

Towards an early warning and information system for invasive alien species (IAS) threatening biodiversity in Europe

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The present report is an abridged version of the report 'Towards an early warning and information system for invasive alien species (IAS) threatening biodiversity in Europe', prepared by a team of experts led by Istituto Superiore per la Protezione e la Ricerca Ambientale (ISPRA) (Italy, Rome) within a project financed by the European Environment Agency (EEA) (Contract No. 3606/B2008/EEA.53386). That report was based on a literature analysis, an in-depth assessment of the European situation, a review of the early warning and rapid response frameworks in other regions of the world, and replies to a questionnaire circulated to representatives and experts from 38 European countries.

Preface

Towards a pan-European early warning and rapid response system to tackle biological invasions — the crucial role of information management

In recent decade, invasions of various alien species have become a major driver of biodiversity loss, second only to habitat fragmentation. One-third of bird species included in the IUCN Red List, 6 % of mammals, and 11 % of amphibians are threatened by invasive species, which account for more extinctions worldwide than any other agent.

Europe is particularly affected by alien species, which are invading the continent an unprecedented pace. DAISIE — a Sixth Framework Programme project funded by the EU — records the presence of more than 10 000 alien species in Europe. Their impact means that many of the region's rarest endemic species are on the brink of extinction. Examples include the European mink, the white-clawed crayfish and the white-headed duck.

Invasions do not only threaten our biodiversity. They also affect our well-being and economies, causing losses exceeding EUR 12 billion annually, endangering the ecosystem services that we depend on and transforming the landscapes that have formed Europe's cultural background for millennia.

The European Commission has formally recognised the urgent need to tackle invasions in its Communication 'Towards an EU Strategy on Invasive Species' (COM (2008) 789 final). There it commits to develop a policy on the issue and establish an early warning system. The Council of European Ministers endorsed these commitments in the Conclusions of its 2953rd meeting (Luxembourg, 25 June 2009). In addition, G8 Environment Ministers in 2009 stressed the urgent need to combat invasive species, calling on the world community to establish a global early warning system.

The rapid increase in invasive species in recent decades requires us to implement these

commitments immediately. In particular, establishing an early warning and rapid response framework should be a key target for post-2010 biodiversity protection activities.

It is essential that we improve our ability to react to invasions. That means enhancing prompt detection of new incursions and correct taxonomic identification of invaders, assessing related risks and ensuring immediate reporting of relevant information to the competent authorities.

The present publication is the EEA contribution to achieving this goal. It is based on a longer EEA-managed study, 'Towards an early warning and information system for invasive alien species (IAS) threatening biodiversity in Europe'. Prepared by leading European scientists led by ISPRA, the study assesses the models for a European early warning system, identifying key challenges and cost estimates for different institutional managements.

In past years, the EEA has invested considerable resources in addressing the issue of alien species. Another major initiative in this context was the Streamlining European 2010 Biodiversity Indicators (SEBI 2010) project, aimed at ensuring maximum streamlining and comparability of national, regional and global biodiversity indicators. A specific SEBI 2010 Expert Group on Trends in Invasive Alien Species in Europe developed specific indicators for inclusion in the SEBI 2010 indicator set.

Ensuring transparent and authoritative information sharing has always been the core business of EEA. Integrating knowledge about invasive species into the Biodiversity Information System for Europe (BISE), and supporting advanced platforms to share biodiversity information across Europe, will enhance science-based decision-making, a key contribution from EEA.

Jacqueline McGlade
Executive Director

1 Rationale for an early warning and rapid response system for invasive species

The number of invasive alien species established in Europe is growing rapidly, severely impacting regional biological diversity (Hulme, 2007) the ecosystem services that ensure our health and well-being (Vilà *et al.*, 2010). Furthermore, biological invasions also affect the European economy, with overall losses estimated to exceed EUR 12 billion annually (Kettunen *et al.* 2009).

It is now widely acknowledged that, together with preventing unwanted introductions, early warning and rapid response are crucial for mitigating the impacts of biological invasions (Genovesi and Shine, 2004; Wittenberg and Cock, 2001). Indeed, at the ninth meeting of the Conference of the Parties to the Convention on Biological Diversity, held in Bonn in 2008, Parties were invited 'to collaborate on the



Photo: © Riccardo Scalera

The coypu *Myocastor coypus* is a typical example of an invasive alien species causing impacts on biodiversity, economic activities and human health. The impact on wetlands of this large semi-aquatic rodent, introduced in Europe from South America for the fur trade, can be severe. Besides feeding on aquatic vegetation it destroys nests and preys on eggs of several aquatic birds, including endangered species. Moreover the species could play a role in the epidemiology of leptospirosis. The species is also considered a pest for feeding on crops, such as sugar beets and maize, and for its burrowing, which disrupts riverbanks and dikes. In Italy during 1995–2000, despite control activities involving the removal of 220 688 coypus at a cost of EUR 2 614 408, damage to the riverbanks exceeded EUR 10 million and impacts on agriculture reached EUR 935 138 (Panzacchi *et al.*, 2007).

development and use of early warning systems, including networks of focal points, and on the development and use of rapid response mechanisms' (Decision IX/4 In-depth review of ongoing work on alien species that threaten ecosystems, habitats or species).

The need to develop effective global early warning and rapid response systems has also been stated as a priority action in the 'Charter of Syracuse' on biodiversity, adopted at the G8 Environment Ministers Meeting (22–24 April 2009, Syracuse, Italy).

The European capacity to detect and react promptly to new invasions is often limited (see, for example, Genovesi, 2005a). Measures to prevent either unwanted introductions or the spread of already established alien species are rarely applied and new entries are often detected or revealed only when effective response is no longer feasible. For this reason it is crucial to improve the ability to detect and report new incursions of alien species into Europe promptly, so that timely and reliable risk assessments can be produced and effective management responses can be enacted promptly wherever needed.

In order to respond to these needs, the Council of Europe adopted the European Strategy on Invasive Alien Species in 2003 (Genovesi and Shine, 2004). The Strategy, whose recommendations have been carefully included in the present report, calls for the establishment of effective systems to share IAS information with neighbouring countries, trading partners and regions with similar ecosystems to facilitate identification, early warning and coordination of prevention, mitigation and restoration measures. Furthermore, it underlines the need to produce information systems helping to locate, document and provide electronic access to sources of information, provide quality control and ensure controlled, agreed and shared terminology.

At the European Union scale, the Commission's Communication 'Halting the loss of biodiversity by 2010 and beyond: sustaining ecosystem services for

human well-being' (COM(2006) 216 final) stressed the need to reduce substantially the impact of invasive alien species and alien genotypes on EU biodiversity, and highlighted the need to develop specific actions including an early warning system.

More recently, the Commission's Communication 'Towards an EU Strategy on Invasive Species' (COM(2008) 789 final), proposed, among other options, the immediate establishment of a Europe-wide early warning and information system to report new and emerging alien species, in line with the internationally agreed three-stage approach

to tackle invasive species based on prevention, early detection and eradication, and control and containment measures.

Finally, the 'Council conclusions on a mid-term assessment of implementing the EU Biodiversity Action Plan and Towards an EU Strategy on Invasive Alien Species' adopted at the 2953rd Environment Council meeting, Luxembourg, 25 June 2009, underlines that the cooperation of all Member States and the Commission in addressing IAS issues such as early warning is a necessary condition for successful management of IAS. It also underlines



Note: The European Environmental Agency's work area includes 32 member countries (27 European Union Member States together with Iceland, Liechtenstein, Norway, Switzerland and Turkey) and six cooperating countries (Albania, Bosnia and Herzegovina, Croatia, the former Yugoslav Republic of Macedonia, Montenegro and Serbia), as well as Kosovo under UNSC Resolution 1244/99.

Source: EEA.

the urgent need for the Commission and the Member States to develop together an appropriate information system for early warning and rapid response, including through developing and updating specific lists of IAS, linking European lists to international lists, cooperating on biosecurity and control measures within the EU, with neighbouring countries and with international organisations.

It should be noted that, as also stressed by Miller *et al.* (2006), coordinated frameworks dealing with the issue of alien species already exist in some sectors. The European plant health system, for example, includes an obligation to report new findings of invasive species and to perform appropriate eradication or containment measures rapidly. Most sectors lack such provision, however, including those that deal with nature conservation.

1.1 Scope and aims

Before addressing the core issues of the present study, it is essential to define early warning and rapid response systems for invasive alien species. In the present report, such systems are defined as frameworks aimed at responding to biological invasions, through a coordinated system of surveillance and monitoring activities, diagnosis of invading species, assessment of risks, circulation of information, reporting to competent authorities, identification and enforcement of appropriate responses.

On that basis, the present report aims:

- to identify gaps in early warning and rapid response at the pan-European scale;
- to identify priorities for improving the ability of European Member States to respond rapidly to new incursions;
- to propose a set of options to bridge the existing constraints and gaps in the response to invasive alien species in Europe.

The geographic scope comprises the entire work area of the European Environmental Agency but the conclusions are also relevant elsewhere, such as the European overseas territories. Furthermore, the present report covers invasions in all environments (marine, terrestrial and freshwater) and all taxonomic groups in Europe, with the exception of human pathogens.

In the present report, references to 'European institutions' signify any institution, body or agency

acting at the pan-European level (the European Commission, the European Environment Agency, etc.) unless otherwise specified.

1.2 Glossary of key terms

- **Alert lists (alarm list):** list of alien species not yet present in a territory or present only in a very limited range that pose risks to the invaded area, and for which it is recommended to apply particular surveillance and monitoring efforts in order to enhance prompt response in the case of arrival/expansion.
- **Black list:** a list of alien species that have been shown through risk assessment to pose risks to the environment, economy or human well being.
- **Early warning and rapid response system (EWRR):** a framework designed to respond to biological invasions through a coordinated system of surveillance and monitoring activities; diagnosis of invading species; assessment of risks; circulation of information, including reporting to competent authorities; and identification and enforcement of appropriate responses.
- **Response:** actions aimed at preventing or mitigating impacts of biological invasions, including rapid eradication, continuous monitoring, containment of potential spread or permanent population control.
- **Risk assessment:** the evaluation of the likelihood of entry, establishment or spread of an alien species in a given territory, and of the associated potential biological and economic consequences, taking into account possible management options that could prevent spread or impacts. Risk assessment includes risk analysis (process of evaluating biological or other scientific and economic evidence to determine whether an alien species will become invasive) and risk management (evaluation and selection of options to reduce the risk of introduction and spread of an invasive alien species).
- **Watch list:** a list of alien species not yet present in a territory — or present only in a limited range — that are considered potentially to pose risks to the invaded area and for which it is recommended to monitor arrival, expansion and impacts, and/or application of prevention measures.

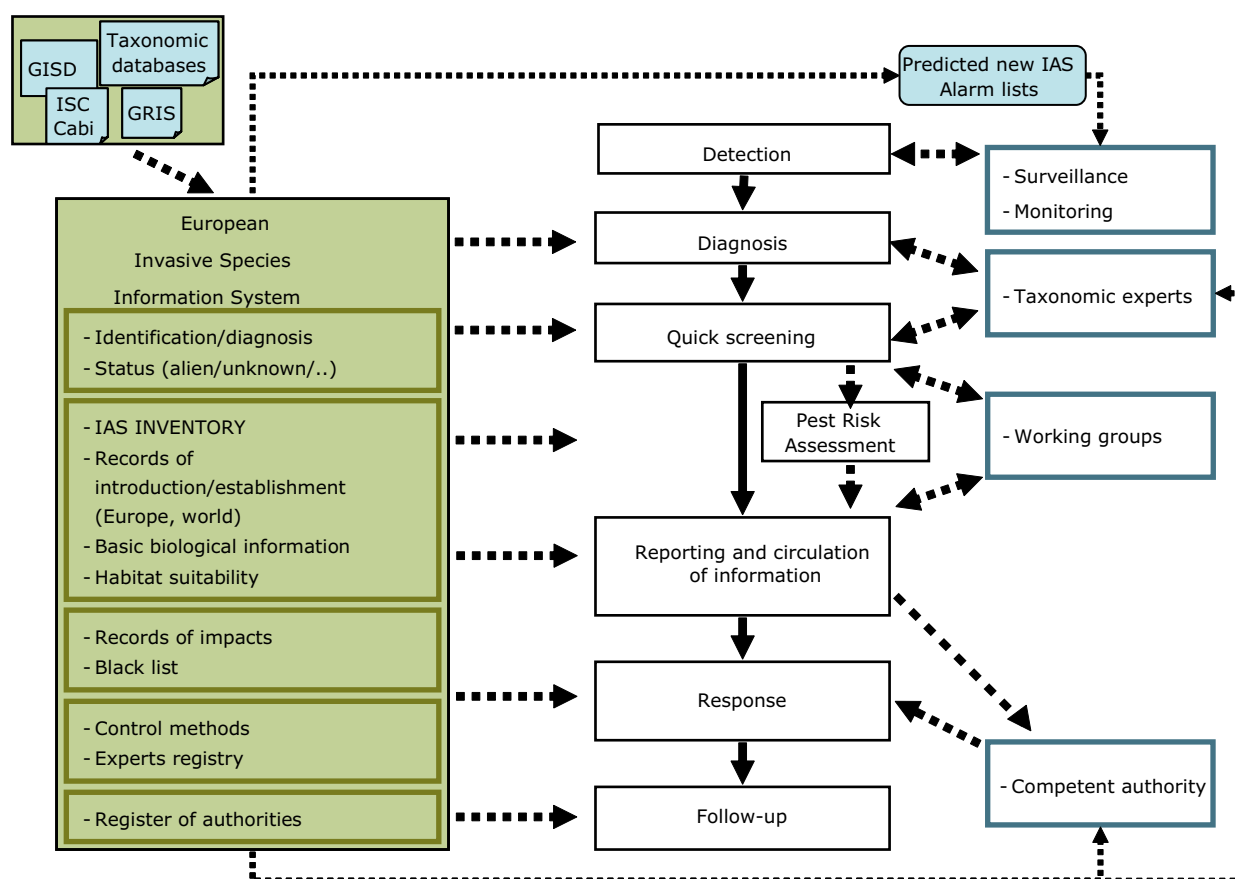
2 Structure of a European early warning and rapid response framework

In order to respond adequately to the threat of alien species, an effective early warning system should be based on a framework of activities. These include measures to detect the occurrence of new propagules and invaders, supported by activities to diagnose new species correctly and acquire all related information. Such information represents a necessary basis for science-based risk assessments that evaluate the severity of the threat and consequently identify the best options for managing the species.

