

Management in Practice

A French working group on biological invasions in aquatic environments: towards an improvement of knowledge and management of freshwater invasive alien species

Emmanuelle Sarat^{1,*}, Alain Dutartre², Yohann Soubeyran³ and Nicolas Poulet⁴¹IUCN French committee, 17 place du Trocadero, 75016 Paris, France²Hydrobiologist, Independent expert, 21 avenue du Médoc, 33114 Le Barp, France³IUCN French committee, CIRAD, AMAP, TA A-51 / PS2, Boulevard de la Lironde, 34398 Montpellier cedex 5, France⁴French Biodiversity Agency, pôle écohydraulique, Allée du professeur Camille Soula, 31400 Toulouse, FranceAuthor e-mails: emmanuelle.sarat@iucn.fr (ES), alain.dutartre@free.fr (AD), yohann.soubeyran@iucn.fr (YS), nicolas.poulet@afbiodiversite.fr (NP)

*Corresponding author

Received: 11 November 2016 / Accepted: 17 July 2017 / Published online: 22 July 2017

Handling editor: Elena Tricarico

Editor's note:

This is one of five papers prepared by participants of the conference “Freshwater Invasives – Networking for Strategy II”. Held in Zagreb, Croatia from the 11th – 14th July 2016, the conference was organized by the University of Zagreb, Faculty of Agriculture, European Inland Fisheries and Aquaculture Advisory Commission (EIFAAC) and the Croatian Biological Society (HBD). The primary objective of the conference was to share new information and provide a forum where international scientists, policy makers and stakeholders could encourage the development of the management and policy in the increasingly important area of biological invasions.

Abstract

In order to respond to the growing concern on invasive alien species and their impact in freshwater environments in France, a working group on biological invasions in freshwater environments was created in 2009. Meeting internationally recognised recommendations, its main objective is to increase management capacity by valuating and promoting expert knowledge, digesting and giving access to scientific information and providing guidance on decision-making. Coordinated by the French Biodiversity Agency and the IUCN French Committee, the group brings together more than 60 members from communities of practitioners, scientists and policy-makers. The group's activities are determined by the shared needs of the formed network. Examples of projects undertaken to date include: the development of an internet platform to provide access to information; the publication of a best practices guide with fully detailed feedbacks from management efforts; and the setting up of an information database focussed on the operational management of introduced aquatic species in France.

Key words: IAS management, best practices, communication platform, networking, freshwater environments, France**Introduction**

Invasive alien species (IAS) are acknowledged as the third cause of biodiversity loss worldwide (CDB 2016; Millennium Ecosystem Assessment 2005; Clavero and García-Berthou 2005). IAS compete with native species, modifying the functioning of natural habitats and services provided by ecosystems, affecting economic activities and can undermine human health (Simberloff et al. 2013; Nentwig et al. 2017; Early et

al. 2016). This issue is so important that the Convention on Biological Diversity (CBD) decided to include it as a major work stream. The 2011–2020 strategic plan approved by the CBD set a specific objective that the ratifying States, including France, have committed to achieving by 2020 (CBD 2010). Furthermore, the European Union (EU) has made the management of IAS a major objective, with a new regulation to prevent and manage IAS introductions and propagation which was recently voted upon and

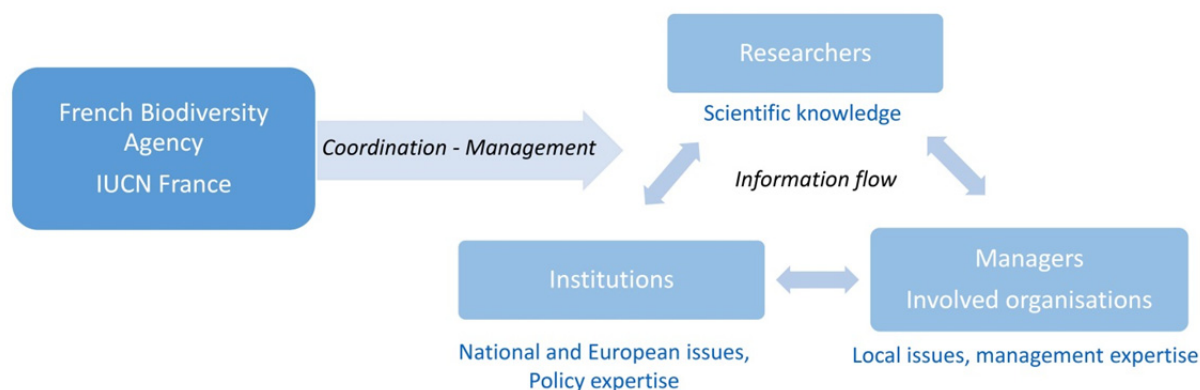


Figure 1. IBMA organisational chart.

entered into force in 2015 (Genovesi et al. 2015). France faces the growing threat of IAS, with many examples of both plant (waterprimrose, Asian knotweed, etc.) and animal (crayfish, coypu, etc.) invasions known (IUCN France 2015). These problems have become one of the major concerns for managers of natural areas and for policy-makers. Over the past fifteen years, a growing number of managers in areas including highly diverse administrative and geographical scales have entered the fray in an attempt to overcome the difficulties created by IAS (Sarat et al. 2015a; IUCN France 2015). Specific needs rapidly became apparent in terms of coordinating work, organising monitoring, assessing the impacts, establishing research programs, defining strategies and producing effective results. In spite of this, no coordination at the national level existed at that time which could have facilitated the management of these species. The interests of establishing such coordination on this scale therefore seemed just as important, if not more so, than the acquisition of data on a particular species (Dutartre et al. 2012a). Furthermore, knowledge transfer between those engaged in research, policy and management is recognised as a key issue for IAS management in Europe (Caffrey et al. 2014) and at the international level (Lucy et al. 2016). In this context and in order to meet those needs, a French national working group on biological invasions in aquatic environments (IBMA) was created in 2009, with the aim to develop a general approach to aquatic IAS management in metropolitan France.

