



Information Management

Invasive Alien Species in Belgian marine waters: an information platform and checklist for science and policy support

Ann-Katrien Lescauwaele^{1,2*}, Leen Vandepitte^{1,2}, Nancy Fockedeey^{1,2}, Daphnis De Pooter^{1,2}, Thomas Verleye^{1,2} and Jan Mees^{1,2}

¹Alien Species Consortium and ²Flanders Marine Institute (VLIZ), InnovOcean Site, Wandelaarkaai 7, 8400 Oostende, Belgium

E-mail: annkatrien.lescauwaele@vliz.be (AKL), leen.vandepitte@vliz.be (LV), nancy.fockedeey@vliz.be (NF), daphnis.depooter@vliz.be (DD), thomas.verleye@vliz.be (TV), jan.mees@vliz.be (JM)

*Corresponding author

Received: 3 November 2014 / Accepted: 27 May 2015 / Published online: 15 June 2015

Handling editor: Helen Roy

Abstract

Since 2006, the 'VLIZ Alien Species Consortium' has collected data and information on species that were introduced by humans in marine and brackish habitats and have established reproducing populations in the study area. The consortium consists of a network of experts in marine and brackish environments in Belgium, representing more than 22 different institutions and supported by a secretariat hosted at Flanders Marine Institute VLIZ. Evidence on invasiveness is reported for 12 of the 73 alien species that are currently included in the checklist for the study area (October 2014). The network brings together scientific information from distributed sources in a central platform. It is a first step to developing an evidence-based approach to inform environmental policy objectives for Belgian marine waters and support effective measures to address invasive alien species in the study area. The information platform and species checklist are presented, approaches for collection and integration of information are described, and opportunities for collaboration between information systems at different governance levels are briefly discussed.

Key words: alien species, invasive species, marine waters, Belgium, information system

Introduction

The recently (22 October 2014) approved *EU Regulation on the prevention and management of the introduction and spread of invasive alien species* (Regulation (EC) No 1143/2014) addresses the recommendations of the EU Biodiversity strategy 2020 (COM(2011)244) and the EU resolution 2011/2307(INI) with regards to Invasive Alien Species (IAS). IAS have demonstrable impacts on the local biological diversity and associated ecosystem services, human health and economy, after introduction in their new environments (Directive 2000/60/EC, Directive 2008/56/EC, COM(2011)244, Regulation (EC) No 1143/2014). In marine waters, the invasiveness of alien species is a major cause for concern as it can affect endemic species and their ecosystems by changing the habitat, predation, competition, spread of diseases, and other patterns (Eno et al. 1997; Leppäkoski et al. 2002; Streftaris

et al. 2005; Wolff 2005; Kerckhof 2006). Combined, the currently existing EU legislative instruments require Member States to address aspects of data collation, prevention, early warning and rapid response, and management of marine IAS. Strategic action at EU level requires a list of IAS of EU concern, which must be prioritised using risk assessments and scientific evidence as contributed by Member States. A number of initiatives have compiled a list of aquatic alien species at the national level (Eno et al. 1997; Olenin 2004; Wolff 2005; Jensen and Knudsen 2005; Gollasch and Nehring 2006; Dewarumez et al. 2011), or at the scale of regional seas (Reise et al. 1999; Streftaris et al. 2005; Zenetos et al. 2005; Olenin et al. 2007).

In response to the growing information needs in support of EU environmental policies, Flanders Marine Institute (VLIZ) initiated in 2006 a platform for scientifically validated information on marine

and brackish alien species in Belgium (Vandepitte et al. 2012). The current inventory includes the occurrence and impact of IAS in marine and brackish environments in Belgium. It is a first step in developing an evidence-based approach to inform environmental policy objectives in Belgian marine waters and support effective measures to address IAS in the study area. In the current communication we present the information platform and species checklist, describe the approaches for collection and integration of information, and briefly discuss opportunities for collaboration between information systems at different governance levels.

