European Commission

LIFE and Invasive Alien Species

LIFE Nature

Environment

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Authors: João Pedro Silva (Nature and Biodiversity Senior Expert), Aixa Sopeña (ASTRALE GEIE Idom ES) and Jan Sliva (ASTRALE GEIE Particip DE), Justin Toland (Editor), Stephen Nottingham, Wendy Jones, Jon Eldridge, Ed Thorpe, Christophe Thévignot (ASTRALE GEIE-AEIDL, Communications Team Coordinator) **Managing Editors**: Angelo Salsi (Head of unit LIFE E.3, Environment DG, European Commission) **LIFE Focus series coordination**: Simon Goss (LIFE Communications Coordinator - Environment DG, European Commission), Valerie O'Brien (Environment DG, Publications Coordinator). **Technical assistance**: Ainhoa Darquistade Fadrique, Alberto Cozzi, An Bollen, Anastasia Koutsolioutsou, Andras Kovacs, Andrej Baca, Anita Rubene, Audrey Thenard, Camilla Strandberg-Panelius, Carlo Ponzio, Chiara Caccamo, Chiara Spotorno, Cornelia Schmitz, Cristobal Ginés, Donald Lunan, Edyta Owadowska, Ellen von Rekowski-Degott, Emilian Burdusel, Felix Bergmann, Inga Racinska, Ioana Lucaciu, Irune Oses Garcia, Isabel Silva, Itxaso Mora Garcia, Iva Rossi, Ivan Norscia, Jean-Paul Herremans, João Salgado, John Houston, Jorg Bohringer, Katerina Raftopoulou, Luule Sinnisov, Lynne Barratt, Marta Kaczynska, Maud Latruberce, Mitja Kaligaric, Neil Wilkie, Quirin Renard, Rolands Ratfelders, Ruth Brauner, Sara Luchetti, Sara Mora, Stanislaw Tworek, Stoyan Yotov, Thomas Wouters and Eric Evrard (Astrale GEIE).
The following people also worked on this issue: Maja Mikosińska (Environment DG, LIFE Nature Unit), Myriam Dumortier and Valentina Bastino (DG Environment, Unit B2 – Biodiversity) **Production**: Monique Braem (ASTRALE GEIE-AEIDL). **Graphic design**: Daniel Renders and Anita Cortés (ASTRALE GEIE-AEIDL). **Photos database**: Sophie Brynart (ASTRALE GEIE-AEIDL). **Acknowledgements**: Thanks to all LIFE project beneficiaries who contributed comments, photos and other useful material for this report. **Photos**: Unless otherwise specified; photos are from the respective projects. For reproduction or use of these photos, permission must be sought directly from the copyright holders. Cover photo: LIFE08 NAT/PL/000513/Piotr Chmielewski.

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Foreword

Photo: European Commission

Angelo Salsi
Head of the LIFE Nature Unit
Directorate-General
Environment
European Commission

The term 'invasive alien species' sounds like something from the realm of science fiction. In fact, IAS are a very real threat to Europe's native species and habitats and the important ecosystem services that nature provides. Invasive alien species also can have harmful effects on human health and on the economy, not to mention the financial costs of dealing with them.

Global trade patterns have contributed to the spread of IAS in Europe, whether through the introduction of ornamental plants or exotic pets that can be problematic if released into the wild, or through accidentally-introduced 'stowaways', such as mussels on the hulls of ships. Because invasive alien species know no borders, it is vitally important to take a trans-national approach to them. This is the rationale behind the new European Union Regulation on Invasive Alien Species, which supports the aims of the EU Biodiversity Strategy to 2020.

The new IAS Regulation is the first comprehensive legal framework for dealing with invasive alien species at EU level. It includes measures to deal with both the intentional and unintentional release of IAS, focusing on the need to identify priority species and priority pathways; to prevent invasions; to establish early warning and rapid eradication procedures; and to control and - where feasible - eradicate IAS.

This new LIFE Focus publication places LIFE's work in tackling the threat of invasive alien species within the context of the IAS Regulation. As well as highlighting the many effective and replicable management methods developed by LIFE projects across Europe, it also looks at lessons learned that can be fed into project proposals and actions for the new LIFE programme for 2014-2020. The new LIFE will put more focus on prevention and early warning (and invasion pathways), as reflected in the project topics for the thematic priorities of the LIFE work programme for 2014-17.

As the publication shows, LIFE's strength has been in the control and eradication of invasive alien species when and where they have become established and pose a threat to the survival of the species and habitats of the Natura 2000 network of protected sites. Indeed, LIFE has consistently targeted actions at some of the most pervasive IAS (as identified by the EU FP7 research project, DAISIE). However, in line with the strategic approach identified by the IAS Regulation, LIFE projects are also increasingly starting to address the need to prevent invasions in the first place, and to develop early warning and rapid response systems to deal with invasive alien species before they gain a foothold. This is not only good science, it is good economics: the cost of managing IAS once they are established is far higher than the cost of preventing them from becoming established in the first place.

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INTRODUCTION

Invasive alien species in Europe

Invasive alien species (IAS) are a growing threat to Europe's native flora, fauna, habitats and economy. A new EU Regulation sets out a framework for the prevention and management of the introduction and spread of IAS.

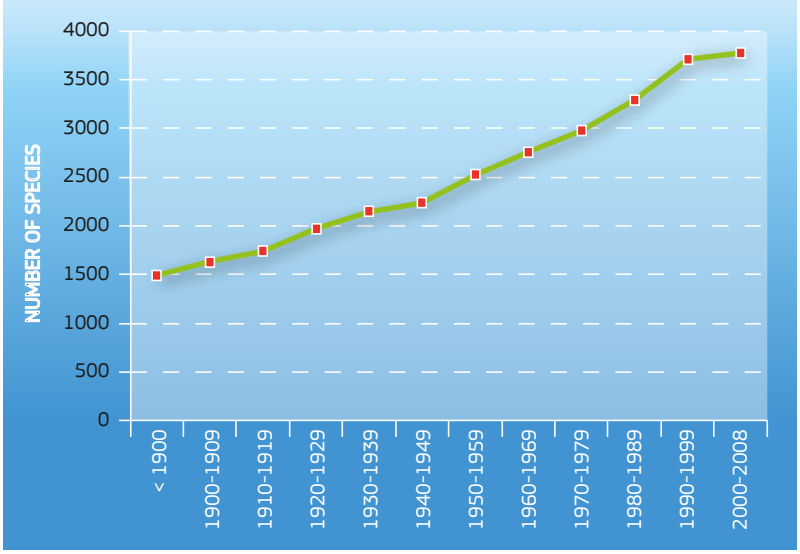
Photo: LIFE08 INF/B/000052/Emmanuel Delbart

The invasive alien plant, water primrose (Ludwigia grandiflora) was one of the species targeted by the Belgian LIFE project, AlterIAS

Invasive alien species (IAS), also known as invasive non-native species, "A species whose introduction and/or spread outside their natural past or present distribution threatens biological diversity"[1] are considered to be the second most important cause of biodiversity loss, after habitat loss and fragmentation. The cumulative number of IAS in Europe has been increasing steadily over the last 100 years (see Figure 1).

Many non-native species in the EU have been introduced intentionally. They include trees and crops from other continents that are more productive or hardier; ornamental plants for gardens; and pets. Such species do not have an impact on the environment if they are kept in confined conditions. However, such species have often escaped or have been released into the environment.

Figure 1: **Cumulative number of alien species established in terrestrial environment in 11 EU countries**



Source EEA (Invasive alien species in Europe (SEBI 010) - Assessment published May 2010)

1 *Convention on Biological Diversity definitions from COP VI/23, http://www.cbd.int/decision/cop/default.shtml?id=7197*

Photo: LIFE07 NAT/IRL/000341

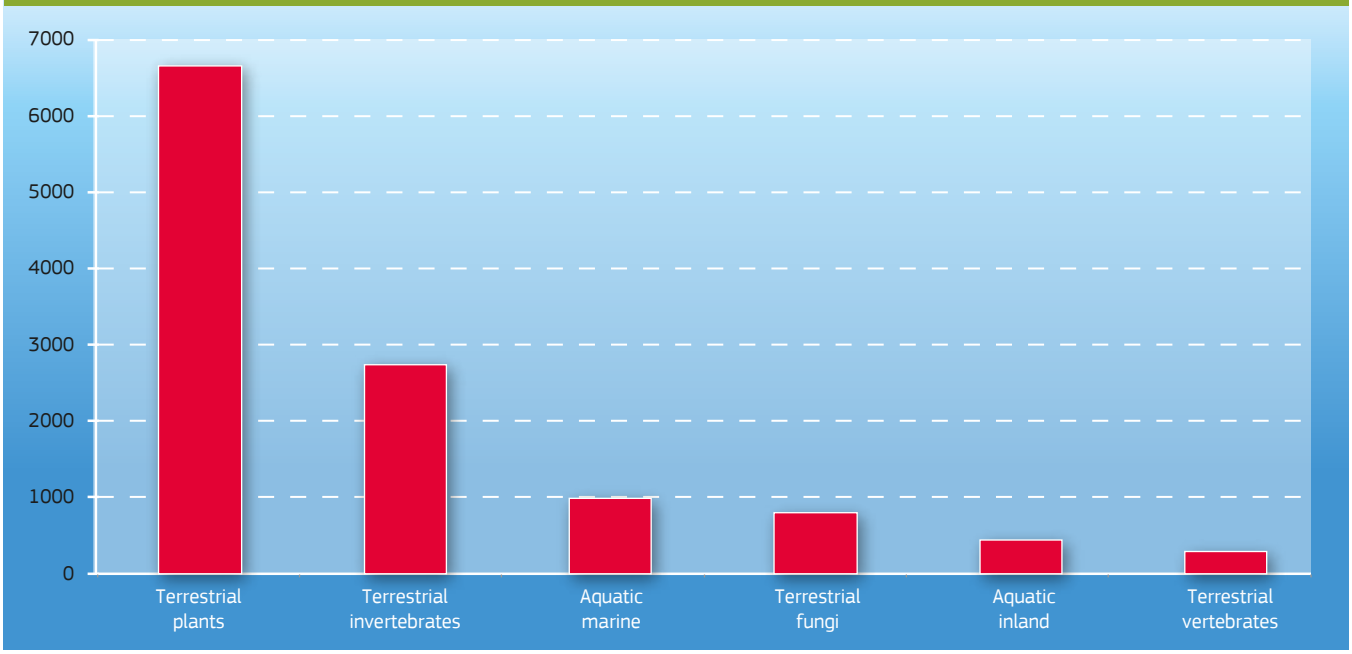
Prevention protocols, such as those developed by the CAISIE project, play a vital role in stopping the spread of invasive alien species

Other species, thanks to growing international trade and travel, have arrived accidentally, as 'stowaways' trapped in airfreight or shipping containers or "contaminants" - for instance, mussels carried on the hulls of ships. Although the majority of non-native species cause no harm, some spread very rapidly and can harm biological diversity, human health, and/or economic and aesthetic values.

According to the DAISIE[2] project, which was funded by the European Commission's Sixth Research Framework Programme, there are more than 12 000 non-native species in Europe. An estimated

2 FP6 DAISIE (Delivering Alien Invasive Species Inventories for Europe), research project funded by the European Commission, and the Centre for Ecology and Hydrology (CEH). http://www.europe-aliens.org

Figure 2. **Groups of invasive alien species in Europe (2012)**



Source: DAISIE http://www.europe-aliens.org

1 200-1 800 of these are invasive and the figure is predicted to rise with the growth in global trade and travel. Climate change is also likely to make matters worse. As the climatic conditions of some locations change, they may become more favourable to previously harmless alien species, making native species more vulnerable to invasion.

Costs to nature and society

DAISIE also showed that in Europe, as elsewhere, biological invasions can disrupt the services provided by ecosystems, with significant socio-economic consequences. IAS can, for instance, alter ecosystem processes, reduce biodiversity, change landscapes and reduce the value of land and water for human activities.

In 2012 the EEA[3] identified 14 types of IAS impacts in Europe at four different levels: biodiversity, ecosystem services, human health, and economic activities.

Impacts on biodiversity

IAS can affect biological diversity in various ways. They can pose a major threat to native species and habitats through competition, predation and transmission of diseases. Hybridisation between alien and native species is another concern, as shown by the impact of the ruddy duck on the native white-headed duck (see box).

IAS can alter the functioning of entire ecosystems. For example, the black cherry (*Prunus serotina*) is outshading the ground vegetation and preventing rejuvenation of native forest trees, which is having a long lasting effect on forest succession.

Island biodiversity is particularly vulnerable to the impact of invaders. The relatively small selection of species on islands and the lack of defence against mainland invasive predators put island species, birds for example, especially at risk.

Impact on ecosystem services

Ecosystems, if they are in good condition, provide a range of important services. The arrival of IAS can disrupt an ecosystem's equilibrium, alter its nature and affect the provision of services, for example, by altering water or soil quality, or interfering with pollination. One example is the water hyacinth (*Eichhornia crassipes*), an invasive plant that changes water flow by overgrowing and blocking water bodies.

3 *EEA 2012. The impacts of invasive alien species in Europe http://www.eea.europa.eu/publications/impacts-of-invasive-alien-species*

Hybrid ducks

The ruddy duck (*Oxyura jamaicensis*), a species native to North America, was brought to Europe in the 1940s. Since then it has aggressively interbred with the white-headed duck (*Oxyura leucocephala*), which is now threatened with extinction. In the UK, where there is a significant ruddy duck population, the government approved a total cull of the species. The white-headed duck breeds in Spain, North Africa and western and central Asia. A number of LIFE projects have been carried out to diminish the threats to this native duck, notably **LIFE97 NAT/F/004226** in Corsica, **LIFE00 NAT/E/007311** in the region around Valencia and **LIFE05 NAT/UK/000142** in the UK.

*Ruddy duck (*Oxyura jamaicensis*)*

Photo: Dick Daniels/CC BY-SA 3.0

Impact on human health

Some invasive alien species pose a threat to people as potential carriers of disease, and can also cause allergies and skin damage. In Europe, plants are the main culprit (mainly in terms of causing allergies), but invertebrates, reptiles and mammals are also vectors of disease. For example, the red-eared slider (*Trachemys scripta*), a popular pet turtle species, can cause outbreaks of Salmonella.

The high cost of invasions

Invasive alien species are also a major economic and social concern. A 2008 IEEP report[4], conservatively estimated the damage and control cost of IAS at some €12 billion per year in Europe. The real figure is likely to be much higher, as many countries have only recently started to document costs in relation to IAS.

4 *Kettunen, M., Genovesi, P., Gollasch, S., Pagad, S., Starfinger, U. ten Brink, P. & Shine, C. 2008. Technical support to EU strategy on invasive alien species (IAS) - Assessment of the impacts of IAS in Europe and the EU (final module report for the European Commission). Institute for European Environmental Policy (IEEP)*

A European problem

All EU Member States are affected by IAS, and almost all have taken some action to deal with the problem. However, the response has been largely reactive and has resulted in a patchwork of uncoordinated action. Once an invasive alien species becomes established in one country it can easily spread to its neighbours, highlighting the need for EU-level action to tackle the problem.

A variety of relevant EU legislation has been in force already for a few years, in particular legislation targeting plant health and animal diseases, wildlife trade (CITES) or the use of alien or locally-absent species in aquaculture. However, prior to the Regulation of the European Parliament and of the Council on the prevention and management of the introduction and spread of invasive alien species ('IAS Regulation') in 2014, there was not any comprehensive legal framework for dealing with IAS at EU level.

Stricter control of invasive alien species is one of the six main targets of the EU biodiversity strategy to 2020 adopted by the European Commission in May 2011[5]. The strategy underpins the revised EU target of "halting the loss of biodiversity and the degradation of ecosystem services in the EU by 2020 and restoring them in so far as feasible, while stepping up the EU contribution to averting global biodiversity loss." One of the stated aims of the strategy is that, "By 2020, invasive alien species and their pathways are identified and prioritised, priority species are controlled or eradicated, and pathways are managed to prevent the introduction and establishment of new IAS."

5 Our life insurance, our natural capital: an EU biodiversity strategy to 2020, COM(2011) 244 final

New EU Regulation

The European Commission thus proposed a new regulation to build on the existing instruments, and the measures already undertaken by Member States, in order to fill any remaining policy gaps and ensure a coherent legal framework for concerted action against IAS.

The IAS Regulation[6] will be an important milestone in EU efforts to halt biodiversity decline. It establishes the first European framework for national, regional and EU-wide actions that prevent, minimise, and mitigate adverse impacts from IAS. Endorsement of the legislation followed a detailed consultation and impact assessment process that took into account a diverse cross-section of options and opinions from stakeholders and Member States.

The IAS Regulation introduces coordinated actions that focus resources on priority species. Actions will be deployed in accordance with the Convention on Biological Diversity approach. The approach chosen is also similar to that of the EU's plant and animal health regimes.

The legislation includes dedicated articles on prevention, early detection and rapid eradication, and management of priority IAS. Building on existing approaches, Member States will be required to implement measures to address: intentional IAS introduction into the Union and their intentional release into the environment; and unintentional IAS introduction and release.

6 Regulation (EU) No 1143/2014 of the European Parliament and of the Council of 22 October 2014 on the prevention and management of the introduction and spread of invasive alien species

*Monitoring the impact of habitat management measures on the invasive alien Japanese knotweed (*Fallopia japonica*)*

Photo: LIFE06 NAT/CZ/000121/Lubos Halada

These measures will be accompanied by others designed to manage the spread of priority IAS, including early warning and rapid response systems, as well as measures to manage the priority IAS that are already established.

Cooperation and coordination

The new IAS policy recognises the fact that the problem will get worse without action. Stakeholder cooperation is highlighted as being vital to prevent IAS problems worsening, as is cooperation between regions and nations to ensure that resources invested in tackling IAS threats in one area are not undermined by a lack of action in a neighbouring territory.

A key goal of the new legislation is thus to eliminate fragmented approaches and promote a coherent approach at EU level to increase the effectiveness of IAS measures.

Within the framework of the Regulation a list will be drawn up of the most problematic invasive alien species - the IAS of Union concern - on the basis of detailed risk assessments. These species will require concerted action across the Union and will be the main focus of the prevention, control and eradication actions. The Regulation establishes that, once created, the list of IAS of Union concern will be updated regularly by the Commission in cooperation with the Member States. An information support system will also be developed to optimise the EU's ability for dealing with IAS. Actions on species at regional and national level are also foreseen.

Whilst the legislation is not accompanied by dedicated funds, support for implementation can be found through existing instruments (including the LIFE programme).

Preventing the spread of invasive alien species

Prevention is internationally recognised as the most effective means of tackling IAS. Hence, the Regulation emphasises the importance of preventing IAS from being introduced into the EU, or released into the environment.

The species listed as IAS of Union concern will be effectively banned from the EU, with some well-defined and regulated exceptions. Member States will thus need to ensure that the listed species are prevented from being introduced in the EU and will also be required to produce Action Plans to address pathways of unintentional introduction of IAS of Union concern. Furthermore, the IAS Regulation calls for penalties for infringements.

Photo: LIFE09 NAT/ES/000529

*LIFE has taken steps to raise awareness about the impact on native habitats and species of dumping unwanted exotic pets such as the pond slider (*Trachemys scripta spp.*)*

Early detection and rapid eradication

The Regulation proposes the use of cost effective tools for early detection of IAS, including continuous surveillance to collect data on the occurrence of IAS in the environment by survey, monitoring or other procedures and border checks. When invasive alien species are detected, notification needs to be given to the responsible authorities to trigger rapid eradication actions. In this context, information collected through any existing monitoring or surveillance scheme can also be useful to detect the presence of IAS. Training for customs services is also encouraged to facilitate detections at customs.

Managing IAS

The Regulation obliges Member States to introduce management measures for controlling already widely spread IAS of Union concern. Such measures taken to manage IAS will need to have due regard for human health and the environment and, if they are aimed at eradicating or controlling animals, they should have due regard to animal welfare. The Regulation also underlines the importance of restoring IAS damage and strengthening ecosystems' resilience towards invasions.

INTRODUCTION

LIFE helps to tackle IAS

Since 1992, LIFE has been the main source of EU funding for actions aimed at tackling the threats from invasive alien species (IAS) to species and habitats listed in the Habitats and Birds directives in Natura 2000 network sites throughout the European Union.

The LIFE programme provides a testing ground for actions aimed at tackling invasive alien species (IAS). Many LIFE projects have included specific actions dealing with the control and eradication of IAS, even if, in the majority of cases, the main objective of the projects has not been exclusively IAS management. Nevertheless, the actions of these projects have demonstrated that threats posed can be successfully addressed, especially when affecting Natura 2000 network sites, species and habitats.

Between 1992 and 2013, a total of 265 LIFE projects included measures dealing with IAS. Just over half (52%) of these either exclusively targeted invasive alien species, or included actions to tackle IAS that were relevant to achieving the main objective of the project.

The vast majority of the 265 projects have been co-funded under the LIFE Nature strand. Since 2007 (LIFE+), five LIFE Biodiversity projects have been co-funded, each principally aimed at prevention, early warning and/or control of IAS (e.g. LIFE RIPISILVA - **LIFE13 BIO/ES/001407** - which is working on Spain's Segura River. There has also been one LIFE+ Information and Communication project, AlterIAS (**LIFE08 INF/B/000052** – see pp. 21-23), as well as seven LIFE Environment projects that have included actions targeting IAS and one relevant project supported by the now defunct LIFE Third Countries (LIFE-TCY) strand (see project list, pp. 68-76).

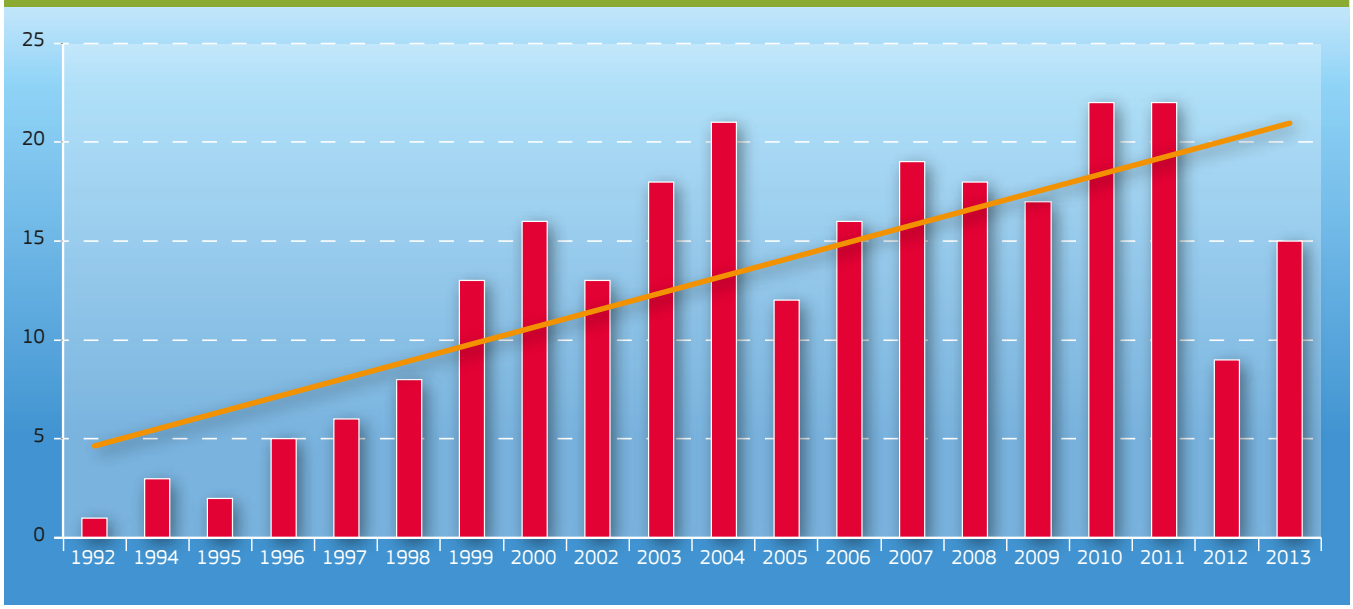
A growing focus on IAS

The number of LIFE projects including actions to tackle IAS has steadily increased over the duration

*LIFE has helped to safeguard several species and habitats listed in the Habitats and Birds directives through control and eradication actions, such as those aimed at invasive alien American mink (*Neovison vison*) populations*

Photo: LIFE00 NAT/E/007299/Angel Ayala /Diario de Burgos

Figure 1. **LIFE IAS projects per year (1992-2013)**



of the programme's existence. As Figure 1 shows, the number of such projects has increased more than threefold between LIFE I (1992-1995) and LIFE+ (2007-2013). There have been at least 10 projects with actions targeting invasive alien species every year since 1999, including 26 projects in 2011 alone.

Figure 2 shows the number of LIFE IAS projects by Member State. In line with the overall distribution of LIFE project funding, the two most represented countries are Spain and Italy (each with over 45 projects); they are followed by Belgium and the UK. Slovenia and the most recent EU entrant, Croatia, are the only two Member States that have had no IAS projects (although both were represented in a transnational LIFE-TCY project that took actions against IAS in Sava River habitats – see pp. 14-15).

The new IAS Regulation foresees a range of measures for tackling the problem: prevention; early detection and rapid eradication; and management of IAS. To date, the overwhelming majority (97%) of LIFE projects have focused on the eradication and management of IAS that have already become established, with prevention (2%) and early detection and rapid eradication (1% of projects) only recently becoming areas of concern.

