meetings on invasive species and ballast water management

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Skabeikis, A., Morkūnė, R., Bacevičius, E., Lesutienė, J., Morkūnas, J., Poškienė, A., & Šiaulys, A. (2019). Effect of round goby (*Neogobius melanostomus*) invasion on blue mussel (*Mytilus edulis trossulus*) population and winter diet of the long-tailed duck (*Clangula hyemalis*). Biological Invasions, 21(3), 911-923. [Information on further spread and cascading trophic effects of the round goby]

NETHERLANDS

National Report 2019
Prepared by drs. A.A.J. (Sander) Smolders, a.a.j.smolders@nvwa.nl
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Content:
1. **Regulations:** An update on new regulations and policies (including, aquaculture and vector management)
Alien species regulation EU: 1143/2014/EU with the Union list of NIS
Management and Action Plan Alien species Wadden See – 14 March 2019
2. **Intentional:**
3. **Summary of sighting.**
Unintentional:
New Sightings
1.The bivalve *Mulinia lateralis* was recorded to be present, locally in high densities, in estuaries and coastal waters off the Dutch coast in several separate studies. The species was first recorded for the Netherlands, Germany (and Europe) in August 2017 in subtidal sediment samples taken in the Wadden Sea on both sides of the border between the Netherlands and Germany (Gittenberger et al., 2019; Klunder et al., 2019). About a month later it was additionally recorded in the south of the Netherlands off the coast of Zeeland (Craeymeersch et al., 2019). In 2018 populations were recorded at various localities along the Dutch coastline indicating that the species is establishing itself.

2. A recent rise in sightings of the assumed (formerly reported, 1980 onwards) bivalve *Abra nitida* in predominantly Delta and brackish waters was in 2019 identified to be actually *Theora lubrica*, originating from the NW Pacific.

4. **Pathogens**
5. **Research and Monitoring Programs**

PROJECT INFORMATION
Contact: drs. A.A.J. (Sander) Smolders, a.a.j.smolders@nvwa.nl
Office of Risk Assessment and Research, Netherlands Food and Product Safety Authority (NVWA)

1. UPDATE OF LIST OF ALIEN SPECIES FOR THE WADDEN SEA
The list of alien species known for the UNESCO World Heritage Site the Wadden Sea was updated in 2019. The Wadden Sea is one of the largest unbroken wetlands in the world and is positioned along the Dutch, German and Danish coast.
Report: Gittenberger, A., 2019. Waddenzee exotenlijst 2018 update. I.o.v. Bureau Risicobeoordeling & onderzoek, Nederlandse Voedsel en Waren Autoriteit. GiMaRIS project 2019_04

2. RISK OF INTRODUCING OF MARINE ALIEN SPECIES BY SEAWEED FARMING
A pilot study was conducted to identify potential risks from introducing and promoting the establishment of marine alien species through sea-weed farming. Surveys were

conducted in the spring and summer of 2019. The study included seaweed farms along the Dutch coast that used a variety farming techniques. The surveys focused at recording alien species that can be found in association with such farms. Next to assessing whether the species farmed were alien or not, the results were used to get an indication of the risk that alien species could potentially be promoted in spreading and/or establishment through seaweed farming. The findings of th pilot study are at present planned to be reported early 2020.
Report: Gittenberger, A. & M. Rensing, in prep. Zeewierkweek in Nederland.

3. REVIEWS/EXPERT OPINIONS ON RISK ASSESSMENTS OF POTENTIAL UNION LIST SPECIES

Within the EU, member states may propose that specific alien species are put on "the" EU list of alien species for which all member states are obliged by EU legislation to participate in the management, monitoring and/or control (Regulation 1143/2014/EU). Which species are placed on this list is decided by an international committee appointed by the member states. The species are selected in accordance with EU risk assessments for such alien species. In support of the procedure the Netherlands commissioned reviews of the EU risk assessments of seven marine species, assessing whether the risks for Europe were correctly and completely described. In addition, based on the risk assessments, the level of risks for the Dutch coastal waters.

6. **Meetings**

Future meetings:
(In preparation but no date yet): International conference aquatic invasive species (ICAIS) 2021 in The Netherlands.

7. **References and bibliography**

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Source:
https://www.naturetoday.com/intl/nl/nature-reports/message/?msg=2518

NORWAY

National Report from Norway. 2019

Report prepared by Anders Jelmert, IMR, anders.jelmert@hi.no,With contributions from Jan Sundet, Ann Merete Hjelset, Vivian Husa, Ann Lisbeth Agnalt and Per Erik Jorde, IMR, Norway

Summary:

No sightings of new marine NIS have been recorded for 2019, but the efforts has been very low.

The genetics of the snow crab in the Norwegian Barents Sea has been compared to samples from NE. Canada, W. Greenland and Bering Sea. It is distinct from its western conspecifics but resembles its Eastern conspecifics. No signs of founding effects weaken the hypothesis that this species was introduced to the BS by e.g. ballast water. The species continues to expand its population and range and is now moving into the Kara Sea (maily S. of Novaya Zemlya).

The red king crab is slowly migrating SW along the Norwegian coast. Catch is regulated and the population appear to be stable. Both crabs are surveyed, and advice are given for catch quotas.

The genetics of the cupped oyster *Magallana gigas* along the SW Swedish and S. Norwegian coast. Little genetic structure suggests that the populations in Sweden and Norway have been seeded by a common flow of larvae (And it is known that the broodstock and spat of the species has been translocated in the area). The “Scandinavian” populations are genetically separated from their conspecifics in The Netherlands and France.

1. Regulations:

Nothing to report

General information:

No dedicated surveys for (new) NIS were conducted in Norway in 2019. There has been alimited work on the cupped oyster *Crassostrea gigas*.

Public outreach / Citizen science.

A new portal “Havfunn” (“findings in the sea”) has been established https://havfunn.hi.no/about . The portal allows anyone to register, send in their observations of both IS and NIS (With georeferenced and options for picture storage). The portal will forward the inquiry to relevant experts and these will provide information on species or OUT.

2. Intentional:

No new alien species being introduced intentionally to Norway has been reported. There is still widespread translocation (within Norwegian borders) of several wrasse species in the aquaculture industry (employed for biological de-lousing of salmon). The translocation is still considered a high risk for transferring diseases as well as changing the variation of the genetical composition of the wrasse species populations in Norway.

A new report on effects of wrasse fishery on the various wrasse species populations has been released. For two species, an incomplete depth overlap between fishery and habitat has demonstrated limited effects from fishery on population size, due to refugium effects. For more information contact Kim Halvorsen kim.halvorsen@hi.no

3. Unintentional:

No new specimen of ***Homarus americanus*** has been detected in 2019.

Hybrid specimen *H. americanus* x *H. gammarus* kept at IMR have been /will be subjected to mating experiments. Both hybrid males X *H. gammarus* females, as well as hybrid females x *H. gammarus* males, and the survival and development of offspring will be recorded. Contact: Ann-Lisbeth Agnalt, IMR Ann-Lisbeth.agnalt@hi.no

Previous Sightings.

Pink salmon: *Onchorhynchus gorbuscha.* has been observed in rivers (typically in northern Norway) since early 1960ies. This species is a biannual spawner (and has a corresponding short life cycle). In Norway, pink salmon has runs in uneven years, and both 2017 and 2019 had high return of spawners. The total recorded catch in rivers in 2019 was approx.14 000 specimen weighing 21 tons. While the main proportion of pink salmon spawn in rivers in Northern Norway, straying specimen have been caught in rivers scattered around the coast. For 2019, records on specimen also caught in the sea has been collected, and is available in https://www.ssb.no/statbank/table/09243/

These numbers are therefore also reported to WGITMO.

In 2019, a total of 5710 pink salmon were caught in the sea in Norway.

A risk evaluation for the further spread of Pink Salmon in Norway was finalized in January 2020, and can be downloaded from The Norwegian Scientific Committee for Food and the Environment

https://vkm.no/english/riskassessments/allpublications/assessmentoftheriskfromanincreaseofpinksalmoninnorway.4.303041af1695012160976b28.html

Range expansions:

Cupped oyster: *Magallana gigas* (*Crassostrea gigas)*. Validation surveys confirms that a simple niche model for *M. gigas* based on depth/bottom stratum and energy (waves/current) was inadequate to predict distribution (at a local scale). Vegetation appears be an important factor governing distribution, and current models for vegetation does not seem to have enough predictive value to adequately inform a local scale model.

Genetical samples collected in a survey around the coast of Southern Norway in 2017 has been analyzed by ddRAD. The DNA represented by 455 SNP's from specimen in populations around the Swedish (1 locality) and Norwegian (6 localities) coast had very low genetical structure. The "Scandinavian samples where however distinctly different from samples from France and the Netherlands This confirms the findings by a similar study (Auriac et al, 2017) based on microsatellite analysis.
No records north of the current northernmost observation (62.95 N) has been recorded. In 2019, the "front" of actively spreading *M. gigas* appears to take place between 59.50 N – 60.50N on the coast of Western Norway.

Snow Crab: *Chionoecetes opilio.* First observed in Russian sector 1996, 2004 in Norw. EEZ. Still expands geographical distribution and stock is increasing both in Norwegian and Russian EEZ (Figure 1). In addition to continued northward and eastward range expansion, several specimens were caught E. of Novaya Zemlya (Kara Sea proper).

C. opilio refer colder water (typ. below 3-4 C) than red king crab. S & W distribution may even retract if the Arctic gets warmer. SSB for Snow crab is now much larger than the SSB for king crab. Stray individuals have been caught close to the Svalbard archipelago, and model projections indicate that the species will have colonized the areas around Svalbard by 202, (Figure 1). The combined catches of snow crab in the Barents Sea are however somewhat reduced compared to 2016 and 2015. This is likely due to fishing efforts being concentrated in a small area.

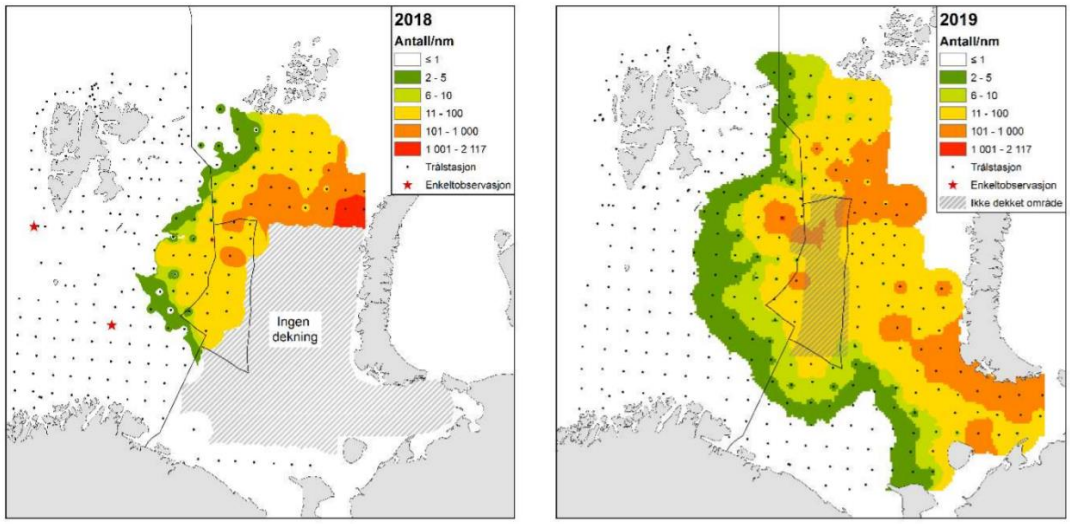

Figure 1. Distribution (density) for snow crab, 2018 and 2019. Left panel, 2018, right panel (2019) Grey Hatch (no access to Russian data. Colours and numbers_ number of snow crab/ trawled. Grey dots: trawl stations, Red stars: individual specimen in catches.

The stock size has increased considerably since 2010. A very coarse estimate of catchable crabs (carapace width >100mm) is calculated to be in the range 0.1-0.41 tons/km2. The stock net production for 2018 is estimated to be between 2000 and 11000 tons. There are large uncertainties related to these estimates.

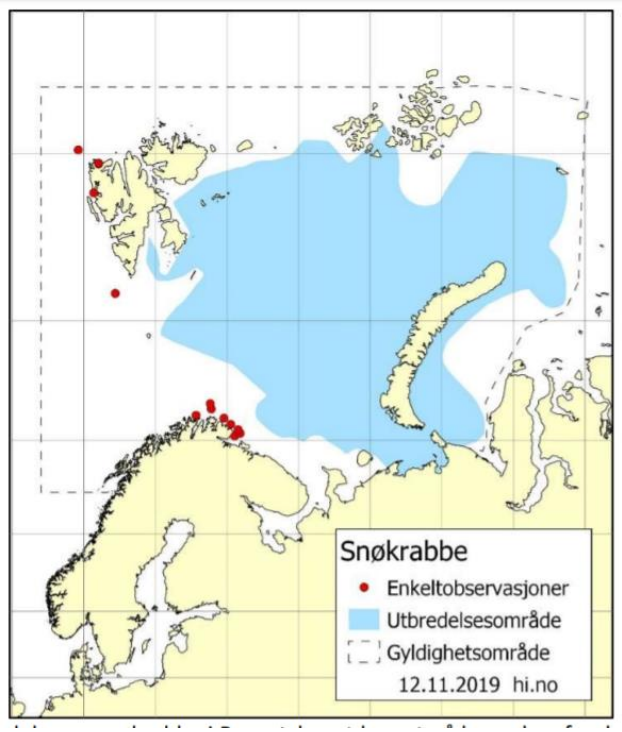

Figure 2. Current distribution in The Barents Sea (Light blue). Stitched lines, delimitation of distribution area. Red dots: confirmed single specimen records

More information: Ann Merete Hjelset: ann.merete.hjelset@hi.no , Karsten Hvingel: karsten.hvingel@hi.no, IMR.

