

The EASIN Editorial Board: quality assurance, exchange and sharing of alien species information in Europe

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Abstract

The European Alien Species Information Network (EASIN) aims to facilitate the exploration of alien species information in Europe, and is recognized as the information system supporting European Union Member States in the implementation of the recently published Invasive Alien Species Regulation. In this paper, we present the role and activities of the EASIN Editorial Board (EB), which is responsible for the quality assurance, safeguarding and constant improvement of EASIN. The EB is supported by a web platform that facilitates online discussions about alien species. This platform creates a virtual community by providing a forum-like interface that is moderated by the EB Members but is freely accessible to the scientific community and the general public. It allows all registered users to make comments, raise questions and share experience and expertise on alien species in Europe. Moreover, it provides a means for exchanging opinions and solving disputes in a transparent way. The overall EB activity is commonly agreed upon procedures and standards.

Key words: data quality, database, information system, invasive alien species, web platform

Introduction

Invasive Alien Species (IAS) constitute one of the most important threats to biodiversity, causing severe ecological and socio-economic impacts (Mack et al. 2000; Ricciardi et al. 2013; Jeschke et al. 2014). As a conservative estimate, IAS cost the European Union (EU) €12 billion in damages on an annual basis (Kettunen et al. 2009). In addition, there is an increasing trend towards introduction of new alien species, with the vast majority being introduced unintentionally (Hulme 2009; Essl et al. 2015; Roques et al. 2016). To this end, economic resources invested by the EU in both the research and management of IAS have been growing steadily over the years, despite the lack of a dedicated EU strategy (Scalera 2010; Silva et al. 2014). Recognizing the need for a coordinated set of actions to prevent, control and mitigate alien species invasions, the European Parliament and the Council therefore adopted the EU Regulation no. 1143/2014 (EU 2014; hereafter referred to as the IAS Regulation) on the prevention and management of the introduction and spread of IAS, which entered into force on 1 January 2015.

Tackling biological invasions effectively relies on the availability of up-to-date scientific information, and requires the sharing and integration of knowledge on the topic in order to enhance science-based decision-making (McGeoch et al. 2012; Roy et al. 2014; Lucy et al. 2016). Plenty of information on alien species is available in Europe, but it is generally scattered across many different information systems and databases (Gatto et al. 2013). In addition, data incompatibility is a frequent limitation to the interoperability of data repositories and information systems (Essl et al. 2015). It is therefore crucial to establish a single aggregation point for sharing and disseminating information, where all available knowledge on alien species from various data sources is standardized, harmonized and integrated, as well as for defining management actions (Ojaveer et al. 2014) and building robust IAS-indicators (Rabitsch et al. 2016). To address this need, the European Alien Species Information Network (EASIN; <http://easin.jrc.ec.europa.eu>) has been developed by the European Commission's Joint Research Centre (JRC) (Katsanevakis et al. 2012), and formally recognized as the information system supporting EU Member States in the implementation of the IAS Regulation (EU 2014, Art. 25) (Scalera et al. 2016). The EASIN system aims to facilitate easier access to data of alien species in Europe, and to provide a single repository for accessing all the information necessary to underpin alien-species-related policy and management decisions (Katsanevakis et al. 2013). In

addition, EASIN facilitates the exploration of existing alien species data from distributed sources through a network of publicly and freely available interoperable (and user friendly) web services, following internationally recognized standards and protocols (Katsanevakis et al. 2015).

A key part of the EASIN system is the "EASIN Catalogue": a comprehensive list of alien species in Europe, currently including information on more than 14,000 taxa in a wide range of environments. For each taxon, information is available on the year and country of the first observation in Europe, alien status (alien, cryptogenic: species with no definitive evidence of their native or alien status, questionable: observations not verified by experts or species with unresolved taxonomic status), native range, taxonomy, synonyms, common names, environment, pathways, vectors and impact. Factsheets are also provided for selected taxa (Katsanevakis et al. 2015). The initial EASIN Catalogue was compiled by gathering, harmonising, standardising and integrating information from 43 databases (Katsanevakis et al. 2012). An extensive revision and update based on scientific literature was then performed by scientific experts. EASIN also offers flexible and efficient online mapping tools for the retrieval of spatial data, based on species occurrence records coming from the EASIN Data Partners. These are global, regional and national databases that provide EASIN with spatial information of alien species in Europe. The EASIN Data Partners gain increased visibility and networking possibilities through EASIN, and can also benefit from mutual data exchange. In addition, they can be notified of updates introduced in the EASIN system through a retro-feedback mechanism that can lead to a continuous improvement in the quality of species data. EASIN follows international standards and protocols for spatial data (INSPIRE Framework Directive 2007/2/EC – EU 2007). Given the vast amount of information recorded in EASIN and the need for constant updates and revision, an Editorial Board is needed to ensure the efficient data quality assurance of the EASIN system.

