

## Alien species related information systems and information management

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The conservation of biodiversity and ecosystem services is severely challenged by biological invasions. The rapid globalisation and increasing trends of trade, travel, and transport in recent decades have caused increasing rates of new introductions through various pathways in both aquatic and terrestrial biomes (Hewitt et al. 2004; Hulme 2009; Katsanevakis et al. 2013a). The Convention on Biological Diversity (CBD) calls the Contracting Parties “to prevent the introduction of, control or eradicate those alien species which threaten ecosystems, habitats or species”.

To achieve this target there is a need for accurate, detailed, and timely information on alien species, such as species distribution, pathways of introduction, impacts, and effective management measures (Hewitt et al. 2009; McGeoch et al. 2012; Roy et al. 2014). The CBD calls for the “*compilation and dissemination of information on alien species that threaten ecosystems, habitats, or species, to be used in the context of any prevention, introduction and mitigation activities*” (CBD 2000). Such information is necessary to implement policies for the efficient prevention, early detection, rapid response, and management of biological invasions and also to evaluate management measures. However, often data are limited for certain species or ecosystems, making evaluations of impact or an understanding of management options difficult (Ojaveer et al.

2015). In recognition of this, a large number of information systems and online databases have been created that document biological invasions on a national, supranational, or global scale, but also act to raise awareness and improve surveillance of biological invasions (Katsanevakis et al. 2013b).

The overarching aim of this Special Issue of *Management of Biological Invasions* is to describe such information systems. Particular focus has been given to documenting the various approaches for collection, harmonization and integration of information; discussing related technical issues and developments, including data publishing; providing examples of collaboration of information systems through networking and interoperable web services; discussing sustainability and funding issues; prioritizing future efforts through horizon scanning; and assisting the publication of large datasets related to the information systems, as citable online supplementary material. This Special Issue is not inclusive of all information systems that focus on biological invasions, but it does present a number of international, regional, national and local initiatives.

In their viewpoint paper in this Special Issue, Groom et al. (2015) argue that data related to biological invasions should be published openly, by making use of repositories in which the data are licensed in a permissive manner, while ensuring that they are credited by the adequate provision of citation. The Special Issue includes

contributions on a variety of information systems and approaches, from global to continental, regional, and national, including:

- The Invasive Species Specialist Group (ISSG), presented by Pagad et al. (2015). This is a global network of scientific and policy experts on invasive species, organized under the auspices of the Species Survival Commission (SSC) of the International Union for Conservation of Nature (IUCN). The scope, history, contribution to policy and technical advice on biological invasions, and its products for information management (such as GISD – the Global Invasive Species Database) are presented;

- The Global Invasive Species Information Network (GISIN), which has implemented a data portal based on a protocol developed by representatives from 15 countries and 27 organizations. Jarnevich et al. (2015) present GISIN, its architecture and technical challenges, its achievements and successes, but also funding issues and organizational challenges that remain;

- The European Alien Species Information Network (EASIN), which is a European Commission's information system and online platform aiming to facilitate the exploration of existing alien species information in Europe and to assist the implementation of European policies on biological invasions. The structure, technical innovations, online tools and some scientific outputs by analyzing EASIN data are presented by Katsanevakis et al. (2015). Furthermore, the current version of the EASIN Catalogue, which is a pan-European inventory of alien and cryptogenic species with species-specific information, is openly provided as a supplementary file to the Katsanevakis et al. article;

- The U.S. Geological Survey's Nonindigenous Aquatic Species (NAS) Database, which has tracked introductions of freshwater aquatic organisms in the United States for the past four decades. Fuller and Neilson (2015) provide an historical overview of the database, a description of its scope, current capabilities and functionality, and a basic characterization of the data contained within the database;

- The CIESM Atlas for Crustaceans, presented by Galil et al. (2015). The updated list of alien decapod and stomatopod crustaceans recorded in the Mediterranean Sea since 1870 is provided in this article, as well as recommendations on terminology, taxonomic expansion and usage of innovative information and communication technologies;

- The Marine Biosecurity Porthole – a web-based information system on non-indigenous marine species in New Zealand (Seaward et al. 2015). The data contained in the portal, its features, design, functionality, interactive mapping tools, web services, current and future directions are described;

- ELNAIS, the Greek network on aquatic alien species (Zenetos et al. 2015). The database structure and the main outputs are described; emphasis is given on data acquisition, mainly coming from the literature, the scientific community and through citizen scientists initiatives;

