



## Invasive species: how should this be managed in aquatic environments?

*A symposium organised jointly by Onema and Cemagref, on 12-14 October 2010*

**Exotic crayfish, bullfrogs, Japanese knotweed, primrose willows...** invasive species are one of the main pressures that ecosystems are subjected to, just like the destruction of natural habitats, pollution and overusing resources. Onema and Cemagref organised a seminar in Paris on the management of these species in aquatic environments, bringing together more than 130 researchers and managers of aquatic environments. Its objective? Provide three days for exchanging between the various stakeholders involved with these species, while also providing scientific and technical knowledge that can improve management practices.

With the increase in international exchanges, voluntary or accidental introductions of species have accelerated much faster than the progress in scientific knowledge which is indispensable in setting up effective management tools, whether entailing knowledge on the determinisms of biological invasions, their impacts and means of controlling them» as introduced by Patrick Lavarde, director of Onema, when the symposium was opened. Confronted for a long time now in the field with the difficulties caused by the presence of these invasive species, managers have already initiated many actions. Lacking knowledge on ecology of the species and on the potential intervention strategies, some of these actions have resulted in failures. So the need for genuine integrated management that takes the expectations of the various stakeholders into account is now obvious.

Continental aquatic ecosystems are particularly concerned with these

### Note

In this document, the term «invasive species» is used in the sense of «invasive alien species»

biological invasions. The European Water Framework Directive has moreover recognised the impact of invasive species as a pressure that can prevent continental waters from reaching a good ecological condition. In addition to their effects on fauna, flora and more generally on the operation of ecosystems, these introductions of species frequently have repercussions in terms of uses of the environments and sometimes on health

(ragweed, for example, responsible for many allergies). The economic consequences can also be substantial. As such, according to Myriam Dumortier of the European Commission, «the costs linked to the damage caused by invasive species and to the combative measures needed would in Europe amount to at least 12 billion euros a year». A cost for the community that is continuously increasing.



Primrose willow - *Ludwigia grandiflora*

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Red swamp crayfish - *Procambarus clarkii*

Faced with these challenges, the European Commission for two years now has been developing a European strategy concerning invasive species, based on prevention, early detection and eradication, control and confinement in the long term. Likewise, in France, the ministry in charge of sustainable development has launched a national prevention and control strategy against invasive species that have an impact on wild biodiversity in metropolitan France and overseas.

## Developing prevention

Prevention and early detection seem to be the most effective means of management as this makes it possible to prevent or limit the arrival and installation of new potentially invasive species. And it is acknowledged that once a species has established itself, it is practically impossible to eradicate it. And even confining it and limiting its numbers are still operations that are excessively complicated and expensive and often cause damage to the natural environment. This prevention must be based on regulations that make it possible to best control the exchanges of species. In this sense, the environmental code makes it possible to prohibit the introduction of non-native species into the natural environment as well as peddling, using and marketing some of them: an order L411-3 was taken concerning primrose willows in 2007 and is currently being revised in order to include new species of plants. An order concerning the fauna was published on 30 July 2010: vertebrates are specifically targeted, excluding fish which will be addressed in work in 2011.

Prevention also entails risk analysis: what is the probability of a species establishing? That it becomes invasive? What is the gravity of the potential negative effects? Risk assessment must be based on the biological and ecological knowledge that is available on the species in question and on the characteristics of the favourable habitats in the reception area. Many organisations and States, in particular New Zealand, Australia and the United Kingdom, have as such developed procedures for evaluating risks that make it possible to define the lists of species «at risk» and to prioritise the actions. To date, one of the limits as to the effectiveness of these risk analysis tools is still the lack of scientific knowledge on the invasion processes, on the ecology of the species and their

ability to adapt, and on the sensitivity of ecosystems to biological invasions. Within the framework of the national strategy concerning invasive species, the National Museum of Natural History (MNHN) and the Federation of National Botanical Conservatories (FCBN) are developing a methodology of prioritising invasive species according to the impacts on the biodiversity and to the cost/benefit ratio for their management, particularly in light of implementing national control plans. Although fundamental, this work exclusively concerns species that are already present on the territory, and as such does not form a prevention tool per se.