This paper presents the role and activities of the EASIN Editorial Board (EB), a voluntary group of taxonomic experts responsible for guaranteeing quality assurance and updates of the EASIN system. The activities of the EB are supported by a web platform that facilitates online discussions on alien species. This platform offers a forum-like interface that is moderated by the EB Members, freely accessible to the public, and allows registered users to raise questions, make comments, share experience and expertise, and participate in discussions on alien species in Europe.

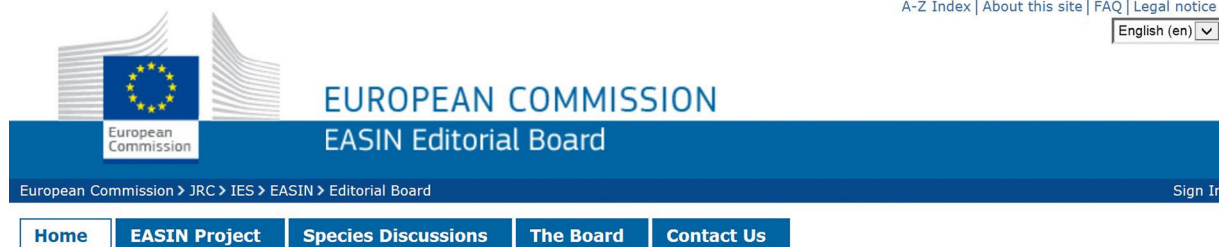


Figure 1. The EASIN EB platform's home page.

Description of the EASIN Editorial Board

The web platform

The EB is supported by an online web platform (<http://easin-eb.jrc.ec.europa.eu>; Figure 1), which is linked to the EASIN system and can be accessed by all registered users. The platform facilitates scientific discussions among users, which are triggered by means of opening a “ticket”: a question, a comment, a taxon revision, or an addition to existing data related to alien species information, e.g. a new alien species in Europe. When a ticket has been created, all users can join and post a reply, leading to the creation of the ticket discussion (Figure 2). It should be noted that a ticket and any subsequent reply should be based on scientific reports/publications supporting the user's statement.

Editorial Board Members

All tickets in the EB platform are handled by the EB Members. Each EB Member is responsible for taxa belonging to one or more taxonomic groups and habitats, according to his/her scientific expertise. Therefore, when a ticket is opened for a specific taxon, it is automatically assigned to the relevant EB Member, who follows and handles each ticket discussion assigned to him or her. When there is sufficient scientific evidence provided by the users' posts, the EB Member responsible writes the conclusion of the discussion and closes the ticket. The conclusion may lead to modifications, additions, or deletions of data in the EASIN system.

At the beginning of 2016, the EB consisted of 28 Members with specific expertise and competence covering 95% of all taxa listed in the EASIN system. A short CV and the field of expertise of each EB Member is available on the web platform (<http://easin-eb.jrc.ec.europa.eu/the-board>). Most EB Members are

assigned for terrestrial plants, which represent almost 50% of the reported alien taxa in Europe (about 6,500 taxa based on the latest version of the EASIN system – v.5.6 28.06.16).

How the EB platform works

The EB platform operates through automated e-mail notification exchanges. Each time a ticket is launched, the relevant EB Member is notified by e-mail. Similarly, when an EB Member posts a conclusion and closes a ticket, the system notifies all users participating in the specific ticket discussion.

Users must register in order to have full access to the functionalities of the EB platform. Acceptance of registration by the EB platform administrator is required. Non-registered users can read all the ticket discussions, but cannot contribute.