- The Invasive Species Environmental Impact Assessment (ISEIA) protocol and the Harmonia<sup>+</sup> information system, which are tools developed to tackle invasive alien species in Belgium. Vanderhoeven et al. (2015) describe how the collaboration of scientists and policy makers led to the development of these tools, the components of Harmonia<sup>+</sup>, and some important initiatives for the management of biological invasions in Belgium that use information from Harmonia<sup>+</sup>;

- The 'VLIZ Alien Species Consortium' and the related information platform on alien species of marine and brackish environments in Belgium. Lescrauwaet et al. (2015) present the information platform and the related species checklist, describe approaches for collection and integration of information, and discuss opportunities for collaboration between information systems at different governance levels; and

- Efforts to engage citizens in recording invasive alien species in Europe through two smartphone applications, presented by Adriaens et al. (2015). An overview of available smartphone applications for recording invasive alien species in Europe is given, and issues of data integration, data openness, data quality, data harmonisation and database interoperability are addressed.

The breadth and depth of information contained within these information systems is encouraging. We hope that the contributions to this Special Issue will provide examples of current global efforts and approaches for information management in relation to alien species at all stages of the data cycle (August et al. 2015), from data collection to interpretation and dissemination. This collection of articles provides an overview that will be useful to information managers, biological invasion scientists, and policy makers. The implementation of novel approaches and technologies will undoubtedly provide inspiration for further improving information management in the field of invasion biology.