Materials and methods

The ‘VLIZ Alien Species Consortium’ consists of a network of experts, and is supported by a secretariat hosted by VLIZ (http://www.vliz.be/wiki/Niet-inheemse_soorten_Belgisch_deel_Noordzee_en_aanpalende_estuaria#VLIZ_Alien_Species_Consortium). Since 2006, it collects data and information on species that were introduced by man in marine and brackish habitats and have established reproductive populations. The geographical scope covers all marine and brackish environments in the Belgian coastal zone and marine waters, the sluice dock of Oostende and the Scheldt estuary. The overview of marine and estuarine IAS recorded in the adjacent marine and brackish waters of The Netherlands (Wolff 2005) served as a reference document for the initial inventory in Belgium. For each species recorded as alien in Wolff’s list (op. cit.), an extensive literature search was used to check the occurrence in the Belgian part of the North Sea and/or adjacent estuaries. The literature search included peer-reviewed publications in scientific journals, monitoring and survey reports, technical reports of (inter)national working groups, as well as short announcements in local publications. Historical sources were screened going as far back in time as possible. Alien species with reported established populations in the study area, were added to the Belgian checklist, and the year of first observation for each species in Belgian waters was determined based on the literature records. This excludes vagrants and species that have colonized the area as an extension of their natural distribution range, also e.g. in response to climate change.

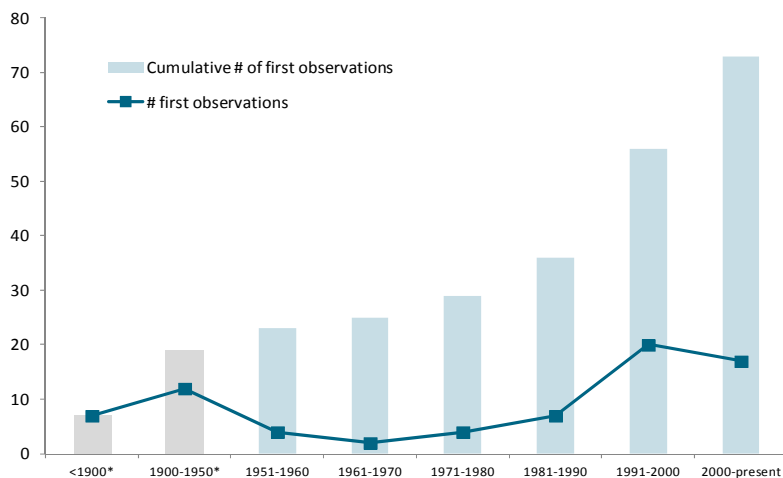
Today, the network consists of more than 50 biologists, taxonomists, ecologists and other field experts that are active in the study area, and

represent more than 22 different institutions in Belgium. The network brings together scientific information from distributed sources in a central platform. The information is collected by the VLIZ secretariat through systematic screening of scientific literature and based on field records contributed by the network. The experts contribute through early warning or validated new records on alien species and their distribution, sharing information sources, and conducting expert review of the species information factsheets. For all validated records of alien species with established populations, the updated taxonomy, biological status, life cycle, date and location of first record in the study area, first record in neighbouring countries, pathway of introduction, invasiveness and control mechanisms, are included in the factsheets accessible through the online information system (http://www.vliz.be/wiki/Lijst_nietinheemse_soorten_Belgisch_deel_Noordzee_en_aanpalende_estuaria). The information is organized in a layered structure: from a summarized key message to full-text reference documents and deep-links to supporting databases. International databases are used for standardization purposes (taxonomy, geography, terminology). ‘Marine Regions’ (Claus et al. 2015) is a global geo-referenced database for geographic standardization. The World Register of Introduced Marine Species (WRIMS) (Pagad et al. 2015) is a thematic species database embedded within the World Register of Marine Species (WoRMS 2015). WRIMS is compiled by the IUCN SSC Invasive Species Specialist Group (ISSG). WoRMS uses the Aphia database - hosted and maintained at VLIZ - as consolidated taxonomic backbone (WoRMS 2015).

