Marine Forum

Alien species from ballast water: How does it affect the North Sea region?

North Sea Foundation 2001

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North Sea Foundation
Utrecht, 2001

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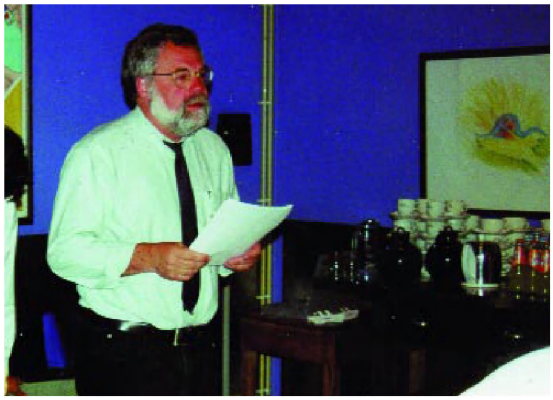
About the North Sea Foundation...

The North Sea Foundation is a professional environmental organisation, located in the Netherlands, which strives for sustainable use of the North Sea. The organisation operates independently and is assisted by a large network of specialists and advisors from various sectors and branches. The foundation occupies an observer seat for Friends of the Earth International in the International Maritime Organization.



Prof. dr. Jan de Leeuw, director of the NIOZ-institute and chairman of this Marine Forum.

What is a "Marine Forum"?

A Marine Forum is a round-table conference organized on a regularly basis by the North Sea Foundation. A Marine Forum fosters open dialogue between all interested parties on major marine public policy issues through participation by public authorities, industry, NGO's and other relevant interested parties. Each Marine Forum focuses on a single marine public policy issue. The objective of a Marine Forum is to stimulate environmental awareness to marine public policy issues and to develop effective solutions to those issues.

Central question and objective Marine Forum "Alien guests from ballast water"

The central question addressed at this Marine Forum was:

How important is protection of the (Netherlands) North Sea area against introductions of alien species by ships' ballast water?

The question was addressed through review of the existing international policy and legislation related to non-indigenous species from ballast water, and through consultation with all relevant interested parties participating in this Marine Forum.

Purpose of this brochure

This brochure provides a report of the presentations and discussions that took place during the Forum, and serves as a record of the proceedings for participants and other interested parties. Apart from a report of this Forum meeting, some relevant information on recent developments in the field is included. In addition, the brochure will serve as a vehicle for increasing awareness about the problem of alien species from ballast water and about the North Sea environment in general. For that purpose, the brochure will be distributed broadly to relevant organisations and will be published on the North Sea Foundation internet site (www.noordzee.nl/scheepvaart).

Introduction

BALLAST WATER AND THE SHIPPING INDUSTRY

The use of ballast water is necessary to provide stability to a vessel. The growth the shipping industry during the last century has led to a dramatic increase in the transport of ballast water. Annually, up to 10 billion tons of ballast water is transferred around the world.

It is well known that in the course of transferring ballast water many organisms from the area of uptake are deposited in the sea (or sometimes fresh water) area of discharge. The sediment in the ballast tanks appears to contain a relatively high number of marine species, often times more than the ballast water itself. In this respect, a ship functions as a transport mechanism for aquatic species. The shortening of travel time of ships (because of increase of vessel speed) has resulted in better opportunities for alien species to survive in ballast tanks. It is well-known that the hull of ships can also function as a transport meganism for alien species. However, it is generally assumed that the number of transported species on the ship's outer hull has decreased massively because of the use of anti-fouling systems.

These rough sea conditions illustrate the need for ballast water in a vessel.

The potential negative effects of introductions of alien species are significant. They vary from:
- radical change of the marine ecosystem;
- economic effects (damaging fishing stock and shellfish aquacultures); and
- human health risks (primarily because of toxic algae).

The severity of the potential impact does not depend on the quantity of ballast water discharged. Indeed, even a small amount of ballast water containing alien species can cause considerable damage. Such seriousness of the potential risk and consequent damage is exasperated by the fact that effects of harmful introductions are irreversible.

A number of serious problems related to introductions of alien species have become apparent over the last two decades. The Great Lakes in the USA (the Zebra Mussel) and the Black Sea (the Comb Jelly) were the first areas to be confronted with significant measurable and identifiable effects. Ships' ballast water was indicated as a likely source of these introductions. The international community is addressing this concern within the IMO[1], where the issue has been studied and discussed in recent years. An international convention designed to regulate management of ballast water is currently being negotiated and is due to be agreed within the next few years.

So far, only two introductions of shell fish parasites (see 1.2) have caused significant effects in the Netherlands North Sea area. Apart from these introductions, no harmful introductions have been identified as causing serious problems in the Netherlands North Sea area. The question is whether this is a fortunate coincidence or whether we are truly at risk and dealing with a potential "environmental time bomb."

1 The International Maritime Organization: the regulatory body on shipping of the United Nations

Chapter 1

"ECOLOGICAL HELICOPTER VIEW" OF THE NORTH SEA

During the Forum, a number of presentations were made about the ecosystem of the North Sea. These presentations were intended to assist the participants in determining how vulnerable the North Sea is with regard to introductions of non-indigenous species.
In the context of these presentations references to the "North Sea" were limited to the Netherlands part of the North Sea, i.e., the Netherlands Continental Shelf (NSC: see Figure 1).