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## References

- Adriaens T, Sutton-Croft M, Owen K, Brosens D, van Valkenburg J, Kilbey D, Groom Q, Ehmig C, Thürkow F, Van Hende P, Schneider K (2015) Trying to engage the crowd in recording invasive alien species in Europe: experiences from two smartphone applications in northwest Europe. *Management of Biological Invasions* 6: 215–225, <http://dx.doi.org/10.3391/mbi.2015.6.2.12>
- August T, Harvey M, Lightfoot P, Kilbey D, Papadopoulos T, Jepson P (2015) Emerging technologies for biological recording. *Biological Journal of the Linnean Society*, <http://dx.doi.org/10.1111/bj.12534>
- CBD (Convention on Biological Diversity) (2000) Interim Guiding Principles. Conference of the Parties Decision V/8 Alien species that threaten ecosystems, habitats or species. <http://www.cbd.int/decision/cop/default.shtml?id=7150>
- Fuller P, Neilson ME (2015) The U.S. Geological Survey's Nonindigenous Aquatic Species Database: over thirty years of tracking introduced aquatic species in the United States (and counting). *Management of Biological Invasions* 6: 159–170, <http://dx.doi.org/10.3391/mbi.2015.6.2.06>
- Galil BS, Froglija C, Noël P (2015) Looking Back, Looking Ahead: The CIESM Atlas, Crustaceans. *Management of Biological Invasions* 6: 171–175, <http://dx.doi.org/10.3391/mbi.2015.6.2.07>
- Groom QJ, Desmet P, Vanderhoeven S, Adriaens T (2005) The importance of open data for invasive alien species research, policy and management. *Management of Biological Invasions* 6: 119–125, <http://dx.doi.org/10.3391/mbi.2015.6.2.02>
- Hewitt CL, Campbell ML, Thresher RE, Martin RB, Boyd S, Cohen BF, Currie DR, Gomon MF, Keough MJ, Lewis JA, Lockett MM, Mays N, McArthur MA, O'Hara TD, Poore GCB, Ross DJ, Storey M, Watson JE, Wilson RS (2004) Introduced and cryptogenic species in Port Phillip Bay, Victoria, Australia. *Marine Biology* 144: 183–202, <http://dx.doi.org/10.1007/s00227-003-1173-x>
- Hewitt CL, Everett RA, Parker N, Campbell ML (2009) Marine Bioinvasion Management: Structural Framework. Chapter 18. In: Rilov G, Crooks J (eds), *Biological Invasions in Marine Ecosystems. Ecological, Management, and Geographic Perspectives*. Springer, Heidelberg, Germany, pp 327–334, [http://dx.doi.org/10.1007/978-3-540-79236-9\\_18](http://dx.doi.org/10.1007/978-3-540-79236-9_18)
- Hulme PE (2009) Trade, transport and trouble: managing invasive species pathways in an era of globalization. *Journal of Applied Ecology* 46: 10–18, <http://dx.doi.org/10.1111/j.1365-2664.2008.01600.x>
- Jarnevich CS, Simpson A, Graham JJ, Newman GJ, Barger CT (2015) Running a network on a shoestring: the Global Invasive Species Information Network. *Management of Biological Invasions* 6: 137–146, <http://dx.doi.org/10.3391/mbi.2015.6.2.04>
- Katsanevakis S, Zenetos A, Belchior C, Cardoso AC (2013a) Invading European Seas: assessing pathways of introduction of marine aliens. *Ocean and Coastal Management* 76: 64–74, <http://dx.doi.org/10.1016/j.ocecoaman.2013.02.024>
- Katsanevakis S, Genovesi P, Gaiji S, Nyegaard Hvid H, Roy H, Nunes AL, Sánchez Aguado F, Bogucarskis K, Debusscher B, Deriu I, Harrower C, Josefsson M, Lucy FE, Marchini A, Richards G, Trichkova T, Vanderhoeven S, Zenetos A, Cardoso AC (2013b) Implementing the European policies for alien species – networking, science, and partnership in a complex environment. *Management of Biological Invasions* 4: 3–6, <http://dx.doi.org/10.3391/mbi.2013.4.1.02>
- Katsanevakis S, Deriu I, D'Amico F, Nunes AL, Pelaez Sanchez S, Crocetta F, Arianoutsou M, Bazos I, Christopoulou A, Curto G, Delipetrou P, Kokkoris Y, Panov V, Rabitsch W, Roques A, Scalera R, Shirley SM, Tricarico E, Vannini A, Zenetos A, Zervou S, Zikos A, Cardoso AC (2015) European Alien Species Information Network (EASIN): supporting European policies and scientific research. *Management of Biological Invasions* 6: 147–157, <http://dx.doi.org/10.3391/mbi.2015.6.2.05>
- Lescrauwaet A-K, Vandepitte L, Fockedeey N, Depooter D, Verleye T, Mees J (2015) Invasive Alien Species in Belgian marine waters: an information platform and checklist for science and policy support. *Management of Biological Invasions* 6: 209–213, <http://dx.doi.org/10.3391/mbi.2015.6.2.11>
- 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>
- Ojaveer H, Galil BS, Campbell ML, Carlton JT, Canning Clode J, Cook E, Davidson AD, Hewitt CL, Jelmert A, Marchini A, McKenzie CH, Minchin D, Occhipinti-Ambrogi A, Olenin S, Ruiz GM (2015) Classification of non-indigenous species based on their impacts: the marine perspective. *PLoS Biology* 13(4): e1002130, <http://dx.doi.org/10.1371/journal.pbio.1002130>
- Pagad S, Genovesi P, Carnevali L, Scalera R, Clout M (2015) IUCN SSC Invasive Species Specialist Group: invasive alien species information management supporting practitioners, policy makers and decision takers. *Management of Biological Invasions* 6: 127–135, <http://dx.doi.org/10.3391/mbi.2015.6.2.03>
- Roy HE, Preston CD, Harrower CA, Rorke SL, Noble D, Sewell J, Walker K, Marchant J, Seeley B, Bishop J, Jukes A, Musgrove A, Pearman D, Booy O (2014) GB Non-native Species Information Portal: documenting the arrival of non-native species in Britain. *Biological Invasions* 16: 2495–2505, <http://dx.doi.org/10.1007/s10530-014-0687-0>
- Seaward K, Acosta H, Inglis GJ, Wood B, Riding TAC, Wilkens S, Gould B (2015) The Marine Biosecurity Porthole – a web-based information system on non-indigenous marine species in New Zealand. *Management of Biological Invasions* 6: 177–184, <http://dx.doi.org/10.3391/mbi.2015.6.2.08>
- Vanderhoeven S, Adriaens T, D'hondt B, Van Gossum H, Vandegehuchte M, Verreycken H, Cigar J, Branquart E (2015) A science-based approach to tackle invasive alien species in Belgium – the role of the ISEIA protocol and the Harmonia information system as decision support tools. *Management of Biological Invasions* 6: 197–208, <http://dx.doi.org/10.3391/mbi.2015.6.2.10>
- Zenetos A, Arianoutsou M, Bazos I, Balopoulou S, Corsini-Foka M, Dimiza M, Drakopoulou P, Katsanevakis S, Kondylatos G, Koutsikos N, Kytinou E, Lefkaditou E, Pancucci-Papadopoulou MA, Salomidis M, Simbora N, Skoufas G, Trachalakis P, Triantaphyllou M, Tsiamir K, Xentidis NJ, Poursanidis D (2015) ELNAIS: A collaborative network on Aquatic Alien Species in Hellas (Greece). *Management of Biological Invasions* 6: 185–196, <http://dx.doi.org/10.3391/mbi.2015.6.2.09>