Registered users can find the relevant ticket discussions in the “*Manage Tickets*” page, where all tickets are listed in chronological order. For each ticket, a user can find information regarding the latest update, the ticket title, the related species, the status of the ticket (Open/Discussing/Closed) and the status of the discussion (Closed/Ongoing). There is also an option for sending a notification to scientists/EB Members for a specific ticket. The architecture of the functioning of the EB platform is depicted in Figure 3. The EB's activities are based on commonly agreed procedures and standards (Gervasini et al. 2016).

Preliminary performance of the EASIN Editorial Board

The EASIN Editorial Board was established in May 2014. It acquired a sufficient number of EB Members in late 2015, in terms of covering the vast majority of all taxa listed in the EASIN system (95%). By early



EUROPEAN COMMISSION
EASIN Editorial Board

European Commission > JRC > IES > EASIN > Editorial Board

Welcome, **tsiamko!** Sign out

Home | EASIN Project | Species Discussions | Create Ticket | Manage Tickets | The Board | Contact Us

Anteaeolidiella foulisi

Closed on 8/28/2014 10:45:33 AM by cmaster

By cmaster, Apr 30 2014 5:36 PM

The species found in the Atlantic-Mediterranean Sea is no more *A. foulisi*, but *Anteaeolidiella lurana* (Marcus & Marcus, 1967). The species should be removed from aliens, and included among cryptogenics...

See:

Carmona et al. (in press). Systematic review of *Anteaeolidiella* (Mollusca, Nudibranchia, Aeolidiidae) based on morphological and molecular data, with a description of three new species

<http://onlinelibrary.wiley.com/doi/10.1111/zoj.12129/full>

By zenetos, May 6 2014 3:22 PM

This is true but it does not exclude the introduced status of the species in the Mediterranean (ship transferred).

By FaCrox, May 7 2014 5:07 PM

Uhm, I would say that its introduction via shipping looks like not so sure now...I feel it may easily be a species overlooked due to its small sizes and environment...

By cmaster, Aug 28 2014 12:45 PM

A new taxon was created: *Anteaeolidiella lurana* (R18211), that includes data from *A. foulisi* (R16542). It was furthermore moved to cryptogenics, and the pathway was moved to "unknown".

1

Figure 2. An example of the ticket discussion on the species *Anteaeolidiella foulisi*, including all posts by EB users.

2016, 185 tickets had been dealt with by the EASIN EB. Of these, 157 had been addressed by EB users and closed by the relevant EB Members, and the EASIN system had been updated accordingly, while discussions were still ongoing for the remaining tickets.

Most tickets referred to alien marine invertebrates and terrestrial plants. Ticket discussions included several topics, mainly questions or suggestions for revisions regarding species traits, such as: a) enquiries on species' "alien status" (e.g. *Oculina patagonica* was changed from "alien" to "cryptogenic"), b) corrections on "environment" (e.g. *Spartina versicolor* environment was corrected from "marine" to "terrestrial"), c) remarks on "pathways" (e.g. *Heniochus intermedius* and *Pterois miles*, whose previous pathways were listed as being the aquarium trade, have now been moved to corridor: Suez Canal, Lessepsian immigration), d) changes of "year of the first introduction to Europe" (e.g. the first years of introduction to

European seas of *Maetra olorina* and *Haliotis rugosa pustulata* were changed from 1889 to 1883 and from 1971 to 1961, respectively), e) revisions of taxa nomenclature (e.g. the name *Saurida undosquamis* was changed to *Saurida lessepsianus*), f) corrections of typos (e.g. *Clypeomorus bifasciata* and *Monotyigma lauta* were misspelled as *Clypeomorus bifasciatus* and *Monotigma lauta*, respectively), g) enrichment of spatial occurrences of species in Europe (e.g. *Drosophila suzukii*), h) enquiries on the native range of species within Europe (e.g. *Trifolium repens*), i) new additions to the EASIN Catalogue (e.g. *Hypoglossum caloglossoides*), and j) deletions from the EASIN Catalogue (e.g. *Codium fragile atlanticum*). Most tickets concerned species nomenclature (35%) and alien status in Europe (31%, Figure 4).