1.1 How vulnerable is the (Netherlands) North Sea view to alien species?

A presentation was made by the *Netherlands Institute for Sea Research* (NIOZ). A (non-exhaustive) list of parameters was presented which are important in considering the risks of alien introductions and its effects on the NCS and wider North Sea area:

Important parameters when assessing the risk of an introduction:

- All oceans and seas are open ecosystems. There are various opportunities for species to migrate naturally over long distances (e.g. from the Atlantic Ocean to the North Sea);
- Besides ballast water from ships, aquaculture was mentioned during this Forum as an important source of non-indigenous species in the North Sea;
- The successful introduction and establishment of alien species is largely dependent on a-biological conditions necessary for survival and reproduction. One of these conditions is the presence of solid substrate (e.g., stones on the sea bottom, dikes, pipes, timber jetties), which can function as "ecological stepping stones" for invasive species. In this respect, the coast of Zeeland (see figure 2) with its large surface of dikes can be regarded as a high risk area for introductions;
- Another important a-biological condition in the North Sea area is the occurrence of severe winters. Strong climatic fluctuations in the North Sea decrease the chance for successful introduction of alien species. Nevertheless, within the NCS are areas which have less fluctuations in temperature. Generally, the waters further from the coast (water temperature above freezing-point throughout the year) have better conditions for successful introductions than coastal areas and the Wadden Sea (where water temperatures can be below zero); and
- The large nutrient supply in the North Sea area is a favourable biological condition for the establishment of an alien species.

Important parameters when assessing the potential effects of an introduction:

- Generally, sea areas with high biodiversity are more vulnerable to alien introductions than waters where biodiversity is low. In this respect, the Northern part of the Netherlands North Sea (with silty benthos and relatively high biodiversity) as well as the entire coastal area, can be regarded as particularly vulnerable to harmful introduction of alien species. The more sandy, southern part of the North Sea has a lower biodiversity and is possibly less vulnerable to introductions;
- The NCS (and wider North Sea) ecosystem is largely dominated by a few species, making the potential effects of an introduction enormous. If, for example, a species would be introduced which causes disastrous effects in the cockle-population, the bird population in the Wadden Sea would also be seriously affected; and
- The NCS and wider North Sea is already a heavily stressed ecosystem, due to many economic activities taking place there (shipping, fishery, off-shore drilling). The risk of introduction of alien species must therefore be regarded within the context of the cumulative impact of these activities.

When the above mentioned parameters are considered altogether, certain parts of the NCS can be regarded as "potentially vulnerable" for introductions of alien species. In figure 1, these potentially sensitive areas are indicated:

Figure 1: Potential sensitive areas in the Netherlands North Sea for introductions of alien species.

On the basis of figure 1 it can be concluded that, generally spoken, the coastal area (inlcuding the Delta region and the Wadden Sea) can be considered as relatively more vulnerable to harmful introduction of alien species. In the open sea, more vulnerable areas with relatively high biodiversity include the Frisian Front area, the Cleaverbank, the Oystergrounds and Dogger Bank.

1.2 Which species in the Netherlands North Sea are non-native?

A representative of the *University of Groningen, Department of Marine Biology* made a second ecological introduction. The presentation defined "non-indigenous", "alien" or "exotic" species[2] as species which have crossed natural barriers and have established themselves due to human activities. They are identified by the following characteristics:

- they have established themselves suddenly in a ecosystem;
- they have have a population which increases quickly;
- these species are genetically uniform within the established population; and
- they are genetically equal compared with other populations throughout the world.

In addition to providing a general definition of what constitutes non-indigenous species, it is important to determine whether a given organism is non-indigenous to the North Sea ecosystem. Although there are certain tidal fronts in the North Sea which can prevent planktonic migration, the current patterns in the Southern North Sea require that the entire area be regarded (and managed) as a whole. Further it was noted that the entire sea area between Norway and Portugal (and therefore the OSPAR-region, including the entire North Sea) can be considered as an ecosystem "without frontiers". That is, species within this region can migrate actively or replace themselves passively by water movements. In addition, species originating from outside the OSPAR-region can be considered as non-indigenous to the North Sea.

Regarding identification of non-indigenous species on the NCS, research has produced only rough estimations. It is predicted that the actual amounts of non-indigenous species are higher than the current estimates. The question of "what is alien in the North Sea and what is not" remains partly unanswered and is somewhat academic. Generally, there is a lack of historical reference on this subject.

On the basis of scientific studies at the University of Groningen, at least 108 species can be regarded as non-indigenous in the entire NCS and its coastal areas (including the Wadden Sea and the coast of Zeeland).

2 There are many synonyms for alien species. Other common descriptions include: non-native, non-indigenous and exotic. Within IMO, definitions like harmful or unwanted are used. For the sake of this brochure, exclusively the names non-indigenous or alien are used. Therefore, where the name non-indigenous or alien species is used, it means all the organisms that have crossed natural barriers and originate from outside of the North Sea and OSPAR-region.

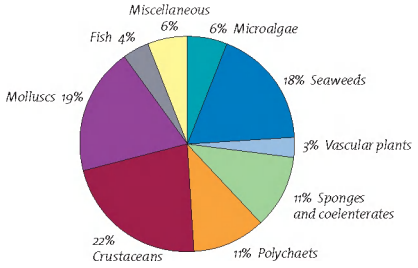


Figure 2: Taxonomic division of non-indigenous species on NCS

The majority of these species have established themselves permanently. The Delta region (see figure 1) is an area with a relatively high incidence of non-indigenous species. In figure 2, the taxonomic division of non-indigenous species on the NCS is presented.