Red King Crab : *Paralithodes camtschaticus* A follow-up study (2012 vs 2007-2009) on the effects of king crab on soft bottom fauna has been published, Oug at al., (2018).

Likely due to higher fishing efforts and higher fishing mortality, the stock size of catchable males (CL>130mm) decreased in 2017. Currently the stock net production is below the level for MSY (Maximum Sustainable Yield). This is likely coupled to a fishing effort (mortality) larger than F_{lim}. (Figure a , Lower panel).

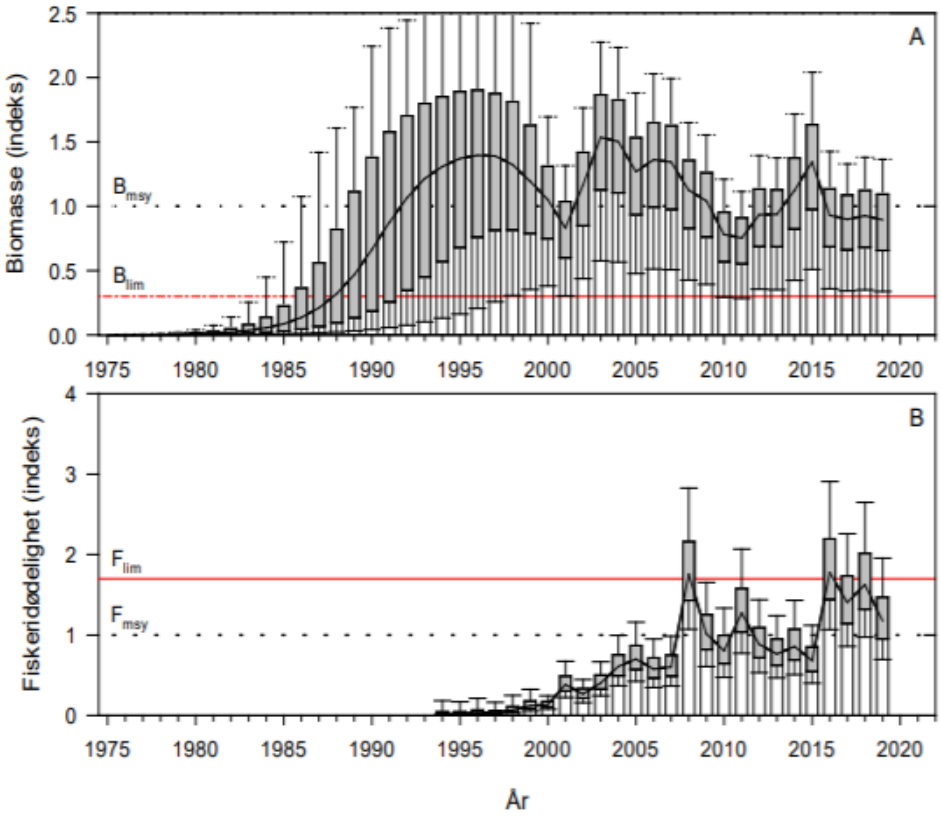

Figure 3. Development of relative stock size (upper panel), and fishing mortality (lower panel) of catchable male king crab in the quota-regulated sector (East of E26° to Russian EEZ, 1975-2019). Dotted horizontal black lines shows levels for biomass (upper panel) and fishing mortality (lower panel) giving maximum sustainable yield. Horizontal red lines denote the level for biomass (upper panel) and fishing mortality (lower panel) where the stock will be reduced. Horizontal lines denote 95% confidence interval, grey bars denote the 25-75 percentiles.

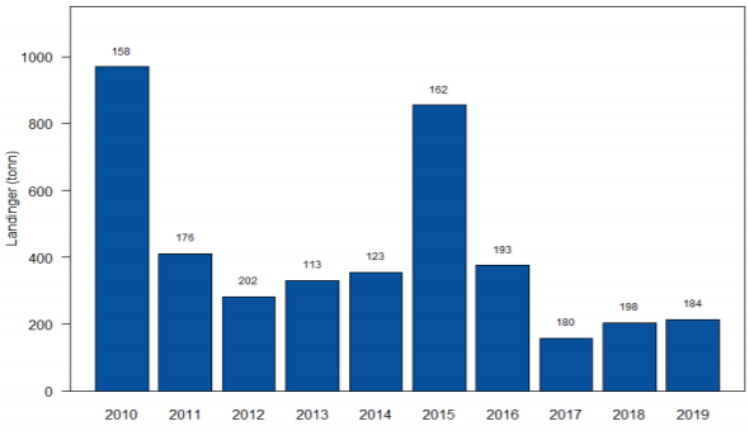

Figure 4. Landed catch in the “free fishing” area W. of 26°E, 2010 - October 2019.

X-axis: year, Y-axis: Landings in metric tonnes, Numbers on top of coloumns, Participating vessels.

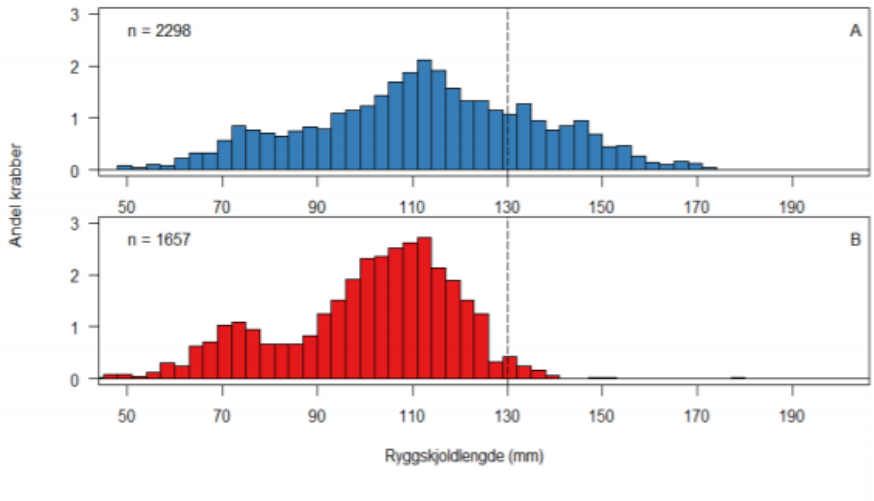

Figure 5 Distribution of size- and sex of king crabs in the fjord-survey (autumn, 2019). Upper panel: males, lower panel: females. X-axis : Carapace length (mm).

For more information: Jan.h.sundet@hi.no .

"Clinging jellyfish": *Gonionemus vertens*. In 2019, considerable expansion (geographically and numbers) of *G. vertens* has been recorded in Swedish coastal areas and in coastal areas south of Bergen, Norway.

Eradication programmes:

Crassostrea gigas: Eradication of C. gigas has been implemented as part of action plan for one municipality (Oslo and Akershus). Other eradication efforts have been carried out in other designated areas in SE Norway. One effort has been made at the border of the "Raet nasjonalpark" ("Raet, national park"), in the Arendal municipality N 58.4, E 8.8. Preliminary results indicate that culling may reduce the presence in designated areas but does not prevent re-establishment from neighbouring areas.

Several counties in SE part of Norway consider management by a combination of commercial harvest and site selective culling (in areas of great biological value, or e.g. public beaches). A recent report can be downloaded here: https://norden.diva-portal.org/smash/get/diva2:1375473/FULLTEXT01.pdf (*In Norwegian*).

***Homarus americanus**:* Not formally established or regularily funded (!),

but suspect specimens collected by fishermen are voluntarily sampled and are being genetically analysed at IMR. Since 2000, 37 specimens of American lobsters have been found in Norway, 24 in Sweden, 1 i Denmark and 3 in Ireland. All have been verified as *H. americanus* by DNA analysis at IMR, Norway.

Not Seen (or not confirmed) Species Yet:

The *Hemigrapsus* spp. and *Cancer irroratus* crabs observed in Denmark and Sweden have not been observed, but is expected to be found in the near future.

Import and exports:

Table 1. Export figures for raw live(!) king crab. Three upper column headers: left: December, 2017, Non-revised numbers, middle: January- December 2017, non-revised numbers, right: January-december 2016, preliminary numbers. Mengde= Amount (tons), Verdi = value(NOK), Pris pr. Kg= Price per kilogram(NOK). Source: Norwegian fishermens sales organization, http://www.rafisklaget.no/portal/page/portal/RafisklagetDokumenter/Markedstiltak/Norwegian_King_Crab_des2017.pdf

	Desember 2017 Ureviderte tall			Januar - desember 2017 Ureviderte tall			Januar - desember 2016 Foreløpige tall		
	Mengde	Verdi	Pris pr.kg	Mengde	Verdi	Pris pr.kg	Mengde	Verdi	Pris pr.kg
TOTALT	93	25.424	272,32	958	250.291	261,14	1.169	260.648	222,97
Sør-Korea	40	10.163	255,76	526	130.647	248,26	776	161.370	207,85
U S A	21	5.976	279,46	160	41.478	258,52	161	36.672	228,09
Canada	9	2.544	282,92	102	30.025	294,81	97	27.641	284,50
EU27	11	3.238	291,16	94	25.580	272,54	97	24.158	249,01
Italia	6	1.640	298,00	39	11.291	288,55	38	10.635	278,72
Taiwan	4	1.350	303,56	29	8.951	305,94	18	5.270	290,59
Vietnam	4	1.034	277,62	18	4.942	280,12	0	14	342,80
Storbritannia	2	584	246,21	14	3.432	240,74	16	3.953	242,23
Belgia	1	364	298,20	11	3.226	290,09	10	2.682	264,47
Kina	3	797	277,26	11	3.026	270,20	6	1.257	197,17

Table 2 : Amount of exported frozen King crab to various markets. Legends and source as in Table 1. Corresponding numbers for the export of snow crab is unfortunately not available for the time being.

	Desember 2017 Ureviderte tall			Januar - desember 2017 Ureviderte tall			Januar - desember 2016 Foreløpige tall		
	Mengde	Verdi	Pris pr.kg	Mengde	Verdi	Pris pr.kg	Mengde	Verdi	Pris pr.kg
TOTALT	58	19.978	346,64	919	255.157	277,65	1.081	270.706	250,51
EU27	57	19.750	346,29	526	155.359	295,26	429	123.199	286,97
Sør-Korea	.	.	.	170	39.546	232,55	22	5.880	268,77
Nederland	9	3.276	353,80	94	30.572	326,72	99	28.959	293,96
Sverige	9	3.329	380,58	80	27.624	346,28	88	25.437	288,43
Danmark	12	3.929	341,62	91	26.416	291,09	83	21.494	258,77
Frankrike	11	4.248	382,53	99	23.584	239,28	69	20.366	295,96
Japan	.	.	.	70	15.727	224,69	474	109.977	231,94
Spania	1	533	399,81	63	14.813	236,29	12	3.184	267,78
U S A	.	.	.	50	13.943	276,90	68	11.621	171,96

4. Pathogens

No severe Ostreid Herpes-virus µ-var. reported for *Crassostrea gigas* or other mussels in 2019.

5. Meetings

No dedicated meetings to report.

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POLAND

POLAND NATIONAL REPORT 2019-2021

Report prepared by:

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

Overview:

There were no new sightings of non-indigenous species in 2019.

The consent to ratify the BWM Convention expressed in the Act was signed by the President of the Republic of Poland.

Content:

1. **Regulations**

In July 2019 the Council of Ministers adopted a draft Act on the ratification of the BWM Convention. The multi-stage process of adopting the Act by the Polish Parliament lasted until November, when the consent to ratify the BWM Convention expressed in the Act was signed by the President of the Republic of Poland. Since then, BWMC ratification document is waiting for signature of President of the Republic of Poland.

In March 2019, Ministry of the Environment submitted to the legislative process a draft of new Act on alien species. The purpose of the act is the implementation of: (1) the EU Regulation No 1143/2014 of the European Parliament and of the Council of 22 October 2014 on the prevention and management of the introduction and spread of invasive alien species and (2) Commission Directive (EU) 2018/350 of 8 March 2018 amending Directive 2001/18/EC of the European Parliament and of the Council as regards the environmental risk assessment of genetically modified organisms. In addition to the general provisions, the draft Act includes guidelines on reporting the records of invasive alien species in the environment and emergency measures, prohibitions and permits, controls or criminal penalties. In the case of marine organisms, many obligations under this Act will be fulfilled by directors of maritime offices and the Chief Inspector of Sea Fisheries.

2. **Intentional**

In 2019 deliberate releases of salmon *Salmo salar* (ca. 543 thou.), sea trout *Salmo trutta trutta* (ca. 3410 thou.), whitefish *Coregonus lavaretus* (ca. 47 thou.), and vimba bream *Vimba vimba* (ca. 70 thou.) to the wild (either directly to the marine environment or rivers dis-charging to the Baltic Sea) were conducted (Dr. inż. Tomasz Czerwiński, Inland Sea Fisheries Institute in Olsztyn, pers. comm.). The releases were carried out as part of the "Restocking of Polish sea areas in 2019" task, where fish material is released to the upper and lower Vistula inflows, to the central Oder tributaries, to the Pomeranian rivers and Puck Bay basin. However, it should be noted that these are not the only deliberate releases of migratory fish species to the Polish rivers. Restocking resulted also, on a small scale, from the deliberate release of fish by The Polish Angling Association, which additionally restore fish stocks in fishing districts, as well as rivers dis-charging to the Baltic Sea.

3. **Summary of sighting**

Unintentional

There were no new sightings in 2019.