Dedicated extensive revisions and updates to the EASIN Catalogue were made by several EB Members following the EB procedures (Gervasini et al. 2016),

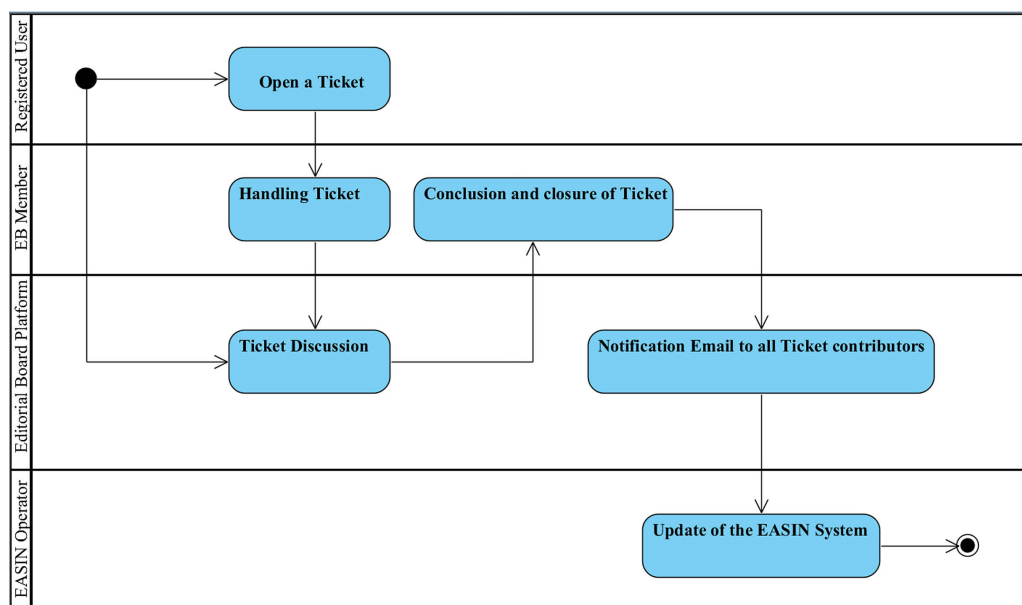


Figure 3. Overall architecture behind the functionality of the EB platform.

especially for marine aliens and alien land plants. During only a three-month period (January–March 2016), 100 new alien species were added to the EASIN system and listed as alien or cryptogenic in Europe, while six species were deleted from the EASIN Catalogue due to misidentifications, erroneous and vague data or because they were recently considered to be native to Europe (supplementary Tables S1–S2).

Discussion

Data that are to be used in decision-making and planning must be of high quality (Herzog et al. 2007). The most commonly cited features of high quality data are: relevance, accuracy, timeliness, accessibility, clarity, comparability, coherence and completeness (ISO 9000: 2015). Data quality assurance includes data profiling to discover inconsistencies and other anomalies, as well as performing data cleansing activities (e.g. removing outliers, interpolating missing data). All of these quality features are of particular relevance to EASIN, as an information system serving both the scientific community as well as the EU Member States in the implementation of the IAS Regulation.

Databases that are scientifically validated and continuously updated and maintained are the most reliable sources of information on alien species data for undertaking control measures (Genovesi 2001). An effective IAS information system requires an editorial board composed of scientists with taxonomic,

biogeographic or other expertise, in addition to a solid conceptual knowledge of biological invasions, to ensure data quality (Olenin et al. 2014). The EASIN EB is key to the quality assurance of the EASIN Catalogue, ensuring that it is safeguarded and constantly improved, which is critical to the long-term maintenance and reliability of a database system (Costello et al. 2014). The EB web platform provides a simple and time-saving tool for tracking revisions and updates of alien species data. Furthermore, it creates a virtual community by providing a forum-like interface, where anybody is welcome to post comments, remarks or questions about alien species data in Europe. In this way, the EB web platform can offer a suitable tool for quickly disseminating information, knowledge, and scientific expertise on alien species within the scientific community. It offers a means for exchanging opinions and solving disputes on many issues in a transparent way. Moreover, the EASIN EB web platform is publicly and freely available to all users, including citizen-scientists, who are increasingly recognized as an important source of alien species data (Thiel et al. 2014; Adriaens et al. 2015; Daume 2016).

Other relevant information systems have developed similar data quality and assurance mechanisms, including the involvement of experts (e.g. AquaNIS 2016; WoRMS 2016; WRIMS - Pagad et al. 2016), but, in contrast to the EASIN EB, these are not supported by a web platform that is open to everyone and that allows for the participation of all interested communities.