Figure 2. **– IAS projects by Member State (1992-2013)**

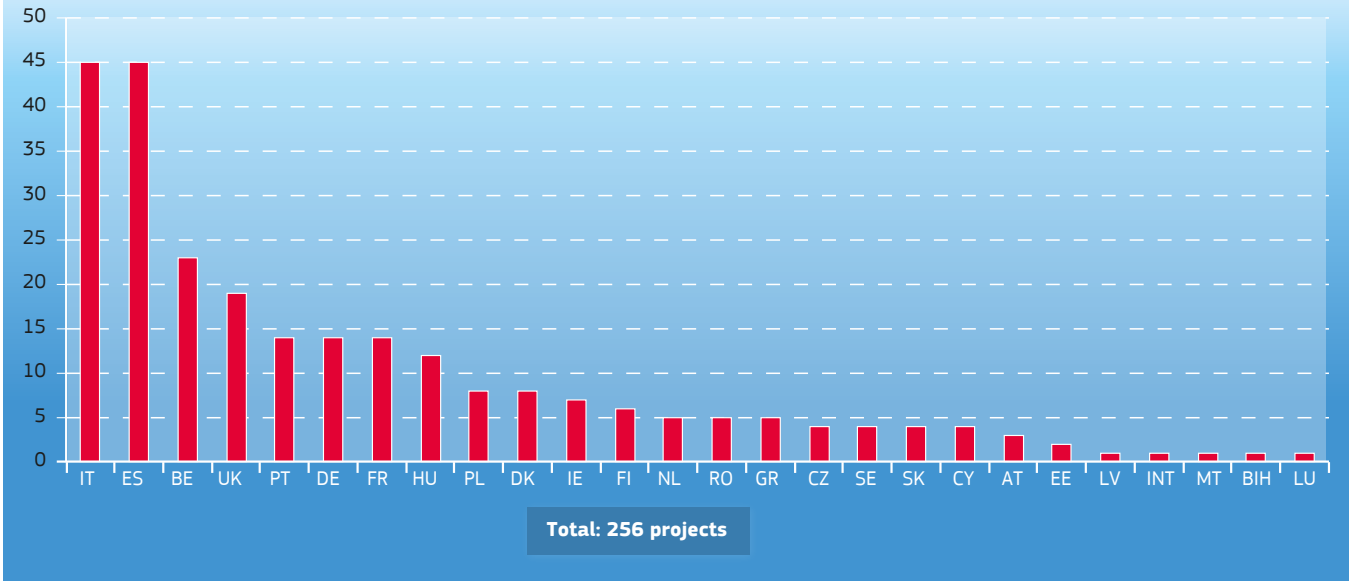
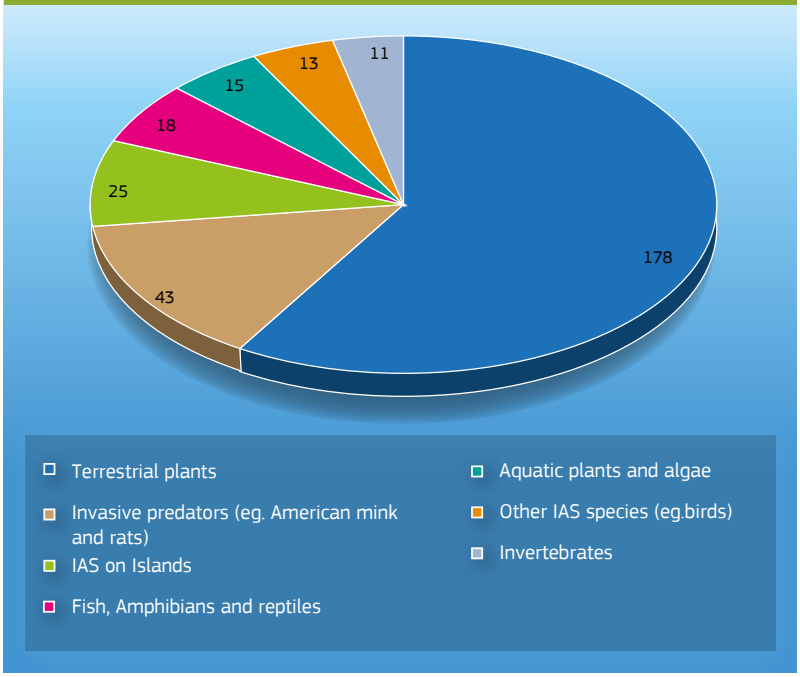


Figure 3. **Distribution of IAS eradication and management projects**



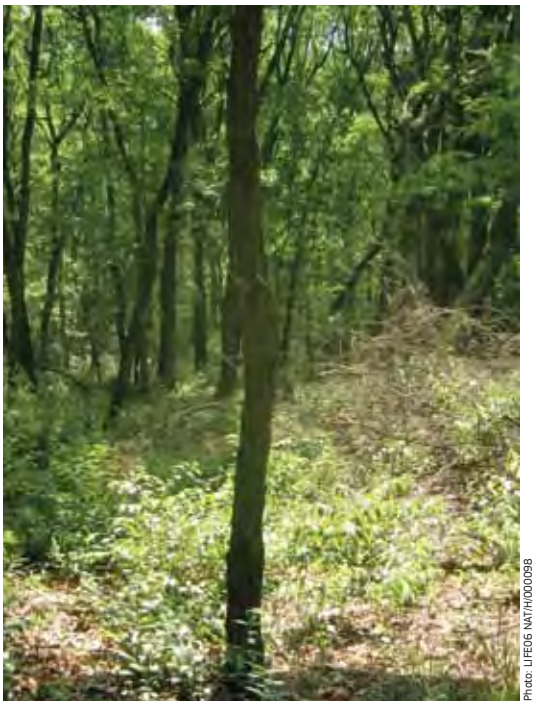


Photo: LIFE06 NAT/HI/000098

*More than 50 LIFE projects have targeted actions at the black locust (*Robinia pseudoacacia - *pictured)*

Control and eradication

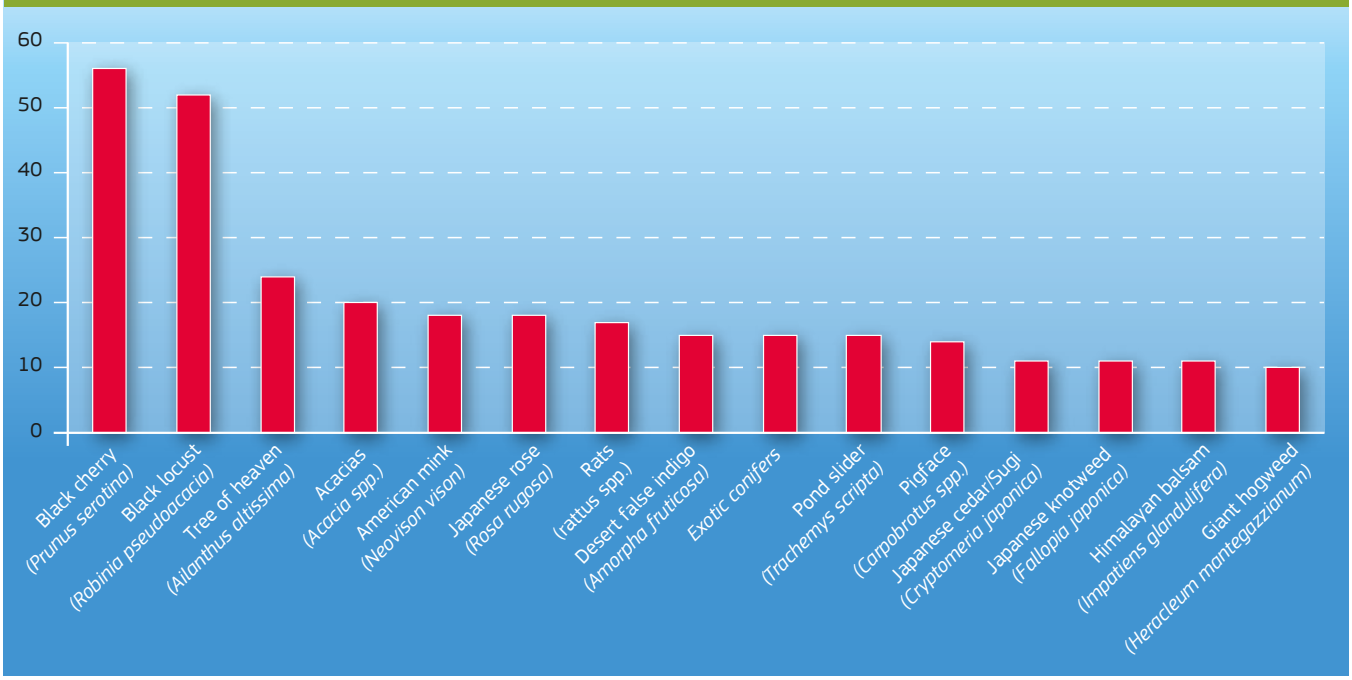
Invasive alien terrestrial plants have been targeted by more than half (59%) of the projects concerned with eradication and management of IAS. As Figure 3 shows, the next largest category is invasive predators, such as the American mink (*Mustela vison*) and rats (14% of control and eradication projects).

Targeting problem species

DAISIE[1], compiled a list of the 100 worst IAS at EU level. This list includes the three species that have been most targeted by LIFE: black cherry *(Prunus*

1 Delivering Invasive Alien Species In Europe (DAISIE) http://www.europe-aliens.org/speciesTheWorst.do

Figure 4. **LIFE projects by IAS (1992-2013)**



serotina), black locust (*Robinia pseudoacacia*) and tree of heaven (*Ailanthus altissima*) – see Figure 4. All three are plants that are widespread across the EU and which typically pose a threat to species listed in Annex I of the Habitats Directive.

Monitoring LIFE's impact on IAS

In order to evaluate LIFE's contribution to the implementation and development of Community environmental policy and legislation, the European Commission has been regularly gathering information, including statistical data, from LIFE+ projects. One of the output indicators that has been gathered in order to evaluate in concrete terms the effects of the LIFE programme on nature and biodiversity is "Removal of Alien Species". For 2007-2012, the Commission has gathered data from 99 LIFE+ projects that have taken actions to remove alien species (see Table 1).

The data allow a good estimate to be made of the cost of eradication of IAS per species. One of the conclusions is that the price of eradication and/or control of IAS differs a lot from project to project and Member State to Member State. For example, the cost per hectare of eliminating black locust ranges from €100/ha in Hungary to €10 000/ha in Germany. Different labour costs partly contribute to these significant differences, but by far the biggest factor is the legal and ethical framework within which projects operate: in Germany it is forbidden to apply chemicals to Natura 2000 network sites, meaning that on the one hand all removal work must be done either mechanically or by hand (see pp. 29-33), but on the other hand that side effects on native species are avoided.

Table 1 – LIFE+ project data on 'Removal of Alien Species'

LIFE+ (2007-2012) action indicator	Removal of alien species
Number of projects	99
Total budget spent on the action	€16.5 million
Number of actions	175
Number of Natura 2000 network sites targeted	262
Area involved in the actions (ha)	316 000 ha
Average cost of removal/elimination per hectare	€52.16/ha

Manual painting and spot-spraying were amongst the chemical treatment techniques employed by the Hungarian LIFE project, HUNDIDI

Photo: LIFE06 NAT/H/000104

INTRODUCTION

LIFE programme could be “extremely important”

The new EU Regulation on Invasive Alien Species (IAS) places much-needed emphasis on prevention, says Piero Genovesi, chair of the Species Specialist Group on invasive alien species at the International Union for Conservation of Nature (IUCN).

“We tend to be often reactive instead of proactive – because, of course, it is quite natural to address a problem only when you see it. But this approach is not effective when you deal with invasive alien species,” explains Dr Genovesi.

He is pleased that new European legislation has taken on board the outcomes of scientific discussion and studies of recent decades. Overwhelming evidence shows that once an invasive alien species arrives in a new location it can quickly become established and spread into other areas: “Then it’s often too late to act – or, at least, it becomes more costly and more complicated to do so,” he cautions.

The IAS Regulation promotes prevention by imposing restrictions on species that are considered of Union concern, as well as by supporting an early warning and rapid eradication approach for those species. This includes many types of action where the LIFE programme could be “extremely important”, affirms Dr Genovesi.

LIFE projects have been particularly effective in addressing the pathways by which IAS arrive in Europe – another significant aspect of the Regulation, according to Dr Genovesi. “We have very good data at the European level that can help identify the most relevant paths of introduction. For example, for

*The Louisiana crayfish or crawfish (*Procambarus clarkii*) has contributed to the decline of the native European crayfish. LIFE projects have been trying to eradicate it*

Photo: LIFE09 NAT/ES/000531

plants we know that horticulture is a key activity that has brought into Europe many invasive alien species. For vertebrates, the pet trade is becoming very important. In the past hunting was a factor, but nowadays this is less relevant. We also know that many invertebrate species arrive unintentionally as contaminants - that is, as hitchhikers of global trade."

The EU is encouraging Member States to work together and to develop action plans to address these pathways. "We know that in order to prevent invasions it may be more effective to address the source - sometimes it's a deliberate activity [e.g. for squirrels it was the pet trade and for the American mink fur farms] and sometimes it's an unintentional vector - instead of working on the species itself afterwards," says Dr Genovesi.

He gives the example of the voluntary code of conduct in horticulture that was drawn up by the Council of Europe, the European Plant Protection Organisation and the SSG (the IUCN group that he chairs). Such an approach was trialled by a Belgian LIFE project, leading to the successful adoption of this code of conduct (see pp. 21-23). Furthermore, other codes have been drawn up for botanical gardens and hunting.

Effective removal methods

Once an invasive alien species is established, however, the method of its removal varies from species to species. While studies show that the number of IAS found in Europe have increased alarmingly, actions to remove these species have become more effective. One good example cited by Dr Genovesi is the Montecristo 2010 project, eradicated rats from the small Italian island of the same name: "The intervention that was co-funded by LIFE is incredible. In just one year, we saw a very dramatic increase in the reproduction success rate of several native animals and birds [as a result of the project]." (see pp. 56-59).

The support garnered for the eradication of the ruddy duck in the UK was also impressive given that the LIFE project was undertaking actions to protect a species that breeds in Spain. "It did require a lot of effort to explain to the public why it was important that a beautiful bird [the ruddy duck] needed to be removed... It's really a credit to the UK institutions that have carried out that project, because it was technically very complex and very challenging, but also in terms of communication, it was indeed a complicated challenge," he says.

Photo: ASTRALE EEIG/Justin Toland

Piero Genovesi (with microphone) contributing to the LIFE Platform Meeting on Invasive Alien Predators in Sweden

Both eradications took due precautions to ensure that the project actions didn't adversely affect other species. But complacency is not an option, warns Dr Genovesi. "The data that we have shows that the situation is rapidly progressing, and we need to start working now on this issue."

No particular type of environment is safe, even a totally natural environment. "For example, in freshwater, even the most pristine areas, the less disturbed streams, can be severely affected by invasions," says Dr Genovesi, who notes that, "Montecristo is an island that is particularly vulnerable to invasions... For several species of shearwaters in the Mediterranean, wherever we have rats on the island, the reproduction of these birds may collapse to zero. So we can expect the total extinction of a species if we allow an introduced predator into those types of environments."

He adds that freshwater areas are similarly vulnerable: "Introduced predators – or sometimes introduced weeds – can dramatically alter these ecosystems."

However, Dr Genovesi is eager to emphasise that the decision to introduce the new European legislation on invasive alien species was not taken simply to protect biodiversity. "Decision-makers realise that invasive alien species also affect ecosystem services, the economy and the health of European society. In this hard time of financial crisis, it has been a major argument in deciding to develop a more effective policy. It's important to stress that protecting our environment from the threat of alien species can help protect our clean water, our pure air and our infrastructure – and it is important to work jointly to save our environment and also our livelihoods."

IAS PREVENTION

LIFE helps make the case for IAS prevention

The IAS policy highlights the ecological and economic benefits of preventing the spread of invasive alien species (IAS). The LIFE programme provides some useful lessons with regard to practical ways of achieving this goal.

The new IAS Regulation gives a strong message about the importance of prevention being better than cure when it comes to invasive alien species. In presenting the IAS Regulation, the Commission explained that Member States are taking a number of measures to tackle IAS, but such action remains predominantly reactive, seeking to minimise the damage already being caused without paying sufficient attention to prevention or to detecting and responding to new threats. Prevention is internationally recognised as the most effective way of avoiding the IAS problem.

Article 7 of the IAS Regulation places restrictions on invasive alien species of Union concern. The Regulation also requires Member States to take measures to support the prevention of reinvasion by IAS following an eradication campaign.

*The Asian clam (*Corbicula fluminea*) could have a catastrophic impact on EU freshwater habitats and species unless prevention programmes are in place*

Photo: LIFE07 NAT/IRL/000341

Prevention measures and LIFE

Three areas that have been identified as key to preventing the spread of IAS are the identification of priority pathways for invasion, risk assessment (of the likelihood of invasion), and communication to raise awareness of the risks and the need for IAS prevention. Whilst, as the previous chapter illustrates, the majority of LIFE projects relevant to the topic have focused on the control and/or eradication of invasive alien species, there are a number of good examples of projects that have contributed to vital prevention strategies.

One such is the recently completed Spanish project LIFE TRACHEMYS (**LIFE09 NAT/ES/000529**), which addressed the impact of the pet trade in the introduction of invasive freshwater turtles, such as the red-eared slider (*Trachemys scripta*), that endanger native species such as the European pond turtle (*Emys orbicularis*). Amongst a range of project actions (see feature article on pp. 36-41), LIFE TRACHEMYS campaigned for the introduction of regulations to tackle the trade and use of exotic invasive turtles as pets and prevent their release into the wild. This was supported by a public awareness campaign to highlight the problems caused by exotic turtles.

As part of their overall aim of producing inventories and maps for underwater habitat types and their flora and fauna in key marine Natura 2000 sites, a Finnish marine project, FINMARINET (**LIFE07 NAT/FIN/000151**) has plotted the distribution of two IAS, the zebra mussel (*Dreissena polymorpha*) and Conrad's false mussel (*Mytilopsis leucophaeata*) at some of the project areas in the Baltic Sea. These freshwater species are known for their ability to

Photo: LIFE07 NAT/P/000630/ASTRALE EEIG/João Salgado

Prevention strategies for invasive alien species can reduce the need for costly control and eradication actions

disperse efficiently in favourable conditions. Since it has been predicted that climate change may lead to a reduction in the salinity of the Baltic Sea, the data gathered by FINMARINET provide an important insight into priority pathways for the spread of these two invasive alien species that could feed into future management strategies to prevent their further spread.

Another project that addressed the threat from invasive alien species within the context of protecting biodiversity across national boundaries was SAVA RIVER BASIN (**LIFE06 TCY/INT/000246**), a LIFE Third Countries project that ran from 2007 to 2009. The project recommended a trans-border Action Plan to halt the dispersal of invasive alien species along the Sava, a tributary of the Danube that connects Slovenia, Croatia, Bosnia and Herzegovina and Serbia.

Two of the most engaged projects in terms of prevention work are CAISIE from Ireland (**LIFE07 NAT/IRL/000341**) and the Belgian project AlterIAS (**LIFE08 INF/B/000052**), both of which are featured in-depth on the following pages of this publication.

Preventing reinvasion

A number of LIFE projects have put in place strategies for preventing reinvasion of IAS as part of an after-LIFE conservation plan. One notable example comes from Portugal, where the laurissilva da Madeira project (**LIFE97 NAT/P/004082**) worked to recover and preserve laurel forest through actions to eradicate invasive plants, in particular Kahili Ginger (*Hedychium gardnerianum*). In order to prevent the exotic plants reinvading the laurel forest, the Madeira Natural Park established a permanent "exotics prevention team", including three of the people who carried out eradication and control actions during the LIFE project. This prevention team is continuing collaborations established through LIFE, regularly involving the army in fieldwork and local farmers in the cultivation of areas that were previously invaded or near to cleared buffer areas (sanitary belts) in order to prevent invasion and (re)invasion of the targeted laurel forest habitat. LIFE projects on islands in the Azores and the Tuscan archipelago have also focused their attention on preventing reinvasion – in their case of rats that predate on protected seabirds (see pp. 56-59).

IAS PREVENTION

Preventing biodiversity loss from IAS in Ireland

CAISIE – Control of aquatic invasive alien species (IAS) and restoration of natural communities in Ireland – developed new and effective methods for preventing the spread of submerged aquatic species in some of the Irish Republic's most treasured inland waterways.

The EU IAS Regulation highlights the need to increase the focus on prevention as the most effective means of tackling the problem of invasive alien species. The CAISIE project (**LIFE07 NAT/IRL/000341**), which ran from 2009 to 2013, developed some innovative approaches that, in addition to strengthening biosecurity in Ireland, are attracting the interest of practitioners and policy-makers across the globe.

CAISIE originated in response to a significant infestation of curly-leaved waterweed (*Lagarosiphon major*) on Lough Corrib in the west of Ireland, one of the country's best-known brown trout and salmon fisheries, as well as a Natura 2000 network site that houses a number of protected habitats and species. "This was 2005: we knew we needed rapid reaction but we had no idea what to do," explains Joe Caffrey of Inland Fisheries Ireland (IFI). He put together a proposal for a LIFE Nature project to tackle not only the *Lagarosiphon* outbreak (which, by the time the project started, had gone from nine to 113 sites on Lough Corrib), but a range of additional threats from invasive plant, invertebrate and fish species in and along the Barrow Navigation in south-east Ireland.

The CAISIE project developed the world's first angler disinfection kit to help prevent the spread of IAS in Ireland

Rapid reaction force

One key element of the CAISIE project was the testing and optimising of some novel control and eradication methods for curly-leaved waterweed (see box). These were accompanied by the development of a strategy to prevent the spread of the species into the shallow lower basin of Lough Corrib. "If *Lagaropsiphon* colonises this shallow and highly suitable habitat it will overgrow the entire watercourse, with devastating consequences for biodiversity, recreational exploitation and it could even result in flooding events for Galway city," warns Dr Caffrey. Thus, the project team developed techniques for early detection based around thorough underwater searches of areas marked out by transect lines mapped to GPS coordinates. The quickest way of surveying this large (18 000 ha) lough was found to be towing one of the team in diving gear behind a boat. The lower basin is checked regularly (every few months) and intensively. During the LIFE project alarm bells rang when curly-leaved waterweed was found at a location less than 1 km from the lower basin. "Immediately all of the operations in the upper lake were ceased and the entire control team moved down there for three weeks – It turned out to be a bigger operation than we thought but we completed it successfully and protected the lower lake from infestation on this occasion," recalls Dr Caffrey.

He believes this early detection and rapid reaction strategy has paid dividends: "I'm confident we have removed the imminent threat (*Lagarosiphon*) to the lower basin and that's thanks to early detection and effective rapid reaction."

The role of stakeholders

Dr Caffrey notes that "it was an angler who identified the invasive alien species in the lake close to the lower basin." This highlights the value of the project's efforts to engage key waterways user groups, such as anglers and boaters, as eyes and ears on the ground. Thus, CAISIE contributed to the setting up of an emergency hotline for pollution, protection and invasive alien species reporting. The project also created a smartphone app that gives users access to photographs and key facts about a number of IAS and enables them to immediately send a GPS-tagged image of any suspect plant or other species directly to the IFI invasives team. "It's a very simple system and it's being used extensively and with good effect," affirms Dr Caffrey.

Rinerroon Bay, Lough Corrib colonised by curly-leaved waterweed (Lagarosiphon major) in 2005

As well as a source of information, the coarse fishing community was another potential pathway for invasion to Ireland's natural watercourses. Through engagement with the Irish Angling Development Alliance (IADA), which represents the interests of thousands of anglers in Ireland, the CAISIE team was able to turn initial antagonism towards preventive actions into active support for disinfection of fishing gear. Indeed, the Angling Biosecurity Guidelines developed through the LIFE project have been adopted and implemented at international angling competitions such as the Trout Angling World Cup in Lough Mask and the cross-border World Pairs Coarse Angling

The CAISIE team pioneered the use of jute matting to eradicate the invasive alien weed, a method now used worldwide

Photo: ASTRALE EEIG/Justin Toland

Championship. Persuading the IADA to make disinfection mandatory for all its events (The so-called 'no dip, no draw' policy) was a crucial step on the path to effective prevention of the spread of invasive alien species. "It was a magnificent initiative and all the more so because they were the ones that drove it," says Dr Caffrey. "We are facilitating these [angling] groups, they are working closely with us and it is a powerful and highly effective union...Empower the anglers and significant progress can be made."

Empowerment also comes in the form of an 'angler disinfection kit', believed to be a world first, developed to provide anglers with a portable, reasonably-priced and effective disinfection tool directly out of the work of the CAISIE project, which will go on sale shortly. IFI is also working with the company Kingspan Environmental to set up permanent disinfection stations at some of the most popular fishing sites in the country. And, recognising that biosecurity begins at home, IFI has recently introduced a mandatory disinfection policy for all its field staff and vehicles. "We're approaching [invasive alien species] a little bit like foot and mouth disease," explains Dr Caffrey.

Priority pathways

Alongside Lough Corrib, the CAISIE team also focused on the Grand Canal-Barrow Line, an artificial watercourse stretching across Ireland from Dublin to the River Shannon and southwards to the River Barrow. "We were looking at this from a pathways and vectors point of view because it's a highly effective conduit for invasive alien species," says Dr Caffrey. In recent years, aquatic IAS have become a major threat to the rich and diverse flora and fauna of the Grand Canal-Barrow Line - including to Annex II-listed species such as the opposite-leaved pondweed (*Groenlandia densa*), the white-clawed crayfish (*Austropotamobius pallipes*) and the European river lamprey (*Lampetra fluviatilis*) - as well as increasing the likelihood of flooding events and being a hazard to boating.

Curly-leaved waterweed (Lagarosiphon major)

"The first job was to identify what invasive alien species were there, to what extent and then to target the various problems each might cause," recalls Dr

Lough Corrib prior to the curly-leaved waterweed invasion

Caffrey. The project focused on 13 IAS along the waterway. "We achieved a high level of control and even eradication with some of the species involved." Others, we realised, had firmly established and were more or less beyond control.," he explains. For instance, IFI decided only to tackle the spread of Himalayan Balsam (*Impatiens glandulifera*) at and above Carlow town, which is close to its upper limit on this river, because it was too widespread below that. Similarly, although there were great collaborative efforts (IFI and Waterways Ireland) to remove the New Zealand pygmy weed (*Crassula helmsii*) from the Grand Canal, effectively reducing it from almost 100% cover to less than 1% in key areas, "it's still there," warns Dr Caffrey.

The limitations of CAISIE's control and eradication actions have only served to strengthen IFI's resolve to focus on prevention. "As an organisation, IFI is currently putting a lot more effort into biosecurity, to stop these harmful invasive alien species being introduced and spreading," says Dr Caffrey. "Part of this project was to study the vectors and pathways; it's something that is poorly understood Europe-wide. Towards that end we have been working closely with the European Inland Fisheries Aquaculture and Advisory Commission (EIFAAC), an organisation with representatives in 35 countries throughout Europe. We've conducted a lot of work in this area and we're continuing to focus attention here. We've got a PhD student working out of IT Sligo[1] and he is now looking at the angling vectors: Is it the anglers' boots? Is it the nets? Is it the stink bags[2] that carry liquid? Are there better designs for boats? Should trailers be introduced to the lakes? We're looking at all of these various methods," he adds.

Legislation and dissemination

Another aspect of the prevention strategy is a new piece of legislation that IFI is proposing to introduce. This new Inland Fisheries Act, which is currently at the Heads of Bill stage, "will have a specific section on invasive alien species and harmful fish pathogens, including a requirement for mandatory disinfection of angling gear," explains Dr Caffrey. Work undertaken as part of the CAISIE project has brought into sharp focus the need for this national IAS legislation.

The pending Inland Fisheries Act will reinforce the provisions of the EU IAS Regulation and two existing articles relating to invasive alien species in Ireland's 2011 Habitats Directive (SI 477/2011). Dr Caffrey says one of the lessons of the CAISIE project was the recognition that more could be done to ensure prevention of accidental spread of IAS via the horticultural trade – the project targeted garden centres and sales outlets as potential pathways of invasion, but with mixed results: "Some are very active, engage very rapidly with you and support you, and others just ignore you." Hence, IFI is currently carrying out rigorous risk assessments of all the ornamental species it would like to see restricted in order to win ministerial approval for their ban under article 50 of Ireland's Habitats Directive.

1 Institute of Technology Sligo
2 A colloquial name for the bags in which anglers transport their (wet) nets

Photo: ASTRALE EEIG/Justin Toland

Project manager Joe Caffrey explains why L. major is extremely invasive

The project worked with angling associations to set up portable disinfection stations at competitions

Weed control on Lough Corrib

Methods of controlling and eradicating curly-leaved waterweed on Lough Corrib have been greatly enhanced by the LIFE project. The project team studied the lifecycle of the species (which exhibits its most vigorous growth in winter) as a means of identifying weaknesses to better inform control methods. These were then honed into three main methods: mechanical cutting using trailing knives or v-blades; light exclusion using jute matting; and manual removal by scuba divers. In addition, the project assessed the potential of biological control agents under strict quarantine conditions and has identified a duck fly larva that may be suitable for controlling this invasive aquatic plant.

Control and eradication methods were developed through trial and error: "We tried lots of different weed cutting boats and cutting methods," recalls Dr Caffrey, the project leader. Similarly, after attempts to use plastic sheeting for light exclusion failed, the project team pioneered the use of jute matting instead, a method that has since been implemented elsewhere in Ireland, UK, Netherlands, North America, Canada and New Zealand. Importantly, believes Dr Caffrey, "Not only have we got the methods, we now have the staff that is educated in using the methods – they know what works and what doesn't."

Summarising the project's achievements on Lough Corrib, Dr Caffrey says: "We've achieved an early detection capacity; we have a rapid reaction capacity, and, I think equally importantly, we now have an armoury of effective control methods that we developed with the CAISIE money... Without European intervention this just wouldn't have progressed: Lough Corrib would not be a fishery of international repute now; much of it would be a weed bed."

Dr Caffrey also believes it is important to clarify the distinction between non-native species and non-native invasive species: "a non-native species that causes ecological, health or economic damage is an invasive non-native species. We have lots of non-native species that are not harmful and even very beneficial - in agriculture, in forestry - so the last thing we want to do is to brand them as invasive, because they are not."

Lessons from CAISIE have been disseminated far and wide through project presentations in Belgium, France, UK and a keynote speech at ICAIS, the world's largest aquatic invasive alien species conference (held in Niagara Falls, Canada). An end-of-LIFE conference (Freshwater Invasives – Networking for Strategy (FINS)) was held in Galway, Ireland in 2013 to discuss and disseminate invasive alien species issues. The deliberations at this conference resulted in the recent publication of a paper in an international scientific journal[3] Indeed, the networking and dissemination work he has been involved in through the LIFE project has proven to Dr Caffrey that EU Member States can learn important lessons from the biosecurity measures currently in place in countries such as Canada, Australia, New Zealand, Iceland and Norway. For instance, anglers visiting the latter two nations are required to present a certificate of disinfection at the border for any fishing gear they bring: "That's one of the things we are hoping to get through with our fisheries legislation [the Inland Fisheries Act]," says Dr Caffrey.

3 http://dx.doi.org/10.3391/mbi.2014.5.1.01

Project number: LIFE07 NAT/IRL/000341

Title: CAISIE - Control of aquatic invasive species and restoration of natural communities in Ireland

Beneficiary: Inland Fisheries Ireland

Contact: Joe Caffrey
Email: joe.caffrey@fisheriesireland.ie
Website: http://caisie.ie/
Period: 01-Jan-2009 to 31-Jan-2013
Total budget: €1 533 000
LIFE contribution: €738 000

IAS PREVENTION

Acting to **limit impacts of the plant trade**

A voluntary code of conduct within the horticulture sector raises awareness and prevents the spread of invasive alien plants, with an alternative native species solution.

Ornamental horticulture is the main pathway of plant invasion worldwide. In Belgium, a LIFE+ Information and Communication project has pioneered a national approach to stop invasive terrestrial and aquatic plant species from being planted in nurseries, parks, gardens and other green areas. The project's approach centres on the production of the country's first voluntary code of conduct to promote best practices within the horticulture sector.

"The code of conduct is a voluntary approach that aims to increase awareness amongst horticulture professionals and gardeners, but it is also a tool that aims to reduce the deliberate introduction of invasive alien plants", says Dr Mathieu Halford of the project's coordinating beneficiary in Gembloux, Gx-ABT. "With the AlterIAS project, the administration in charge of the environment here in Belgium decided to try a voluntary approach, instead of focusing efforts on regulation tools."