Previous Sightings

A tanaid *Sinelobus vanhaareni* (Crustacea), found previously only in the Gulf of Gdańsk (eastern Polish coast) and in Port of Świnoujście (western Polish coast), in 2019 has been also recorded in other regions, i.e. in Vistula Lagoon (the most eastern part) and in the marina in Kołobrzeg (middle coast /open sea coast) (unpublished data, University of Gdańsk).

A talitrid *Platorchestia platensis* (Crustacea), has extended its range of occurrence beyond the area of Puck Bay and nowadays it also is recorded in the Gulf of Gdansk (Tykarska et al., 2019).

4. **Pathogens**

There were no new sightings of pathogens in 2019.

5. **Research and Monitoring Programs**

In 2019 national biological monitoring of the Polish Marine Areas was carried out under coordination of Chief Inspectorate for Environmental Protection. One of the tasks was to detect new non-indigenous species as well as to determine distribution of selected, already introduced ones. Monitoring included marine internal and territorial waters as well as the Polish Exclusive Economic Zone. Samples of phytoplankton and zooplankton were taken 5-6 times in a year while zoobenthos once a year. In 2019 additional samples of ichthyofauna were also collected in transitional (according to EU Water Framework Directive) and coastal waters.

In addition to national monitoring, studies on non-indigenous species (NIS) in four Polish marinas were carried out based on the biofouling assessment protocol developed under COMPLETE project. Samples were collected from fouling plate sets deployed horizontally during vegetation season as well as by scraping from vertical surfaces. In addition, samples of biofouling were collected from recreational boats taken out of the water after the season. The information on NIS found in the marinas will be used to determine the potential risk of the introduction and spread of these species by recreational boats to the Baltic Sea Region.

Studies on of most vulnerable areas for new introductions and spread of non-indigenous species in the Baltic Sea region (e.g. ports and marinas, hull cleaning facilities, natural reserves, offshore wind farms and drilling units, artificial habitats, seawater discharge sites and power plants) were conducted under COMPLETE project. As the result, GIS maps were created.

Planned Research

It is planned to conduct study on distribution and population status of tanaid *Sinelobus vanhaareni* in the Polish coastal waters.

Research Gaps

Lack of: (1) studies on NIS introduction pathways and vectors, (2) studies on secondary spreading and population status of recently introduced NIS and (3) regular monitoring of ports and other hot spots.

6. **Meetings**

Past year

145th Meeting of the National Section for the Protection of the Marine Environment (MEPC) operating at the Center for IMO, at the Polish Register of Shipping S.A., Gdańsk, Poland, 25 April 2019.

146th Meeting of the National Section for the Protection of the Marine Environment (MEPC) operating at the Center for IMO, at the Polish Register of Shipping S.A., Gdańsk, Poland, 26 June 2019.

Seminar "Ballast water and ship hulls - harmonized procedures for the Baltic Sea to reduce the risk of introduction of invasive species through shipping", national meeting with stakeholders in the frame of COMPLETE project, University of Gdańsk, Gdynia, 12th September 2019.

Future meetings

55th European Marine Biology Symposium, 24-28 August 2020, Gdańsk, Poland

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PORTUGAL

National Report for Portugal for 2019 presented in 2020

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Overview 2019:

A list of 182 aquatic non-indigenous species (NIS) is currently registered for the Portuguese estuarine and coastal aquatic systems. There were 16 new additions to the 2018 report, including including 3 Rhodophyta, 1 Chlorophyta, 1 Porifera, 1 Bryozoa, 5 Arthropoda and 5 Chordata species. These new records included species that had been overlooked but also species that seem to be new records, including for European waters (*Pyromaia tuberculata* (Lockington, 1877)). There were also several records resulting from the development of recent dedicated research projects. Some species were deleted from the list of NIS for Portugal due to taxonomic revisions based on molecular analysis and A new Decree-Law establishing the legal framework applicable to the introduction and control of non-indigenous fauna and flora species in the natural environment was published in 2019 (Decree-Law No. 92/2019, 10th July 2019). Reports on the reassessment of Descriptor 2 (non-indigenous species) for the period 2012-2018, regarding mainland Portugal and the autonomous regions of Azores and Madeira have been produced under the implementation of the Marine Strategy Framework Directive.

Content:

1. Regulations

Decree-Law No. 92/2019 was published in July, revising the Decree-Law No. 565/1999, on the introduction of non-indigenous species of fauna and flora in the natural environment. The new legislation supported the transposition into national regulation of the Regulation (EU) No. 1143/2014 of 22 October on the prevention and management of the introduction and spread of invasive non-indigenous species.

In accordance with Article 17(2) of the Marine Strategy Framework Directive (MSFD), the Member States have to review and update their marine strategies every six years. Information on Article 8 was updated under the scientific coordination of IPMA for mainland Portugal, with the collaboration of several partners. The reports of Azores and Madeira were coordinated respectively, by the Regional Directorate for Sea Affairs (DRAM, Azores) and the Regional Directorate for Spatial Planning and Environment (DROTA, Madeira) were responsible for the reports of the two subdivisions. In January 2020 the draft report was launched for public consultation by the Directorate-General for Natural Resources, Safety and Maritime Services (DGRM), which is the competent authority for the MSFD implementation in Portugal. The final report was submitted to the European Commission in March 2020, and it is now available at https://www.dgrm.mm.gov.pt/web/guest/implementacao and at

http://cdr.eionet.europa.eu/pt/eu/msfd_art17/2018reporting/textreport/envxnjctw as well.

According with Tsiamis et al. (2019), the non-indigenous species refined national baseline inventories under the MSFD, should also include cryptogenic and data-deficient species. Following the author, a list of 105 species registered in marine and transitional waters, was compiled for the subdivision of mainland Portugal, 15 of which being recently introduced (period 2012 - 2017). A list of 105 non-indigenous species registered in marine and transitional waters, was compiled for the subdivision of mainland Portugal, 15 species being recently introduced (period 2012 - 2017). In the Azores the present non-indigenous species list consists in 83 species, most of these have been recently compiled and confirmed from previous works but 20 correspond to new registers in the referred period. In the Azores some species display invasive behavior (4 macroalgae, one bryozoan and one mollusk). A total of 17 new non-indigenous species have been recorded between 2012 and 2017 in Madeira.

The good environmental status was re-assessed considering the primary criterion D2C1 (the number of non-indigenous species which are newly introduced via human activity into the wild, per assessment period). Taking into account that no thresholds are yet defined, and that the number of newly registered species (15) follows the new millenia tendencies, and none of those showed invasive behavior so far, it was considered that the marine and transitional waters of mainland Portugal are in a Good Environmental Status. Yet, the confidence level attributed to the evaluation carried out was **low,** mainly due to data insufficiency.

2. Intentional introductions

Information available for introductions in Portuguese estuarine and coastal waters is insufficient to distinguish between intentional and unintentional introductions.

3. Summary of sighting

Rhodophyta

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

Asparagopsis taxiformis was reported for the first time in Madeira between the 1968 and the 1973 by Levring 1974. It is a cosmopolitan species that is widely distributed in warm temperate and tropical seas throughout the Pacific Ocean, Atlantic Ocean, and Mediterranean Sea (Abbott and Hollenberg 1976; Abbott 1999). In Madeira is fairly common along the intertidal rocky shores. The most likely vector of introduction is by maritime traffic (ballast water or fouling).

Porifera

Prosuberites longispinus Topsent, 1893

Prosuberites longispinus was recorded for the first time in the marina of Porto Santo Island in 2014 (Ramalhosa et al. 2019). The species is likely arrived through marine traffic (hull fouling).

Bryozoa

Tricellaria inopinata d´Hondt & Occhipinti Ambrogi, 1985

Tricellaria inopinata was first reported in Madeira Island in 2013, in the marinas of Funchal and Quinta do Lorde (Caniçal; Ramalhosa et al. 2019). The most likely vector of introduction is by maritime traffic (mostly fouling). This species is native from the Pacific Ocean, but still no information is available about its precise regional origins (Dyrynda et al. 2000).

Arthropoda

Callinectes sapidus Rathbun, 1896

The blue crab has been introduced in the Tagus and Sado estuaries, respectively in the 70s and 80s, with a reduced population recorded in the later estuary since then. Nevertheless, recent records in Algarve indicate the establishment and expansion of new populations across the entire South coast of Portugal, mainly in the Ria Formosa coastal lagoon and in the Guadiana estuary (Morais et al., 2019; Vasconcelos et al., 2019).

This species has also been recorded during 2019 for the area between Faro and Sagres, including the Arade estuary and Alvor coastal lagoon, indicating a westwards expansion of the blue crab along the southern coast of Portugal (NEMA project).

Cronius ruber (Lamarck, 1818)

Cronius ruber was first identified during underwater visual census surveys done by scuba diving in July 2018 and was repeatedly observed during the following months, in different locations on the south coast of Madeira. After the record in the Canary Islands in 2016 (González et al. 2017), this represents a further step northward on this species' expansion in distribution in the eastern Atlantic. The relatively short time span between sightings of *C. ruber* at different locations around the south coast of Madeira suggests this species has already spread and its sightings are not random or sporadic occurrences. It is not clear how this species arrived to Madeira, as there is no direct evidence suggesting that it was intentionally or unintentionally introduced.

Ericthonius didymus Krapp-Schickel, 2013

Ericthonius didymus was reported for the first time in the Azores, where it was found for the first time in 2014 in São Miguel island.

Pyromaia tuberculata (Lockington, 1877)

Pyromaia tuberculata was first recorded in the Tagus estuary (Lisbon) in 2016 (Lobo-Arteaga et al., *subm.*). The specimens collected were morphologically and genetically identified. The most likely vector of introduction is ballast waters. This is also the first record of the species in European waters. One of the specimens sampled was an ovigerous female, leading to the assumption that the population is already established. The manuscript is already submitted for publication.

Pseudodiaptomus marinus Sato, 1913

Since the 1950s, this copepod, native to the Indo-Pacific region, has widened its distributional range, showing a high invasive potential, and since 2007, it is present in European waters. Ballast waters are considered the primary vector of introduction. The workshop entitled "Towards an EURopean OBservatory of the invasive calanoid copepod *Pseudodiaptomus marinUS*" (WKEUROBUS) was held at the Stazione Zoologica Anton Dohrn in Naples, Italy, in 2018, aiming at establishing a network of European scientists and institutions working on the biology and ecology of this species (Uttieri et al. 2020). It was firstly identified in 2011 in Mondego estuary, and its population is already established (Uttieri et al. 2020 and references therein).

Stenothoe georgiana Bynum & Fox, 1977

Stenothoe georgiana was found in 2013 in São Miguel, and its presence in the Azores is reported and confirmed.

Mollusca

Ruditapes philippinarum (A. Adams & Reeve, 1850)

The harvesting and commercialization of the Manila clam continued to grow in Portuguese estuarine and lagunar systems. This activity continues to be mainly based on illegal harvesting and trade, with most shellfish exported to Spain. Studies on the potential for trophic competition between this species and native sympatric species have been developed. A first approach using stable isotopic analysis indicated that the trophic niche of *R. philippinarum* overlaps with the trophic niche of other native bivalves (Dias et al., 2019). There are ongoing studies on the estimation of clearance rates based on the reduction os particles and on the determination of biodeposits.

Phorcus sauciatus (Koch, 1845)

Phorcus scauciatus has been expanding its distributional range within the Azores archipelago from Santa Maria to São Miguel island where it is becoming fairly common along its intertidal rocky shores.

Chordata

Aplidium glabrum (Verrill, 1871)

Aplidium glabrum was reported for the first time in Madeira in the marina of Funchal in October 2013 and in the marina of Calheta in August 2014 (Ramalhosa et al. 2019). Since then, the species has been seen in both marinas throughout the years. This species was also found in a recreational vessel which arrived at Quinta do Lorde in September 2013. and here suggesting that the species arrived through marine traffic (fouling). This species occurs in numerous regions worldwide but is native from the eastern Atlantic (Locke 2009; Zhang et al. 2019).

Botrylloides diegensis Ritter & Forsyth, 1917

This colonial tunicate was registered at the Albufeira lagoon during 2019 where dense colonies have been observed as fouling communities over mussel culture rafts (Brito et al., 2020).

Botrylloides niger Herdman, 1886

Botrylloides niger was found on settling plates from both Madeira and Porto Santo Islands, with records for all marinas since October 2013 (Ramalhosa et al. 2019). This species is distributed worldwide in the tropical region and a recent molecular study showed that probable region of origin is in the West Atlantic (Sheets et al. 2016).

Distaplia magnilarva (Della Valle, 1881)

Distaplia magnilarva was first recorded from Madeira in 2013, in the marina of Quinta do Lorde (Caniçal; Ramalhosa et al. 2019). The most likely vector of introduction is by fouling. The species is an European species found in the Atlantic and Mediterranean Sea (Mastrototaro and Brunetti 2006) and the only appearance in the marina suggests its classification as NIS.

Didemnum vexillum Kott, 2002

Although the occurrence of this species has been reported for Algarve, the molecular analysis of some specimens indicated that it had been misidentified. The species has been removed from the NIS list for Portugal.

Polyandrocarpa zorritensis (Van Name, 1931)

Polyandrocarpa zorritensis was found on settling plates placed in the marina of Calheta in January and August of 2014 (Ramalhosa et al. 2019). Since then, this species has never been detected again. The species is widely distributed in shallow waters, has been found in the Mediterranean since 1974, where it is considered introduced, and was originally described from Peru (Brunetti and Mastrototaro 2004)... Its original geographical distribution is still unknown, but the lack of reports in east Atlantic and its appearance in one site only for a short time suggest that this species is a NIS in Madeira Archipelago. It has spread probably due to hull fouling

Fishes

Cynoscion regalis (Bloch & Schneider, 1801)

The weakfish seems to be extending its distribution along the Portuguese coast since it was firstly detected in the Sado estuary in 2014. Still, only a few specimens were detected in 2016 and 2017 in Algarve (south Portugal), followed by a two-year period without records and another three specimens in 2019 in Guadiana estuary (NEMA project), suggesting that this species is not currently established in Algarve.