These assessment procedures result in providing each species with a status, in relation to its invasive potential (establishment, colonisation, impact), making it possible to compile lists of invasive species. These lists comprise a major first step in terms of involving the public authorities, professionals and other stakeholders in setting up a prevention strategy for the species.

In light of the difficulty of having standardised tools making it possible to assess the risks for all of the taxonomic groups, the national working group on biological invasions in aquatic environments (IBMA) has begun compiling a list of invasive alien species in aquatic environments, which can rely on validations from experts, scientific members or managers of the group.

### Jean-Patrice Damien, Regional Natural Park of Brière Jacques Haury, Agrocampus Ouest

#### Regional natural park of Brière: the interest of research-action combining managers and researchers

Located to the north of the Loire estuary, the Brière marshlands extend over a surface of more than 20,000 hectares. The wealth of this territory is threatened by the anthropogenic pressures and, with increasing intensity, by the alien invasive species. The phenomenon is not new: black bull-head and pumpkinseed were introduced at the beginning of the 20th century. For 20 years now, attention has been focused on the Red swamp crayfish and large-flowered primrose willow. Today, Asian knotweed, baccharis and Brazilian water milfoil, among others, are settling on the territory. The multiplication of these invasions is at the source of profound changes in the operation of ecosystems. Unprecedented trophic webs are appearing, initiating native species-invasive

species relations and relations between invasive species: consumption of primrose willow by the crayfish, which itself is prey to the sacred ibis. From observations in the field, we need to move on to evaluations in order to consider several species at the same time and to back up management choices rationally. With the French National Institute for Agricultural Research (Inra) for the Red swamp crayfish, and the institute for life, food and horticultural sciences and landscaping for primrose willow, collaboration with researchers makes it possible to better understand and quantify the processes of colonisation, assess the impacts and recommend measures for management, whether directly or indirectly. This cooperation between researchers and stakeholders in the field open new doors for integrated management of territories and species, especially alien ones.





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Field of primrose willow

## Setting up monitoring networks: an indispensable mesh

Implementing management that is effective and ecosystem compliant requires increasing the knowledge pertaining to the causes and the channels of introduction, to the state of colonisation and to the impacts of these species on the ecosystems. In this part of the approach, detecting introductions rapidly is an imperative in terms of effectiveness that can make it possible to reduce the risks of exotic species establishment at the least cost. Which stakeholders should be involved? Which monitoring methods should be implemented in the field? Which species should be monitored? How can in-the-field inventories be shared? Setting up monitoring networks raises many questions. Certain privileged entry points to the territory – canals, ports, metropolitan areas... – would be the zones to monitor with preference. In addition, identifying certain species – due to their small size, their reduced numbers or the fact that

they are not well known – requires training observers that are capable of detecting them. The skills of these observers will be one of the keys to the good operation of these networks. Using molecular biology techniques could facilitate the early detection of certain invasive alien species (see box). Finally, one of the major levers in the effectiveness of prevention and monitoring of environments is the awareness of elected officials, users and the general public as to the risks that are inherent with introducing species. With regards to this, information efforts are indispensable.

Monitoring networks have existed for several years now at various geographical and organisational levels. In the Pays-de-la-Loire region, a working group has facilitated the setting up of networks in the départements. The key to success for this type of coordination: implementing partnerships between territorial governments, associations and researchers. Another example is the invasive plant observatory set up by the Conseil Général in Charente. Data collecting, advising, event organisation and communication are the primary missions of this observatory that brings together, on the scale of a département, the water agencies, Cemagref, Onema, the departmental federation of fishing and protection for aquatic environments, technicians of the inter-municipal syndicates on rivers, Institution du fleuve Charente (Charente river institution) and the Périgord-Limousin regional natural park. On a national level, within the framework of the strategy concerning invasive species, MNHN and FCBN are currently studying a natural environment monitoring network organisation in metropolitan France.