Genesis, objectives and operating principle of the working group

The group was created through an agreement between the French National Agency for water and aquatic environments (Onema, now French Biodiversity

Agency, FBA) and Cemagref (now National institute of science and technology for environment and agriculture, Irstea). It was originally planned to last three years (2008 to 2010), but its activities have been pursued, as a consequence of the positive results obtained, the quality of the formed network and a permanent need for knowledge, communication and coordination in this field at a national scale (Sarat et al. 2015a). The first agreement was renewed in 2010 for three years and, since 2014, the coordination of the working group is now ensured by a new partnership between Onema and the French committee of the International Union for the Conservation of Nature (IUCN). The IUCN French committee was quickly identified as a partner due to his significant experience in managing various working groups and networks, and especially because it is coordinating a similar initiative on IAS in the French overseas territories since 2005 (Soubeyran et al. 2014).

The IBMA working group is entirely funded by the FBA. A dedicated team ensures that it is active, enthusiastic and coordinates its activities. Figure 1 presents the IBMA organisational chart and the links between the main categories of members that are part of the working group.

It is acknowledged that bringing together scientists, managers and policy-makers can help close the knowing-doing gap in IAS management (Gibbons et al. 2008; Shaw et al. 2010; Heger et al. 2013; Matzek et al. 2014). To this end, the IBMA working group aims to bring together all types of potential stakeholders involved in IAS management, from the “producers of scientific knowledge” to “people active in the field”, in order to create links that cover all IAS related issues (Dutartre et al. 2012a). Established by 25 members at its beginning, the working group now includes approximately 60 members, including

managers of natural areas, researchers, non-profits, public agencies, state services, local governments, for example. Participation in the working group is based on a very flexible and simple principle: anyone interested, with skills and experience on IAS, who would like to share information and reflections on biological invasions can join the working group, without any further heavy formalisation process.

Most members of the working group can be considered as “experts”. Indeed, the majority of members hold substantive information about aquatic IAS management and reflect knowledge in this particular domain. Practitioners are considered as providing an abundant wealth of latent knowledge (Drescher et al. 2013) and are well represented in the IBMA working group. Through training, years of experience in the field, and liberate practice (Ericsson 1996), they have gained practical, technical and scientific knowledge to solve question of IAS management (Drescher et al. 2013). Therefore, natural area managers and decision-makers are considered as experts within the working group, as the research members. More than ten fields of expertise currently exist (early 2017) in the working group (Table 1). It aims to gather together the diverse expert knowledge (scientific knowledge, local ecological knowledge and policy knowledge) that is available on aquatic IAS in France. The group regularly welcomes new members that strengthen and broaden its expertise.

The members of the working group meet twice a year. Since 2015, one meeting per year is organised in a French region, lasting two days and enabling members to go on a fieldtrip and to meet local practitioners. Discussions and sharing among members of the working group allow the identification of knowledge gaps and provide ecological insights in support of IAS management decision-making. It also contributes to the identification of scientific issues and the need for applied research. The members also participate in the formulation of strategies and public policies for IAS management and support management operations for certain species by responding directly to questions from field operators.

Main achievements and benefits for IAS management

The group’s achievements are mostly focussed on management of aquatic IAS and can be implemented in three main categories.

1) Valuation and promotion of expert knowledge

Invasion processes are complex (Lodge 1993), context-dependant (Blackburn et al. 2009) and linked

Table 1. Main expertise fields covered by the IBMA working group and number of associated experts. An expert can have several expertise fields.

Expertise fields	Number of members
Management of IAS	19
Invasive animals (biology, ecology and management)	14
Invasive plants (biology, ecology and management)	10
Applied research on IAS management	7
Waste management	2
Agricultural pests	2
IAS economics	2
IAS policy	1
Sociology / ethnology	2
IAS in urban areas	2
Aquatic ecology - Epidemiology	2
Invasions in great river systems	1
IAS in French overseas territories	1

to societal issues (disparate perceptions of IAS, cultural influences and socio-cultural activities) (Heger et al. 2013; Menozzi and Pellegrini 2012). Management methods need to take into account the multiple interactions that occur in the invasion process, the history of each invasion and the specificities of each situation (Heger et al. 2013; Cassey et al. 2005). It is therefore difficult to propose universal management approaches and no “cure all” methods currently exist. However, scientific-based approaches to assist environmental managers in setting up management projects can be proposed. Such approaches need to consider expert knowledge coming from field operators. Indeed, managers of natural areas hold a great quantity of substantive on-site information and data on IAS management. This type of local knowledge is not widely documented or acknowledged (Martin et al. 2012), is harder to collect and remains hidden until it is expressed for specific applications (Boiral 2002). However, its use in the field of ecology has increased during the last 30 years (Drescher et al. 2013) and it needs to be collected, analysed and validated.

In this scope, in 2015 the IBMA working group undertook a comprehensive review on the management of invasive alien species (Sarat et al. 2015a, b). A hundred contributors from different fields of expertise (scientists, researchers, natural area managers, policy-makers, etc.) were mobilised to gather the scientific and expert knowledge available on aquatic IAS management in France, and proposed a methodical and reasoned approach to implement IAS management. A complete review of IAS in aquatic environments was made available, providing an overview on scientific knowledge, legislation and regulation, strategies, actions and management issues implemented at the international, European, and

national scale. To further value local ecological knowledge held by natural area managers, a panorama of feedbacks from IAS management efforts in aquatic environments supports this scientific-based approach (e.g., reference). This collection of information serves as a reflection basis for the implementation of management actions, trying to take into account the specificities of each situation (including the study site itself, the alien species to manage and the relevant human needs).

Feedbacks from management efforts are one of the group's main activity and are continuously synthesised and made available online through a dynamic mapping. Currently, sixty-nine feedbacks on 30 species are searchable on the IBMA internet platform. In conjunction with the IUCN French committee's Initiative on IAS in the French overseas territories, the collection of feedbacks has been extended to those regions since 2016.

Several surveys and studies (Matzek et al. 2014; Pullin and Knight 2005; Bayliss et al. 2012) have shown that managers heavily rely on their own observations and those of their colleagues, and that there is a strong reliance on experience-based information. Sharing of experience of invasive species management, whether effective or otherwise, is important in providing an evidence base to evaluate and to inform practice (Bayliss et al. 2013). Indeed, although the effectiveness of the management efforts collected by the IBMA working group can hardly be assessed, due to the scarcity of monitoring, they are considered to have given satisfactory results to the managers, in view of the objectives set in each context. These examples can be considered as first references, which remain to be improved, since the management objectives that are implemented on the field do not necessarily include all the components that would ideally be required for fully effective management interventions. These feedbacks from management efforts constitute an operational source of information for managers, and should be considered as a first step of more accurate data acquisition on IAS management. Environmental management should be evidence-based (Sutherland et al. 2004; Lucy et al. 2016) and further data needs to be collected to assess the effectiveness of these management interventions (for example, data from studies applying Before-After-Control-Impact (BACI), before/after treatment designs, etc.) (Schindler et al. 2016). Developing this evidence-based information requires scientific information (Young et al. 2014) but inputs from communities of practice such as feedbacks from management interventions can provide useful guidance for managers (Roux et al. 2006).