Table 1. List of new NIS registered in Portuguese waters in 2019-2020

Taxa	Year of first record	Location of first record	Possible introduction vector	Population Status	References
Algae – Rhodophyta					
Antithamnionella boergesenii (Cormaci & G.Furnari) Athanasiadis, 1996	2001	Madeira	Fouling; Ballast water	Unknown	Neto et al., 2001
Asparagopsis taxiformis (Delile) Trevisan de Saint-Léon	1968-73	Madeira	Fouling; Ballast water	Established	Levring, 1974
Melanothamnus sphaerocarpus (Børgesen) Díaz-Tapia & Maggs, 2017	2000	Madeira	Fouling; Ballast water	Unkown	Haroun et al., 2002
Ulva australis Areschoug	2005	Ria Formosa		Established	Bárbara et al., 2014
Porifera					
Prosuberites longispinnus Topsent, 1893	2014	Porto Santo	Fouling	Established	Ramalhosa et al., 2019
Bryozoa					
Tricellaria inopinata d´Hondt & Occhipinti Ambrogi, 1985	2013	Madeira	Fouling	Established	Ramalhosa et al., 2019
Arthropoda – Copepoda					
Pseudodiaptomus marinus Sato, 1913	2011	Mondego estuary	Ballast water	Established	Uttieri et al. 2020
Arthropoda – Amphipoda					
Ericthonius didymus Krapp-Schickel, 2013	2014	Azores, São Miguel	Fouling	Established	Gouillieux et al., 2020

Stenothoe georgiana Bynum & Fox 1977	2013	Azores, São Miguel	Fouling	Established	Martinez-Laiz et al., 2020
Arthropoda – Decapoda					
Cronius ruber (Lamarck, 1818)	2018	Madeira	Unknown	Unknown	Schafer et al., 2019
Pyromaia tuberculata (Lockington, 1877)	2016	Tagus estuary	Ballast water	Established	Lobo et al., (*submitted*)
Chordata – Tunicata					
Aplidium glabrum (Verrill, 1871)	2013	Madeira	Fouling,	Established	Ramalhosa et al., 2019
Botrylloides diegensis Ritter & Forsyth, 1917	2019	Albufeira lagoon	Fouling, Aquaculture	Established	Brito et al., 2020
Distaplia magnilarva (Della Valle, 1881)	2013	Madeira	Fouling	Unknown	Ramalhosa et al., 2019
Perophora japonica Oka, 1927	2019	Albufeira lagoon	Fouling, Aquaculture	Established	Brito et al., 2020
Polyandrocarpa zorritensis (Van Name, 1931)	2014	Madeira	Fouling	Unknown	Ramalhosa et al., 2019

4. NEW **Research and Monitoring Programs**

Planned Research:

- 2019-2020 - RAGES Risk-based Approaches to Good Environmental Status. Funded by the Marine Strategy Framework Directive- Second Cycle: Implementation of the new GES Decision and Programmes of Measures"– "DG ENV/MSFD 2018 call European Comission (PI: Tim O'Higgins, University College Cork; WP3- Application of risk based approach to non-indigenous species (Descriptor 2)- WP coordinator, IPMA, Jorge Lobo).

- 2018-2021 – ENVMETAGENOMICS - eDNA: from rare species detection to whole-community diversity using high-throughput sequencing. Support: PTDC/BIA-CBI/31644/2017. MARE – FCUL. Funded by FCT (PI Judite Alves and Filipe Ribeiro)

- 2019-20XX - NEMA – Novas Espécies Marinhas do Algarve. (PI: João Encarnação & Alexandra Teodósio CCMAR)

- 2020 – 2022. Progreso de la Planificación Sostenible de Areas Marinas en Macaronesia (PLASMAR+). Programa INTERREG MAC 2014-2020. (Local PI: João Canning-Clode).

- 2020-2022. Seguimiento, control y mitigación de proliferaciones de organismos marinos asociadas a perturbaciones humanas y cambio climático en la Región Macaronésica (MIMAR+). Programa INTERREG MAC 2014-2020. Local PI: João Canning-Clode).

Research Needs:

Taking into account the spread of non-indigenous species, some of which with invasive behavior, coordinated programmes at regional and subregional level should be adopted, for better controlling, eradicating and mitigating adverse effects of NIS. Moreover, an effort must be made to harmonize the existing reference databases, as an important step forward in providing the different stakeholders with accurate, detailed and up-to-date information, as well as to support European policies targeting the conservation of biodiversity and the sustainable use of the marine environment.

Taxonomic studies dedicated to some species currently considered cryptogenic should include molecular studies in cooperation with other international teams to highlight, not only evidence regarding the taxonomic entities under study, but also potential relationships with other Mediterranean and Atlantic populations. More efforts have to be directed to species inventories in marinas not surveyed so far.

5. Meetings

2018 - International Meeting on Marine Research 2018 (IMMR'18), Peniche, Portugal, 5th and 6th of July. The IMMR'18 is an international congress planned to communicate novel scientific knowledge on marine resources and research towards the sustainability of our planet. It included a special session on Marine Invaders. Organized by MARE-IPLeiria.

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SWEDEN

NATIONAL REPORT FOR SWEDEN 2019

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Overview:

Two new species were discovered in Sweden during 2019: the comb jellyfish *Beroe ovata* at the station Släggö, North Seaand the Atlantic rock crab *Cancer irroratus* in the southern Kattegat. The round goby *Neogobius melanostomus* continues to expand its range in the Baltic Sea every year. Round goby was detected in Östhammar (Archipelago Sea), which shows that the species is spreading northwards on the Swedish coast. On the 19th September 2019, one individual of round goby (male) was caught in Rökan, Instön, which is located 25 km from the Gothenburg harbour. This is the first confirmed round goby observation in truly saline water (23-25 psu), although two other citizen science observations in the Skagerrak (2015 and 2018) indicate even higher salinity conditions around 30 psu. The occurrence of all different development stages, from juveniles to adults and ovigerous females of the Harris mud crab, *Rhithropanopeus harrisii,* indicates that *R. harrisii* has been established in the invaded area. No observations were made on the American lobsters *Homarus americanus* during 2019. The two Asian shore crabs *Hemigrapsus sanguineus* and *H. takanoi* are still found in an increasing number on the Swedish west coast. Both observations of juveniles of the two species and egg bearing females of *H takanoi* is a strong indication of reproduction on the west coast. The Chinese mitten crab, *Eriocheir sinensis* is sporadically found along the coast of eastern Sweden and up to the archipelago of Piteå in the Bay of Bothnia. During summer 2019, five individuals of pink salmon*, Oncorhynchus gorbuscha* were observed in the fish counter at the Hertin, Halland County. Several individuals of the dark false mussel *Mytilopsis leucophaeata* were found at two sites in Singö, the north of Stockholm County. The Japanese wireweed (*Sargassum muticum*) is seemed to have continued stable occurrence at Ringhals nuclear power plant. Since 2016, the Pacific oyster *Magallana gigas* has been expanding its range southwards.

Content:

1. **Regulations:**

Several new actions have been undertaken by the Swedish Agency of Marine and Water Management (SwAM):

- Updating on web information and factsheets on alien species
- National and regional information meetings and workshops on alien species
- Updating on web information on American lobsters
- Management plan for round goby (manuscript).
- Information campaign – to report and send in live American lobster for genetic and diseases analysis.
- A new national monitoring program on marine non-indigenous species started by SwAM in 2019 after many years of development and evaluation. The program is developed according to MSFD to assessment of the scale of the pressure and impacts of marine non-indigenous descriptor D2. The methodology is based on the Helcom guidelines for non-indigenous species monitoring by extended

Rapid Assessment Survey (eRAS). 20 hotspot areas will be investigated the next coming years in Swedish coastal waters.

- The citizen science project Rappen has continued for the fifth year (started from 2015) with the aim to facilitate and encourage to reports of alien and threatened aquatic species by the public. It also aims to increase awareness of alien species. The web-based smartphone/tablet was developed further, essential to enable a direct connection to the Swedish Species Observation System, more species to report and increased performance. The project is run by SwAM, University of Gothenburg and the Swedish Species Information Centre at SLU (www.havochvatten.se/Rappen).
- The Swedish Species Information Centre has classified 1033 alien plants and animals (freshwater, marine and terrestrial) on behalf of SwAM and the Swedish Environmental Protection Agency during 2017-2018 and published in January 2019. Twenty, of the aquatic classified species from the two high-risk categories (High and Severe), were selected and further analysed for their current impact on ecosystem services. The report was finalized in December 2019.
- Member states shall, according to article 13 of the the regulation (EU) no 1143/2014, establish and implement an action plan to address the priority pathways of unintentional introduction and spread of invasive alien species of union concern in (at least) their territory. SwaM and The Swedish Environmental Protection have, in collaboration, written an action plan which was reported to the EU in june 2019. The actiona plan is based on an analysis of prioritized pathways for the unintentional introduction of invasive alien species which was conducted by the Swedish Biodiversity Centre (CBM) at the Swedish University of Agricultural Science (SLU) in 2019. The results of the analysis showed 12 highly prioritized pathways; through which at least three species could spread that were classified as highly invasive (high rate of invasion and high potential damage to biodiversity). Additional information was used in the determination of prioritized pathways for aquatic species within this action plan. Two additional pathways were included based on this, bringing the total to 14 prioritized pathways. The measures in this action plan includes, among others, communication and information to the general public, especially through non-profit organizations and to other bodies through trade organizations. Developing or sharing best praxis for operators in different fields can also be effective measures for reducing the risk of unintentional introduction and spread of invasive alien species.

2. **Intentional:**

No information

3. **Summary of sighting.**

Unintentional:

New Sightings

The comb jellyfish *Beroe ovata* was sighted at the station Släggö (N 58°15.50', E 11°26.00') in North Sea (https://www.artportalen.se/Sighting/81863021) on April 23, 2019. The Atlantic rock crab *Cancer irroratus* was discovered in crayfish trap at a depth of 27m in North of Kullen, outside Skäldeviken in the southern Kattegat (N 56°22'0.0", E 12°26'0.0"E) on April 17, 2019 (https://www.artportalen.se/Sighting/81887473). The species has planktonic larvae, so it is likely that the rock crab could reach the coast of Sweden through ballast water from vessels. Young small crabs can also settle on ship's hulls and be transferred to new marine area. It is also likely that adult animals could

come from trade in live crab and be released, since Swedish trade with Iceland brings in live crabs (https://www.havochvatten.se/hav/fiske--fritid/arter/arter-och-naturtyper/stenkrabba.html)

Previous Sightings

An occurrence of the toxic clinging jellyfish *Gonionemus vertens* was assumed to be the cause of burning of the skin for swimmers in Swedish west coast in July 2018 (Björn Källström, pers. comm.). It has been suggested that the outbreak at the Swedish west coast is linked to the exceptionally warm summer of 2018 following either a climate-driven range shift or a direct introduction to the area via shipping activity (Govindarajan et al. 2019). An analysis of mitochondrial COI sequences demonstrated that the Swedish medusae belong to the same clade as highly toxic populations previously found in the Sea of Japan and the northwestern Atlantic (Govindarajan et al. 2019). Govindarajan et al. (2019) speculated that the toxic clinging jellyfish belong to a species other than *G. vertens* and that there has been a cryptic invasion of this species (*Gonionemus* sp.).

Range expansions

Round goby *N. melanostomus* has slowly been expanding its range in the Baltic Sea now commonly occurring from the site of first introduction in Karlskrona eastwards along the coast through Kalmar strait and up to Oskarshamn then the inner part of Bråviken and the northernmost findings at Muskö, south of Stockholm as well as in Östhammar, Uppsala County. The occurrence of individuals larger than 15 cm in the catch collected from Hargshamn on the Uppland coast during summer 2019 indicated an established stock of the round goby in this area. The previous northernmost finds in Sweden have been made in Nynäshamn. On the 19th September 2019, one individual of round goby (male) was caught in Rökan, Instön (57°53.397'N 11°39.941'E) which is located 25 km from the Gothenburg harbor (salinity in the surface water: 23-25 psu; Björn Källström, Pers.Com.) (https://www.artportalen.se/Sighting/82182166). This is the first confirmed round goby observation in truly saline water (23-25 psu), although two other citizen science observations in the Skagerrak (2015 and 2018) indicate even higher salinity conditions around 30 psu.

The findings of the Harris mud crab, *Rhithropanopeus harrisii,* have been reported for a wider area than before, first more or less the whole coast of Blekinge county and then westward in Öresund and into the channels of Malmö (Matz Berggren, Martin Stålhammar, pers. comm.). The occurrence of all different development stages, from juveniles to adults and ovigerous females of this species indicates that *R. harrisii* has been established in those areas.

No observations were made on the American lobsters *Homarus americanus* during 2019 (Mats Ulmestrand, pers. comm.). Hence, a total of 38 American lobsters has been observed in Sweden since 2008. The two Asian shore crabs *Hemigrapsus sanguineus* and *H. takanoi* are still found in an increasing number on the Swedish west coast (Matz Berggren, pers. comm.). In 2019, a huge number of *H. sanguineus* was found in the Stenungsund area Västra Götaland County (Matz Berggren, Björn Källström, pers. comm.). Many juveniles of *H. takanoi* were observed occasionally in the Koster area (north part of the Swedish west coast down to Öresund (only one finding) (Matz Berggren, pers. comm.). Occurrence of ovigerous females of *H. takanoi* in the Stenungsund area (five from 11 females found on the 13th Sep 2019) indicted that his species is reproducing in the Swedish west coast Björn Källström, pers. comm.).