Before the project, the general public could buy invasive alien plants, both terrestrial and aquatic, in nurseries and garden centres. They were often deliberately planted, with no awareness of their invasive-

The AlterIAS project encouraged gardeners and the horticulture trade to substitute low-impact species such as Myriophyllum brasiliensis (pictured) for harmful ornamental invasive alien plants

Photo: Mathieu Halford

ness, and subsequently spread to semi-natural and natural habitats. "That is the basic problem", notes Dr Halford. "At the very beginning of the project we performed an initial survey to quantify the presence of invasive alien plants within the horticultural market." GxABT found that 93% of invasive plants were still available. "Those plants have economic value and include species that are highly appreciated for gardening or landscape plantings," he explains. Therefore, to ensure the code of conduct was generally acceptable, it was produced through a process of consultation.

Promoting good practice

"The problem remains little known outside the scientific audience, so it was first important to address the issue and to explain the environmental problem," recalls Dr Halford. "After 10 months of negotiations, both the federations and the authority in charge of the environment, with the scientific community also present at the table, agreed on five good practices." These can be implemented within horticultural firms and nurseries, departments responsible for parks and gardens in cities and municipalities, and by landscape architects, garden contractors and gardeners (see box). "It is a multiple stakeholder approach. All these horticultural professions can subscribe to the code of conduct and the five good practices," he continues.

Five good practices recommended in the AlterIAS code of conduct

1. Keep informed about the list of invasive plants in Belgium;
2. Stop selling/planting certain invasive plants (the consensus list);
3. Disseminate information on invasive plants;
4. Promote the use of non-invasive alternative plants; and
5. Participate in the early detection of new invasive plants.

"The second measure is the most important one; it is to stop the sale and planting of certain invasive plants. We call this the consensus list, because everybody around the table agreed on that list of species." The consensus list consists of 28 species, including eight aquatic plants, which represent around 44% of the total invasive plants listed for Belgium. Close to 200 garden centres and other selling points had adopted the code of conduct by 2014 and all have withdrawn the plants on the consensus list from sale. A second list, of 25 terrestrial and four aquatic plants, was classified for restricted use, with their cultivation to be avoided near vulnerable habitats and protected areas.

Alternatives to invasive alien species

A brochure was produced that suggested alternative non-invasive plants to grow instead of the withdrawn invasive alien species (IAS). "It was not always easy to find plants that are morphologically similar to invasive plants, so in the brochure we present plants according to similar ornamental function," explains Dr Halford. "For all the invasive plants in Belgium, we identified their main ornamental function, for example, whether it's a border plant, groundcover, a climbing plant, green-screen, or an ornamental shrub or tree, and we proposed alternative plants with the same ornamental function". The Alternatives to Invasive Plants brochure was well-received by gardeners, the general public and horticulture teachers and students, although some horticulture professionals indicated they would have preferred a wider focus than just native plants. The project suggested only native plants to ensure there was no risk of them becoming invasive in the future.

There is a type of early-warning measure in the code of conduct, which comprises the fifth and final good practice. "Say, if you are a nurseryman and notice a plant not on the list that appears to be escaping into natural habitats, then there is a factsheet with the

code of conduct that you can fill in with the name of the species and its behaviour," says Dr Halford, "and the factsheet is sent to the scientific authority in Belgium that is responsible for the risk assessment of species. They determine if this species may become invasive and can start a risk assessment for that species."

Transferring the voluntary approach

The AlterIAS approach could easily be adopted by other EU Member States. "I really think that all the stages of the consultation process are completely transferable," says Dr Halford. "The concept of a consensus list has already been taken up outside Belgium, especially in France". However, he stresses that a code of conduct requires a communication campaign to promote it and can only be effective if a high proportion of horticulture professionals subscribe to it. The AlterIAS website includes a map showing the location of those - both professional and amateur - who have signed up so far. Dr Halford notes that there are other codes for invasive plants implemented around Europe, "but without this subscription element you just have a document on a website and don't know the number of horticultural professionals who have adopted it. So I think it is important to plan a subscription process with a database, which is transferable to other Member States as well."

Surveys conducted before and at the end of the project showed a significant change in attitude and an increase in knowledge concerning invasive plants for horticulture professionals. However, there was little change in recorded attitude among the general public, because there are millions of gardeners in Belgium and with limited resources the project only reached a small proportion of them. A specific communications campaign aimed at the general public is therefore still needed.

The After-LIFE communication plan is now being implemented, to ensure the continuity of the Code of conduct and other project tools. "We have gathered

Photo: Mathieu Halford

Gardeners consult the project's alternatives to invasives brochure

federations and associations to see who can take charge of the code in the future, so it will still be operational once the project is over," explains Dr Halford, "and the online registration process will continue so the number of partners can continue to increase. There is also a revision process that is planned every three years." The project team are confident that a successful and flexible code for self-regulation will mean that mandatory legislation for invasive ornamental plants is not required in Belgium.

The spread of invasive alien species is widely recognised as one of the main drivers of biodiversity loss in Europe. "Because plant introductions in parks and gardens are the starting points for the invasion of natural habitats," concludes Dr Halford, "the basic principle of the Code of conduct and the other AlterIAS tools is that by reducing deliberate introduction in parks, gardens and other green areas, you subsequently reduce the risk of invasion in natural habitats." The project's communication strategy was crucially based on positive messages, "because here we really wanted to focus on solutions, rather than on problems, and show that people can be part of the solution," he explains.

Project number: LIFE08 INF/B/000052

Title: AlterIAS – Alternatives to Invasive Alien Species

Beneficiary: Université de Liège, Gembloux Agro-Bio Tech (GxABT)

Contact: Mathieu Halford
Email: mhalford@ulg.ac.be
Website: http://www.alterias.be
Period: 01-Jan-2010 to 31-Dec-2013
Total budget: €1 011 000
LIFE contribution: €501 000

EARLY DETECTION AND RAPID ERADICATION

Bringing to LIFE **early detection and rapid eradication**

As the new EU Regulation on invasive alien species proposes – and LIFE projects already show – early detection and rapid eradication are necessary to tackle IAS, wherever prevention fails.

Invasive alien species (IAS) are a significant and growing problem in all EU Member States. Combating IAS requires rapid action: as soon as a problem emerges, however small, it is essential to act swiftly to eliminate it, rather than leaving it to reproduce and invade other areas. Once identified, it is also essential to remain ever vigilant of reoccurence.

To this end, a second main component of the new IAS Regulation (the first being prevention) focuses on early detection and rapid eradication. Each Member State will need to set up an official surveillance system to collect and record data on invasive alien species of Union concern in their country. This is coupled with notification obligations to share up-to-date information on the current status and distribution of IAS; any measures taken to control or eradicate them; and the effectiveness of such measures.

Under surveillance

These surveillance measures should enable countries to notify the Commission and other Member States as soon as an IAS of concern has been detected. Thus, immediate actions can be taken to eradicate the problem early on, before it has had an opportunity to spread and cause serious damage. Information collected through surveillance can also feed into the information exchange mechanism allowing Member States to share information and experiences on the various management techniques that have been adopted for the eradication or management of different invasive alien species.

The efficacy of this strategy in combating specific IAS is already being put to the test in a cluster of LIFE projects that are currently being carried

The POSIDONIA project enlisted the help of volunteer scuba divers to protect neptune grass beds from the threat of invasive alien macroalgae

Photo: LIFE09 NAT/ES/000534/Consejeria de Medio Ambiente de la Junta de Andalucia (falta «andalucia»)

out in different Member States. For instance, the Spanish marine project, POSIDONIA (**LIFE09 NAT/ES/000534**) - targeting the protection of the Habitats Directive Annex I-listed underwater meadows of Neptune grass (*Posidonia oceanica*) in Andalusia - is enlisting the support of recreational scuba divers to assist it in vital early IAS detection work (see box).

Another Spanish-led project – this time on land, on the island of Gran Canaria, is targeting a reduction of the density and abundance of the Californian kingsnake (*Lampropeltis getula californiae*). Although this invasive alien snake species was only recently introduced to the island, it already poses a serious threat to some endemic species including reptiles (see pp. 36-41).

This project also is heavily dependent on volunteers. Among its main actions is the recognition of the importance of establishing an early warning system to first detect and then eradicate the snakes. To assist in the task, local volunteers have been enlisted via a communications campaign.

Paying dividends

Early results indicate the volunteer work is time-consuming (in many cases the workers have to travel to other locations to catch the snakes) but, it is already paying dividends in terms of ensuring the local population is becoming progressively more involved in the project. For example, several people are regularly catching snakes and handing them over to the LIFE team.

Also launched in 2010, the Romanian Iron Gates wetlands project (**LIFE10 NAT/RO/000740**) has introduced an important early warning IAS action. Located in the south-west of the country, the 'Iron Gates' wetland area - a Natura 2000 network site - is an important stopover point for migrating birds. The rare pygmy cormorant (*Phalacrocorax pygmeus*) is just one of 23 bird species listed in Annex I of the EU Birds Directive found there. The wetlands are also home to rare or threatened amphibian species, such as the Habitats Directive Annex II-listed fire-bellied toad (Bombina bombina). However they are threatened by several problems, including overgrowth of aquatic plants, notably by the aquatic invasive weeds (*Eichhornia cras sipes*, *Azolla filiculoides* and *Nymphoides peltata*).

One of the project's main practical actions, therefore, is the creation of a toolkit for the early warning of IAS. This will feature, for instance, factsheets on the most encountered IAS, including comprehensive information for identifying invasive alien species. The creation of an up-to-date GIS database for wetlands' management is another important element that will assist in highlighting any potential problems affecting the area's biodiversity. A key priority is that the system can also be replicated in other Natura 2000 sites. To complement its early warning measures, the project is also planning to purchase special floating equipment that will be used by trained operators to cut back the excessive water plant growth, especially by the invasive alien species.

Scuba divers aid IAS detection

An increase of invasive macroalgae (C*aulerpa racemosa* and *Lophocladia lallemandii*) has been identified as one of the main threats to the conservation status of the priority underwater Neptune grass habitats targeted for conservation by the LIFE POSIDONIA project. To assist in the task of their rapid detection in several marine Natura 2000 sites of Andalusia, the project, which favours social participation, has enlisted the aid of a network of diving volunteers.

Since 2011, the local scuba divers, have carried out a number of sorties (approximately 19 per year) to help track and monitor the IAS. Their work is viewed as critical in providing the project team with early warning of any degradation of the targeted Posidonia beds and enabling mitigation actions. The divers are part of the project's larger team, of around 100 volunteers annually, who are assisting in various important management and/ or monitoring tasks.

Early detection of the presence of the California kingsnake on Gran Canaria was the precursor to LIFE co-funded actions to reduce the abundance and density of this invasive alien reptile

Photo: LIFE10 NAT/ES/000565

CONTROL AND ERADICATION

LIFE and invasive plant management: an introduction

Invasion of alien biota is the second largest threat to biodiversity after habitat loss. The problem of invasive alien flora has significant implications for agriculture, forestry, aquaculture, ecosystem services and human health.

The new IAS Regulation introduces provisions on the management of invasive alien species (IAS), including plant species. LIFE Nature & Biodiversity has mainly focused on the effects of invasive alien plant species on ecosystems and ecosystem services within the Natura 2000 network of protected sites.

Since 1992, 185 LIFE projects have included at least one concrete conservation action dedicated to the eradication or management of invasive alien plant species, with the majority of these projects occurring since 2003 (see Figure 1).

More than 150 invasive alien plant species have been managed within the scope of LIFE projects so far. The bio-geographical diversity of the Member States is reflected in the species targeted. For example alien *Rhododendron* species are targeted in the oceanic climate of the UK, Ireland and Belgium (e.g. **LIFE06 NAT/B/000081**, **LIFE97 NAT/UK/004244**, **LIFE06 NAT/UK/000134**, **LIFE09 NAT/IE/000222**) and/or invasive alien species in the Mediterranean region, such as *Opuntia, Acacia, Yucca* or *Agave*, are tackled in Spain, Portugal, France, Italy or Cyprus (e.g. **LIFE04 NAT/ES/000064**, **LIFE98 NAT/E/005300**, **LIFE07 NAT/F/000193**, **LIFE05 NAT/IT/000037**, **LIFE09 NAT/PT/000041** or **LIFE10 NAT/CY/000716**).

Invasive alien plants are defined to include species that occur naturally in Europe but which have been introduced into habitats outside of their natural bio-geographical regions. For example, mountain pine (*Pinus mugo*) is native to central and south-eastern Europe, where it grows mostly in subalpine regions above the timberline (1 400-2 700 m), or at lower altitudes in peat bogs. However, as a result of human introductions, the species is

Figure 1. **Number of LIFE projects that managed terrestrial and aquatic invasive alien plant species between 1992 and 2012 (n=185)**

now found in coastal dune areas of Scandinavia, where it is considered invasive and has been the subject of three Danish LIFE projects (**LIFE94 NAT/DK/000492**, **LIFE96 NAT/DK/003000**, **LIFE12 NAT/DK/001073**). It is a similar story for grey alder (*Alnus incana*), sycamore maple (*Acer pseudoplatanus*), black pine (*Pinus nigra*) and red elderberry (*Sambucus racemosa*).

Most-targeted plants

More than 150 invasive plants have been targeted by LIFE project actions. The most frequently-targeted species are listed in Table 1. These are also in the Top 25 species (flora and fauna) targeted by LIFE Nature and Biodiversity.

A total of 56 LIFE projects have included black cherry (*Prunus serotina*) management amongst their conservation activities. However, there is scope within future LIFE projects for more research and practical testing of efficient methods of eradicating this species, since results have been less satisfactory than for black locust (*Robinia pseudoacacia*) and tree of heaven (*Ailanthus altissima*).

Native to North America, the black locust was originally introduced as an ornamental tree, before becoming an increasingly popular plantation species amongst timber producers. The species adapted well to environmental conditions, especially in southern Europe and in the Pannonic region where it became invasive. Nowadays it occupies not only disturbed and ruderal sites across Europe but has invaded an increasing number of rare habitats, reducing their biodiversity.

A total of 33 projects have included actions to tackle black locust invasion. These have utilised a variety of management methods and developed a body of best practice on the eradication and control of the species. The 20 LIFE projects targeting tree of heaven have also contributed substantially to the development of eradication methods (see pp. 29-33).

Photo: BasKers

*Black cherry (*Prunus serotina*) has been targeted by more LIFE projects than any other invasive alien species*

Herbaceous successes – and challenges

LIFE has had a mixed set of results with regard to herbaceous invasive alien species. On the plus side suitable management practices have been identified for *Solidago* species (long-term application mowing and/or grazing schemes) and for *Asclepias syriaca* or *Fallopia* species (chemical treatment using appropriate application methods or combined methods).

Table 1 – Invasive alien plant species most frequently targeted by LIFE management measures

	Species	Nr. LIFE projects	Member States
1	*Prunus serotina*	56	BE(13), DE, HU, IT, NL, SK
2	*Robinia pseudoacacia*	52	AT, BE, CZ, DE, ES, FR, HU(7), IT, PT, PL, RO, SK
3	*Ailanthus altissima*	24	AT, BE, ES, HU, IT(7), MT, RO, SK
4	*Fallopia japonica / F.sachal. / F. spec.*	15	AT, BE, CZ, DE, FR, IE, PL,
5	*Solidago canadensis, S. Gigantea*	13	AT, DE,

Photo: LIFE06 NAT/H/000104

Use of adapted quad for spraying IAS plants

On the other hand, on many Natura 2000 network sites, the spreading of Himalayan balsam (*Impatiens glandulifera*) is out of control. If the species is able to establish itself in a river catchment, there are as yet no efficient and sustainable methods for its control or eradication.

Until now, few projects have made the control or eradication of invasive alien plant species their main objective (exceptions include the Irish project CAISIE – see pp. 16-20 – and the Czech project Morávka - **LIFE06 NAT/CZ/000121** – for Japanese knotweed - *Fallopia japonica*). Rather, projects have tended to propose IAS management as one of various measures designed to improve the conservation status of habitats and species listed in the Habitats and Birds Directives. Furthermore, unlike for projects dealing with invasive alien animals, the majority of LIFE Nature projects aiming to manage invasive plants have not focused on one particular species but have tried to control all significant IAS on the project sites. So, for example, an eradication of all tree species occurring in the area is performed or even broader "packages" of eradication of trees and shrubs together with herbaceous terrestrial and aquatic plants are proposed (e.g. *Prunus serotina, Quercus rubra, Robinia pseudoacacia, Fallopia japonica* and *Ludwigia grandiflora* in **LIFE07 NAT/B/000024** or *Lagarosiphon major, Elodea nuttalii, Crassula helmsii, Impatiens glandulifera* and *Fallopia japonica* in CAISIE).

There is a reasonably close correlation between the number of LIFE projects dealing with particular invasive plant species and the severity of the impact of those on habitats and biodiversity at European scale. However, more could be done to tackle certain taxa, such as the warty cabbage (*Bunias orientalis*), a yellow flowering perennial or biennial cruciferous plant native to the Caucasus and southern Russia. Although the species is spreading rapidly in most parts of the EU and has a negative impact on the biodiversity of grassland habitats, to date only one LIFE project - in Germany - has included warty cabbage control in its action plan.

This case demonstrates a common problem related to early actions and efficient eradication of invasive plants: the new invaders are typically placed under observation at first, with actions only following when they have become so widespread that total eradication is impossible.

Chemical constraints

Another challenge with regard to the efficient management of IAS is the different position of Member States in respect of the application of chemicals in protected areas or elsewhere in the landscape except agrarian land. This also affects the way trans-boundary problems with IAS are treated. For instance, Germany applies very strict rules and special permits to apply herbicides outside agricultural land are required, whereas registered herbicides are commonly used for IAS management even in Natura 2000 sites in neighbouring Czech Republic (as well as in Austria, Slovakia and Hungary).

LIFE projects thus have an opportunity to support the exchange of information across Europe, efficiently disseminate lessons learned and demonstrate best-practice approaches and methods.

CONTROL AND ERADICATION

Developing management methods for problem plants

LIFE has played an important role in helping to develop effective control and eradication methods for problematic invasive alien plants that are found EU-wide.

Japanese knotweed (*Fallopia japonica*), Himalayan balsam (*Impatiens glandulifera*) and black locust (*Robinia pseudoacacia*) are, according to DAISIE, some of the most problematic invasive plants in Europe. LIFE projects have applied a range of management methods for each of these species.

Japanese knotweed

Native to south-east Asia and brought to Europe as an ornamental plant, Japanese knotweed is a tall, herbaceous perennial that grows quickly to form a dense, dark canopy capable of changing completely the structure and species composition in affected ecosystems, especially the autochthonous vegetation in floodplains and along streams. By out-competing indigenous flora it also has a negative impact on the specialised insects that depend on those native plants.

A total of 15 LIFE projects in seven countries have included actions to control or eradicate Japanese knotweed, including three with a primary focus on this species – Rohrhardsberg (**LIFE06 NAT/D/000003**), Ochrona obszaru PKOG (**LIFE11 NAT/PL/000432**) and LIFEPieninyPL (**LIFE12 NAT/PL/000034**).

Management methods used have varied from country to country and project to project, but the most common approach has involved a mixture of mechanical treatment combined with the use of herbicides.

The Moravka project

The only LIFE project to date that has attempted to eradicate Japanese knotweed along an entire water course is the Moravka project in the Czech Republic (**LIFE06 NAT/CZ/000121**), which ran from

LIFE has helped in the development of effective methods to tackle Japanese knotweed invasions

Table 1 – Comparison of different Japanese knotweed management methods			
Method	**Possible environ. impact**	**Efficiency**	**Time expenditure**
Herbicide spraying	high	high	low
Herbicide injection	medium	high	high
Combination herbicide application and mowing	medium	medium	medium
Mowing	low	low	high
Grazing	low	low	high
Grubbing up	low	low	high

2007 to 2010. Actions focused on the Morávka river basin, which is part of the Beskydy Natura 2000 network site and where the invasive alien species (IAS) presented a major threat both to the natural riverine vegetation and to protected priority species such as Brook lamprey (*Lampetra planeri*) and the European otter (*Lutra lutra*).

"Several previous attempts to fully eradicate Japanese knotweed were unsuccessful because of limitations of scope and scale," explains project manager Roman Barták. "It was only thanks to the LIFE project that a significant breakthrough was possible," adds Frantisek Jaskula, director of the Protected Landscape Area CHKO Beskydy.

Management actions focused on eight habitats along the Morávka, with almost total containment (90% eradication) of the species across an area of some 350 ha in total.

The project applied a number of different chemical and combined approaches, including spraying and stem-injection of glyphosate of different concentrations and mowing combined with herbicide use (see Table 1). Autochthonous herbs, shrubs and trees were sown or planted to speed up the recovery of bare habitats after the removal of the invasive alien species.

The project team compiled the most efficient methods in a "Management Manual on Fallopia eradication" that can be downloaded from the project website[1]. Lessons from the project were disseminated to other invasive alien species control practitioners across Europe and are being successfully applied elsewhere in the Czech Republic and in other EU countries.

As Table 2 shows, costs may vary considerably during the treatment period depending on the stage of the treatment (initial costs are higher because of the difficulty of dealing with high and dense stands, whereas later work involves searching for still resprouting individuals).

1 http://life-moravka.kr-moravskoslezsky.cz/en/doc/kridlatka_nahled_ENG_FIN2.pdf

Table 2 – Treatment costs by year			
Year	**Area (density of stands)**	**Application method**	**Approximate cost / hectare* (€)**
2007	17 ha (high)	Spraying (2 appl./yr)	1 000-2 200
2008	35 ha (high)	Spraying (2 appl./yr) Injection	400-1 100 1 100
2009	84 ha (medium)	Spraying (2 appl./yr)	200-300
2010	30 ha (low)	Spraying (2 appl./yr)	250
2013 (After-LIFE)	100 ha (low)	Spraying (2 appl./yr)	50-100

** cost of subcontracted services without herbicide solution (herbicide Roundup-Biactive was provided by the project to ensure the correct concentration and to avoid manipulation)*

Himalayan balsam moves in

Although the Moravka project exceeded its goals with regard to Japanese knotweed, Petr Chytil, botanist with the CHKO Beskydy, points out that it is still "a struggle to overcome setbacks that hinder achieving the optimal conservation status of the area."

Firstly, in spite of consecutive seeding and woodland planting after the knotweed elimination, the open bare surfaces have been increasingly invaded by another aggressive alien plant, Himalayan balsam (see box). The replacement of an eliminated invasive plant by another alien species is a quite common, but often underestimated phenomenon. This unwanted arrival prompted the project beneficiary to begin mechanical removal of Himalayan balsam in 2009. However, repeated attempts to eradicate the species have yet to have the desired results.

The spread of Himalayan balsam is also encouraged by changes to the natural dynamics of the Morávka through the earlier construction of weirs, dams and water abstraction points upstream. These changes to the natural hydrology have led to an absence of regular floods that would suppress the spread of Himalayan balsam.

This development demonstrates the importance of applying a broad, holistic approach to the management of invasive alien species. If feasible, projects should not only focus on efficient eradication of targeted invaders but should also ensure that this is accompanied by proper habitat restoration. The abrupt elimination of invasive plants significantly disturbs the plant cover and soil, and the free space in the altered ecosystems is prone to new infestations.

Highly competitive alien species often have an advantage over native species in the early successional stages. However, this can be partly compensated by suitable restoration measures accelerating the recovery of the natural vegetation.

Black locust techniques

Unlike Himalayan balsam, which is a relatively recent invader of EU habitats, the black locust has been present in Europe since the early 17th century and was recommended for timber production on dry, sandy sites as far back as the early 18th century. Widely distributed across Europe, it is invasive mainly in dry and warm regions.

Himalayan balsam (*Impatiens glandulifera*)

Himalayan balsam occupies similar habitats to Japanese knotweed, however, it generally prefers more moist and nutrient-rich places. This native of the western Himalayas was introduced to Europe via Kew Gardens in London in the first half of the 19th century.

The main pathways of introduction are by escape to nature from private gardens and by beekeepers. The species is rapidly expanding across Europe, and in addition to various types of moist ruderal sites it is now found in natural and semi-natural habitats such as moist forests, moist meadows, flooded ground, in ditches and on seashores as well as along watercourses. The current massive expansion of the species in river systems is especially due to the dispersal of seeds by water currents.

Although the species is annual and management methods are uncomplicated, eradicating Himalayan balsam stands is costly, time consuming and often impossible, due to its impressive ability to regenerate and spread (in pure stands the production of 32 000 seeds/m² has been reported).

Photo: ASTRALE EEIG/Jan Sliva

Black locust penetrates into open land habitats such as sandy dry and calcareous grassland and triggers rapid and far-reaching changes in the vegetation cover. The shift in species composition together with a significant reduction of the original species diversity is partly caused by the increasing shading of previously open biotopes, but mainly by the mycorrhizal nitrogen fixation and allelopatic effects of black locust roots in the upper soil horizons. With the increasing density of *Robinia* stands, the low-competitive native vegetation is replaced by just few nitrophilous plant species.

The first of 33 LIFE Nature projects to target black locust expansion was implemented in Italy in 1997. The experience gained in these projects shows that

Photo: LIFE06 NAT/CZ/000121/DRAHOSLAV Ramik

Demonstrating an injection method for Japanese knotweed removal

simple mechanical control of the species is very difficult and both labour- and cost-intensive. It involves cutting trees and larger saplings and subsequently uprooting the stubs. Simple removal of above-ground biomass by cutting without consecutive management only aggravates the invasion problem as this stimulates growth of shoots from the trunks and the root system. The same also applies to the mechanical removal of Black cherry (*Prunus serotina*) and tree of heaven (*Ailanthus altissima*).

Projects in Hungary - GrassHabit (**LIFE05 NAT/H/000117**) and HUNVIPURS (**LIFE04 NAT/HU/000116**) - have shown that good results can be achieved by cutting in combination with long-term grazing of the sites by goat or mixed sheep-goat herds. The GrassHabit team used machines to remove black locust and black cherry before introducing grazing schemes on formerly abandoned grasslands. The encroached shrubs and trees were cut and removed and a mixed herd of sheep and goats fed on young shoots. Enclosures were established to enable the impact of grazing to be monitored. Results showed that regular grazing over a period of time led successively to the impairment and death of the root system. Similarly, the HUNVIPURS project used mixed livestock herds to get rid of locust root sprouts, with good overall results.

One important lesson from several LIFE projects is that stem grinding (i.e. a circumferential removal of the bark), a method once widely used, does not provide the desired long-lasting effects. The projects reported that, even after being subject to this time-consuming and costly method, 30-50% of trees produce root offshoots that must be eradicated later.

A number of LIFE projects have confirmed that better results are achieved with a combination of mechanical and chemical control, with the experience of the Hungarian projects and two Spanish projects - Riparia-Ter (**LIFE08 NAT/E/000072**) and Proyecto Estany (**LIFE08 NAT/E/000078**) – indicating that stem injection into standing trees is the most effective means of application. This best practice led to the efficient and complete elimination of the invasive black locust from the treated area.

Lessons from Hungary

Hungary provides a typical example of how natural landscapes and their biodiversity are increasingly affected by invasive alien plants. According to the Landscape Ecological Vegetation Database & Map of Hungary (MÉTA), invasive alien plants cover some 13.1% of the country's (semi-)natural habitats. The Hungarian ministry responsible for nature conservation recognised the importance of this problem and supported projects both gathering knowledge on the biology of invasive plant species and focusing on their control. LIFE Nature projects represent a significant part of these national efforts.

Chemicals are applied using this light wiper

Photo: ASTRALE EEIG/Jan Silva

New management methods developed in cooperation with Hungarian LIFE projects

Spot-spraying using selective herbicides or in a limited area around invasive sprouts, or wiping the plant with (glyphosate) herbicides

- 30% coverage: individual painting/wiping of young leaves by brushes;
- 30-70% coverage: individual wiping or spraying with small (2 l) hand sprayers;
- 70-100% coverage: spraying from back tanks (15-20 l) with adjustable spraying head.

Spraying boom with air-assisted nozzles mounted on a light (280 kg) all-terrain vehicle (ATV)

- Little soil treading damage, easy navigation, moving from field to field.

Application of herbicide foam (containing glyphosate)

- Foam-producing equipment;
- Foam remains visible for 10-15 minutes and allows immediate check of the treatment, no drifting or spillage;
- Foam collapses after 10-15 minutes, and active ingredients can be absorbed;
- Air producing compressor can be mounted onto an ATV.

Tree stem injection

- Electric drill with lithium battery used to drill holes;
- Veterinary mass-injector used to fill the holes with herbicide;
- Wounds are closed immediately with common silicon-pistol;
- Technology provides full safety for the neighbouring environment;
- No resprouting.

Tree bark painting

- Oil-based solution of species-specific herbicide and paints;
- Deep-tissue penetrating without ringing or bark removal;
- No (or very limited) resprouting effects.

One-third of the 31 completed or ongoing LIFE Nature projects in Hungary include actions to control invasive alien plants. In some cases, IAS management is a substantial part of the project. For example, the HUNSTEPPICOAKS project (**LIFE06 NAT/H/000098**) eradicated or substantially reduced arboreal invasive alien species (*Robinia, Prunus serotina* and *Ailanthus*) on 420 hectares of Euro-siberian steppic woods and Pannonic sand steppes habitats within the "Nagykörösi pusztai tölgyesek" Natura 2000 site. Eradication was by means of stem injection or combined mechanical/chemical methods.