There are a few examples of introduced species in the NCS that have had positive economic effects. For example, the Chinese Mitten Crab (see picture on page 8: known to be introduced in the North Sea by means of ballast water) is a source of income for the fishery sector. This species is exported to China[3]. In Table 1, a few examples are given of introduced species on the NCS with (potential) negative effects.

An example of a species that has shown explosive growth since its introduction on the NCS is the American jack-knife clam or *Ensis directus*. Negative effects because of this introduction have not yet been observed.

A group of organisms that deserves special attention and further research are (toxic) micro algae. During this presentation and the discussion it was emphasized that introduction of micro algae can have huge effects. There is a lack of knowledge about the number of introductions and the presence of these species in imported ballast water on the NCS. The Dutch National Institute for Coastal and Marine Management (N.I.C.M. MANAGEMENT) has undertaken a monitoring project partly focused on this group of organisms (see also 1.3). Another matter of concern is the difficulty of removing these organisms when applying Ballast Water Management Techniques (BWMTs: see chapter 3).

A group of micro-organisms that should also be of particular concern are pathogens. Although there is no specific example of a harmful introduction of a pathogen in the North Sea, there are serious risks involved. Ballast water discharged from vessels in coastal waters can contain a cocktail of potential pathogens. Many micro-organisms, thus pathogens, can tolerate a broad range of environmental conditions such as salinity and temperature (Ruiz et al. 2000). In this same article, it was stated that large-scale movement of micro-organisms by ships merits attention from both biologists and epidemiologists.

1.3 Is ships' ballast water a major source of introductions?

A number of Forum participants pointed out that (shellfish and other) aquacultures are a major source of non-indigenous species. The contribution of ships' ballast water in the total amount of introduced species in the North Sea region is difficult to determine. Research at the University of Groningen has found that ballast water is one of the "vectors" of marine species that are introduced in the Netherlands North Sea. For a large number of introduced species

Species	(Potential) negative effect
Pileworm/ Shipworm[4]	damage to dikes and timber piles for housing (18th century)
Chinese Mitten Crab	hazardous for fishing nets, dikes
Oyster parasites (*Bonamia* species: imported by oyster cultures from France)	Damage to oyster cultures
Mussel parasites (*Mytilicola* species: origin unknown)	Damage to mussel cultures
Japanese Oyster	possible change of ecosystem (crowding out native species)
Japanese Seaweed	„ „ „
Slipper	competing for food with Oysters
Tubeworm spec.[5]	Obstructing inlets of cooling water

Table 1: Examples of introduced species NCS and (potential) negative effects.

3 Telegraaf (daily newspaper in the Netherlands), 26 September 2000.
4 *Teredo navalis*
5 *Ficopomatus enigmatus*

The Chinese Mitten Crab: "alien invader" in the North Sea.

(approximately 30 % of the 108 alien species in the Netherlands North Sea), however, the origin is unknown.
When amounts of imported and exported ballast water are considered (for the Netherlands part of the North Sea respectively 7.5 million and 68 million tonnes a year, Aquasense 1998b) there might be a greater problem associated with exported ballast rather than imported ballast water. The vast amount of exported ballast water is primarily because of tankers leaving Netherlands ports which are in "full ballast" condition. The contribution of ships' ballast water to the total amount of introduced species in the Netherlands North Sea, however, could be substantial (Aquasense, 1998b). It must be emphasized that "one teaspoon" of ballast water containing an alien species can be enough to cause a harmful introduction. Therefore, a risk assessment solely on the basis of quantities of incoming and outgoing ballast water is not valid.

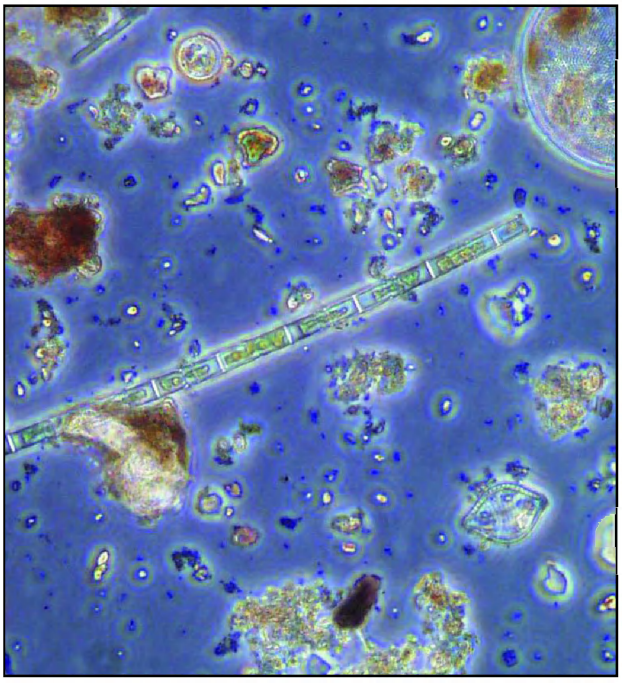
During the Marine Forum, a presentation was also made by the *National Institute for Coastal and Marine Managment (N.I.C.M. Management:* a division of the Dutch Ministry of Transport, Public Works and Water Management).
This organization is currently concucting a study on:

1. Which organisms occur in ballast water of ships visiting Netherlands ports?
2. Which of these organisms survive in Netherlands coastal waters and waters of port areas?