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Japanese knotweed – *Reynoutria sp.*

**Tony Dejean, Spygen company  
Claude Miaud, University of Savoy**



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Water sampling for DNA analysis

## Molecular tools at the service of species detection in aquatic environments

Early detection is one of the major challenges in controlling invasive alien species. However, this is still difficult to carry out with conventional means of taking inventory when the species is discrete, or at low density. This difficulty could also result in prematurely stopping eradication programmes. Confronted with this situation in the framework of the study programme on the feasibility of managing bullfrog populations in southwest France, we have initiated developing methods for detecting species using molecular tools. The principle of the «Environmental DNA» method is based on detecting specific traces of DNA left by the organisms in the water, via epidermal cells, urine and faeces. This is a true genetic footprint allowing a species to be identified. We have compared this new method with the conventional inventory-taking technique (prospection during the day and listening at night). The results are striking: with the DNA technique, bullfrogs were detected in 38 ponds in the southwest, while the conventional inventory method only detected 7 ponds. We are currently developing a technique for detecting *Xenopus*, the red-eared slider turtle or other flag species such as the white-clawed crayfish. We are also working in complex ecosystems such as watercourses: a project has just begun with Onema to detect the various species of fish in watercourses.



## The contribution of social sciences to management

How can social sciences contribute to improving the management of invasive species? They require adopting a framework for reflection and observation that is wider than just the questions of a



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Flowered Japanese knotweed – *Reynoutria sp.*

technical nature, which often neglect the human incidences of the interventions. Moreover, they have tools and knowledge that may prove useful in establishing and in successfully carrying out complex management strategies. Sociologists and ethnologists are especially interested in the way in which the social stakeholders perceive and represent invasive species, as the plurality of perceptions induce

visions that are sometimes far from the management measures that are in place. They can as such be invited to understand the role of humans in the dissemination of species, in the actions undertaken, the acceptability of certain techniques for regulating species or the «disinterest» of certain social stakeholders in terms of invasive species.

The costs linked to intervention in the management of these species can be extremely high: their amount on a European level indeed shows the required financial needs. These are still difficult to evaluate. For example, in a little less than a decade, the region of Pays-de-la-Loire has devoted nearly 6 million euros in managing invasive plants. But in many cases these evaluations of expenses are yet to be carried out. As such, economists can shed some light on the monetary as well as the non-monetary costs of the damage to the ecosystem services and to the human activities that stem from it (farming, fishing, recreational activities). The economics can also take the form of a «science of arbitrages», by providing assistance in specifying the technical choices for management and in defining the most optimal interventional and control policies using the cost/benefit approach of implementing them. Finally, it can assist in developing incentive measures for modifying certain human behaviours at the origin of species introduction or which favour propagation.

These disciplines are intended to facilitate dialogue between stakeholders and as such contribute in developing a shared vision.



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Uprooting of primrose willow in the Brière Regional Natural Park

### Is the problem of invasive alien species solvable from a technical standpoint?

Marie-Jo Menozzi, ethnologist

The search for technical solutions, which is complex, also raises issues of a social and cultural nature. The way in which the techniques are perceived can form a brake or leverage for their use. As such, elaborated logistics had to be set up in order to facilitate the social acceptance of manually uprooting the primrose willow, perceived as a «step backwards», in relation to the use of herbicides, deemed of higher performance. In addition, the technical effectiveness is under the influence of social configurations. Problems with management often stem from the difficulty encountered by social stakeholders in defining the collective rules and in getting organised. In the Vilaine marshlands, while the experts were recommending to eliminate the primrose willow «at the source», in every nook and cranny, users found this type of action useless, when the plant didn't have any visibility in the landscape. In les Landes, the disinterest of some managers with regards to the primrose willow problem is one of the causes of its proliferation. Effective management requires analysing the role of the social configurations at work and the manner in which the social stakeholders, managers, scientists, users understand, or don't understand, each other. Most social stakeholders agree that the primrose willow should be qualified as invasive, but this is far from being the case for all of the species considered as such by scientists. On the one hand we have the experts who are wearing themselves out sounding the alarm, and on the other hand, users and managers for whom the species is invisible...

Beyond the question of «how to manage this», it would be pertinent to ask «why» it seems indispensable for us to manage these species. This brings us to territories for reflecting on the relations that we, human societies, hold with the natural environment. Social sciences then take on as a subject for study the manner in which we speak about these species, against which we must «fight» and in which we are losing hope in being able to control them. But why? What does this desire to master «nature» without fail mean? A fascinating question for representatives of sociology or anthropology.