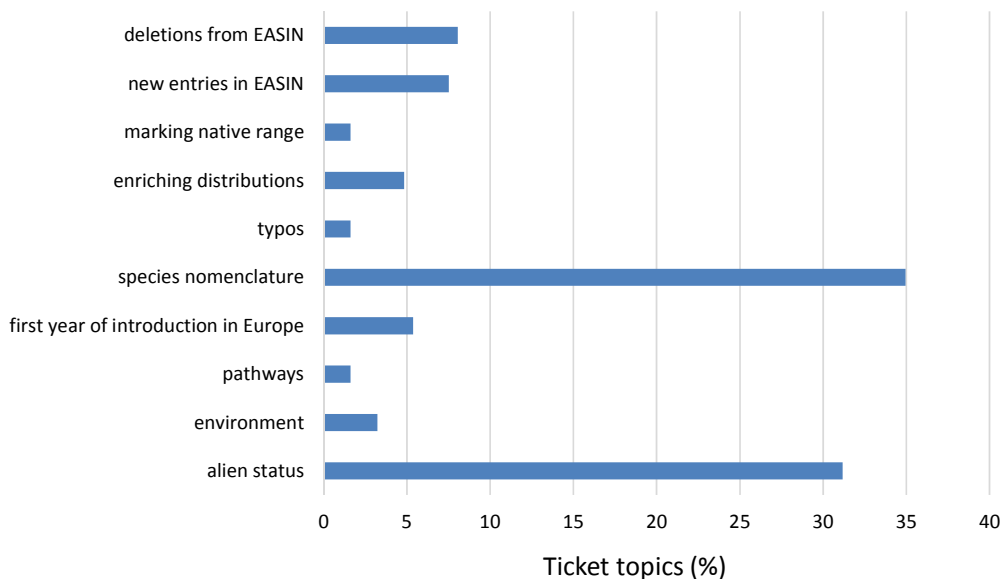


Figure 4. EB ticket topics up to 31.03.2016.

The EASIN EB could potentially be a more sustainable mechanism for supporting the real-time updating of information on alien species.

There is an increasing amount of information on alien species data coming from the scientific community, national monitoring authorities and citizen-scientist groups. In addition, recent studies, molecular works in particular, have resulted in numerous changes in the taxonomic concept and nomenclature of many alien species, shedding light on their global alien/native biogeographic range (Carmona et al. 2014; Bariche et al. 2015; Russell et al. 2015; Kawai et al. 2016). These constant changes have been partly addressed by the majority of the EASIN EB ticket topics (Figure 4), and reveal the necessity of the EB to constantly provide revisions and updates about alien species data. In addition, the high number of the EB tickets on species' "alien status" reflects the uncertainties, gaps and contradictory opinions of experts on numerous alien species in Europe, specifically in the marine environment (Marchini et al. 2015). With 10 marine taxonomic experts across taxa and European regions, the EB could address these issues through open discussions in which all experts could give their opinions and contribute to fruitful discussions.

The EB activity could help enrich the spatial data of alien species hosted in EASIN. Despite including more than 17 million records of the occurrence of

alien species, EASIN maps are not always comprehensive and exhaustive, and there are still gaps in the spatial information of species. Therefore, it is crucial that the network of the EASIN Data Partners be enlarged. Several databases and organizations dealing with alien species have already agreed to join EASIN and become Data Partners in 2016. The EB could contribute to the constant updates and revision of occurrence records that are needed, at least for the priority species, such as the IAS of Union concern under Art. 4 of the IAS Regulation.

The EASIN database can be conceived of as an evolutionary process, serving a dynamic community of users and a wide range of questions. The use of the EASIN EB is expected to increase in the future as the system becomes increasingly known amongst alien species stakeholders, but also because it is linked with EASIN, the official information support system of the European Commission for the implementation of the IAS Regulation. Based on the latter, an Early Warning and Rapid Response Notification System (NOTSYS) has been developed within EASIN, to be used by the competent authorities of EU Member States for notifying the European Commission and all Member States about new detections of IAS of Union concern in their territory, and for reporting on eradication and management measures and their effectiveness, as foreseen in Art. 14–18 of the IAS Regulation. In the

frame of NOTSYS, the EB platform could prove to be a valuable complementary tool for sharing experience and expertise among Member States. The EB would be especially useful for eastern European countries, which may lack the professionals and experience to deal with invasions and their outcomes (Sirbu and Benedek 2016).