For the first part of this survey, the occurance of (primarily) phytoplankton and zooplankton will be measured in samples taken from a group of container vessels that regularly visit Netherlands ports. The chances for survival of these species will be examined in the second part of this study. Results from the study can be expected during 2001.

1.4 What about export of North Sea species to other sea areas?

Although the amount of exported ballast water is much greater than the imported volume (see paragraph 1.3), there are few examples of North Sea species introduced in other sea areas. One example is the "shore crab" (or green crab), which has been observed in US waters. Other species originating from the North Sea region which have been introduced in foreign ecosystems have not yet been identified.



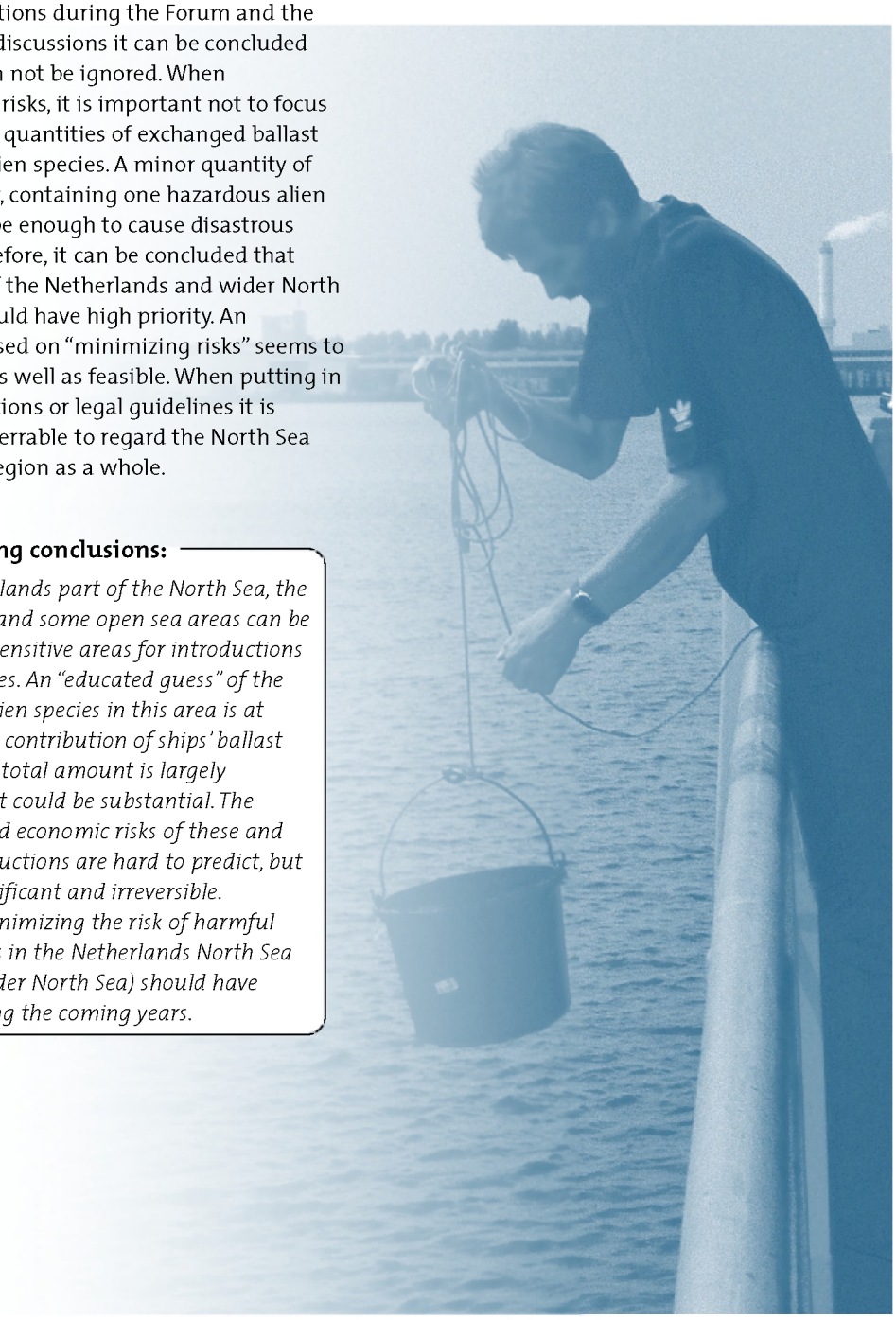
This sample shows the great variety of mico-organisms in ballast water.

1.5 The central question: How important is protection against alien species?

The central question during this Forum was what priority should be given to the problem of introductions of alien species in the (Netherlands) North Sea area. On the basis of the presentations during the Forum and the subsequent discussions it can be concluded that risks can not be ignored. When determining risks, it is important not to focus too much on quantities of exchanged ballast water and alien species. A minor quantity of ballast water, containing one hazardous alien species can be enough to cause disastrous effects! Therefore, it can be concluded that protection of the Netherlands and wider North Sea area should have high priority. An approach based on "minimizing risks" seems to be sensible as well as feasible. When putting in place regulations or legal guidelines it is strongly preferrable to regard the North Sea and OSPAR-region as a whole.

Summarizing conclusions:

In the Netherlands part of the North Sea, the coastal area and some open sea areas can be regarded as sensitive areas for introductions of alien species. An "educated guess" of the number of alien species in this area is at least 108. The contribution of ships' ballast water to this total amount is largely unknown, but could be substantial. The ecological and economic risks of these and future introductions are hard to predict, but could be significant and irreversible. Therefore, minimizing the risk of harmful introductions in the Netherlands North Sea area (and wider North Sea) should have priority during the coming years.



