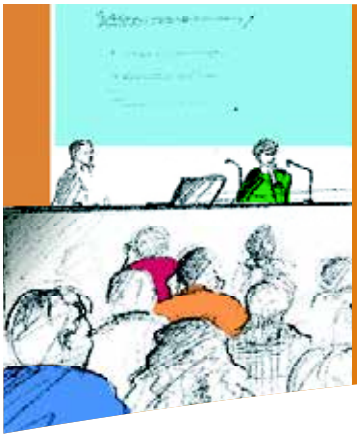
No. 74
JULY
2020



Meetings

Biosecurity : the key to preventing biological invasions in freshwater and marine environments

This is a summary of the two-day cross-border information exchange held on 16 and 17 May 2019 in Concarneau, Brittany. The event was co-organised by the French Invasive Alien Species Resource Centre (which is co-managed by the IUCN French committee and the French Biodiversity Agency[1]) and the Animal and Plant Health Agency of Great Britain, who are leading the EU-funded RAPID LIFE project.

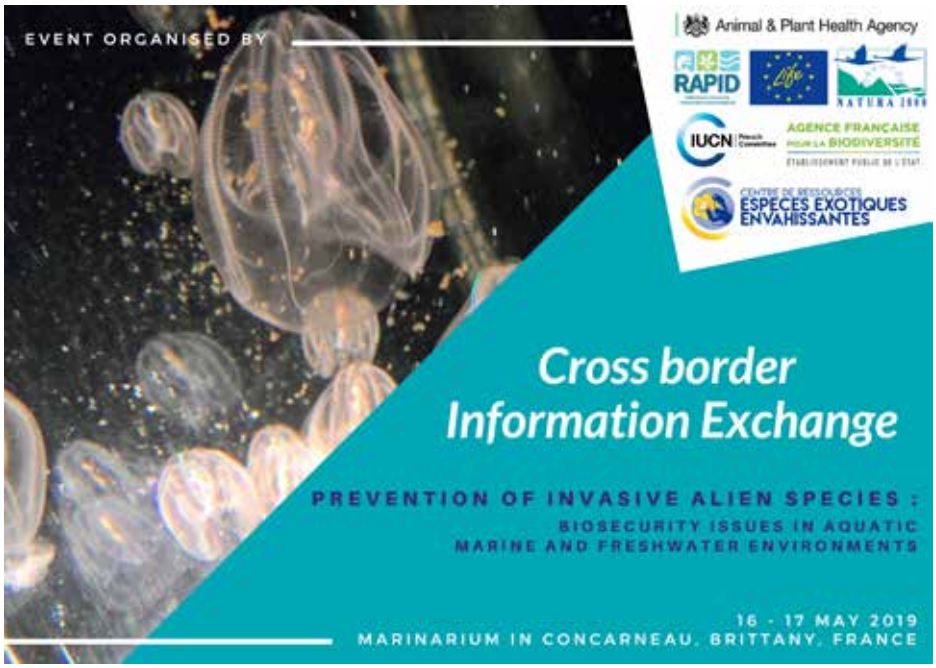
The event brought together some 50 participants from the UK, Belgium, France and Ireland. The topic was the use of biosecurity measures in freshwater and marine environments to prevent biological invasions. Exchanging information on experience and good practice between these countries helped to identify potential collaborations and make recommendations.

Invasive alien species (IAS) are acknowledged to be one of the main causes of biodiversity loss worldwide. They can also affect economic activities and human health. Over the past two centuries, as commerce has grown and the movement of goods and people has accelerated, the rate of introductions has increased significantly.

There are several international preventative measures to control introduction pathways. These include the International Convention for the Control and Management of Ships' Ballast Water and Sediment and the EU IAS regulation. However, to ensure maximum effectiveness, these measures need to be implemented at every organisational level and at every geographic scale, because anybody interacting with the natural environment can unintentionally transport and introduce IAS.

Biosecurity measures are already in place in the UK and Ireland, but no coordinated measures for aquatic environments have, as yet, been set up in continental France or in the majority of France's overseas territories.