Thus, this work contributes to the creation of a community of practice by encouraging managers to

share their experience through a national network. As described in the INVASIVESNET concept, which aims to facilitate greater understanding and improved management of IAS by developing a sustainable networks of networks for effective knowledge exchange (Lucy et al. 2016), this community plays an important role in the knowledge flows among practice, science and management. These feedbacks from management efforts are also a mechanism to identify gaps in management practice and knowledge. By collecting information and data for the feedbacks, managers often realise that key information was not collected during field operations, such as quantitative results, costs of operations, and long term monitoring. As a result, the next management plan on aquatic IAS can be improved by addressing these gaps and broadened data collection that is better-suited to intervention protocols and monitoring on the long term. In addition to valuating the skills and expertise held by practitioners, feedbacks from management efforts constitute a way to formalize by writing management efforts which can be used to justify their implementation to project funders and local authorities (Dutartre 2004).

2) Access to digested scientific information

The reliance on experience, rather than scientific evidence, observed among different communities of practitioners (Matzek et al. 2014; Pullin and Knight 2005), suggests that underlying knowledge transfer issues relate to accessing and translating research evidence (Bayliss et al. 2012). Matzek et al. (2014) have shown that land managers and restoration practitioners in California, USA, scarcely use peer-reviewed articles to get scientific information about invasive plant species, mostly because they lack time to find and read those papers. According to this survey, they prefer research results that have been synthesised for manager readership rather than scientific journals, which they find moderately relevant. Additionally, English-written papers are an important barrier for French stakeholders, as they do not often speak English and are easily discouraged in reading peer-reviewed papers.

Matzek et al. (2014) noted that free online information, books that synthesize relevant IAS information, best management practices guides and dedicated newsletters were most often used to inform managers, with a heavy reliance upon colleagues and personal knowledge. These results were supported by a similar study in Great-Britain (Bayliss et al. 2012), where stakeholders demonstrated a clear preference for free, easily accessible online information, and predominantly used internet search engines and specialist

websites to find information. It is also admitted that evolving online platforms, integrating knowledge from different disciplines and providing easy access to existing knowledge on IAS are considered to enhance communication among scientists and other stakeholders (Heger et al. 2013). Such platforms are available at different geographical scales: for example, the Global Invasive Species Database (GISD) (<http://www.iucngisd.org>), developed and managed by the Invasive Species Specialist Group (ISSG) of the IUCN, the Invasive Species Compendium (ISC), managed by CAB International (<http://www.cabi.org/isc/>), the Delivering Alien Invasive Species Inventories for Europe database (DAISIE) (<http://www.europe-aliens.org>) funded by the sixth framework programme of the European Commission, or, at a national scale, the Great-Britain Non-native Species Secretariat information portal (GB NNS) (<http://www.nonnativespecies.org>) and the Belgian Forum on Invasive Species (BFIS) (<http://ias.biodiversity.be/>). However, most information available on those platforms are delivered in English and this constitutes a real obstacle for French natural area managers. In France, the IUCN French committee's initiative on IAS in the French overseas territories has developed an information database (<http://www.especes-envahissantes-outremer.fr/>) but information on IAS in aquatic environments in continental France remained scattered in many documents and websites.

In view of this context, to meet those needs and to improve managers' access to scientific information, in 2012 the IBMA working group created an online resource centre on IAS (<http://www.gt-ibma.eu>). The working group gathered all available and relevant tools and resources and made them available online: feedbacks from management efforts, information databases, management guides and best practices, dynamic mapping, international, European, national, local strategies and legislation, species alerts, and current events. Since its creation, the platform has been improved and expanded upon, offering new webpages, resources and features. Its visitor rate is continuously rising, with a number of unique visitors multiplied by eight in three years, and the number of downloaded documents has been multiplied by four during the 2014–2016 period (from 4,231 in 2014 to 17,884 in 2016) (Figure 2). These growing visitation rates highlight the usefulness of the platform and its importance at the national level.

In order to centralise, structure, and make available information on differing IAS management options, in 2016 the working group created an online information database on more than 450 introduced species in aquatic environments. Inspired by the existing international and national databases on IAS (GISD, DAISIE, ISC,

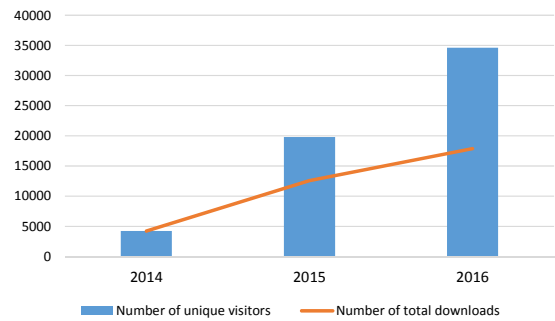


Figure 2. Evolution of the frequentation rate of the resource center <http://www.gt-ibma.eu>, from 2014 to 2016.

GB NNS, etc.) and drawing on the experience of the database system developed for the French overseas territories by the IUCN French committee, the IBMA database provides for each species access to documented management techniques, introduction pathways, assessed impacts and links to distribution maps. Resources such as feedbacks from management efforts, photo galleries, fact sheets, bibliography and legislation are openly accessible. The database provides access to other national or regional platforms on biodiversity (for instance, to the National Inventory of the Natural Heritage (INPN) (<https://inpn.mnhn.fr>), the Information System on Flora (SI FLORE) (<http://siflore.fcbn.fr/>) and to international and European databases on IAS such as ISSG-GISD, ISC-CABI, DAISIE, the Belgian Wallonia Biodiversity platform (<http://biodiversite.wallonie.be/fr/invasives.html>) or the GB NNS. The database is updated as often as possible, for instance when new information on management is available or when new species are mentioned in continental France.