Sampling of ballast water in Netherlands ports during the N.I.C.M. Management project.

Chapter 2

POLICY MAKING

2.1 What is the state of affairs in IMO?

A representative of the Ministry of Transport, Public Works and Water Management, North Sea Directorate made a short presentation on policy making in the IMO (2.1) and two studies (Aquasense 1998a and b) on alien species executed on behalf of the ministry (2.2).

Within the IMO, there is consensus to strive for a diplomatic conference on ballast water in 2003. The Marine Environment Protection Committee (MEPC) has recommended that:

- every state controls its own sea area;
- minimal requirements be agreed for the administration/record keeping on the amount and area of intake of ballast water ("tier one"); and
- zones be identified where discharge of untreated ballast water is prohibited ("tier two").

It is yet unclear how performance standards for various BWMTs will be regulated in a future legal instrument.

It was indicated that the IMO, together with the World Health Organization (WHO), has been trying to deal with this issue for almost twenty years. Various ship owners and other participants during the Forum expressed their hope that the 2003 deadline for an international convention will be met.

From a paper distributed during the Forum (Fraser, Armstrong, 2000) it appeared that various stringent regulations are in place or will enter into force in the near future. In the State of California, for example, discharges containing live exotic ballast water organisms will have to be eliminated in 2005. Apart from the US, there are various states that have put in place regulations with regard to discharge of ballast water (including Australia and Canada). In Frasers' paper, it is stated that only the most committed operators will identify a satisfactory solution in time to meet these deadlines. This can be regarded as a great challenge for the shipping industry.

As mentioned before in paragraph 1.5, it can be useful to design measures for the North Sea and OSPAR-region. For example, the OSPAR-region might be identified as a ballast water management area. This could include requirements for adequate notification and mandatory ballast water treatment. The ongoing process of policy making in IMO will have to clarify the exact contents of these measures. Also, every port or coastal state has certain sovereign competencies under UNCLOS[6]. Apart from this, UNCLOS includes other important guiding principles such as: innocent passage, rights of states to intervene and Exclusive Economic Zones. If action is undertaken within OSPAR to designate this region as a BWM area, these legal provisons must be taken into account. The available regional co-operation within the IMO Convention might be a suitable framework to tackle and short-circuit these issues.

2.2 Does the situation in the Netherlands North Sea raise concern?

On the NCS, there are only a few incidents of introduced species with significant negative effects. Oyster parasites and the pile worm (see table 1) are the most clear examples. Apart from these species, no introductions have taken place in Netherlands waters that have had major ecological or economic consequences. The question remains whether this is a lucky coincidence, or if the North Sea has unfavourable ecological conditions for introduction and survival of non-indigenous species. Therefore, the North Sea Directorate (Ministry of Transport) has executed studies on the frequency of introductions and economic and environmental aspects (Aquasense, 1998a

6 United Nations Convention on Law Of the Sea, Jamaica, 10 December 1982

Discussions during the Forum on existing and forthcoming legislation.

and b). The major finding of these studies is that approximately every 4 years an introduction of an alien species takes place because of discharge of ballast water, i.e. one introduction per every million m^3 ballast water discharged (Aquasense 1998b). On the basis of one of these Aquasense studies, a minimum of 41 marine species is estimated to be non-native in Netherlands coastal waters (the estimation of 108 of the University of Groningen is an estimation for the entire NCS).

From the Aquasense studies, it also became clear that the potential economic damage fishery and tourism sector could be approximately 150 million guilders (approx. $ 70 million). The greatest environmental effects can be expected from the introduction of pathogens and a radical change of the North Sea ecosystem.

Public health
Certain algae are known to negatively influence the quality of swimming water. In this respect, there are no examples of radical effects on the NCS and the Netherlands North Sea coast. Studies have been conducted on the potential impact of the introduction of micro algae (Aquasense, 1998a), but uncertainty remains.

2.3 Existing legislation and how to deal with it...

During the Forum, a few articles from existing legislation on alien species were presented. Discussion started on the applicability and relevance of the EU Habitat Directive[7] and the UN Biodiversity Convention[8].

The EU Habitat Directive contains regulations on alien species in article 22 (b):

EU Habitat Directive, article 22

In implementing the provisions of this Directive, Member States shall:

(....) (b) ensure that the deliberate introduction into the wild of any species which is not native to their territory, is regulated so as not to prejudice natural habitats within their natural range or the wild native fauna and flora and, if they consider it necessary, prohibit such introduction. (...)

There was a brief discussion on whether introductions of alien species by ships' ballast water can be considered as "deliberate" introductions. A representative of the shipping industry expressed the view that a ship owner does not have knowledge of the biological contents of ballast water. Therefore, introductions of organisms by ballast water can not be considered as intentional. Other participants expressed the view that the shipping industry has a responsibility to treat its ballast water. This responsibility results from the large volumes of imported ballast water into the North Sea region, and, also, the extensive quantity of ballast water that is exported from the North Sea region to other sea areas.

7 COUNCIL DIRECTIVE 92/43/EEC, on the conservation of natural habitats and of wild fauna and flora, 21 May 1992
8 CONVENTION ON BIOLOGICAL DIVERSITY, United Nations, 5 JUNE 1992

The following articles were discussed from the UN Convention on Biodiversity:

Article 6. General Measures for Conservation and Sustainable Use

Each Contracting Party shall

(...) b) Integrate, as far as possible and as appropriate, the conservation and sustainable use of biological diversity into relevant sectoral or crosssectoral plans, programmes and policies

Article 8. In-situ Conservation

Contracting Party shall

(...) h): prevent the introduction of, control or eradicate those alien species which threaten ecosystems, habitats or species.