- detection (surveillance and monitoring);
- diagnosis and data processing;
- risk assessment (or quick screening);
- reporting to competent authorities and circulation of information;
- response action (e.g. eradication, control);
- follow up.

In Figure 2.1, the logical framework that underpins the activities mentioned above is presented as a workflow, which includes the following six linked elements:

Figure 2.1 Structure of a pan-European early warning and rapid response framework



Each element (described in detail below) should be under the responsibility of one or more competent authorities acting at the European, national or local level (see Chapter 4). The procedure and protocols for an optimal circulation of information can vary according to the actual species in question, the region targeted and the available knowledge and tools (including legal instruments, when available). However, the efficiency of the system is guaranteed by an optimal and rationalised circulation of information among all involved actors through an effective European information system (see Chapter 3).

For this reason, a key element for adequate coordination of all the activities in a regional EWRR is the establishment of a dedicated European technical scientific body. Such a body should ensure prompt and transparent access to high level scientific knowledge and expertise on the different aspects of the EWRR system, with the primary task of implementing and maintaining a European information system on alien species.

The possible options for establishing a dedicated technical scientific body are discussed in more detail in Chapter 5. These options are based on an evaluation of administrative cost analyses conducted on existing panels of experts, observatories and agencies that act at the pan-European level in comparable fields and with similar levels of responsibilities to those that might be assigned to a European technical body on invasive alien species. Organisations such as the European Maritime Safety Agency (EMSA), the European Centre for Disease Control (ECDC) and the European Community Urgent Radiological Information (ECURIE) system are assessed as potential models.

Five options are identified, implying varying levels of commitment by EU institution and Member States (including differing budgetary and personnel needs). A dedicated structure could take the form of a scientific panel, an observatory, or a centralised agency at the pan-European level. A further alternative is a simple network of experts and/or scientific institutions from individual European countries.

2.1 Surveillance and monitoring

Monitoring and surveillance activities are essential to collect the information needed to guarantee rapid response actions and implement measures to prevent newly-introduced IAS establishing. The difference between surveillance and monitoring activities can be summarised as follows:

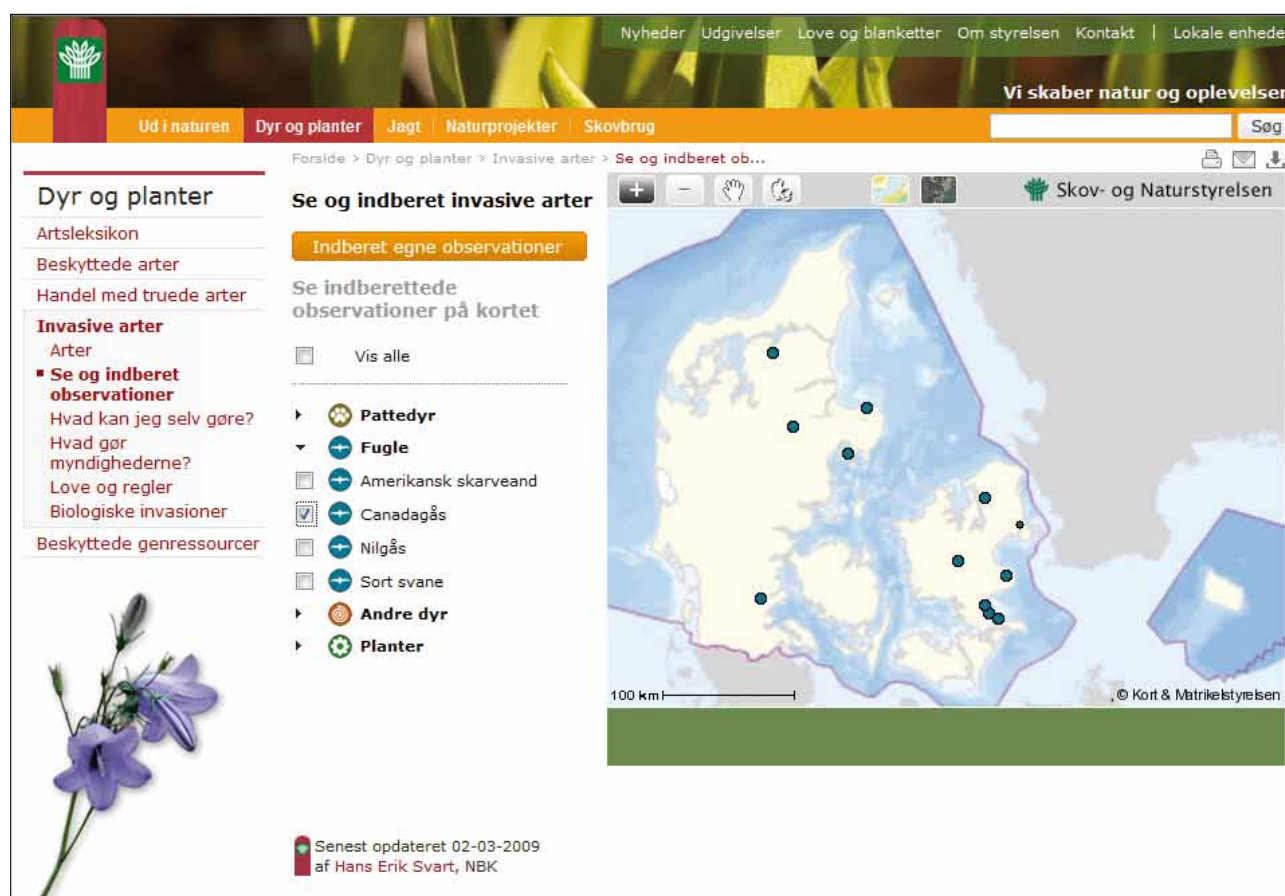
- surveillance is an activity aimed at identifying alien species new to a country, and as such is a pivotal element of prevention;
- monitoring programmes are useful to acquire a better understanding of the ecology, distribution, patterns of spread and response to management of an IAS, and as such can strengthen the capacity to predict the consequences of alien species introductions, and identify or assess the best management options if required.

Dedicated surveillance programmes can be established at entry points (i.e. points of import) in the form of border controls and quarantine measures. Implementation such programme can help prevent or minimise the risk of introducing alien species that are or could become invasive, or protect particularly vulnerable areas, such as islands. Surveillance programmes would be of limited efficacy if carried out on a local scale. As such, it is clearly important to launch a European surveillance system to optimise use of existing capacity; involve key societal sectors; and promote standardised procedures to collect, analyse and promptly circulate information on new incursions.

Contrastingly, monitoring programmes can be designed for specific regions or species and are useful to provide critical information to support IAS prevention, mitigation and restoration actions. Monitoring programmes may also provide a stronger scientific basis for decision-making and allocation of resources.

The ability of European institutions and national governments to detect new incursions of alien species promptly can only be improved by increasing the number of surveillance activities and monitoring programmes dedicated to alien species. That means bridging the gaps in taxonomy and environments not covered by existing programmes, and ensuring that existing monitoring programmes focusing on native species are integrated in a coordinated system so that all sightings of alien species are reported promptly.

In order to enable better coordination among national surveillance and monitoring efforts, the establishment of a coordinated body at the European level is fundamental. A coordinated information system is also necessary, particularly an interlinked system of national or taxonomic inventories and easily accessible databases such as Delivering Alien Invasive Species Inventories for Europe (DAISIE), the North European and Baltic Network on Invasive Alien Species (NOBANIS), the European and



Note: In Denmark the Forest and Nature Agency has recently launched a portal that allows the public to record observations of a number of invasive alien species. In this way people can help the authorities monitor the spread of species invading the country, and in the future it could help to detect new incursions. The map depicts recent sightings of the Canada goose *Branta canadensis*, introduced in Europe from North America.

Source: www.skovognatur.dk/DyrOgPlanter/invasivearter/Indberetning.

Mediterranean Plant Protection Organization Plant Quarantine Data Retrieval System (EPPO PQR).

Key recommendations

- 1 At the pan-European scale, a coordinated surveillance system should be established under the responsibility of a European technical structure dedicated to IAS or of a network of national authorities/institutions. The surveillance system should be aimed in particular at:
 - 1.1 collecting and storing information on new incursions through direct contacts with countries, institutions, stakeholders and experts, and regularly screening scientific journals, grey literature, newsletters, etc.;
 - 1.2 promoting best use of existing capacity and procedures to collect, analyse and circulate information on IAS promptly;
 - 1.3 providing guidance on effective techniques for rapid detection of newly arrived alien species, and disseminating information on best practices;
 - 1.4 developing ad hoc alarm lists based on predictions of the spread or arrival of IAS;
 - 1.5 identifying and encouraging regular surveillance of key pathways and high-risk areas, such as:
 - 1.5.1 areas of predicted spread of established invasive species;
 - 1.5.2 main entry points for commercial or tourist arrivals (airports, ports, harbours, open moorings, train stations) and areas frequently visited by tourists;
 - 1.5.3 areas adjacent to containment facilities for potential IAS;
 - 1.5.4 highly disturbed areas (land clearance, construction, storm damage) and areas where disturbance occurs regularly (roads, railways etc.);

- 1.5.5 isolated ecosystems and ecologically sensitive areas (e.g. islands).
- 2 At the European scale, a coordinated monitoring system should be established under the responsibility of a European technical structure dedicated to IAS or a network of national authorities/institutions. The monitoring system should be aimed in particular at:
- 2.1 establishing and updating an inventory of active monitoring programmes for different areas/taxonomic groups and analysing the information to identify the main gaps, areas for development and opportunities for more effective collaboration within Europe;
- 2.2 promoting monitoring programmes of pathways, vectors and vulnerable points, as appropriate (e.g. through identification and risk analysis of different pathways and vectors for species introductions or spread, including methods to predict potential invasiveness of alien species prior to introduction).
- 3 At the European scale, it is of primary importance that, before being circulated, information is accurately checked by the responsible European technical structure dedicated to IAS (or by the network of national authorities or institutions) and that all references are provided and verified to trace back the data.
- 4 At the national or local level, all competent authorities should ensure that appropriate information is provided by:
- 4.1 supporting existing surveillance and monitoring schemes and promoting the development of new ones to ensure that records of alien species are regularly collected and reported;
- 4.2 ensuring sharing of data among countries from all relevant stakeholders (quarantine facilities, plant health, public health, maritime and port facilities);
- 4.3 identifying priority pathways, entry points and target species (e.g. alarm lists) and concentrating surveillance efforts on those pathways, areas and species;
- 4.4 strengthening cooperation with neighbouring countries by enhancing transnational surveillance programmes where appropriate;
- 4.5 implementing training and capacity-building programmes for field officers, protected areas staff and other public employees;
- 4.6 facilitating access by key staff to IAS databases and expert networks;
- 4.7 involving relevant stakeholders and the general public by:
- 4.7.1 improving awareness of invasive alien species issues through specific information campaigns tailored to the target audience (public, commercial and institutional);
- 4.7.2 developing information materials to assist farmers, gardeners, birdwatchers, foresters, fishermen, hunters, divers, hikers and photographers to detect and report new arrivals;
- 4.7.3 encouraging specialist NGOs to participate in reporting networks;
- 4.7.4 introducing reporting requirements for landowners and other stakeholders, based on a list of priority IAS.

2.2 Diagnosis and data processing

Identifying a species correctly is the first step in an early warning and rapid response process aimed at preventing its establishment in a newly invaded region. Quick and reliable identification of the species and its status in the concerned area (i.e. whether the target species is alien to Europe, alien to the area concerned but native in other areas of Europe, cryptogenic, or unknown) will allow, in the event that the *taxa* is considered alien, a prompt start of the entire process for an early warning and rapid response.

Some well known groups of species can be identified using specific guides and manuals or other identification tools. These include species accounts and profiles available at inventories and databases on the internet, which often include species' pictures (e.g. DAISIE, the Global Invasive Species Database (GISD), NOBANIS and the Invasive Species Compendium (ISC)).

For most groups, however, particularly marine and terrestrial invertebrates and plants, competent expert support is often needed. Tools like the Aliens-L list of the IUCN/SSC Invasive Species Specialist Group (ISSG) and the DAISIE expert registry, which are discussed in Chapter 3, represent an important response to this need, facilitating contact among experts all over the world. A mechanism to enable access to taxonomic expertise and diagnostic tools is a crucial component in any EWRR framework.



Photo: © Riccardo Scalera

The American mink *Neovison vison* is one of the species whose profile is included among the 100 worst species section of the DAISIE portal, as one of the 59 facts available in the NOBANIS website, and as one of the 63 identification sheets of the UK Non-Native Species Secretariat website. Detailed species accounts for invasive alien species are important tools for agencies, resource managers, decision-makers, and interested individuals. Accounts covering high profile invasive alien species not only deliver end users with relevant details for species identification and management but also help raise public awareness on biological invasions. Accounts should include information on biology, ecology, distribution, management techniques, and bibliographic references, links and images. A key requirement for effective management of invasive alien species is also the ability to identify, map, and monitor invasions in order to assess their extent and dynamics; such information should be provided in species accounts in a standardised way.

In a number of cases, identifying new invaders can be a major challenge. Factors include the large number of unwanted organisms potentially arriving; the difficulty of identifying species in different life stages (i.e. eggs, seeds, spores, larvae); gaps in taxonomic knowledge; and the absence of relevant expertise.

For the reasons above, the traditional taxonomy practices are sometimes inadequate and diagnosing new invaders may require a framework of identification techniques relying on image assessment, digital image capture and internet-based identification. DNA barcoding could even provide valuable support to timely and cost-effective identification of invaders (Chown *et al.*, 2008).

Once a species has been identified and its status ascertained, information should be compared with an up-to-date European inventory (i.e. see DAISIE), and with alarm lists and black lists developed

ad hoc. For species recorded for the first time in Europe, other basic data should be searched in global inventories and databases or — if necessary — in scientific and 'grey' literature.