Newsletters are an important tool to disseminate research results (Matzek et al. 2014; Bayliss et al. 2013). It is a way to engage managers, and due to the summarised format of the information being disseminated managers can more easily allocate time to read a newsletter and hence keep up with latest research and news (Martin et al. 2012). Since 2014, as requested by the members of the IBMA working group, a newsletter is edited every two months and sent to more than 850 subscribers. The newsletter summarises current activities on IAS at different geographical scales. Particular research subjects such as biological control, biosecurity, species alerts, and innovative management techniques are regularly explored in technical dossiers. Local managers regularly participate by submitting short articles on their on-going projects. Such documents give access to written synthesised scientific data and are an important source of information for French practitioners.

3) *Networking and guidance on decision-making*

Another strategy to improve the flow of information between researchers and practitioners is to convene conferences and workshops that bring together scientists, managers and policy-makers (Gibbons et al. 2008; Shaw et al. 2010; Heger et al. 2013). These types of events can catalyse new relationships between these stakeholders, help each other's to understand the different motivations (Gibbons et al. 2008), narrow the gap between science and management (Shaw et al. 2010), and can be used as forums for transdisciplinary research (Heger et al. 2013).

The two annual meetings of the working group facilitate exchanges between its members, but are restricted to an average of 30 participants and limit the opportunities to meet new experts and create synergies. Thus, in 2010, the IBMA working group organised the first national conference on IAS in aquatic environments, bringing together 180 participants. This conference represented a first of its kind in continental France, where it focussed on current knowledge and tools for IAS management in France and gave orientations for future applied research programs. It also provided the opportunity to improve knowledge interchange between researchers, managers and policy-makers. The proceedings of the conference constituted a synthesis of scientific information available for practitioners (Dutartre et al. 2012b).

The IBMA coordinating team was also largely involved in the organisation of the first national conference "Invasive aliens species: towards an enhancement of action strategies" organised by the IUCN French committee and its partners in 2014. Bringing together more than 200 delegates from continental France and the French overseas territories, a series of recommendations and priority actions to strengthen and structure collective efforts to manage IAS were produced and used as guidelines for the elaboration of the French national strategy on IAS in 2016 (IUCN France 2015; Muller 2017). Improvement of knowledge transfer, needs for best practices, management and biosecurity protocols have been identified as priority objectives, as well as the creation of a national network of stakeholders. Field operators and decision-makers are also requesting the development and expansion of the group's activities on terrestrial environments, which currently lack data, tool and information centralisation, and broadcasting. To meet those needs, the IBMA working group will broaden its scope and plans to play an important role in the future implementation of the French national strategy on IAS.

Since 2000, numerous local working groups at different administrative scales addressing biological invasions have originated from the field. They have demonstrated great dynamism and responsiveness, and have greatly contributed to the improvement of IAS management and its coordination in many French territories (Sarat et al. 2015a; Dutartre et al. 2012a). The IBMA working group follows and supports those territorial entities by helping their reflections and developing tools to meet their needs. For example, the IBMA working group has allowed the emergence of the first LIFE programme dedicated to invasive species in France (LIFE CROAA - Control strategies Of Alien invasive Amphibians in France, LIFE15 NAT/FR/000864), by bringing together researchers, managers and policy-makers and helping them to set up the project. Approximately, ten local groups are followed by the IBMA coordinating team each year. In 2015, a dynamic mapping of all local groups and managers involved in IAS management was created by the IBMA working group. It illustrates the distribution and variety of stakeholders and enables a quick identification of contact structures.

Future prospects and improvements

In spite of the significant progress made to date, management of IAS still needs to be enhanced, and best practices need to be developed and promoted. This verdict is shared by many existing networks, working groups and experts from around the world (Lucy et al. 2016). Clear needs for better dissemination of lessons learned and basic knowledge are expressed by conservation practitioners (Esler et al. 2010; Matzek et al. 2014) and targeted efforts are needed for transferring evidence-based information to decision makers, field operators but also to the general public (Lucy et al. 2016). Knowledge transfer between those stakeholders to improve IAS management was also identified amongst the top 20 IAS issues in Europe (Caffrey et al. 2014), and many recommendations are made from regions across the globe (Gibbons et al. 2008; Soubeyran et al. 2014; Esler et al. 2010; Shaw et al. 2010; Matzek et al. 2014; Matzek et al. 2015; Lucy et al. 2016) to encourage cooperation and information flow in both directions, with managers and policy-makers informing researchers, and *vice versa* (Caffrey et al. 2014). In continental France, the IBMA working group was created to close the knowing-doing gap in IAS management and is in direct line with these internationally recognized recommendations. In this scope and since its beginning, the working group has allowed the identification of the improvements needed in France for the development of stronger and more

effective regulations, a better dissemination and circulation of information, an enhanced knowledge on management techniques and the development of strategic networks and programmes of applied research (Dutartre et al. 2012a; Sarat et al. 2015a).

In compliance with recommendations emerging from international research communities (Kühn et al. 2011), IBMA pleads that research on biological invasions in France needs to be pursued on many subjects and target different objectives, including impact assessments, species biology and ecology, invaded environments, monitoring and surveillance methods (Sarat et al. 2015a). Criticism has been made that much of the scientific literature on invasive species focuses on furthering knowledge and quantifying impacts rather than on delivering practical solutions (Esler et al. 2010; Hulme et al. 2006). For instance, a study comparing the published research on exotic invasive plants with research needs identified by practitioners in California, USA, has found that basic research is heavily overrepresented compared to applied research (Matzek et al. 2015). This finding is similar in other countries such as South Africa (Esler et al. 2010) or Great-Britain (Bayliss et al. 2013), and France is no exception. In 1999, the French ecology ministry launched the INVABIO programme. The main objective was to provide the information required for a coherent approach based on improved knowledge (theoretical and practical) on biological invasions and to propose management tools designed to prevent, minimise or eradicate IAS (Barbault and Atramentowicz 2010). Between 2000 and 2006, 30 research projects on a vast range of organisms and processes were funded by INVABIO, but only one-third addressed management issues (Sarat et al. 2015a). Even though the IBMA working group includes a few researchers among its members (approximately 15%), it remains difficult to make applied research projects emerge. As is the case at European level (Caffrey et al. 2014), this can be charged to a lack of funding and rare calls for the research and development of control methods. A lack of interest on applied research is also felt, probably due to the fact that fundamental research on biological invasions makes its way to a greater degree into the peer-reviewed literature than applied research (Esler et al. 2010). The IBMA working group still has an important role to play to help closing this knowing-doing gap, by recruiting new research members, improving communication, raising awareness and encouraging partnerships between academics and managers. To meet these goals, the existing networks and initiatives at different geographical scales will provide useful advice and the IBMA working group should benefit from their experience.