The Chinese mitten crab, *Eriocheir sinensis* is sporadically found along the coast of eastern Sweden and up to the archipelago of Piteå in the Bay of Bothnia (Matz Berggren, pers. comm.). In 2019, although a finding of this crab was reported from inside Lake Mälaren, there was no reports for this species in Lake Vänern where the species has often been reported in the previous years (Matz Berggren, pers. comm.). Perhaps the fishermen do not consider it as a non-indigenous species and do not report it any longer (Matz Berggren, pers. comm.).

Pink salmon *Oncorhynchus gorbuscha* was observed for the first time in river Ljusnan (Hälsingland) in 1974. Since then, stray individuals of this species have occasionally been found in Sweden. The fish is probably originating from stocking in the Arctic Ocean. During summer 2019, five individuals of pink salmon were observed in the fish counter at Herting (Ätran), in southeast Falkenberg (Halland County) (Björn Fagerholm, pers. comm.). In this fish counter, 18 individuals of pink salmon were previously observed in 2017 (Björn Fagerholm, pers. comm.).

Several individuals of the dark false mussel *Mytilopsis leucophaeata* (≤ 5 mm shell length) were found at two sites in Singö, the north of Stockholm County (Enholmen and Höggrundet) (Chiara D'Agata, pers. comm.) in 2019. Moreover, one individual of *Gammarus* (CF) *tigrinus* was reported in the Askö area, Södermanland County) (Chiara D'Agata, pers. comm.). The Japanese wireweed (*sargassum muticum*) is seemed to have continued stable occurrence at the Ringhals nuclear power plant (Karin Svanfeldt, pers. comm.).

Since 2016, the Pacific oyster *Magallana gigas* has been expanding its range southwards. Under a school project (see below), 30 individuals of *M. gigas* were found on the sandy beach in Båtvik (Västra Götaland County) on the 27th August 2019.

During 2019 the dinoflagellate *Dinophysis tripos* (possibly harmful) has been more frequent in Swedish waters (Marie Johansen, pers. comm.). One single cell of the dinoflagellate *D. caudata*, which is a tropical-subtropical species and occurs in the southern Europe, was also found during fall 2019 (Marie Johansen, pers. comm.). Nevertheless, these two plankton species, are most probably transported by water currents and not by humans, so these are not NIS for Sweden.

There is risk to overlook the two coastal shrimps, which were found in neighboring waters (*Palaemon macrodactylus* and *Palaemon tigrinus*) of eastern Denmark and Baltic coasts of Germany, in Sweden due to their similarity to Swedish indigenous species (*P. adspersus* and *P. elegans*) (Matz Berggren, pers. comm.). Public awareness about these two species can be increased.

4. **Pathogens**

5. **Research and Monitoring Programs**

1) Projekt Nya arter" is financed by County of Västra Götaland involving schools along the west coast of Sweden. In the project, there are 15 schools, about 35 teachers and 1500 students who learn more about invasive alien species and conduct their own field research. Following alien species are in focus (and investigated with different methods: *Ficopomatus enigmaticus, Austrominius modestus, Watersipora subtorquata, Caprella mutica* (panels) *H. takanoi, H. sanguineus* (cages) *M. gigas*

(collection) *and N. melanostomus* (fishing with cage and angling). This project was run in 2017-2019 and will continue in 2020.

2) Round goby in County of Blekinge and County of Kalmar (granted in 2019): the purpose of the project is to investigate the seasonal distribution, movement patterns and habitat utilization of round goby in the area. Environmental toxin analysis will be performed and the importance of round as prey, predator and competitor (including behavioral interactions with native species) will be investigated.

3) Goby fishing- a new resource": here, Kalmar municipality is project coordinator who together with most partners will investigate the potential for commercial fishing on the round goby.

6. **Meetings**

1) Flora and Fauna Conservation Conference (SLU Ultuna, April 2019): The theme of this conference was "Nature in transformation - alien species and nature conservation". Discussion was about the risk with alien species in Swedish nature - how are the new species estimated, who is responsible for them and do they get rid of them? Where do they show up? And what happens next?

2) **The Pacific oyster – a new Nordic food resource and a basis for tourism (Gothenburg Feb 2019):** The workshop had 44 participants from Sweden, Norway and Denmark (both researchers, industry and authorities) and was about management of Pacific oysters (*Magallana gigas*).

A report (https://www.norden.org/no/publication/hosting-av-stillehavsosters) and a policy brief (https://www.norden.org/en/publication/policy-brief-pacific-oyster-new-nordic-food-resource-and-basis-tourism) were published. In this workshop, mapping of the Pacific Ocean's distribution in Koster National Park and around Tjärnö, as well as around Orust was made in 2019. Further mappings will be carried out in the Grebebstad–Lysekil area.

7. **References and bibliography**

Govindarajan AF, Källström B, Selander E, Östman C, Dahlgren TG. 2019. The highly toxic and cryptogenic clinging jellyfish *Gonionemus* sp. (Hydrozoa, Limnomedusae) on the Swedish west coast. PeerJ 7: e6883 https://doi.org/10.7717/peerj.6883

UNITED KINGDOM

Compiled by

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Overview:

2019: One new species was recorded in 2019, the polychaete *Lepidasthenia brunnea*, and another was first reported in 2019 from 2017 records, the freshwater/brackish amphipod *Crangonyx floridanus*. The anticipated invasion of UK rivers by pink salmon *Oncorhynchus gorbuscha*, as a repeat of that observed in 2017, did not occur. Relatively few specimens were reported (33), and these almost entirely in Scottish rivers (20 fish), with three in England, one in Wales and nine in Northern Ireland. A study was undertaken in the summer of 2019 on the distribution of pink salmon using eDNA surveys, with a complementary study of the species impacts on food webs using stable isotope analysis. The results of these studies will be reported in 2020. The global trial of the Aquatic Species Invasiveness Screening Kit (AS-ISK), a contribution to the WGITMO ToR, reached its conclusion during 2019, with preparation of the journal article underway. The non-native bryozoan, *Watersipora subatra*, was recorded for the first time in Scotland. The specimen was found at the Stromness Marina, Orkney Islands during the 2019 non-native species monitoring surveys by the Orkney Islands Council Harbour Authority.

Content:

1. **Regulations:**

2019: The UK government launched a consultation in 2019 on how best to manage invasive non-native species that threaten native wildlife. Under EU law, management measures must be put in place for widespread invasive alien species. The eight-week consultation asked for views on ways to manage populations of species of concern of which the aquatic species listed were mainly inhabitants of freshwater environments, i.e. Nuttall's waterweed (*Elodea nuttallii*), floating pennywort (*Hydrocotyle ranunculoides*), curly waterweed (*Lagarosiphon major*), parrot's feather (*Myriophyllum aquaticum*), signal crayfish (*Pacifastacus leniusculus*) and all sub-species of slider terrapins (*Trachemys scripta*), and Egyptian goose (*Alopochen aegypticus*). However, one marine/brackish water inhabitant was listed: Chinese mitten crab (*Eriocheir sinensis*). This consultation was followed by the UK government's enactment of the statutory instrument, the Invasive Alien Species (Enforcement and Permitting) Order 2019, which came into force on 1 December 2019 and thus aligned UK and EU legislation.

2. **Intentional:**

Synthesis of introductions

Fish

2019: Salmonid egg imports continue into England and Wales from traditional sources, at levels similar to those reported for previous years. Surveillance on these imports by the FHI shows that they pose a low risk of pathogen introduction.

Marine Scotland Science provide salmonid egg import statistics for Scotland (www.gov.scot/policies/fish-health-inspectorate/). UK export statistics are also presented in these publications.

Invertebrates 2019:

None reported.

Plants 2019:

None reported.

3. **Summary of sighting Unintentional:**

Species	**Location**	**Date**	**Note**
polychaete *Syllis garciai*	Offshore Overfalls MCZ	24/01/19	New location for the UK
scale worm *Lepidasthenia brunnea*	Greater Haig Fras MCZ	09/06/19	Mediterranean species new to UK
crangonyctid amphipod (*Crangonyx floridanus*)	Lake Windermere in Cumbria, and Smestow Brook, West Midlands	Sept. 2017, July 2018, Sept. 2018	New record for UK first reported in 2019 by Mauvisseau *et al.*.
slipper limpet *Crepidula fornicata*	Numerous locations on the South Coast, from Kent to Devon and the Channel Islands: Ices rectangles: 26E7 / 27E8 / 27E9 / 29E6 / 30E6 / 30E7 / 30 E8 / 30E9 / 30F0 / 30F1 / 31F1	2019	Very high numbers occurring in beam trawls (23 – 176 individuals per trawl) throughout the English Channel

leathery sea squirt *Styela clava*	English Channel from Sussex to Southampton; Channel Islands; Southwest Wales ICES rectangle: 27E7 / 27E8 / 28F0 / 29E8 / 29F0 / 30E8 / 30E9 / 30F0 / 32E5	2019	Further record for Sussex where the species is rare
red ripple bryozoan *Watersipora subatra*	Orkney Islands, Scotland	28/02/2019	First record for Scotland (Kakkonen et. al., unpublished)

Fish

2019: None reported.

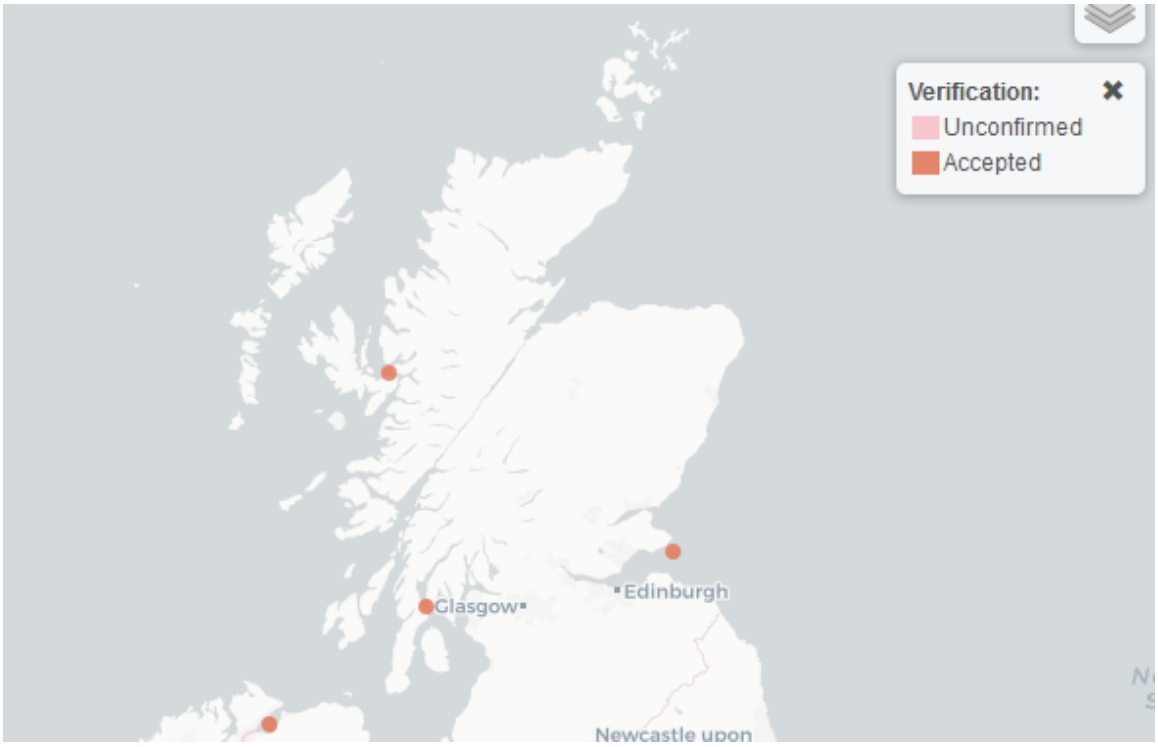
Invertebrates

2019: ***Crepidula fornicata*:** Removal of Scottish *Crepidula fornicata* records from the NBN (see map below):

There are three remaining records for *C. fornicata* in Scotland and these have been queried and the request has been made to have them removed:

1. (Kyle of Loch Alsh) Record has been proved to be a mis-identification of a juvenile species – the type specimen held at the National Museums Scotland was re-examined and found NOT to be *C. fornicata.*
2. (Clyde) Record is a transcription error in the geographic reference and the record is part of a sample set of a survey in the south coast of England where the recorder has recorded *C. fornicata* on the same day as the Clyde record!
3. (Firth of Forth) Record is from a MCS biological survey communications with the recorder confirmed this is a mistaken record. This is a regularly dived area and there is no *C. fornicata* found at this site.

All other records have been checked and removed, therefore meaning that this species is not found in Scotland (yet).



First reports from the UK were published in 2019 from freshwater sites for the amphipod *Crangonyx floridanus*, which also occurs in brackish waters elsewhere in its non-native range (e.g. California). Mauvisseau *et al.* (2019) report its discovery at two locations separated by over 200 km: Lake Windermere in Cumbria, and Smestow Brook in the West Midlands. Both sites are well connected to the UK river and canal network, so further spread, possibly into lower reaches of rivers and into estuaries, is considered likely.