The GRASS-TAPOLCA project (**LIFE06 NAT/H/000102**) instigated frequent mowing of 15 ha of abandoned wet sites close to Lake Balaton to supress dense *Solidago* stands in favour of the development of *Molinia*-rich meadows.

The 2006 project HUNDIDI (**LIFE06 NAT/H/000104**) targeted several invasive plant species that were threatening the endangered long-lasting pink (*Dianthus diantinus*). Chemical treatment reduced areas infested with common milkweed (*Asclepias syriaca*) from 56 ha to 7.7 ha, whilst black locust and tree of heaven were successfully eliminated on 38 ha.

Three ongoing projects - Eastern Bakony (**LIFE07 NAT/H/000321**), Hungarian Little Plain (**LIFE08 NAT/H/000289**) and HUTURJAN (**LIFE10 NAT/HU/000020**) - are building on these earlier successes. Control of invasive plants is the main objective of the latter two projects. HUTURJAN aims to eliminate or substantially supress black locust, tree of heaven, black pine, black cherry, common milkweed, box elder (*Acer negundo*) and giant goldenrod (*Solidago gigantea*) across an area of 1 100 ha.

With IAS control of such national significance, Hungarian conservationists have placed great importance on the development of efficient techniques and methods. LIFE projects have worked closely with SMEs on the development of special machinery, management equipment and chemicals for the most effective treatment of particular plant species, with good results. Istvan Szidonya, CEO of SM Consulting, who has collaborated with a number of LIFE projects in Hungary, explains that there is large-scale application of approved techniques, whilst new techniques and new chemical agents are tested in parallel on small plots (see box).

The Moravka project in the Czech Republic was the first LIFE project to attempt to eradicate Japanese knotweed along an entire water course

Photo: LIFE06 NAT/CZ/000121

CONTROL AND ERADICATION

LIFE **targets aquatic invasive plants**

The LIFE programme has helped detect, monitor, control and eradicate freshwater and marine invasive alien plant species that threaten biodiversity in vulnerable habitats.

Some 15 LIFE projects have dealt to some extent with aquatic invasive alien species (IAS), providing lessons for Member States as they undertake to implement the IAS Regulation and EU policy relating to biodiversity. Intervention measures have playing a significant role in approximately half of these projects..

Algal spread in the Mediterranean

LIFE projects involving invasive aquatic plants have mainly addressed problems in freshwater. However, a significant project cluster has addressed the major threat posed to Neptune grass (*Posidonia oceanica*) meadows, a characteristic and important Mediterranean Sea ecosystem, by invasive green algae.

*LIFE has taken action to protect Neptune grass (*Posidonia oceanica*) beds from the threat of aquatic invasive alien plants*

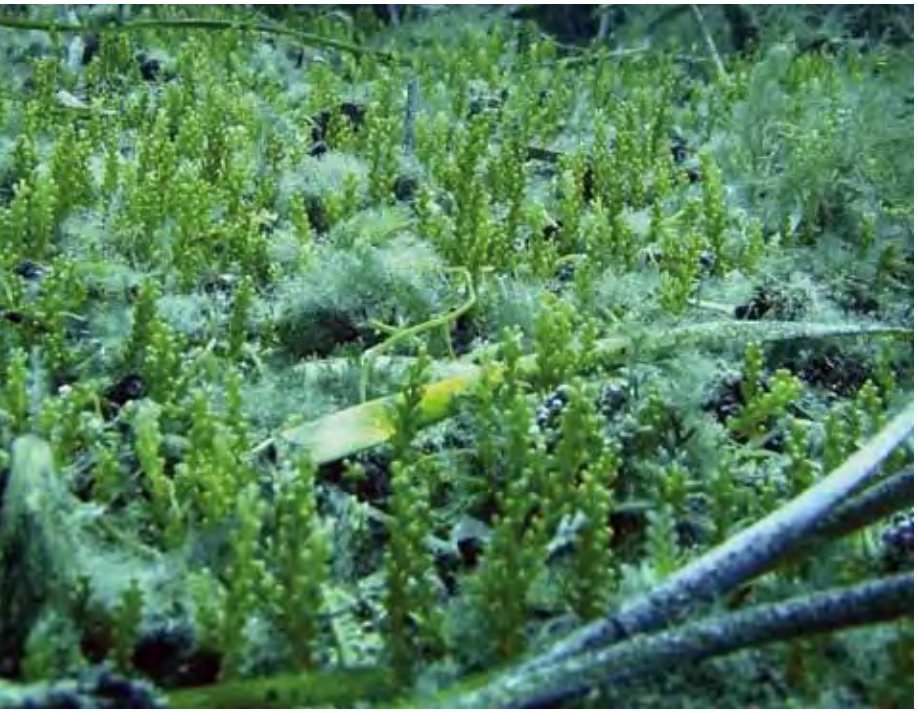


Photo: LIFE09 NAT/ES/000534/Consejería de Medio Ambiente de la Junta de Andalucía

An algae native to the Pacific, *Caulerpa taxifolia*, was first reported as a new invasive type in the early 1980s near Monaco. It spread rapidly through asexual reproduction and the presence of a toxin (caulerpenyne) that makes it inedible to native invertebrate and fish species. As a result, Neptune grass meadows were replaced with an algal monoculture of very low biodiversity. Projects were established at the very start of the LIFE Programme in 1992 to assess the range of this "killer algae" (**LIFE92 ENV/F/000066**) and possible methods for eradicating *Caulerpa taxifolia* (**LIFE95 ENV/F/000782**). These projects focused on the rapid detection of populations outside the original infestation area, using mapping techniques and a public awareness campaign that extended around the Mediterranean. However, no eradication actions were implemented.

A new variety of the related green algae *Caulerpa racemosa* was found in 1990 off Libya, which also spread quickly to threaten Neptune grass meadows. The Posidonia Baleares project created a rapid detection network (**LIFE00 NAT/E/007303**). This was extended by the LIFE Posidonia Andalucia project (**LIFE09 NAT/ES/000534**); which mapped the occurrence of *Caulerpa racemosa* and other exotic and invasive alien species, including the red algae *Lophocladia lallemandii*, using a series of diving transepts. The project assessed the applicability of local eradication measures, including dredging and manual removal by divers, but these were only considered feasible for small areas (e.g. 5 m^2).

Preventing introductions at source

In freshwater habitats, a major source of invasive alien species has been nurseries and other aquatic supply outlets. Aquatic IAS are introduced either accidentally or deliberately into natural habitats from aquariums or garden ponds, by the general public who are often unaware of the risks of IAS.

To raise awareness and to act as a tool to prevent the introduction of invasive plants in Belgium, the AlterIAS project produced a code of conduct (see pp. 21-23). Nursery professionals agreed on a consensus list of 28 species that should no longer be sold, eight of which were aquatic plants. The project produced a brochure of alternative native plants, including 12 aquatic suggestions to replace withdrawn alien species for ponds. The AlterIAS project can be a case study for other EU Member States wanting to adopt similar voluntary agreements to prevent the introduction of aquatic IAS.

Cutting-edge technology

There are a variety of techniques that can be used to control aquatic invasive plants that have become established, some of them either invented or pioneered by LIFE projects (see, for example, the feature article on the CAISIE project in Ireland - pp. 16-20). Similarly, the Lago Ganna project (**LIFE04 NAT/IT/000159**) established an ongoing monitoring programme to quickly identify alien and invasive alien species on an alpine lake in the Lombardy region of Italy.

The Iron Gates wetlands project (**LIFE10 NAT/RO/000740**) purchased and is now testing a floating weed harvester for the cutting and removal of excessive floating and submerged weed growth in a Natura 2000 site in south-west Romania. The project will eradicate the aquatic invasive alien species *Eichhornia crassipes, Azolla filiculoides* and *Nymphoides peltata* from an area of 60 ha to help stop the loss of wetland biodiversity. It also will produce factsheets with illustrations and information about all terrestrial and aquatic IAS to help in their early detection and control.

In Belgium, the Grote Nete project (**LIFE05 NAT/B/000090**) created an inventory of aquatic IAS that had spread from ornamental pools created near holiday cottages. These plants, primarily floating pennywort (*Hydrocotyle ranunculoides*), water primrose (*Ludwigia grandiflora*) and parrotfeather watermilfoil (*Myriophyllum aquaticum*), presented a serious threat to protected habitat types, and were removed from 32 locations. A LIFE project dedicated to the preservation of a Natura 2000 site in the Po river basin (**LIFE96 NAT/IT/003073**) increased the area of open flowing water by removing the invasive lotus species *Nelumbo nucifera* over a 34 ha area. Other wetland management LIFE projects, in Italy (**LIFE00 NAT/IT/007161**) and Hungary (**LIFE03 ENV/H/000280**), have also included the removal of aquatic invasive plants.

Photo: LIFE10 NAT/ES/000582/ASTRALE EEIG/Sara Mora

INVASEP implemented early warning monitoring of the Guadiana river (Spain/Portugal) for outbreaks of Nymphaea mexicana (pictured)

European corridors and trans-border cooperation

The TIB project (**LIFE10 NAT/IT/000241**) is concerned with preserving the ecological corridor between the Alps and the Apennines through the Po valley, by improving habitats and overcoming obstacles to species dispersal. One obstacle is caused by two invasive plant species, Indian lotus (*Nelumbo nucifera*) and water primrose, clogging watercourses. The project is removing these from an extensive area in two sites, while assessing different techniques such as mechanical eradication, single mowing and double mowing.

Invasive alien species are no respecters of borders. INVASEP (**LIFE10 NAT/ES/000582**) is a transboundary project addressing IAS in the Tagus and Guadiana river basins in Spain and Portugal. One project action is to map and produce an inventory for the invasive water fern *Azolla filiculoides*. Cost-benefit analyses for the control of this and other aquatic invasive alien species are being conducted and mechanisms for their early detection put in place, including an awareness-raising media campaign.

The LIFE programme is well-placed to continue funding projects aimed at preventing the introduction and spread of aquatic alien species in marine and freshwater habitats. Early detection methods and rapid control responses are central to this, and several recent LIFE projects are demonstrating the way forward.

CONTROL AND ERADICATION

When pets go wild – **eradicating invasive reptiles and amphibians**

Reptiles and amphibians sold as pets and released into the environment can have a devastating impact on endangered species and protected ecosystems. LIFE has pioneered methods of managing invasive turtles, snakes and other species.

Several LIFE projects have addressed the impact of invasive reptiles and amphibians on Natura 2000 sites and on other species. Turtles, frogs and snakes kept as pets are often alien species that can have negative effects on native ecosystems and other species if they are released. IAS such as the red-eared slider (*Trachemys scripta elegans*), American bullfrog (*Lithobates catesbeianus*) and California kingsnake (*Lampropeltis getula californiae*) compete for resources and predate upon species listed in the annexes of the Habitats Directive and Birds Directive. For example, the American bullfrog feeds upon the eggs and larvae of the endangered common spadefoot (*Pelobates fuscus insubricus*), as well as the larvae of several fish species.

Invasive reptiles and amphibians can also be a source of disease. Some invasive alien amphibians are a vector of transmission of chytridiomycosis[1], whilst the red-eared slider is a vector for Salmonella-related conditions.

Controlling the trade in wildlife

The EU wildlife trade regulations not only provide a basis for the implementation of CITES within the Community, but have also been useful as a legal tool for controlling imports of species that may become invasive.

Regulation 338/97 provides that the Commission may establish restrictions on the import of "live specimens of species for which it has been established that their introduction into the natural environment of the Union present an ecological threat to wild species of fauna and flora indigenous to the Union."

The American bullfrog and the red-eared slider are examples of amphibian and reptile species subject to an import ban (according to Commission Regulation (EC) No. 349/2003).

This regulation also covers the ruddy duck (*Oxyura jamaicensis*) (see pp. 45-48), as well as the following species: Pallas's squirrel (*Callosciurus erythraeus*), grey squirrel (*Sciurus carolinensis)*, fox squirrel (*Sciurus niger*) and painted turtle (*Chrysemys picta*). These species will be considered as a matter of priority for listing as invasive alien species of Union concern within the framework of the new IAS Regulation.

Tackling the red-eared slider in Iberia

The pet turtle trade has led to a large number of specimens being exported to Europe from turtle farms in the US. Between 2002 and 2012, these farms exported more than 100 million turtles worldwide, mainly two genera, *Pseudemys* and *Trachemys*. These lifespan of these turtles (typically 20-30 years) means they often outlive their usefulness as pets and are released into the wild.

"Even today after the EU import ban we see kids having them as pets," says José Ignacio Lacomba, project manager of the LIFE TRACHEMYS project (**LIFE09 NAT/ES/000529**), a recently completed LIFE Nature project in Spain and Portugal that demonstrated a strategy and techniques for the eradication of invasive freshwater turtles. Pet turtles that are released can out-compete endemic turtles listed in Annex I of the Habitats Directive, namely the European pond turtle (*Emys orbicularis*) and the Spanish pond turtle (*Mauremys leprosa*). Exotic turtles can also be vectors of several pathogen agents that can be transmitted to other turtles and to humans.

1 Caused by the fungus Batrachochytrium dendrobatidis, is an emerging disease of amphibians responsible for population declines and even extinctions globally

Table 1 – Trapping techniques tested by LIFE TRACHEMYS			
Passive traps	**Results**	**Active traps**	**Results**
Fyke nets	Good results: 6.3 captures/day	Active capture tools (hand nets)	Good results (for juveniles)
Floating traps with bait	Average results: 5 captures/day	Nets	Bad results
Floating traps with bait and PVC	Good results	Capture by hand	Bad results
Floating enclosed traps with external entrances	Bad results	-	
Floating traps	Good results		
Floating traps with 4 ramps	Good results: 8 captures/day		

LIFE TRACHEMYS sought to address the negative environmental impacts on wetland environments from alien exotic turtle species in Valencia (Spain) and the Algarve (Portugal) and to enable the native populations of European pond turtle and Spanish pond turtle to recover.

The first step towards achieving this goal involved testing innovative and practical ways to capture the invasive turtles. As Table 1 shows, the project team (led by the Environment Ministry of the Valencian regional government), tested a number of trapping techniques to identify the most effective ones.

"We tested and designed several traps for capturing turtles in different conditions but in the end only two systems were effective: the floating traps with four ramps and the 'salabres', a type of traditional fishing gear," explains project coordinator, Vicente Sancho..

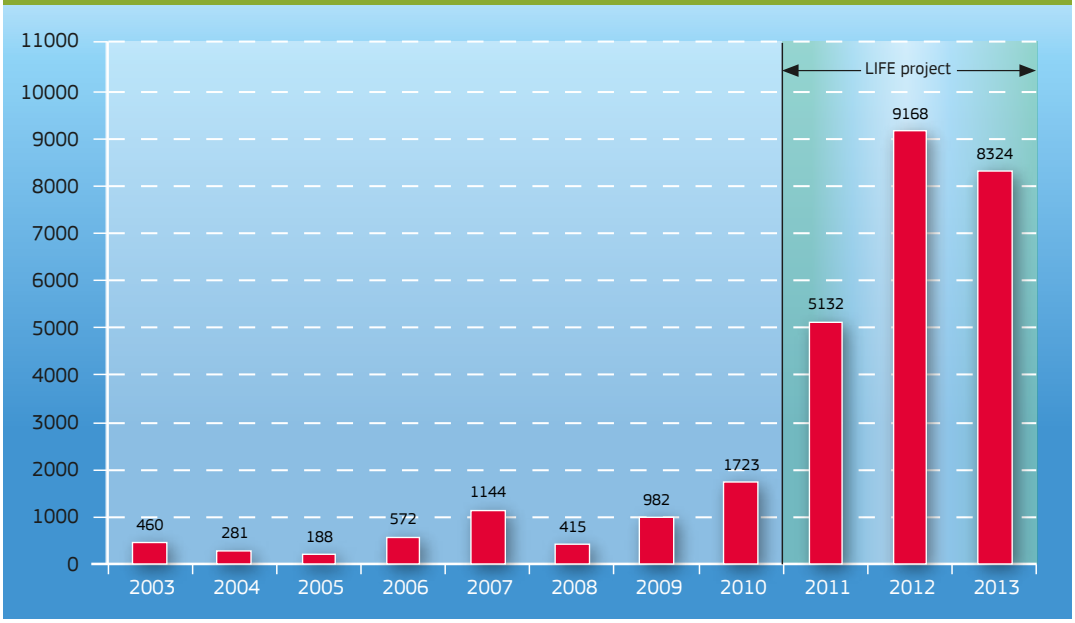
With this knowledge, the project then set about installing traps. In Valencia it hired two survey teams to construct platforms and floating traps. A total of 53 floating traps, 50 platforms and 150 pots were installed. The Portuguese project partner used the same methods, itself installing 15 floating traps and 20 pots.

The results were impressive, with some 23 000 turtles captured between 2011 and 2013, most of which were red-eared sliders (see Figure 1). In Valencia, several other invasive alien turtle species were also

The TRACHEMYS project tested a number of techniques for trapping invasive alien turtles

Photo: LIFE10 NAT/ES/000582/ASTRALE EEIG/Sara Mora

Figure 1. **Evolution of T.scripta captures before and during the LIFE project (2011-2013)**



captured (*Graptemys ouachitensis, G. kohni, G. pseudogepgraphica, Pseudemys concinna* and *Trachemys emolli*). The floating traps and pots were responsible for half of all captures, with 33% of invasive specimens captured by hand and 16% using 'salabres'.

Captured specimens were put down. "Turtles were eliminated in a humane way and according to defined international protocols," stresses Mr Sancho.

The project also tested two methods of detecting and destroying red-eared slider nests: the first using dogs and the second ground-penetrating radar (GPR). Results from the first approach were not good, explains Mr Sancho: "The dogs do not spot the nests as soon they dry up. At best, they can only detect egg-laying points with recent eggs." Thus, this technique may be useful for discovering egg-laying areas in general, but not for finding specific nests.

The GPR trials found that the technology could not distinguish between invasive turtle nests and other types of cavities in the ground. However, georadar did help to identify two new major breeding grounds in Spain - in the marshlands of La Safor and the Pego-Oliva Natural Park.

The LIFE TRACHEMYS project created a captive breeding programme for two native pond turtle species

Photo: LIFE09/NAT/ES/000529

Testing for disease and captive breeding

Another element of the project involved sending exotic turtle carcasses to the Faculty of Veterinary Science, CEU San Pablo, where they were tested for the presence of Salmonella and other highly pathogenic bacteria. “Eighty percent of the turtles have Salmonella. There was even one turtle with Cholera bacteria,” notes Mr Lacomba. “This shows that, as well as having a direct impact on endemic turtles and wetland ecosystems, pet turtles are a public health issue.”

Another ex-situ project activity was the creation of a captive breeding programme for the two native pond turtle species. This was established at the El Palmar Breeding Centre in collaboration with Valencia Bioparc (zoo) and Oceanographic (marine aquarium). Valencia Oceanographic has two aquariums to take care of up to 30 juveniles during their first year of life, whilst the Bioparc has created a nursery for up to 21 specimens. More than 100 captive bred European pond turtles and Spanish pond turtles have been released so far to help restock numbers in the wild. Thirty specimens have also been released in Portugal as a result of the work of two breeding centres set up with the support of the LIFE project (Parque Biológico de Gaia and RIAS-Centro de Recuperação e Investigação de Animais Selvagens Ria Formosa, Algarve).

“Do not leave your pet turtle in the wild!”

Raising awareness about the harm invasive freshwater turtles can do has been an important aspect of the LIFE TRACHEMYS project. Efforts have been targeted at groups that currently own exotic turtles or who may wish to acquire one as a pet (i.e. mainly children).

Mr Ignacio says that the main challenge is to make people aware of the risks to nature and to themselves (as vectors of disease) of these invasive alien species (IAS). One way the project has tried to do this is by keeping some of the specimens it captured for use in awareness activities. The La Granja del Saler centre includes an area where visitors can observe full-grown adult turtles, some weighing more than 2.5 kg and demonstrating aggressive behaviour. “Showing these big turtles to a kid has an effect; they no longer see them as small, lovely pets that you keep in a little terrarium,” he explains.

Photo: LIFE09/NAT/ES/000529/J.V. Bataller

The LIFE TRACHEMYS project captured some 23 000 invasive alien turtles between 2011 and 2013

The TRACHEMYS team also has partnered with Valencia Bioparc and Oceanographic to gain greater visibility for a jointly-developed and targeted awareness campaign on invasive alien turtles and endemic terrapins. Valencia Oceanographic attracts more than 1.5 million visitors per year. This was supported by significant media coverage in Spain and Portugal for the LIFE project, as well as workshops in schools in Portugal and Valencia that have been attended by more than 5 000 pupils.

*Red-eared slider (*Trachemys scripta elegans*)*

Photo: LIFE09 NAT/ES/000529

Photo: LIFE09 NAT/ES/000529/Universidad Complutense de Madrid/Alberto Álvarez

One of the turtle trapping methods tested by LIFE

A key message of the project is that pet turtle owners should not release them back into the wild when they get too big and aggressive, especially as these releases normally occur where endemic species are already present. "We said: do not abandon your pet turtle. Give it to us, we will take care of it," stresses Mr Lacomba.

Thus, the project set up recovery centres in each of the three provinces of the Valencian community, at La Granja del Saler (Valencia), Santa Faz (Alicante) and Forn del Vidre (Castellón), as well as two in Portugal (Algarve and Gaia). In total, more than 3000 invasive turtles have been handed over to the centres, two-thirds of which have come from local people.

Turtle alert network

The project also established a turtle alert network, an early detection protocol created through a series of meetings between environmental technicians, NGOs and local administrations. The network has more than 100 participants, who provide useful information about the presence of invasive freshwater turtles, for instance, identifying 10 locations in Valencia where these alien species had not previously been observed. The LIFE TRACHEMYS website also includes a form that anyone can fill it to note sightings of non-native species. In total, the project has received more than 500 warnings from 23 municipalities by means of the alert network.

Despite the project's achievements, Mr Lacomba says that one of its main findings is that, "it is impossible to eradicate invasive alien turtles from Valencia... it is too large and too expensive a task." Instead, the beneficiary will concentrate its future efforts on preventing reinvasion in the places where the IAS have been removed and endemic terrapins reintroduced.

Snakes out of control

The California kingsnake is an invasive alien species that is quickly spreading on Gran Canaria, one of Spain's Canary Islands. The snake is native to the western side of North America (from Oregon, USA, down to Baja California in Mexico) and has a mean adult size range of 76-122 cm (the largest specimens are up to 2 m long). It has a varied diet, including rodents, small mammals, birds, reptiles, amphibians and eggs.

The Canary Islands have no native snake species. This enables the California kingsnake to predate a wide range of vulnerable targets, including some reptile species endemic to the Canary Islands, in particular the Gran Canaria giant lizard (*Gallotia stehlini*). It also poses a serious threat to other endangered species, such as the Gran Canaria blue chaffinch (*Fringilla teydea*).

The first indications of the snake's presence on the island date back to 1998, although the naturalisation of California kingsnake populations was not observed until 2004. Evidence suggests that the invasive pathway of the snake was escape from captive breeding for the pet trade - the albino form of the kingsnake is a popular pet. The species is currently present in two main large nuclei in Gran Canaria. Given its capacity for adaptation and acclimatisation, it is likely to spread to the rest of the island.

The LIFE project LAMPROPELTIS (**LIFE10 NAT/ES/000565**) started in September 2011 and will run for four years. It aims to develop new techniques to

The LAMPROPELTIS project sought to gain a clearer understanding of the size of the California kingsnake population and its genetic variability in order to optimise control of this species

Photo: LIFE10 NAT/ES/000565

capture California kingsnakes, increase knowledge of the biology of the species and its distribution in Gran Canaria, monitor its interaction with environmental variables and estimate the population status.

Trapping techniques

The project has already tested several different methods of trapping the invasive snakes, including board traps (more than 400 installed), double-funnel tube traps (70 constructed and 59 placed in the field), experimental box traps (12 installed, six in each population nucleus), the use of various attractants (lizard excrement, mice, snake pheromones and live female snakes), and trained dogs (it is early stages but five dogs have been trained, with two snakes captured).

Perhaps the most innovative capture method involves the use of trained hawks (*Parabuteo unicintus*), which so far in 2014 have captured five snakes. The project intends to use the hawks more once hunting permits are granted.

As Figure 2 shows, the project had captured 1 104 snakes by May 2014. Traps accounted for 9% of captures, with 41% from direct search and manual catch. However, the most effective method so far (50% of captures) has been an early warning system established by the project.

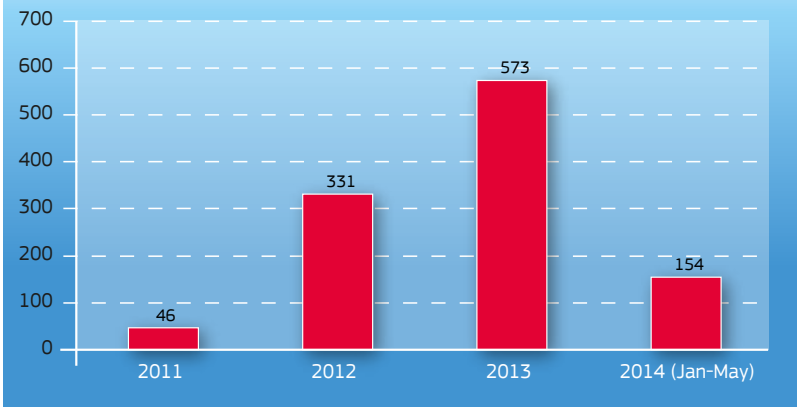
The early warning system consists of a phone hotline for local people to report the presence of a snake to the project team.

Project manager Ramón Gallo notes that while the work involved in capturing snakes reported via the early warning system is demanding for the project team, the hotline is increasing engagement with the project and its objectives: "The local population is feeling progressively more involved in the project (for instance, several people catch the snakes themselves and give them to the project workers on a regular basis)." This highlights the importance of community involvement in controlling the spread of invasion, he believes.

Monitoring and management

According to Mr Gallo, the aim of the project is not to fully eradicate the invasive alien species: "It's a control programme and the search for techniques to achieve better control results." One aspect of more effective management is a clear understanding of the size of the California kingsnake population and its genetic variability. To this end, the project is carrying out genetic analysis using molecular markers. The LAMPROPELTIS project expects to contain the spread and increase of the snake's core population and to reduce by 50% the secondary core.

Figure 2. **Number of kingsnakes captured (2011-2014)**



Invasive amphibians

No LIFE Nature project has specifically targeted the control or eradication of invasive alien amphibians, however, some projects have included such actions to help them meet their wider objectives. For instance, the Italian Pelobates fuscus insubricus project (**LIFE98 NAT/IT/005095**) successfully took measures to control the American bullfrog in the Poirino Favari Natura 2000 network site as part of an overall goal of conserving the common spadefoot and its natural habitat.

Although a negative impact on the common spadefoot has not yet been proven, the American bullfrog's potential role as a predator on eggs and tadpoles suggests the need for a future eradication (e.g. by means of recurring winter drainage of the ponds).

An ongoing Belgian project, LIFE Hageland (**LIFE11 NAT/BE/001067**) is working to restore a mosaic of Annex I habitat types including wet grasslands, dry grasslands and heaths, woodland, mires and ponds. As well as controlling a number of invasive plant species, the beneficiary plans to survey numbers of American bullfrogs in the Netel and Demer valleys and combat the species in project sites.

American Bullfrog

Photo: Wikimedia Commons/Jarek Tuszynski/CC BY-SA 3.0

CONTROL AND ERADICATION

Combating invasive alien fish in Europe's aquatic habitats

Several LIFE projects have carried out measures to tackle the problem of invasive alien fish species in European rivers and freshwater areas. Such actions have helped maintain populations of endangered native fish, amphibians and other freshwater species.

Endemic to the Adriatic basin, the Adriatic sturgeon (*Acipenser naccarii*) is a priority species under the Habitats Directive. Its numbers, particularly in the Po River basin, Italy, have decreased markedly as a result of the construction of dams. These structures prevent the sturgeon from reaching its main spawning areas. However, the sturgeon population has also declined with the rapid rise in numbers of the Wels catfish (*Silurus glanis*), an invasive alien species (IAS).

Amongst a raft of measures to protect the sturgeon, a 2003 LIFE project (**LIFE03 NAT/IT/000113**) planned to capture the large invasive catfish in the Ticino River, a tributary of the Po, and conduct further analysis of this species to better understand how it competes with the endangered sturgeon.

The study of the Wels catfish showed that it can occupy all the habitat types in the tributary, from the low-depth areas to the big pools and from slow flowing reaches to the cascades. The IAS predates on gammarids (crustaceans), an important food source of the Adriatic sturgeon, and the project's analysis confirmed the view that the presence of this catfish represents a genuine obstacle to the recovery of the sturgeon population in the Ticino. The project thus removed some 2 000 catfish from the river.

Furthermore, the project showed that in recent years the Wels catfish has been directly predating on young sturgeon. Its control (through electrofishing) has been vital to the ability of autochthonous species to recolonise areas of the Po Basin.