Key recommendations

- 5 At the European scale, a European dedicated structure on IAS should be given the task of ensuring the rapid screening of new records of alien species. The work of the European dedicated structure would be facilitated by a range of existing identification tools. The European dedicated structure would have the mandate to:
 - 5.1 provide support to national authorities and other actors for prompt and reliable taxonomic identification of possible new incursions;
 - 5.2 compare confirmed data with existing databases and inventories in order to define the status of recorded species ('alien to Europe', 'alien in Europe', 'alien to specific countries', 'native', 'cryptogenic' or 'uncertain');
 - 5.3 maintain and update a European inventory of alien species, including data on recorded impacts;
 - 5.4 maintain a regularly updated register of experts;
 - 5.5 process the collected data relating to new recorded alien species to enhance subsequent data analysis (quick screening, risk assessment, identification of response actions, etc.);
 - 5.6 promote existing capacity, establish procedures to collect, analyse and circulate information on IAS, including identification keys for different taxonomic groups.
- 6 At the European scale, the European institutions should provide support to ensure:
 - 6.1 use and circulation of existing tools (e.g. DAISIE);
 - 6.2 integration of existing web-based European (e.g. DAISIE, NOBANIS, etc.) and global (GISD, ISC, etc) databases with descriptive pictures, and other identification tools;
 - 6.3 development of further research in the field of taxonomy and the development of innovative diagnostic tools such as DNA bar coding of alien species;
 - 6.4 production and circulation of ad hoc guides and manuals for identifying the most invasive species.

2.3 Risk assessment

A fundamental element of an early warning and information system is risk assessment. The assessment of the risks connected to the actual or potential introduction of an alien species is a necessary step that builds on the information collected (i.e. by the European dedicated structure on a target alien species, before or soon after its introduction). It leads to a decision on the actual measures (e.g. eradication, control, regulation of trade) that should be undertaken so as to prevent



Photo: © Riccardo Scalera

The red palm weevil *Rhynchophorus ferrugineus* is essentially a pest of palms (Arecaceae), introduced in Europe from Asia through the plant trade. This species, included in the EPPO list recommended for regulation as quarantine pests (list A2), has been recently subject to a specific Pest Risk Assessment (PRA) carried out within the EPPO Decision support scheme. This scheme, initially developed for quarantine organisms and extended to invasive alien plants, represents an example of best practice in terms of PRA. It is in fact a readily usable tool for performing a PRA, helping assess the risk posed by an organism and propose preventive measures. It is to be kept in mind that the EPPO process is intended as a tool to justify preventive measures with an impact on international trade. For this reason, the process is complex and time-consuming. Assessing the risk posed by an organism can be done more rapidly and without extensive justifications in the framework of an early warning system.

a target species being introduced or permanently established.

The risk assessment can be done at very different levels of accuracy, depending on its objectives. For example, when deciding how to respond to a new incursion, a quick screening of the risks connected to the introduced species is in general more than sufficient to identify the proper response; when assessment is aimed at prioritising action or at supporting regulations of trade, a full and comprehensive risk assessment is required.

Whenever a new incursion is detected, a quick screening of the potential risks (based on available records of invasiveness in other areas, available information on ecological characteristics, etc.) should be promptly undertaken, so as to determine how to react.

A full risk assessment is the comprehensive evaluation of the likelihood of entry, establishment or spread of an alien species in a given territory, and of the associated potential biological and economic consequences, taking into account possible management options that could prevent spread or impacts.

Risk assessment includes risk analysis (the process of evaluating biological or other scientific and economic evidence to determine whether an alien species will become invasive) and risk management (evaluation and selection of options to reduce the risk of introduction and spread of an invasive alien species). For this reason, a full and comprehensive risk assessment is a complex process, which requires considerable time and human and economic resources. A detailed risk assessment may be strictly necessary only to support decisions that involve, for example, trade regulation under the World Trade Organization (WTO) treaty.

The efficacy and consistency of a sound risk assessment (and quick screening) would be guaranteed only if done at a EU regional level (though taking into account the local situations and conditions), and the results jointly endorsed by all interested countries. A local approach would limit the actual impact of this exercise and would negatively affect any follow up in terms of response actions.

Some European countries have already started regulating the movement and introduction of species on the basis of detailed risk assessments. Therefore, a good number of best practices and tools are already available to this regard, for example

those defined by EPPO, the European Food Safety Authority (EFSA) and the UK Department for Environment, Food and Rural Affairs (DEFRA).

Key recommendations

7 At the European scale, a European dedicated technical structure should be given the mandate to:

- 7.1 perform, where appropriate, a detailed, standardised and transparent quick screening or risk assessment of a newly recorded alien species or of a species that could potentially be introduced intentionally or unintentionally (e.g. via trade pathways);
- 7.2 develop and update protocols for quick screening and risk assessments of groups of species not already covered by existing screening mechanisms (e.g. excluding species already covered by EPPO, OIE);
- 7.3 identify existing tools and analyse international standards to be applied in the European regional context;
- 7.4 provide assistance to national authorities on standardised methods and protocols to carry out risk assessments of alien species at the local scale;
- 7.5 provide independent evaluation of risk assessments of alien species performed autonomously by other national or local authorities (e.g. national agencies) when such assessment might have a regional impact;
- 7.6 provide guidance to national authorities by updating and developing protocols for quick screening and risk assessments.

8 At the national or local level, national risk assessment authorities should be established to perform risk assessments for species of national concern (e.g. UK Pest Risk Working Group) with the aim of:

- 8.1 implementing standardised techniques and protocols defined at the European level by or in accordance with the European central body;
- 8.2 collecting and providing prompt and reliable taxonomic identification of possible new incursions, and informing the European dedicated technical structure;
- 8.3 performing quick screening for confirmed new incursions and informing the European dedicated technical structure where appropriate;
- 8.4 circulating updated information on management techniques to competent

national and local authorities, and informing the European dedicated technical structure where appropriate;

- 8.5 involving relevant stakeholders (e.g. the horticultural sector for the introduction of invasive alien plants) in developing or revising protocols for risk assessment and in relevant assessment processes, including decision-making.

2.4 Reporting and circulation of information

After collecting and duly analysing all available information and knowledge about the target species, it is important to circulate the results of the risk assessment and the recommended response actions (see Section 2.5 below) to the competent national and local authorities. In order to guarantee that tasks foreseen in the EWRR workflow are implemented effectively, it is crucial that roles and responsibilities be identified.

To date, clear protocols for identifying roles and responsibilities have not been available at the European level and this has prevented an optimal information flow to address the risk of new alien species entering one or more countries. However, some good examples exist at the European (or even wider) scale of mechanisms to circulate information,



Photo: © Hans Erik Svart

The Spanish slug *Arion lusitanicus* was found for the first time in Latvia in 2009. In the same year also the harlequin ladybird *Harmonia axyridis* was found in the country for the first time. Both species are currently locally distributed and rare but as they are reported as invasive in many countries they might also spread in Latvia. Early detection is key to rapid response and the NOBANIS network, which contributed to circulating and sharing this information through a dedicated newsletter, provides an excellent example in this regard.



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POUR LA PROTECTION DES PLANTES

EUROPEAN AND MEDITERRANEAN
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EPPO Reporting Service

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Note: The EPPO reporting service is one of the few examples of an effective circulation of IAS information. It covers organisms of phytosanitary concern and invasive alien plants with limited distribution. No other groups of organisms, including vertebrates and marine organisms, are covered. In its current form, the reporting service is appreciated by its readers, and the alert list of emerging organisms seems to be what the countries consider most useful. One peculiarity of the system, is that countries are obliged to report new outbreaks of organisms of phytosanitary concern to the EU, while no similar obligation exists for other organisms.

Source: www.eppo.org.

such as the EPPO Reporting Service and the open access, peer-reviewed international journal 'Aquatic Invasions', member of The Publishers International Linking Association (PILA).

In many cases, long time lags between finding a new species and publicising the invasion arise due to general unawareness of the invasion problem as a whole rather than inadequate expertise in identifying the species correctly. This is perhaps understandable when an invasion is first detected by a layman not skilled in the field of nature conservation. However, expert biologists may also be unaware of the potential threats from invasive alien species and as such may be reluctant to circulate results of their findings until their work is published. As a consequence, control actions may be considerably delayed.

An example of tools that might help to increase prompt reporting of records of new invasive species threatening biodiversity is the online journal 'Aquatic Invasions'. It provides the opportunity for timely publication of first records of aquatic invaders and other relevant information needed for risk assessments and early warning systems. The journal's record in publishing information quickly is remarkable: about 50 % of records are reported within a year from their 'discovery'. Unfortunately, 'Aquatic Invasions' has few counterparts in the terrestrial realm. One such is the EPPO Reporting Service, which promotes existing information and publications in the field of plant health, and records new occurrences of species.

Key recommendations

- 9 At the European scale, the European dedicated technical structure should establish a prompt, simple and transparent web-based information exchange mechanism, aimed at ensuring that:
 - 9.1 information on newly recorded species, for all taxa and all environments, are properly stored and the relevant associated risks and appropriate responses are promptly reported to the competent national and local authorities;
 - 9.2 information on predicted new arrivals (alarm lists) are collated and reported to competent national and local authorities so as to allow the implementation of prevention measures, and suitable monitoring programmes.

2.5 Response action

Once a new incursion is detected, and associated risks are preliminarily screened, it is crucial to decide promptly what measures have to be implemented (either eradication, control, containment or no action), what techniques have to be applied and who should enforce them.

Eradication is the most effective solution in terms of ecological results. When carried out successfully, it is more cost-effective than control, which requires continuous expenditures over a long period of time. As a general rule, eradication is considered to be feasible in the early stages of invasion when populations are small and localised, and only in areas of manageable size, such as islands or other isolated ecosystems (which should always be considered priority areas for this type of intervention).

In addition to a sound feasibility study, a successful eradication campaign requires the support of the competent authorities and good coordination among



Photo: © Riccardo Scalera

Early action was a key element for halting the invasion of American bullfrog *Rana catesbeiana* in the United Kingdom. A project lasting several years apparently eradicated the largest population of this species in south-east England. Monitoring for the last three years has not detected any remaining bullfrogs at this site. Early efforts to eradicate the first breeding bullfrog population cost some USD 29 000 (Inskipp, 2003). On the other hand, in Germany, although detected early, individual American bullfrogs were not controlled for several years. When control started in 2001, there were already several populations. Fortunately, they were still rather localised and by 2004 they were eradicated, although the total cost of these measures was EUR 1 million — definitely much more than if the control had been started immediately (Nehring and Klingenstein, 2008).

all administrations responsible for the territory. This helps ensure that other interventions, which are at odds with the objectives of the project, are not carried out in the same area. To be successful, the methods applied should be socially, culturally and ethically acceptable.

When eradication is not a feasible or practicable option, the best alternative may be control. The aim of control is to reduce the density and abundance of an alien species in order to keep its impact below an acceptable threshold. Effective control may be achieved through a range of integrated management techniques, including mechanical, chemical and biological control. Control methods should be selected after taking into consideration their efficiency and selectivity and undesired effects they may cause, as well as prevailing regulations and codes.



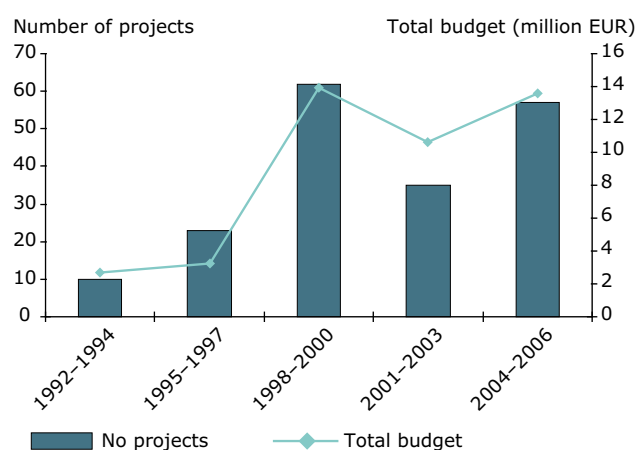
Photo: © Riccardo Scalera

According to the EEA report, 'EU funding for management and research of invasive alien species in Europe', over the last 15 years, despite the lack of a specific strategy or a dedicated financial instrument to deal with invasive alien species, the EU has contributed to financing almost 300 management and research projects on the issue. The total budget of projects funded under the LIFE and the RTD Framework Programmes exceeds EUR 132 million. The report was a part of the EEA work on 'Streamlining European 2010 Biodiversity Indicators' (SEBI 2010) aimed at assessing progress toward the target of halting the loss of biodiversity by 2010. The LIFE and the RTD Framework programmes have provided steadily increasing support over recent years both in terms of the number of projects targeting invasive alien species and the total budget. In particular, the LIFE programme has financed a wide range of measures addressing invasive alien species. These were mostly aimed at preventing, controlling or eradicating unwanted populations (American mink, ruddy duck, *Caulerpa taxifolia*, rhododendron, etc.), and were often connected with either the restoration of habitats or recovery of species of EU interest (Scalera, 2008).

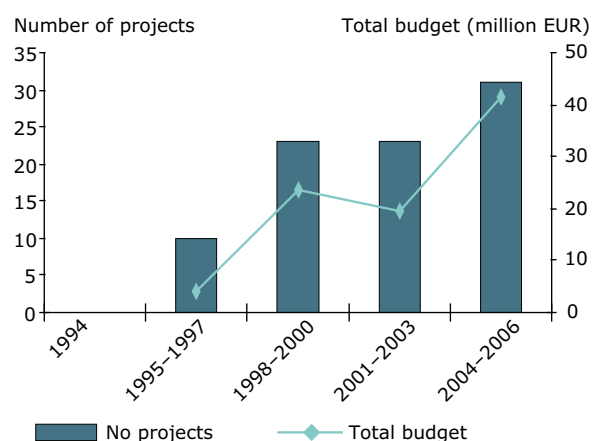
Another option is containment, which aims to limit spread and restrict IAS within regional barriers, especially when eradication is no longer feasible. Spread of IAS in suitable habitats can be avoided through natural or artificial barriers and exclusion fencing can be an effective control measure in some circumstances. This strategy is particularly appropriate where the range of the introduced population is small enough to achieve a significant result. Either control or containment is a high priority for IAS that could spread to neighbouring countries and to ecologically sensitive areas.