Cefas' Marine Protected Area (MPA) surveys have identified new records for polychaete worms normally restricted to warmer Mediterranean waters. 2019 marks the first UK record of the Mediterranean polychaete *Lepidasthenia brunnea*. This small scale worm originally described off South Africa, but known from the Mediterranean was recovered in samples from the Greater Haig Fras MCZ, west of Cornwall. MPA surveys continued to record range extensions and new records for benthic invertebrates with the polychaete *Syllis garciai,* native to the Western Mediterranean found in the Offshore Overfalls MCZ in Southeast England. Cefas' integrated monitoring surveys recorded a number of Non-Indigenous species currently on the MSFD monitoring list in benthic beam trawls in the English Channel.

In 2019 the Orkney Islands Council Harbour Authority's marine non-native species (NNS) surveys recorded a new non-native species for Scotland, the red ripple bryozoan *Watersipora subatra* (Kakkonen et. al., unpublished). The record was made at Stromness Marina, Orkney where annual NNS surveys have been conducted since 2014. This record will be published during 2020.

Plants

2019: None reported

Previous Sightings

Fish

2019: Various species and hybrids of sturgeon, including sterlet *Acipenser ruthenus* and Siberian sturgeon *Acipenser baerii*, are regularly caught by rod-and-line anglers in the UK, most notably in England. Under UK law, these species should be present in managed, consented fisheries only, but captures of escapee non-native sturgeons are reported in the angling press (including social media and internet sites). Following the invasion of rivers of Great Britain in 2017 by pink salmon *Oncorhynchus gorbuscha*, also known as 'humpback salmon', specimens were reported in small numbers in the UK (England, Scotland, Wales) and the Republic of Ireland (www.wildtrout.org/assets/img/general/Pacific-Pink-Salmon-Update-2019-Final-002.pdf). These include a few specimens captured in July 2019 in the lower River Dee and in the River Kyle of Sutherland (Scotland). Also in Scotland, no pink salmon were captured from the River Ness in 2019, but a live specimen was recorded on underwater cameras on 26 August 2019. And, a dead male was found by an angler on the banks of the Ness at Whin Park on 11 September 2019 – the carcass was sent to Marine Scotland Science. The first known record of pink salmon on the River Findhorn was a dead specimen found at Gordon's Pool on the lower Findhorn on 26 August 2019, by local angler – the fish was male, length 53 cm and weight 0.7 kg (1.5lb). During 2019, the Fisheries Management Scotland reported pink salmon to have been recorded in a number of Scottish rivers, including the rivers Awe, Dee, Deveron, Esk, Irvine, Kyle of Sutherland, Polla, Spey and Tweed. The numbers recorded were much lower than observed in 2017 (www.fnlft.org.uk/2019/08/pink-salmon-in-findhorn/). To assess the extent of pink salmon incursions of UK rivers in 2019, a UK-wide survey was using eDNA detection methods was undertaken in August and September 2019 (details here below under 'Research and Monitoring Programmes').

Invertebrates

2019:

Species	**Location** (in N. Ireland)	**Date**	**Note** (geo-coordinates)
Austrominius modestus	Strangford North	June 2019	various locations at or near Lat./Long. 54.560133/–5.629225
Caprella mutica	Belfast Outer	July 2019	54.664611/–5.671717
Corella eumyota	Strangford North	May 2019	54.531732/–5.56146
Crassostrea (Magallana) gigas	Strangford North	June 2019	55.14738301/–7.160736241
Cymbovula acicularis	North Channel	June 2019	55.20816981/–6.114486094

Dugesia japonica	Carlingford	May 2019	54.04004735/–6.172953192
Dreissena polymorpha	River Articlave at Ardina Bridge, Bann Brook at Quilley Road Bridge, Lower Bann at Portglenone, River Sillees at Drumkeen New Bridge and at Carr Bridge	March, April & Sept. 2018	IC 789 350, IH 230 413, IH 130 471, IC 975 038, IH 120 497, IC 794 335, IC 975 038
Styela clava	Belfast Outer	July 2019	54.664611/–5.671717

Only three reports were received in 2019 for the American lobster (*Homarus americanus*) being found in UK waters: one adult in Cornwall and two juveniles in Northumberland and Scotland, the latter of which underwent molecular testing (in addition to the visual identification). However, owing to the preservatives used, the assessment was inconclusive. An awareness campaign is due to be launched across the fishing industry in early 2020 to ensure that fishers are aware of the issues around American lobsters, and to encourage them to report all possible sightings.

In a drift-dive recorded by D. Phillips on 06/07/2016, the carpet sea squirt (*Didemnum vexillum*) was found to occupy a substantial proportion of the open seabed off Herne Bay, north Kent, England (www.youtube.com/watch?v=eHrwWFaUF4Y). *Didemnum vexillum* has been confirmed by Marine Scotland at a new Scottish site, Loch Fyne (Peel Ports online information sheet dated 01/02/2018).

The clinging jellyfish (*Gonionemus vertens*) rarely recorded in the UK, was reported from Brightlingsea, Essex, in June 2019 (D. Shillito and R. Tabor, personal communication to John Bishop, MBA). Based on photographs, Dr A. Govindarajan (Woods Hole Oceanographic Institution, Mass., USA) considered the specimens to be most likely referable to the very toxic form of *G. vertens*, which probably deserves recognition as a separate species.

Plants

2019:

Species	**Marine locations** (in N. Ireland)	**Date**	**Notes** (geo coordinates)
Bonnemaisonia hamifera	North Coast	June 2019	55.210401/–6.655203
Caulacanthus okumurae	North Channel & Foyle	June & July 2019	55.20816981/–6.114486094 and 55.15643441/–7.126876165
Codium fragile atlanticum	North Channel	June 2019	55.20816981/–6.114486094

Codium fragile fragile	North Channel	June 2019	55.20816981/–6.114486094
Colpomenia peregrina	Strangford North & South, Dundrum outer, Foyle, & Carlingford	May–July 2019	various locations, including 54.531732/–5.56146
Gracilaria vermiculophylla	Foyle & Carlingford	May & July 2019	various locations at or near Lat./Long. 55.14738301/–7.160736241
Neosiphonia harveyi	Belfast inner & Foyle	May & July 2019	54.67921296/–5.883474873 and 55.15643441/–7.126876165
Sargassum muticum	Belfast Lough, Belfast inner, Carlingford, Strangford North & South, Foyle, North Coast & Dundrum Outer	May–Sept. 2019	various locations, including 54.718285/–5.796194
Undaria pinnatifida	Belfast Outer	July 2019	54.710721/–5.812562

Species	**Freshwater locations** (in N. Ireland)	**Date**	**Notes** (geo coordinates)
Impatiens glandulifera	Lake Neagh	August 2018	IH 98860 86554, IJ 09810 77819, IJ 00504 63241, IH 90121 66139, IH 95021 85031, IH 95865 87204, IJ 11727 87944, IH 95731 73307, IH 97692 64353, IJ 08141 86448
	And various riverine locations	June to Sept. 2019	C384005, H293940, H352964, H353907, H373900, H364875, H315845, H438873, H576875, H614848, H535859, H392766, H625530, H766933, H774953, H816982, H 49300 86713

Fallopia japonica	And various riverine locations	July 2018 & June–July 2019	C384005, H353907, H315845, H450886, G942518, H 84856 91471, IC 668 229, IC 683 098, IC 473 171, IC 474 175, IC 474 135
Mimulus sp.	Lake Neagh River Mourne at Victoria Bridge, Douglas Burn (Goyle) at Douglas Bridge	August 2018 July 2019	IJ 09810 77819, IH 90121 66139, IJ 11727 87944, IH 95731 73307, IH 97692 64353 H353907, H373900
Azolla sp.	Lake Neagh	August 2018	IH 90121 66139
Elodea nuttallii	Lake Neagh	August 2018	IH 96668 77751
Elodea canadensis	lakes Neagh, Lattone, Tullynawood & Yoan River Blackstaff (south down) at Tullymurry Bridge, River Connswater	July & August 2018 March & April 2018	IH 96668 77751, IH 00286 45042, IG 99877 45407, IH 86240 29185, IH 85884 29352, IH 25168 42323, IH 25303 42421, IH 25461 42195, IH 25334 42066 IJ 429 411, IJ 374 732, IJ 364 735
Elodea nuttallii	Lake Moor	July 2018	IH 44871 98164, IH 44540 98294, IH 44698 98427, IH 45067 98361
Heracleum mantegazzianum	lakes Neagh & Moor Six Mile Water at Castle Farm Bridge (Antrim), River	July & August 2018 July–Sept. 2018	IJ 08141 86448, IH 45067 98361 IJ 144 868, IC 474 175, IH 339 454

	Faughan above Gorticross, River Temp River Mourne at Victoria Bridge, Douglas Burn (Goyle) at Douglas Bridge, River Colebrooke at Pollboy Bridge, River Owenkillew at Trinamadden Bridge	June & July 2019	H353907, H373900, H445434, H 49300 86713

Species Not Yet Seen

Fish

2019: The arrival in the UK of Ponto-Caspian invertebrate species in past years has not yet been followed by the arrival of Ponto-Caspian fish species of which the most notable are the gobies.

Invertebrates

2019: The dwarf surf clam (*Mulinia lateralis*) has been reported in large numbers in the Dutch and German sections of the Wadden Sea and in the Westerschelde estuary, Netherlands, these being the species' first recorded occurrences outside its western Atlantic native range (Craeymeersch *et al.* 2019; Klunder *et al.* 2019). Published records date back to 2017 and 2018. The species should therefore be regarded as a potential arrival in the UK.

Plants

2019: None reported.

4. **Pathogens**

2019: A reoccurrence of oyster herpes virus (OHV-1) in farmed *Crassostrea gigas* was reported. New confirmed designations of koi herpes virus (KHV) on recreational coarse fisheries and in Japanese koi carp at ornamental facilities were also reported.

Further Information on finfish disease surveillance and compliance for the UK and designations for England and Wales is provided at: www.gov.uk/government/publications/fish-health-inspectorate-reports-2019

5. **Research and Monitoring Programmes**

2019:

In Scotland, validation of real time PCR assay for the detection of *Didemnum vexillum* in environmental samples (water/sediment) was completed by Marine Scotland Science (MSS) and a peer-reviewed paper will be published in 2020. A pilot eDNA-based routine monitoring programme was launched in the wider inner seas off the west coast of Scotland, also including Loch Linnhe and Loch Etive; as well as the Clyde

area including Firth of Clyde, Loch Fyne and Sound of Bute, targeting artificial marine structures such as harbours, ferry terminals, recreational marinas and/or aquaculture related installations and infrastructures. The main aim of this pilot is to assess the spread of *D. vexillum* in these hotspot areas, however there is an intention to utilise environmental samples collected to screen for presence of additional NIS according to the Scottish NIS Strategy Priority Species List in future. For further information, contact Iveta Matejusova (iveta.matejusova@gov.scot).

Since 2018, MSS has investigated the potential of DNA-based monitoring to assess biofouling communities associated with the commercial harbours and recreational marinas. In collaboration with the Orkney Harbour Authority and Solway Firth Partnership, Marine Scotland Science investigates the use of settlement panels to capture biofouling and carries out comparisons between traditional rapid assessments followed by morphology-based identification of biofouling and high throughput sequencing (HTS) outputs. The HTS data for both 18S and COI markers have been analysed for panels collected in 2018 and a peer reviewed paper will be published in 2020. The HTS data collected from the bulk settlement panel material will be compared to HTS data, being currently generated from water samples collected alongside of the settlement panels. Contact: (iveta.matejusova@gov.scot).

A PhD project started in October 2019 to investigate the potential uses of eDNA to monitor marine invasive species in relation to the native European oyster (*Ostrea edulis*) restoration initiatives in the Dornoch Firth (Scotland). This is a collaborative project between MSS, the University of Aberdeen and Heriot Watt University Edinburgh and will develop and support robust biosecurity protocols relevant to the restoration project, using second and third generation sequencing approaches. Contact: (iveta.matejusova@gov.scot).

The Orkney Islands Council's Harbour Authority is continuing with its annual marine non-native species monitoring programme, which began in 2013. The monitoring programme has recorded 18 NNS, including the red ripple bryozoan (*Watersipora subatra*), mentioned here above, during the 2019 surveys. A manuscript of this record is in preparation for publication in 2020. Also, in 2019, range expansions within Orkney were recorded for the sand gaper *Mya arenaria*, red seaweeds (*Bonnemaisonia hamifera* and *Dasysiphonia japonica*), Japanese skeleton shrimp (*Caprella mutica*), oyster thief (*Colpomenia peregrina*), marine splash midge (*Telmatogeton japonicas*) and the bryozoan *Fenestrulina delicia*. The distributions of the other ten NNS previously recorded in Orkney Islands remained unchanged in 2019. The monitoring programme continues annually with surveys for each year starting in June and ending in October. For further information, contact Jenni Kakkonen (jenni.kakkonen@orkney.gov.uk).

Published SEPA Classification results report that *Didemnum vexillum* has been confirmed for another water body. However, this water body was already downgraded for non-native species as it already had *Styela clava* present. Details available at: www.sepa.org.uk/environment/water/aquatic-classification/.

The anticipated invasion of UK rivers, in particular those of Scotland and Northern England, by the diadromous salmonid fish, pink salmon (*Oncorhynchus gorbuscha*), following the elevated numbers reported in 2017, did not occur. Relatively few specimens were reported, and these almost entirely in Scottish rivers. An eDNA survey of GB rivers for pink salmon was undertaken in August and September 2019, involving a collaboration of scientists from Cefas, the Game & Wildlife Conservation Trust (GWCT), Queen Mary University (London), Marine Scotland Science, Scottish Natural Heritage, the Environment Agency (England) and the University of Gdańsk (Poland) (see: www.gwct.org.uk). This study was

complemented by studies, using stable isotope analysis, to assess the impact of decaying carcasses on the invaded water course's food web. The eDNA analysis revealed a detectability issue using a primer taken from the literature, so the existing samples will require re-analysis with an alternative primer before results of the eDNA survey can be reported.