Nevertheless, the EB system can be further improved and become more user friendly and time effective. To this end, the EASIN EB web platform will be re-organized and merged with the main EASIN website, which recently underwent a substantial upgrade. Finally, the recent contributions of the EB's activities (Table S1) demonstrate a taxonomic/environment data bias, most likely related to the magnitude of each taxonomic group. It is therefore planned to further increase the number of EB Members during 2016, especially regarding taxonomic groups of alien species for which additional experts are required, such as alien viruses, sponges, arachnids and various marine plankton. In addition, since the EB Members carry out their activities on a voluntary basis, the ability to open new tickets or to collect the necessary information to address them greatly depends on the time and resource availability of each individual EB Member. This could have implications on, for example, the timeliness and reliability of the data. Therefore, EASIN aims to stimulate the activity of EB Members by disseminating their work using the EASIN webpage and social media, and by the organization of EB meetings.

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References

- Adriaens T, Sutton-Croft M, Owen K, Brosens D, van Valkenburg J, Kilbey D, Groom Q, Ehlig 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>
- AquaNIS (2016) Information system on aquatic non-indigenous and cryptogenic species, <http://www.corpi.ku.lt/databases/index.php/aquanis> (accessed 14 April 2016)
- Bariche M, Torres M, Smith C, Sayar N, Azzurro E, Baker R, Bernardi G (2015) Red Sea fishes in the Mediterranean Sea: a preliminary investigation of a biological invasion using DNA barcoding. *Journal of Biogeography* 42: 2363–2373, <http://dx.doi.org/10.1111/jbi.12595>
- Carmona L, Bhawe V, Salunkhe R, Pola M, Gosliner TM, Cervera JL (2014) Systematic review of *Anteaeolidiella* (Mollusca, Nudibranchia, Aeolidiidae) based on morphological and molecular data, with a description of three new species. *Zoological Journal of the Linnean Society* 171: 108–132, <http://dx.doi.org/10.1111/zoj.12129>
- Costello MJ, Appeltans W, Bailly N, Berendsohn W, de Jong Y, Edwards M, Froese R, Huettmann F, Los W, Mees J, Segers H, Bisby FA (2014) Strategies for the sustainability of online open-access biodiversity databases. *Biological Conservation* 173: 155–165, <http://dx.doi.org/10.1016/j.biocon.2013.07.042>
- Daume S (2016) Mining Twitter to monitor invasive alien species — An analytical framework and sample information topologies. *Ecological Informatics* 31: 70–82, <http://dx.doi.org/10.1016/j.ecoinf.2015.11.014>
- Essl F, Bacher S, Blackburn T, Booy O, Brundu G, Brunel S, Cardoso AC, Eschen R, Gallardo B, Galil B, García-Berthou E, Genovesi P, Groom Q, Harrower C, Hulme PE, Katsanevakis S, Kenis M, Kühn I, Kumschick S, Martinou AF, Nentwig W, O'Flynn C, Pagad S, Pergl J, Pyšek P, Rabitsch W, Richardson DM, Roques A, Roy HE, Scalera R, Schindler S, Seebens H, Vanderhoeven S, Vilà M, Wilson JRU, Zenetos A, Jeschke JM (2015) Crossing frontiers in tackling pathways of biological invasions. *BioScience* 65: 769–782, <http://dx.doi.org/10.1093/biosci/biv082>
- EU (2007) Directive 2007/2/EC of the European Parliament and of the Council of 14 March 2007 establishing an Infrastructure for Spatial Information in the European Community (INSPIRE). *Official Journal of the European Union* L108: 1–14
- EU (2014) Regulation (EU) No 1143/2014 of the European Parliament and of the Council on the prevention and management of the introduction and spread of invasive alien species. *Official Journal of the European Union* L315: 35–55
