

Wadden Sea Board

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Agenda Item: 5.2 Nature Conservation

Subject: **Management and Action Plan for Alien Species (MAPAS)**

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Attached is the final draft of the Trilateral Wadden Sea Management and Action Plan for Alien Species (MAPAS), submitted by the Working Group Alien Species (WG-AS).

Schleswig-Holstein has solved reservations after further consultation in the advisory boards and the German Federal Ministry for Transport agreed on the MAPAS as well. There are no further reservations left by the countries.

Proposal: **The WSB is requested to adopt the management and action plan for Alien Species.**

Trilateral Wadden Sea



Management and Action Plan for Alien Species (MAPAS)

Final draft

Authors: Trilateral Working Group Alien Species & A. Gittenberger

Publisher

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Cover Photo

*Australian barnacle (*Austrominius modestus*) was introduced with hull fouling (photo: C. Buschbaum)*

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Content

1.	Introduction	4
1.1.	Alien species.....	4
1.2.	Political and legal frameworks for alien species management.....	5
1.3.	Background and strategic goals	7
1.4.	Cycle of management actions for alien species in the Wadden Sea	9
2.	Prevention of alien species introduction	10
2.1.	Current prevention measures	12
2.2.	Proposed prevention measures.....	20
3.	Monitoring and early detection of alien species.....	21
3.1.	Current monitoring and early detection of alien species	21
3.2.	Proposed new actions on alien species monitoring and detection.....	24
4.	Risk assessment.....	26
5.	Trilateral coordination (Decision making)	29
5.1.	Decision making on member state level.....	29
5.2.	Actions at the trilateral level.....	30
6.	Management control and eradication and other mitigation measures.....	31
6.1.	Current eradication and control activities to manage alien species in the Wadden Sea	31
6.2.	Proposed eradication and control activities	33
7.	Evaluation of the effectiveness of mitigation measures.....	35
8.	Communication, awareness and education.....	36
8.1.	Capacity building initiatives (agencies, training, awareness, international collaboration)	37
8.2.	Proposed actions for communication, awareness and education	38
9.	Concluding remarks	39
10.	References.....	41
11.	Annex.....	44

1. Introduction

1.1. Alien species

Globally, an increasing number of plant, animal and other species are being introduced to areas outside their natural range, with no sign of these alien* introductions (both intentional and unintentional) slowing down (Seebens *et al.* 2017). Increasing human activities, such as shipping and boating, transport, trade and cultivation are responsible for this worldwide trend. The increasing frequency and volume of transport is driving the influx to new highs.

Once an alien species establishes itself in a new area, secondary establishment may follow, either with witting or unwitting human assistance (travel and trade), or through natural means, such as movement of water and drifting material.

*Alien species means any live specimen of a species, subspecies or lower taxon of animals, plants, fungi or micro-organisms introduced outside its natural range; it includes any part, gametes, seeds, eggs or propagules of such species, as well as any hybrids, varieties or breeds that might survive and subsequently reproduce (EU Regulation No 1143/2014).

Many alien arrivals adapt to their new surroundings without causing problems in their non-native environment. However, some will become invasive alien species**, threatening or adversely impacting native biodiversity, related ecosystems and ecosystem services, industries and human health (Simberloff *et al.* 2013).

**Invasive alien species means an alien species whose introduction or spread has been found to threaten or adversely impact upon biodiversity and related ecosystem services (EU Regulation No 1143/2014). For the purposes of the present guiding principles, the term "invasive alien species" shall be deemed the same as "alien invasive species" in decision V/8 of the Conference of the Parties to the Convention on Biological Diversity.

The Guiding Principle of the Trilateral Wadden Sea Cooperation (TWSC) is “**to achieve, as far as possible, a natural and sustainable ecosystem, in which natural processes proceed in an undisturbed way**” (see chapter 1.3). If possible, alien species’ introduction and distribution through anthropogenic means must be prevented in the entire Wadden Sea Area¹ (Annex 1), and invasive alien species that have already established themselves should be managed in an effective and harmonized way.

Horticulture, pet trade and transport are the main terrestrial pathways of introduction and spread of invasive alien species on the Wadden Sea Isles and Halligen. Recreational and commercial shipping and aquaculture are the main marine pathways. Vectors include ships’ ballast water, biofouling of vessels, and aquaculture (van der Have *et al.*, 2015). Further (secondary)

¹ Due to matters of responsibilities, Wadden Sea Conservation Area in Schleswig-Holstein and Hamburg (see map in Annex).

spreading can occur by natural means, for example by active migration or passive spreading via water currents or winds.

This management and action plan aims to give an overview of the measures that are already laid down as obligations in international law and EU legislation regarding the Wadden Sea Area² and proposals, where feasible, for appropriate trilateral actions.



Figure 1. Terrestrial and aquatic alien species of the Wadden Sea Area (from upper left clockwise) *Rugosa rose* (*Rosa rugosa*), Pacific oyster (*Magallana gigas* syn. *Crassostrea gigas*) reef, Japanese skeleton shrimp (*Caprella mutica*) Japanese seaweed (*Sargassum muticum*), (photos: M. Stock, A. Gittenberger, C. Buschbaum).

1.2. Political and legal frameworks for alien species management

The Wadden Sea Plan 2010 provides, in accordance with the Joint Declaration on the Protection of the Wadden Sea, a framework for the integrated management of the Wadden Sea Area as an ecological entity. It sets out targets, as well as policies, measures and actions to achieve these targets (CWSS, 2010). In the Wadden Sea Plan, alien species are dealt with as an overarching theme, but not as specific targets. Nevertheless, the overarching theme “alien species” overlaps with several of the defined habitat and species targets, *e.g.*, for landscape and culture, water and sediment, salt marshes, tidal areas, beaches and dunes, estuaries, offshore areas, rural areas, birds, marine mammals and fish (Büttger *et al.*, 2017).

² Wadden Sea Area according to the definition of the 2010 Joint Declaration..

Several global and EU policies, articles and guidelines are implemented within national policies for the management of alien species in the Wadden Sea Area². Some refer to alien species directly, such as:

International policies and conventions directly related to alien species

- **Convention on Biological Diversity (CBD)**, which has adopted guidance on prevention, introduction and mitigation of impacts of alien species that threaten ecosystems, habitats or species, as manifested in Aichi Biodiversity Target 9: “By 2020, invasive alien species and pathways are identified and prioritized, priority species are controlled or eradicated, and measures are in place to manage pathways to prevent their introduction and establishment”;
- **IMO - International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWMC), its relevant guidelines** and the designated Ballast Water Exchange areas in the North Sea (BWMC.2/Circ.56);
- **IMO-** Biofouling guidelines for commercial ships (MEPC.207(62)) and guidance for recreational craft (MEPC.1/Circ.792);
- **IPPC – International Plant Protection Convention**, which aims to secure coordinated, effective action to prevent and to control the introduction and spread of pests of plants and plant products (<https://www.ippc.int/en>);
- **AEWA – Agreement on the Conservation of African-Eurasian Migratory Waterbirds** contains obligations to limit the development of non-native species which may be detrimental for waterbirds listed under AEWA ³;
- **The Berne Convention “on the Conservation of European Wildlife and Natural Habitats”** requires “to strictly control the introduction of non-native species”⁴.

European regulations and directives directly related to alien species

- **EU Regulation No 1143/2014 (EU-IAS)**, on the prevention and management of the introduction and spread of invasive alien species;
- **EU Regulation No. 304/2011** amending Council Regulation (EC) No 708/2007 concerning the use of alien and locally absent species in aquaculture;
- **Directive 2008/56/EC** of the European Parliament and of the Council (**Marine Strategy Framework Directive - MSFD**). The MSFD focuses directly on the introduction of alien species in its Descriptor 2: “Non-indigenous species introduced by human activities are at levels that do not adversely alter the ecosystems”.

In addition, several European Directives indirectly address issues related to alien species. These include the **Habitat (92/43/EEC)** and **Birds Directives (2009/147/EC)**, the **Water Framework Directive (2000/60/EC)** and the **Regulation on the protection of species of wild fauna and flora (338/97/EC)**, the latter by regulating trade therein.

³ Cf. No. 2.5.1- 2.5.3 of the AEWA Annex 2 (Action plan)

⁴ Cf. Article 11 (2) b.

1.3. Background and strategic goals

Since 1978, Denmark, Germany and The Netherlands have cooperated to protect, conserve and restore the Wadden Sea as an ecological entity. The Guiding Principle of the TWSC is to “achieve, as far as possible, a natural and sustainable ecosystem in which natural processes proceed in an undisturbed way”.

The TWSC is based on the “Joint Declaration on the Protection of the Wadden Sea”, which was first signed in 1982 and has been frequently updated, most recently in 2014. The Joint Declaration is a declaration of intent, and includes the objectives and areas of cooperation and the institutional and financial arrangements. For almost 40 years, the TWSC has united partners from politics, nature conservation, science and administration, along with local stakeholders, and it represents an enormous store of knowledge and experience.

The inscription of the Danish-German-Dutch Wadden Sea on the UNESCO World Heritage List in 2009 has further strengthened combined efforts to protect, conserve and manage this area. It is a worldwide unique example of effective trans-boundary ecosystem-based collaboration in order to conserve a UNESCO Wadden Sea World Heritage Property.

The TWSC:

- Protects and conserves the Wadden Sea as an ecological entity through common policies and management;
- Monitors and assesses the quality of the Wadden Sea ecosystem, in collaboration with national and regional authorities and scientific institutions, as a basis for effective protection and management;
- Cooperates internationally with other marine sites or fora related to the protection, conservation and management of Wadden Sea habitats or species;
- Engages the public in the protection of the Wadden Sea through awareness-raising activities and environmental education;
- Secures the sustainable development of the Wadden Sea with respect to its natural and cultural values.

At the 11th Trilateral Governmental Conference on the protection of the Wadden Sea at Sylt (Sylt, Germany, March 2010) it was agreed to develop a common strategy to deal with alien species in the Wadden Sea, taking into account the request of the UNESCO World Heritage Committee (2009) to **“implement a strict monitoring program to control invasive species associated with ballast water and aquaculture”** in the Wadden Sea World Heritage property.