In 2019, a new project on diadromous species was initiated in the Interreg Atlantic Region 'Assessing and enhancing ecosystem services provided by diadromous fish in a climate change context' (DiadES). Led by colleagues at the French *Institut national de recherche en sciences et technologies pour l'environnement et l'agriculture* (Irstea), this project involves two UK partners (Cefas, the University of Plymouth) and their associates (Angling Trust, Rivers Trust) as well as partners from the Republic of Ireland, Portugal and Spain. The DiadES project aims to assess and enhance ecosystem services provided by diadromous fish in the Atlantic Area, and in parallel, the conservation status of these species, by explicitly considering in their management expected impacts of climate change on their distributions. Data compiled for this project include existing data from partner countries as well as new data, including the analysis of water samples for eDNA and the microchemistry analysis of tissue samples to inform species distribution databases. For further information contact Tea Bašić (tea.basic@cefas.co.uk) or Lynda Rodwell (lynda.rodwell@plymouth.ac.uk).

The global trial of the Aquatic Species Invasiveness Screening Kit (AS-ISK) (available for free download at: www.cefas.co.uk/nns/tools/), reached its conclusion during 2019. Co-coordinated by scientists from Cefas and the University of Łódź (Poland), this study involves risk screenings of marine, brackish and freshwater species around the globe. The outcome of this initiative, which involves several WGITMO delegates, is a contribution to the WGITMO ToR "Advance knowledge base to further develop indicators to evaluate the status and impact of non-indigenous species in marine environments". For further information contact Gordon H. Copp (gordon.copp@cefas.co.uk) and Lorenzo Vilizzi (lorenzo.vilizzi@gmail.com).

During 2019, Cefas contributed further to the development of a list for the EU Regulation on the management of invasive alien species (Roy *et al.* 2019), resulting in the revision of assessments of western mosquitofish *Gambusia affinis* (Aislabie *et al.* 2019a), eastern mosquitofish *Gambusia holbrooki* (Aislabie *et al.* 2019b), and the completion of risk assessments on black bullhead *Ameiurus melas* (Aislabie *et al.* 2019c), brown bullhead *Ameiurus nebulosus* (Aislabie *et al.* 2019d), and northern snakehead *Channa argus* (Aislabie *et al.* 2019e). Risk screenings of non-native species during 2019 included jellyfishes in the Mediterranean (Killi *et al.* 2019) as well as marine and brackish species for the Arabian/Persian Gulf and Sea of Oman (Clarke *et al.* 2019). For further information contact Gordon H. Copp (gordon.copp@cefas.co.uk) or Luke Aislabie (luke.aislabie@cefas.co.uk) or Stacey Clarke (stacey.clarke@cefas.co.uk).

GBNNSS Risk Assessments completed in 2019 include species-specific assessments of sea walnut *Mnemiopsis leidyi* and pink salmon *Oncorhynchus gorbuscha* as well as a collective assessment of Ponto-caspian gobies. For further information, refer to the risk assessments made available by the GB Non-Native Species Secretariat: www.nonnativespecies.org

An R&D project at Cefas, funded by the UK Department for Environment, Food & Rural Affairs (Defra), on Pacific oyster (*Magallana* [*Crassostrea*] *gigas*) population dynamics commenced in 2019. The project spans two financial years (2019/2020 and 2020/2021) and aims to: (1) use a modelling approach to provide insight into the impacts of temperature and external recruitment on oyster populations

dynamics, and (2) integrate management into the model to examine the relative merit of different approaches. Where possible and appropriate this projects draws insight from the 2017 EMFF project on pacific oyster control in the southwest. Further project outputs will be linked to the particle tracking project (see below) where possible.

A Defra-funded Cefas R&D project on the application of particle tracking modelling to NNS risk assessment and management commenced in 2019. Particle tracking modelling was combined with habitat suitability assessment to assess the risk of introduction and spread of NNS by the natural dispersal pathway. The work focussed on the Pacific oyster, however the approach can be broadly applied to non-native species with a pelagic phase.

In March 2019, the Defra Centre of Excellence for DNA Methods was launched. This brings together UK government agencies with shared interests in developing molecular methods, with non-native species detection recognized as one of the group's priorities. One of the first set of projects launched by this virtual centre was to develop monitoring protocols for high-risk marine invasive NNS, led by Cefas, Natural England and Marine Science Scotland. A workshop was held at Cefas, Weymouth on 26 November 2019, which invited stakeholders from across the UK to contribute to a review of the current status of monitoring for invasive NNS at high-risk sites and provide recommendations for standardised protocols, incorporating molecular methods, and further research moving forwards. Cefas, Natural England and Marine Science Scotland are currently working on developing targeted PCR assays for particular high-risk species which will allow verification of methods across a range of species' ecologies and field conditions. For further information, contact Phil Davison (phil.davison@cefas.co.uk) or Louisa Wood (louisa.wood@cefas.co.uk) or Iveta Matejusova (iveta.matejusova@gov.scot).

Amongst the various initiative to develop eDNA (e.g. Davison *et al.* 2019; Holman *et al.* 2019), a project to improve eDNA monitoring by filling sequencing gaps for North Sea invertebrates was launched in 2019, as an element of the Interreg GEANS programme. Cefas are the UK partners, providing specimens for sequencing that will be led by the Senckenberg Institute. Non-native species for the North Sea region, including horizon species, will be included in this project. For further information, contact Phil Davison or see the website: https://northsearegion.eu/geans/.

A PhD project on the Asian date mussel (*Arculata. senhousia*) began in October 2019. The project aims to include assessment of distribution, population dynamics, dispersal potential and impacts of the species in order to inform risk assessment and management. The PhD candidate is based at the University of Portsmouth, with supervisors from Cefas-Weymouth and APEM. For further information, contact Hannah Tidbury (hannah.tidbury@cefas.co.uk).

Pathway action plans, led by the GBNNSS, have been drafted for angling and recreational boating pathways and are due to be completed in early 2020. Additionally a species pathway action plan for *Didemnum vexillum*, which is being lead by Scottish Government under the Marine Pathways Action Group, is nearing completion. Cefas has input into the UK Marine Strategy Part 2, which involves monitoring, review for consultation, and the provision of information on the current UK marine NNS monitoring programme and its gaps and limitations. The consultation is planned for Summer 2020

UK horizon scanning, led by Helen Roy (Centre for Ecology & Hydrology), was undertaken in December 2019. Updated horizon lists across freshwater and marine (and terrestrial) environments will be published during 2020.

Discussions have been taking place between Cefas and Defra regarding gaps in current knowledge with respect to marine litter as a vector of NNS and monitoring at high-risk locations.

The RAPID LIFE project, which is coordinated by the Animal and Plant Health Agency (APHA) in England with partners Natural England and the Bristol Clifton West of England Zoological Society, will come to an end in July 2020 (https://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=search.dspPage&n_proj_id=6300). This project has produced Regional Invasive Species Management Plans (www.nonnativespecies.org/index.cfm?sectionid=139) as well as a biosecurity toolkit and training packs. Natural England hopes to continue work to develop estuary-wide biosecurity plans in four further locations in 2020.

The Pacific Oyster Control (Southwest) Project continues with local community groups working in a number of estuaries in the South West to monitor and control Pacific oysters. In 2017, funding was provided by the European Maritime Fisheries Fund to continue and expand the project to consider the effectiveness of population management. This includes assessment of changes in distribution before and after removal activity, beginning with oyster density surveys which started in 2014. Multiple volunteer groups are now in place to monitor and remove Pacific oysters in their areas. In Cornwall, five Pacific oyster reefs have been recorded and the species has also been found within seagrass beds in Devon. This project will end in August 2020. For further information, contact Adele Morgan (adele.morgan@naturalengland.org.uk).

The project 'Mapping Invasive Alien Species in intertidal habitats within Natura 2000 sites in the Solent', which Natural England and the Marine Biological Association carried out, funded by the European Maritime Fisheries Fund, was completed in 2019. A new survey protocol was developed in order to replicate rapid assessment surveys in marinas to shoreline environments. Rapid assessment surveys of 14 'Clusters' of three sites, one marina/harbour site, one nearby shore and one more distant shore, were completed in the Solent, recording alien species (AS) and native species (NS) from target lists. For further information, contact Jessica Taylor (Jessica.Taylor@naturalengland.org.uk).

6. **Meetings**

2019:

CCFFR 2019 – Canadian Conference for Fisheries Research (London, Ontario, Canada; 4–6 January 2019) (www.uwo.ca/sci/ccffr_scl2019/).

ICZEGAR 2019 – International Conference on the Zoology and Ecology of Greece and the Aegean Region (Thessaloniki, Greece; 27–30 June 2019) (http://14iczegar.bio.auth.gr/).

ICAIS 2019 – International Conference on Aquatic Invasive Species (Montréal, Canada; 27–31 October 2019) (www.icais.org/).

ASC 2019 – ICES Annual Science Conference (Hamburg, Germany; 24 September 2018) (http://ices.dk/news-and-events/asc/ASC2018/Pages/default.aspx)

Meetings in 2020

CCFFR 2020 – Canadian Conference for Fisheries Research "*Aquatic Science in Changing Habitats*" (Halifax, Nova Scotia, Canada; 2–5 January 2020) (http://ccffr2020.acadiau.ca/home.html).

12th Global Summit on Aquaculture & Fisheries, Hong Kong, 30–31 March 2020 (https://aquaculture.global-summit.com/events-list/aquatic-invasive-species)

RAPID LIFE End of Project Conference (Bristol Zoo, Bristol, England, 6 June 2020)

ICMIS 2020 – International Conference on Marine Invasive Species (Berlin, Germany, 23–24 July 2020) (https://waset.org/marine-invasive-species-conference-in-july-2020-in-berlin)

ICMISM 2020 – International Conference on Marine Invasive Species Management (Venice, Italy; 12–13 November 2020)_(https://waset.org/marine-invasive-species-management-conference-in-november-2020-in-venice).

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UNITED STATES

United States National Report covering 2019

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1. Overview:

The US Environmental Protection Agency (USEPA) continues to work toward development of ballast water discharge standards within the framework of the 2018 Vessel Incidental Discharge Act (VIDA), with the goal of finalizing those standards by the end of 2020, at which point the US Coast Guard (USCG) will begin development of implementing regulations scheduled to take effect by 2022. Unfortunately, 2019 saw the discontinuation of the Invasive Species Advisory Committee, a high-level non-federal stakeholder group providing advice to the National Invasive Species Council on all aspects of invasive species research, management, and policy. We here report 10 new introductions or substantial range expansions within the US, along with 3 additional taxa that have been observed in US waters but are suspected not yet to have established populations. We report no new intentional introductions or pathogens. In addition to establishing a new regulatory framework for vessel discharges, VIDA also establishes the Great Lakes/Lake Champlain Invasive Species Program, to be administered by the USEPA. This Program, once established, will represent a major research and monitoring effort aimed at detecting introduction and spread of ANS into or within these waters and assisting with and prioritizing management and response actions including monitoring vectors likely contributing to ANS concerns.

2. Regulations:

On December 4, 2018, President Trump signed into law the Vessel Incidental Discharge Act (VIDA). That law establishes a new framework for the regulation of vessel incidental discharges under Clean Water Act (CWA) Section 312(p). VIDA requires EPA to develop performance standards for those discharges within two years of enactment and the U.S. Coast Guard (USCG) to develop implementing regulations (i.e., monitoring, reporting, recordkeeping, equipment design requirements, etc.) for those standards two years thereafter. VIDA calls for these new standards to be technology-based and generally at least as stringent as existing VGP requirements. The EPA expects to publish draft standards for more than 20 different vessel discharges, including ballast water, for public comment in Spring 2020 and finalize those standards in December 2020. To support public input on these draft standards, the EPA is planning to host several in-person public meetings and webcasts during the public comment period. Until the new USCG implementing regulations are final, effective, and enforceable, all provisions of the 2013 Vessel General Permit (VGP) and existing USCG regulations remain unchanged and in full force and effect.

In 2019, the Invasive Species Advisory Committee (ISAC), a non-federal stakeholder group advising the National Invasive Species Council (NISC), was placed on administratively inactive status and its charter

was not renewed for administrative and financial reasons. In its absence, the Council and its staff continue to engage with these non-federal entities by participating in conferences, stakeholder meetings, and field activities. The implementation of priority activities contained in the NISC Annual Work Plan includes efforts to engage with relevant constituencies and experts as appropriate. Council staff and member agencies are open to identifying additional opportunities for interaction.

3. New Introductions

New intentional introductions

No known intentional introductions to report.

New unintentional introductions (including significant range expansions)

Annelida: Polychaeta: Spionidae *Polydora onagawaensis* Abe, Nishitani & Endo 2013. *Polydora onagawaensis* is a shell-boring polychaete of the family Spionidae. It is native to the Northwest Pacific from Bohai Bay, China, and Miyagi Prefecture, south to Shanghai. In 2018, in a survey of shell-boring polychaetes at ten Eastern Oyster (*Crassostrea virginica*) farms from Buzzards Bay, Massachusetts to Mount Desert Island, Maine, the widespread cryptogenic shell-boring polychaete *Polydora websteri* was found at all farms, but at five farms in Maine, from Casco Bay northward, an unidentified shell-boring polychaete was found. Morphological features of the worms and DNA sequencing by PCR-RFLP (restriction fragment length polymorphism) of mitochondrial COI DNA matched *Polydora onagawaensis,* its first occurrences outside the Northwest Pacific. (Rawson and Rice 2018, Silverbrand 2019). The likeliest vector for introduction of this polychaete *Polydora onagawaensis* was unsuccessful plantings of Pacific Oysters (*C. gigas =Magallana gigas*) in 1949 and the 1970s (Shatkin et al. 1979). Shell-boring spionids can riddle the shells of oysters, weakening the shells, and creating mud-blisters, decreasing the quality of oysters as food. The abundance and impacts of these polychaetes are exacerbated when oysters are cultured (Rawson et al. 2018; Simon and Sato-Okoshi 2015).