The removal of alien fish species not only helps conserve endemic fish species but other fauna, such as amphibians and anisoptera. An ongoing Estonian LIFE project is a good example of such conservation. Dragonlife (**LIFE08 NAT/EE/000257**) is targeting the endangered yellow-spotted whiteface toad (*Leucorrhinia pectoralis*) and spadefoot toad (*Pelobates fuscus*). As part of a range of conservation measures, it is drawing up guidelines for the eradication of aquatic alien species, such as crucian carp (*Carassius carassius*) and waterweed (*Elodea sp.*), in small water bodies. The removal of these competing species will improve conditions for the protected toads.

An ongoing LIFE biodiversity project - BIOAQUAE (**LIFE11 BIO/IT/000020**) - is also focusing on alien species removal, in this case, of the North American brook trout (*Salvelinus fontinalis*) from high-altitude alpine lakes in order to improve the biodiversity of the rivers, streams and lakes of Italy's Gran Paradiso National Park.

Originally these alpine lakes lacked fish species and the endemic fauna consisted mostly of zooplankton, arthropods and the common frog (*Rana temporaria*). But its ecosystems have degenerated as a result of the introduction of brook trout and some species have become extinct locally. Moreover, in some rivers in the region, such as the Campiglia and Forzo, the native marble trout (*Salmo marmoratus*) is hybridising with the brown trout (*Salmo trutta subsp. Fario*).

Releasing Adriatic sturgeon in the Ticino River

Photo: LIFE03 NAT/IT/000113

CONTROL AND ERADICATION

LIFE at forefront of invasive aquatic invertebrate control

Europe's aquatic invertebrates face significant threats from invasive alien crayfish and mussels. Control and eradication is a major challenge as these species are typically well established and widely distributed. LIFE is at the forefront of efforts to identify solutions.

The Louisiana crayfish (*Procambarus clarkii*), signal crayfish (*Pacifastacus leniusculus*) and spinycheek crayfish (*Orconectes limosus*) are species native to North America. They are highly invasive in Europe, where they are threatening many sub-populations of native crayfish - such as the noble crayfish (*Astacus astacus*) and white-clawed crayfish (*Austropotamobius pallipes*) - through direct competition. They can also carry crayfish plague that seriously threatens native European species..

LIFE projects have been at the forefront of testing possible techniques for controlling and eradicating these invasive crayfish species. One of the earliest projects that worked on this issue was the French project LIFE TBFPA (**LIFE04 NAT/FR/000082**). It tried, albeit with limited success, to limit the presence of spinycheek crayfish in small rivers using various fishing techniques, including fishing by lamplight, fishing with baskets and electric fishing.

The ongoing Italian project CRAINat (**LIFE08 NAT/IT/000352**) has conducted several additional attempts to capture invasive crayfish using creels – large wicker baskets – in Lombardy. The first five attempts – using 60 baskets each time – failed to capture any of the targeted species. Placing the creels in the key location of an infested lake delivered some success, but still only 33 individuals were captured in the following five attempts, during 2012-2013. The project also tried electro-fishing techniques in 2011, but was only able to capture five crayfish.

Neutering invasive alien crayfish

The recent French project "LIFE Continuité écologique" (**LIFE10 NAT/FR/000192**) has gone further. It has conducted a literature review and confirmed that the capture and destruction of the invasive crayfish is not likely to be sufficient to reduce populations. It has confirmed that additional techniques to prevent reproduction are needed. It started to explore the potential for castrating male crayfish, but was unable to pursue this idea to fruition.

Photo: LIFE08 NAT/E/000078/Consorci de l'Estany

Invasive alien crayfish pose a major threat to native aquatic invertebrate species

The LIFE project RARITY (**LIFE10 NAT/IT/000239**) has been working to build on what has been learnt about the challenges of eradicating invasive alien crayfish. This has included exploring new and advanced methods for capturing individuals, and also exploring the means to reduce the fertility of the invasive population. It has particularly targeted the invasive Louisiana crayfish in Friuli-Venezia Giulia region.

Using university research partners, the project has been exploring the use of female sexual pheromones

Photo: LIFE09 NAT/SI/000347/Nika Debeljak Šabec

*The white-clawed crayfish (*Austropotamobius pallipes*) is threatened through direct competition with other invasive alien crayfish species*

to lure males into traps. A new cheaper methodology to synthesise the pheromones has been developed, although the project is still conducting tests to identify which are the most stimulating and attractive molecules for the males. Tests have been encouraging, with 1 113 non-native crayfish specimens removed in 2012.

The project is testing use of the 'Sterile-Male-Release' Technique for the *P. clarkii* after laboratory tests demonstrated a 40% reduction in fertility. It has treated three groups of 25 males with 20, 40 and 60 Gy of radiation respectively and released them into project sites. Morphometric and cytologic analyses of the testicles as well as ongoing study of the reproductive behaviour of the released individuals should reveal the optimal dose required to control the invasive alien species (IAS).

RARITY has also identified an alternative technique for reducing fertility of the invasive alien species, by using hormone-laced baits to inhibit the sexual maturation of individual crayfish. Laboratory tests demonstrated the fertility-reducing effects of gonad-inhibiting hormone (GIH). A system for the oral use of protein peptides has been developed, using the hyperglycaemic hormone of crustaceans. The long-term aim is to produce a cheap synthetic version of the GIH.

The search for solutions to the problem of invasive alien crayfish is not over. However, LIFE projects are playing an essential role in ruling out the techniques that do not work and enabling further investigation of those that offer the greatest potential. The initial results of the RARITY project suggest that the feasibility of the new capturing technique and fertility-reducing measures is good and may provide the long-term answer. The project expects to consolidate these into a formal Action Plan to control allochthonous species.

Addressing invasive alien threat

Invasive alien species of mussel – including the zebra mussel (*Dreissena polymorpha*), false dark mussel (*Mytilopsis leucophaeata*) and Asiatic clam mussel (*Corbicula fluminea*) – are having a negative impact on the endangered native freshwater pearl mussel (*Margaritifera margaritifera*) and native species of clam.

Furthermore, the zebra mussel in particular has been found to alter the structure and functioning of entire ecosystems, as well as blocking and damaging pipes and other infrastructure in a process known as biofouling. The sheer extent of their proliferation and their impact on aquatic ecosystems presents a major environmental challenge.

The Spanish project INVASEP (**LIFE10 NAT/ES/000582**) is working to combat a number of invasive alien species in the Tagus and Guadiana river basins, including the zebra mussel and Asiatic clam mussel. The project seeks to contribute to the development of a National Strategy for the control of these species.

Its planned activities include the development of risk maps. These would identify hot spots where interventions are needed to prevent the spread or introduction of these invasive alien species, notably through disinfection of equipment that might be carrying mussel larvae. It also hopes to develop an emergency protocol to be implemented in cases where introduction has already occurred, based on an early warning system.

The Finnish project FINMARINET (**LIFE07 NAT/FIN/000151**) conducted studies on the distribution of the zebra mussel and false dark mussel in the Baltic Sea to provide a baseline against which to identify and mitigate future spread, taking into account concerns that the Baltic's decreasing salinity will provide conditions for these invasive alien species to proliferate.

CONTROL AND ERADICATION

Red squirrel survival depends on grey squirrel control

The grey squirrel, a native of North America, has already had a devastating impact on the UK's native population of red squirrels, and conservationists are eager to prevent the same pattern of disappearance occurring in Italy.

Photo: Carlo Morelli

The native red squirrel (pictured) is under threat from the invasive alien grey squirrel in northern Italy

At present, researchers believe that the grey squirrel (*Sciurus carolinensis*) can be eradicated from areas of northern Italy where sizable populations of the invasive squirrel already exist. The EC-Square project (**LIFE09 NAT/IT/000095**) was set up to demonstrate best methods for effecting this removal and for promoting habitats for red squirrel (*Sciurus vulgaris*). The native species suffers as a result of the alien grey's superior ability to store food and propagate. Immediately after World War II, the grey squirrel was restricted on Great Britain mostly to areas in and around London. Over the intervening years, however, its range has spread to much of the rest of the island, including parts of lowland Scotland. Pure red squirrel colonies are restricted to areas of the Isle of Wight and Anglesey, two islands off England and Wales.

In the UK, the grey squirrel is widely understood by the population to be the cause of the demise of the red squirrel in vast areas, and the need to control greys, which are commonly seen as pests, is broadly accepted. This attitude, however, is not shared by many in the regions targeted by the Italian LIFE

The LIFE project made use of feeding stations that only the smaller red squirrels could access

project: Liguria, Lombardy and Piedmont. Much of the project's attention has thus been focused on fostering a more sympathetic attitude to the aims of the conservationists and to explain to those concerned by the killing of animals the reasons for doing so. The task of its awareness campaign has been made all the more difficult by a fervent counter campaign supported by a range of animal welfare groups.

Though the red squirrel conservation project has proved to be controversial, the co-ordinating beneficiary, the regional government of Lombardy and its partners are optimistic that the measures that it has taken can, if continued, ensure the long-term survival of the native species in Italy. Whilst an accommodation with ardent protesters is unlikely, the organisers say that their message is finally being heard, and following a spate of initially negative newspaper articles, efforts to work with journalists and organise meetings and school trips to project sites are starting to change hearts and minds. The project, which is due to finish in early 2015, represents an important first step in the fight to prevent grey squirrels leading to the demise of red squirrels in the country, as well as their spreading to neighbouring countries.

To sterilise or not

One of the underlining factors behind the presence of the grey squirrel in Italy was their trade as pets. It is now illegal to sell the animal in Italy, and one of the first successes of the project was to work with the Ministry of the Environment in order to demonstrate to other competent ministries the need for a trading ban, according to Elisabetta Rossi of the Lombardy region's environment department. "It was necessary to show the need for this ban for the purpose of protecting biodiversity to counter socio-economic arguments," she explains.

Whilst it is possible to carry out sterilisation programmes to ensure the elimination of invasive greys in small areas with low populations – such as the urban parks of Genoa – in Lombardy and Piedmont the numbers are too great and neutering is not a cost-effective, or even feasible, solution. As a result, the project team initiated measures to trap and euthanase grey squirrels in order to establish areas favourable to red squirrel conservation.

Other methods such as shooting are more problematic. "Shooting is likely to arouse the suspicion of those against hunting," says the project leader Sandro Bertolino, a veterinary scientist at the University of Turin.

But Mr Bertolino recognises the sensitivity of killing an animal that is easy to 'Disney-fy'. "Because they are so cute and so nice, it's difficult for people to think that they can cause problems," he says. (In fact, as well as its impact on red squirrel populations, the grey squirrel may be responsible for other impacts on natural ecosystems that have yet to be

Humane trapping of a grey squirrel

Photo: LIFE09 NAT/IT/000095

determined.) The example of the UK's native red squirrel features highly in the project's campaign material and on the information boards erected at selected regional parks that are actively working on the project in collaboration with the regional government.

At one large site, Parco di Montevecchia, a red squirrel observation area has been established. Many school visits have been organised to the area, where pupils can, if they're lucky, watch the shy red squirrels make use of the project-built facilities – nut boxes and nesting boxes. Also, the retiring reds are able to enjoy the improved habitat conditions. Pines favourable to squirrel conservation have been planted with a view to providing a long-term sustainable habitat for the population. However, these measures will only be effective if greys are removed.

The project's prototype feeding apparatus is also being trialled at this site. The feeder is designed to permit only red squirrels to enter and reach a collection of nuts (reds are typically much smaller, weighing 280-350 g whilst greys are around 500-600g on average). The wooden runway is sprung open under the greys' extra weight and they are unable to reach the end where the nuts are kept.

In spite of these efforts to promote red squirrel conservation in a 'positive' way - the logo 'Rosso Scoiattolo' (literally 'red squirrel' but reversing the correct Italian word order scoiattolo rosso as a way of adding recognition value) featured prominently in all communication efforts - detractors chose to single out the project for special criticism, provoking a string of sensational headlines in newspapers. Some animal rights groups were opposed to aspects of the project, including the need for grey squirrel control. "We are currently trying to work with some of these stakeholders to find possible alternatives and solutions," says Mr Bertolino.

Though meetings were organised to address the protestors concerns, a fundamental divergence of philosophies makes it difficult to reach consensus, says the project team. The groups supporting the anti-conservation campaign, are not concerned by the ultimate impact of the grey squirrel on biodiversity in Europe, and do not favour human intervention if it means the killing of animals, however humane and scientifically advisable it may be.

To combat misinformation, however, the project has been actively using social media, such as Facebook, to reach as wide an audience as possible. Its website has moreover regularly attracted more than one thousand visits a month. The education kit for schools includes a booklet, CD-ROM and DVD games.

One clear success of the project is the drawing up of management guidelines for the areas favourable to red squirrels. These include increasing the number of hazelnut trees at Parco del Ticino and Montevecchia, for example. There also has been an increase in the number of red squirrels where greys are removed. "At the beginning of the project we proposed to re-introduce red squirrels [into these areas], but at this point we are finding that when we remove the grey squirrels the red squirrels come back naturally," says Elisabetta Rossi.

Genoese manoeuvres

The 300-strong population of grey squirrels in Parco di Nervi, Genoa, is truly loved by locals and its removal by euthanasia would have provoked considerable opposition among those already suspicious of the conservationist message. In view of this consideration and because the population in the park is

The project has improved habitat conditions for red squirrels in parts of Liguria, Lombardy and Piedmont

Ruddy duck eradication

Prior to the launch of a highly successful LIFE project, the population of the white-headed duck (*Oxyura leucocephala*), a small stiff-tailed aquatic bird, was in free fall. The population decline of the species, which breeds in open water with areas of dense vegetation in Spain and North Africa, can be attributed to habitat loss and hunting, among other factors. But another significant threat to the species was emerging: interbreeding with the ruddy duck (*Oxyura jamaicensis*).

The ruddy duck is American in origin, but individuals have escaped from wildfowl collections in Europe. Its aggressive mating behaviour and willingness to interbreed is threatening the survival of the white-headed duck. At the start of the ERDUK project (**LIFE05 NAT/UK/000142**), there were some 5 000 feral ruddy ducks in the UK, 95% of Europe's total. The LIFE project was launched in recognition of the fact that if these ducks were to colonise mainland Europe in significant numbers, the costs of eradication would be much higher and the chances of success very much reduced.

The preferred method of controlling the invasive alien species was shooting with sound-moderated rifles and shotguns, but other methods such as trapping and egg oiling were used occasionally where appropriate. Though a full eradication was not achieved, at the close of the project in 2011, fewer than 100 birds remained in the UK and funding was in place to continue the control activities. The project also managed to secure an agreement at the Standing Committee of the Bern Convention that commits all Member States to a complete eradication of the ruddy duck by 2015.

A second conservation project targeting the white-headed duck, OXYURA LEUCOCEPHALA-MURCI (**LIFE09 NAT/ES/000516**), is focusing on important habitats of the target species, namely three lagoons in Murcia, Spain: Campotejar, Moreras and Alhama de Murcia. The project is improving understanding of this species and addressing its specific threats. It is moreover ensuring that the ruddy duck does not settle in Murcia, and that the region is not a breeding ground for this species and its hybrids.

relatively isolated, the decision was taken to undertake a sterilisation programme here.

The park is one of the most picturesque locations along the Ligurian coastline and is famed among the Genoese for its squirrels – albeit grey ones. The project has sought to harness this interest in the all things bushy-tailed to elicit support for its efforts to replace the grey population with a native red one, making campaign t-shirts available alongside the

Cartoons such as this one helped explain the project's aims and highlight the need to manage the threat posed by the grey squirrel

bags of nuts that vendors sell to the people that enjoy feeding grey squirrels, which they have come to think of as belonging to the park.

In recognition of these sentiments, the project partnered with environmental group, Legambiente, to help establish support for the project. Even though the trapped animals are sterilised and released into another park, Villa Gambaro, which has a suitable habitat, resistance has been as fierce as in other regions of Italy. Some traps have been stolen, but nevertheless, around 50 individuals have now been neutered at a local veterinary clinic and micro-chipped for monitoring purposes. To ensure that the squirrel doesn't remain in the trap longer than necessary, the traps include a radio mechanism that automatically alerts the park manager as soon as an animal is captured.

The local authorities and scientists working on this aspect of the project are evaluating the possibility that red squirrels will return to the park once the grey squirrels have been removed. The park is located at the foot of a mountain that contains a few red squirrels. One possibility that the project beneficiary plans to discuss further with local authorities and stakeholders is to instigate a reintroduction programme for the native species.

Says Andrea Balduzzi of the University of Genoa: "We hope that they [red squirrels] become as visible and as familiar as the grey ones, and become a substitute for them in the hearts of the locals."

Project number: LIFE09 NAT/IT/000095

Title: EC-SQUARE - Eradication and control of grey squirrel: actions for preservation of biodiversity in forest ecosystems

Beneficiary: Regione Lombardia

Contact: Franco Binaghi
Email: franco_binaghi@regione.lombardia.it
Website: www.rossoscoiattolo.eu/
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CONTROL AND ERADICATION

Control and eradication of invasive alien predators

A LIFE Platform Meeting highlighted the complex issues around the management of invasive alien predators and offered useful lessons for people working in the field and those involved in drafting policy.

The LIFE+ Nature project MIRDINEC (**LIFE09 NAT/SE/000344**) brought together more than 30 experts from across the EU, as well as Australia, New Zealand and the United States, for a final conference and Platform Meeting (thematic seminar) in Luleå, northern Sweden in June 2013..

The aim of the event was to demonstrate to relevant authorities and the public successful management of invasive alien species (IAS), with a particular focus on invasive (mammalian) predators.

Several LIFE projects were represented at the event, including LAMPROPELTIS (**LIFE10 NAT/ES/000565** - see pp. 36-41) and SAFE ISLANDS FOR SEABIRDS (**LIFE07 NAT/P/000649** - see pp. 56-59). After two days of presentations and fruitful discussions, the conference concluded with the drafting of a 10-point proposal to the European Commission for the management of IAS[1].

Among the key issues raised by the conference was ensuring that programmes targeting the prevention, control and eradication of alien predators and other invasive alien species are adequately funded. The conference also highlighted the importance of engagement with stakeholders and local communities (indeed, a public presentation of the MIRDINEC project's objectives and results during the meeting was well-attended by local residents).

The MIRDINEC project

Led by the Swedish Association for Hunting and Wildlife Management ('Svenska Jägareförbundet'), the LIFE MIRDINEC project worked from 2010 to 2013 to prevent the spread of the raccoon dog (*Nyctereutes procyonoides*). A native of East Asia, large numbers of this invasive predator were released in western parts of the Soviet Union in the first half of the 20th Century, as a means of developing a fur industry around the species. The raccoon dog has since spread into Finland and further west and is trying to gain a foothold in Sweden. In line with the Rio Convention on Biological Diversity, as well as the Bern and RAMSAR conventions, the eradication programme is necessary because the raccoon dog is harmful to native Swedish biodiversity, protected under the EU Birds and Habitats directives, particularly amphibians and ground-nesting birds. It is also the number one rabies vector in Europe. As a result, the

Photo: LIFE09 NAT/SE/000344/ASTRALE EEIG/Inga Racinska

The raccoon dog (Nyctereutes procyonoides) poses a significant threat to Sweden's native biodiversity

1 jagareforbundet.se/Global/Mardhundsprojektet/Dokument/Conference%20Report_webb_final.pdf

project has developed an early-warning system and eradication programme in Sweden and Denmark.

Fredrik Dahl from the Swedish University of Agricultural Sciences (SLU) was one of the coordinators of the scientific part of the MIRDINEC project. He says "we have called it an 'early warning system' because we want to be able to detect animals that come into the country. We also want to be able to calculate how many animals we have and how the population is developing. Finally, we want to know if our efforts have any effect on the population."

Networks of cameras were installed along potential pathways for the entry of the invasive predator into Sweden and Denmark. Based on the knowledge that a raccoon dog couple has a home range of 700-900 ha, the project team calculated that they needed to install one camera every 2.5 km. This meant, for instance, installing a total of 137 cameras in Haparanda Municipality where Sweden has a land border with Finland. Within sight of each camera is a scent lure (from the anal gland of the American grey fox), a guaranteed way of getting raccoon dogs to show (as well as every other predator in the vicinity – from badgers to bears).

The project also set traps in order to capture and GPS-track raccoon dogs. Information from the cameras and the transmitter animals was collated to enable a more accurate assessment of population size. "They have not expanded their range since we started the project. The population is stable, or if anything seems to be going down," says Dr Dahl.

That is partly due to MIRDINEC's species control activities, since, using the so-called 'Judas' technique, the transmitter animals led project workers to other raccoon dogs, nearly 2 000 of which were then humanely eradicated over the three years of the project.

To increase the effectiveness of the control techniques, the project set up a raccoon dog 'hotel', capable of housing four captured individuals prior to sterilisation and reinsertion into the wild. "We want our Judas animals to be much more attractive than normal wild ones," says Per-Arne Åhlén of the Swedish Association for Hunting and Wildlife Management, who helped coordinate the scientific aspects of the MIRDINEC project. "We feed them in winter and treat them so they don't get sarcotic mange, or other parasites like fleas, just to make them more attractive to other racccoon dogs."

Mr Åhlén highlights the importance of using a combination of methods: "People often think that if you put up a trap you are safe, that you are going to capture the target animals, but most adult raccoon dogs are trap shy and you only gather a proportion of the young of the year class – that's why the Judas technique is so important."

Falling costs of MMS cameras that can send photos directly to the phones of project workers also improved the efficiency of project actions. "They are fantastic for rapid response," says Mr Åhlén. Project workers set the cameras to send a photo

The MIRDINEC project used a number of different methods of trapping raccoon dogs, such as the one shown below

Photo: LIFE09 NAT/SE/000344/ASTRALE EEIG/Justin Toland

of each trap every day. "The MMS cameras really increase the efficiency of capturing and you don't have to do all the kilometres and hours to check the traps," he explains [it is a legal requirement in Sweden to check the traps on a daily basis].

Methods developed during the project are likely to be transferable to other invasive alien predator management programmes and projects across Europe, as well as elsewhere in the world. "Cooperation with Norway, Denmark and Finland has helped get costs down and we have developed lots of tools that can be used in the management of several different species," says Dr Dahl.

Cooperation with local hunters also improved the project's effectiveness and reduced costs. "It's very important to have local support from the beginning of the project," says Mathias Lindström from the Finnish Wildlife Agency, a project partner. "With local people we can save a lot of money and a lot of time. In Finland, we have trained a lot of local hunters to help out – to recognise raccoon dog tracks, take care of traps, fit collars, put new baits in and so on."

Dr Dahl explains that, "at the beginning of the project about 60% of the culled animals were due to observations by the public. Up here [in northern Sweden], the public is usually the hunters."

One challenge facing the MIRDINEC project was, "a small resistant group of hunters who want to make a living from bounties for killing raccoon dogs. They steal the cameras and when they find a Judas animal they kill it and destroy the transmitter," explains Mr Åhlén.

The LIFE Platform Meeting provided an opportunity to discuss the pros and cons of using a bounty system to manage mammalian IAS. Mr Åhlén is, "totally convinced that a bounty system would really speed up the invasion of raccoon dogs in Sweden because people will start to import them." Another of the SLU scientists, Dr Dahl, agrees that, "the worst thing [for preventing the spread of raccoon dogs in Sweden] would be a bounty system."

"As long as populations are low, there will not be much interest in it as a hunting species," believes Mathias Lindström.

"We will never be able to eradicate it because single animals will always come in," says Dr Dahl, "but if we can keep the numbers down and get rid of reproduction [in priority pathways] we would have a very good system...The goal is to have a population of 20-30 raccoon dogs here [northern Sweden] and in Denmark, consisting solely of transmitter animals."

LIFE and invasive alien predators

The invasive alien predators most commonly-targeted by LIFE projects have included rats and feral cats (particularly on islands where protected seabird species breed – see pp.56-59), as well as the American mink (see pp. 52-55). The latter species, which was inadvertently introduced into many parts of Europe as a result of fur farming, is also a problem in mainland Europe.

Raccoon and mink control in Poland

Polskie Ostoje Ptaków (**LIFE09 NAT/PL/000263**) is a LIFE Nature project that is seeking to protect water and marsh birds in five of Poland's national parks by reconstructing habitats and curbing the influence of the invasive predators, American mink (*Neovison vison*) and raccoon (*Nyctereutes procyonoides*). More than 300 live traps have been set and so nearly 700 mink and 50 raccoons have been captured. The project is also trialling methods of satellite-tracking raccoons fitted with transmitter collars in order to assess the feasibility of preventing further colonisation of protected habitats by the species.

Protecting bird lakes in Finland

The negative impact of the raccoon dog on native biodiversity was addressed by an earlier LIFE project in Finland. In 2005, the Pirkanmaa project (**LIFE04 NAT/FI/000076**) took actions to trap raccoon dogs and American mink in four of the country's most important resting, feeding and breeding lakes for bird life, including species listed in Annex I of the Birds Directive, such as the horned grebe (*Podiceps auritus*), whooper swan (*Cygnus cygnus*), crane (*Grus grus*) and wood sandpiper (*Tringa glareola*).

Some 100 traps for American mink and 56 traps for raccoon dogs were set, with volunteers from local hunting clubs implementing the trapping. In total the project was able to eradicate 302 raccoon dogs and 70 mink.

Impact of the American mink (Neovison vison) and raccoon dog (Nyctereutes procyonoides) on eggs of species listed in the Birds Directive

Photo: LIFE09 NAT/PL/000263

CONTROL AND ERADICATION

Managing American mink

LIFE projects located in several EU countries have introduced methodologies that are helping to manage the American mink – a highly invasive predator, which has managed to populate Europe, having escaped, or been released from, fur farms.

Invasive predators can be a significant threat to many native species in the EU: When invasive alien species alter the balance of other native wildlife species and/or their prey, they can even cause radical damage to an entire ecosystem. One of the most problematic invasive alien predators is the American mink (*Neovison vison*), a semi-aquatic carnivore living in freshwater and marine habitats.

This small mammal is an opportunist predator, with a variable diet that includes aquatic, semi-aquatic and terrestrial prey. It was introduced to a number of European countries from North America in the early 20th century, mainly for fur farming. As the trade intensified in the 1950s, mink began escaping from the farms and established feral populations. The high number of farms combined with the ability of the species to adapt in the wild means that the American mink is now widely distributed across Europe. A contributing factor to the population increase in recent decades has been the release from mink farms of large numbers of American mink by animal rights activists.

Photo: Asunción Gómez

*The American mink (*Mustela vison*) is a predatorial species*

Efforts to combat the spread of the species have been ongoing for more than 20 years across Europe. The LIFE programme has supported many of these initiatives, mainly tackling the threats the American mink poses to a host of (protected) native species (see box).

The American mink can have a negative impact on many native species, including mammals such as the European mink, water vole or muskrat (*Ondatra zebethicus*), amphibians, e.g. the common frog (*Rana temporaria*) and birds, notably for species nesting in colonies, such as terns. Alteration of food webs is also likely to occur where high densities of the invasive mink are found.

Apart from direct competition for food and habitat, predation by the American mink can also cause problems for populations of ground-nesting birds. Small rodents have also experienced similar, significant population declines following the arrival of this

Species affected by the American mink targeted by LIFE

Mammals: European mink (*Mustela lutreola*), European otter (*Lutra lutra*), beech marten (*Martes foina*), European polecat (*Mustela putorius*), Iberian desman (*Galemys pyrenaicus*) and water vole (*Arvicola sapidus*).

Birds: Black-tailed godwit (*Limosa limosa*), northern lapwing (*Vanellus vanellus*), common redshank (*Tringa tetanus*), wood sandpiper (*Tringa glareola*) black-headed gull (*Chroicocephalus ridibundus*), purple heron (*Ardea purpurea*), terns (*Sterna dougallii, S. caspia, S. paradisaea, S. hirundo and S. albifrons*), the red and black-throated divers (*Gavia stellata and G. arctica*), corncrake (*Crex crex*), dunlin (*Calidris alpina*), ruff (*Philomachus pugnax*), smew (*Mergus albellus*), Eurasian coot (*Fulica atra*), spotted crake (*Porzana porzana*), capercaillie (*Tetrao urogallus*), great bittern (*Botaurus stellaris*), horned grebe (*Podiceps auritus*), crane (*Grus grus*), cormorant (*Phalacrocorax pygmeus*), swans (*Cygnus Cygnus* and *C. columbianus bewickii*), short-eared owl (*Asio flammeus*); and the ringed plover (*Charadrius hiaticula*).

unwelcome predator. Small islands are particularly vulnerable because widespread damage can occur in a small period of time, with less chance of recovery.

In the Laguna de la Nava (Palencia, Spain), the LIFE Canal de Castilla wetland restoration project (**LIFE06 NAT/E/000213**) reported a loss of 60% of corncrake eggs in the area in 2006. In the Western Isles (Scotland) the Mink Control project (**LIFE00 NAT/UK/007073**) reported a tern colony failure on the Isle of Lewis of over 90%, mostly linked to the presence of American mink.

Predation on small mammals is also significant, with sharp declines reported among populations of water voles and a similar adverse impact on desmans.

Another perceived threat (although research carried out by LIFE teams in Spain remains inconclusive on the matter) is from the spread of disease from American to European mink, e.g. Aleutian disease, which is highly contagious to mink.