In 2011, the Wadden Sea Board decided to initiate the development of a common strategy for dealing with alien species in the Wadden Sea. The report “Neobiota in the Wadden Sea” (Bouma *et al.*, 2011) served as basis for a draft strategic framework for alien species. This strategic framework

is based on six important elements: prevention, early detection, warning and rapid response, eradication and control, raising awareness and implementation.

At the 12th Trilateral Governmental Conference on the protection of the Wadden Sea in Tønder (2014), it was agreed to ***“further develop the trilateral strategic framework for dealing with alien species in the Wadden Sea and to coordinate the development of an management and action plan on alien species, taking into account existing and upcoming legislation and projects”*** (§ 35 of the Tønder Declaration: CWSS, 2014). The TWSC`s ad hoc Working Group on Alien Species (WG-AS) was tasked with developing this trilateral alien species management and action plan (MAPAS).

The overall objective of the MAPAS is to prevent threats from alien species to marine and terrestrial ecosystems 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 this MAPAS are:

- Prevent the introduction of invasive alien species in the Wadden Sea Area (Table 1, Figure 1.);
- Monitor alien species' introduction and presence (Table 2, Figure 1.);
- Assess risks related to alien species' introduction, invasive potential and possible impact (Table 3, Figure 1.);
- Manage or control invasive alien species that entered the Wadden Sea Area (Tables 4, 5 and 6, Figure 1.);
- Assess the effectiveness of measures (Table 7, Figure 1.);
- Raise awareness on alien species prevention, presence and mitigation.

1.4. Cycle of management actions for alien species in the Wadden Sea

Main elements of the MAPAS are prevention, monitoring, risk assessment, decision making, management and/or control and an evaluation of effectiveness of applied measures. These were arranged in a circular and iterative scheme of management actions by the WG-AS (Figure 2).

These elements are described in detail in the following chapters of this management and action plan. In addition, emphasis is set on communication and awareness-raising, a time frame of implementation, and financial implications.

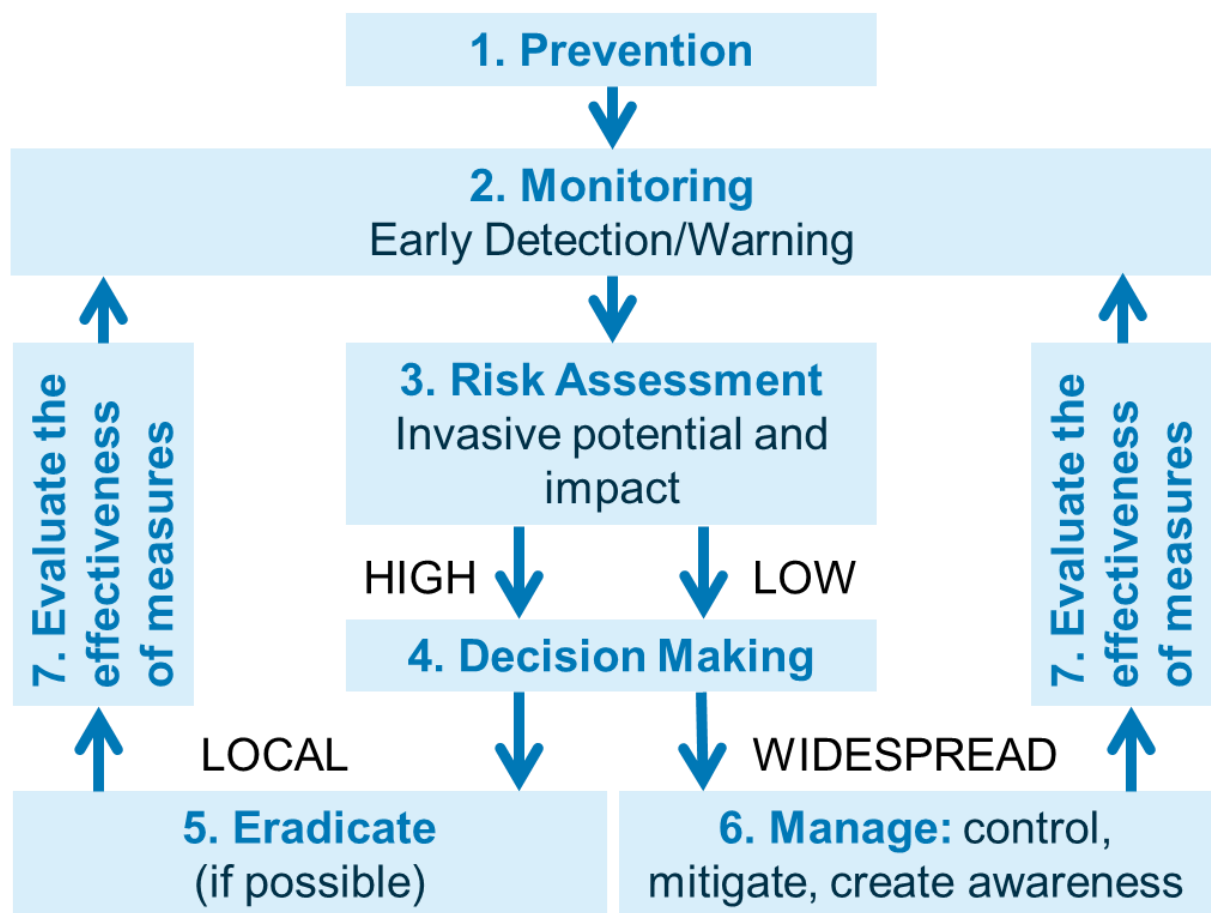


Figure 2. Cycle of management actions for alien species in the Wadden Sea (WG-AS 2016).

2. Prevention of alien species introduction

The problems and damage associated with the spread of (invasive) alien species is a cross-border challenge with magnitudes dependent on the type of environment. The management of alien species newly arrived in aquatic environments, including fresh, brackish and saline water bodies, is often more challenging than controlling those on land. In aquatic environments, newly introduced alien species are usually harder to detect, especially when they are present in low numbers (low abundancy). When they are widely spread and more dominant they are easier to detect but, by then, eradication is almost impossible.

With increasing abundances, management measures can become expensive and difficult to implement (Figure 3). In some cases it may not be possible to take effective measures. Therefore, prevention of potentially invasive introductions is the first line of defence and generally the most cost effective measure in any environment. If an invasive species is at an early stage of establishing itself, a rapid response will in most cases be more cost-effective.

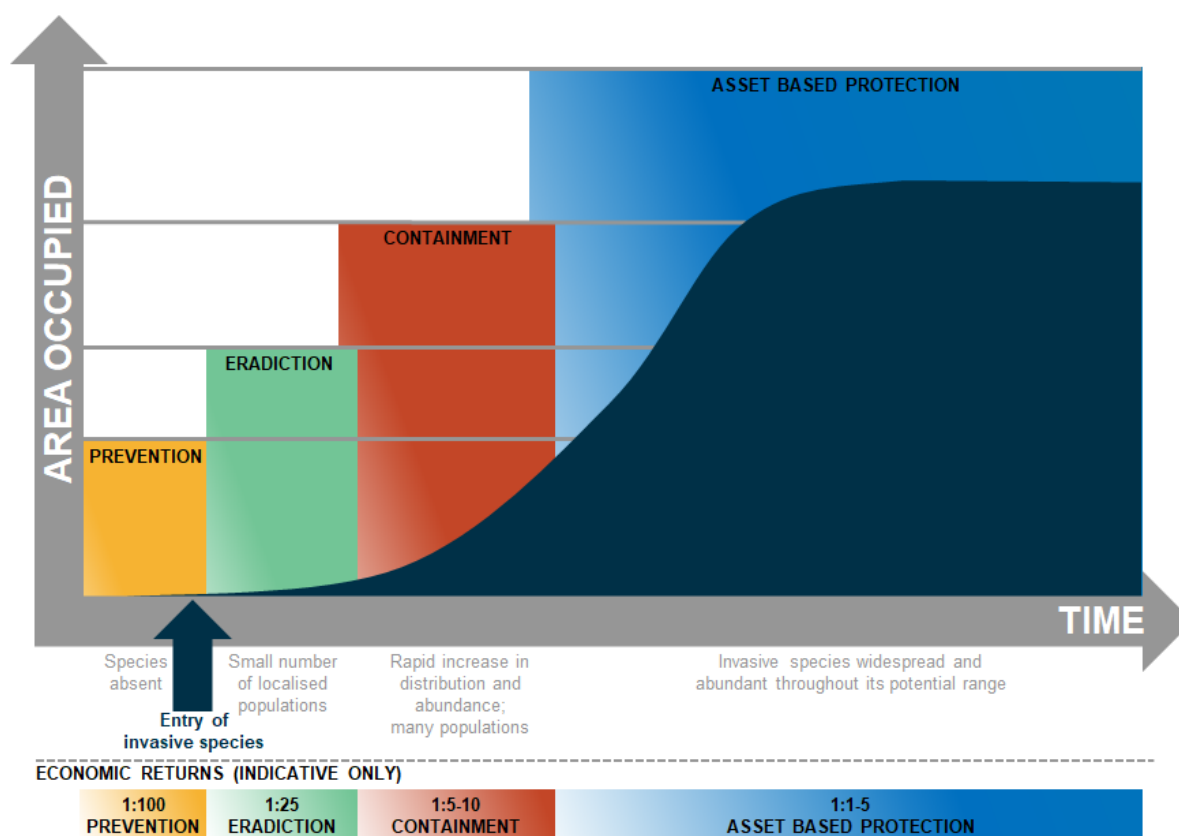


Figure 3. Generalised invasion curve with appropriate actions at each stage and indicated economic returns (credit: Agriculture Victoria, modified).

A variety of measures that prevent the introduction and settlement of new alien species are already taken within the Wadden Sea Area by Denmark, Germany and The Netherlands. These measures are based on restrictions, rules and recommendations that are set out on a local, national and/or international scale. They are implemented for EU and/or national legislation and/or on the basis of international law as ratified by the three countries. Some measures focus on specific invasive alien species, while others treat alien species in general, or on species that cause a nuisance regardless of whether they are native or non-native.

Measures can also be varied to suit different habitats, *i.e.*, on terrestrial and fresh water habitats on the Wadden Sea islands and/or coastal marine waters.

In the trilateral Wadden Sea MAPAS, existing prevention measures are taken into account and additional measures are proposed to further minimize the introduction risk of alien species. Applying measures throughout the Wadden Sea Area (on the basis of existing national implementations) streamlines the process and enhances the effects.