Collective awareness of the risks involved is necessary in order to improve the situation in this field. The British team leading the RAPID LIFE project and the French team managing the IAS Resource Centre co-organised this two-day cross-border information exchange in order to discuss the issues, encourage stakeholders to assume responsibility for preventing biological invasions, share information on European projects and launch collaborations.



[1]On 1 January 2020, AFB and the National Agency for Hunting and Wildlife merged to form the new French Biodiversity Agency (OFB).

Myriam Dumortier, EU Commission, DG Environment

"Exchanging ideas and experience and working together are the best ways to ensure the success of a European policy."
To limit unintentional introductions of IAS, EU Member States need to set up biosecurity measures and action plans for introduction pathways, under the EU IAS regulation. Preventative action is all the more important for marine IAS, given that management measures are much more difficult and complex to implement once the species have become established.
The exchange of good practice and project feedback between European countries, as proposed by RAPID LIFE and the IAS Resource Centre, is a source of inspiration and mutual benefit. This type of work should be encouraged to initiate effective regional cooperation when it comes to dealing with introduction pathways, which may be shared by several Member States.

What is biosecurity?

According to the FAO (2007), biosecurity is an integrated, strategic approach to managing risks to the lives and health of people, animals and plants and to the environment. It covers food safety, zoonoses, the introduction of harmful organisms, the introduction of plant and animal diseases, the spread of living modified organisms (LMOs) and **the introduction and management of IAS**.
It includes all measures aimed at preventing contamination, environmental pollution and biodiversity loss. Biosecurity includes pre-border monitoring (identification of potential threats), border controls (inspections of imports) and post-border measures (coordinated detection and reaction to threats).

Species transfers and unintentional introductions[2]

Ballast water, used to stabilise ships when travelling with no load, contains plants and animals drawn in during loading and represents the most serious vector for introductions across the planet. In France, over 20 million cubic metres of ballast water are pumped back into the sea each year. Patrick Le Mao (Ifremer) noted during his presentation that commercial and recreational maritime activities also result in significant biofouling (Figure 1), i.e. the growth of organisms on the hulls of ships. Trade in shellfish and aquaculture have also produced intentional introductions (e.g. the slipper limpet, the Japanese littleneck clam and wakame seaweed) as well as unintentional introductions. One example is *Rapana venosa*, the veined rapa whelk, a gastropod mollusc that is thought to have been introduced *via* shellfish from the Adriatic Sea. Some commercial species that are regularly transported in most marine regions, such as true oysters, have also served as effective vectors for the introduction of numerous organisms.

The large increase in recreational boating has led to the creation of a wide range of man-made structures that facilitate the establishment of IAS, such as mooring blocks, floating piers and anchoring chains. This is an important economic sector – in the UK, for example, there are over 256 marinas, 50 000 berths and over 540 000 pleasure craft, and the sector represents over 31 000 jobs and generates more than 3.5 billion euro per year. In order to improve our understanding of the role of recreational boating in the dispersal of IAS and to identify the main species being introduced in this way, rapid assessment surveys were carried out in 81 marinas in the UK. The results of the three-year survey of approximately 20 IAS, presented by John Bishop (Marine Biological Association), indicate a 30% increase in their occurrence. As for biofouling, at least four IAS were observed on all 72 of the boats monitored. Species were also observed being transferred between France and the UK. For example, *Asterocarpa humilis*, the compass sea squirt, is an ascidian that was introduced to France in 2005 and was subsequently detected in the UK in 2009.

Transfers of species from one country to another have also been observed in freshwater environments. In France, for example, 36% of non-native fish species were introduced deliberately for recreational fishing, 15% are the result of accidental introductions, and 11% were introduced for aquaculture purposes[3]. The movement of people, such as anglers and boaters, from one aquatic environment to another can result in the transport of IAS, *via* plant fragments or animals attached to boats and fishing equipment (e.g. waders and nets). To assess the role of recreational fishing in the unintentional transfer of IAS between the UK and other European countries, Emily Smith (University College London & Angling Trust) surveyed British anglers[4]. The results indicated that 54% go on fishing vacations at least once each year and that France is the preferred destination. At the 34 fishing locations in France that were visited by British anglers, 19 aquatic IAS, including 8 species regulated by the EU and 4 species not yet recorded in the UK, were detected (Figure 2). Anglers from up to eight different nationalities could be encountered at just one of these sites and very few were aware of the problems caused by IAS or the role they could unintentionally play in spreading them. Only a small minority of the anglers cleaned their equipment before returning to their country or going on to another site. The facilities required to clean equipment were also rare.

