

Viewpoint

Identifying the top issues of marine invasive alien species in Europe

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Abstract

Stemming from a recent freshwater invasives conference, Caffrey et al. (2014) identified 'the top 20 issues' that relate to invasive alien species (IAS) management in Europe. With a view to complement and balance the issues highlighted in their account, we offer six important additions that relate to the marine environment. These are: preventive measures, concerns of loss of taxonomic expertise and species identity, gaps in the knowledge of certain taxa and regions, inconsistencies of terminology, need for validation of data and the importance of concentrating on pathways, and their vectors, and levels of certainty associated with these routes.

Key words: non-indigenous species, information needs, standardization, management, international cooperation

Introduction

Invasions of non-indigenous species (NIS) are acknowledged as one of the major threats to natural environments - terrestrial, freshwater and marine - having ecological, economic and social consequences. A recently published Proposal for a Regulation of the European Parliament and of the Council on the prevention and management of the introduction and spread of invasive alien species (European Commission 2013) states that "...The impact of IAS on biodiversity is significant ... one of the major, and growing, causes of biodiversity loss and species extinction...". The EU Biodiversity Strategy (European Commission 2011) aims that "...by 2020, Invasive Alien Species (IAS) and their pathways are identified and prioritised, priority species are controlled or eradicated, and pathways are managed to prevent the introduction and establishment of new IAS...". Galil et al. (2014) recorded 879 multicellular NIS in European Seas, with a doubling of the number of

NIS records between 1970 and 2013 within some regions. Stemming from a recent freshwater invasives conference, Caffrey et al. (2014) identified 'the top 20 issues that relate to IAS management in Europe'. We agree and support all the issues proposed, and would like to contribute to this important initiative by adding six important topics that relate to the marine environment.

Results

1. Regulatory framework to prevent introduction of IAS

When dealing with the international agreements and measures to prevent introduction of marine IAS, the following documents are fundamental to the conservation and management of the marine environment: the International Convention for the Control and Management of Ships' Ballast Water and Sediments (IMO 2004), ICES Code of Practice on the Introductions and Transfers of Marine Organisms (ICES 2005), Alien Species in

Aquaculture - IUCN considerations for responsible use (Hewitt et al. 2006), EC Regulation on concerning use of alien and locally absent species in aquaculture (European Commission 2007) and EC Marine Strategy Framework Directive (European Commission 2008). These, together with the Proposal for a Regulation of the European Parliament and of the Council on the prevention and management of the introduction and spread of invasive alien species (European Commission 2013) provide the legislative framework and identify some surveillance and management needs for NIS in the marine environment, by covering both deliberate releases as well as accidental introductions. These documents indicate the level, scale and scope of joint efforts required to deal with bioinvasions in the marine environment at an international scale.

2. Reliable NIS identifications and loss of taxonomic expertise

Underpinning the efforts for the prevention and management of the introduction and spread of IAS, be it terrestrial or aquatic, is the assumption that we are able to recognize the NIS from the indigenous. Yet, in the marine realm there is a lack/uncertainty of information for many of the small-sized phyla due to limited research effort and continuing erosion of taxonomic expertise (Terlizzi et al. 2003). For instance, a recent study of diatoms and dinoflagellates reported as NIS in European Seas found dubious identifications, and that synonyms were included as separate species (Gómez 2008). Misidentification of NIS as indigenous and *vice versa* is not uncommon: the Atlantic bryozoan *Zoobotryon verticillatum* and the Pacific isopod *Paranthura japonica* were assumed to be native to the Mediterranean, whereas the Atlantic comb jelly *Mnemiopsis leidyi* was misidentified in the North Sea as a morphologically similar native species and some native macroalgae and hydroids had been identified as NIS (Faasse and Bayha 2006; Schuchert 2010; Tsiamis et al. 2010; Lavesque et al. 2013; Galil and Gevili 2014; Marchini et al. 2014).