Competition has been the main cause of the decline for other mustelids (e.g. American minks are bigger, more robust and more aggressive than many European species and also have a higher reproductive capacity). The impact on the European mink in particular, has been devastating: Once present across most European countries, it has been displaced by its alien counterpart and is only present today in parts of Spain, France, Romania, Russia and Belarus. It is estimated, for instance, that the European mink population has declined more than 90% since the beginning of the 20th century. The widespread presence of the American mink across Europe complicates efforts for the recovery of European mink populations.

The financial cost of eradication

American mink can also have a deleterious impact on certain economic activities, such as fish-farming, rearing of free-range chickens and game birds, and bird-watching tourism (through predation on ground-nesting birds).

It would be advisable to develop a set of indicators that could be used to compare the commercial value of mink farming with the costs to other activities disturbed by American mink (private economic loss), and the cost of eradication and control campaigns paid with public money. Such data would be extremely useful in policy- and decision-making.

The role of LIFE

There have been a total of 19 LIFE projects that have tackled the threats to native European species associated with the American mink (see project list, pp. 68-76). Some projects were devised to protect specific bird species or small carnivores; others had a global ecosystem approach where the alien species was considered a threat to the whole riparian habitat.

The main management methods used have involved live-trapping and humane killing of the captured animals. Traps are placed along riverbanks or on floating rafts. Details such as the distance between traps, frequency with which they are checked and number of stations per trapper, have varied according to the sites, but one constant is that LIFE co-funding has helped improve the efficiency of trapping methodologies.

One of LIFE's key contributions has been in providing training to ensure that trapping campaigns are carried out effectively. It is important also to note the role that volunteers (e.g. from hunting organisations)

American mink traps are placed along riverbanks or on floating rafts

Photo: LIFE00 NAT/E/007299/Angel Ayala /Diario de Burgos

Photo: LIFE07/NAT/PT/000630

*In 2008, American mink killed 32% of the breeding roseate terns (*Sterna dougallii*) in France*

have played alongside trained project workers. Initiatives to trap and remove mink involve enormous manpower that is not always affordable or available at a local level. For example, the Vison Castilla y León project (**LIFE00 NAT/E/007299**) mobilised environmental agents on a voluntary basis across two Spanish provinces, putting down a total of 110 000 traps/night and capturing more than 1 900 American mink. The control campaign started by the project has continued after LIFE.

The search for more efficient control systems has also bolstered the development of floating rafts – each with a 'footprint plate' made from soft clay. These are designed to act both as a monitoring device and a trapping site. Paid trappers (or volunteers) can check the rafts whenever it is convenient, whereas the traps need to be checked daily. Floating rafts have proven highly effective for the capture of mink in low-density populations, and also as an early detection method.

Although all projects have helped control mink densities, in some cases full eradication was thwarted by the reluctance of the species to enter traps. The Mink Control project in Scotland demonstrated that the use of trained dogs to locate dens and mink can help to remove animals of a low-density population.

Strategies are more complicated on mainland Europe, because there is a higher risk of reinvasion. "Reinforcing control campaigns in rivers downstream can have significant results in terms of efficiency," observes Consuelo Temiño, manager of the Visón Castilla y León project. Even if these critical sites are located far away from the areas where threatened species live, they are the natural 'pathways for invasion' to a tributary, she noted, adding that efforts at these strategic locations can prove to be more cost-efficient.

An effective response

When budgets or resources are not fully available, the situation can become serious. This is illustrated by France's Stern de Dougall project (**LIFE05 NAT/F/000137**), which took urgent measures to protect colonies of roseate tern (*Sterna dougallii*). The project had undervalued the real impact of predators (American mink, fox and the peregrine falcon). The result was that, in 2008, American mink killed 32% of the breeding roseate terns in France. The project was, however, able to find an effective temporary fix to protect the birds in the short term: the building of a fence around the tern colonies. The project team also gained considerable knowledge of the targeted bird species.

As for other invasive alien species (IAS), the ideal strategy for the American mink is to prevent an invasion in the first place. In Poland, the Polskie Ostoje Ptaków project (**LIFE09 NAT/PL/000263**) is considering issues such as the location, licensing and security of fur farms in order to address the threat to birds in the country's national parks. It is developing a model as the basis for discussion on the siting of farms in Poland and, by extension, in Europe.

When prevention fails, early detection and rapid response, especially concerning escapes or releases from fur farms, seems to be the most cost-effective management measure. Some LIFE projects - such as INVASEP (**LIFE10 NAT/ES/000582**), which is working in the Tagus and Guadiana river basins in Spain and Portugal - are already looking to develop early warning and response systems.

Long-term management frameworks are essential for effective control of highly mobile IAS, such as the American mink. The work of the Visón Alava project in Spain (**LIFE00 NAT/E/007335**), which drafted a management plan for the European mink that was adopted by the provincial government of Álava, demonstrates what LIFE can achieve in this regard.

This project was one of several that took place in Spain between 2000 and 2005 - the others being led by the administrations of Catalonia, La Rioja, Álava and Castile and Leon - whose timely, concerted and decisive action has played a large part in the continued presence of the European mink in Spain today. These projects worked tirelessly to control the American mink and are important because they highlight that such a task is achievable in a relatively short time frame if decisive efforts are put in place. The projects also showed the value of collaboration, carrying out joint studies and developing methodologies in partnership. At an ex-post visit nearly 15 years later, conservation managers confirmed the benefits of such collaboration. Unfortunately, once LIFE funding ends, these collaboration schemes are harder to keep at such intense levels, but much of the relationship and will to collaborate remains. Hopefully, the new project LIFE LUTREOLA SPAIN (**LIFE13 NAT/ES/001171**) will gain further insight on how to deal with this invasive animal.

It is probably too late to eradicate the American mink from the European environment. Its impact on river ecosystems is however significant from an ecological point of view and for certain species. LIFE can be of great help in the management of this species. One way it can do this is by helping to raise awareness of the most effective ways of keeping this invasive alien predator in check.

The GERVE project made significant improvements to European mink habitats in Aragon. European mink face - note the white markings on the upper lip, which are absent in the American species

Photo: LIFE05 NAT/E/000073/GAVRN

CONTROL AND ERADICATION

Protecting **island ecosystems from the impact of IAS**

LIFE has supported ground-breaking actions to eradicate invasive alien species from islands and enable the restoration or return of native habitats and species. It has also highlighted the necessity for prevention measures to avoid future (re)invasion.

Island ecosystems are particularly vulnerable to the impact of invasive alien species (IAS). Endemic species can suffer from competition or predation by IAS. Within the European Union, there are thousands of islands: The majority of these are located in the Mediterranean and Macaronesian biogeographical regions, globally important biodiversity hotspots.

IAS have been one of the main causes of biodiversity loss on European islands, including in the Mediterranean and overseas territories. Invasive alien species cause particular damage to isolated ecosystems containing many endemic species – such as types of seabird, lizard, small mammal and plant - and characterised by a lack of natural competition.

Since its launch, the LIFE programme has supported numerous projects dealing with IAS on islands belonging to EU countries. Most have focused on control and eradication of IAS, particularly: invasive plants; invasive predators, such as rats, feral cats and mink; or herbivores that can threaten native flora. The beneficiaries of several projects have implemented additional prevention systems to avoid reinvasion – sometimes after their project's end.

*Yellow ginger lily (*Hedychium gardnerianum*) roots cut prior to spraying*

Photo: LIFE07 NAT/PT/000630/João Salgado

Recovering Priolo's habitat

In the Azores, several invasive plant species have been taking over the once-thriving endemic Macaronesian laurel forests. This has been particularly disruptive to the 100 remaining pairs of the critically endangered Azores bullfinch (*Pyrrhula murina*) - known locally as Priolo - which is highly dependent on the native laurel forest for its food. Three LIFE projects have directly addressed IAS plants affecting Priolo habitats.

LIFE PRIOLO (**LIFE03 NAT/P/000013**) developed new techniques of IAS control, testing and deploying chemical controls to remove exotic plants - such as the yellow ginger lily (*Hedychium gardnerianum*) - from 227 ha on the island of São Miguel. The project cut down Japanese cedar (*Cryptomeria japonica*) from 10 ha and managed to eradicate 92% of the invasive Madeiran sweet pepperbush (*Clethra arborea*) from the island.

The follow-up Laurissilva Sustentavel project (**LIFE07 NAT/P/000630**) cleared invasive trees from more than 50 hectares, including, as well as the above-mentioned species, others such as the Australian cheesewood (*Pittosporum undulatum*). Both projects planted native specimens grown in nurseries in the cleared areas to restore the natural habitat of the Azores bullfinch.

In total, the two projects eliminated more than 275 ha of invasive trees and planted more than 100 000 native plants in the cleared areas. Monitoring showed that the native habitats recovered quickly. The impact on the endangered Priolo seemed to be immediate: some 775 individuals were counted after the project actions, almost three-times as many as before.

The ongoing LIFE Terras do Priolo project (**LIFE12 NAT/PT/000527**) is seeking to fill gaps not covered by the first two projects. These include efforts to develop understanding and control of the threat posed to the Priolo by predators - such as rats and weasels, and methods to control additional invasive plants - such as the Australian tree fern (*Sphaeropteris cooperi*). The project will also take actions to recover 24 ha of invaded habitat on steep slopes.

More efforts are still needed to secure the unique species and habitats on São Miguel. With this long-term perspective, the 2012 project is developing a concise strategy for combating IAS in the island's Natura 2000 site involving all the relevant stakeholders, including foresters, farmers, and public authorities. As well as control mechanisms, it aims to set up prevention and early-warning systems to avoid further (re)invasions.

Saving the Reunion cuckoo-shrike from extinction

In La Réunion, one of the EU's outermost regions and situated in the Indian Ocean, an endemic bird species, the Reunion cuckoo-shrike (*Coracina newtoni* - known locally as the *Tuit tuit*) is threatened with extinction essentially due to predation by the introduced black rat. By 2009, there were fewer than 20 Reunion cuckoo-shrike couples living in the island's high forest areas, all localised in an area of some 200 ha in the Réserve de la Roche Ecrite.

LIFE CapDom (**LIFE09 NAT/FR/000582**) aimed to find a cost-effective and financially sustainable way of intensifying and making more effective a rat control programme using poison-baited traps that was started in 2004. The project team recognised that it would be impossible to eradicate the black rat from the whole island, or even from the high forests. Therefore it developed an innovative two-tier approach to safeguard the Reunion cuckoo-shrike, establishing an area of 630 ha where the density of rats is reduced to very low levels, with a core area of 250 ha that is totally rat-free and protected from reinvasion by a surrounding dense ring of poison-baited traps.

Photo: LIFE09 NAT/FR/000582/Yabalex

*Rat control is essential to safeguarding the future of the Reunion cuckoo-shrike (*Coracina newtoni*)*

Whilst it is still too early to evaluate the effectiveness of this approach, ongoing monitoring indicates that egg predation has stopped and that there are now more than 30 couples, with the area where the *Tuit tuit* is found having doubled to some 400 ha. The project team envisages extending areas of intensive rat control to 1 000-1 200 ha.

Seabirds benefit from control efforts

Seabirds only use land for nesting, typically preferring remote islands and islets. The presence of IAS on such islands – particularly predators such as rats – seriously threatens the ability of seabirds to breed successfully. Nearly 30 LIFE Nature projects have addressed this issue, covering islands in areas including the Mediterranean, the Azores and the Canaries.

The Mediterranean islands of Montecristo and Pianosa, located in Italy's Tuscan Archipelago (Italy) have been for long under protection of the Tuscan Archipelago National Park and included in the Natura 2000 network. Nevertheless, the archipelago's biodiversity has been profoundly altered by IAS brought there over the centuries, either intentionally or accidentally, by local inhabitants and tourists.

Several LIFE projects have targeted the specific threat posed by the black rat (*Rattus rattus*) to the eggs and chicks of nesting seabirds in the Tuscan Archipelago. LIFE Capraia (**LIFE97 NAT/IT/004153**) provided the first successful eradication of the rat from an Italian island (the islet of La Scola) using poisoned baits, which were confirmed safe for native species in

pre-testing. The project brought local attention to the issue of invasive predators for the first time.

The project's impact is still felt today. The eradication techniques used have been replicated in other interventions, including in additional LIFE projects (see below). Meanwhile the techniques and benefits are still informing the drafting of official plans such as the Biodiversity Protection Plan for Capraia and a potential Italian national strategy for IAS control.

The ISOTOSCA project (**LIFE04 NAT/IT/000172**) used poisoned bait traps to eradicate rats from islands such as Giannutri and Pianosa. Also on Pianosa, over 50 feral cats were removed using humane trapping techniques. The Montecristo 2010 project (**LIFE08 NAT/IT/000353**) used a helicopter to distribute poisoned baits evenly across the mountainous terrain of Montecristo using a GPS-based grid system.

The eradications were essential to the long-term reproductive success of nesting seabirds on the islands such as Cory's shearwater (*Calonectris diomedea*) Audouin's gull (*Larus audouinii*) and the Mediterranean shearwater (*Puffinus yelkouan*). Positive results were seen quickly: 93-95% of breeding pairs of Mediterranean shearwater on Montecristo successfully fledged juveniles over two years. Nesting boxes installed by the project are starting to be used (a first Mediterranean shearwater egg has been found in one) and the number of breeding pairs is expected to increase over the next 10 years with the expansion of the archipelago's breeding colonies.

All these projects also tackled invasive tree species. They eradicated the invasive tree of heaven (*Ailanthus altissima*) from Capraia and Montecristo. They also removed or controlled invasive acacia species (*A. saligna* and *A. pycnantha*), creeping groundsel (Senecio angulatus) and Aleppo pine (Pinus halepensis) from different islands. These efforts worked to restore natural habitats and vegetation, including mosaic formations on the islands.

Current projects are continuing the work. LIFE Pelagic Birds (**LIFE11 NAT/IT/000093**) aims to eradicate the black rat on Linosa to protect currently nesting seabirds and enable the European storm petrel (Hydrobates pelagicus) to re-establish itself on the island. The objective of the LIFE Puffinus Tavolara project (**LIFE12 NAT/IT/000416**) is to eradicate rats and house mice (Mus musculus) from Tavolara - and three smaller islets - using mainly helicopter-distributed baits. Finally, a brand new project, RESTO CON LIFE (**LIFE13 NAT/IT/000471**), continues eradication work on Giannutri, Pianosa and Montecristo to improve the breeding success of several protected seabird species.

Actions to protect Azores seabirds

Corvo is the smallest and most isolated island in the Azores with a population of some 430 inhabitants. The Azores archipelago was once a perfect nesting sites for millions of seabirds in the middle of the Atlantic. However, the introduction of predators (rats and feral cats) and invasive alien plant species has had a major impact on bird colonies. Currently, seabird populations are limited to isolated small islets and inaccessible cliffs.

The SAFE ISLANDS FOR SEABIRDS project (**LIFE07 NAT/P/000649**) combined innovative IAS control methods with habitat restoration and the provision of nesting areas for target seabird species. The first stage of the project involved the mapping of invasive alien mammals and plants on Corvo and the neighbouring islet, Vila Franca do Campo. This was used as the basis of a control and eradication plan that focused on the impact of both feral and domestic cats. The project trapped 60 feral cats - 40% of the population - before sterilising, chipping and releasing them into safe areas. It also neutered 51% of domestic cats with cooperation from the local population. These marked the first steps of a longer-term plan to both neuter and identify with a microchip all cats on the island.

The project also conducted a valuable review of rodent eradication actions on inhabited islands - "Eradication of invasive Mammals on Islands Inhabited by Humans and Domestic Animals" - which was published in the

Flora Menorca was a pioneering project that involved volunteers in actions to eradicate Carpobrotus edulis. The continuation of this voluntary programme after LIFE ensures that reinvasion will not take place on Menorca

Photo: LIFE00 NAT/E/0073559

peer-reviewed Conservation Biology journal[1]. In addition, the project showed that whilst eradicating rats from uninhabited islands in the Azores was technically feasible, it was not possible given the current social, economic and political framework. The project concluded that measures to control and manage these IAS should be implemented alongside biosecurity measures to prevent the entrance of other alien species onto Corvo.

Remote control

The LIFE Mink Control project (**LIFE00 NAT/UK/007073**) sought to eradicate or control the American mink (*Neovison vison*) from islands in the Scottish Hebrides. Complete eradication from Benbecula and the Uists was achieved following the end of the project. Perhaps the most important long-term impact of the project was to convince people that elimination of the highly destructive mink was even realistic in such remote locations. This has had a profound impact on how the Scottish Government and its agencies approach invasive predators. It is possible that the whole of the Western Isles will be clear of mink in the next few years.

Canna Seabirds (**LIFE05 NAT/UK/000141**) focused heavily on eradication of the brown rat (*Rattus norvegicus*) from the Hebridean islands of Canna and Sanday. It established and maintained a grid of stations containing poisoned bait to kill rats during the winter months. Diversionary feeding of raptors to avoid them scavenging on dead rats was part of mitigating actions to reduce the threat of accidental or secondary poisoning of non-target animals.

The islands were declared rat-free in 2008. This has already translated into positive signs of increased breeding success for important nesting birds, including the European shag (*Phalacrocorax aristotelis*), razorbill (*Alca torda*) and Atlantic puffin (*Fratercula arctica*). The project saw the first successful breeding in over 10 years of Manx shearwater (*Puffinus puffinus*) on the islands. The LIFE project actions included rat-proof waste management, freight and quarantine procedures and long-term rat surveillance, coupled with early-warning and contingency plan for action in the event of a rat being accidentally reintroduced to the islands.

The main actions of a more recent project (**LIFE11 NAT/UK/000387**) involve the removal of rats from the islands of St Agnes and Gugh in the Scilly Isles (off the coast of Cornwall, UK), where nesting seabirds have all but abandoned the available breeding grounds. These would be the first inhabited islands in Scilly to be cleared of rats, promoting the return of the nesting seabirds. Its actions should also help protect nearby uninhabited islands from invasion by rats.

Preventing IAS gaining a foothold

LIFE projects have demonstrated that focused and coordinated action can result in eradication of IAS from remote islands. However, these actions are always expensive. The projects thus highlighted that prevention systems - to avoid the presence of invasive alien species in the first place - are more cost-efficient in the long term. Furthermore, total eradication often only proved feasible if accompanied by measures to prevent (re)invasion.

The 2005 UK project Canna Seabirds introduced rat-proof waste management as well as improved freight and quarantine procedures to prevent reinvasion following the eradication of rats from some Hebridean islands. It also established long-term rat surveillance, coupled with a contingency plan for action in the event of a rat being accidentally reintroduced.

The SAFE ISLANDS FOR SEABIRDS project created a new Biological Reserve on Corvo as a safe nesting area. As well as eradicating IAS in the reserve, a crucial innovation was to erect a 100%-predator-proof fence for 700m around it, to prevent reinvasion. The reserve has already started to be used by several bird species.

Rat trapped in Giannutri and Pianosa

Photo: LIFE04 NAT/IT/000172

1 DOI: 10.1111/j.1523-1739.2010.01601.x

TRANS-BORDER COOPERATION

LIFE is **a valuable tool for trans-border cooperation**

Geographical borders such as mountain ranges or seas may limit the spread of certain species. However national borders are, in themselves, meaningless for nature. LIFE projects provide an opportunity to develop the cooperation necessary to tackle IAS across borders.

Trans-border cooperation is essential to tackle invasive alien species (IAS) that have already established themselves on both sides of a border. Promoting cooperation will also be important as part of future efforts to limit the introduction or spread of IAS. For example, such cooperation will be needed to increase the effectiveness of early warning and rapid response systems to rapidly tackle new or emerging threats.

Unfortunately, the general level of trans-border cooperation in nature protection in Europe is still insufficient to adequately address these challenges. However, the LIFE programme is at the forefront of promoting and developing such initiatives. It has supported projects to augment capacity, build working relationships and establish networks across EU borders to tackle IAS.

Atlantic island cooperation

As the previous chapter showed, the threat of invasive alien species is particularly strong on islands where unique ecosystems have often evolved over time, isolated from the continental mainland.

Handbook for the management of invasive alien vertebrates in Spain and Portugal produced by the LIFE cooperation project

The LIFE cooperation project Invasive vertebrates (**LIFE02 NAT/CP/E/000014**) was set up to address the threat of IAS in the Spanish and Portuguese Atlantic archipelagos. The need to tackle this issue with a cooperation project became clear as a result of more than a dozen LIFE Nature projects involving work against invasive vertebrates on the islands of the two countries.

The project sought to share the experiences and lessons of the various LIFE projects that had already taken place and lay the foundations for joint work to tackle this emerging challenge. It organised a symposium bringing together some 60 technicians from the islands of Spain and Portugal to share and exchange information about their recent initiatives to tackle IAS.

The project produced a handbook for the management of invasive alien vertebrates which became a reference for administrations in Spain and Portugal as well as for international organisations such as the IUCN. Just as importantly, it delivered an 'Institutional Declaration' committing the regional governments participating in the project to future cooperation on this issue.

A concrete result from the increased cooperation capacity developed by LIFE was a successful joint application for subsequent funding for additional joint work. The partners developed the INTERREG IIIB-funded project ATLANTICO to establish a database of the animal and plant life of the Atlantic islands. This included information on the presence of non-native species to inform future eradication efforts.

Trans-border challenge

Trans-border cooperation involves coordination between organisations and/or administrations working in different national frameworks, with different capacities and often in different languages. Efforts to

support such cooperation are essential, but can also encounter problems. LIFE projects are confronting and attempting to overcome such obstacles.

The recent LIFE project INVASEP (**LIFE10 NAT/ES/000582**) has been aiming to halt the loss of biodiversity associated with invasive alien species on the Iberian Peninsula. Its planned activities include inventories, mapping, threat assessment, prevention and some eradication of numerous IAS along the Tagus and Guadiana river basins, both of which cross the Spanish-Portuguese border.

The project targets the following invasive alien species: zebra mussel (*Dreissena Polymorpha*); Asian clam (*Corbicula fluminea*); mimosa tree (*Acacia dealbata*); tree of heaven (*Ailanthus altissima*); water fern (*Azolla filiculoides*); American mink (*Neovison vison*) and red-eared slider (*Trachemys scripta*). It also targets non-native species occupying the habitat of the only palm species native to continental Europe - the European fan palm (*Chamaerops humilis*) - and the arrowhead plant (*Sagittaria sagittifolia*).

The project is still ongoing. Nevertheless, it has been able to obtain some results already, such as the identification of the presence of new invasive alien threats. It has notably found the Asiatic dayflower (*Commelina communis*) and purple veldtgrass (*Ehrharta calycina*) in the Tagus river basin, as well as the four o'clock flower (*Mirabilis jalapa*) and tall willowherb (*Epilobium brachycarpum*) in the Guadiana basin.

Mink collaboration

Visón Co-op (**LIFE03 NAT/CP/E/000002**) was a LIFE Cooperation project focused on developing collaborative actions between project partners in Spain and Estonia for conservation of the European mink (*Mustela lutreola*). The partners came from several related LIFE projects from the two countries that were ongoing at the time (2004-2005).

A key part of the project's activities was to work towards the eradication of the invasive American mink (*Neovison vison*), an essential prerequisite for long-term conservation of the European mink. The project examined ways to standardise procedures for conducting population estimates of the invasive alien species in different European countries to confirm its distribution range, status and population trends. This also meant cooperating with researchers in the species' eastern population in Romania, Ukraine and Moldova.

Photo: LIFE06 TCY/INT/000246

IAS are one of the six main threats to the biodiversity of the Sava River Basin

Protecting Sava River basin biodiversity

The LIFE Third Country project Sava River Basin (**LIFE06 TCY/INT/000246**) aimed to protect biodiversity along the second-largest tributary of the Danube, flowing through Slovenia, Croatia, Bosnia-Herzegovina and Serbia. The project's work identified IAS as one of the six most important threats to biodiversity along the river basin.

Its research confirmed the significant presence of invasive alien species, including the desert false indigo (*Amorpha fruticosa*), wild cucumber (*Echinocystis lobata*), Japanese knotweed (*Fallopia japonica*), black bullhead (*Ameiurus melas*), pumpkinseed sunfish (*Lepomis gibbosus*), Prussian carp (*Carassius gibelio*), western mosquitofish (*Gambusia affinis*) and the coypu (*Myocastor coypus*).

The removal of such invasive alien species and prevention of further introductions was a key recommendation of the LIFE project for the future protection of biodiversity in the Sava River Basin. It specifically called for the drafting of a Trans-border Action Plan to halt the dispersal of IAS along the river basin as an essential part of integrated river basin management.

COOPERATION, DISSEMINATION AND AWARENESS-RAISING

It's 'good to talk' about IAS

All LIFE projects contain elements of awareness-raising and an obligation to disseminate results. Not all are doing so effectively – especially when tackling invasive alien species. But this is changing as EU policy, experts and projects work to spread knowledge of IAS.

The importance of awareness-raising and communication about invasive alien species were among the priority actions highlighted by the 2013 LIFE+ Nature Platform Meeting on Invasive Alien Predators in Sweden (see pp. 49-51).

In a closing session, moderated by Dr Piero Genovesi, assembled IAS management practitioners agreed that stakeholder involvement was crucial to the development of a European policy on invasive alien species; and that the support of the general public through communication and awareness-raising about IAS is also essential.

Raising awareness of the harmful impact of the American mink on native biodiversity

Photo: LIFE09 NAT/ES/000531

These recommendations followed an earlier "Learning from LIFE" international conference, held Brussels in 2008, where delegates attending an IAS session put forward various best practices in tackling invasive alien species. Among their conclusions, experts emphasised that awareness-raising should be carried out "before, during and after" a LIFE project. They also stressed the need for dissemination of methodologies and know-how, as well as enhanced cooperation in order to address threats from across regions.

The EU policy on IAS also draws attention to the need for extensive public awareness campaigns - alongside regulatory approaches. The fact that there are so many different types of invasive alien species and so many different pathways into the EU makes it essential that all parties, including the general public, are made aware of the problem and given an opportunity to play a role in combating IAS.

Good conduct

Some sectors, with the support of international initiatives, as well as the LIFE programme, have already started work on the preparation of European codes of good conduct to address risks from invasive alien species, such as the highly successful Belgian project AlterIAS (see pp. 21-23).

The project produced a range of dissemination tools that were distributed to all those who signed the code of conduct. This includes an 'alternative plant brochure' to promote the use of non-invasive native plants, to counterbalance the restrictions of use of invasive ones. The brochure presents plants with

similar ornamental functions as invasive ones. For example, the invasive Himalayan balsam (*Impatiens glandulifera*) is replaced by Salicaire (*Lythium salicaria*).

Linked with the code of conduct, the project has also developed a type of "early-warning measure" to help detect exotic plants that may become invasive in gardens, explains project manager, Mathieu Halford. If anyone notices that a plant not on the current list appears to have "escaped", he explains, they can fill in a factsheet which is forwarded to the Belgian authorities responsible for risk assessment of species.

This is just one example of the importance of engaging with stakeholders and local communities. Another comes from the LIFE MIRDINEC project (**LIFE09 NAT/SE/000344**) tackling the invasive raccoon dog in Scandinavia, whose outreach and dissemination actions have led to more reported observations of the alien species, which, in turn "has enabled the project to put the efforts where they are most needed," explains project manager, Per-Arne Åhlén.

As the LIFE projects tackling the grey squirrel in the UK and Italy have discovered, it's very important that public awareness-raising on IAS is carried out in a coordinated way. "The public needs to understand that there is no point carrying out an eradication programme for grey squirrels in a region if local pet shops are still able to sell squirrels that could be accidentally released back into the wild," comments IAS expert Dr Genovesi.

In the UK, the grey squirrel is widely understood by the population to be the cause of the demise of the red squirrel in vast areas, and the need to control greys, which are commonly seen as pests, is broadly accepted. This attitude, however, is not shared by many in the three regions targeted by the Italian EC-Square LIFE project (**LIFE09 NAT/IT/000095** – see pp. 45-48). Much of the project's attention has thus been focused on fostering a more sympathetic attitude to the aims of the conservationists and to explain to those concerned by the killing of animals the reasons for doing so. The task of its awareness campaign has been made all the more difficult by a fervent counter campaign supported by a range of animal welfare groups.

Another underlying problem faced by the Italian project is that unlike the UK, which has had a ban in place since 1938 preventing the sale or import of grey squirrels, such a ban has only recently come into force in Italy. Indeed, one of the first successes of the project was to gather monitoring data to confirm the positive impact of this ban on native flora and fauna.