Results

Currently 73 alien species with established populations are on the checklist for the study area in Belgium. Most of these species are arthropoda (30), algae (11) and molluscs (10). The cumulative number of recorded alien species has doubled over the last 30 years. The inventory also suggests an increase in the number of first observations by time interval, which has tripled at least over the last 30 years since the 1980s (Figure 1). At present it is unknown to what degree the increase in the number of first observations is influenced by an increased monitoring and observation in the study area. Extensive literature screening confirmed that 16 of these 73 alien species with established populations have been reported as ‘invasive’, in the immediate neighbouring waters

Figure 1. Cumulative number of validated records of alien species in the study area in Belgium, and number of first observations by time interval (<1900, 1900–1950, and subsequent decades).



(Wolff 2005; Dewarumez et al. 2011; Minchin et al. 2013). Published evidence and/or personal communication by experts reports on invasiveness for 12 of these species (October 2014) in the study area in Belgium. These are mainly arthropods (6) and molluscs (4) and include the brackish water mussel (*Mytilopsis leucophaeata*), freshwater hydroid (*Cordylophora caspia*), common cord-grass (*Spartina townsendii* var. *anglica*), naval shipworm (*Teredo navalis*), big ear shipworm (*Psiloterdo megotara*), Japanese oyster (*Crassostrea gigas*), calanoid copepod (*Acartia tonsa*), New-Zealand barnacle (*Austrominius modestus*), protist (*Bonamia ostreae*), killer shrimp (*Dikergammarus villosus*), swim-bladder nematode (*Anguillicoloides crassus*), and round goby (*Neogobius melanostomus*).

The information is available online by accessing the checklist ‘Alien species’ in the VLIZ Coastal Wiki portal. The Alien species checklist contains factsheets on the life cycle, ecology and specific distribution data, invasive behaviour, impact, etc. and full-text references for each of the species on the checklist (in Dutch). The checklist and summaries are available in Dutch and English.

Discussion

Informing National and EU policies

IAS are considered one of the five most important causes of global biological diversity loss (EC 2008), as a consequence of the influence of human beings on the world’s ecosystems. At an EU scale, it is estimated that around 12,000 species are

alien, of which 10–15% are considered to be invasive (Regulation (EC) No 1143/2014). Prioritising is necessary for an effective use of available resources to monitor, control or eradicate IAS where most needed. The Belgian forum on invasive species developed the ISEIA-protocol (Invasive Species Environmental Impact Assessment) (Branquart 2007) as an established method to screen alien species on their potential invasive behavior and impact on the environment. ISEIA is currently followed up by the revised HARMONIA⁺ protocol (D’hondt et al. 2015). However, this screening is as yet not conducted for species in the marine environment. The ‘VLIZ Alien Species Consortium’ and checklist currently offers the best available information and overview for AS and IAS in Belgian marine and brackish waters. The information system offers an evidence-based approach to inform the implementation of the programmes of measures and monitoring for the EU Marine Strategy (Directive 2008/56/EC, transposed in national law as Royal decree 23 June 2010) and its Decision regarding technical criteria and standards for the Good Environmental Status (Decision No 477/2010/EU), the measures required for the recently approved EU Council Regulation, and the national legislation that is in place to protect the marine environment in Belgium (Marine Environment Act 1999, Royal decree 21 December 2001). The information system follows the bottom-up approach as required for the EU Council Regulation on IAS whereby Member States identify priorities that may subsequently inform the list of IAS of EU concern. This list must be prioritised using risk assessments

and scientific evidence as contributed by Member States. As a next step to pursuing the objectives of the marine environmental policies, formal assessment of IAS through the HARMONIA⁺ protocol (D'hondt et al. 2015) to set priorities for action, remains necessary. The 'VLIZ Alien Species Consortium' information system and species checklist can inform and support this process. However, it must be cautioned that the list is presented as a management checklist rather than an exhaustive inventory, as uncertainty and information gaps for particular taxonomic groups e.g. plankton, need to be addressed (McGeoch et al. 2012).