Annelida: Polychaeta: Spionidae: *Polydora websteri* Hartman 1942 (CRYPTOGENIC) The shell-boring spionid polychaete *Polydora websteri* was described from Milford, Connecticut, on Long Island Sound, where it infested the shells of oysters held in suspended trays (Loosanoff and Engel 1943). Shell-boring polychaetes weaken the shell and deposit sediment on the mantle, causing the oyster to create mud-blisters, making the oysters less edible. *Polydora websteri* had been previously confused with the European *P. ciliata*, which is not a shell-borer. *Polydora websteri* has been found from Maine to Alabama on the Atlantic Coast Washington State, Hawaii, Australia, New Zealand, China, and Ukraine. (Simon and Sato-Okoshi 2015; Rice et al. 2018; Lopes 2019; Silverbrand 2019). This polychaete shows a high degree of genetic homogeneity worldwide, with little variation and high connectivity among populations. Rice et al. suggest that *P. websteri* may have been native to the Northwest Pacific, and widely introduced with Pacific Oysters, but indicate the need for further genetic sampling. Lopes et al. (2019) treat *P. websteri* as cryptogenic in Washington State, based on the tentative nature of Rice et al.'s conclusions. We also will consider this species cryptogenic in the Northwest Atlantic, pending more conclusive genetic information.

Bryozoa: Cheilostomata: *Cribrilina mutabilis* Ito, Onishi, and Dick 2015. *Cribrilina mutabilis* was described from the Akkeshi-ko estuary in northern Japan in 2014 but was found at about the same time off Kristineberg on the west coast of Sweden (Ostrovsky, cited by Ito et al. 2015) and off Norway. This bryozoan is probably native to Northwest Pacific, including China and Russia (Trott and Enterline 2019).

On September 12, 2018, it was found growing on Eelgrass (*Zostera marina*) around Clapboard, Mackworth, and Hog Islands in Casco Bay, near the harbor of Portland, Maine. Eelgrass is the most frequent substrate for this organism, but it has also been found on kelp *(Laminaria* sp.) and Rockweed (*Fucus* spp.). Portland receives much shipping from Europe, and ship fouling is the likeliest vector for *C. mutabilis*. *Cribrilina mutabilis* is of concern, as a fouler of Eelgrass, a critical component of coastal habitats and should be monitored (Trott and Enterline 2019).

Crustacea; Amphipoda: *Grandidierella japonica* Stephensen, 1938. *Grandidierella japonica* was originally described from Abashiri, Hokkaido, Japan. Its native range is from the southern Sea of Okhotsk to the East China Sea (Chapman and Dorman 1975). It is established on the West Coast, from British Columbia to northern Mexico (Pilgrim et al. 2013) and in Europe from England and Sweden to Italy (Marchini et al. 2013; Berggren 2015). In 2013 it was collected near the western end of the Connecticut shore of Long Island Sound at Stratford and Greenwich Points and by 2018 it was found at 14 stations along most of the coast of Connecticut. In 2018 it was also collected in Casco Bay, off Portland, Maine. This amphipod was found on a wide range of habitats, including rocky, muddy, and sandy substrates, and in Eelgrass (*Zostera marina*) beds (Trott et al. 2020). Since this amphipod is established north and south of Cape Cod, in the Acadian and Virginian provinces, it is likely to have a wider range in the Northwest Atlantic.

Crustacea: Decapoda: *Eriocheir sinensis* H. Milne Edwards 1853 (Chinese Mitten Crab)

A single specimen of the Chinese Mitten Crab (male, 51.9 mm carapace width) was collected in New Haven Harbor Connecticut, Long Island Sound in April 2018 (Hudson et al. 2019). This may represent an independent introduction of crabs illegally imported as seafood, or dispersal from a population established in the Hudson River estuary (Schmidt et al. 2009; USGS Nonindigenous Aquatic Species Program 2020). Collections of single juvenile mitten crabs in the Mianus River, Connecticut, a Long Island Sound tributary, in 2012 and 2014 could represent natural or human-caused dispersal from the Hudson River (Hudson et al. 2019).

Crustacea; Mysida: *Deltamysis holmquistae* Bowman and Orsi 1993

Deltamysis holmquistae is a mysid known from fresh to marine waters. It was first described from the Sacramento-San Joaquin Delta, but appears to be conspecific with *Kochimysis pillai*, described from the Cochin backwater, India (the extent of its range in Asia is unknown). Its relatively recent (1977) appearance and its taxonomic uniqueness are strongly suggestive of introduction. In a recent *Zootaxa* paper it was reported from Jacksonville, the Indian River, a canal in Fort Lauderdale, (all in Florida) and Freeport, Texas (Scripter et al. 2020). In 2014-2018 it was collected in four estuaries of the East and Gulf Coast, from Florida to Texas. It is associated with marshes and submerged vegetation and has been collected at 0.5 to 32.5 PSU. In general, collections of this mysid are rare and sporadic.

Chordata: Ascidiacea: *Ciona intestinalis* Linnaeus 1767

Ciona intestinalis, (Sea Vase Tunicate) was formerly considered a cosmopolitan species, with a wide native and introduced distribution in the Atlantic and Pacific Oceans. Genetic sequencing and morphological observations revealed that '*Ciona intestinalis'* was actually several species, two of which, 'A' and 'B', were widely distributed. Species 'B', which is found along the coastlines of the North Atlantic, is the original *C. intestinalis (*Caputi et al. 2007; Nydam and Harrison 2007; Zhan et al.

2010). Historical records and recent genetic evidence (Hudson et al. 2019) support native status in European waters, an early introduction in coastal New England (Couthouy 1838; Agassiz 1859, cited by Gould 1870; Verrill 1880) and a more recent one in Atlantic Canada (2004, in the Brudenell River estuary, Prince Edward Island (2003, Ramsay et al. 2008). Hudson et al. (2020) found evidence that Atlantic Canada populations contain a combination of English Channel and Swedish shallow-water genotypes. They suggest that hybridization between English Channel and Swedish populations resulted in a population well-adapted to colonization of artificial structures in shallow water (Hudson et al. 2020). Further genetic sampling is needed in US waters to determine the origin of their populations of *Ciona intestinalis.* In US waters, *Ciona intestinalis*, is common south to Long Island Sound (Osman and Whitlach 1995). One complication in its invasion history in the Northwest Atlantic is the presence of some early records in deep waters off Nova Scotia ('east of Halifax', 232m, USNM 3471) and the Gulf of St. Lawrence (Van Name 1912; Carver et al. 2006). There may be genetic differentiation between deep (possibly native) and shallow-water populations, as was found for Sweden (Johannesson et al. 2018). *Ciona intestinalis* has had negative economic impacts on shellfish aquaculture in Atlantic Canada where it reduces the growth rates of cultured mussels and fouls ropes and equipment. It is also a formidable competitor, quickly occupying space and potentially displacing native fouling species (Carver et al. 2006; Ramsay et al. 2008).

Chlorophyta: Caulerpales: *Codium simulans* Setchell & N.L.Gardner 1924.

The green seaweed *Codium simulans* was described from San Marcos Island in the Gulf of California, and ranges from Santa Cruz Island, California, south to Guerero Mexico, and has also been reported from Robinson Crusoe Island, Chile (Setchell and Gardner 1924; Norris 2010). Molecular analysis indicates that this eastern Pacific seaweed has been introduced to subtropical western Atlantic waters and has been unrecognized and misclassified. The earliest collection from US Atlantic waters was from St. George Island, Franklin County, Florida, in Apalachicola Bay (1972, Barcode 00231308, US National Museum of Natural History Botanical Collections 2017, initially as C. *isthmocladium* ssp. *clavatum* (Schneider et al. 2019)). A specimen originally identified as *C. decorticatum*, from the Indian River Lagoon, Florida, clustered next to sequences of *C. simulans*, and is considered conspecific (Schneider et al. 2019). In a genetic analysis, *Codium* previously identified as *Codium isthmocladium* ssp. *clavatum* from Bermuda were found to match *C. simulans*. Historical evidence suggests that this alga was established in Bermuda by the early 20th century. Solid ballast was considered the likeliest vector for transport of this seaweed, because it is unlikely to survive cold waters in the Straits of Magellan (Schneider et al. 2019).

Chordata: Osteichthyes: Pomacentridae *Neopomacentrus cyanomos* Bleeker 1856 (Regal Demoiselle).

This fish has a broad native range in the Indo-Pacific from the Red Sea and Japan, to Madagascar, and New Caledonia. Its habitats include coral reefs and reef slopes, and harbors. It reaches lengths of 100 mm and is strictly marine (Froese and Pauly 2018). It was first discovered outside its native range in 2013 on coral reefs south of Veracruz, Mexico. Since then it has been recorded at multiple locations at sites in the northern Gulf of Mexico off Louisiana, Alabama, Florida, and Texas (2016-2019; USGS-NAS 2020). In July 2019, *N. cyanomos* was video recorded from various sites on the western side of **Trinidad. These locations are 2050 miles southeast of the other known sightings in the northern Gulf of Mexico. Most probably, these fish were hitchhikers** on oil platforms transported to Trinidad from the Indo-Pacific (Robertson and Kingon 2019).

Phaeophyta: Ectocarpales *Colpomena peregrina* Sauvageau 1927. This brown seaweed is native to the North Pacific and was first recorded in the Atlantic in 1960 in Halifax county, Nova Scotia. It has been extending its range southward through the Gulf of Maine, reaching the north shore of Cape Cod (Sandwich, Massachusetts) by 2012 (Green et al. 2011). In 2012 it was collected south of Cape Cod in Buzzards Bay, in the town of Bourne, Massachusetts (Macroalgal Herbarium Portal 2018, cited by Green-Gavrielidis et al. 2019), and in 2017 in several locations in Rhode Island in Narragansett Bay and Rhode Island Sound (Creen-Gavrielidis et al. 2019).

Sightings of species not yet known to have established

Chordata: Osteichthyes *Heniochus acuminatus* Linnaeus, 1758 (pennant coralfish).

This fish is widespread through the Indo-Pacific. It is usually found alone or in small groups and feeds primarily on zooplankton and benthic invertebrates. One specimen was observed on 9/17/2019 at Spud barge/Upsidedown barge off Palm Beach County, Florida. The introduction has been attributed to aquarium release. One previous sighting of the same species was made off the Florida Atlantic coast in 2016 (USGS NAS 2020).

Chordata: Osteichthyes *Zebrasoma veliferum* Bloch, 1758 (sailfin tang).

This fish is distributed in the Indo-Pacific from Indonesia, Micronesia, Hawaii and from southwest Japan to the Great Barrier Reef and New Caldonia. It inhabits lagoon and seaward reefs and feeds on fleshy green and red algae. One specimen was observed on 6/28/2019 at Fishbowl/the Trench off Palm Beach County, Florida. The introduction has been attributed to aquarium release. 14 previous sightings of the species have been made off the Florida Atlantic coast between 2000-2017 (USGS NAS 2020).

Crustacea: Decapoda: *Metacarcinus magister* Dana 1852 (Dungeness Crab)

The Dungeness Crab is native from the Bering Sea to Point Conception, California. It is a large, edible crab, the subject of a male-only fishery. On July 26, 2017, a male Dungeness Crab was caught in a lobster trap near Norwalk, Connecticut, in Long Island Sound. Another was caught in Cape Cod Bay, Massachusetts, in November, 2018 (D. Hudson et al. 2019). Earlier catches of single male Dungeness Crabs were made in 2006 and 2009, near Cape Ann, Massachusetts (Prybot 2010). Since only male crabs are usually caught and sold, establishment of this species in the Atlantic is unlikely.

4. Pathogens

No new pathogens to report

5. Research and Monitoring Programs

The 2018 Vessel Incidental Discharge Act (VIDA), discussed in section 1 above, also establishes two non-regulatory programs designed to address invasive species concerns from commercial vessel discharges. The first, the Coastal Aquatic Invasive Species Mitigation Grant Program, to be administered by the Secretary of Commerce and the National Fish and Wildlife Foundation, is designed to award grants to improve the understanding, prevention, mitigation of, and response to, aquatic invasive species in the coastal zone and the Exclusive Economic Zone; to support the prevention and mitigation of impacts from aquatic invasive species in the coastal zone; and to support the restoration of Pacific Island habitats, marine, estuarine, and Great Lakes environments in the coastal zone and the Exclusive Economic Zone

that are impacted by aquatic invasive species. The second, the Great Lakes and Lake Champlain Invasive Species Program, to be administered by the EPA's Great Lakes National Program Office, in collaboration and consultation with other federal agencies, is intended to, among other things, monitor for the introduction and spread of ANS into or within these waters; assist with and prioritize management and response actions including monitoring vectors likely contributing to ANS concerns; develop ballast water management systems available for use by commercial vessels; and facilitate meaningful federal and state implementation of the VIDA regulatory framework. These programs are both currently under development and although substantial funding has been authorized in the legislation it is uncertain what level of appropriation they will receive in coming federal budgets.

6. Meetings

Past year

No significant meetings to report in the past year.

Future meetings

No significant meetings to report in 2021. Stay tuned for details on the 11th International Conference on Marine Bioinvasions, to be held Spring of 2021 in Annapolis, Maryland.

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