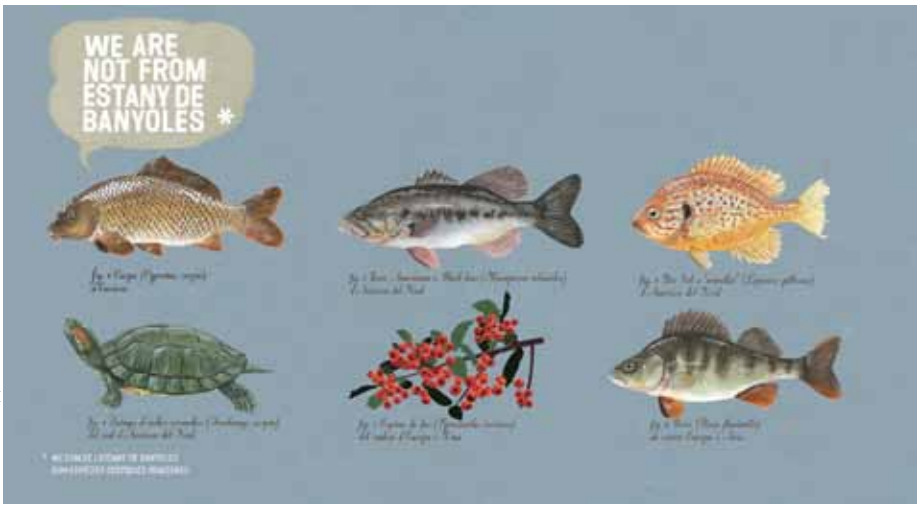

Photo: LIFE08 NAT/E/000078

PROYECTO ESTANY produced engaging awareness materials such as the above to win public support for actions to remove invasive alien fish and turtles from Lake Banyoles in Spain

A fun day out

Finally, its important to remember that project dissemination and awareness-raising activities can also be great fun – as clearly demonstrated by the CAISIE project (**LIFE07 NAT/IRL/000341**) in Ireland combating the control of aquatic invasive alien species (see pp. 16-20). As part of its activities, the project organised so-called "Himalayan Balsam Bashes" – which were open days, involving the local community in tackling the invasive alien plant.

LIFE07 NAT/IRL/000341

Says project manager, Dr Joe Caffrey, these were "fantastic" – helping to engage stakeholders. Moreover, they were also very successful in clearing areas of the annual plant, which has a tiny rootball making it easy to be pulled up. "It's such an easy job, you simply pull and we deal with the plant," he says, adding: "In two years you can eradicate Himalayan balsam – as long as it hasn't gone to the hectares stage."

CONCLUSIONS

Lessons from LIFE for IAS policy and practice

Invasive alien species are a thematic priority for the LIFE programme 2014-2020 and the new funding period offers an opportunity to build on LIFE's existing strengths and address weaknesses in how it helps tackle this threat.

The LIFE programme is one of the main sources of funding for tackling invasive alien species (IAS) at EU level. Since 1992 it has co-financed more than 260 IAS projects across Europe, investing a total of some €70 million in the problem (see pp. 8-11).

Strengths of the programme

A strength of the LIFE programme until now has been the fact that it is very effective in helping to eradicate and control certain IAS, especially at Natura 2000 network site level. This has been particularly evident on small islands, where projects managing the impact of invasive alien plants and eradicating invasive alien predators such as rats have had a measurable effect on native habitats and species. LIFE projects have developed and enhanced control techniques – such as methods of trapping invasive alien mammals and reptiles – providing useful examples for other conservation specialists seeking to tackle IAS.

American mink in the park

Photo: Matt MacGillivray/CC BY 2.0

In 'learning by doing' many LIFE projects have helped to raise the state-of-the-art and disseminated their experiences in the scientific community and to other site managers through networking activities. LIFE strongly supports this kind of dissemination work. For example, the ongoing Spanish project LIFE Desmania (**LIFE11 NAT/ES/000691**) is developing control strategies for the American mink in several provinces of Castile and León, building on the experience of the earlier project, LIFE Vison Castilla y León (**LIFE00 NAT/E/007299**). As well as using LIFE co-funding to refine the methodology, the regional administration also intends to establish it as a reference for American mink control throughout Castile and León.

These Spanish examples also highlight the important role of LIFE projects in concentrating financial and human resources on a particular challenge over a relatively short period of time. A LIFE project can be of great help in providing 'ideal' conservation strategies: helping to buy equipment, hiring specialised external assistance, training people in the necessary skills, etc. For some small administrations and organisations this can give a strong boost to conservation initiatives, an impetus that often continues post-LIFE. As this publication shows, some very successful IAS eradication programmes have been set up thanks to LIFE projects.

Control and eradication

The vast majority of LIFE project actions relevant to invasive alien species have focused on the control and eradication of IAS in areas where they have a direct impact on the conservation status of species and habitats listed in the Birds and Habitats directives, and its Natura 2000 network sites.

Photo: LIFE05 NAT/CZ/000121

These before and after images from the Czech Republic demonstrate how LIFE can help manage alien plant invasions (in this case, Fallopia japonica*)*

The ideal scenario is for a LIFE project to carry out concerted actions with competent authorities, since the post-project period is essential to the success of an IAS management programme. The lesson from a UK project targeting the removal of the American mink from Hebridean islands (Mink Control - **LIFE00 NAT/UK/007073**) is that focused and coordinated action can not only make feasible the eradication of invasive predators on islands, it can also overcome initial scepticism from regional and local administrations. Important lessons were learnt through the LIFE project which have influenced current work, and it is now a clear priority for the Scottish Government to tackle invasive alien species more broadly.

LIFE can provide excellent platforms for partnerships and alliances, which are more effective than isolated initiatives. The programme also typically enables project beneficiaries to invest adequate time and resources in raising stakeholder awareness and acceptance, something that can be of crucial importance to the success of actions that go beyond simple conservation (e.g. humane eradication of invasive alien mammals).

LIFE also has been very effective in providing evidence-science that can be used to inform or influence decision-makers, as in the example of the CAISIE project in Ireland (see pp. 16-20). More often, however, the policy impacts of LIFE projects can only be recognised in the longer term.

Gaps in coverage

LIFE has been the major EU source of funding on addressing IAS. However, there are several areas in which the programme's impact could be strengthened. These include:

- Prevention (in particular by tackling pathways of unintentional introduction);
- Early warning and early eradication actions;
- Targeting missing highly problematic invasive alien species (those included in DAISIE's list of Top 100 IAS);
- Actions outside the Natura 2000 network and in marine environments;
- Raising awareness of interest groups (e.g. the horticulture trade) and the general public;
- Working to ensure that lessons from projects feed into policy tools (e.g. legislation on the sale of certain IAS).

The new programming period provides an opportunity for LIFE to focus more on preventing IAS from becoming established in the first place, in line with the focus of the IAS Regulation. Experience has shown that full eradication of new invaders is more difficult and costly once the population and affected area exceed certain thresholds. Furthermore, efforts to remove IAS from protected areas can be undermined if the same invasive alien species are allowed to become established outside Natura 2000 network sites.

LIFE projects have, between them, covered a wide range of invasive alien species. However, actions have focused on 10 species in particular (see pp. 8-11) and some species that pose a threat to nature and biodiversity across the EU have not been tackled at all. This is particularly the case for invasive alien species from marine and freshwater environments, as well as invertebrates and fungi. This gap is partly due to a lack of knowledge on how to control and eradicate these particular IAS and partly due to the fact that they are not (yet) found in Natura 2000

Photo: LIFE09 NAT/ES/000531

A field trip to a LIFE project site: comprehensive public relations are essential to the successful management of IAS

network sites or threatening species listed in the annexes of the Birds Directive or Habitats Directive.

Spreading best practices

LIFE projects are a fount of knowledge about control and eradication methods for particular invasive alien species. For instance, several projects have demonstrated the effectiveness of a single herbicide treatment in wiping out completely invasive alien plants in target areas (see pp. 29-33). However, this know-how is not always transferred to other projects tackling the same species elsewhere. Sometimes this is because of reluctance at Member State level to allow the use of chemicals in (semi-)natural landscapes and Natura 2000 sites.

Conversely, some LIFE projects have implemented methods for eliminating black cherry (*Prunus serotina*) that contradict lessons in the literature of other countries on the ecology and control of this invasive tree. By cutting or grinding the trees without subsequent chemical treatment or intensive grazing, these projects risk further spread and reinvasion of the species in the near future.

These gaps show the need for a more comprehensive and effective transfer of practical know-how between projects and a means of scaling-up the lessons from successful projects to regional, national and European level. The new LIFE programme and the IAS Regulation both provide opportunities to do this. The European Alien Species Information Network (EASIN) that was developed by the Joint Research Centre already plays a central role.

With the exceptions of the projects featured in the previous chapter (see pp. 62-63), the LIFE programme has done little to foster trans-border cooperation to tackle IAS. There is a general lack of awareness across Europe of the threat posed by invasive alien species, a fact that hinders acceptance by the general public and interest groups of necessary measures to prevent and control the spread of IAS. In general, there is seldom sufficient awareness of IAS even in heavily-infected areas. Thus, comprehensive public relations must be one of essential requirements of successful management of IAS, reaching large parts of the population and all relevant stakeholders, nationally and internationally in Europe, as well as at local or regional level.

LIFE projects such as TRACHEMYS and AlterIAS have already shown the value of raising awareness amongst pet owners and traders, garden centres and gardeners of their unintentional role in spreading IAS. Future projects could build on these successes and, for example, involve the public ('citizen science') in IAS early warning and eradication of individuals, at least for some easily recognisable species, such as Himalayan balsam (*Impatiens glandulifera*) or giant hogweed (*Heracleum mantegazzianum*).

The work of volunteers can be of special relevance and highly useful for eradication campaigns since it can help projects achieve a larger spatial coverage than would otherwise be possible. In Finland, trapping campaigns instigated by several LIFE projects benefitted from the voluntary involvement of hunting clubs (e.g. **LIFE99 NAT/FIN/006278**, **LIFE03 NAT/FIN/000039** and **LIFE04 NAT/FI/000076**). The hunters' involvement helped the projects identify the most effective methods of trapping small predators, knowledge that management protocols for the targeted sites. In the 1999 project, this work also improved the cooperation between hunters and the nature conservation administration within the project areas. In the 2004 project, the role of a regional game management district was essential in motivating hunters to do the voluntary work.

Rose-ringed parakeet (Psittacula krameri) in Belgium. This species, native to South Asia, is becoming increasingly common in European cities, where it may pose a threat to native wildlife

Photo: Louis Dewame/CC BY 3.0

These kind of participatory actions can both raise awareness and increase sense of ownership. However, experience has shown that the long-term effectiveness of such initiatives requires voluntary work to be included in a strategically-designed approach that ensures continuity and good planning.

Project planning and life after LIFE

The impact of LIFE on IAS sometimes can be constrained by the limits of the project format. The time lapse between project preparation and start-up can be one-to-two years. The swift dynamics of invasive mammal species can make the facts on the ground when a project starts work rather different from the situation when the project proposal was drafted. For instance, the LIFE Visón Alava project (**LIFE00 NAT/E/007335**) had to move budgetary resources from habitat management and land purchase to mink control, because the invasive alien species had colonised areas where it had not previously been present. This transfer of resources limited the project team's ability to reach specific targets laid out in the proposal, but was a more effective contribution to the overall objective (conservation of the European Mink). This shows that, when dealing with invasive alien predators, flexible strategies within proposals need to be envisaged in order to be able to adapt to changing scenarios.

Although LIFE has been a reliable source of funding for many IAS projects, some projects have been unable to ensure the continuity of actions after LIFE. It is therefore of the utmost importance that administrations take on the role of funding these initiatives to ensure that the work initiated is not lost. Post-project funding should be an integral part of project planning. Control measures shouldn´t be undertaken without making sure in advance that an appropriate method is available and that funding is sufficient to continue the work for a sufficient time to preclude reinvasion. If IAS control is implemented within a LIFE project the monitoring and all necessary management measures should be included in the mandatory After-LIFE Conservation Plans. This should include a prevention plan and an early eradication system to avoid reinvasion.

Some LIFE projects that eradicated rats from islands did implement preventive measures such as boat inspections and changes to refuse collection procedures to avoid reinvasion. However, they have been notably absent from other projects, particularly those dealing with invasive alien plants.

IAS a programme priority

As part of the LIFE programme 2014-2020, the new LIFE sub-programme for the Environment includes priority thematic topics for the priority areas, Nature and Biodiversity and Environmental Governance and Information.
Thematic priorities for **Nature** include:
Projects targeting invasive alien species, where these are likely to deteriorate the conservation status of species (including birds) or habitat types of Community Interest in support of the Natura 2000 network.

Thematic priorities for **Biodiversity** (activities for the implementation of the Union Biodiversity Strategy to 2020) include:
Projects implementing actions targeting invasive alien species (under Target 5 of the Biodiversity Strategy or in view of contributing to reaching the level of protection set out in descriptor 2 - Non-indigenous species of the Marine Strategy Framework Directive[1] through actions testing and applying approaches aimed at:

- Preventing the introduction of invasive alien species, in particular by tackling pathways of unintentional introduction;
- Establishing an early warning and rapid response system; and
- Eradicating or controlling established invasive alien species on an appropriate spatial scale.

These projects shall address with their actions the three steps (prevention; early warning and rapid response; eradication/control) in a comprehensive framework, or, where one of the steps has already been addressed, their actions shall at least be clearly situated in a broader framework that links all three steps. They should be set up to improve existing - or introduce new - technical, administrative or legal frameworks on the relevant

LIFE **Environmental Governance and Information** has a number of Nature and Biodiversity thematic priorities, including:
National and transnational awareness-raising campaigns on invasive alien species targeting the general public and key stakeholders including policy-makers, businesses, and local, regional or national authorities.

1 Annex I(2) to the Marine Strategy Framework Directive.

New opportunities to target IAS

In conclusion, this publication demonstrates how LIFE has supported efforts to deal with IAS and highlights the difficulties involved. The new LIFE programme (2014-2020) provides an opportunity to build on the important work done and knowledge gained by LIFE project beneficiaries over more than two decades. In this way, it can be a catalyst for improving existing practices and methodologies and helping to spread best practices. The new funding framework will be of crucial relevance to the implementation of the new IAS Regulation and provides an opportunity to address some of the gaps in the LIFE programme with regards to invasive alien species (see box).

Selected projects focusing on Invasive Alien Species since 2002

The table below provides examples of some of the LIFE projects focusing on Invasive Alien Species since 2002. For more information on individual projects, visit the online database at: http://ec.europa.eu/environment/life/project/Projects/index.cfm.

PROJECT	TITLE	IAS
AUSTRIA		
LIFE04 NAT/AT/000003	Alluvial forests and slope forests of the Upper Danube Valley	*Exotic conifers*
LIFE04 NAT/AT/000002	Pannonic Steppes and Dry Grasslands	*Ailanthus altissima, Robinia pseudacacia*
LIFE05 NAT/A/000078	Conservation strategies for woodlands and rivers in the Gesäuse Mountains	*"Impatiens glandulifera, Fallopia japonica, Solidago canadensis, Solidago gigantea, Impatiens parviflora"*
BELGIUM		
LIFE96 NAT/B/003034	Action plan for heaths, mat-grasslands and associated habitats in Belgium	*Several plants*
LIFE99 NAT/B/006296	Cross-border recovery and conservation of wet ecosystems	*Trees*
LIFE02 NAT/B/008595	Minerotrofic mires and heath ecosystems in the Zuiderkempen	*Exotic conifers*
LIFE04 NAT/BE/000010	Habitat restoration in Landschap De Liereman	*Prunus serotina*
LIFE05 NAT/B/000091	Transboundery habitat restoration in the valley of the Dommel	*Prunus serotina, Pinus spp., Populus sp*
LIFE05 NAT/B/000090	Restoration of the lowland river system 'Grote Nete'	*Hydrocotyle ranunculoides, Ludwigia grandiflora, Myriophyllum aquaticum*
LIFE05 NAT/B/000085	Restoration of European otter habitats (Be & Lu)	*"Impatiens glandulifera; Fallopia japonica"*
LIFE06 NAT/B/000084	Large-scale Habitat Restoration in "Turnhouts Vennengebied"	*Prunus serotin, Quercus rubra*
LIFE06 NAT/B/000087	Zwindunes Ecological Nature Optimalisation	*Acer pseudoplatanus, Populus sp., Pinus spp.*
LIFE06 NAT/B/000081	Habitat restoration in Averbode Bos en Heide	*Quercus rubra, Prunus serotina, Rhododendron*
LIFE06 NAT/B/000085	Cross-border restoration of heathland on continental dunes	*Prunus serotina, Rhododendron ponticum*
LIFE07 NAT/B/000043	Dry calcareous and rupicolous grasslands of lower and middle valleys of the Meuse basin	*Robinia pseudoacacia, Prunus serotina, Ailanthus altissima, Cotoneaster horizontalis, Fallopia japonica*
LIFE07 NAT/B/000024	Restoration of Intermediate Atlantic heathland habitats in Flanders	*Prunus serotina, Quercus rubra, Amelanchier lamarckii, Fallopia japonica,*
LIFE08 NAT/B/000034	Habitat restoration in the Visbeekvalley	*Prunus serotina, Quercus rubra, Robinia pseudoacacia*
LIFE08 NAT/B/000035	Habitat restoration in the Abeekvalley	*Impatiens glandulifera, Prunus serotina, Quercus rubra, Robinia pseudoacacia*
LIFE08 INF/B/000052	Increase awareness to curb horticultural introductions of invasive plants in Belgium	*Several*
LIFE09 NAT/BE/000416	Habitat restoration in the Valleys of the eastern region of Limburg: Bosbeek and Itterbeek	*Prunus serotina, Quercus rubra, Robinia pseudoacacia, - Water plants (e.g. Ludwigia grandiflora) Fallopia japonica); Crassula helmsii, Spirea douglasii*
LIFE11 NAT/BE/001068	Large-scale restoration of a complex of ground- and seepage water dependent habitats	*Prunus serotina, Quercus rubra*
LIFE11 NAT/BE/001067	Habitat restoration HAGELAND	*Prunus serotina, Quercus rubra and Robinia pseudoacacia , Populus sp. Alnus incana, Cornus alba, Aronia x prunifolia; water plants e.g.: Myriophyllum aquaticum, Ludwigia grandiflora, Hydrocotyle ranunculoides. ; Garden plants e.g. Fallopia japonica; Present, combat not foreseen in revised application: Lithobates catesbeianus*
LIFE11 NAT/BE/001061	Most-Keiheuvel nature restoration: restoring nature in the transition from peat to land dunes	*Prunus serotina*

PROJECT	TITLE	IAS
LIFE12 NAT/BE/000596	Habitat Restoration of alluvial forests and creeks within the flood controlled Scheldt estuary site Kruibeke-Bazel-Rupelmonde.	*Fallopia japonica, Cornus alba*
LIFE13 NAT/BE/000074	Cross-Border heath restoration, inland dunes and pools, integrated invasive plant management.	*Prunus serotina; Quercus rubra; Rhododendron ponticum*
BOSNIA AND HERZEGOVINA		
LIFE99 TCY/BIH/035	Development of a new management policy for the Hutovo Blato wetlands, Bosnia-Herzegovina Hutovo Blato wetlands, Neretva Canton	*Lepomis gibbosus*
CYPRUS		
LIFE04 NAT/CY/000013	Conservation management in Natura 2000 sites of Cyprus	*Acacia spp.*
LIFE09 NAT/CY/000247	Improving the Conservation Status of Fauna Species in Cyprus: from microhabitat restoration to landscape connectivity	*Trachemys scripta*
LIFE10 NAT/CY/000716	Restoration and management of Oroklini Lake SPA (CY6000010) in Cyprus	*Acacias, Parkinsonia aculeata*
LIFE13 NAT/CY/000176	Improving lowland forest habitats for Birds in Cyprus	*Several plants*
CZECH REPUBLIC		
LIFE04 NAT/CZ/000015	Restoration of thermophilous habitats in the Moravian Karst	*Robinia pseudacacia*
LIFE06 NAT/CZ/000121	Preservation of alluvial forest habitats in the Morávka river Basin	*Fallopia spec.div., Impatiens glandulifera*
LIFE09 NAT/CZ/000363	Lounské Středohoří Steppe - Active protection of the SCIs with thermophilous habitat types and species in Lounské Středohoří hills	*Robinia psuedacacia, Pinus nigra, Quercus rubra, symphoricarpos albus, Lycium barbarum*
LIFE11 NAT/CZ/000490	Grasslands and streams restoration in SCI Krkonoše: Future of Nardus grasslands*, Dwarf gentian* & Bullhead	*Lupinus polyphyllos*
DENMARK		
LIFE94 NAT/DK/000492	Re-establishing lichen and coastal heaths in the Anholt desert, Denmark	*Pinus mugo*
LIFE96 NAT/DK/003000	Protection of grey dunes and other habitats on Hulsig Hede/ Hulsig Heath	*Pinus mugo*
LIFE02 NAT/DK/008584	Restoration of Dune Habitats along the Danish West Coast	*Exotic conifers*
LIFE04 NAT/DK/000020	Restoration of Dry Grasslands in Denmark	*Rosa rugosa*
LIFE08 NAT/DK/000464	Dry Grassland in Denmark - Restoration and Conservation	*Rosa rugosa*
LIFE11 NAT/DK/000893	LIFE LAESOE - restoration of birdlife and natural habitats at Laesoe	*Rosa rugosa; Spartina anglica; Pinus mugo; Pinus contorta; Picea sitchensis; Prunus serotina*
LIFE12 NAT/DK/001073	Restoration of Danish Coastal Habitats	*Rosa rugosa; Pinus mugo, Pinus Contorta, Pinus nigra, Picea sitchensis*
LIFE13 NAT/DK/001357	Restoration of wetlands in dune habitats	*Rosa rugosa; Heracleum mantegazzianum*
ESTONIA		
LIFE08 NAT/EE/000257	Securing Leucorrhinia pectoralis and Pelobates fuscus in the northern distribution area in Estonia and Denmark	*Carassius auratus gibelio, C. Auratus, Elodea*
LIFE10 NAT/EE/000107	Restoration and Public Access of Urban Coastal Meadow Complex in Parnu Town	*Impatiens glandulifera, Hippophae rhamnoides, Rosa rugosa*
FINLAND		
LIFE00 NAT/FIN/007061	Protection and management of the valuable wetland Siikalahti	*Neovison vison*
LIFE02 NAT/FIN/008468	Management of Urban Nature 2000 areas in SW Finland	*Neovison vison; Nyctereutes procyonoides*
LIFE03 NAT/FIN/000039	Management of wetlands along the Gulf of Finland migratory flyway	*Neovison vison; Nyctereutes procyonoides*
LIFE04 NAT/FI/000076	Restoration and maintenance of valuable aquatic bird habitats of Pirkanmaa	*Neovison vison; Nyctereutes procyonoides*
LIFE07 NAT/FIN/000151	Inventories and planning for the marine Natura 2000 network in Finland	*Dreissena polymorpha; Mytilopsis leucophaeata*
LIFE10 NAT/FI/000048	Improving the Conservation Status of Species-rich Habitats	*Heracleum mantegazzianum, Impatiens glandulifera, Impatiens parviflora, Lupinus polyphyllus, Sambucus racemosa, Rosa rugosa*

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FRANCE		
LIFE92 ENV/F/000066	Expansion of the tropical green algae Caulerpa Taxifolia in the Mediterranean Sea Méditerranée occidentale	*Caulerpa taxifolia*
LIFE95 ENV/F/000782	Control of the Caulerpa Taxifolia extention in the Mediterranean Sea.	*Caulerpa taxifolia*
LIFE98 NAT/F/005250	Maritime archipelagos and islets of Brittany	*Neovison; Rats*
LIFE99 NAT/F/006304	Conservation of Mediterranean temporary ponds	*Several plants*
LIFE03 NAT/F/000102	Conservation of marine birds of Marseille islands	*Rats*
LIFE04 NAT/FR/000082	Headwater streams and faunistic Heritage associated	*Fallopia japonica*
LIFE04 NAT/FR/000086	Conservation of the Aquatic Warbler in Brittany	*Baccharis halimifolia; Cortaderia selloana; Fallopia japonica*
LIFE06 NAT/F/000146	Preservation of the coast biodiversity on the Gâvres-Quiberon site	*Baccharis halimifolia, Cortaderia selloana*
LIFE07 NAT/F/000193	Creating an experimental and demonstrative network of lagoon and dune Natura 2000 sites on the mediterranean coastline of Languedoc-Roussillon.	*Trachemys scripta elegans, Opuntia ficus indica, Nicotiana glauca, Carpobrotus spp, Lippia spp, Ludwigia peploides, Amorpha fruticosa, Ambrosia coronopifolia, Senecio inaequidens*
LIFE07 NAT/F/000188	Conservation, restoration and reconstitution of the semi-xerophilic habitats of the "massif de la Montagne" in Reunion	*Hiptage benghalensis, Rhus longipes, Litsea glutinosa, Furcraea foetida, Albizzia lebbeck, Tecoma stans, Lantana camara, Syzygium jambos; Ratus ratus, Lissachatina immaculata*
LIFE08 NAT/F/000478	Urban bee biodiversity action plans	*Several plants*
LIFE09 NAT/FR/000582	Conserving French overseas threatened bird species and their habitats using demonstrative conservation tools.	*Rattus norvegicus on islands, Herpestidae (Mongoose, Mangusten) Racosperma (Acacia) mangium*
LIFE10 NAT/FR/000192	LIFE ecological continuity, management of catchment area and associated patrimonial fauna	*American crayfish ?? (Pacifastacus or Procambarus?)*
LIFE11 ENV/FR/000746	Development of an urban green infrastructure in the Chanteloup loop	*Fallopia japonica; Robinia pseudoacacia; Ludwigia spp.*
GERMANY		
LIFE98 NAT/D/005064	Rhön Biotope region - Building Block for Natura 2000	*Lupinus spp.*
LIFE03 NAT/D/000004	Regeneration of "Grosses Torfmoor"	*Prunus serotina*
LIFE05 NAT/D/000152	Rehabilitation of the Baltic coastal lagoon habitat complex	*Rosa rugosa*
LIFE05 NAT/D/000051	Large Herbivores for Maintenance and Conservation of Coastal Heaths	*Prunus serotina*
LIFE06 NAT/D/000003	Rohrhardsberg, Upper Elz and Wilde Gutach	*Fallopia japonica*
LIFE07 NAT/D/000225	Hillsides and Floodplains in the Danube valley between Neustadt and Bad Abbach (DONAU KEH)	*"Robinia pseudoacacia Populus canadensis"*
LIFE07 NAT/D/000233	Restoration of habitats in the Federsee bog (ReHa Federseemoor)	*Solidago canadensis, Impatiens glandulifera, Helianthus tuberosus, Cornus alba*
LIFE07 NAT/D/000213	Conservation and development of the steppe grasslands in Thuringia	*Robinia pseudoacacia, Lycium barbarum*
LIFE08 NAT/D/000013	Improvement and Long-Term Safeguarding of the Natura 2000 Site "Dessau-Wörlitz Elbe Floodplain"	*Fraxinus pennsylvanica*
LIFE09 NAT/DE/000010	Reestablishment of the Marsh Fritillary (Euphydryas aurinia)	*Prunus serotina*
LIFE10 NAT/DE/000008	Rur and Kall – fluvial habitats	*Castor canadensis*
LIFE10 NAT/DE/000009	Acidophilous oak woods with bogs and heaths	*Prunus serotina*
LIFE11 NAT/DE/000344	Re-wetting valuable raised bogs in the northern Hannover Region	*Vaccinium x hybr.*
LIFE12 NAT/DE/000091	Heathland alliance: Biodiversity and habitat network in Nördlinger Ries and in the Wörnitz Valley	*Robinia pseudoacacia, Fallopia japonica, Bunias orientalis, Prunus serotina*
GREECE		
LIFE03 NAT/GR/000091	Conservation measures of Falco eleonorae in Greece	*Rats*
LIFE04 NAT/GR/000101	Conservation management of an Island SPA	*Rats*
LIFE07 NAT/GR/000285	Concrete Conservation Actions for the Mediterranean Shag and Audouin's gull in Greece including the inventory of relevant marine IBAs	*Rats*