- Gatto F, Katsanevakis S, Vandekerckhove J, Zenetos A, Cardoso AC (2013) Evaluation of online information sources on alien species in Europe—the need of harmonization and integration. *Environmental Management* 51: 1137–1146, <http://dx.doi.org/10.1007/s00267-013-0042-8>
- Genovesi P (2001) Guidelines for the Eradication of Terrestrial Vertebrates: A European Contribution to the Invasive Alien Species Issue. Other Publications in Wildlife Management, Paper, 24 pp, <http://digitalcommons.unl.edu/icwdmother/24>
- Gervasini E, Tsiamis K, D'Amico F, Deriu I, Addamo A, Cardoso AC (2016) Strengthening the EASIN Editorial Board. Procedures & training session. European Commission, Joint Research Centre, Institute for Environment and Sustainability, Water Resources Unit, 28 pp, <http://easin.jrc.ec.europa.eu/EditorialBoard>
- Herzog ThN, Scheuren FJ, Winkler WE (2007) Data Quality and Record Linkage Techniques. Springer, USA, 234 pp
- 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>
- Jeschke JM, Bacher S, Blackburn TM, Dick JTA, Ess F, Evans T, Gaertner M, Hulme PE, Kühn I, Mrugała A, Pergl J, Pyšek P, Rabitsch W, Ricciardi A, Richardson DM, Sendek A, Vilà M, Winter M, Kumschick S (2014) Defining the impact of non-native species. *Conservation Biology* 28: 1188–1194, <http://dx.doi.org/10.1111/cobi.12299>
- Katsanevakis S, Bogucarskis K, Gatto F, Vandekerckhove J, Deriu I, Cardoso AS (2012) Building the European Alien Species Information Network (EASIN): a novel approach for the exploration of distributed alien species data. *BioInvasions Records* 1: 235–245, <http://dx.doi.org/10.3391/bir.2012.1.4.01>
- 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 (2013) 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, Sanchez SP, 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>
- Kawai H, Kogishi K, Hanyuda T, Arai S, Gurgel CF, Nelson W, Meinesz A, Tsiamis K, Peters AF (2016) Phylogeographic analysis of the brown alga *Cutleria multifida* (Tilopteridales, Phaeophyceae) suggests a complicated introduction history. *Phycological Research* 64: 3–10, <http://dx.doi.org/10.1111/pre.12113>
- Kettunen M, Genovesi P, Gollasch S, Pagad S, Starfinger U (2009) Technical support to EU strategy on invasive alien species (IAS) – Assessment of the impacts of IAS in Europe and the EU. Final report for the European Commission. Institute for European Environmental Policy (IEEP), Brussels, Belgium, 44 pp
- Lucy FE, Roy H, Simpson A, Carlton JT, Hanson JM, Magellan K, Campbell ML, Costello MJ, Pagad S, Hewitt CL, McDonald J, Cassey P, Thomaz SM, Katsanevakis S, Zenetos A, Tricarico E, Boggero A, Groom QJ, Adriaens T, Vanderhoeven S, Torchin M, Hufbauer R, Fuller P, Carman MR, Conn DB, Vitule JRS, Canning-Clode J, Galil BS, Ojaveer H, Bailey SA, Theriault TW, Claudi R, Gazda A, Dick JTA, Caffrey J, Witt A, Kenis M, Lehtiniemi M, Helmisari H, Panov VE (2016) INVASIVESNET towards an International Association for Open Knowledge on Invasive Alien Species. *Management of Biological Invasions* 7: 131–139, <http://dx.doi.org/10.3391/mbi.2016.7.2.01>
- Mack RN, Simberloff D, Lonsdale WM, Evans H, Clout M, Bazzaz FA (2000) Biotic invasions: Causes, epidemiology, global consequences, and control. *Ecological Applications* 10: 689–710, [http://dx.doi.org/10.1890/1051-0761\(2000\)010\[0689:BICEGC\]2.0.CO;2](http://dx.doi.org/10.1890/1051-0761(2000)010[0689:BICEGC]2.0.CO;2)
- Marchini A, Galil BS, Occhipinti-Ambrogi A (2015) Recommendations on standardizing lists of marine alien species: lessons from the Mediterranean Sea. *Marine Pollution Bulletin* 101: 267–273, <http://dx.doi.org/10.1016/j.marpolbul.2015.09.054>
- McGeoch MA, Spear D, Kleynhans EJ, Marais E (2012) Uncertainty in invasive alien species listing. *Ecological Applications* 22: 959–971, <http://dx.doi.org/10.1890/111-1252.1>