2.1. Current prevention measures

In most cases the below-mentioned measures are applied with different aims, as they were designed for more than one purpose. Only the main legal basis or purposes of the current measures that prevent the introduction and settlement of alien species in the Wadden Sea Area are named here.

International conventions, agreements and guidelines

Table 1 illustrates the international conventions, agreements and guidelines that are the basis of prevention measures that are or have been implemented in Denmark, Germany and The Netherlands.

Many alien species currently in marine areas of the Wadden Sea arrived with ballast water discharges and biofouling on ships, pleasure crafts and drifting material.

To prevent introductions through ballast water, all three Wadden Sea countries have ratified the IMO-Ballast Water Management Convention (IMO, 2004), which came into force on 8 September 2017.

As a result, all ships that arrive in the Wadden Sea have to manage any ballast water they carry in accordance with the standards of the BWMC. To limit the risk of alien organisms arriving in ballast water, ballast water exchange according to the D-1 standard has to be performed followed by date-dependent compliance with the D-2 standard (defined amount of organisms in discharged ballast water). The date depends on several factors *e.g.* date of the International Oil Pollution Prevention (IOPP) renewal and construction date of the ship (BWMC B-3). This does not apply to ships that have been granted an exemption (BWMC A-4) or operate at the same location (BWMC A-3).

To prevent the introduction and spread of invasive alien species through biofouling by recreational craft, both Germany and The Netherlands are working to raise public awareness of the IMO Guidance for minimizing the transfer of invasive aquatic species through biofouling (hull fouling) by recreational craft: MEPC.1/Circ.792 (2012). The Netherlands has already published a study to highlight the extent of hull fouling by recreational boats in Dutch waters, including the Wadden Sea (Gittenberger *et al.*, 2017).

The Convention on Biological Diversity (CBD/United Nations, 1992) was ratified by all three countries. A policy framework based on the CBD is being developed in The Netherlands to manage the prevention of alien species introductions nationally. Denmark, Germany and The Netherlands all have a National Strategy on Biological Diversity.

While the BWMC and guidelines focus mostly on saline waters of the Wadden Sea, measures based on the CBD will also target terrestrial and fresh water habitats on the Wadden Sea islands and Halligen.

Table 1. International conventions, agreements and guidelines: Prevention measures taken by the three countries to prevent the introduction of alien species in the Wadden Sea. It identifies whether these measures focus mainly on invasive alien species, on all alien species or on species that cause a nuisance, regardless of whether or not they are alien, and whether they target the terrestrial (and freshwater) habitats on the Wadden Sea islands and/or the more open saline (brackish to marine) waters of the Wadden Sea.

Main legal basis Measures taken	Islands (terrestrial)		Open Water (saline)		Invasive alien species		Alien species		Nuisance species		Netherlands Germany Denmark				
	Yes	No	Yes	No	Focus	Other	Focus	Other	Focus	Other	Yes	No	NA		
UNESCO Wadden Sea World Heritage property															
The alien species management and action plan (MAPAS) is an implementation of a direct UNESCO request to “implement a strict monitoring program to control invasive species associated with ballast water and aquaculture” in the Wadden Sea World Heritage property.	Yes	Yes	Yes	Yes	Focus						Yes	Yes	Yes		
IMO Ballast Water Management Convention (BWMC)															
Following the IMO Ballast Water Convention (IMO, 2004), all ballast water holding ships arriving in the Wadden Sea have to manage their ballast water according to BWMC standards, unless they have been granted an exemption (BWMC A-4) or operate at same location (BWMC A-3).			Yes			Focus					Yes	Yes	Yes		
IMO Guidance for recreational boats MEPC.1/Circ.792															
Dissemination of IMO Guidance for minimizing the transfer of invasive aquatic species through biofouling (hull fouling) by recreational craft: MEPC.1/Circ.792 (2012).			Yes		Focus						Yes	Yes			
Convention on Biological Diversity (CBD)															
A policy framework or strategy based on CBD (United Nations, 1992) is developed to manage the prevention of alien species introductions on a national level.	Yes	Yes			Focus						Yes	Yes	Yes		

EU Regulations

Table 2 illustrates the EU Regulations that are the basis of prevention measures in Denmark, Germany and The Netherlands.

EU Regulation No. 1143/2014 sets out management measures to minimise and mitigate the adverse impacts of alien species of European Union concern (EU, 2014). These species, with negative impacts on biodiversity and ecosystem services and possibly also on economy and human health, have been placed on the so called Union list for all EU member states (European Union, 2017). For these Union list species, the regulation includes three distinct types of measures, which follow the internationally agreed hierarchical approach to combating invasive alien species:

- Prevention: consisting of a number of prohibitions (Art 7) and obligations to prevent Union list species from entering (non-invaded areas in) the EU, either intentionally or unintentionally;
- Early warning and rapid response: Member States must initiate a surveillance system (Art 14) to detect the presence of Union list species as early as possible and take rapid measures to prevent it from becoming established (Art 16 and 17);
- Management of already established Union list species: some invasive alien species are already well established in the EU territory, concerted action is needed to manage them so to minimise the harm they cause (Art 19).

For the species on the Union list⁵, the Wadden Sea countries Denmark, Germany and The Netherlands are obliged to implement national measures. As a part of these, all three countries have to identify the priority pathways with which Union list species are unintentionally introduced and spread. All countries have and are implementing border control measures to prevent intended and unintended introduction. All three countries have been investing in supporting their border inspection posts aiming at preventing importations, and maintaining the import and trade ban of Union listed species.

Besides the Union list, member states may generate a list of species of national concern or regional concern and cooperate with other member states to combat them. Denmark is in the process of making a national list, while Germany and The Netherlands have yet to develop national lists. To prevent the intentional import of certain invasive alien species for trade or aquaculture respectively, Council Regulation (EC) No. 338/97 and EU Regulation No. 304/201 (EU, 2011) are implemented (in addition to Regulation 1143/2014/EU that prevents the import of species of Union concern). Restrictions on the trade of species concern mostly terrestrial and fresh water alien species.

⁵ http://ec.europa.eu/environment/nature/invasivealien/list/index_en.htm

Table 2. EU Regulations and corresponding measures to prevent the introduction of alien species in the Wadden Sea Area², as taken by Denmark, Germany and The Netherlands. The measures are distinguished by focusing on invasive alien species, all alien species or species that cause a nuisance. It also shows if terrestrial (and freshwater) habitats on the Wadden Sea islands and/or the more open saline (brackish to marine) waters of the Wadden Sea are targeted.

Measures that are taken or have been taken N.B. Although all three countries have to fulfil the obligations of each EU Regulation, the measures they take to do so do not necessarily need to be the same.	Islands (terrestrial)	Open Water (saline)	Invasive alien species	Alien species Nuisance species	Netherlands	Germany	Denmark
EU Regulation No. 1143/2014 on the prevention and management of the introduction and spread of invasive alien species (EU, 2014)							
A list of invasive alien species of national concern may be established.	Yes	Yes	Focus				Yes
For invasive alien species of Union concern, measures are taken including a) a surveillance system for early detection, b) a rapid response mechanism for eradication, and c) control measures.	Yes	Yes	Focus		Yes	Yes	Yes
Within three years of adoption of the Union list, a national action plan or set of action plans will be established and implemented to address the priority pathways for unintentional introduction and spread.	Yes	Yes	Focus		Yes	Yes	Yes
Identification of priority pathways is done or in progress, based on <i>e.g.</i> , the volume of species or the potential damage caused by species entering the European Union through those pathways. Priorities are set before drafting action plans.	Yes	Yes	Focus		Yes	Yes	Yes
Training or training material to identify alien species of Union concern is being carried out, enabling the identification of these species, <i>e.g.</i> , at border control posts.	Yes	Yes	Focus		Yes		Yes
Policies have been developed to support controls at border inspections posts (BIPs) when carrying out official controls that are necessary to prevent the intentional introduction into the Union of invasive alien species of Union concern.	Yes	Yes	Focus		Yes		Yes
EU Regulation No. 304/2011 (EU, 2011)							
The use of alien and locally absent species in aquaculture is regulated, aimed at preventing the introduction of alien species.		Yes	Focus		Yes	Yes	Yes
Council Regulation (EC) No 338/97							
This Regulation on the protection of species of wild fauna and flora by regulating trade therein, places restrictions and bans on the trade of various species (mainly terrestrial and fresh water species), including invasive alien species.	Yes			Focus	Yes	Yes	Yes

EU Directives

Table 3 illustrates the EU Directives that form the basis for the development of prevention measures implemented in The Netherlands, Germany and Denmark.

The Natura 2000 status of most of the marine areas and many islands in the Wadden Sea is often one of the main driving forces for applying measures that prevent the introduction and/or settlement of alien species. If any species that may threaten the specific Natura 2000 conservation objectives is found in a Natura 2000 Special Area of Conservation (SAC), that species is eradicated or controlled, if feasible. This accounts for all species that cause a negative impact on the Natura 2000 conservation objectives, regardless of whether it is alien or not.

The Natura 2000 conservation objectives of the SACs that lie within the Wadden Sea also serve as the basis for the shellfish transport policy framework throughout the Wadden Sea. In The Netherlands it is usual to assess whether alien species that may be imported with blue mussel seed transports would be expected to have a negative impact on the Natura 2000 conservation objectives of the Dutch Wadden Sea. In such a case transport is prohibited. In the Schleswig-Holstein National Park, imports of seed mussels and oysters from outside the park have been forbidden since a court decision in 2012 that underlined the general provision in the National Park Act. In Lower-Saxony, a management plan for mussels is applied in the Wadden Sea National Park, including *e.g.*, a ban on the import of seed mussels from outside their part of the Wadden Sea Conservation Area.

Based on the European Water Framework Directive (WFD) the coastal waters of the Wadden Sea, *i.e.*, the saline waters and the WFD fresh to slightly brackish waters on the Wadden Sea islands are monitored to assess the ecological water quality in all three countries. On the Frisian Wadden Islands this concerns for example the slightly brackish streams, *e.g.*, the “Polder eilanden – zwak brakke sloten, M30” (www.wetterskipfryslan.nl). A species that threatens the water quality of these water bodies, *i.e.*, a nuisance species (including invasive alien species), has to be eradicated or controlled whenever feasible.