3. Data-gaps impede comprehensive assessments

Arising from issue 2, the poor coverage of data and information on several taxonomic groups, some of which include disease agents and pathogens (Drake et al. 2007), should be considered as major gaps in the knowledge base when undertaking marine NIS assessments (Roy et al. 2014). The unicellular NIS are also underreported, though it is

well established that anthropogenic dispersal and redistribution of propagules in ballast water and sediments, biofouling and shellfish transplantation, facilitate their range expansions (Hudson and Hill 1991; Hülsmann and Galil 2002; Minchin and Gollasch 2003; David et al. 2007). Gaps are evident also in coverage of different habitats and geographical regions: for example, half as many marine NIS have been recorded from Syria as from Lebanon, and a third as reported from the Mediterranean coast of Turkey (Galil et al. 2014). Compared to the terrestrial realm, environmental impacts of marine NIS are not as well studied (Pyšek and Richardson 2010) and therefore fragmentally documented (e.g. Ruiz et al. 1999). These deficiencies as a result hamper comprehensive environmental assessments of marine NIS and deserve greater attention.

4. Need for a unified and appropriate terminology

There is a need for a unified, unambiguous and appropriate terminology, based on transparent, quantitative criteria, to describe the status of biological invasions (Occhipinti-Ambrogi and Galil 2004). Several high-level EU policy documents use ambiguous terminology (e.g. non-indigenous species vs. non-indigenous exotic species; non-indigenous species introduced by human activities), or introduce undefined and non quantitative criteria (e.g. significant negative effect and serious economic damage) (e.g. European Commission 2008, 2010, 2013). In order to avoid misinterpretations and enhance harmonization of efforts, the terminology should be inevitably standardized. The unified suggestion for the terminology for invasive biota (Blackburn et al. 2011) should be consulted and applied in the harmonizing process.

5. Standardization of data and information systems

In order to ensure comprehensive assessments, data and information systems should be scientifically validated and standardized (Ojaveer et al. 2014). An example is provided by the AquaNIS information system (<http://www.corpi.ku.lt/databases/index.php/aquanis>), dealing with aquatic NIS and cryptogenic introductions to marine, brackish and coastal freshwater environments of Europe and adjacent regions, which is designed to assemble, store and disseminate comprehensive data for both NIS and cryptogenic biota and aid in achieving management goals (Olenin et al. 2014). Also, the European Alien Species Information Network (EASIN; <http://easin.jrc.ec.europa.eu/>),

developed by the European Commission to harmonize and integrate information, comprises at present several relevant existing European, regional and national databases (Katsanevakis et al. 2012).

6. Management should focus on invasion pathways/vectors and be regionally coordinated

The main pathways/vectors for introduction of marine NIS to European Seas are shipping, aquaculture and canals with the Suez Canal likely to be 'responsible' for a third of the marine NIS in European Seas, and more than two thirds in the eastern Mediterranean Sea (Galil et al. 2014). However, secondary dispersal also takes place with currents, and unlike many inland water bodies, seas are connected. Therefore, the entire scope of 'issues' and 'recommendations' should be calibrated to take account of these realities. A unified EU strategic approach to marine biosecurity and 'rapid response' will be to little avail without the coordination and the cooperation of those nations within regional seas (e.g. Sambrook et al. 2014). When compared with terrestrial and freshwater bioinvasions, only a handful of eradications in the marine environment (e.g. Bax et al. 2002; Wotton et al. 2004; Galil 2002) will have succeeded. Therefore, invasion pathway/vectors management is key for success in dealing with NIS in the marine environment when developing NIS management strategies and converting these into legislative acts. Where possible, pre-border prevention measures should be taken into account (ICES 2005; David and Gollasch 2008). However, knowledge of the level of certainty ascribed to pathways and their vectors is also needed (Olenin et al. 2010). The scrupulous and rigorous monitoring of pathway/vector introduction hubs and habitats/locales vulnerable to invasion (i.e. harbours and marinas as well as aquaculture sites) is of the utmost importance for management. Further, established NIS, as well as newly recorded ones, should be carefully monitored for outbreaks and blooms.

Conclusions

The six issues concerning marine IAS outlined above stem from discussions held among participants in several EU-funded projects (MarBEF, IMPASSE, ALARM, DAISIE and VECTORS), as well as among members of the Working Groups on Introductions and Transfers of Marine Organisms (WGITMO) and Ballast and Other Ship Vectors (WGBOSV) of the

International Council for the Exploration of the Sea (ICES). We suggest these topics deserve attention at national, regional and pan-European level. This will hopefully lead to a systematic and comprehensive assessment and management of IAS in Europe and through this ensure long-term sustainability and protection of the marine environment Latvian waters.

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