Socio-economic activities and global transportation cause difficulties for the prevention and management of IAS (Heger et al. 2013), but also create the need to integrate socio-cultural sciences into research (Kowarick et al. 2003). Approaches in human and social sciences have shown that the intervention choices for the management of IAS also depend on socio-cultural factors and their successful implementation requires to bring together the different stakeholders involved (Menozzi and Pellegrini 2012; Courchamp et al. 2017). Efforts to bring together researchers from ecological and non-ecological fields and practitioners need to be strengthened (Heger et al. 2013; Matzek et al. 2014) and have been undertaken in many cases. For example, interdisciplinary research was conducted in several French overseas departments (Réunion island, Martinique and French Guyana) and on the Mediterranean coast on integrated mosquitoes control management (*Aedes albopictus* and *Aedes aegypti*) (Claeys and Mieulet 2013). This research allowed to examine the issues of public perception on management actions, but also outlined the difficulties encountered on the methodology by researchers from ecological and non-ecological fields, and thus the need for dialogue (Claeys and Thiann-Bo Morel 2015). Other research project have for example focussed on the integration of public perception in the development of IAS risk assessment models (Cliff and Campbell 2012), or analysed public perception on the impacts of IAS and management actions (Andreu et al. 2009; Bardsley and Edwards-Jones 2006; Bremner and Park 2007).

Members of the IBMA working group were originally involved in such interdisciplinary research projects, particularly during the INVABIO programme (Menozzi and Dutartre 2007; Dutartre and Menozzi 2008). They have actively participated in the emergence of socio-cultural reflections on the management of IAS in France (for example, Tabacchi and Planty-Tabacchi 2010; Menozzi and Pellegrini 2012). Still, as shown in Table 1, the IBMA working group lacks skills and expertise in socio-economics and social and human sciences. It should seek to fill those gaps, by recruiting members from those fields, in order to better integrate related-issues in its reflections, but also to improve the balance between researchers from ecological and non-ecological disciplines. The knowledge gained will improve management practices, provide guidance for policy and regulatory decisions and should contribute to a more global awareness of issues related to biological invasions, as identified by the French National Strategy on IAS (Muller 2017).

France has not been well represented among the international community of IAS management. For

example, no French network or initiative on IAS was identified as a potential contributor to the INVASIVESNET initiative, a new international association for knowledge and open data on IAS, launched in 2016 (Lucy et al. 2016). Until now, this was due to a lack of a national coordination, mostly exclusive French-written papers on local management actions and no identified national internet platform. The IBMA working group is now trying to catch up with those initiatives and has developed a functional internet platform and information database. It has also translated its main productions into English to facilitate their transfer to other countries. With a view to exchanging information on a wider scale, the IBMA working group wishes to participate in different networks and initiatives at a European scale, to trigger regional cooperation and share best practices, information and knowledge. New connections and networks at the European scale are created by attending international conferences and presenting the working group. New projects, such as cross-border initiatives on feedbacks from management efforts, should be carried out and feed into existing European networks on IAS management. At a broader scale, the working group could also become a future member of INVASIVESNET. Information from the community of practitioners formed by the IBMA working group could feed this international “network of networks” and the working group could benefit from the open data publishing that will result from INVASIVESNET.

Conclusion

Through its constitution, operational mode and achievements, the IBMA working group is an innovative communication and information platform on IAS management in freshwater, in France. After ten years of existence, some “ingredients” for its success can be identified.

One of these is the flexibility of the working group, recruiting members without heavy formalisation processes and allowing open discussions on many IAS related issues. This “easy-going” manageability is the key to rich and creative exchanges as well as high member diversity, and leads to a unique blend of managers, researchers and decision-makers.

The enthusiasm and the coordination of the IBMA working group rest on a dedicated team of four scientific officers and is the result of a successful partnership between a government agency (French Biodiversity Agency) and a non-profit organisation (IUCN French committee). Funding the coordination of the working group, the French Biodiversity Agency is established at the national

and local levels and involved in the implementation of national public policies on management and applied research programmes. The IUCN French Committee, thanks to its network of organisations and experts, is a unique knowledge base and platform for dialogue on biodiversity issues. It has a large national expertise on IAS (overseas territories and continental France) and issues practical recommendations to produce better policies and strengthen actions to tackle IAS.

Exchanges and dialogue are one of the best ways to improve management and knowledge of IAS. The transfer of scientific and technical information towards the various stakeholders that have to deal with biological invasions is vital to improve management of these numerous species. On the one hand, questions emerging from field operators about the difficulties they face locally have compelled researchers to take into account the great diversity of contexts and the associated social aspects, leading to more complex and adapted answers to those requests. Alternatively, managers who have been involved in management actions for several decades have now become privileged interlocutors that hold an important expertise. They are progressively taking a more active part in management implementation, using their valued expert knowledge, and are now considered as unavoidable partners in applied research programmes. Consequently, joint projects carried out by researchers and managers are emerging. A few presentations involving teams consisting of researchers and managers can now be listed during “Science and management” conferences held in France (for example, Dutartre and Quenault 2016; Haury et al. 2013) and international symposiums (Nicolas et al. 2011). Other methods to overcome communication issues between researchers and practitioners could be explored and promoted by the IBMA working group, such as the “snap sessions” organised during the International Conference on the Ecology and Management of Alien Plant Invasions (EMAPI) held in South Africa in 2009, where practitioners had the opportunity to ask questions and discuss issues amongst themselves and with researchers (Shaw et al. 2010).

The IBMA working group offers an effective interface for communication and the development of new tools and studies. It is an entity that analyses, produces and broadcasts knowledge on IAS in France. For the past years, it has started to breakdown the isolation managers have faced in the field and to answer some of their questions, to promote best practices, and to develop better links between researchers and field operators. It contributes, in a convivial way, to the creation of long lasting networks on biological invasions in aquatic environments.