In Denmark and Germany the coastal waters of the Wadden Sea also fall under the Marine Strategy Framework Directive (MSFD). In The Netherlands, the MSFD is applied for the North Sea coast of the islands of the Wadden Sea. For alien species a similar approach to the MSFD is being followed in the Dutch Wadden Sea. The main difference between the WFD and the MSFD is that the WFD does not specifically address alien species, while the MSFD specifically indicates that alien species should be managed when they threaten the “Good Environmental Status” (GES) of the waters concerned (*i.e.*, Descriptor 2). In practice, this difference has not resulted in different measures being taken in the three countries where it concerns preventing the introduction of alien species. If the ecosystem is threatened by a species that is introduced, regardless of whether or not it is alien, both the WFD and the MSFD indicate that species should be managed, preferably by preventing its settlement in the first place.

Table 3. EU Directives and corresponding prevention measures taken by the three countries to prevent the introduction of alien species in the trilateral Wadden Sea Area. The measures are distinguished by focusing on invasive alien species, all alien species or species that cause a nuisance. It also shows if terrestrial (and freshwater) habitats on the Wadden Sea islands and/or the more open saline (brackish to marine) waters of the Wadden Sea are targeted.

Measures that are taken or have been taken N.B. Although all three countries have to fulfil the obligations of each EU Directive, the national measures may differ.	Islands (terrestrial)	Open Water (saline)	Invasive alien species	Alien species	Nuisance species	Netherlands	Germany	Denmark
Habitats Directive & Birds Directive: Natura 2000								
Nuisance species are eradicated and controlled when they are threatening Natura 2000 conservation objectives, if feasible.	Yes	Yes			Focus	Yes	Yes	Yes
Policy and laws have been developed to prevent alien species introduction by shellfish transportation, as specified in more detail in the three measures described below.		Yes		Focus	Focus	Yes	Yes	Yes
In The Netherlands, the policy framework of shellfish transportation is implemented by the use of the “Shellfish Import Monitoring Protocol”. This is applied to minimize the risk of alien nuisance species having a negative impact on the Natura 2000 values/conservation objectives of the Dutch Wadden Sea because of mussel imports from the Oosterschelde.		Yes	Focus			Yes		
In Denmark, it is possible to apply for a permit to conduct fisheries in the Danish part of the Wadden Sea.		Yes			Focus			Yes
In the Schleswig-Holstein (SH) National Park, imports of seed mussels from outside the park are forbidden since a court decision 2012, underlining the provision of the National Park Act. It is mandatory to apply for an exemption from the provisions of the National Park Act.		Yes		Focus			Yes (SH)	
A management plan for mussel fisheries is applied in the Wadden Sea National Park of Lower Saxony (LS), including e.g., a ban on the import of seed mussels from outside the Wadden Sea Conservation Area.		Yes		Focus			Yes (LS)	
Water Framework Directive (WFD)								
Waters falling under the WFD are monitored or their ecological quality assessed. Nuisance species management is applied, including prevention, eradication and control measures whenever feasible. In all three countries WFD waters include fresh to brackish water bodies on the islands and the more saline water of the Wadden Sea.	Yes	Yes			Focus	Yes	Yes	Yes
Marine Strategy Framework Directive (MSFD)								
Alien species are managed when they threaten the “Good Environmental Status” (GES) of the Wadden Sea. A regular monitoring program focused at the detection of alien species is applied accordingly.		Yes		Focus		Yes, reciprocal ⁶	Yes	Yes

⁶ The Dutch Wadden Sea is within the regime of the WFD instead of MSFD. In The Netherlands the MSFD is applied for the North Sea coast of the islands of the Wadden Sea.

Prevention measures on various legal and or policy bases

Table 4 includes a variety of prevention measures that have not yet been described, but are or have been implemented in Denmark, Germany and The Netherlands.

Public safety is always an important driver for implementing measures. Some alien species, such as alien plants and crabs like the Chinese mitten crab (*Eriocheir sinensis*), are known to weaken dikes by their roots and tunnels. The populations of such species are eradicated or controlled, *e.g.*, on the Wadden islands where the dikes and dunes have to be protected for public safety. In addition to weakened dikes, waterways, corridors, and sluices can flood if they become clogged or damaged by for example alien shellfish and plant species. Fresh water systems are relatively scarce on the islands, so this is a limited risk.

A number of measures have been implemented in the three countries. These are not directly linked to one legal basis, but support several legislations and/or policies.

General measures that may prevent the settlement of some invasive alien species include the support that is given to environmentally friendly ships in Germany. Moreover, rising water temperatures can help alien species establish, so sources of heat input into the sea by all three countries are monitored and thresholds evaluated.

Focused specifically on alien species, risk assessment and scoring systems are being developed and updated, specific policies are implemented to prevent the introduction of alien nuisance species in general, and alien species advisory/working groups are set up and include researchers, governments and other stakeholders. Pathway analyses are also conducted for established alien species in all three countries. The Netherlands also performed a horizon scan (Leuven) and the result will be part of the process of identifying priority pathways (EU 1143/2014). Also, 10 countries participating in the European Network on Invasive Alien Species NOBANIS have produced a pathway analysis and horizon scanning for countries in Northern Europe (Nordic Council of Ministers, 2015).

Table 4. Prevention measures taken by Denmark, Germany and The Netherlands to prevent the introduction of alien species in the Wadden Sea on various legal bases and or policies: The measures are distinguished by focusing on invasive alien species, all alien species or species that cause a nuisance. It also shows if terrestrial (and freshwater) habitats on the Wadden Sea islands and/or the more open saline (brackish to marine) waters of the Wadden Sea are targeted.

Measures that are taken or have been taken	Islands (terrestrial)	Open Water (saline)	Invasive alien species	Alien species	Nuisance species	Netherlands	Germany	Denmark
Protecting public health enforced by local, national and/or international legislation								
Nuisance species are eradicated or controlled when they threaten public health, e.g., by causing flooding, due to clogging of waterways, corridors, and sluices on the islands, or by weakening dikes by penetrating them with their roots or tunnels.	Yes	Yes			Focus	Yes	Yes	Yes
General measures that will minimize the impact of alien species on public health, environment and/or economy.								
Support for environmentally friendly ships, including support for measures against transport of alien species.		Yes			Focus		Yes	
Derivation and evaluation of heat output and application of thresholds for it. Heat output into the sea is considered as a promoting factor for the establishment of alien species and areas with heat discharge are seen as hot-spots for alien species settlement.	Yes	Yes			Focus	Yes	Yes	Yes
A pathway analysis was done based on alien species that are already present in e.g., the Wadden Sea, to identify the main pathways of alien species introduction.	Yes	Yes		Focus		Yes	Yes	Yes
Advisory/expert group of researchers, government and stakeholders was set up to share information on invasive alien species.	Yes	Yes	Focus			Yes	Yes	Yes
Policy to support the prevention of alien nuisance species introduction.	Yes	Yes	Focus			Yes	Yes	Yes
On a national level a risk assessment and scoring system is used to assess the threat of all alien species. This risk assessment is updated regularly.	Yes	Yes		Focus		Yes	Yes	Yes

2.2. Proposed prevention measures

The prevailing prevention measures in the three countries, as described in the previous section, already reduce the risk that (invasive) alien species are introduced into the Trilateral Wadden Sea area. These measures focus on preventing the introduction of alien species into the Wadden Sea by ballast water, hull fouling, and shellfish transports, which are considered to be three main introduction vectors of alien species in the marine environment. In addition, various measures are in place, which specifically focus on terrestrial alien species and aquatic alien species that may be introduced into the fresh or brackish waters of the Wadden islands. Implementing these measures fulfils various regulatory obligations by the three countries.

To increase the effectiveness of these prevention measures, and to assist the implementation of regulatory obligations even further, several additional management actions could be taken up by the countries of the TWSC and developed on a trilateral level where the national legislations allow it. To achieve this, a trilateral alien species coordination group may use its networks (including national managing authorities) to facilitate, where possible, the recommendations in table 5. Where national obligations, agreements and legislation allow, a trilateral alien species coordination group should be set up, similar to the existing WG-AS.

Table 5. Recommendations to increase the effectiveness of prevention and dissemination measures on a trilateral level and to assist the implementation of regulatory obligations where national legislations allow it.

Recommendations	
1	Initiate information campaigns on a national level, aimed at preventing the (un)intentional introduction and spread of (invasive) alien species in the Wadden Sea Area ¹ .
2	National information campaigns should be shared on a trilateral level, optimizing their success within each of the member states.
3	Data on horizon scanning analyses could be shared between the three countries to determine which invasive alien species might become a threat in the Wadden Sea in the future.
4	Based on the results of the alien species pathway analyses that have already been conducted by the three countries separately for their respective parts of the Wadden Sea (Table 4), a single combined pathway analysis could be constructed, distinguishing between pathways into and within the Wadden Sea. Hereby more effective, coordinated pathway management may become possible both to reduce the chance that invasive alien species are introduced into the Wadden Sea as a whole, and to prevent their further spread within the Wadden Sea.
5	All three countries should (and plan to) disseminate and evaluate the IMO guidelines for the control and management of ships' biofouling to minimize the transfer of invasive aquatic species: MEPC.207(62)(2011).
6	Information exchange on artificial stepping stones for alien species in the Wadden Sea and best practice exchange for mitigation.

3. Monitoring and early detection of alien species

3.1. Current monitoring and early detection of alien species

All three countries in the TWSC have national monitoring systems in place. Often, these are designed to monitor native species with little or no relevance to species in the trilateral Wadden Sea Area. However, some of these monitoring programs focus specifically on invasive alien species. Early detection can facilitate an efficient decision-making process to eradicate, manage or control the incoming alien species in a cost effective manner, or to develop or adjust pathway management to prevent further introductions and/or spread of the alien species of concern. Early detection is therefore considered to be the first step in monitoring new alien species introductions. Ongoing monitoring efforts in the Wadden Sea Area, which may facilitate early detection and possibly a rapid response, are indicated in Table 6. In addition, Table 6 describes monitoring efforts in the Wadden Sea during which alien species may be detected, even though they may not be ideally suitable for early detection.