Collaboration with EU and global marine information systems

While informing national and EU policies, the information system feeds into and integrates with global databases and information systems related to IAS (WRIMS, WoRMS). Through this collaboration, the efforts of experts at local scale are upscaled to answer research questions at different spatial scales and produce data products for different governance levels (global, EU, regional seas). The European Marine Observation and Data Network (EMODnet) - Biology – focuses on spatially explicit information for marine species, of relevance in the context of EU policies. The European Ocean Biogeographic Information System (EurOBIS) is a distributed information system that allows querying distribution records e.g. for particular IAS, to conduct scientific analysis. Together with the European Strategy Forum on Research Infrastructures Lifewatch (ESFRI-Lifewatch), these systems aim to develop webservices that allow querying specific traits by species and by area. By collaborating with standardized and integrated information systems at global or international level, the local and national records are integrated in a standardized EU wide or global information system. This in turn supports quality services to inform national policies (e.g. benchmarking, updated species distribution maps, updated taxonomic validation, 'watch list' of IAS occurrence in neighbouring countries) and the delivery of effective response in addressing marine environmental objectives at the local and national level. By connecting with the global taxonomic backbone databases, the network benefits from the expertise of taxonomic editors who validate documented taxon names. As the traits 'alien' and 'invasive' only cover relevance within a specific geographical and temporal context, WRIMS adds information on traits for species

records, by geographical area (country, sea area and/or latitude-longitude). The 'VLIZ Alien Species Consortium' contributes information for the Belgian marine and brackish waters. Records are linked to source publications or databases, and species with reported environmental and/or economic impact are labelled as IAS for that particular area. The secretariat integrates the information in a format that is relevant for the target public: scientists and field experts, managers and decision-makers. The inventory, its information sources, pictures and relevant links, are updated on a frequent basis.

Acknowledgements

The 'VLIZ Alien Species Consortium' is supported by the staff of Flanders Marine Institute. The contributing experts and their research groups and institutions are acknowledged online on the webpage of the network: Ghent University, De Strandwerkgroep België (SWG), Institute for Agricultural and Fisheries Research (ILVO), Belgian Science Policy (Belspo), Belgian Biodiversity Platform (BBPF), Netherlands Centre for Biodiversity Naturalis (NCB Naturalis), eCOAST Research Centre Ostend, Royal Belgian Institute of Natural Sciences (RBIN), Catholic University of Leuven, Research Institute for Nature and Forest (INBO), Université Paul Sabatier, University of Amsterdam, University of Oxford, Ecosub, Netherlands Entomological Society (NEV). We thank the contributions of the 2 anonymous reviewers of the manuscript.

References

- Branquart E (2007) Guidelines for environmental impact assessment and list classification of non-native organisms in Belgium, version 2.1. <http://ias.biodiversity.be>
- Claus S, De Hauwere N, Vanhoorne B, Souza Dias F, Hernandez F, Mees J (Flanders Marine Institute) (2015) MarineRegions.org. <http://www.marinerregions.org> (Accessed October 2014)
- Dewarumez JM, Gevaert F, Massé C, Foveau A, Grulois D (2011) Les espèces marines animales et végétales introduites dans le bassin Artois-Picardie. UMR CNRS 8187 LOG et Agence de l'Eau Artois-Picardie, 140 pp
- D'hondt B, Vanderhoeven S, Roelandt S, Mayer F, Versteirt V, Adriaens T, Ducheyne E, San Martin G, Grégoire J-C, Stiers I, Quoilin S, Cigar J, Heughebaert A, Branquart E (2015) Harmonia⁺ and Pandora⁺: risk screening tools for potentially invasive plants, animals and their pathogens. *Biological Invasions* 17: 1869–1883, <http://dx.doi.org/10.1007/s10530-015-0843-1>
- EC (2008) Developing an EU Framework for Invasive Alien Species Discussion Paper, final. EC. http://ec.europa.eu/environment/nature/invasivealien/docs/ias_discussion_paper.pdf (Accessed July 2014)
- Eno NC, Clark RA, Sanderson WG (ed) (1997) Non-native marine species in British waters: a review and directory. Joint Nature Conservation Committee: Peterborough, 152 pp
- Gollasch S, Nehring S (2006) National checklist for aquatic alien species in Germany. *Aquatic Invasions* 1: 245–269, <http://dx.doi.org/10.3391/ai.2006.1.4.8>
- Jensen K, Knudsen J (2005) A summary of alien marine invertebrates in Danish waters. *Oceanological and Hydrobiological Studies* 34 (suppl. 1): 137–162