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LIFE09 NAT/GR/000323	Demonstration of the Biodiversity Action Planning approach, to benefit local biodiversity on an Aegean island, Skyros	*Rats*
LIFE10 NAT/GR/000637	Management of the SPA site of Andros Island to achieve a favourable conservation status for its priority species	*Rats*
HUNGARY		
LIFE03 ENV/H/000280	Sustainable use and management rehabilitation of flood plain in the Middle Tisza District	*Amorpha fruticosa*
LIFE04 NAT/HU/000116	Establishing the background of saving the Hungarian meadow viper (Vipera ursinii rakosiensis) from extinction	*Robinia pseuroacacia, Pinus nigra*
LIFE05 NAT/H/000117	Habitat management on the Pannonian grasslands in Hungary	*Prunus serotina, Robinia pseudoacacia, Asclepias syriaca, Ailanthus altissima*
LIFE06 NAT/H/000104	Conservation of the Pannon endemic Dianthus diutinus	*Asclepias syriaca*
LIFE06 NAT/H/000098	Conservation of Euro-siberian steppic woods and Pannonic sand steppes in "Nagykörösi pusztai tölgyesek" pSCI	*Prunus serotina, Robinia pseudoacacia*
LIFE06 NAT/H/000102	Restoration and grassland management of Felsö-Kongó meadows	*Solidago gigantea*
LIFE07 NAT/H/000324	Restoration of sodic lake sub-type of the Pannonic salt steppe and marsh habitat in the Hortobágy	*Salidago canadensis, Elaeagnus angustifolia,Hordeum jubatum*
LIFE07 NAT/H/000320	Conservation of alluvial habitats of community interest on the Szabadság Island and side channel in Béda-Karapancsa pSCI	*Acer negundo, Fraxinus pennsylvanica, Amorpha fruticosa*
LIFE07 NAT/H/000321	Restoration and conservation of priority habitats and species in the Eastern Bakony area	*Eleagnus angustifolia, Ailanthus altissima, Robinia pseudo-acacia, Pinus nigra*
LIFE08 NAT/H/000289	Restoration and conservation of priority-listed Pannonic sand land habitats in military owned area of the Hungarian Little Plain	*Solidago gigantea, Ailanthus altissima, Asclepias syriaca, Robinia pseudo-acacia*
LIFE10 NAT/HU/000018	Restoration and conservation of the Pannonic salt steppes of Pásztó grassland with sustainable management	*Asclepias syriaca, Ambrosia artemisiifolia, Erigeron canadensis, Robinia pseudoacacia, Amorpha fruticosa*
LIFE10 NAT/HU/000020	Conservation of priority natural values in 'Turjánvidék' Natura 2000 site southern unit	*Robinia pseudo-acaci,Eleagnus angustifolia, Prunus serotina, Ailanthus altissima, Asclepias syriaca, Pinus sylvestris, Pinus nigra, Acer negundo, Populus x canadensis*
INTERNATIONAL		
LIFE06 TCY/INT/000246	Protection of Biodiversity of the Sava River Basin Floodplains	*Several plants*
IRELAND		
LIFE02 NAT/IRL/008490	Restoring Active Blanket Bog in Ireland	*Exotic conifers*
LIFE04 NAT/IE/000121	Restoring raised bogs in Ireland	*Exotic conifers*
LIFE05 NAT/IRL/000182	Restoring Priority Woodland Habitats in Ireland	*Exotic invasive shrubs*
LIFE07 NAT/IRL/000341	Control of aquatic invasive species and restoration of natural communities in Ireland	*Lagarosiphon major, Heracleum mantegazzianum, Fallopia japonica, Crassula helmsii, Elodea nuttallii, Impatiens glandulifera, Corbicula fluminea (Asiatic Clam Mussel)*
LIFE07 NAT/IRL/000342	Restoration of the Lr.Shannon SAC for Sea lamprey, Atlantic salmon and European otter	*Heracleum mantegazzianum, Fallopia japonica, Impatiens glandulifera*
LIFE09 NAT/IE/000222	Demonstrating Best Practise in Raised Bog Restoration in Ireland	*Exotic conifers and Rhododendron*
LIFE09 NAT/IE/000220	Restoration of the Upper River Blackwater SAC for the Fresh-water Pearl Mussel, Atlantic Salmon, European Otter and Kingfisher	*Impatiens glandulifera*
ITALY		
LIFE96 NAT/IT/003068	Proposed sites of conservation importance (SCIs - Bioitaly) environment restoration on the Groane Regional Park.	*Prunus serotina*
LIFE96 NAT/IT/003073	Active preservation of the natural reserve Valli del Mincio.	*Nelumbo nucifera*
LIFE97 NAT/IT/004134	Restoration of alluvial woods and oak woods along the Ticino River	*Prunus serotina*
LIFE97 NAT/IT/004153	Capraia and other small islands of the Tuscan Archipelago: biological diversity conservation	*Ailanthus altissima, Rattus rattus*
LIFE98 NAT/IT/005089	Conservation of forests in "Conero Natural Regional Park"	*Pinus spp.*

PROJECT	TITLE	IAS
LIFE98 NAT/IT/005095	Urgent actions for the conservation of Common Spade-foot Pelobates fuscus insubricus	*Lithobates catesbeianus; Procambarus clarkii, Myocastor coypus*
LIFE98 NAT/IT/005125	Protection of biodiversity in Tuscan Valtiberina	*Invasive trees*
LIFE99 NAT/IT/006235	Actions of environmental restoration of Alserio Lake	*Robinia pseudoacacia*
LIFE99 NAT/IT/006245	Bosco Fontana: urgent conservation's actions on relict habitat	*Quercus rubra*
LIFE99 NAT/IT/006252	Restore the alluvial forests - Regional Natural Reserve Naviglio di Melotta	*Robinia pseudoacacia;Acer negundo; Phytolacca americana; Lonicera japonica*
LIFE99 NAT/IT/006189	"JUNIPER DUNES": Rearrangement and conservation SCI Monte Russu	*Carpobrotus edulis*
LIFE99 NAT/IT/006212	Biodiversity of Iseo peat-moss: conservation and management	*Amorpha fruticosa*
LIFE00 NAT/IT/007209	Conservation and management of the biotope 'S. Genuario Wetland'	*Trachemis scripta; Myocastor coypus*
LIFE00 NAT/IT/007246	Restoration of the Soltarico oxbow Lake	*Amorpha fruticosa*
LIFE02 NAT/IT/008526	Restoration of ecological balance for conserving the habitats of species of Community interest	*Myocastor coypus*
LIFE02 NAT/IT/008572	Toce River: conservation of riparian habitats in favour of breeding and migratory birds	*Robinia pseudoacacia; Buddleja davidii*
LIFE03 NAT/IT/000109	Conservation of Alder woods in Lomellina area's SIC	*Robinia pseudoacacia; Ailanthus altissima*
LIFE03 NAT/IT/000113	Conservation of Acipenser naccarii in the River Ticino and in the middle reach of the River Po	*Silurus glanis*
LIFE03 NAT/IT/000119	Safeguard of ecologically interesting habitats inside Colli Euganei	*Robinia pseudoacacia; Ailanthus altissima*
LIFE03 NAT/IT/000141	Concerted action for biodiversity on the Veneto coast	*Plant species in general*
LIFE03 NAT/IT/000147	Biocenosis restoration in Valvestino Corno della Marogna 2	*Plant species in general*
LIFE04 NAT/IT/000153	Actions to preserve the NATURA 2000 sites in Alta Tuscia Viterbese	*Exotic conifers*
LIFE04 NAT/IT/000190	Conservation actions in NATURA 2000 sites managed by the State Forest Service	*Ailanthus altissima; Robinia pseudacacia*
LIFE04 NAT/IT/000172	Tuscan Islands: new actions towards sea birds and habitat	*Rattus rattus, Felis silvestris*
LIFE05 NAT/IT/000037	Conservation of ecosystems in northern Tuscany	*Amorpha fruticosa, Yucca gloriosa*
LIFE07 NAT/IT/000433	Improvement of the conservation status of SCIs in the high appenine area and in the plain around Prato.	*Many fauna species Procambarus clarkii, Trachemis scripta, Myocastor corpus (nutria) etc.*
LIFE07 NAT/IT/000499	Actions for the bird species of EU interest in the Natura 2000 sites in the lowlands of Parma (Italy)	*Myocastor corpus*
LIFE08 NAT/IT/000352	Conservation and Recovery of Austropotamobius pallipes in Italian Natura2000 Sites	*Procambarus clarkii (Red Swamp Crayfish / Louisiana Crayfish)*
LIFE08 NAT/IT/000353	Montecristo 2010: eradication of invasive plant and animal aliens and conservation of species/habitats in the Tuscan Archipelago,Italy.	*Ailanthus altissima, Rattus rattus*
LIFE09 NAT/IT/000118	Restoration and conservation of dry grasslands in southern and central Italy	*Ailantus, Robinia*
LIFE09 NAT/IT/000095	Eradication and control of grey squirrel: actions for preservation of biodiversity in forest ecosystems	*Sciuris carolinensis (Grey squirrel), Callosciurus erythaeus (Mountain red-bellied Squirrel)*
LIFE10 NAT/IT/000224	Conservation and Improvement of Spina Verde SCI Habitats	*Robinia pseudoacacia*
LIFE10 NAT/IT/000241	TIB - Trans Insubria Bionet. Habitat connection and improvement along the Insubria ecological corridor between the Alps and the Ticino valley	*Ludwigia grandiflora, Nelumbus nuficera*
LIFE10 NAT/IT/000239	Eradicate Invasive Louisiana Red Swamp and Preserve Native White Clawed Crayfish in Friuli Venezia Giulia - RARITY	*Procambarus clarkii*
LIFE10 NAT/IT/000243	Restoration of Dry grasslands (Magredi) in four Sites of Community Importance of Friuli Lowland	*Amorpha fruticosa*
LIFE10 NAT/IT/000256	Environmental Management and Restoration of Mediterranean Salt Works and Coastal Lagoons	*Sea Gulls*
LIFE11 BIO/IT/000020	Biodiversity Improvement Of Aquatic Alpine Ecosystems	*Salvelinus fontanilis; Salmo trutta subsp. fario*
LIFE11 NAT/IT/000232	Dune habitats protection in the greenhouse landscape of the Gela Gulf for the safeguarding of *Leopoldia gussonei*	*Saccharum aegyptiacum, Carpobrotus edulis, Acacia saligna, Eucalyptus camaldulensis*

PROJECT	TITLE	IAS
LIFE11 NAT/IT/000093	Conservation of the main European population of Calonectris d. diomedea and other pelagic birds on Pelagic Islands	*Carpobrotus edulis, Nicotiana glauc, Ratus (black rat)*
LIFE11 NAT/IT/000094	Control of invasive alien species to restore threatened habitats in inland wetlands of northern Tuscany	*Myocastor coypus; Procambarus clarkia*
LIFE12 BIO/IT/000213	Control and eradication of the invasive exotic plant species Ailanthus altissima in the Alta Murgia National Park	*Ailanthus altissima*
LIFE12 NAT/IT/000416	Protection of the largest population of Puffinus yelkouan on Earth and containment and eradication of invasive alien species	*Carpobrotus sp.*
LIFE13 BIO/IT/000204	Management of grey squirrel in Umbria: conservation of red squirrel and preventing loss of biodiversity in Apennines	*Sciurus carolinensis*
LIFE13 NAT/IT/000433	LIFE RES MARIS - Recovering Endangered habitatS in the Capo Carbonara MARIne area, Sardinia.	*Carpobrotus spp.; Acacia spp.; Agave spp.*
LIFE13 NAT/IT/000471	Island conservation in Tuscany, restoring habitat not only for birds	*Eucalyptus camaludulensis; Carpobrotus spp; rats; feral cats*
LATVIA		
LIFE06 NAT/LV/000196	The improvement of habitats management in Natura 2000 site - Vestiena	*Heracleum mantegazzianum*
LUXEMBOURG		
LIFE11 NAT/LU/000857	Restoration of Unio crassus rivers in the luxemburgish Ardennes	*Muskrat Ondatra zibethicus*
MALTA		
LIFE12 NAT/MT/000182	Soil stabilisation measures to protect Annex I habitats in Buskett-Girgenti Natura 2000 site	*Ailanthus altissima, Vitis sp., Agave sp. Ricinus communis*
THE NETHERLANDS		
LIFE09 NAT/NL/000417	Revitalising the Noordduinen: from concrete surfaces to grey dune habitats	*Rosa rugosa*
LIFE09 NAT/NL/000418	Realisation of Natura 2000 targets for calcareous white, grey dunes and dune slacks in three Dutch dune sites	*Prunus serotina, Cotoneaster sp, Mahonia aquifolium*
LIFE10 NAT/NL/000023	Restoration of inland dunes and psammophyle heathland in the North-western Veluwe	*Prunus serotina*
LIFE11 NAT/NL/000776	'Amsterdam Dunes - source for nature', dune habitat restoration project	*Prunus serotina*
LIFE11 NAT/NL/000777	"Let the raised bogs grow" Natura 2000 Deurnsche Peel/Mariapeel	*The Bluecrop (Vaccinium corymbosum)*
LIFE12 NAT/NL/000372	Restoration programme for Natura2000 fen areas in the Netherlands	*Vaccinium macrocarpon*
POLAND		
LIFE08 NAT/PL/000513	Conservation and restoration of xerothermic grasslands in Poland - theory and practice	*Heracleum sosnowskyi, Robinia pseudoacacia*
LIFE09 NAT/PL/000263	Protection of water and marsh birds in five national parks - reconstructing habitats and curbing the influence of invasive species	*Neovison vison, Nyctereutes procyonoides (Raccoon)*
LIFE10 NAT/PL/000655	Protection of natural resources of Kampinos Forest – Natura 2000 Site, through the renaturalisation of bought-up land.	*plant species in general*
LIFE11 ENV/PL/000459	Evaluation of the health state of forests and an effect of phosphite treatments with the use of photovoltaic SLE UAV	*Phytophthora spp.*
LIFE11 NAT/PL/000431	Endangered species and habitats protection of the Natura 2000 "Ostoja Wigierska" site	*Impatiens grandiflora*
LIFE11 NAT/PL/000432	"Protection of valuable natural non-forest habitats typical of the "Orle Gniazda" Landscape Park "	*Fallopia sachalinensis*
LIFE12 NAT/PL/000034	Nature mosaics - protection of species and habitats in Natura 2000 site "Pieniny"	*Fallopia japonica,Fallopia sachalinensis,*
LIFE13 NAT/PL/000032	In harmony with nature- Life + for Janowskie Forest	*Prunus serotina*
PORTUGAL		
LIFE94 NAT/P/001032	Conservation of the Azorian bullfinch, Pyrrhula murina	*Hedychium gardnerianum*
LIFE95 NAT/P/000125	Restoration measures for the terrestrial habitat of Deserta Grande Deserta Grande	*Goats; rats*

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LIFE97 NAT/P/004082	Measures for the Management and Conservation of the Laurisilva Forest of Madeira (code 45.62*)	*Hedychium gardnerianum*
LIFE99 NAT/P/006436	Restoration of the laurel forest in Funduras	*Several plants*
LIFE99 NAT/P/006439	Gerês valley natural habitats restoration	*Acacia dealbata*
LIFE03 NAT/P/000013	Azores bullfinch habitat recovery in Pico da Vara/Ribeira do Guilherme SPA	*Cryptomeria japonica; Hedychium gardnerianum; Clethra arborea; Gunnera tinctoria*
LIFE04 NAT/P/000214	Management and conservation of the sites of S. Mamede and Nisa/Laje de Prata	*Acacia spp.*
LIFE07 NAT/P/000649	Safe islands for seabirds/ Initiating the restoration of seabird-driven ecosystems in the Azores	*Rats*
LIFE07 NAT/P/000630	Recovery, conservation and sustainable management of Tronqueira/Planalto dos Graminhais	*Cryptomeria japonica; Hedychium gardnerianum; Clethra arborea; Gunnera tinctoria, Pittosporum undulatum; Acacia melanoxylon; Dicksonia antarctics*
LIFE09 NAT/PT/000041	Halt the loss of European Biodiversity through the recovery of habitats and species of the islets of Porto Santo and surrounding marine area.	*Nicotiana glauca;Agave Americana;*
LIFE10 NAT/PT/000075	Bussaco´s Recovery from Invasions Generating Habitat Threats (BIODIV)	*Acacia sp.; Pittosporum undulatum; Robinia pseudoacacia; Cortaderia selloana; Prunus laurocerasus; Pittosporum euginioides; Facicularia bicolour; Tradescantia fluminensis.*
LIFE11 NAT/PT/000327	Recovery and conservation of species and habitats on the Madeiran Central Massif	*Several plants*
LIFE13 BIO/PT/000386	Invasive species control through public participation	*Carpobrotus edulis*
LIFE13 NAT/PT/000458	Conserving threatened habitats and species in Berlengas SPA through sustainable management	*Larus michahellis; Carpobrotus edulis*
ROMANIA		
LIFE06 NAT/RO/000177	Conservation and integrated management of Danube islands Romania	*Amorpha fruticosa*
LIFE06 NAT/RO/000172	Conservation, restoration and durable management in Small Island of Braila, Romania	*Amorpha fruticosa*
LIFE08 NAT/RO/000502	Securing favorable conservation status for priority habitats from SCI Calimani-Gurghiu	*Robinia pseudoacacia*
LIFE10 NAT/RO/000740	Improving the conservation status for the priority species and habitats in the Iron Gates wetlands	*Invasive weeds (Eichhornia crassipes, Azolla filiculoides, Nymphoides peltata), invasive trees (Robinia pseudoaccacia, Rhus hirta, Alianthus altissima), Neovison vison*
LIFE11 NAT/RO/000828	Environmental restoration and support of natural processes in the forests and eutrophic marshes from Prejmer and Harman	*Rumex alpinus, Solidago canadiensis, Juncus tehuis, Urtica dioica, Salix capraea, Betula pendula*
SLOVAKIA		
LIFE03 NAT/SK/000097	Conservation and management of Danube floodplain forests	*Fraxinus pennsylvanica*
LIFE07 NAT/SK/000707	Conservation of Endangered Bird Species Populations in Natural Habitats of the Danube Inland Delta	*Solidago canadensis, S. gigantea, Acer negundo, Fraxinus pennsylvanica*
LIFE10 NAT/SK/000080	Restoration of Natura 2000 sites in cross-border Bratislava capital region	*Ailanthus altissima, Solidago spp., Calamagrostis spp., Phragmites australis, Fraxinus americana, Fraxinus lanceolata, Fraxinus pennsylvanica, Acer negundo, Ligustrum vulgare, Cornus mas, Berberis vulgaris*
LIFE10 NAT/SK/000083	Restoration of endemic pannonic salt marshes and sand dunes in Southern Slovakia	*Solidago sp. , Ailanthus altissima, Robinia pseudoacacia, Gleditchia triacanthos, Padus serotina, Celtis occidentalis,*
SPAIN		
LIFE96 NAT/E/003095	Increase in the size population of Columba bollii y Columba junoniae	*Rats*
LIFE97 NAT/E/004157	Project of physical and ecological recovery of “Playa del Matorral”	*Palms*
LIFE98 NAT/E/005300	Conservation of island SPAs in the Valencian region	*Opuntia spp.*
LIFE98 NAT/E/005348	Restauration and management of the “Estanys de Sils”	*Phytolacca americana; Arundo donax*
LIFE99 NAT/E/006392	Restoration of the islets and the cliffs of Famara (Lanzarote Island)	*Nicotiana glauca; Rats; feral cats*

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LIFE99 NAT/E/006417	Conservation of priority habitats in the Valencian Community	*Several plants*
LIFE00 NAT/E/007303	Protection of Posidonia grasses in SCIs of Baleares	*Caulerpa racemosa*
LIFE00 NAT/E/007311	White-headed duck preservation plan in the Valencian community	*Oxyura jamaicensis*
LIFE00 NAT/E/007330	SCI Parga-Ladra-Támoga: recovery of bog woodland and dystrophic lake	*Pinus spp., Populus spp. and Eucalyptus spp*
LIFE00 NAT/E/007331	Conservation of european mink (Mustela lutreola) in La Rioja	*Neovison vison*
LIFE00 NAT/E/007340	Black vulture conservation in Mallorca and in other ZEPAs in Spain	*Felis catus*
LIFE00 NAT/E/007299	Conservation of european mink (Mustela lutreola) in Castilla y Léon	*Neovison vison*
LIFE00 NAT/E/007335	Conservation of the European mink (Mustela lutreola) in Álava	*Neovison vison*
LIFE00 NAT/E/007355	Conservation of areas with threatened species of the flora in the island Minorca	*Carpobrotus edulis*
LIFE02 NAT/E/008604	Conservation of european mink (Mustela lutreola) in Catalonia (Spain)	*Neovison vison*
LIFE02 NAT/E/008608	Conservation of Audouin's gull in the Valencian Community	*Larus michahellis (Yellow-legged Gull)*
LIFE02 NAT/E/008612	Conservation of Larus audouinii in Spain: Catalonia	*Larus michahellis (Yellow-legged Gull)*
LIFE02 NAT/E/008614	Recovery plan for the giant lizard of La Gomera	*Felis catus*
LIFE02 NAT/CP/E/000014	Control de vertebrados invasores en islas de Portugal y de España	*Felis catus and rats*
LIFE03 NAT/E/000054	Conservation of coastal habitats of the Province of Cádiz	*Carpobrotus edulis*
LIFE03 NAT/E/000061	Conservación de Larus audouinii en España. (Isla Grosa) Murcia. (Murcia)	*Larus michahellis, Agave americana, Acacia retinoides Carpobrotus sp*
LIFE03 NAT/E/000067	Recuperation of the aquatic environment of Porqueres and the lake of Banyoles	*Prunus sp., Arundo donax, Pyracantha coccinea*
LIFE03 NAT/E/000064	Gestión y puesta en valor de 3 hábitats de alta montaña	*Robinia pseudoacacia; Populus nigra x canadensis*
LIFE04 NAT/ES/000035	Conservation of Aphanius iberus genetic stocks (Murcia)	*Gambusia spp.*
LIFE04 NAT/ES/000044	Recovery of the littoral sand dunes with Juniper spp in Valencia	*Carpobrotus edulis; Agave Americana*
LIFE04 NAT/ES/000048	Recovery of a priority habitat in l'Albufera natural Park	*Sander lucioperca; Lepomis gibbosus; Tinca tinca*
LIFE04 NAT/ES/000059	Recovery of the habitat of amphibians and Emys orbicularis in the Baix Ter	*Trachemys scripta elegans, Trachemys scripta scripta*
LIFE04 NAT/ES/000064	Restoration of Juniperus spp. forests on Tenerife	*Opuntia maxima, Opuntia dillenii, Agave americana*
LIFE05 NAT/E/000058	Management and conservation of temporary ponds in Minorca	*Arundo donax; Gleditsia triacanthos*
LIFE06 NAT/E/000213	Wetland restoration and management: Canal de Castilla Special Protection Area	*Neovison vison*
LIFE08 NAT/E/000064	Development and demonstration of eradication and control methods for an invasive species: Carybdea marsupialis (Cubozoa), Mediterranean	*Carybdea marsupialis (Box Jelly; Würfelqualle)*
LIFE08 NAT/E/000055	Restoration of habitats of Community interest in the Basque Country's estuaries.	*Baccharis halimifolia*
LIFE08 NAT/E/000072	Recovery of riparian habitats of the Ter river	*Robinia pseudoacacia, Arundo donax, Ailanthus altissima, Yucca sp., Platanus orientalis var. Acericifolia, Phyllostachys bambusoides, Ligustrum japonicum, Acer negundo*
LIFE08 NAT/E/000078	Improvement of the Natura 2000 habitats and species found in Banyoles: a demonstration project.	*Micropterus salmoides, Lepomis gibbosus, Perca fluviatilis, Cyprinus carpio, Trachemys scripta, Chrysemis picta, Pseudemys concina, Pseudemys nelsoni, Trachemys emolli Lonicera japonica, Populus deltoides, Robinia pseudoacacia Ligustrum lucidum*
LIFE09 NAT/ES/000529	Demonstration strategy and techniques for the eradication of invasive freshwater turtles	*Trachemys scripta*
LIFE09 NAT/ES/000534	Conservation of Posidonia oceanica meadows in Andalusian Mediterranean Sea	*Caulerpa racemosa, Lophocladia lallemandii*

PROJECT	TITLE	IAS
LIFE10 NAT/ES/000582	Combating invasive species within the Tagus and Guadiana river basins in the Iberian peninsula	*Acacia dealbata, Ailanthus altissima, Zebra mussel, Azolla filiculoides, Neovison vison, Trachemys scripta, Corbicula fluminea (shell)*
LIFE10 NAT/ES/000565	Control of the invasive species Lampropeltis getula californiae on the island of Gran Canaria (BIODIV)	*Lampropeltis getula californiae*
LIFE11 NAT/ES/000707	Inland wetlands of Northern Iberian Peninsula: management and restoration of mires and wet environments	*Several plants*
LIFE12 ENV/ES/001140	RIVERLINK	*Arundo donax*
LIFE13 BIO/ES/001407	Strengthening associated biodiversity of habitat 92A0 and control of Invasive Alien Species in the Segura River.	*Several species*
LIFE13 NAT/ES/000586	PRESERVATION AND IMPROVEMENT IN PRIORITY HABITS ON THE ANDALUSIAN COAST	*Several plants*
LIFE13 NAT/ES/000883	In situ and Ex situ innovative combined techniques for coastal dune habitats restoration in SCIs of northern Spain	*Several plants*
LIFE13 NAT/ES/000899	Biodiversity conservation in river Miera	*Baccharis halimifolia; Cortadeira selloana*
LIFE13 NAT/ES/001210	Restoration of lentic habitats and aquatic species of Community interest in high mountains of the Pyrenees	*Phoxinus sp.*
SWEDEN		
LIFE00 NAT/S/007118	Restoration of alvar-habitats at Stora Karlsö	*Prunus mahaleb and Acer pseudoplatanus*
LIFE02 NAT/S/008483	Restoration of deciduous forest in Söderåsen National Park	*Acer pseudoplatanus, Quercus rubra and Thuja occidentalis*
LIFE09 NAT/SE/000344	Management of the invasive Raccoon Dog (Nyctereutes procyonoides) in the north-European countries	*Nyctereutes procyonoides (Raccoon)*
LIFE11 NAT/SE/000849	Restoration of habitats on sandy soils in southern Sweden	*Rosa rugosa*
UNITED KINGDOM		
LIFE94 NAT/UK/000580	SCOTLAND'S CALEDONIAN FOREST	*Exotic conifers*
LIFE97 NAT/UK/004244	Restoration of Atlantic Oakwoods	*Rhododendron*
LIFE97 NAT/UK/004242	Securing Natura 2000 objectives in the New Forest	*Exotic conifers and Rhododendron*
LIFE98 NAT/UK/005432	The Border Mires - Active Blanket Bog Rehabilitation Project	*Exotic conifers*
LIFE99 NAT/UK/006094	The Lowland Limestone Pavement Rehabilitation Project	*Exotic conifers*
LIFE00 NAT/UK/007073	Mink control to protect important birds in SPAs in the Western Isles	*Neovison vison*
LIFE00 NAT/UK/007075	Restoring active blanket bog of European importance in North Scotland	*Exotic conifers*
LIFE00 NAT/UK/007078	Restoration of Scottish raised bogs	*Exotic conifers*
LIFE00 NAT/UK/007074	Woodland Habitat Restoration: Core sites for a forest habitat network	*Rhododendron ponticum*
LIFE02 NAT/UK/008544	Sustainable Wetland Restoration in the New Forest	*Rhododendron ponticum*
LIFE03 ENV/UK/000614	Sustainable Urban Planning Networks for green spaces	*Invasive plants*
LIFE03 NAT/UK/000044	Restoration of the Core Ravine Woodlands of England & Wales	*Invasive broadleaves, eg. Platanus occidentalis (sycamore)*
LIFE05 NAT/UK/000141	Canna seabird recovery project	*Brown rat*
LIFE05 NAT/UK/000142	Eradication of Ruddy ducks in the UK to protect the white-headed duck	*Ruddy Duck*
LIFE06 NAT/UK/000134	Restoring active blanket bog in the Berwyn and Migneint SACs in Wales	*Exotic conifers and Rhododendron*
LIFE08 NAT/UK/000201	Irfon Special Area of Conservation Project	*Pacifastacus leniusculus (Signal crayfish)*
LIFE08 NAT/UK/000199	The Alde-Ore Estuary - Securing a sustainable future for wildlife	*Brown rat*
LIFE11 NAT/UK/000387	Maintaining and enhancing the Isles of Scilly SPA through the removal of rats from two key islands	*Brown rat*
LIFE13 NAT/UK/000209	Protecting and restoring the Shiant Isles SPA through rat removal, and safeguarding other seabird island SPAs in the UK	*Rats*

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LIFE "L'Instrument Financier pour l'Environnement" / The financial instrument for the environment

The LIFE programme is the EU's funding instrument for the environment and climate action

Period covered 2014-2020

EU funding available approximately €3.46 billion

Allocation of funds Of the €3.46 billion allocated to LIFE, €2.59 billion are for the Environment sub-programme, and €0.86 billion are for the Climate Action sub-programme. At least €2.8 billion (81% of the total budget) are earmarked for LIFE projects financed through action grants or innovative financial instruments. About €0.7 billion will go to integrated projects. At least 55% of the budgetary resources allocated to projects supported through action grants under the sub-programme for Environment will be used for projects supporting the conservation of nature and biodiversity. A maximum of €0.62 billion will be used directly by DG Environment and DG Climate Action for policy development and operating grants.

Types of projects Action Grants for the Environment and Climate Action sub-programmes are available for the following:

> "Traditional" projects – these may be best-practice, demonstration, pilot or information, awareness and dissemination projects in any of the following priority areas: LIFE Nature & Biodiversity; LIFE Environment & Resource Efficiency; LIFE Environmental Governance & Information; LIFE Climate Change Mitigation; LIFE Climate Change Adaptation; LIFE Climate Governance and Information.

> Preparatory projects – these address specific needs for the development and implementation of Union environmental or climate policy and legislation.

> Integrated projects – these implement on a large territorial scale environmental or climate plans or strategies required by specific Union environmental or climate legislation.

> Technical assistance projects – these provide financial support to help applicants prepare integrated projects.

> Capacity building projects – these provide financial support to activities required to build the capacity of Member States, including LIFE national or regional contact points, with a view to enabling Member States to participate more effectively in the LIFE programme.

Further information More information on LIFE is available at http://ec.europa.eu/life.

How to apply for LIFE funding The European Commission organises annual calls for proposals. Full details are available at http://ec.europa.eu/environment/life/funding/life.htm

Contact

European Commission – Directorate-General for the Environment – B-1049 Brussels (env-life@ec.europa.eu).
European Commission – Directorate-General for Climate Action – B-1049 Brussels (clima-life@ec.europa.eu).
European Commission – EASME – B-1049 Brussels (easme-life@ec.europa.eu).

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LIFE Publication / LIFE and Invasive Alien Species

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