Discussion focused on whether the current plans and guiding principles for policy sufficiently reflected the above mentioned articles. There was a strong consensus that the Biodiversity Treaty does not provide stringent guiding principles for policy making.

Shortly before the Marine Forum, the fifth meeting of the Conference of the Parties to the Convention on Biological Diversity (COP5) was held in Kenya. During this Conference, the problem of alien species was included on the agenda. The following outcome[9] was important regarding alien species from ballast water:

- Parties, governments are urged to implement the above mentioned article 8(h) of the Convention;
- In the framework of the "Global Invasive Species Programme" (GIPS), the IMO and other organizations are urged to cooperate and design measures to prevent the introduction of alien species.

These developments made clear that the priority and urgency about the introduction of alien species is increasing. Obviously, this raises the question of which measures should be implemented for the (Netherlands part of the) North Sea region.

Summarizing conclusions:

An international convention within the IMO on alien species from ships' ballast water will likely be held in 2003. International regulations will designate ballast water management areas and performance standards for BWMTs.
Up until now, no significant harmful introductions have been reported for the ecosystem of the NCS. However, the number of introduced species (1 every four years) and the vast amount of exported ballast water from the (Netherlands part of) the North Sea to other sea areas raises concern.
Although the current international legislation on habitats and biodiversity does not provide clear guidelines for national policies, priority within these frameworks is growing to tackle the problems of introductions of alien species.

9 MEPC 45/INF.13, IMO, London, 19 July 2000

Chapter 3

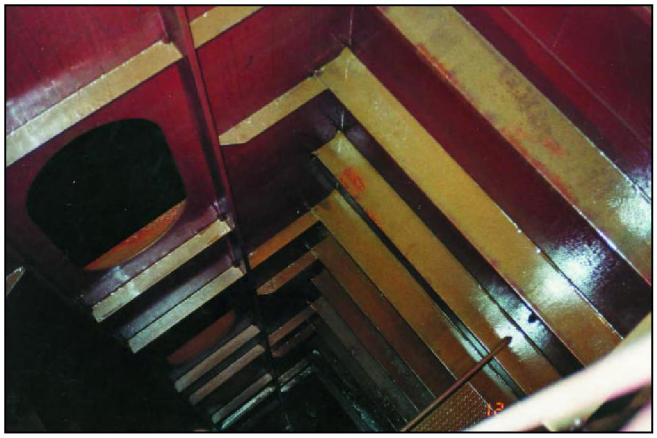
ANTHOLOGY OF BALLAST WATER MANAGEMENT TECHNIQUES (BWMTs)

3.1 What are conditions on treatment options?

Around the world, many projects have been executed to treat ballast water and sediment. Some of these Ballast Water Management Techniques (BWMTs) have proven to have a good performance. It is difficult, however, to determine whether these techniques could be applied on board ships. Apart from "scale-problems' (upgrading of small pilot-projects to actual larger facilities), it is very complicated to designate performance standards for BWMTs. Which percentage of "(micro-)organism-kill" is required to call a certain BWMT effective? From various studies and publications it became clear that no BWMT can be 100% effective. BWMTs can, however, reduce the risk of introduction of alien species in ballast water by approximately 99 %. This is often achieved by combining different techniques. Future IMO-regulations will have to designate world-wide performance standards.

A presentation made by a representative from the Rotterdam Municipal Port Management presented the clear message that ports strongly prefer "on board"-BWMTs. It was emphasized that treatment facilities ashore will not provide an effective solution if ships are not strictly required to use those facilities. It was suggested that the use of port facilities for large volumes of ballast water is not preferred. Treatment of ballast water sediment ashore might be a viable option.

A representative from the Royal Association of Netherlands' Shipowners emphasized that BWMTs should be designed for easy application. In this regard, it was suggested that a BWMT like filtering, when applied prior to departure, is quite promising. If, for example, ballast water would be treated at the point of intake in port, the amount of sediment in the ballast tanks could be minimized. Since ballast sediment is known to contain a vast variety and number of alien species, a reduction in the amount of sediment in ballast water can significally reduce the potential for harmful introduction of species. This BWMT has positive economic benefits as well, by reducing the weight of the ballast.



A look inside a ballast tank.

3.2 Which BWMTs are promising?

A brief presentation was made on a report on promising BWMTs: "Suitable techniques for treating ballast water"[10], written at the direction of the North Sea Foundation. The major finding of this study was that filtration and hydrocyclone are particularly promising BWMTs. They can be regarded as forms of pre-treatment, since additional treatment is necessary to remove the smallest micro-organisms from the ballast tanks. As mentioned earlier, these techniques can have a positive economic effect by reducing the amount of sediment in the tanks. UV-treatment is considered as a promising additional BWMT in combination with filtration and hydrocyclone techniques.

10 Netherlands and original titleL "Kansrijke technieken ter behandeling van ballastwater", S.C. Tervoort, Heiloo 14 januari 2000. An english summary of this report is available at NSF's internet site www.noordzee.nl.

UV-methods can result in nearly 99 % kill of all ballast water organisms. Disadvantages of this technique are its high costs and the necessity for frequent replacement of the UV-lamps.