A last option is to do nothing. This is selected when the measures described above are considered infeasible because of technical or financial reasons, or because the actions are not considered socially or politically acceptable.

Number of projects and budget spent by LIFE for projects dealing with IAS over the years on a three-year period



Number of projects that include measures dealing with IAS and relative budget spent by the RTD Framework Programmes over the years on a three-year period



Key recommendations

- 10 At the European scale, the European institutions should:
 - 10.1 develop new legislation (or, as an alternative, adapt existing legislation) including provisions on mandatory responses to incursions and possible emergency orders where urgent measures are deemed necessary at the European scale or in the event of inaction by Member States;
 - 10.2 establish dedicated European funding instruments based on a clear, transparent and prompt decision-making process, to ensure adequate and timely support to Member States or other competent actors for enforcing rapid responses to new invasions.
- 11 A European dedicated technical structure should be established with the purpose of:
 - 11.1 coordinating implementation of a framework of activities pertaining to the early warning system that would support a transparent decision process aimed at identifying appropriate management measures (e.g. rapid eradication, monitoring, do-nothing) that could be recommended to national and local authorities (on a case-by-case approach, also based on a quick screening and risk assessment and contacting relevant experts if appropriate);
 - 11.2 establishing a prompt and effective procedure or protocol of reporting to competent national and local authorities;
 - 11.3 establishing, within the decision process, consultation mechanisms with national and local authorities, especially if the decision process may affect trade regulations or other economically relevant issues (e.g. recorded presence of regulated pests with effects on exports);
 - 11.4 preparing, in contact with national and local authorities and relevant stakeholders if appropriate, contingency plans for eradicating or containing selected sets of, as yet undetected species, whose introduction is considered probable (e.g. those species included in alarm lists);
 - 11.5 preparing contingency plans for eradicating or containing groups of species with similar characteristics (e.g. terrestrial and water plants, invertebrates, marine organisms, freshwater invertebrates, freshwater fish, reptiles, amphibians, birds, small mammals, large mammals) and eventually considering the use of emergency orders where urgent eradication or containment actions are needed;
- 11.6 providing guidance on best available financial resources and relevant funding instruments, and provide adequate funds and equipment for rapid response to new invasions and train relevant staff to use the control methods selected;
- 11.7 contribute to regional cooperation on research and development of emergency response materials (e.g. prepare a toolkit aimed at providing guidance on best practices and procedures to establish the optimal management option).
- 12 At the national or local levels, all competent authorities should:
 - 12.1 revise national legislation to remove obstacles (such as automatic protection of IAS) to response measures and make possible the adoption of emergency orders where urgent measures are deemed necessary;
 - 12.2 revise national frameworks to streamline response decision processes and to ensure that all competent authorities (including local authorities and protected area authorities) have sufficient powers to remove alien species with high potential to become invasive, in accordance with relevant laws and policies;
 - 12.3 establish dedicated funding instruments to ensure adequate resources and equipment for rapid response to new invasions;
 - 12.4 encourage competent agencies, including protected areas, to enhance training of staff to use selected control methods and to set up basic control equipment;
 - 12.5 prepare national and local contingency plans for eradicating and containing groups of species with similar characteristics (e.g. terrestrial and water plants, invertebrates, marine organisms, freshwater invertebrates, freshwater fish, reptiles, amphibians, birds, small mammals, large mammals).



Photo: © Ahmet Uludag

The Asiatic tearthumb *Polygonum perfoliatum* is one of the species included in the EPPO A1/A2 Lists of pests recommended for regulation as quarantine pests. The EPPO communication framework provides an example of a system where countries are called to report on the enforcement of recommended actions in the case of incursions by regulated organisms (list A1). The Bern Convention can open case files against countries that fail to comply with their obligations under the Convention, and the text of the Convention provides for the possibility of recourse to arbitration for any dispute. The general mechanism of the Convention is based on a moral suasion of Contracting Parties to comply with recommended actions, however, and does not include mechanisms for infraction proceedings (such as those for examples for infringement of EU directives).

2.6 Follow up

A final but essential element of the EWRR is reporting by the authorities in charge of the enforcing response actions. Such reporting addresses the progress of management measures and assesses their impact once the task is considered complete. Such reporting can allow a follow-up by the European technical structure and the European institutions, to inform other countries of the efficacy of the management options applied and to aid preparation should similar incursions occur elsewhere.

This part of the communication flow is crucial to enable independent technical evaluation of the activities and a more transparent supply of information on progress to the entire community of states and stakeholders.

Key recommendations

- 13 At the European scale, European legislative institutions should adapt existing legislation, or design new legal tools, to include provisions for:
 - 13.1 establishing a clear mechanism to guarantee a mandatory, prompt, regular and detailed activity report on progress and the impact of the actions carried out in response to the detection of an alien species, as enforced by competent authorities of the territories affected by new incursions;
 - 13.2 making it possible to open infraction proceedings or an infringement procedure against Member States that fail to implement the recommended or required response actions, and to impose fines as appropriate.
- 14 At the European scale, a European dedicated technical structure should be given the mandate to:
 - 14.1 establish a reporting mechanism to enhance the information flow to and from national and local authorities (and other actors), and to promote the circulation of information on the results of response actions carried out by some competent authority to other interested countries and actors;
 - 14.2 establish a mechanism for carrying out on-the-spot appraisals where appropriate.
- 15 At the national or local level, all competent authorities should revise national legislations and distribution of roles and competencies in order to ensure prompt and detailed monitoring and reporting of the progress and the impact of responses to invasions.

3 Information system

In order to assess the key components of a possible EWRR framework in Europe, we reviewed similar frameworks developed in other areas of the world. We selected several countries or regions that have put particular effort into developing EWRR systems and thus provide good opportunities to identify key points of an efficient EWRR. These include Australia, California, Galapagos, New Zealand and the United States of America. In Europe the only system that we reviewed was Great Britain's, which is among the most advanced in Europe, particularly after the adoption of the Invasive Non-Native Species Framework Strategy for Great Britain in May 2008.

The review of international EWRR systems revealed that measures to protect the natural environment



Photo: © Riccardo Scalerà

The United Kingdom Minister for Marine and Natural Environment has authorised a controlled release of the psyllid *Aphalara itadori* for controlling Japanese knotweed *Fallopia japonica*, one of IUCN's top 100 invasive alien species. The project's novelty in Europe presented the challenge of navigating European and national legislation that was not designed with the release of biocontrol agents in mind. The carefully controlled release process is expected to start in Spring 2010 and will be accompanied by a detailed monitoring programme. The project is now set firmly within the policy framework of the 'Invasive Non-Native Species Framework Strategy for Great Britain' and its pursuit through the relevant regulatory regimes may set a helpful precedent for other EU countries in undertaking similar projects.

against biological invasions are far less developed than frameworks addressing risks of introducing alien agents in the phytosanitary and veterinary sectors. It should be noted, however, that European countries — and Europe as a whole — have developed many different information systems that could significantly improve the ability to detect new incursions, identify invaders, assess the risks of the incursion and identify a proper response. These tools include:

- species databases (DAISIE, NOBANIS, etc.);
- identification tools (AdventOI, DAISIE species fact sheets, NOBANIS species fact sheets, etc.);
- risk assessment tools (EPPO scheme, PRATIQUE programme, etc.);
- experts registers (DAISIE experts register);
- documents showing best practices for management options (DAISIE species fact sheets, NOBANIS fact sheets, EPPO datasheets, etc.).

Many open-access tools have also been created or are being developed at the global scale such as the Global Invasive Species Database, the Invasive Species Compendium, the Global Register of Invasive Species and the Global Invasive Species Information Network.

In order to establish a European EWRR it is thus essential to develop a permanent dedicated information system, linked to the information tools available at the European and global scale. Several of the tools listed above might either provide examples of best practice or be extended to cover the needs of all European countries. Initiatives such as DAISIE and NOBANIS should be afforded a special role because they have collected a remarkable amount of information and established comprehensive networks of collaborators. Accompanied by information sharing tools, such as the EPPO Reporting Service, Aquatic Invasions and others yet to be developed, they have great



Note: Correct taxonomic diagnosis of species is essential to assess risks and respond to invasions. In this respect, Europe has contributed to developing identification tools to support rapid detection and early warning of new invasions. Among them, an example of best practices is AdventOI, an innovative tool developed on the basis of the software AdvenRun V.1.0 created for identifying major weeds at La Réunion island. The system uses a graphical system that identifies the plants step by step using images. The user has free choice of characters to describe using graphical modalities. Each species is completely described with numerous colour illustrations, botanical drawings and descriptive text. Species descriptive files can also be accessed from a website where the information (distribution, control methods, etc.) is regularly updated. AdventOI is designed for use on the field, by practitioners with UMPC (Ultra mobile computer) or in the office on PC. It is thus extremely easy to use, and allows almost 100 % of correct identification.

Source: www.prvp.org/index.php/fr/organismes_nuisibles/savoir_les_identifier/identifier_les_mauvaises_herbes_adventoi.

potential to underpin an early warning system for Europe.

In conclusion, in order to implement a sound early warning system at the European level, various technical, scientific and legal tools are required. Indeed, a broad range of tools should be available to the European dedicated structure (and to the competent national/local authorities as well) to support decision-making for rapid detection and early warning of new invasions.

The remainder of the present chapter provides comprehensive descriptions of the key decision-support tools that together make up the information system.

3.1 Species databases and inventories


The capacity to identify, prevent and mitigate IAS threats depends on the availability of accurate and updated information, easily accessible at the appropriate scale. In addition to global databases and inventories (such as GISD and ISC), several tools focus specifically on species occurring in the pan-European region. Additionally, projects like GISIN (the Global Invasive Species Information Network) aim to develop an online platform for sharing information on alien species globally.

Besides some important resources for specific taxonomic groups (notably the EPPO/EC plant health system), the most comprehensive and updated information mechanisms on invasive alien species currently available are DAISIE and NOBANIS. The main databases that may be useful as a basis for developing a European early warning and information system are described below.

3.1.1 DAISIE database

The DAISIE portal and associated database (www.europe-aliens.org) provide the first pan-European inventory on invasive alien species with extensive taxonomic and geographic scope. DAISIE (Delivering Alien Invasive Species Inventories for Europe) is funded by the Sixth Framework Programme of the European Commission. It provides an exhaustive inventory of invasive species that threaten European terrestrial, freshwater and marine environments, with information to help prevent and control biological invasions through the understanding of the environmental, social, economic and other factors involved. The data currently available (assembled and verified by experts) refer to alien vertebrates, invertebrates, marine and inland aquatic organisms and plants from up to 63 countries or regions (including islands) and 39 coastal and marine areas in the wider Europe. In total it covers 10 961 alien species recorded in Europe.

The largest database on invasive species in the world, DAISIE also aims to assess and summarise the ecological, economic and health risks and impacts of the most widespread and noxious invasive alien species. With free and direct access to national knowledge bases throughout Europe, it provides comprehensive data on which species are invasive or potentially invasive in particular habitats. It thereby aims to gather all information useful to prevent spread and impact, and to apply effective and appropriate control strategies. Information on species distribution in each



Delivering Alien Invasive Species Inventories for Europe

DAISIE

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Delivering Alien Invasive Species Inventories for Europe

Biological invasions by non-native or 'alien' species are one of the greatest threats to the ecological and economic well-being of the planet.

Alien species can act as vectors for new diseases, alter ecosystem processes, change biodiversity, disrupt cultural landscapes, reduce the value of land and water for human activities and cause other socio-economic consequences for man..

To help those tackling the invasive species challenge, this website provides a 'one-stop-shop' for information on biological invasions in Europe..

This website is the result of the DAISIE project, funded by the European Commission under the Sixth Framework Programme (Contract Number: SSP1-CT-2003-511202). Click [here](#) for more information about DAISIE..

Please note that the DAISIE database behind this website is continually being updated. The current version is only provisional for invertebrates and fungi where a large amount of data is currently being incorporated and corrections are being made.


To cite DAISIE, please use:
 DAISIE European Invasive Alien Species Gateway (<http://www.europe-aliens.org>)

To cite specific DAISIE content, please use (e.g.):
 DAISIE European Invasive Alien Species Gateway, 2008. *Oxyura jamaicensis*. Available from: www.europe-aliens.org/speciesFactsheet.do?speciesId=50432 [Accessed 1st April 2009].

DAISIE Handbook of alien species in Europe available NOW


[Preface, contents, contributors](#) [Chapter1](#)

1 Search Species




Register as a DAISIE expert

2 Search Experts



3 Search Regions



Note: DAISIE has compiled and peer-reviewed national lists of hundreds of species of fungi, plants, invertebrates, fish, amphibians, reptiles, birds and mammals. To date, over 50 000 invasion events have been recorded within the DAISIE database. These data need continual review as new information becomes available. Robust definitions of alien species status, impact and invasion have been applied across the breadth of alien taxa in marine, freshwater and terrestrial ecosystems built upon common approved formats and standards for recording information. These steps to maximise interoperability are essential to ensure that the inventory is compatible across geographic and bioclimatic regions and coordinated with initiatives operating at the national, regional and global levels. It is also essential that concepts are used that can be applied across all alien taxa and the biomes they occur in. Besides listing the occurrence of alien species within regions (countries and marine areas), the status of all species (e.g. alien) and persistence (e.g. established, endangered species) is vital information that is also included. DAISIE provides an extensive baseline for an inventory of Europe's aliens but there is an ongoing need to add new information and to address known geographic and taxonomic gaps in the current data.

Source: www.europe-aliens.org.

country is based on the advice of experts provided according to predefined status categories (e.g. 'alien/established', 'alien/non-established', 'alien/extinct', 'alien', 'cryptogenic/established').

DAISIE also includes detailed species accounts for a sample of '100 worst' invasive aliens in Europe, covering a broad spectrum of life forms and representing some of the species that have the greatest impact on biodiversity, the economy and health. Each species account contains information

on synonyms, description, biology/ecology, habitats (on the basis of the EUNIS codes), distribution worldwide (with a map of European distribution), impact and management.

DAISIE species descriptions can help identify newly introduced taxa, although in most cases specific tools — and taxonomic expertise — are essential. In the context of an EWRR, the information provided could be sufficient to complete the initiation and categorisation stages of risk analysis. Other stages of risk assessment (probability of entry, establishment, spread and impact) would require substantial additional information.