Continuous monitoring programs are run in all three countries to fulfil the obligations from *e.g.*, the WFD and the MSFD (Tables 2-4). All member states have established or adapted existing surveillance systems to detect invasive alien species of Union concern according to the EU-Regulation No. 1143/2014 on invasive alien species (EU, 2014). These general monitoring programs focus only on a few species that may threaten the ecological water quality or the good environmental status of the Wadden Sea Area. In Denmark the national monitoring program (NOVANA) has been adapted to also register invasive alien species of Union concern from its conventional monitoring since 2017. Besides this, a project has been started where additional water samples are taken for environmental DNA analyses, using specific qPCR analyses to detect marine invasive species. To do this, 20 invasive species-specific primer pairs were developed. Countrywide 16 Danish harbours, including one in the Wadden Sea, are at present monitored for invasive alien species with these environmental DNA methods. In Germany, an annual alien species monitoring program based on extended Rapid Assessment Survey (eRAS) is implemented that focuses on hot spots for introduction (*e.g.*, ports, marinas and aquaculture spots) and additional sites. In The Netherlands, alien species are similarly detected by alien species hotspot focused surveys in the Wadden Sea that have been organised on a three to four year basis since 2009 (Gittenberger *et al.*, 2015).

In addition to these programs several alien species focused surveys have been conducted to monitor alien species introduction in the Wadden Sea by ballast water and shellfish transports. These surveys were done in the frameworks of the BWMC and Natura 2000 (Table 4). They followed the Joint Harmonised Procedure for the Contracting Parties of HELCOM⁷ and OSPAR⁸ (2013) and the Dutch policy framework on shellfish transports (Bleker, 2012).

Finally, with no specific legal basis, the Wadden Sea is continuously monitored by volunteers (citizen science) and by some research institutions (*e.g.*, Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research, Germany). The latter includes for example the Synoptic Intertidal Benthic Survey (SIBES) project focusing on soft substrata habitats in the intertidal (<https://www.nioz.nl/en/research/projects/4126-0>) and the SEtTLement-project (SETL) focusing on fouling species in the Dutch Wadden Sea (Gittenberger *et al.*, 2017). With the governmental support of the countries concerned, data on alien species records in the Wadden Sea resulting from these private and citizen science based projects are becoming increasingly and more easily accessible.

Although most of the above monitoring efforts are focused on the marine environment, the monitoring for the WFD also includes fresh to slightly brackish waters on the Wadden Sea islands. In addition, terrestrial alien species on these islands are detected in surveys in (nature) protected areas, including for example a selection of forests and dunes on the islands. During volunteer based monitoring programs, focused on mammal, bird and insect species, terrestrial invasive alien species are also detected.

In all three countries, national online portals and databases have been developed specifically to improve the accessibility of data on alien species records in the Wadden Sea that originate from various sources. These portals and databases include the Dutch National Database Flora and Fauna (NDFF), telmee.nl and waarneming.nl in The Netherlands, the “Alien Species Platform” (Neobiota Plattform), where all information on marine alien species is collected, and the beachexplorer.org website in Germany, and the national online portal for mapping observations of invasive species in Denmark.

⁷ HELCOM - (Baltic Marine Environment Protection Commission - Helsinki Commission) is the governing body of the Convention on the Protection of the Marine Environment of the Baltic Sea Area

⁸ OSPAR - Convention for the Protection of the Marine Environment of the North-East Atlantic

Table 6. Current monitoring programs and actions for alien species detection in the Wadden Sea, indicating whether the respective program or action was at least partly developed for early detection and/or for enabling a rapid response, if this is feasible and required. Focuses on invasive alien species, all alien species or species that cause a nuisance, as well as on habitat - terrestrial (and freshwater) on islands and/or marine waters of the Wadden Sea Area - are indicated.

Monitoring programs and actions	Rapid response	Early detection	Islands (terrestrial)	Open Water (saline)	Invasive alien species	Alien species	Nuisance species	Netherlands	Germany	Denmark
EU Regulation No. 1143/2014										
A surveillance system of invasive alien species of Union concern is in place nationwide to collect data on the occurrences of these species and to prevent their further spread.	Yes	Yes	Yes	Yes	Focus			Yes	Yes	Yes
IMO Ballast Water Management Convention (BWMC)										
Several ports in the Wadden Sea have been surveyed for alien species with a selection of methodologies that are described in the Joint harmonised procedure for the contracting parties of HELCOM and OSPAR on the granting of exemptions to the BWMC convention (HELCOM/OSPAR, 2013).				Yes	Focus			Yes	Yes	Yes
Water Framework Directive (WFD)										
Monitoring is conducted to assess the ecological water quality of WFD waters, including the presence of nuisance species that may be detrimental to this quality.	Yes		Yes	Yes		Focus		Yes	Yes	Yes
Marine Strategy Framework Directive (MSFD)										
Regular monitoring is done to assess the presence of alien species that may threaten the “Good Environmental Status” (GES) of the Wadden Sea. This is achieved by rapid assessments focused on alien species by using conventional monitoring techniques and/or environmental DNA analyses.	Yes	Yes		Yes	Focus			Yes, reciprocal	Yes	Yes
Habitats Directive & Birds Directive: Natura 2000										
Alien species focused surveys were done in the Dutch Wadden Sea in 2009, 2011 and 2014 to assess the risk of mussel imports from the Oosterschelde, for the Natura 2000 values of the Dutch Wadden Sea. A similar survey is planned in 2018.				Yes	Yes			Yes		
Alien Species must be addressed in the context of the habitat compatibility check, for example in connection with the mussel industry in Schleswig Holstein (SH); Seed mussel collectors in SH are monitored for alien species (licensing requirement).				Yes	Yes				Yes (SH)	
Citizen science based monitoring										
Tools such as websites and databases have been developed to promote citizen science based monitoring and to make sightings of alien species by citizens easily accessible on various platforms.	Yes	Yes	Yes	Yes	Yes			Yes	Yes	Yes
Other										
Ongoing monitoring programs focused on assessing species in the soft- and on hard-substrates of the Wadden Sea conducted by private companies and research organizations.	Yes	Yes		Yes				Yes	Yes	

3.2. Proposed new actions on alien species monitoring and detection

By cooperating on a trilateral level, the alien species monitoring and detection efforts currently done on a national level by each country, could be optimized. This could be based on recommendations that were developed at a trilateral Wadden Sea expert workshop on 23-24 November 2016 in Hamburg, Germany. This workshop aimed to harmonize existing monitoring efforts for alien species. The monitoring instruments have to be appropriate and may become more cost-effective while being in line with the legal requirements of, for example, the MSDF in the marine environment.

To achieve these optimizations, several actions are proposed for trilateral alien species coordination (Table 7) and for a trilateral alien species coordination group (Table 8), which could be setup if national obligations, agreements and legislations allow it, similar to the existing WG-AS (see 5.2). This coordination group will facilitate these actions where possible using its networks (e.g. including national managing authorities). Some recommendations for optimizing alien species monitoring in the Wadden Sea concern aspects that are already partly implemented in current monitoring programs, but can be further considered for national implementation by the three countries (Table 9). These recommendations were given during the trilateral Wadden Sea expert workshop and/or were issued within the WG-AS. They concern points of attention where improvements of the existing monitoring methods and protocols may be made.

Table 7. Proposed actions to optimize on a trilateral level the current alien species monitoring and detection efforts in the Wadden Sea (Table 6).

Proposed actions for trilateral alien species coordination	
1	An overview of monitoring approaches followed within the existing resources has to be maintained on a trilateral level within the Trilateral Monitoring and Assessment Programme (TMAP) framework.
2	Data and knowledge gathered in the national programs and monitoring efforts should be shared trilaterally (integrated into TMAP). While all three countries have developed national online portals and databases where records of alien species are stored, efforts will be made to combine trilateral data for alien species records in the Wadden Sea.
3	An updated list of alien species recorded throughout the entire Wadden Sea should be kept updated up to 2018, based on what has already been made (Gittenberger, 2016).
4	These data (2 and 3) should be made publicly available through the CWSS website or a portal.

Table 8. Proposed actions for a trilateral alien species coordination group to be set up, to optimize the current alien species monitoring and detection efforts in the Wadden Sea on a trilateral level (Table 6)(see 5.2).

Proposed actions for a trilateral alien species coordination group to be set up	
1	To advise on optimizing the national monitoring methods of alien species and harmonize the methods on a trilateral level where legally possible; to share expertise on the effectiveness of methods used. This concerns for example the effectiveness of environmental DNA analyses, but also the use of citizen science based projects for the rapid detection of alien species. These innovative methods are already used in varying degrees in the three countries. By sharing efforts, knowledge and experiences, such innovations will be enhanced and expedited on a trilateral level.
2	As all three countries fall under HELCOM and/or OSPAR, HELCOM/OSPAR protocols and target species lists will be used to assess where the monitoring of marine alien species can be harmonized on a trilateral level.
3	General site selection procedures for monitoring and rapid assessment methods could be analysed for harmonization across Denmark, Germany and The Netherlands.
4	Terrestrial alien species should be considered in Wadden Sea monitoring. This could for example be done by installing an annual terrestrial alien species monitoring program using citizen science and experts on at least one island (and Halligen) in every part of the Wadden Sea. Thereby, the Union List of invasive species and “alien” predators on these islands will be monitored on a regular basis.
5	Organize a workshop on the topics aquaculture in the Wadden Sea/shellfish imports or mussel transfers.

Table 9. Recommendations concerning points of attention where improvements of the existing alien species monitoring methods and protocols may be achieved in the Wadden Sea Area¹.

Recommendations	
1	It is recommended in general to consider both marine and terrestrial habitats for national monitoring programmes with a focus on “hot spots” of introduction (e.g., ports, marinas, aquaculture sites) and natural “hot spots” where alien species may prefer to settle (e.g., oyster reefs).
2	Within the Wadden Sea region, communities need to be considered in intertidal, subtidal and terrestrial habitats and on soft substrates, artificial and natural hard substrates, salt marshes and the dunes.
3	Concerning the marine habitats, an extended rapid assessment including a full species inventory from various habitats of different hotspots, can be used (Gittenberger et al., 2015, Buschbaum and Lackschewitz, 2016).
4	Ideally, all marine, freshwater and terrestrial species should be considered, including also viruses, micro-organisms, fungi, phytoplankton, zooplankton, fish and birds.
5	Alien species should be included in established trilateral monitoring parameters.