Acknowledgements

We would like to thank all the members of the IBMA working group, who greatly contribute to its success and development, by submitting new and ambitious project ideas, sharing information and knowledge for all, providing articles for the newsletter, species alerts, contributions to the information database, and, last but not least, for the great enthusiasm, dynamism and support they have shown since the creation of the working group. We would also like to warmly thank the FINS II organisation team and committee who have allowed us to present our work during the FINS II conference in Croatia, Zagreb, July 11–14 2016. We thank the reviewers for their constructive and helpful suggestions that have greatly improved the manuscript. We also wish to thank the ONEMA and the French Biodiversity Agency for funding the coordination team of the IBMA working group and its activities.

References

- Andreu J, Vila M, Hulme PE (2009) An assessment of stakeholder perceptions and management of noxious alien plants in Spain. *Environmental Management* 43: 1244–1255, <https://doi.org/10.1007/s00267-009-9280-1>
- Bardsley DK, Edwards-Jones G (2006) Stakeholders' perceptions of the impact of invasive exotic plant species in the Mediterranean region. *Geojournal* 65: 199–210, <https://doi.org/10.1007/s10708-005-2755-6>
- Bremner A, Park K (2007) Public attitudes to the management of invasive non-native species in Scotland. *Biological Conservation* 139: 306–314, <https://doi.org/10.1016/j.biocon.2007.07.005>
- Barbault R, Atramentowicz M (2010) Les invasions biologiques, une question de natures et de sociétés, éditions QUAE, 192 pp
- Bayliss HR, Wilcox A, Stewart GB, Randall NP (2012) Does research information meet the needs of stakeholders? Exploring evidence selection in the global management of invasive species. *Evidence & Policy: A Journal of Research, Debate and Practice* 8: 37–56, <https://doi.org/10.1332/174426412X620128>
- Bayliss H, Stewart G, Wilcox A, Randall N (2013) A perceived gap between invasive species research and stakeholder priorities. *NeoBiota* 19: 67–82, <https://doi.org/10.3897/neoBiota.19.4897>
- Boiral O (2002) Tacit knowledge and environmental management. *Long Range Planning* 35: 291–317, [https://doi.org/10.1016/S0024-6301\(02\)00047-X](https://doi.org/10.1016/S0024-6301(02)00047-X)
- Blackburn TM, Lockwood JL, Cassey P (2009) Avian invasions. Oxford: Oxford University Press, 320 pp, <https://doi.org/10.1093/acprof:oso/9780199232543.001.0001>
- Caffrey JM, Baars, J-R, Barbour JH, Boets P, Boon P, Davenport K, Dick JTA, Early J, Edsman L, Gallagher C, Gross J, Heinimaa P, Horrill C, Hudin S, Hulme PE, Hynes S, MacIsaac HJ, McLoone P, Millane M, Moen TL, Moore N, Newman J, O'Conchuir R, O'Farrell M, O'Flynn C, Oidtmann B, Renals T, Ricciardi A, Roy H, Shaw R, Weyl O, Williams F, Lucy FE (2014) Tackling Invasive Alien Species in Europe: the top 20 issues. *Management of Biological Invasions* 5: 1–20, <https://doi.org/10.3391/mbi.2014.5.1.01>
- Cassey P, Blackburn TM, Duncan RP, Lockwood JL (2005) Lessons from the establishment of exotic species: A meta-analytical case study using birds. *Journal of Animal Ecology* 74: 250–258, <https://doi.org/10.1111/j.1365-2656.2005.00918.x>
- CBD (2010) Aichi Biodiversity Target 9 of the Strategic Plan for Biodiversity 2011–2020. Tenth meeting of the Conference of the Parties to the Convention on Biological Diversity, 18–29 October 2010, Nagoya, Aichi Prefecture, Japan, <https://www.cbd.int/sp/targets/rationale/target-9/> (accessed March 6th, 2017)
- CDB (2016) Convention on Biological Diversity, Programme of work in Invasive Alien Species, <https://cbd.int/invasive/> (accessed March 6th, 2017)
- Claeys C, Mieulet E (2013) The spread of Asian tiger mosquitoes and related health risks along the French Riviera: An analysis of reactions and concerns amongst the local population. *International Review of Social Research* 2: 151–173, <https://doi.org/10.1515/irsr-2013-0015>
- Claeys C, Thiann-Bo Morel M (2015) L'apport de la sociologie à l'analyse des invasions biologiques: retour d'expériences et pistes de recherche pour dépasser déceptions méthodologiques et irritation épistémologiques. *Revue d'Ecologie, Terre et Vie, Société nationale de protection de la nature* 70: 175–190, <https://hal-amu.archives-ouvertes.fr/hal-01449980/document> (accessed July 20th, 2017)