[2]See the review of current knowledge on marine biological invasions and the implications for management drafted by the IAS Resource Centre in 2019.
[3]Keith, P. & Allardi, J. (1997). Bilan des introductions des poissons d'eau douce en France. Bulletin Français de la Pêche et de la Pisciculture, (344-345), 181-191.
[4]Smith, E. R. C., Bennion, H., Sayer, C. D., Aldridge, D. C. & Owen, M. (2020). Recreational angling as a pathway for invasive non-native species spread: awareness of biosecurity and the risk of long distance movement into Great Britain. Biological Invasions, 22(3), 1135-1159.

Figure 1. Biofouling on the motor of a pleasure boat.

Knowledge to monitor and prevent introductions

The best way to limit new biological invasions is to reduce the unintentional transport of species. Examples of successful IAS management are rare[5] for freshwater environments and even rarer for marine waters.[6] This is due to species being identified too late, the ineffective management of dispersal vectors and a lack of knowledge of species' life histories. This allows species to spread rapidly, particularly in marine environments where dispersal is easy. There is a general consensus that early detection and rapid intervention is important, particularly at introduction locations.

Knowledge on introduced species

Prevention relies on the monitoring and early detection of marine IAS, but the necessary methods and equipment have to be available. The monitoring programme[7] for marine non-native species (NNS, another term for 'alien species') required by the EU Marine Strategy Framework Directive has proposed a pressure descriptor (D2) based on the number of NNS, their abundance and range.

To date, in European waters, approximately 1 460 NNS have been recorded. However, the monitoring scheme suffers from several knowledge gaps and observation biases due, among other things, to a decline in taxonomic competency, the high number of cryptic species and the difficulty of identifying species at the larval stage. Further problems include difficulties with accessing environments and the large number of samples that require expensive analysis.

In addition to standard taxonomic techniques, molecular tools are currently being developed. Frédérique Viard, from the Roscoff Marine Station (CNRS), gave a presentation on these at the exchange day. Barcoding, for example, is a technique based on the molecular signature that is specific to each species. This technique made it possible to detect a solitary ascidian *(Asterocarpa humilis)* for the first time in the English Channel and to detect the arrival of the ctenophore *Mnemiopsis leydii* in English waters, as explained by Elvire Antajan (Ifremer) in her presentation. This technique is also capable of distinguishing between cryptic species and of differentiating between native and introduced species. Unlike barcoding, metabarcoding is based on the molecular signature specific to a taxonomic group (e.g. diatoms) and can be used to