In summary, therefore, as outlined by Roy and Roy (2008), the DAISIE portal could act as a central information system for invasive alien species and

as such form the core instrument of a European early warning system.

3.1.2 NOBANIS gateway

Another major resource in Europe is NOBANIS (www.nobanis.org), a gateway to information on alien and invasive species in 19 countries of north and central Europe. NOBANIS (North European and Baltic Network on Invasive Alien Species) covers marine, freshwater and terrestrial environments and provides a distributed but integrated database on introduced species in the region.

NOBANIS provides minimal information for more than 6 000 species. Like the DAISIE database, invasiveness is assessed independently for each country. NOBANIS provides references for each



NOBANIS
European Network on Invasive Alien Species
Gateway to information on Invasive Alien species in North and Central Europe

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Search alien species
Invasive species fact-sheets
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International regulation on IAS
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Regional portal on invasive alien species

The North European and Baltic Network on Invasive Alien Species (NOBANIS) is a gateway to information on alien and invasive species in North and Central Europe.

NOBANIS covers marine, freshwater and terrestrial environments and provides

- a distributed but integrated database on introduced species in the region
- fact sheets on many of the most invasive aliens
- a catalogue of the regulation relevant to invasive species in participating countries
- a literature database
- connects to regional and global networks and projects of invasive alien species

The participating countries

Austria, Belgium, Czech Republic, Denmark, Estonia, Faroe Islands, Finland, Germany, Greenland, Iceland, Ireland, Latvia, Lithuania, the Netherlands, Norway, Poland, European part of Russia, Slovakia, Svalbard and Jan Mayen and Sweden.

Have a look at the ISSG campaign "Invasive species of the week"

Invasive Species of the Week

Note: The North European and Baltic Network on Invasive Alien Species (NOBANIS) is a gateway to information on alien and invasive species in north and central Europe. NOBANIS covers marine, freshwater and terrestrial environments and provides a distributed but integrated database on introduced species in the region, as well as fact sheets on many of the most invasive aliens, a catalogue of the regulation relevant to invasive species in participating countries, a literature database and connections to regional and global networks and projects of invasive alien species.

Source: www.nobanis.org.

individual species reported in a country, allowing traceability and verification of information. Detailed datasheets on 59 species provide sufficient information to answer the initiation and categorisation stages of the risk analysis, and would provide a good starting point to perform a full risk assessment on the species. Other useful tools include a catalogue of regulations relevant to invasive species in participating countries and a literature database connecting to regional and global networks and projects on invasive alien species.

3.1.3 EPPO database

In Europe, other data resources exist for other, more specific, purposes related to IAS. For example EPPO, the European and Mediterranean Plant Protection Organization (www.eppo.org), maintains a database containing information on the distribution of quarantine pests: the Plant Quarantine Data Retrieval System (PQR). The PQR system developed by this European intergovernmental organisation with 50 Member States (aimed at protecting plants, developing international strategies against the introduction and spread of dangerous pests and promoting safe and effective control methods) provides detailed information on the geographical distribution and host plants of quarantine pests. Its search tools also allow users to identify commodities that act as pathways for moving pests and diseases in international trade. In recent years, the database has been extended to cover invasive alien plants. This information is particularly helpful to identify



Photo: © Riccardo Scalera

The Hottentot fig *Carpobrotus edulis* is one of the species on the EPPO List of invasive alien plants, which consists of species that a Panel identified as posing an important threat to plant health, the environment and biodiversity in the EPPO region. EPPO strongly recommends countries endangered by these species to take measures to prevent their introduction and spread, or to manage unwanted populations (for example with publicity, restrictions on sale and planting, and controls).

the probability a pest entering. All distribution data are referenced. Additionally, EPPO displays datasheets on quarantine pests, which are aligned to those in the CAB International (CABI) Crop Protection Compendium.

3.1.4 Other databases

In addition to the databases specifically developed for Europe, similar tools collect information at the global level. Examples are the Global Invasive Species Database (GISD) of the IUCN Invasive Species Specialist Group, and the CABI Invasive Species Compendium (ISC).

GISD (www.issg.org/database/welcome) is the most authoritative and comprehensive database on alien species at the global scale. Accessible for free online, it provides detailed and constantly updated information for 615 invasive alien species. Information covers matters such as taxonomy, description, habitats, general impacts, uses, geographical range, introduction pathways to new locations, local dispersal methods and reproduction. Distribution data and other information are well documented and referenced. The information is sufficient to answer the initiation and categorisation stages of the pest risk analysis, and would provide a good starting point to perform a full risk assessment on the species. GISD also contains detailed information on management techniques, to enhance response. The strength of GISD is the network of IUCN experts that constantly provide updates and information on a voluntary basis. Its weakness is that GISD only covers species for which a profile has been produced and does not take into account those species for which only simple records of presence are available.

The Invasive Species Compendium (ISC) is a global, comprehensive database of invasive species, being developed by a consortium of partners, led by the international organisation CABI in association with the US Department of Agriculture. The compendium, due to be released in 2010, contains very detailed profiles prepared by leading experts on the different taxonomic groups. It was partly developed based on information from previous compendia (addressing crop protection, forestry, animal health and aquaculture) but also includes information on many more alien species with records of invasiveness. The profiles contain information on the biology of species, records of invasiveness, distribution, management and so on. If regularly updated, the information stored in ISC could be very valuable for assessing risks connected

to the species, as the profiles contain information on all the most relevant biological traits. In contrast to other CABI compendia, there is a commitment to make ISC freely available via the internet. For the purposes of the present study, CABI a preliminary version of the ISC database to be assessed to judge its potential for early warning in Europe.

3.1.5 Future options

On the basis of experiences in Europe, particularly implementing the DAISIE project and developing associated tools, it is possible to define the structure of a comprehensive and dynamic database, including specifying priority data and updating mechanisms. Ideally, there should be a list of all alien species found in Europe for all taxonomic groups, together with their status — whether breeding, increasing, extinct, casual, vagrant and so forth. Additional information should address when the species was introduced, its native range, its reproduction and spread, its biology and impact.

In particular it is clear that the following core elements should be central to an optimal information system:

- A register of alien species — an up-to-date and extensive inventory of terrestrial, freshwater and marine alien species within terrestrial, coastal and marine regions of Europe, built upon:
 - common data standards and information protocols in order to maximise interoperability, compatibility and coordination with and among initiatives operating at the national, regional and global levels;
 - robust definitions of alien species status, impact and invasion that can be applied across the alien taxa in marine, freshwater and terrestrial ecosystems, built upon common approved formats and standards for recording information.
- A compilation of species accounts of the most invasive alien species, including detailed distribution information, detailed description for identification of impacts and potential control methods. Selected species accounts covering high profile alien species would not only be valuable for end users (such as agencies, resource managers, decision-makers and interested individuals) with relevant details for species identification and management but would also help raise public awareness of invasions.

3.2 Expert registry

The support of specialised experts is key for both the European dedicated structure and the competent authorities operating at the national and local level. Such experts should represent the totality of human resources holding current expertise directly or indirectly related to biological invasions, whose skills might be either specific to alien species issues or other related fields (e.g. wildlife management and taxonomy for groups of species that do not necessarily hold alien status). Therefore, experts might be classified in two main groups:

- scientists, researchers and other professionals with specific expertises on alien species issues;
- scientists, researchers and other professionals without a specific expertise on alien species but whose skills might be useful for purposes related to diagnosis, identifying risks and managing alien species (i.e. specific fields of plant and animal biology, ecology and conservation, and taxonomy).

This expertise is distributed across research organisations and institutions throughout Europe and is mainly funded by national or local programmes. In particular, expertise is mostly found scattered in offices, university departments, museums and other scientific institutions. However, in some cases, expertise is organised within a dedicated network, such as the Belgian Forum on Invasive Species (<http://ias.biodiversity.be/ias/>) and the Centre for Invasive Species based at the University of Copenhagen (<http://cis.danbif.dk/>).

A dedicated European expert registry was developed within the DAISIE project. This registry is currently the most comprehensive tool available, linking and mobilising current expertise on biological invasions with details of individuals experts on taxonomy, geographic units and thematic areas. It includes information on approximately 1 858 experts from 92 countries, with specific competence on 3 502 taxa. Since alien species invading Europe may originate from any region of the world, experts from all over the world were invited to register. Some 20 % of the registered experts declared specific expertise on species in Europe.

3.3 Black, watch and alert lists

Central to prevention and rapid, targeted action to combat invasive species within Europe is the



Photo: © Riccardo Scalera

The red-eared slider *Trachemys scripta elegans*, a North American freshwater turtle usually sold as a pet, is one of the four alien species whose trade in Europe has been suspended because its presence is known to present an ecological threat for the indigenous fauna and flora, as foreseen by the Wildlife Trade Regulation (WTR). Such species, together with those from other existing lists of known IAS (i.e. DAISIE, NOBANIS, EPPO) have been gathered together so as to make a first attempt to produce a European black list based on the assumption that the best predictor of a species invasiveness in a new area is whether the species has shown invasive patterns in other areas. The black list, together with a preliminary assessment of the role of trade in the introduction of the included species, has been the result of the Council of Europe report, 'Toward a black list of Invasive Alien Species entering Europe through trade, and proposed responses'. Such a list should be improved through the definition of explicit and solid criteria for inclusion, also ensuring proper justification of trade regulations in the context of regional and international free trade agreements (Genovesi and Scalera, 2007).

identification of alien species that are already or are likely to become invasive. An effective response relies on being able to pinpoint those species currently absent from Europe but likely to enter at some future time, as well as species that are already present but have not yet become invasive and/or widespread. Species can be assigned to the following three broad categories:

- **Black list:** a list of alien species that sound risk assessment has shown to pose risks to the environment, economy or human well-being. Species subject to detailed risk assessment and which may be introduced via trade should be proposed for trade regulation to competent European and/or national scale. Lists of species judged harmful through a quick screening, shall be communicated to competent authorities of affected countries for prioritising responses.
 - **Watch list:** a list of alien species not yet present in a territory or present only in a limited range that are considered to pose potential risks to the invaded area and for which it is recommended to monitor arrival, expansion and impacts, and/or application of prevention measures. The list shall be communicated to authorities competent for the potentially affected territories.
 - **Alert list (or Alarm list):** lists of alien species not yet present in a territory or present only in a very limited range that pose risks to the invaded area and for which particular surveillance and monitoring efforts are recommended, in order to enhance prompt response in the case of arrival/expansion. The list shall be communicated to the authorities competent for the invaded or potentially invaded territories.
- Key recommendations**
- 16 At the European scale, the European dedicated technical structure should establish a European information system on Invasive Alien Species, building on the experience and tools developed within DAISIE, NOBANIS, EPPO PQR and other existing databases. The information system should include an alien species inventory, detailed accounts for selected species, a registry of invasiveness, diagnostic tools, an expert registry and a registry of competent authorities. The system should be permanently hosted by the European dedicated technical structure, which will be given the mandate and resources to:
 - 16.1 regularly update the inventory to include newly detected alien species recorded in Europe;
 - 16.2 create a new database and regularly update alien species pages in the national biodiversity Clearing House Mechanism or equivalent and link these to relevant European and global IAS information networks to ensure rapid dissemination of information;
 - 16.3 mobilise existing expertise for species inventory and review, based on a partnership approach (universities, research institutes, botanic gardens, non-governmental organisations and other stakeholders);
 - 16.4 produce, validate and communicate black, alert and watch lists to relevant authorities and actors;
 - 16.5 work closely with counterpart national focal points, relevant instruments and organisations (e.g. European Commission,

- European Environment Agency, Bern Convention Secretariat, CBD Secretariat, IUCN/SSC ISSG, GISP, Ramsar Secretariat, CMS Secretariat, UNESCO Man and the Biosphere Programme, IMO, IPPC/EPPO Secretariat, European Maritime Safety Agency) to exchange information and promoting effective responses to biological invasions;
- 16.6 engage with stakeholders and relevant sectors (e.g. the horticultural industry) to promote best practices;
 - 16.7 promote coordination among countries, sectors and key institutions to harmonise actions with particular reference to shared IAS pathways and problems;
 - 16.8 use existing regional expertise and networks (e.g. DAISIE network, NOBANIS network, International Commission for Scientific Exploration of the Mediterranean Sea, Regional Biological Invasions Centre hosting the virtual European Research Network on Aquatic Invasive Species, Hellenic Centre for Marine Research for the Mediterranean Sea, EPPO).
- 17 At both the European and national scale, a commitment should be taken to:
 - 17.1 provide the resources to maintain and update the European information system permanently;
 - 17.2 ensure that European, regional, and national databases on alien species including species accounts, are built on the basis of a common data shell and are linked to the European information system on alien species;
 - 17.3 support the development of international comprehensive registers, such as the Global Register of Invasive Species (GRIS) being developed by IUCN ISSG.

4 Organisational aspects of a European EWRR framework

In several cases the main constraint for a proper response to incursions has been an inadequate legal framework at the national or European scale. The complex separation of roles and responsibilities on the issue in European countries has also created significant obstacles. European countries and institutions generally lack authorities with clear competences over biological invasions.

In 2006 and 2008 the Institute for European Environmental Policy carried out a regional review of existing measures and procedures, including responses to incursions. The results show that policy and legislation relevant to IAS exist at the European Union and the national levels but there are significant constraints to an effective EWRR system (Miller *et al.*, 2006). For example, most European countries have several departments and agencies responsible for some aspect of IAS prevention and management and several different laws may be relevant (e.g. plant and animal health and quarantine, hunting and fishing, nature conservation). In several European states the responsibility for environmental policy and nature conservation is decentralised to subnational authorities which has, in some cases, limited the efficacy of responses (e.g. grey squirrel eradication in Italy).

A priority step is that all European countries establish an officially recognised technical body, with a clear mandate and terms of reference, composed of a team of 'leading experts'. This should take the form of an agency or equivalent network or mechanism, with the task of leading and coordinating all responsible agencies and subnational governments dealing with IAS. The team of leading experts should have the necessary expertise in all fields of alien species management and all related legal and policy issues, and if appropriate include representatives of local departments and agencies.