- Clavero M, García-Berthou E (2005) Invasive species are a leading cause of animal extinctions. *Trends in Ecology & Evolution* 20: 110, <https://doi.org/10.1016/j.tree.2005.01.003>
- Cliff N, Campbell ML (2012) Perception as a tool to inform aquatic biosecurity risk assessments. *Aquatic Invasions* 7: 387–404, <https://doi.org/10.3391/ai.2012.7.3.010>
- Courchamp F, Fournier A, Bellard C, Bertelsmeier C, Bonnaud E, Jeschke JM, Russell JC (2017) Invasion Biology: Specific Problems and Possible Solutions. *Trends in Ecology & Evolution* 32: 13–22, <https://doi.org/10.1016/j.tree.2016.11.001>
- Drescher M, Perera A, Johnson C, Buse L, Drew C, Burgman M (2013) Toward rigorous use of expert knowledge in ecological research. *Ecosphere* 4: 83, <https://doi.org/10.1890/ES12-00415.1>
- Dutartre A (2004) De la régulation des plantes exotiques envahissantes à la gestion des hydrosystèmes. *Ingénieries* numéro spécial: 87–100, <http://www.set-revue.fr/sites/default/files/articles-eat/pdf/DG2004-PUB0016655.pdf> (accessed July 20th, 2017)
- Dutartre A, Menozzi MJ (2008) De la gestion des plantes aquatiques envahissantes: intervenir pour quoi, pour qui, avec quelles modalités? Ou comment agir malgré la variabilité des situations et des enjeux: application à la gestion des Jussies. In: Allard P, Fox D, Picon B (eds), Incertitude & environnement: la fin des certitudes scientifiques. EDISUD, Aix en Provence, pp 371–382, http://www.ecologie-humaine.eu/DOCUMENTS/SEH_Incertitude/Incertitude_32_Dutartre&Menozzi.pdf (accessed July 20th, 2017)
- Dutartre A, Mazaubert E, Poulet N (2012a) Le groupe «Invasions biologiques en milieux aquatiques»: origines, réalisations, perspectives. *Sciences Eaux et Territoires* 6: 12–17, <http://www.set-revue.fr/le-groupe-invasions-biologiques-en-milieux-aquatiques-origines-realisations-perspectives> (accessed March 6th, 2017)
- Dutartre A, Mazaubert E, Poulet N (2012b) Comment gérer les espèces exotiques envahissantes? *Sciences Eaux et Territoires* 6: 12–17, <http://www.set-revue.fr/comment-gerer-les-especes-exotiques-envahissantes> (accessed July 20th, 2017)
- Dutartre A, Quenault F (2016) Gérer les espèces exotiques envahissantes: apports du GT IBMA. Rencontre Sciences-Gestion «Pour concilier biodiversité fonctionnement écologiques et usages des plans d'eau». Aix-en-Provence, France, nov 22–23 2016, http://www.onema.fr/sites/default/files/pdf/13_DUTARTRE-QUENAULT.pdf (accessed March 6th, 2017)
- Early R, Bradley BA, Dukes JS, Lawler JJ, Olden JD, Blumenthal DM, Gonzalez P, Grosholz ED, Ibañez I, Miller LP, Sorte CJB, Tatem AJ (2016) Global threats from invasive alien species in the twenty-first century and national response capacities. *Nature Communications* 7: 12485, <https://doi.org/10.1038/ncomms12485>
- Ericsson K (1996) The acquisition of expert performance: an introduction to some of the issues. In: Ericsson K (ed), The road to excellence: the acquisition of expert performance in the arts and sciences, sports, and games, Erlbaum, Mahwah, New Jersey, pp 1–50
- Esler KJ, Prozesky H, Sharma GP, McGeoch M (2010) How wide is the “knowing-doing” gap in invasion biology? *Biological Invasions* 12: 4065–4075, <https://doi.org/10.1007/s10530-010-9812-x>
- Genovesi P, Carboneras C, Vila M, Walton P (2015) EU adopts innovative legislation on invasive species: a step towards a global response to biological invasions? *Biological Invasions* 17: 1307–1311, <https://doi.org/10.1007/s10530-014-0817-8>
- Gibbons P, Zammit C, Youngentob K, Possingham HP, Linden-mayer DB, Bekessy S, Burgman M, Colyvan M, Considine M, Felton A, Hobbs RJ, Hurley K, McAlpine C, McCarthy MA, Moore J, Robinson D, Salt D, Wintle B (2008) Some practical suggestions for improving engagement between researchers and policymakers in national resource management. *Ecological Management & Restoration* 9: 182–186, <https://doi.org/10.1111/j.1442-8903.2008.00416.x>
- Hauray J, Coudreuse J, Zozec M, Damien J.-p, Bottner B, Maisonneuve J.-I, Matrat R, Lambert E, Dutartre A (2013) Les jussies: de nouvelles adventices dans les prairies inondables. Colloque Macrophytes. Bordeaux, France, 28–30 mai 2013, <http://prodinra.inra.fr/?locale=fr#!ConsultNotice:277786> (accessed July 20th, 2017)
- Heger T, Pahl AT, Botta-Dukát Z, Gherardi F, Hoppe C, Hoste I, Jax K, Lindström L, Boets P, Haider S, Kollmann J, Wittmann MJ, Jeschke JM (2013) Conceptual Frameworks and Methods for Advancing