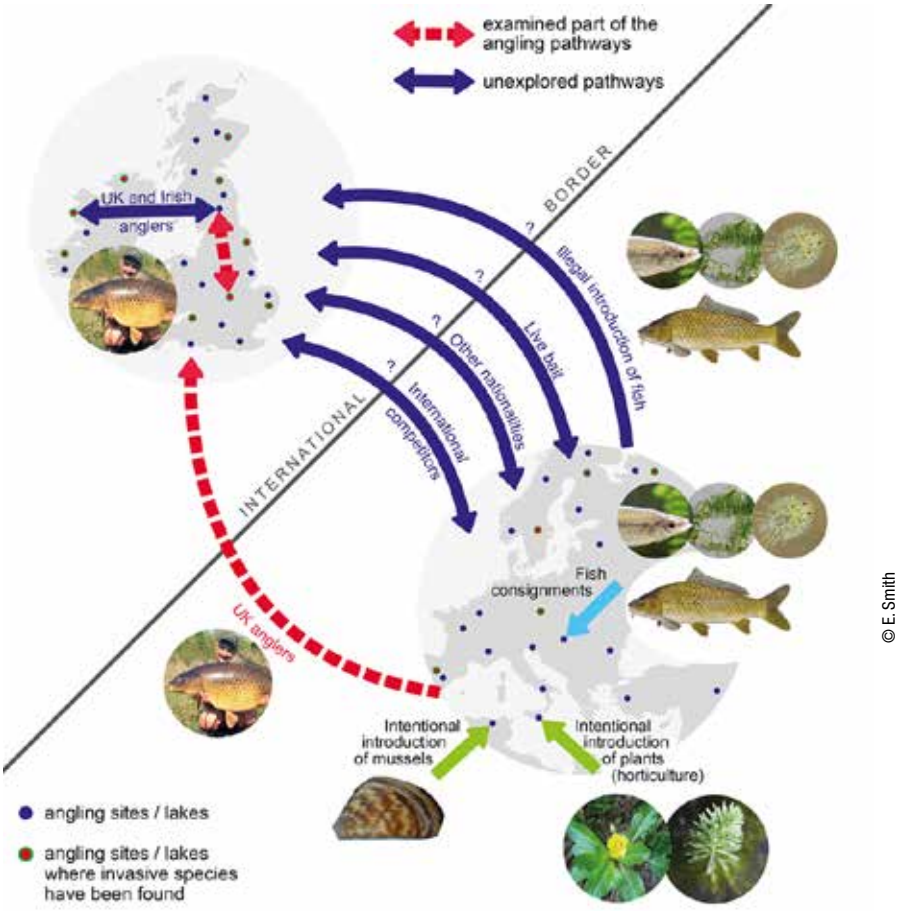


Figure 2. Map showing the transfers of non-native freshwater species between different European countries via fishing activities, based on the results of the surveys carried out by Emily Smith.

[5]Booy, O., Mill, A. C., Roy, H. E., Hiley, A., Moore, N., Robertson, P. & Campbell, S. (2017). Risk management to prioritise the eradication of new and emerging invasive non-native species. Biological Invasions, 19(8), 2401-2417.
[6]Ojaveer, H., Galil, B.S., Carlton, J.T., Alleway, H., Goulletquer, P., Lehtiniemi, M., et al. (2018). Historical baselines in marine bioinvasions: Implications for policy and management. PLoS ONE 13(8): e0202383.
[7]vvvSee the full article on the monitoring and management of marine species, including the discussion on the D2 pressure descriptor and the monitoring programme.

rapidly identify the presence of species belonging to that group within a particular sample.

It is now possible to apply metabarcoding to the DNA present in environments such as water or sediment (environmental DNA) and to identify the species present there. This method has the advantage of simultaneously detecting several NNS and increasing observer capacity. It could supply the information required to meet the D2 criterion of the MSFD and contribute to a more active monitoring programme targeting a limited number of NNS. There are plans to use this technique in freshwater environments for monitoring IAS, particularly mussels, amphibians, fish and some mammals[8].

Knowledge of stakeholders

In addition to improving our knowledge of species and developing monitoring techniques, in-depth knowledge of stakeholders is essential for the effective implementation of preventative measures.

In the UK, surveys of the general public and recreational users of aquatic habitats allowed their awareness of the problem to be assessed and their activities to be analysed. «Key categories» of stakeholders were identified. Specific biosecurity awareness-raising materials were then developed for each category. Rebecca Jones (APHA) presented the national Check Clean Dry campaign that was updated to create more targeted materials as part of RAPID LIFE. The campaign has over 60 partners and has included posters, leaflets, and online materials as well as stands at stakeholder events to raise awareness about biosecurity. A total of 2 800 biosecurity signs have been installed at waterbodies throughout the UK (Figure 3).

National and local government have been involved in spreading good practice and deploying biosecurity measures in the UK. England's Environment Agency, which has 10 000 employees in regular contact with natural environments, has developed biosecurity protocols for its teams in the field. In his presentation, Trevor Renals (Environment Agency) explained how training on the risks of invasion and necessary protocols, combined with the creation of a network of biosecurity officers, has contributed to employees having greater awareness of the responsibility they have for avoiding the unintentional transfer of species between sites. A biodiversity strategy was proposed in 2014 for the various areas managed by the Environment Agency. The strategy is aimed at identifying introduction pathways and zones and proposing measures to reduce risks, taking into account local needs in terms of equipment and training.