4.1 European scale

On the basis experience from other parts of the world, a fundamental step for improving Europe's



Photo: © Vibe Kjædegaard

Hundreds of wintering Canada geese *Branta canadensis* and recent examples of successful breeding zoo escapees leave little doubt that Poland will host stable freely ranging populations in the very near future. As the species is not listed as game, its control will be hindered, even though the invasion is likely to be detected early and followed by birdwatchers. Indeed, in many countries, the only species that may be removed are those designated as 'game'. Therefore alien species may be automatically protected by national laws failing to distinguish between alien and native species (for example in the Italian or German legal frameworks alien established species are automatically protected to the same degree as native species), or protecting higher taxa (e.g. genus) that includes alien species. This is consistent with the results of a regional reviews carried out in 2006 and 2008 by the Institute for European Environmental Policy on existing measures and procedures to respond to incursions. The results show that policy and legislation with provisions relevant to invasive alien species are active both at the European Union level and the national scale, and that there are significant constraints to an effective early warning and rapid response system (Miller *et al.*, 2006).

ability to react promptly and effectively to new incursions of alien species is establishing a centralised European structure. The existence of a dedicated working group of specialists would guarantee sound coordination of all actors involved in the issues in Europe, particularly all competent authorities identified at the national and levels.

Engaging a broader set of experts and members of the general public is also required.

Whether a dedicated European centralised structure is in place or not, Member States should identify all existing structures with procedures on invasive alien species and the required expertise relevant to trade, movement, holding and managing potential invasive alien species. A requirement for establishing an EWRR system in Europe is that each member country and relevant European institution identify competent authorities at the appropriate scale, including at the subnational level, if appropriate.

4.2 National scale

The identification of competent authorities, their roles and responsibilities, is a priority step towards developing an effective early warning system for alien species in Europe. Indeed, the European Strategy on IAS (Genovesi and Shine, 2004) underlines the primary challenge of networking activities carried out at the national level, and recommends that each country establish appropriate structures or networks of structures for this purpose. Experiences in other regions of the world underline the need to prioritise establishing appropriate structures; all the frameworks that have

Note: The UK Non-Native Species Secretariat is an excellent example of identification of competent authorities, their role and responsibilities. The recent Invasive Non-Native Species Framework Strategy for Great Britain provides a comprehensive overarching policy framework for IAS-related activity, including early detection and rapid response. Although not all components of the Strategy are fully operational yet, at the European scene it constitutes an outstanding example of Government commitment to tackling biological invasions.

Source: www.nonnativespecies.org.

led to positive outcomes in terms of prevention and response to biological invasions have created a coordination system.

A key role should be given to officers and experts from institutional bodies (such as ministries and agencies) working at either national or local levels on issues related to nature conservation, species management, habitat management, implementation of environmental laws and regulations. European countries should identify all existing structures, at the national and local levels, with competence over activities related to movement, holding, establishing or managing alien species, for example national plant protection organisations, veterinary authorities, customs and quarantine services and CITES authorities. The objective is to identify a clear leadership or appropriate coordination at the country level (or different levels of government as appropriate) for IAS prevention and mitigation, involving relevant sectors.

Countries involved in the EWRR must also engage scientific experts, including specialists in biodiversity monitoring, species biology and ecology, taxonomy, wildlife and plant management. It is crucial to involve universities and other scientific institutions in developing a European EWRR on invasive alien species.

National technical authorities and institutions with competence in IAS related issues should also act as focal points of a pan-European dedicated network of structures, or interact with the European technical structure.

4.3 Distribution of roles and competencies

From the information analysed in the present report, it is evident that a primary obstacle to an effective EWRR system in Europe is the absence, at the national or supranational scale, of authorities with clear competences over biological invasions. Examples reported from other world regions confirm that a clear division of roles is a crucial step in preventing and responding rapidly to incursions.

As reported in the previous chapter and shown in Figure 2.1, an ideal structure for an early warning and rapid response system should consider the roles and competencies of the people and institutions involved. The engagement of people and institutions may vary in accordance with the tasks at hand and the level of political commitment to implementing an early warning system. For example, in the case

of actions by a voluntary network of experts, there is practically no involvement of authorities acting at a European or EU level. Contrastingly, such involvement is prominent in the case of actions coordinated by a European agency or within a biosecurity policy.

The spectrum of activities related to sound management of invasive species is very broad, including identifying unwanted species, assessing the risks arising from their presence, and identifying and implementing measures to prevent associated socio-economic and environmental impacts.



Photo: © Sandro Bertolino

The well known case study of the grey squirrel *Sciurus carolinensis* eradication in Italy is a good example of how an inadequate legislation and the decentralisation of powers have in some cases limited the efficacy of responses to biological invasions. In fact, the complex distribution of roles and responsibilities in European countries has often created significant obstacles to effective reaction to new incursions. Therefore, identifying competent authorities, their roles and responsibilities, is a priority step in developing an effective early warning system for invasive alien species in Europe.

Responsibility for carrying out these activities can be divided among different bodies, depending on the division of roles and on the legal basis at the different scales. Many of the activities can be the responsibility of government agencies and departments or non-governmental organisations and stakeholders (e.g. when based on codes of conducts or voluntary activities).

In general, the number of people and institutions that would be directly or indirectly involved in the activities needed for sound and effective implementation of an EWRR system is enormous. The problems related to invasive alien species concern many social, economic and environmental sectors, including transport, trade, forestry and agriculture, fishery and aquaculture, land and water management, infrastructure development, tourism and recreation, and health. For this reason, a European framework should involve key stakeholders, including the sectors involved directly or indirectly in the movement, release, detection or management of alien species (e.g. horticulturists or fishermen).

Based on international experience and the work of organisations such as EPPO and EFSA, it appears that the most effective means of distributing roles and responsibilities would be establishing a European technical structure on Invasive Alien Species (as described in section 4.1 above). Such a structure would provide technical assistance to European countries and enhance coordination of national actions.

A centralised technical body is also justified by biogeographical considerations. The European context, characterised by shared coastlines, transboundary mountain ranges and international watercourses, calls for a supranational technical approach to prevention and responses. One of the main tasks of the European technical structure should be coordinating the activities to be carried out by the competent authorities, which should be identified by each country at the national and regional levels, if appropriate.

4.4 European survey: the questionnaire

In order to analyse the main organisational requirements needed to guarantee a sound EWRR system, a questionnaire was circulated to public authorities and other relevant institutions of EEA member countries, as well as to experts, conservation officers and practitioners from other European institutions. The questionnaire was also


aimed to collect all basic information to assess the main gaps and constraints that limit the capacity of European states and institutions to respond to biological invasions of alien species, and to analyse a system of standardised and harmonised data flow at both the regional and national scale, also based on a coherent classification of invasive alien species.

Sixty-eight questionnaire responses were received from 33 of the 38 EEA countries. They confirmed that, as outlined by Roy and Roy (2008), across Europe there are many, often disparate, initiatives responding to invasive alien species. In addition, there are many stakeholders and organisations involved in identifying practical and effective solutions to limit the progression of global biotic homogenisation. Collaboration and coordination across Europe (and even within countries) is still lacking, and common data protocols or standards are not yet widely used. Some steps are, however, being taken in this direction.

At the regional level, DAISIE and NOBANIS demonstrate good practice in terms of providing effective systems to share IAS information between countries, trading partners and regions with similar ecosystems, which therefore face the same threats. These tools assist diagnosis, early warning and identification of management options (i.e. prevention, mitigation and restoration measures). They can locate, document and provide electronic access to sources of information (either scientific or legal), provide quality control and ensure the identification of needed expertises. In addition, the systems developed by EPPO and the Belgian Forum on Invasive Species are good examples of best practice and could be used as exemplary models for revision and adoption across Europe.

A detailed gap analysis carried out in 2006 to pave the way for future policy development (Miller *et al.* 2006) identified multiple weaknesses and inconsistencies in existing EC and Member State legal, policy and economic frameworks. Based on these findings (updated by Shine *et al.*, 2008) an effective future EU framework on IAS would need to address:

- low awareness of IAS as a Community-wide threat, whether in the political, private sector, NGO or general public sectors;
- a lack of policy coherence between sectors and across administrations at different levels (Commission, Member States, decentralised administrations, local authorities);



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Source: www.aquaticinvasions.net.

- a lack of coordinated mechanisms for IAS prevention, control and management, despite the risk of spread within terrestrial and aquatic ecosystems that straddle national boundaries;
- the absence of intra-Community barriers on trade and movement within the single market, which is perceived to restrict the scope for Member States to adopt national prevention measures;
- gaps within and between Member States in prediction capacity, early warning, monitoring, research and access to policy-relevant data;
- the prominence of the Common Agricultural Policy and its current connections with renewable energy policy, which provides new pathways for introducing potential IAS;
- the low priority given to global IAS prevention, management and control, including through

export-related tools, despite the fact that the various economic, social and ecological impacts of invasive species clearly compromise the EU's ability to meet the Millennium Development Goals and its other environment and development commitments.

Key recommendations

18 At the European level, the EU should revise European policies and legal frameworks in order to:

- 18.1 remove legal obstacles to control and eradication, including automatic protections of alien species in European legislation;
- 18.2 streamline decision processes, clarify the distribution of roles and responsibilities in European institutions and departments;
- 18.3 provide a clear political and legal mandate for a dedicated European structure linking and coordinating IAS management across Europe;
- 18.4 ensure the possibility of adopting European emergency orders where urgent eradication action is needed;

- 18.5 establish obligations for Member States to report promptly and in detail on the progress of competent authorities in enforcing management measures in territories affected by new incursions;
- 18.6 include the legal possibility of opening infringement proceedings against Member States that fail to implement the recommended or required response actions, including the possibility of imposing fines;
- 18.7 establish specific financial tools dedicated to responding to incursions, or adapt existing financial programmes (for example by including a specific reference to management and research on invasive alien species), based on evaluation processes that enable rapid disbursement of funds when appropriate;
- 18.8 promote the application of voluntary codes and practices; at the trader/producer level these might include clearer legal standards (e.g. a 'duty of care' to follow agreed industry codes) or labelling schemes linked to observing relevant codes.

Box 4.1 Results of the questionnaire on IAS information systems across Europe

The questionnaire results indicate a very heterogeneous situation in European countries regarding the adequacy of legal frameworks, the presence of technical tools to assist decision-making and the availability of financial tools. Respondents perceived the main gap to be scarcity of dedicated funds, followed by limited ability to detect new invasions and an unclear division of roles and responsibilities.

	Not relevant (%)	Partly relevant (%)	Quite relevant (%)	Very relevant (%)
Limited funds	0.7	7.5	11.6	25.8
No/ineffective mechanisms for early detection	1.4	9.5	11.6	23.8
No/ineffective legal tools to prohibit import	2.0	13.6	13.6	15.6
No competent agency for control/eradication	9.5	9.5	9.5	15.0
No/ineffective legal tools to prohibit trade/possession	3.4	13.6	13.6	15.0
Limited ability to detect new invasions	2.0	11.6	17.0	15.0
Unclear roles/responsibilities	2.7	10.2	17.0	14.3
Technical constraints	0.7	14.3	15.6	14.3
Legal obstacles to control/eradication	8.8	15.6	10.2	8.8

-
- 19 At the European level, all countries, including those that are not yet Member States of the EU (and subnational governments when appropriate) should revise their national or subnational policies and legal framework in order to:
- 19.1 harmonise and streamline their institutional and legal frameworks and strategies, policies and approaches relevant to IAS issues, identifying which structures (e.g. ministries of environment, agriculture, transport, trade, fishery, environmental agencies and wildlife institutes) are responsible for action on taxonomic groups and regions;
 - 19.2 provide to a dedicated European structure an updated list of competent authorities, identifying contact officers for each;
 - 19.3 streamline decision processes and ensure that all structures (including local authorities and protected areas authorities) with competence for response to invasions (eradication, control) have a formal responsibility to act promptly and the legal power to take all needed actions;
 - 19.4 establish an internal coordination mechanism (e.g. similar to the UK's Non-Native Species Secretariat) with the mandate to:
 - 19.4.1 coordinate all existing structures with competences over the movement, establishment and management of invasive species;
 - 19.4.2 act as focal point for a European network of dedicated structures;
 - 19.4.3 provide prompt and detailed reports on responses to invasions to a dedicated European structure;
 - 19.5 remove legal obstacles to eradication and control techniques for all taxonomic groups and environments;
 - 19.6 ensure the possibility of adopting emergency orders where urgent eradication action is needed;
 - 19.7 establish specific financial tools dedicated to responding to incursions in all taxonomic groups;
 - 19.8 promote voluntary codes and practices; at the trader and producer levels, these might include clearer legal standards (e.g. a 'duty of care' to follow agreed industry codes) and labelling schemes linked to observance of relevant codes.

5 Future options for a European EWRR framework and dedicated information system

Possible options are set below to assist in establishing an early warning and rapid response system in Europe (as mentioned in the Commission Communication 'Towards an EU Strategy on Invasive Species') and a dedicated European technical body (such as a panel, an observatory or an agency). The options proceed from least to most formal and binding, and distinguish also between short- and medium-term needs.

The European technical structure on invasive alien species should be established with the primary task of enhancing overall coordination of actions at the European and national level to implement a sound early warning and rapid response system. In addition, it should provide technical assistance to European countries and national authorities in fulfilling the obligations of all European and national institutions towards other international agreements on invasive alien species.

On the basis of a review of experience globally and the main constraints highlighted in our European survey, five options for a European EWRR system were identified. For each of the options a concise description of the organisational model is presented below, along with a 'strengths, weaknesses, opportunities, threats' (SWOT) analysis to facilitate evaluation of the alternatives. A tentative estimate of the yearly costs of each option is also provided, based on an assessment of the budget needed for similar structures, and on analyses performed within the DAISIE consortium.

5.1 Option A: voluntary network of national authorities (UK approach)

This option foresees a voluntary, decentralised network of national authorities established following approach of the UK Non-Native Species Secretariat. In this case, the ability to detect new incursions promptly and to respond effectively in Europe would be improved by establishing more effective national legal frameworks and ensuring better networking and coordination of national initiatives, based on a fully 'subsidiary' approach (Figure 5.1).