- Invasion Ecology. *Ambio* 42: 527–540, <https://doi.org/10.1007/s13280-012-0379-x>
- Hulme PE (2006) Beyond control: wider implications for the management of biological invasions. *Journal of Applied Ecology* 43: 835–847, <https://doi.org/10.1111/j.1365-2664.2006.01227.x>
- IUCN France (2015) Synthèse des assises nationales «Espèces exotiques envahissantes: vers un renforcement des stratégies d'action» - Orléans, 23, 24 et 25 septembre 2014. Paris, France, 77 pp, http://ui.cn.fr/wp-content/uploads/2015/11/Synthese_assises_nationales_EEE_2014.pdf (accessed March 6th, 2017)
- Kowarik I (2003) Human Agency in Biological Invasions: Secondary Releases Foster Naturalisation and Population Expansion of Alien Plant Species. *Biological Invasions* 5: 293–312, <https://doi.org/10.1023/B:BINV.000005574.15074.66>
- Kühn I, Kowarik I, Kollmann J, Starfinger U, Bacher S, Blackburn TM, Bustamante RO, Celesti-Grapow L, Chytrý M, Colautti RI, Essl F, Foxcroft LC, García-Berthou E, Gollasch S, Hierro J, Hufbauer RA, Hulme PE, Jarošík V, Jeschke JM, Karrer G, Mack RN, Molofsky J, Murray BR, Nentwig W, Osborne B, Pyšek P, Rabitsch W, Rejmánek M, Roques A, Shaw R, Sol D, van Kleunen M, Vilà M, von der Lippe M, Wolfe LM, Penev L (2011) Open minded and open access: introducing NeoBiota, a new peer-reviewed journal of biological invasions. *NeoBiota* 9: 1–12, <https://doi.org/10.3897/neobiota.9.1835>
- 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, Helmisaari H, Panov VE (2016) INVASIVESNET towards an International Association for Open Knowledge on Invasive Alien Species. *Management of Biological Invasions* 7: 131–139, <https://doi.org/10.3391/mbi.2016.7.2.01>
- Lodge DM (1993) Biological invasions: lessons for ecology. *Trends in Ecology & Evolution* 8: 133–137, [https://doi.org/10.1016/0169-5347\(93\)90025-K](https://doi.org/10.1016/0169-5347(93)90025-K)
- Nicolas H, Martin S, Bottner B, Haury J (2011) Mapping and monitoring of an aquatic invasive plant (*Ludwigia grandiflora*) with multispectral remote sensing in a large wetland in West of France. 3rd International Symposium on Environmental Weeds and Invasive Plants, Ascona, Switzerland, October 2–7, 2011, 5 pp
- Nentwig W, Mebs D, Vilà M (2017) Impact of Non-native Animals and Plants on Human Health. In: Vilà M, Hulme PE (eds), Impact of Biological Invasions on Ecosystem Services, Invading Nature - Springer Series in Invasion Ecology. Springer International Publishing, pp 277–293, https://doi.org/10.1007/978-3-319-45121-3_18
- Martin TG, Burgman MA, Fidler F, Kuhnert PM, Low-Choy S, McBride M, Mengersen K (2012) Eliciting Expert Knowledge in Conservation Science. *Conservation Biology* 26: 29–38, <https://doi.org/10.1111/j.1523-1739.2011.01806.x>
- Matzek V, Covino J, Funk JL, Saunders M (2014) Closing the Knowing-Doing Gap in Invasive Plant Management: Accessibility and Interdisciplinarity of Scientific Research. *Conservation Letters* 7: 208–215, <https://doi.org/10.1111/conl.12042>
- Matzek V, Pujale M, Cresci S (2015) What Managers Want From Invasive Species Research Versus What They Get. *Conservation Letters* 8: 33–40, <https://doi.org/10.1111/conl.12119>
- Millennium Ecosystem Assessment (2005) Ecosystems and Human Well-being: Synthesis. Island Press, Washington, DC, 155 pp, <http://www.millenniumassessment.org/documents/document.356.aspx.pdf> (accessed March 6th, 2017)
- Menozi MJ, Dutartre A (2007) Gestion des plantes envahissantes: limites techniques et innovations sociotechniques appliquées au cas des jussies. *Ingénieries-EAT, IRSTEA*, pp 49–63, <https://hal.archives-ouvertes.fr/hal-00601910/document> (accessed July 20th, 2017)
- Menozi MJ, Pellegrini P (2012) La gestion des espèces exotiques envahissantes: de la recherche d'une solution technique à la construction d'un collectif. *Sciences Eaux Territoires* 6: 106–113, <http://www.set-revue.fr/la-gestion-des-especes-exotiques-envahissantes-de-la-recherche-dune-solution-technique-la> (accessed March 6th, 2017)
- Muller S (coord) (2017) Stratégie nationale relative aux espèces exotiques envahissantes. Ministère de l'environnement, de l'énergie et de la mer, en charge des relations internationales sur le climat, Direction générale de l'aménagement, du logement et de la nature, 44 pp, http://www.ecologique-solidaire.gouv.fr/sites/default/files/17039_Strategie-nationale-especes-exotiques-invahissantes.pdf (accessed July 20th, 2017)
- Pullin A, Knight T (2005) Assessing conservation management's evidences base: a survey of management-plan compilers in the United Kingdom and Australia. *Conservation Biology* 19: 1989–1996, <https://doi.org/10.1111/j.1523-1739.2005.00287.x>
- Roux D, Rogers K, Biggs H, Ashton P, Sergeant A (2006) Bridging the science-management divide: moving from unidirectional knowledge to knowledge interfacing and sharing. *Ecology and Society* 11: 4, <https://doi.org/10.5751/ES-01643-110104>
- Sarat E, Mazaubert E, Dutartre A, Poulet N, Soubeyran Y (2015a) Invasive alien species in aquatic environments. Practical information and management insights. Volume 1. Practical information. Onema. Knowledge for action series, 240 pp, <http://www.gt-ibma.eu/group-activities/best-practices-guide/?lang=en> (accessed March 6th, 2017)
- Sarat E, Mazaubert E, Dutartre A, Poulet N, Soubeyran Y (2015b) Invasive alien species in aquatic environments. Practical information and management insights. Volume 2. Management insights. Onema. Knowledge for action series, 252 pp, <http://www.gt-ibma.eu/group-activities/best-practices-guide/?lang=en> (accessed March 6th, 2017)
- Schindler S, Bayliss HR, Essl F, Rabitsch W, Follak S, Pullin AS (2016) Effectiveness of management interventions for control of invasive Common ragweed *Ambrosia artemisiifolia*: a systematic review protocol. *Environmental Evidence* 5: 11, <https://doi.org/10.1186/s13750-016-0062-y>
- Simberloff D, Martin J-L, Genovesi P, Maris V, Wardle DA, Aronson J, Courchamp F, Galil B, García-Berthou E, Pascal M, Pyšek P, Sousa R, Tabacchi E, Vilà M (2013) Impacts of biological invasions: what's what and the way forward. *Trends in Ecology & Evolution* 28: 58–66, <https://doi.org/10.1016/j.tree.2012.07.013>
- Soubeyran Y, Meyer J-Y, Lebouvier M, Thoisy BD, Lavergne C, Urtizberea F, Kirchner F (2014) Dealing with invasive alien species in the French overseas territories: results and benefits of a 7-year Initiative. *Biological Invasions* 17: 545–554, <https://doi.org/10.1007/s10530-014-0766-2>
- Sutherland WJ, Pullin AS, Dolman PM, Knight TM (2004) The need for evidence-based conservation. *Trends in Ecology & Evolution* 19: 305–308, <https://doi.org/10.1016/j.tree.2004.03.018>
- Tabacchi E, Planty-Tabacchi AM (2010) Espèces introduites et invasions: le point de vue de l'écosystème et celui des usagers. In: Bertrand J-C, Bonis A, Caquet T, Franc A, Garnier E, Olivieri I, Thébaud C, Roy J (eds) (2010) Ecologie 2010, colloque national d'écologie scientifique. Montpellier, France, Septembre 2–4, 2010, Société Française d'Ecologie, pp 190, <http://prodinra.inra.fr/?id=8DAA78B9-62E7-4067-81DB-0F1B40C1A940> (accessed July 20th, 2017)
- Shaw J, Wilson R, Richardson D (2010) Initiating dialogue between scientists and managers of biological invasions. *Biological Invasions* 12: 4077–4083, <https://doi.org/10.1007/s10530-010-9821-9>
- Young JC, Waylen KA, Sarkki S, Albon S, Bainbridge I, Balian E, Davidson J, Edwards D, Fairley R, Margerison C, McCrecken D, Owen R, Quine CP, Stewart-Ropper C, Thompson D, Tinch R, Van den Hove S, Watt A (2014) Improving the science-policy dialogue to meet the challenges of biodiversity conservation: having conversations rather than talking at one-another. *Biodiversity and Conservation* 23: 387–404, <https://doi.org/10.1007/s10531-013-0607-0>