4. Risk assessment

The risk analyses already carried out in the three countries are mainly built upon the obligations and systematics laid down in the relevant EU Regulations and Directives, and thus take offset in the national implementation of those. As a result, risk assessments and/or pathway analyses have been done in all three countries to assess the priority pathways with which alien species may be introduced into the European Union to comply with EU Regulation 1143/2014 on invasive alien species (EU, 2014; Table 2). For minimizing the risk for the Natura 2000 targets of the Wadden Sea, risk assessments have also been done to impose restrictions on shellfish transports to and between the different parts of the Wadden Sea (Table 3). Finally, as a potential basis for a risk assessment to decide upon exemptions to the BWMC, following HELCOM/OSPAR guidelines, surveys have been done in ports in the Wadden Sea (Table 5). In addition, in compliance with the BWMC, *i.e.*, MEPC guideline no. 7, risk assessments are currently being conducted or planned in Denmark and The Netherlands to evaluate the potential implementation of the “Same Risk Area” concept. For example, to implement management and control measures described in chapter 6, all three countries use a common risk assessment and scoring system to assess threats by alien species. Specific analyses have been done on alien species already present, to identify their main pathways of introduction into the Wadden Sea (Table 4).

Trilateral cooperation may help to reduce time and labour of risk assessments, while also reducing costs and increasing the potential effectiveness of measures against invasive alien species in the Wadden Sea region. To achieve this, a trilateral alien species coordination group should be set up and use its networks (including national managing authorities) to facilitate where possible the actions proposed in Table 10 (see 5.2).

Table 10. Proposed actions facilitated by a newly established trilateral alien species coordination group, to assist on a trilateral level risk assessments done for alien species in the Wadden Sea Area¹ (see 5.2).

Proposed actions	
1	In addition to records of alien species in the Wadden Sea, the associated risk assessments will also be coordinated and shared trilaterally. Sharing the results of risk assessments may save time, even if the national risk assessment methods differ.
2	Information on the effectiveness of these eradication and control techniques will be shared on a trilateral level.

The TWSC could also consider launching an extended risk assessment of an alien species in the Wadden Sea, if one of the following questions is positively answered:

[1a] Is it an alien species of Union concern?

[1b] Is it a new alien/cryptogenic/ unidentified non-native species for the Wadden Sea Area¹?

[1c] Is it a species of concern for the Wadden Sea Area¹?

[2] Are there habitats in the Wadden Sea Area¹ suitable for the settlement of this species?

[3] Is it more than likely that the species will have a distinct impact on the ecosystem?

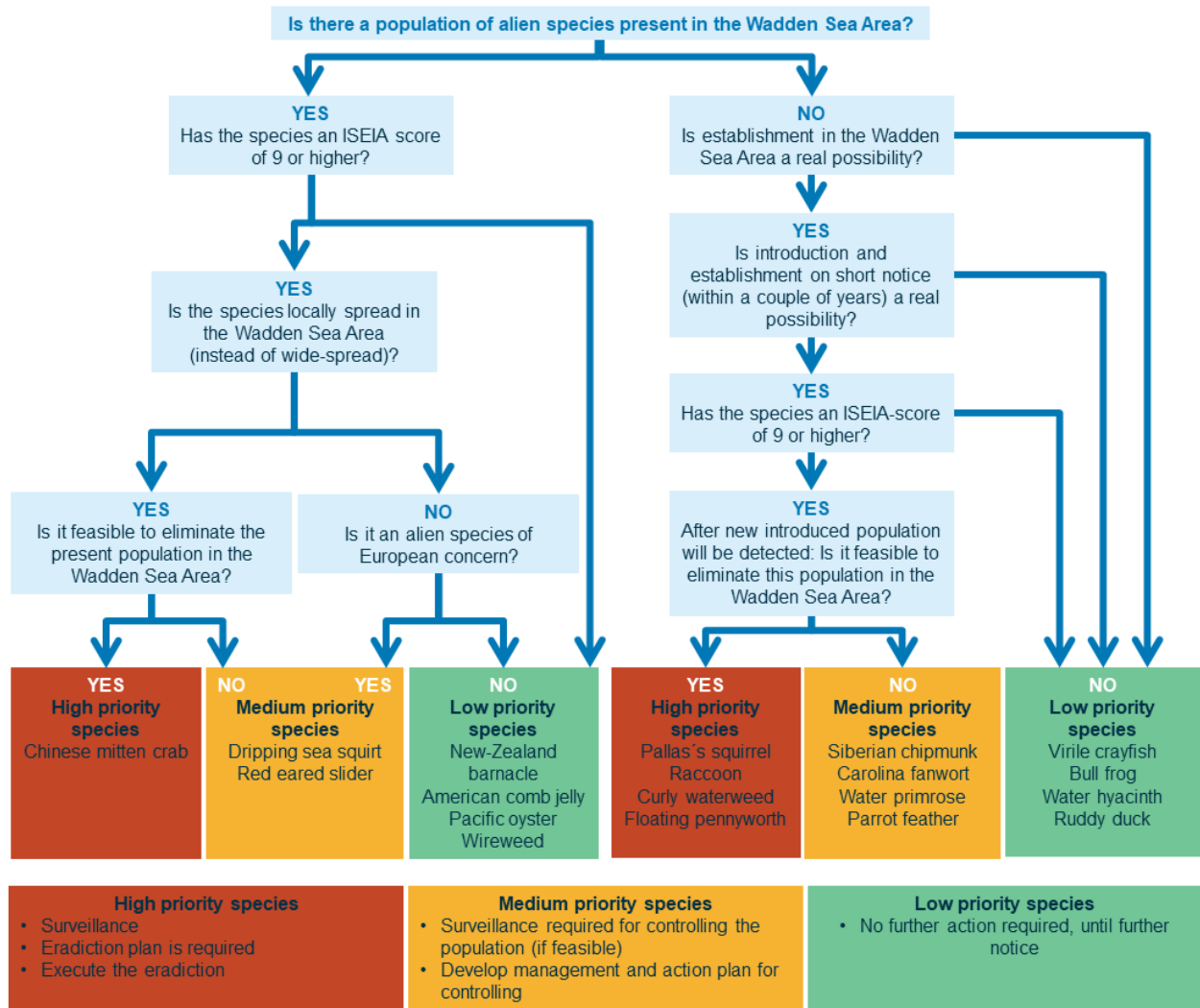
[4] Is it feasible to eliminate the species? Whether the species is of Union concern, can easily be checked and therefore answered.

If “yes” is answered to question [1a], action has to be taken according to EU Regulation 1143/2014 (EU, 2014). If yes is answered to question [1b] more efforts should be made to determine the exact species and if possible perform a risk assessment. If yes is answered to question [1c], then it is for the individual member state to decide appropriate action.

Question [2] is easily answered if a population was found settled in the Wadden Sea region. If it only concerns a single record, this question may be harder to answer depending on available literature and specialist expertise. If a potentially suitable habitat is present, a nationally accepted risk assessment method, such as the internationally recognized ISEIA methodology (http://ias.biodiversity.be/ias/documents/ISEIA_protocol.pdf) can be used to assess the potential risk that this species may form for the environment.

Finally, if the alien species is considered to be high risk, the trilateral countries should consider whether it can be eliminated (and/or controlled). Although this may be difficult for marine species, elimination and control techniques have proven to be successful for terrestrial and fresh water alien species. This will be further elaborated in chapter 6 on “Management control and eradication and other mitigation measures”.

Even if this is not deemed necessary nationally, one may use the priority scheme as depicted in Figure 4 when sharing information between countries on risks of alien species in the Wadden Sea. This scheme is relatively easy to follow and takes the above mentioned questions into consideration. Instead of ISEIA, a different risk assessment method can be used to assess the potential impact of an alien species on the environment, *e.g.*, in Germany the “Naturschutzfachliche Invasivitätsbewertung gebietsfremder Arten für Deutschland” (Nehring *et al.*, 2015) is used.



Due to matters of responsibilities, Wadden Sea Conservation Area in Schleswig-Holstein.

Figure 4: Alien species priority scheme for the Wadden Sea Area¹.

5. Trilateral coordination (Decision making)

5.1. Decision making on member state level

The TWSC does not need a defined decision making body for the management of alien species, as the national authorities (Table 11) will remain responsible for taking management decisions in their areas. These national authorities will be supported on the trilateral level through coordination by the Common Wadden Sea Secretariat.

Table 11. The relevant national authorities responsible for decision-making where it concerns the management of alien species in the trilateral Wadden Sea Area¹.

Denmark	
National level	The Environmental Protection Agency
Regional level	No regional level
Germany	
National level (Exclusive Economic Zone (EEZ))	Federal Agency for Nature Conservation (BfN)
Regional (Länder) level	Ministry for Environment, Energy, Building and Climate Protection of Lower Saxony Ministry of Environment and Energy Free and Hanseatic City of Hamburg Ministry of Energy, Agriculture, the Environment, Nature and Digitalization of Schleswig-Holstein and National Park Authorities of Hamburg, Lower Saxony and Schleswig Holstein
The Netherlands	
National level	Ministry of Agriculture, Nature and Food Quality Ministry of Infrastructure and Water Management
Regional level	Province of Noord-Holland Province of Friesland Province of Groningen

5.2. Actions at the trilateral level

Where national obligations, agreements and legislation allow it, it is proposed that a coordination group with representatives from three countries is set up, similar to the existing WG-AS.

Proposed tasks for trilateral alien species coordination:

[1] Organising and sharing data on alien species records throughout the Wadden Sea Area¹.

Primary actions will be the harmonization of data arising from national alien species monitoring programs and their continuous accessibility e.g., for the Trilateral Monitoring and Assessment Program (TMAP);

[2] Sharing experiences on the development and effectiveness of monitoring, prevention, control and eradication methods;

[3] Streamlining methods and actions (where possible) focused on “alien species in the Wadden Sea” related communication, awareness and education on a trilateral level; the latter includes the introduction of an information (alert) approach and an agreement on standardized information channels to disseminate timely information on new incoming taxa amongst the trilateral parties.

These tasks may encompass coordinating information and citizens science programs, while involving national institutions responsible for alien species management in the Wadden Sea Area¹, with the role to suggest and advise on appropriate common conclusions and measures.

To optimize the effectiveness of decisions made, the coordination group will support, where possible, national decisions, risk assessments and actions that focus on high risk transport vectors and geographical “hot spots”.