As no European framework would be established, no specific Europe-wide decision tools need developing or maintaining. No specific role is assigned for the EEA apart from recipient of data and information. Circulating information on possible expansion of incursions detected in one country to neighbouring authorities would be the responsibility of the national or local authority of the invaded country. Each country would develop and maintain its own national database, possibly designed in a harmonised way so as to facilitate the comparison of data and exchange information across Europe.

Costs

The costs of the network would be entirely covered by each national and local authority. Costs would depend on the specific activities envisaged, which may range from establishing and maintaining a national or local database, to establishing a national coordinating authority, including training, diagnosis and collecting information. The costs may therefore vary from country to country.

To give an idea of the scale of possible costs for each national authority, it should be noted that the aggregate cost of activities of the UK Non-Native Species Secretariat are well over EUR 400 000 per year (EUR 270 000 for the staff and for running the risk assessment mechanism, plus approximately EUR 150 000 for developing a national inventory or database) (Moore, 2009) The incurred or expected costs of other national frameworks (for example Estonia and Sweden) are similar.

Aggregating all national costs, the total cost of a network of national databases and authorities would exceed EUR 10 million annually (based on approximately 27 countries multiplied by EUR 400 000). It should be noted that the rapid growth of IAS problems suggests that in the near future countries will need to increase their activities on the issue rapidly and significantly, and therefore their financial commitment.

This option is the least cost-effective. By contrast, a dedicated European structure would increase

synergies, significantly reducing the costs of national activities. Indeed, the sum of national costs needed to deliver a European information system (supporting detection, identification, circulation of management tools, etc.), would be much higher than the cost of establishing a European framework to support all countries.

SWOT analysis

Strengths

- Being based on national authorities, the framework would not require any external (EU or other European) decision process.
- The organisational design would be simplified by the need for national authorities to tailor it to the national systems and needs (local distribution of roles, competencies, legal framework, etc.).

Weaknesses

- Mobilising all required skills and expertise (in the field of taxonomy, biology, wildlife

management, etc.) could be a significant constraint, especially for the smallest countries.

- The costs for the national authorities could be significant because of the need to overcome the lack of regional information and economic support.

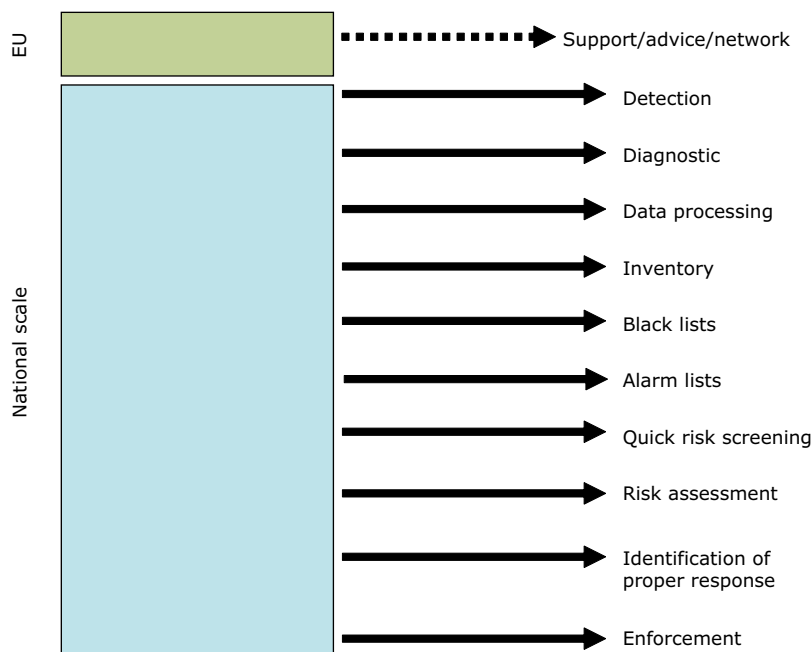
Opportunities

- This option is certainly the least onerous at both the European and the EU level.
- This option would not require the establishment of new bodies or authorities.

Threats

- This option does not follow the directions expressed by the recent EC Communications.
- Limited coordination of actions and harmonisation of approaches (including terminology, coverage, etc.) among countries could affect the sound implementation of the EWRR system.

Figure 5.1 Early warning and rapid response. Option A: Do-nothing



Cost estimate: EU = EUR 0

27 Member States ≈ EUR 10 Mln (400k/country)

- Risk of inconsistencies among different countries' actions.
- No significant advancement from the present unsatisfactory level of action would be achieved.
- The national scope would not allow issues of community competence to be addressed, such as trade regulations.
- Inadequate action by even a single European country could put at risk the efforts of other more active countries.
- The limited use of existing tools (DAISIE, NOBANIS, PRATIQUE, etc), would represent a waste of the resources that the EU and Member States have already invested in such instruments.
- The lack of mandatory commitment might prevent the effective establishment of a comprehensive network, with the inherent risk of failure of the entire strategy and compliance with the provisions suggested by the recent Commission communications.

5.2 Option B: non-institutional European panel (DAISIE-NOBANIS approach)

This option foresees that maximising the use of existing technical instruments and possible voluntary measures can be achieved by establishing an independent, non-institutional scientific initiative dedicated to IAS. This independent panel would comprise a partnership of scientific experts, national and local institutions and government agencies (such as the DAISIE consortium and the NOBANIS partnership) (Figure 5.2).

The structure should consist of a team of experts on the key aspects of biological invasions, with ad hoc coordinators for each taxonomic group. A tentative structure should contain at least 10 experts covering main taxonomic groups, and with competence over management techniques.

The panel would be coordinated by one chair and two programme officers or secretaries. Mechanisms would be established for rapidly accessing taxonomic expertise to ensure prompt species diagnosis. Specialists would be employed

(part-time) directly through contracts with the scientific institutions forming the consortium (covered with external financial support), under the supervision of taxonomic coordinators.

Work would mostly be carried out through email but general issues would be discussed in periodical meetings (one or two per year). Specific tasks could be addressed by working groups set up by the consortium.

Depending on the availability of funds, basic duties of the panel would involve:

- maintaining and updating a freely accessible portal and database;
- regularly providing updated information for the database;
- circulating general information on invasive alien species to all involved and competent actors;
- providing advice and information to national authorities and management bodies to assist in diagnosing new alien species, assessing risks and identifying possible responses;
- raising awareness and improving national response efficacy by circulating information among national authorities and the general public.

Costs

Considering that establishing DAISIE required about EUR 2.1 million over three years (including creating the network of experts and the inventory) it can be expected that a European information system built on existing inventories would be significantly less costly than one that relied on establishing new inventories. In fact the costs of employing part-time scientific staff, limited central coordination staff (chair, programme officer) and organising meetings are estimated at EUR 300 000–500 000 per year.

Implementing a comprehensive European inventory would, however, require further investments to address present data gaps (e.g. inventories for areas such as the Balkans) and improved coordination among existing tools (e.g. linking DAISIE and NOBANIS). In this regard a more realistic estimate of the total budget of the panel is EUR 500 000–700 000 per year.

SWOT analysis

Strengths

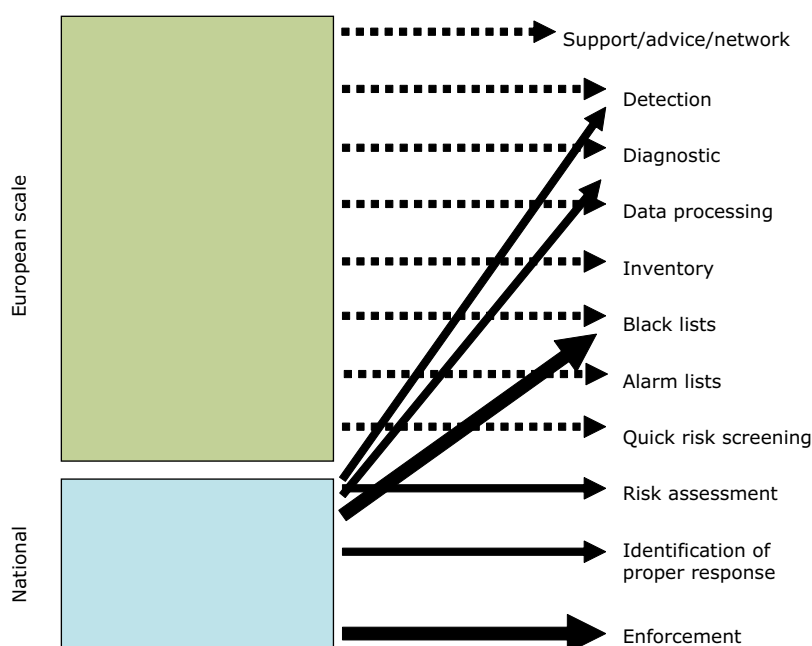
- Management of the partnership would face few limited institutional constraints.
- Activities would have a primarily technical and scientific focus.
- Establishing the panel would not require any decision process at the European level.
- Several successful short-term European initiatives (i.e. DAISIE, PRATIQUE, ALARM) have been launched in this way.
- There are positive examples of independent scientific panels providing effective support to decision-making in other fields (e.g. the Large Carnivores Initiative for Europe supporting the European Commission with technical guidance, assessment of specific cases, etc.)
- Establishing the panel and carrying out some pilot initiatives over a limited number of years could be partially or entirely financed using

existing European instruments (e.g. LIFE) and/or with contributions from the authorities and institutions of regional groups and individual states (as is the case for NOBANIS) and private sponsors.

Weaknesses

- The lack of a legal basis and political mandate would reduce the actual and potential impact of the early warning and rapid response system, and limit the efficacy of information flows.
- The panel's contribution to addressing the IAS problem would depend on the commitment of those involved, with clear risks arising from lack of continuity due to staff changes and uncertainty in resources allocation. The short-term vision of the panel could also reduce the efficiency of the internal organisation of work.
- No financial mechanism could guarantee a medium-term commitment (more than three or four years) and this financial uncertainty would undermine efforts to develop and regularly update comprehensive tools, such as a European inventory and portal on alien species.

Figure 5.2 Early warning and rapid response. Option B: Non-institutional European panel (DAISIE approach)



Cost estimate: EU = EUR 500 000–700 000 per year

Opportunities

- The panel could provide valuable technical support and advice to single countries and other European institutions.
- The framework would build upon existing tools and initiatives (DAISIE, NOBANIS, PRATIQUE, etc.).

Threats

- The lack of a legal basis and political mandate could weaken the entire framework, by limiting the power to coordinate actions by countries, harmonise approaches, etc.
- The panel could only be an advisory body, with no regulatory role.
- The lack of a legal basis would limit the ability to address complex issues such as those involving trade regulations.
- The lack of an institutional role could limit the panel's ability to guarantee the enforcement of recommended measures, which is entirely left to the voluntary commitment of countries.
- The limited use of existing tools developed within past projects (such as DAISIE, NOBANIS, PRATIQUE, etc.) would risk wasting the resources already invested in such initiatives.

5.3 Option C: European observatory (NISC approach)

This option foresees the establishment of a European technical structure in the form of an observatory on invasive species (OIS), based on a clear political mandate derived from a formal EU or Member State policy decision (Figure 5.3). The OIS would have the task of coordinating national action and assisting Member States enforce policies coherent with EU general directions but with no binding authority over national actions.

The OIS should be considered an intergovernmental body (such as, for example, EPPO) to be hosted by a technical body with institutional support (for example, EEA, ETC/BD, EFSA, EPPO or a national scientific institution). The Observatory would be led by a steering committee or council responsible for defining a programme of activities and ensure implementation. It would include a

core management team with experts covering the most abundant and problematic taxonomic groups, plus additional staff for IT support and secretariat work. The work structure could include organising technical/scientific panels (addressing, for example, taxonomy and risk assessment), and ad hoc thematic working groups.

The Observatory would host a European information system on invasive alien species to support decision-making and management.

Funding and institutional structures should be provided to guarantee long-term actions such as:

- hosting and maintaining a freely accessible and constantly updated portal and database on IAS and hosting relevant experts;
- establishing a voluntary reporting mechanism for Member States on new detected incursions, response activities, etc.;
- providing assistance for identifying newly recorded taxa, if required;
- performing quick screening and risk assessments when appropriate, and developing alert lists, watch lists, etc.;
- collecting and disseminating information on specific management techniques;
- preparing technical recommendations for countries and European institutions;
- circulating general information on invasive alien species.

Costs

EPPO early warning and rapid response activities require the equivalent of 1.5 members of staff annually. On that basis, it can be estimated that the European Observatory should include a core management team of between five and seven full time specialists plus two full time positions for IT support and secretariat work. In addition, there will be costs for organising scientific panels. Moreover, the costs for maintaining a dedicated information system are estimated at EUR 300 000–500 000.

On the other hand, in order to reduce logistic costs and considering the limited staff, an existing scientific institution could host the OIS.

Based on the parameters listed above, the overall budget would be EUR 1.5–2 million. This may be covered through national voluntary contributions (as is the case for the EPPO system) or through EU contributions.

SWOT analysis

Strengths

- The low number of personnel needed for implementing OIS activities implies that internal organisation would be relatively simple.
- Recruiting specialised, permanent staff would significantly enhance the technical capacity to deal with the complex tasks of an EWRR system.
- The continued (although not permanent) financial support would ensure the best use of available information systems and tools in the short and medium term. It would also enable better internal coordination, networking and synergy.