The current IMO guidelines[11] rely heavily on Ballast Water Exchange (BWE) methods. There are three BWE-methodologies:

1. mid-ocean exchange and sequential method (emptying and refilling of ballast tanks at one time);
2. dilution method (loading of upper side of ballast tank while discharging from bottom side); and
3. flow-through method (loading of ballast tank from bottom side, discharge of ballast water via deck).

Although these methodologies can significantly reduce the chance of introductions, various BWE-methods can have serious negative repercussions on ship safety. Further, BWE is difficult, if not impossible, to apply inside the North Sea region because of its low water depth. Another disadvantage of most BWE-methods is that a relatively large part of the organisms are able to survive in the sediment. Only the dilution method significantly reduces the amount of organisms in the ballast water sediment. The dilution method is not immediately viable since it requires extensive modification of existing ships. Nevertheless, BWE can be a useful tool for certain ship voyages. The forthcoming IMO regulations will likely allow the application of various BWE-methods.

Apart from on board treatment, it is possible to treat ballast water ashore. Most existing BWMTs can be applied in portside installations. The advantage of this approach is that shore installations have a greater technical flexibility. Heavy reliance on this form of treatment is not currently recommended because of concerns about the capacity of port facilities to handle the large quantities of ballast that would be delivered ashore. However, port facilities for treating ballast water sediment (and, if necessary, ballast water) could be an option for ships that are not capable of on board treatment, or, in case of emergency. An emergency situation could be that harmful introductions have taken place and ships arrive in port with ballast water of a suspicious origin.

Other BWMTs, such as the use of chemicals and heating have numerous adverse environmental or safety effects. Nevertheless, heating could be a promising technique when residual heat of the ships' energy system is used.

Summarizing conclusions:

It is very complicated to produce performance standards for BWMTs. It is clear, however that no single BWMT can be 100% effective.
Although several BWE-methods appear to have numerous disadvantages, new IMO regulations will likely allow the application many of these techniques.
A study conducted on behalf of the North Sea Foundation concluded that filtration and hydrocyclone techniques, in combination with UV are a particularly promising and effective option.
The need for on shore treatment of ballast water and sediment must be minimized. BWM ashore should be considered as an option only when on board treatment is not possible or in case of an emergency (for example, when a certain vessel has taken in ballast water from a sea with toxic algal blooms).

11 "Guidelines for the control and management of ships' ballast water to minimize the transfer of harmful aquatic organisms and pathogens, Resolution A.868(20), IMO, London 1998

Chapter 4

ARE WE PREPARED FOR A WORST CASE SCENARIO? (WORKSHOP)

During the second half of the Marine Forum, the participants were divided into two workshop-groups. A fictitious press release was handed out which contained a worst case scenario: "Exotic species cause disaster in the North Sea". In this scenario, a toxic alga and the Chinese Mitten Crab have caused disastrous effects along the Netherlands North Sea coast. The two groups were asked to design an "emergency plan" for such a situation. A checklist with optional measures included:

- applicable BWMTs (4.1);
- sampling methods and record keeping (4.2);
- monitoring of the Netherlands North Sea coast (4.3); and
- miscellaneous measures (4.4).

The groups prioritized each of these measures and determined measures of high priority. For the sake of clarity: although this workshop was primarily focused on the risks involved with the import of alien species in the North Sea, there was also attention for measures with regard to the export of alien species from the North Sea to other sea areas.

Discussion during the workshops: Ballast Water treatment seems to be the most sensible option.

4.1 Applicable BWMTs

Group A gave equal priority to ballast water treatment compared to sampling and monitoring. On board solutions involving treatment options were regarded as strongly preferable.

Group B argued that the prevention of the harmful introductions should have far more priority than ballast water sampling and ecosystem-monitoring. Argument for this was that ballast water treatment can of course prevent the occurrence of harmful introductions. This group focused on designing a pilot-project for a BWMT and developing performance standards.
The group proposed that sediment should be removed from the ballast water before intake, by using a hydrocyclone or a filtering technique. This could be done on board or by using a properly equipped pontoon in the port of departure. UV was recommended as an additional BWMT to remove the smallest organisms. This approach was chosen because it would allow both newly built ships as well as older ships to take in clean ballast in Netherlands ports, thereby reducing the export of non-indigenous species from the North Sea region. A comprehensive study was proposed to explore options for such "prior to departure"-BWMTs.

This group stated that this measure should be carried out independent of the speed of developments within the IMO. Besides this, it was generally agreed that there is a compelling need for performance standards for BWMTs. A feasibility study should be carried out to designate which performance standards a technique has to meet to be a widely accepted BWMT (see also Appendix III and Chapter 5, action 3). Such a study could contribute to a constructive debate within the IMO on this matter. At the moment of writing this brochure, such a pilot-project has already been started.

4.2 Sampling methods and record keeping

Group A gave high priority to establishing a methodology for identifying the origins of ballast water of ships visiting Netherlands North Sea ports. The group regarded this measure as particularly important because it could serve as the basis for a risk analysis for the Netherlands North Sea. An emergency plan in a worst case scenario should therefore contain a mandatory notice procedure for the origins of ballast water for every incoming vessel. The sampling of ballast tanks of individual vessels was not regarded as appropriate in a worst case scenario.

Group B did not give specific priority to sampling and record keeping.