## Intervene?

Should we intervene and how should we intervene? Until recently, aquatic environment managers were little informed of the extent of the risks of biological invasions and of scientific progress. Pressured by demands from users, they often initiated actions to reduce the damage of invasive species without waiting for guidelines or outside information and developed local intervention programmes. Faced with the emergency nature and also with the lack of pertinent contacts, potential scientific or administrative partners were hardly sought. For several years now, the situation has been changing quickly toward effective changes, based on common management objectives.

Ideally, a management approach to biological invasion should incorporate three main types of elements: up-to-date ecological knowledge on the species and the territories that it is colonising; setting up environmental monitoring making it possible to assess their dynamics and their abilities to do damage and to specify the effectiveness of the management measures that are applied; and finally, selecting the technical means for intervening on these species, intended to eliminate or regulate the populations involved, organised in the context of a sector, based on existing regulations that include assessments of the impacts generated by implementing them.

Various assessments and surveys have been conducted for fifteen years now in order to evaluate the extent of plant colonisation in aquatic environments (native or alien species) but, in most cases, these are not complete, as they

## Preliminary results of the survey on invasive aquatic species and their management in aquatic environments in metropolitan France

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At the end of 2009, the national working group on biological invasions in aquatic environments (IBMA) has started a survey on invasive alien species in aquatic environments and how they are managed in metropolitan France. Sent to over 650 institutions, managers and users of these environments (DREAL, water agencies, regional natural parks, catchment area territorial public establishments, etc.), its aim is to better understand the objectives and characteristics of the management methods, facilitate exchange between managers and specify the distribution of the species identified and current management intervention. The first phase in this study makes it possible to collect information, especially on the stakeholders involved, the species, the environments that are colonised, the impacts and the management methods used. The

preliminary results show the importance of some of the colonisations and the extreme diversity of the management interventions. The most mentioned plant species are knotweed and primrose willows. The Robinia pseudoacacia and the buddleia are also mentioned frequently. There is less information on animal species. This primarily concerns the coypu, Black Bullhead and three species of crayfish: *Orconectes limosus*, *Pacifastacus leniusculus* and *Procambarus clarkii*. A second phase of the survey is scheduled in order to refine the results, especially with regards to the management tools and strategies and financial costs. Ultimately, the results will be enhanced through the writing of a «good practices» guide for managing invasive alien species in aquatic environments, illustrated with concrete examples of management.

are targeted only on the representations of the managers or on certain types of species or environments. That is why, within the framework of the IBMA working group, a general survey on the management of invasive alien species in aquatic environments on the scale of metropolitan France was launched at the end of 2009 (see box) as a partnership with OIEau. Intended for managers and/or users of aquatic environments, the

main objectives of this survey are to take stock of the methods for managing invasive aquatic species that are already being implemented, allow for exchanges between the managers and, in the long term, specify the location of the species and intervention in terms of management. The preliminary results of the survey indeed show the extreme diversity of the situations, including management intervention, and the extent of some of the colonisations. The diversity in the management situations was illustrated very well during the seminar through the presentation of various examples: the management of aquatic plants in the coastal lakes and ponds in Les Landes, that for primrose willows in the Poitevin marshes, crayfish in the département of Vosges, the bullfrog in Sologne, and muskrats in the département of Somme. These concrete examples of management, with specific characteristics that do not allow them to be generalised directly to other sites, are however active approaches from which much information can be drawn.



Coypu habitat

Coypu – *Myocastor coypus*



## A working group steered by Onema and Cemagref

In order to develop action strategies for improved management of biological invasions in aquatic ecosystems and suggest operational tools intended for managers and deciders, Onema and Cemagref partnered in 2008 to create a national working group on biological invasions in aquatic environments. The group also has the mission of defining the scientific challenges for the long term and contributing to national and even international expertise in this area. The group provides technical support for the ministry in charge of sustainable development in the framework of setting up the national

strategy. It brings together managers such as the water agencies, regional natural parks, services of the State – department of water and biodiversity, DREAL – and, of course, research organisations such as Inra, the National Museum of Natural History, CNRS and universities. The fruit of the reflection and work of this group, the seminar organised by Onema and Cemagref, was designed to be a time for exchange between the various stakeholders involved with invasive species, while also providing scientific and technical knowledge that can help improve management practices.



American bullfrog - *Rana catesbeina*



Signal crayfish – *Pacifastacus leniusculus*

### For more information...

<http://www.onema.fr/cr-seminaire-especes-invasives>

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