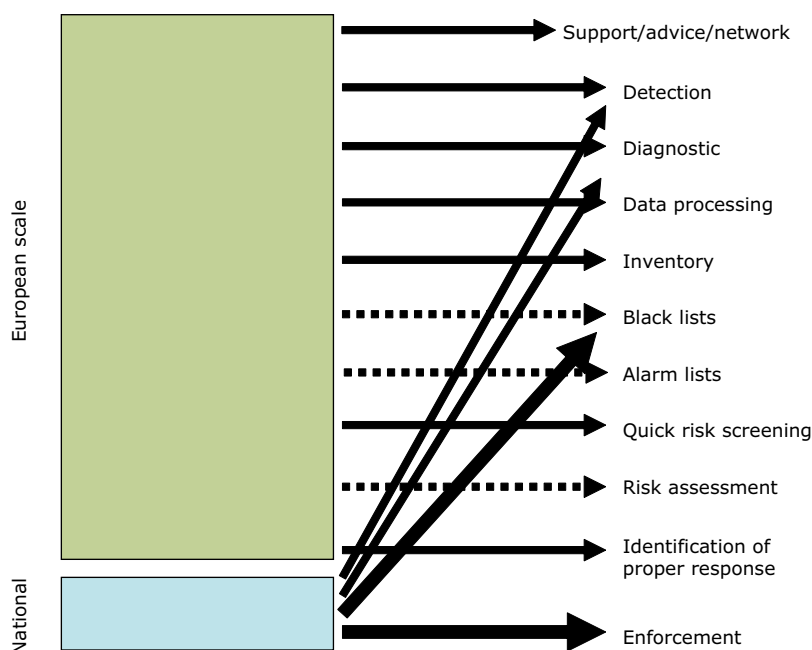
Weaknesses

- Although not very complex, the organisational plan of the technical structure requires careful design.
- The increased institutional role would require greater commitment for horizontal activities (contacts with various Directorates-General etc.), which may be limited by the lack of formal recognition of the OIS.
- The non-permanent character of the financial support and the lack of a strong policy commitment might limit the potential role of the OIS.

Opportunities

- Establishing the OIS would not necessarily require a complex decision process (although a formal EU decision would be essential).
- Formal EU recognition of the role of the OIS could facilitate access to medium-term funding and financial support from Member States.

Figure 5.3 Early warning and rapid response. Option C: European structure with clear political mandate (NISC approach)



Cost estimate: EU = EUR 1 500 000–2 000 000 per year

- A more solid structure would enable the OIS to provide greater technical support to Member States and guarantee more efficient coordination with existing EU or European institutions (EPPO, EFSA, etc.).
- The limited institutional role could facilitate — although not guarantee — that national and local authorities enforce recommended measures.

Threats

- Establishing OIS depends on a strong political commitment at the EU level and could thus be jeopardised by a lack of support due to changing policy priorities.
- The current financial situation, characterised by limited resources, and the non-permanent funding system of OIS means that there is no guarantee that the information system and other tools developed by the Observatory would be used in the long term.
- The lack of a legal basis for establishing the OIS would limit enforcement of measures.

5.4 Option D: EU Agency based on new/revised legislation (ECDC approach)

According to this option, a European technical institution might be established in the form of an EU agency; however, it needs to take into consideration that no new agencies of any kind are foreseen at present. Hypothetically, a founding regulation, based on new or revised EU legislation, would guarantee continued financial support (Figure 5.4). This approach is similar to the model proposed in a recent article published in *Science* (Hulme *et al.*, 2009), calling on the European institutions to create a European Centre for Invasive Species Management (ECISM) on the basis of experience with the European Centre for Disease Control (ECDC). The ECDC was founded by EC Regulation 851/2004 and has the formal mission to **identify, assess and communicate current and emerging threats to human health from communicable diseases**.

The European Agency on Invasive Species (EAIS) should have a more limited mandate, focusing on supporting actions aimed at detecting new incursions of alien species, identifying species, assessing relevant risks, identifying appropriate responses and communicating them in a timely manner to competent authorities in order to improve

the possibilities of prompt and effective response. To achieve these tasks, EAIS would promote the enforcement of legal provisions, ensure coordination of national actions and support Member States in enforcing relevant policies.

EAIS would host the European information system on invasive alien species and would thus be provided with adequate and secure funds and structures to make the best use of the system and to enhance links with other existing European and global tools. The role of the EAIS would be partly regulatory, for example producing opinions on proper Member State responses, which should be included in European legislation on invasive alien species.

Considering the legal aspects involved in the EAIS activities, the workflow would need to ensure standardised and transparent processing of information, science-based evaluation processes and adoption of opinions on the basis of rigorous scientific criteria (see EFSA workflow as an example). EAIS would act as an independent scientific body, working in close collaboration with the EU, national authorities and other competent bodies (EPPO, EFSA, EMSA, etc). The workflow should ensure open consultation with key stakeholders. EAIS should also promote the linkage of the EWRR framework to other EC and European alert systems (animal health, food safety, plant health, etc.).

The European Agency on Invasive Species would have a structure similar to other existing EU agencies (e.g. ECDC, EFSA). The EAIS would thus be governed by a management board responsible for laying down the general guidelines and adopting the work programmes, including available resources and political priorities. The executive director would be responsible for all activities of the agency and the proper implementation of its work programmes. The agency would be supported by a scientific committee made up of leading experts on the issue, covering the needed expertise on the main taxonomic groups. The EAIS structure would be very small, with a permanent staff of 10–15 scientific experts and three to five IT experts in a total of about 30–40 people.

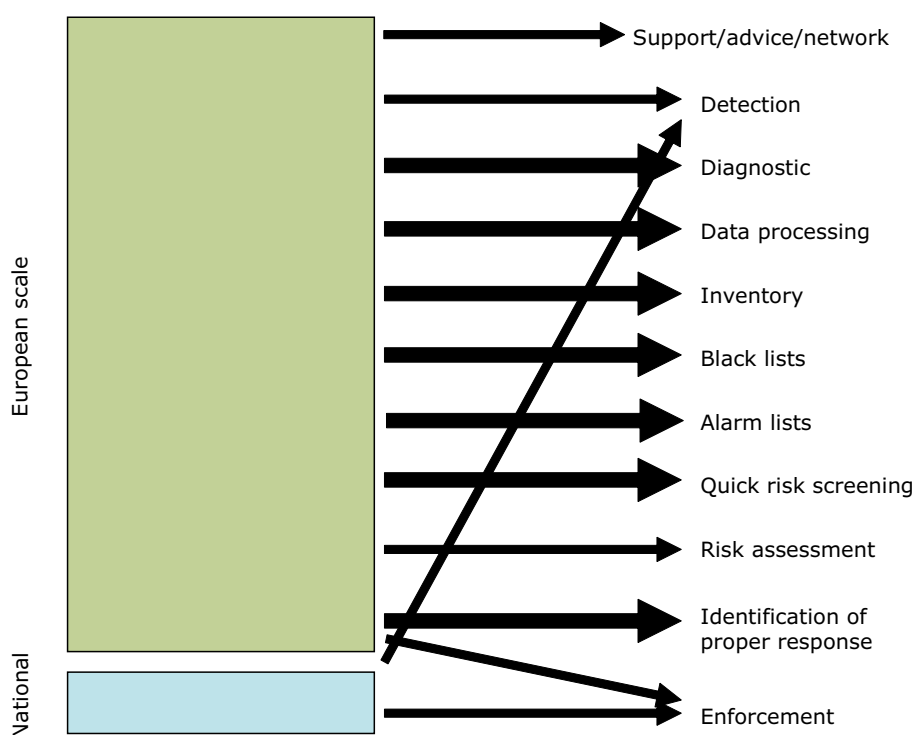
The main possible tasks of EAIS would be:

- hosting and maintaining a freely accessible and constantly updated portal and database;
- collecting information from individual experts, institutions and Member States;

- establishing a reporting mechanism (similar to EPPO) on new detected incursions, enforced response activities, etc.;
- providing assistance in identifying the taxonomy of specimens;
- maintaining and constantly updating a registry of experts;
- performing quick screening and risk assessments where appropriate;
- performing independent evaluation of risk assessments carried out by other authorities;
- accessing and disseminating information on management techniques;
- developing technical recommendations, in the form of formal opinions, to Member States and European institutions;
- developing and circulating to Member States and competent authorities alert lists, watch lists, etc.;
- coordinating with other institutions such as EFSA, EPPO, EMSA;
- promoting and supporting campaigns of eradication or control in emergency situations;
- circulating general information on invasive alien species.

It should be noted that the EAIS should have the specific task of enhancing an EWRR framework, thus adopting a focused approach and a small, light structure (significantly smaller than average EU agencies). However, establishing the Agency opens the possibility — in a second phase and depending on the results of EAIS work and decisions taken in developing a European Strategy on IAS — to consider extending the tasks, for example to cover also aspects related to prevention and management (i.e. control and eradication of unwanted alien species).

Figure 5.4 Early warning and rapid response. Option D: European institution based on new/ revised legislation (EPPO/EFSA approach)



Cost estimate: EU = EUR 3–6 Mln per year

Costs

The total budget of the EAIS would be significantly less than the average budget of other European agencies, and not very different from that of the European Centre for Disease Prevention and Control in its early stage (in 2005 ECDC had a budget of EUR 4.8 million). Allowing for a permanent staff of about 30–40 people and the costs of organising working groups and maintaining and updating the information system, the estimated budget of EAIS is EUR 3–6 million per year. As for all EU agencies, EAIS would be financed from an EU subsidy. Part of the costs may be covered by the hosting Member State.

SWOT analysis

Strengths

- The organisation of a small agency could be based on consolidated experience from establishing similar EU technical institutions.
- Recruiting specialised staff would ensure the best use of synergies and technical ability in implementing an EWRR system.
- The availability of permanent financial support would ensure the best use of available information systems and tools in the long term. It would also enable the best internal coordination, networking and internal synergy.

Weaknesses

- At present the overarching policy is to not establish new agencies.
- Internal management of the activities under the responsibility of the EAIS would require significant work and resources.

Opportunities

- The EAIS would ensure the best use of existing tools, synergy with other European institutions and structures, and improved interaction with other relevant sectors (trade, tourism, agriculture, etc.).
- The institutional role of EAIS would enable effective improvements in enforcing the actions of national and European authorities.

Threats

- Roles and competencies would need to be clearly distributed with other EU and European institutions (e.g. EPPO, EFSA).
- The efficacy of the EAIS would partly depend on the legislative approaches to be adopted by Europe's governments (notably the European Strategy on IAS).

5.5 Option E: EU central authority (NZ Biosecurity approach)

A review of the policies implemented in other regions of the world suggests that the most effective option to reduce both the ecological impacts and the economic costs of IAS is the creation of a framework merging elements of the most relevant European authorities involved in the issue. This is the practice in New Zealand, where a coordinated and comprehensive biosecurity policy has been adopted.

Such a strongly centralised and coordinated framework would require a complex redesign of the entire EU policy architecture, implying major reorganisation of competencies in the areas of environmental protection and agriculture, and human, plant and animal health.

Elaborating a European biosecurity policy would also require a redesign of the entire legal framework regulating the sectors involved (fishery and agriculture; plant, animal and human health; trade and transport, etc.), with significant effects for national legislation.

Costs

Calculating the costs of such a deep political revision is out of the scope of the present report. However, in New Zealand the costs of implementing the biosecurity policy amount to EUR 70–75 million annually (Government of New Zealand, 2008). That is roughly 0.13 % of GDP, implying that a European biosecurity framework may require potentially a budget of up to 10 billion euros.

It should be noted that this amount would not be an additional expense for Europe but would largely be realised through reallocating and optimising the budget currently available — for example by promoting synergies and avoiding inconsistencies — in the above-mentioned sectors (fishery and agriculture; plant, animal and human health; trade and transport; etc.).

Although this option would require deep and very complex revision of European legislation, it should be noted that even the huge cost of establishing such a framework in the EU is well below the economic impacts of invasive species in the region (estimated at more than EUR 12 billion per year according to Kettunen *et al.*, 2009).

SWOT analysis

Strengths

- Comprehensive involvement of all interested sectors would enable the best use of existing capacities and optimise synergies among all involved departments at the European scale.

Weaknesses

- The very complex structure would require a deep revision of the entire EU legal framework in the involved sectors.

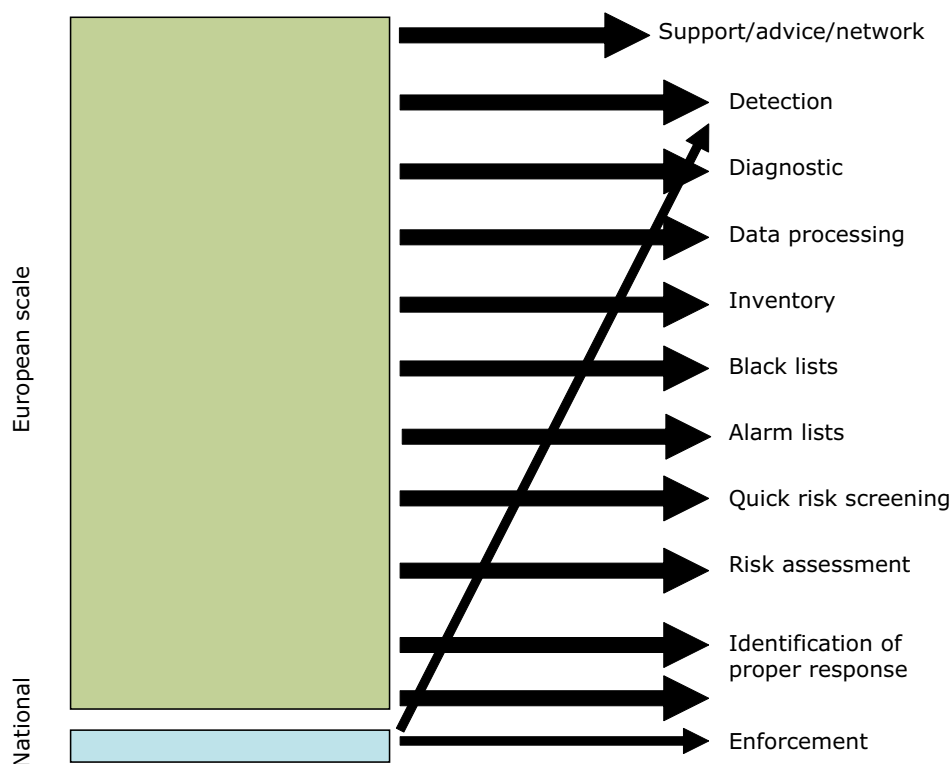
Opportunities

- The design of new legislation could significantly improve the ability to respond to invasions, resulting in greatly reduced impacts from invasive species in Europe and optimised use of human and financial resources.

Threats

- The complexity of such deep reorganisation of existing legislation and the need to design a new ad hoc legal tool might discourage authorities (at both the EU and national level) from addressing the issue in the short and medium term.

Figure 5.5 Early warning and rapid response. Option E: European institution with extensive mandate (New Zealand Biosecurity approach)



Cost estimate: EU up to EUR 10 Bln per year

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