- Kerckhof F (2006) Exotic invasive animals in the marine ecosystem: the situation in Belgian waters. In: Branquart E, Baus E, Pieret N, Vanderhoeven S, Desmet P (eds), SOS invasions! Abstract book of the conference held on 09-10.03.2006 in Brussels. Belgian Federal Science Policy Office, Brussels, 76 pp
- Leppäkoski E, Gollasch S, Olenin S (2002) Invasive aquatic species of Europe: distribution, impacts and management. Kluwer Academic Publishers: Dordrecht, The Netherlands, 583 pp, <http://dx.doi.org/10.1007/978-94-015-9956-6>
- McGeoch MA, Spear D, Kleynhans EJ, Marais E (2012) Uncertainty in invasive alien species listing. *Ecological Applications* 22: 959–971, <http://dx.doi.org/10.1890/11-1252.1>
- Minchin D, Cook EJ, Clark PF (2013) A list of alien brackish and marine British species. *Aquatic Invasions* 8: 3–19, <http://dx.doi.org/10.3391/ai.2013.8.1.02>
- Olenin S (2004) Invasive coastal waters species. Lithuanian National Invasive Species Database. http://www.ku.lt/lisd/species_lists/all_coastal.html (Accessed October 2014)
- Olenin S, Leppäkoski E, Daunys D (eds) (2007) Baltic Sea Alien Species Database. <http://www.corpi.ku.lt/nemo/> (Accessed October 2014)
- Pagad S, Hayes K, Katsanevakis S, Costello MJ (2015) World Register of Introduced Marine Species (WRIMS). <http://www.marinespecies.org/introduced> (Accessed 20 March 2015)
- Reise K, Gollasch S, Wolff WJ (1999) Introduced marine species of the North Sea coasts. *Helgoländer Meeresuntersuchungen* 52: 219–234, <http://dx.doi.org/10.1007/BF02908898>
- Streftaris N, Zenetos A, Papathanassiou E (2005) Globalisation in marine ecosystems: the story of non-indigenous marine species across European seas. *Oceanography and Marine Biology: An Annual Review* 43: 419–453
- Vandepitte L, De Pooter D, Lescrauwaet AK, Fockedey N, Mees J (eds) (2012) Niet-inheemse soorten van het Belgisch deel van de Noordzee en aanpalende estuaria. VLIZ Special Publication, 59. Vlaams Instituut voor de Zee (VLIZ): Oostende, 371 pp
- Wolff WJ (2005) Non-indigenous marine and estuarine species in the Netherlands. *Zoologische Mededelingen* 79(1): 3–116
- WoRMS Editorial Board (2015) World Register of Marine Species. <http://www.marinespecies.org> (Accessed March 2015)
- Zenetos A, Çinar ME, Pancucci-Papadopoulou MA, Harmelin J-G, Furnari G, Andaloro F, Bellou N, Streftaris N, Zibrowius H (2005) Annotated list of marine alien species in the Mediterranean with records of the worst invasive species. *Mediterranean Marine Science* 6(2): 63–118, <http://dx.doi.org/10.12681/mms.186>