For trilateral alien species coordination

[1] Facilitation and aiding of the coordination group;

[2] Providing a regularly updated list of alien species in the Wadden Sea based on national data (TMAP), and making it accessible via the CWSS website.

[3] Providing a focal point on the CWSS website on which examples can be shared about the effectiveness of prevention, control and eradication actions that have been done by any of the States in the Wadden Sea.

Due to the high mobility, in particular of aquatic alien species, timely communication and information about (new) detections, spreading and measures is crucial and has to be disseminated as soon as possible. The above trilateral coordination provides added value for each party and facilitates initiating appropriate and early measures.

6. Management, control and eradication and other mitigation measures

If invasive alien species have been detected in a marina or harbour, risk assessment procedures could be initiated at national level. Based on the findings, it could be advisable to implement appropriate, cost-efficient measures to stop or limit further spread. One option could be eradication and another could be to control.

For newly introduced alien species, which are known as invasive or are being defined as invasive by the appropriate national authorities after a risk assessment procedure, eradication could be considered. However, a basic requirement is the availability of at least one cost-efficient and practically possible eradication method which in any case has to be in line with the guiding principle “to achieve, as far as possible, a natural and sustainable ecosystem in which natural processes proceed in an undisturbed way” and with national regulations of the three Wadden Sea countries and their local administrations.

6.1. Current eradication and control activities to manage alien species in the Wadden Sea

All three countries have experiences with the eradication and control measurements of terrestrial and aquatic species. These measures are taken mostly to comply with EU Regulation No 1143/2014 on invasive alien species (EU, 2014), the Habitats Directive & Birds Directive (Natura 2000), the European WFD and/or MSFD. Alien species that are eradicated and controlled are considered to be invasive alien species and/or nuisance species within these EU Regulations and directives, as is indicated in Tables 2 and 3. These set out current measures taken to prevent the introduction of these species. Whether they are considered invasive alien species and/or nuisance species is mostly decided on the basis of national risk assessments described in chapter 4. Although prevention measures have been in place, some alien species were introduced many years ago and some more recent introductions could not be prevented. Those alien species considered high risk were managed after their presence was detected and monitored within one of the current monitoring programs and actions as described in Table 5. The decision to eradicate or control these candidates was not only taken on the basis of the risk concerned, but also on whether eradication and control measures were feasible, as illustrated in the alien species priority scheme for the Wadden Sea Area¹ (Figure 4).

Table 12. Examples of alien species control and eradication measures in the Wadden Sea and management systems supporting these measures. It shows whether they mainly focus on invasive alien species or nuisance species, and whether they target the terrestrial (and freshwater) habitats on the Wadden Sea islands and/or the more open saline (brackish to marine) waters of the Wadden Sea. This table gives examples of measures that have been taken in the Wadden Sea, and is not a complete overview of measures taken in the three countries.

Alien species control and eradication measures, management systems and actions supporting these measures in the Wadden Sea Area ¹	Islands (terrestrial)	Open Water (saline)	Invasive alien species	Nuisance species	Netherlands	Germany	Denmark
	EU Regulation 1143/2014: Species of Union concern rapid response procedures are in place (EU, 2014: Art. 17).	Yes	Yes	Focus		Yes	Yes
EU Regulation 1143/2014: Procedures for the management of species of Union concern and the restoration of damaged ecosystems are in place.	Yes	Yes	Focus		Yes	Yes	Yes
The distribution of nuisance species is mapped, including invasive alien species, to support potential eradication and control measures, e.g., to get an indication of the cost of (local) eradication and control measures. On the Wadden Sea islands this may include plant species.	Yes		Focus	Focus	Yes	Yes	Yes
National management strategies have been developed to eliminate and/or control mammalian predators of ground nesting birds on a selection of islands and Halligen. These predators are in general considered nuisance species, of which some are alien species.	Yes			Focus	Yes	Yes	Yes
The distribution of <i>Crassula helmsii</i> on Norderney is studied. Based on this study a habitat model was developed and used to identify potential introduction 'hot spots' on three other islands. It is planned to check these regularly. Management recommendations are made based on this study.	Yes			Focus		Yes	
More opportunities to hunt and regulate invasive species have been made available. Hunting is now allowed all year around on all invasive species on the Union list, as well as the American mink (<i>Neovison vison</i>).	Yes		Yes				Yes
A policy framework has been developed on alien species eradication and management.	Yes	Yes	Focus		Yes		

Alien species management can take place either by prevention, eradication after introduction, or by population control if eradication is not feasible. As eradication and control measures may not be possible and tend to be relatively expensive in comparison to prevention measures, so prevention is the preferred method. Prevention measures taken in the Wadden Sea are described in chapter 2 and Tables 1-4. They show for example the national management (and control) systems within the Dutch, German and Danish parts of the Wadden Sea that prohibit the import of mussel seed, and they show how transport bans and restrictions are designed to minimize the risk of invasive alien species (Table 3). Eradication and control measures to manage species in the Wadden Sea vary more widely and tend to be species or species group specific. Species that are eradicated and/or controlled in the Wadden Sea region are considered invasive alien or nuisance species under EU Regulation No 1443/2014, the Habitats Directive & Birds Directive (Natura 2000), the WFD and/or the MSFD. Examples of control and eradication measures and supporting management systems are given in Table 12.

6.2 Proposed eradication and control activities

All three countries have experiences with alien species management and prevention, eradication and control measures in the Wadden Sea. As described in chapter 2, cooperation at the trilateral level can distinctly improve these prevention measures on a national level. Greater effort will be made to assess the possible benefits of trilateral eradication and control measures uniformly applied throughout the Wadden Sea Area. These efforts can be coordinated by a trilateral alien species coordination group with support from CWSS, similar to the already existing WG-AS (see chapter 5.2). Trilateral eradication and control measures will be based on the exchange of experiences and best practices in the field and in the management sector between the trilateral countries.

Specific trilateral activities that could be considered by the trilateral partners in the marine, freshwater and terrestrial environments are described in Table 13. A trilateral alien species coordination group could facilitate these actions by using its networks (*e.g.*, including national managing authorities (see Table 11)).

Species that are already widespread in the Wadden Sea Area can in some cases be controlled to limit their spread while others may be eradicated locally, nationally or in the entire Wadden Sea Area. In particular, trilateral eradicating or control measures, if feasible, will be relatively cost-effective. Long-term, coordinated management may be needed to limit the harmful effects of many invasive species. The methods for management or control will depend on the type of species and how widespread it is. In general, managing invasive species will be more effective if citizens and stakeholders are involved. Communication, awareness and education are therefore important factors within the management of alien species, as is further described in chapter 8.

Table 13. Trilateral eradication and control activities that could be facilitated where possible by the proposed trilateral alien species coordination group, by using its networks (e.g., including national managing authorities).

Proposed trilateral eradication and control activities	
1	Where new alien species for the Wadden Sea are discovered during surveillance and monitoring of marinas or other places, this information should be directed to the relevant national authorities (Table 11) in all three countries immediately.
2	If an alien species inside the Wadden Sea is classified as a nuisance species in any of the countries, the relevant national authorities in each country (Table 11) will be notified so rapid eradication measures can be considered on a trilateral level.
3	All appropriate measures should be taken to ensure that invasive species do not spread across the borders of the three countries in the Wadden Sea Area ⁹ .
4	Information about eradication and management efforts against invasive species will be shared and exchanged between the trilateral countries.
5	Additional measures on a national level can be made concerning: Invasive alien plant and animal species, harmful to the ecosystems on the islands and Halligen will be eradicated when feasible within national strategies and projects on invasive species. In an initial phase pilot projects could be established on selected islands.

⁹ Generally Wadden Sea Conservation Area in Schleswig-Holstein, where possible, also in the entire Wadden Sea Area of Schleswig-Holstein (see map in Annex 1).

7. Evaluation of the effectiveness of mitigation measures

Regular evaluation of the effectiveness of measures is necessary to assess the success of relevant management actions. Measures described in the previous chapter should be evaluated on a national level. In Lower Saxony for example, overall concepts for the regulation of mammalian predators, which are non-indigenous to the Wadden Sea islands in Lower Saxony, are being developed and measures have been implemented on several islands. This is an ongoing process with a continuous evaluation of the measures.

Alien species management measures are also evaluated on an international level. The rate of introductions of alien species per year is an indicator developed by OSPAR for Descriptor 2 within the framework of the MSFD. It can be used to evaluate the effects of management measures on alien species in the Wadden Sea Area. The indicator will be further discussed for adoption and harmonization within the TWSC. The relevant national authorities and OSPAR can then assess if this is appropriate.

In addition to assessing whether the goals of a measure are reached, such as the eradication and/or control of an alien species, an evaluation can also take costs into account. If, in all three countries, different measures are taken to reach the same goal, *e.g.*, for the local eradication of an alien plant species, the best measure from a cost-benefit perspective can be identified.

To make use of such evaluation results on a trilateral level, cost indications and experiences of the effectiveness of control and eradication measures should be shared. This can be facilitated by a trilateral alien species coordination group supported by the CWSS, similar to the already existing WG-AS (see 5.2). This coordination group could facilitate, where possible, the sharing of cost indications and experiences by using its networks (*e.g.*, including national managing authorities).

8. Communication, awareness and education

Raising awareness in the Wadden Sea Area about potential problems with alien species amongst management authorities, companies (*e.g.*, shipping, marina operators and aquaculture facilities), scientists and the general public as well as educational institutions is an important aspect to preventing introductions and the further spreading of alien species in the Wadden Sea Area.

Introduction of alien species happens in some cases because of lack of knowledge about the harmful effects the species may have on both nature and on society. The responsibility to restrict the introduction of new species to the Wadden Sea Area should be shared by a large variety of stakeholders. Everyone should help to limit the impact of invasive species already in the area. However, for that to happen, all the players in the Wadden Sea – the general public, special interest groups, hunters, pet owners, fishermen etc., and those in industries such as horticulture, agriculture, forestry and aquaculture, and administrations – must have sufficient knowledge of the problem to know how they can contribute effectively.

Therefore, awareness raising and education are important tools to prevent the introduction of new invasive species and to achieve success in management initiatives against invasive species that are already present.

8.1. Capacity building initiatives (agencies, training, awareness, international collaboration)

In all three countries, initiatives are taken to raise awareness about alien species with the stakeholders involved. While actions differ from country to country, they all tend to focus on alien species management.