Biosecurity in action

The experiences shared from the UK and Ireland during the second part of the day highlighted several success stories in terms of raising awareness and improving practices, as well as common areas where improvements are possible. Despite the fact that existing IAS regulations allow management interventions to be accelerated, more effort is required to raise awareness of preventative measures amongst politicians.

Joe Caffrey (INVAS Biosecurity) explained that in Ireland, the health problems caused by IAS appear to be better understood by the general public and decision-makers. This was the case with crayfish plague and *Gyrodactylus salaris*, a parasite that affects Atlantic salmon.

[8]See the Meeting Recap titled Environmental DNA for biodiversity studies - the state of the art and the outlook for management (2019, in French).

Figure 3. An example of the biosecurity signs aimed at recreational boaters as part of the Check Clean Dry campaign.

A bottom-up approach is preferable to ensure the success of biosecurity campaigns. An understanding of the issues and the need to act responsibly must be developed among local stakeholders who are in daily contact with people in the field. Biodiversity protocols should be developed in partnership with key, local stakeholders to ensure correct implementation. They should take into account local issues such as the available equipment, any site-specific constraints and staffing. It is also best to opt for the simplest and most effective protocols for a given situation. For example, cleaning and drying equipment is usually sufficient to prevent the spread of IAS, but disinfection is required in cases where the transmission of pathogens needs to be avoided (e.g. crayfish plague, Chytridiomycota or parasites).

The effectiveness of the measures also needs to be assessed. What impact do the biosecurity campaigns have on stakeholder practices and on the movement of IAS? The results of Emily Smith's surveys of UK anglers between 2011 and 2018 revealed an improvement in awareness of the issues and a 44% increase in the systematic cleaning of equipment. However, the actual impact of these efforts on the movement of species remains very difficult to determine.

Recommendations for biosecurity in France

The ecological and economic issues addressed by biodiversity policies should encourage us to change our relationship with our natural environment. We can no longer assume that our presence is without risk for the biodiversity of natural habitats, nor can we disregard the role we play in dispersing IAS and pathogens when we travel between areas without taking the necessary precautions. To behave responsibly, we must profoundly modify our behaviour and accept the new constraints imposed by biosecurity protocols.
The discussion that took place between participants at the meeting, led by Niall Moore (Great Britain Non-native Species Secretariat), Alexia Fish (APHA), Emmanuelle Sarat (IUCN French committee) and François Delaquaize (French Ecology Ministry), produced several recommendations for France with respect to the prevention of biological invasions. These are :

Yohann Soubeyran, coordinator of the IAS initiative in the French overseas territories, for the IUCN French committee

«The overseas territories need to meet significant challenges in order to prevent marine biological invasions.»
In the recent status report that we published, we listed approximately 60 non-native marine species. This is most likely an underestimate, given the fact that there are too few surveys and monitoring programmes.

The rates of introduction and spread for these species will probably increase with the development of activity in ports, recreational boating, aquaculture and environmental changes.

Monitoring of hot spots (ports, marinas and marine protected areas) and a significant increase in awareness amongst people who use marine environments are still required. However, some regional governments have set up monitoring programmes at the local level. For example, Saint Pierre and Miquelon launched a collaboration with the Canadian Department of Fisheries and Oceans in 2012. We should also mention the work done by the National Nature Reserve of St. Martin, who have organised the mooring of pleasure craft in such a way as to limit the spread of Halophila stipulacea, an invasive aquatic plant. Such initiatives should be encouraged and developed further in all of France's overseas territories.

- **Propose a national biosecurity strategy,** that is developed, adopted and implemented by all of the relevant State services (ministries, customs, government agencies, etc.) and that addresses all of the impacts of IAS on biodiversity and health. Training State representatives and encouraging them to take responsibility is another way to ensure the success of biosecurity policies. The actual implementation of the strategy must include local government and stakeholders (including NGOs and the general public) to ensure maximum involvement at a local level.