4.3 Monitoring of Netherlands North Sea coast

Workshop-group A expressed the view that monitoring of the ecosystem is critical to establishing a "baseline" understanding as a reference point for the natural marine biodiversity in the (Netherlands) North Sea area. This was regarded as a measure of high priority in a worst case scenario.

Group B did not work out or give specific priority to monitoring options.

4.4 Miscellaneous measures

Group A stated that, in a worst case-emergency plan, a warning should be made to relevant parties. The shellfish industry would have to be closed for an extended time period. The first response to a disastrous situation, in addition to monitoring and applying BWMTs, should be mobilizing of all parties involved (relevant ministries, scientists, etc.). Also, the available knowledge should be gathered and mobilized.

Summarizing conclusions:

While designing emergency plans for a fictitious worst case scenario, there should be a focus on notice procedures for the origins of ballast water, mobilization of expertise and... last but not least... ballast water treatment. Studies aiming at developing applicable filtering, hydrocyclone and UV-techniques were strongly recommended, regardless of worst case scenario's or IMO proceedings.
Prior to developing BWMTs, performance standards have to be designed. A feasability study for the development of a widely accepted BWMT has started during the autumn of 2000. This can be regarded as a first result of this Marine Forum.

Chapter 5

AGREED ACTIONS AND TIMETABLE

The participants agreed on one initiative to be carried out in the near future: a trial-project aimed at developing performance standards for BWMTs. Also, there was general agreement that a "prior-to departure" BWMT (filtering techniques in combination with UV) should be developed.

As mentioned before, a study on performance standards has already been started. In the following table, these and other potential initiatives are listed with a provisional time table. The lead party, the "guardian" and participants of each action are listed as well.

Agreed action	(Provisional) Time frame	Lead, guardian and participants
1 Writing and publication of Marine Forum brochure on internet site North Sea Foundation (www.noordzee.nl)	July 2000 - Jan 2001	**Lead**: North Sea Foundation **Guardian**: — **Participants** : North Sea Foundation and participants MF
2 Distribution of Marine Forum brochure within relevant frameworks and organisations (possibly ICS and/or IMO)	Oct 2000 - July 2001	**Lead** : North Sea Foundation **Guardian** : - **Participants** : North Sea Foundation, Royal Association of Netherlands Shipowners
3 Feasibility study for the development of a widely accepted BWMT (project has already started during autumn 2000)	Sept 2000 - Dec 2001	**Lead** : IWACO **Guardian** : — **Participants**: Royal Association of Netherlands' Shipowners, IWACO, Ministry of Transport, North Sea Directorate (financier), Wolfard's mechanical engineering, VOPAK
4 Publication of one or more articles in relevant papers/magazines on MF brochure and feasibility study	Jan 2001 - June 2001	**Lead** : North Sea Foundation **Guardian** : — **Participants** : North Sea Foundation, Royal Association of Netherlands' Shipowners, North Sea Directorate
Possible action	**Time frame**	**Possible lead, guardian and participants**
5 Launching of pilot-project: developing a "prior to departure" hydrocyclone and UV technology	2001/2002	**Lead** : Royal Association of Netherlands' Shipowners, IWACO **Guardian** : North Sea Foundation **Participants** : Maritime industry and Ministry of Transport, Directorate - General Freight Transport

Appendix I

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Appendix II

REFERENCES

For the sake of clarity: this is not an exhaustive literature list of publications, but a list of documents used specifically or mentioned during the forum.

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Appendix III

FEASABILITY STUDY FOR THE DEVELOPMENT OF A WIDELY ACCEPTED BWMT

One of the workshop groups at the marine forum decided to focus on the prevention of harmful introductions of marine organisms and pathogens. The group of participants representing the KVNR, VOPAK, WOLFARDS and IWACO got together and laid down the outlines for a feasibility study. This study has the aim to examine the feasibility of a technical solution of the problems related to ballast water within internationally acceptable standards. The study will focus on two related issues: first of all reducing the risk of the introduction of marine organisms and pathogens, as spoken of extensively during the forum, and secondly on preventing the accumulation of sediment in ballast water tanks.

The study will be executed by IWACO, international consultants for water and environment, with the co-operation and input of above named parties and the Ministry of Transport and Public Works and Water Management - North Sea Directorate of the Netherlands.

The study has now started with a first phase financed by the North Sea Directorate of the Ministry of Transport and Public Works of the Netherlands. In this phase a set of criteria or standards will be formulated for the further development of a Ballast Water Management Technique (BWMT). The questions to be answered in this phase are amongst others: which demands by relevant parties e.g. national and international authorities, IMO, ship owners, etc. are placed on a BMWT, and how can we translate these demands into widely acceptable performance criteria for such an installation? After obtaining a notion of these criteria, it is the intention for the following phases of the project to stimulate the development of a BWMT that can meet these standards by combining existing techniques or developing new techniques.

Colofon

Advises

This brochure contains both the report from a recent North Sea Foundation organised Marine Forum meeting (Hotel New York, Rotterdam, 27/6/00) and information on recent developments in the field.

The North Sea Foundation would like to thank all who participated in the Forum and those who have contributed to the content of this brochure.

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The North Sea Foundation (Stichting de Noordzee) is a professional non-governmental environmental organisation based in the Netherlands. Its principle political objective is the sustainable use of the marine environment and in particular the North Sea. The Foundation is a lobby rather than an action group and can draw on a wide network of scientists, policy makers and other interested individuals for input into its work. Internationally the Foundation works closely with Seas At Risk and Friends of the Earth International and via these organisations is a regular participant in meetings of IMO and OSPAR.

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