One example to prevent the introduction of alien species of Union concern (EU, 2014) is training of border control posts, to identify alien species. Fact sheets have been developed to support them further (Table 2). To prevent marine introductions, the IMO guidelines for the control and management of ships' biofouling to minimize the transfer of invasive aquatic species: MEPC.207(62)(2011) are disseminated, together with the IMO Guidance for minimizing the transfer of invasive aquatic species through biofouling (hull fouling) by recreational craft: MEPC.1/Circ.792 (2012)(Table 1). In addition to encourage environmentally friendly ships in a Network of Experts of the German Federal Ministry for Transport and Digital Infrastructure was set up on "Designing environmentally friendly transport and infrastructure" (http://www.bmvi-expertennetzwerk.de/EN/Topics/Topic2/Topic2_node.html).

To improve accessibility of data on alien species in the Wadden Sea from various sources, all three countries have developed national online portals and databases for sharing information on alien species records. These portals and databases include the Dutch National Database Flora and Fauna (NDFF), waarneming.nl and telmee.nl in The Netherlands, the "Alien species Platform" and the beachexplorer.org website in Germany, and the national online portal for mapping observations of invasive species in Denmark. They can be used as basic information suppliers for awareness measures and form portals for citizen science based monitoring programs to detect alien species in the Wadden Sea (Table 5).

Within each of the countries governments have formed alien species expert groups that gather and share information and best practice on eradication and control methods, distribute information including identification materials to raise awareness, and arrange advice to be given to relevant stakeholders on how to prevent introduction and spread of invasive species. In Denmark the responsibilities for invasive species is located at the Ministry of Environment and Food of Denmark www.mfvm.dk. For German terrestrial areas this is organised on a national level by the Federal Agency for Nature Conservation (BfN, <http://neobiota.bfn.de/>) and for the marine areas at the Bund/Länder-Ausschuss Nord- und Ostsee (BLANO) Fach-AG Neobiota, including its 'Neobiota Plattform' (<https://www.neobiota-plattform.de>). For The Netherlands this is organized in the TIE (Team Invasieve Exoten). A non-governmental group of specialists is the Centre of Expertise for Exotic Species (located in Nijmegen), NEC-E.

On the international level there is cooperation within OSPAR and HELCOM.

8.2. Proposed actions for communication, awareness and education

The national authorities responsible for the management of invasive species should provide general information on the species as well as campaigns targeting specific species and their pathways. Although this is already done by all three countries separately, “alien species in the Wadden Sea”, there is scope to streamline communication, awareness and education through trilateral coordination. This may be best done by setting up a coordination group, similar to the already existing WG-AS (see 5.2). In addition to sharing information on the effectiveness of national awareness campaigns, the coordination group members could facilitate a number of actions (Table 14) by using their networks (*e.g.*, including national managing authorities) to promote communication and education about and awareness of alien species in the Wadden Sea.

Table 14. Trilateral actions to be facilitated by a trilateral alien species coordination group to promote communication and education about and awareness of alien species in the Wadden Sea.

Proposed trilateral actions	
1	Coordinate or assist each other with the development of education material about alien species for schools and institutions.
2	Coordinate or assist each other with the development of information material for skippers on prevention activities of new introductions and limiting the spreading of alien species including best practice methods for hull cleaning that could be considered.
3	Development of online learning programs about alien species similar to the learning programs Ecosim and Linvexo about alien species (in general) that were developed in The Netherlands.
4	Pictures and information that help identify alien species in the Wadden Sea can be shared between stakeholders in the three countries with the support of the coordination group.
5	To make communication as easy as possible, contact details for reporting for harbour masters, skippers, guides and the public can be made very widely available.
6	Finally the coordination group may promote the implementation of campaigns related to the detection, reporting, and eradication of alien species on a trilateral level. Especially campaigns in which the public participates are hereby crucial for raising awareness.

9. Concluding remarks

The Management and Action Plan Alien Species (MAPAS) has the major goal of preventing the further introduction of alien species into the Wadden Sea Area. This is the first and most efficient strategy to protect the ecosystem from possible adverse effects of invasive alien species. Each of the countries has already developed strategies to handle alien species in a national context. A coordinated management approach to protect and conserve the UNESCO Wadden Sea World Heritage property will add value to these national activities.

Cooperation and clear communication channels between the partners of the TWSC in relation to monitoring, assessing risks, and assessing the effectiveness of measures enable synergies which make the management of alien species in the entire Wadden Sea Area much more efficient.

Furthermore, the MAPAS enhances early warning capabilities within the trilateral Wadden Sea. This is vital for improved preparedness against, and thus less vulnerability to, newly arriving species.

Finally, raising awareness on prevention and mitigation measures for alien species on the basis of a common communication strategy increases the involvement of the general public and has the potential to increase the identification among inhabitants of and visitors to the UNESCO World Heritage property.

Therefore, it is proposed that a coordination group with representatives from three countries is set up, similar to the already existing WG-AS. The coordination group will be responsible for the following tasks:

[1] Organising and sharing data on alien species records throughout the Wadden Sea Area. Primary actions will be the harmonization of data arising from national alien species monitoring programmes and their continuous accessibility *e.g.*, for the Trilateral Monitoring and Assessment Programme (TMAP);

[2] Sharing experiences on the development and effectiveness of monitoring, prevention, control and eradication methods;

[3] Streamlining methods and actions (where possible) focused on trilateral communication, awareness and education about “alien species in the Wadden Sea”; this includes the introduction of an information (alert) approach and agreement on standardized information channels to disseminate timely information on new incoming taxa amongst the trilateral parties.

These tasks may encompass coordinating information and citizen science programs, while involving national institutions responsible for alien species management in the Wadden Sea Area¹, with the role to suggest and advise on appropriate common measures.

To optimize the effectiveness of decisions made, the coordination group will support, where possible, national decisions, risk assessments and actions that focus on high-risk transport vectors and geographical “hot spots”.

In addition, this group will provide a regularly updated list of alien species in the Wadden Sea based on national data (TMAP), and make it accessible via the CWSS website. This website will also host a focal area where examples can be shared about the effectiveness of prevention, control and eradication actions that have been carried out by any of the States in the Wadden Sea.

Due to the high mobility, in particular of aquatic alien species, timely communication of information about (new) detections, spreading and control measures is crucial and has to be disseminated as soon as possible. The above described trilateral coordination provides added value for each party and facilitates the consideration and implementation of appropriate and early measures.

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11. Annex

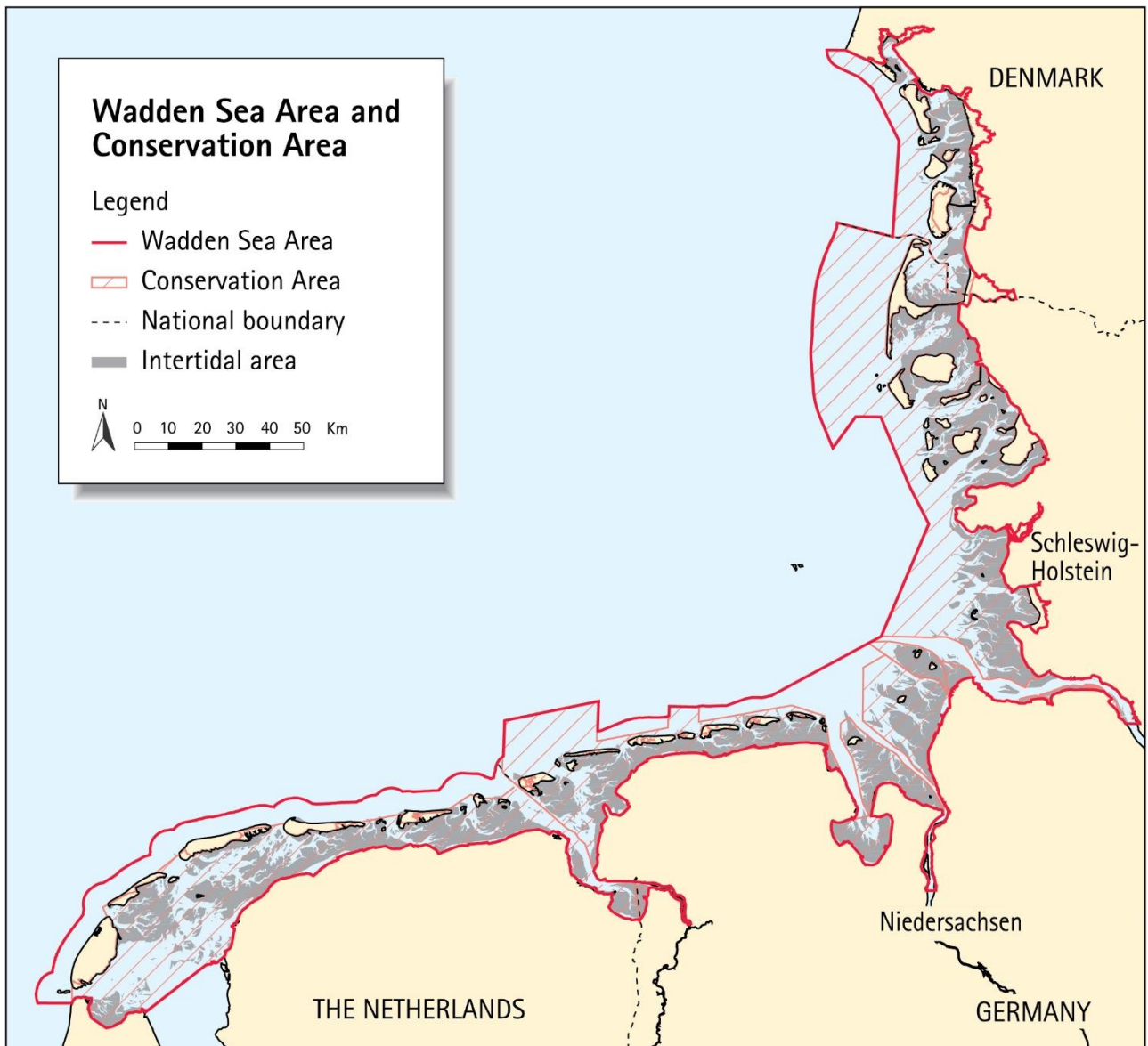


Figure: Map of the Wadden Sea Area and Wadden Sea Conservation Area (Image: CWSS).

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