- **Use existing educational materials and codes of good practice.** For example, protocols and many educational materials from the Check Clean Dry campaign have been made publicly available by the RAPID LIFE project and could easily be adapted for the French public. The EU commission, the International Maritime Organisation, the International Council for the Exploration of the Sea and the IUCN have all published codes of good practice and guidelines concerning the prevention of IAS. These documents could help form the basis for French biosecurity policy.

- **Develop awareness campaigns and biosecurity protocols** in partnership with as many stakeholders as possible. Involve existing groups and networks already working on IAS to ensure that campaigns and protocols are effectively implemented and tailored to suit each area. Involving local partners who are in contact with local people also helps to increase the success of biosecurity campaigns.

- **Identify the links between the different relevant international agreements and policies** that deal with marine and freshwater IAS (e.g. the Ballast Water Management Convention, the MSFD, the EU regulations on IAS prevention and management and on aquaculture and the OSPAR Convention) in order to take action in a coordinated and integrated manner.

- **Launch or reinforce regional cooperation** in the field of IAS prevention between EU Member States, as well as in the French overseas territories and in the main marine regions.

The high level of participation in the discussions held during the information exchange highlighted the value of cooperation in Europe when working to prevent the spread of IAS. The French IAS Resource Centre, in collaboration with its network of French and European partners, will continue to share information and disseminate know-how between countries. It will also assist in the launch of projects in France. Since the meeting, a number of

initiatives have been undertaken in France, including a poster (Figure 4) drafted by the French Sailing Federation, based on the UK's Check Clean Dry campaign, as well as efforts to raise awareness by fishing associations and a number of State services (including regional environmental services such as DDTM and DREAL). ■


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Figure 4. Biosecurity poster prepared by the French Sailing Federation, with support from the IAS Resource Centre and based on the Check Clean Dry campaign.

The RAPID LIFE project

(Reducing and Preventing Invasive Alien Species Dispersal)

The objective of this three-year project (2017-2020), part of the EU LIFE programme, is to create an innovative approach to IAS management in aquatic ecosystems (freshwater, coastal and riparian environments) in England, whilst demonstrating the efficacy of this approach for replication across Europe and sharing good practice with other European countries. Bringing together different stakeholders, RAPID LIFE has developed tools aimed specifically at improving biosecurity in marine and freshwater environments. These include the creation of awareness-raising materials, training toolkits for water resource managers and user groups, and promoting the Check Clean Dry campaign.
http://www.nonnativespecies.org/rapid

The Invasive Alien Species Resource Centre

The IAS Resource Centre is co-managed by the IUCN French committee and the French Biodiversity Agency. It provides practical assistance and contributes to reinforcing the effectiveness of IAS policies in France. Among other functions, the IAS Resource Centre researches management methods, develops training courses and disseminates knowledge, know-how and good practice to all the relevant stakeholders. These include managers of natural areas, NGOs, researchers, local governments, government agencies, State services, corporations and industry.
www.especes-exotiques-envahissantes.fr

For more information:

- Web page about the information exchange, with links to all of the presentations.
- Articles on biosecurity written by the IAS Resource Centre
  IAS and biosecurity: how to help prevent biological invasions.
  Stakeholders and the biosecurity of aquatic environments.
- Biosecurity resources provided by RAPID LIFE

RAPID INNS Management Toolkit: Freshwater Biosecurity Resources

RAPID INNS Management Toolkit: Marine Biosecurity Resources

Meetings

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Meeting organisation: Emmanuelle Sarat (IUCN French committee), Rebecca Jones and Alexia Fish (APHA), Nicolas Poulet (OFB)
Production: Parimage
Printed by: ESTIMPRIM - Printed on paper from sustainably managed forests
Published by: OFB – 5 square Félix-Nadar - 94300 Vincennes
Document available at: https://professionnels.afbiodiversite.fr/fr/rencontres
ISBN web: 978-2-38170-082-3
ISBN print: 978-2-38170-083-0
Free of cost

Animal & Plant Health Agency · RAPID · Life · NATURA 2000 · IUCN French Committee · OFB · CENTRE DE RESSOURCES ESPÈCES EXOTIQUES ENVAHISSANTES