- Ojaveer H, Galil BS, Minchin D, Olenin S, Amorim A, Canning-Clode J, Chainho P, Copp GH, Gollasch S, Jelmert A, Lehtiniemi M, McKenzie C, Miku J, Miossec L, Occhipinti-Ambrogi A, Pećarević M, Pederson J, Quilez-Badia G, Wijsman JWM, Zenetos A (2014) Ten recommendations for advancing the assessment and management of non-indigenous species in marine ecosystems. *Marine Policy* 44: 160–165, <http://dx.doi.org/10.1016/j.marpol.2013.08.019>
- Olenin S, Narščius A, Minchin D, David M, Galil B, Gollasch S, Marchini A, Occhipinti-Ambrogi A, Ojaveer H, Zaiko A (2014) Making non-indigenous species information systems practical for management and useful for research: An aquatic perspective. *Biological Conservation* 173: 98–107, <http://dx.doi.org/10.1016/j.biocon.2013.07.040>
- Pagad S, Hayes K, Katsanevakis S, Costello MJ (2016) World Register of Introduced Marine Species (WRIMS). <http://www.marinespecies.org/introduced> (accessed 26 June 2016)
- Rabitsch W, Genovesi P, Scalera R, Biala K, Josefsson M, Essl F (2016) Developing and testing alien species indicators for Europe. *Journal for Nature Conservation* 29: 89–96, <http://dx.doi.org/10.1016/j.jnc.2015.12.001>
- Ricciardi A, Hoopes MF, Marchetti MP, Lockwood JL (2013) Progress towards understanding the ecological impacts of nonnative species. *Ecological Monographs* 83: 263–282, <http://dx.doi.org/10.1890/13-0183.1>
- Roques A, Auger-Rozenberg MA, Blackburn TM, Garnas JR, Pyšek P, Rabitsch W, Richardson DM, Wingfield MJ, Liebhold AM, Duncan RP (2016) Temporal and interspecific variation in rates of spread for insect species invading Europe during the last 200 years. *Biological Invasions* 18: 907–920, <http://dx.doi.org/10.1007/s10530-016-1080-y>
- 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 nonnative species in Britain. *Biological Invasions* 16: 2495–2505, <http://dx.doi.org/10.1007/s10530-014-0687-0>
- Russell BC, Golani D, Tikochinski Y (2015) *Saurida lessepsianus* a new species of lizardfish (Pisces: Synodontidae) from the Red Sea and Mediterranean Sea, with a key to *Saurida* species in the Red Sea. *Zootaxa* 3956: 559–568, <http://dx.doi.org/10.11646/zootaxa.3956.4.7>
- Scalera R (2010) How much is Europe spending on invasive alien species? *Biological Invasions* 12: 173–177, <http://dx.doi.org/10.1007/s10530-009-9440-5>
- Scalera R, Genovesi P, Booy O, Essl F, Jeschke J, Hulme P, McGeoch M, Pagad S, Roy H, Saul WC, Wilson J (2016) Progress toward pathways prioritization in compliance to Aichi Target 9. Subsidiary Body on Scientific, Technical and Technological Advice, Twentieth meeting, Montreal, Canada, 25–30 April 2016. UNEP/CBD/SBSTTA/20/INF/5, 11 pp
- Silva JP, Sopena A, Sliva J, Toland J, Nottingham S, Jones W, Eldridge J, Thorpe E, Thévignot C (2014) LIFE and invasive alien species. Publications Office of the European Union, Luxembourg, 80 pp
- Sîrbu I, Benedek AM (2016) Requiem for *Melanopsis parreyssii* or the anatomy of a new extinction in Romania. *Tentacle* 24: 26–28
- Thiel M, Penna-Díaz MP, Luna-Jorquera G, Salas S, Sellanes J, Stotz W (2014) Citizen scientists and marine research: volunteer participants, their contributions, and projection for the future. *Oceanography and Marine Biology: An Annual Review* 52: 257–314, <http://dx.doi.org/10.1201/b17143-6>
- WoRMS (2016) World Register of Marine Species. <http://www.marinespecies.org> (accessed 14 April 2016)

Supplementary material

The following supplementary material is available for this article:

Table S1. New alien species entries during January-March 2016 in EASIN.

Table S2. Alien species deleted from EASIN during January-March 2016.

This material is available as part of online article from:

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