TECHNICAL SUPPORT TO EU STRATEGY ON INVASIVE ALIEN SPECIES (IAS)

Analysis of the impacts of policy options/measures to address IAS

Service Contract N° 070307/2007/483544/MAR/B2

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Additional expert input was provided by Piero Genovesi, Stephan Gollasch, Matej David and Uwe Starfinger.

Related studies include:

Shine, C., Kettunen, M., ten Brink, P., Genovesi, P. & Gollasch, S. 2009. Technical support to EU strategy on invasive species (IAS) – Recommendations on policy options to control the negative impacts of IAS on biodiversity in Europe and the EU. Final report for the European Commission. Institute for European Environmental Policy (IEEP), Brussels, Belgium. 32 pp.

Kettunen, M., Genovesi, P., Gollasch, S., Pagad, S., Starfinger, U., ten Brink, P. & Shine, C. 2009. Technical support to EU strategy on invasive species (IAS) - Assessment of the impacts of IAS in Europe and the EU. Final report for the European Commission. Institute for European Environmental Policy (IEEP), Brussels, Belgium. 44 pp + Annexes.

Shine, C., Kettunen, M., Genovesi, P., Gollasch, S., Pagad, S. & Starfinger, U. 2008. Technical support to EU strategy on invasive species (IAS) – Policy options to control the negative impacts of IAS on biodiversity in Europe and the EU. Final report for the European Commission. Institute for European Environmental Policy (IEEP), Brussels, Belgium. 104 pp. + Annexes.

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EXECUTIVE SUMMARY

This report forms part of a broader study for the European Commission to provide Technical Support for the Development of an EU framework on Invasive Alien Species (IAS). It brings together and analyses data, collected from government, industry and other stakeholders around the world, on the cost of different policy measures and actions to address IAS and the benefits of addressing IAS. These include voluntary as well as regulatory measures with a focus on innovative approaches and industry-led initiatives.

Based on this solid foundation of evidence and insights, the report assesses and compares the four Policy Options presented in the Commission Communication "Towards an EU Strategy on Invasive Species" (COM (2008) 789). These Options include the following: (A) Business as usual; (B) Maximising use of existing approaches and voluntary measures; (B+) Amending existing legislation; and (C) Comprehensive, dedicated EU legal instrument. The report sets out possible component measures of the respective Options and develops an aggregated assessment of possible quantitative, qualitative and other impacts of each Option.

The overall purpose of the report is to assist the Commission in selecting an appropriate Option as a basis for formal impact assessment. Based on the analysis, the report suggests that Option C, i.e. a comprehensive EU legal instrument, is the only policy package that could deliver the necessary visibility, coverage, coordination, resourcing and horizon-scanning for all types of IAS risks and impacts. Option C could have prevented a large proportion of the current costs of IAS damage and control in Europe and would also be likely to make the biggest contribution to reducing new species arrivals in the future. Option C provide additional benefits by increasing the resilience of European ecosystems to IAS impacts, taking account of complementary EU policies for adapting to climate change.

ACRONYMS

Animal health instruments	Collective term for EC species-specific and general instruments containing precautions against animal disease introductions
APHIS	Animal and Plant Health Inspection Service (US)
AQIS	Australian Quarantine and Inspection Service
BWM Convention	IMO International Convention for the Control and Management of Ships Ballast Water and Sediments
birds Directive	Council Directive 79/409/EEC on the conservation of wild birds
Communication	EC Communication "Towards an EU Strategy on Invasive Species". Brussels, 3.12.2008 (COM (2008) 789)
Council Conclusions	Council Conclusions on a mid-term assessment of implementing the EU Biodiversity Action Plan and Towards an EU Strategy on Invasive Alien Species (2953rd Environment Council meeting, Luxembourg, 25 June 2009)
DAISIE	Delivering Alien Invasive Species Inventories for Europe
EAFRD	European Agricultural Fund for Rural Development
EC	European Community
ECDC	European Centre for Disease Prevention and Control
EEA	European Environment Agency
EFSA	European Food Safety Authority
EIA	environmental impact assessment
EMSA	European Maritime Safety Agency
EPPO	European and Mediterranean Plant Protection Organisation
EU	European Union
EWS	Early Warning and Information System (covered by EEA feasibility study 2008-2009)
Flood risks Directive	Directive on the assessment and management of flood risks (2007/60/EC)
FP	Framework Programme on Research and Technological Development
FTE	Full-time equivalent staff position
habitats Directive	Council Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora
IAS	invasive alien species
ICES	International Council for the Exploration of the Sea
IMO	International Maritime Organization
IHS	Import Health Standard (New Zealand Biosecurity Act 1993)
LIFE+ Regulation	Regulation (EC) No 614/2007 of 23 May 2007 concerning the Financial Instrument for the Environment
MFD	marine strategy framework Directive (2008/56/EC)
MS	Member State(s): as applicable, includes subnational governments where competence for e.g. environmental management is devolved
NOBANIS	North European and Baltic Network on Invasive Alien Species
Option	Package of policy measures set out in Communication (2008) 789
PIJAC	Pet Industry Joint Advisory Council (North America)
plant health Directive	Directive on protective measures against the introduction into the Community of organisms harmful to plants or plant products and against their spread in the Community (2000/29/EC) as amended
renewable energy Directive	Council Directive 2009/28/EC of 23 April 2009 on the promotion of the use of energy from renewable sources
Three-stage hierarchy	Internationally-recommended sequence of interventions (prevention; early detection and rapid response; long-term control and containment)
UK	United Kingdom
US	United States
WFD	water framework Directive (2000/60/EC)
wildlife trade Regulation	Wildlife Trade Regulations (Council Regulation 338/97/EC and Commission Regulation 1808/2001/EC), as amended by Commission Regulation 252/2005

1 INTRODUCTION

1.1 Background to this report

IAS are considered to be the second most important reason for biodiversity loss worldwide (CBD, 2001)[1]. Since 2006, the need to prepare a comprehensive EU Strategy on IAS has been formally endorsed by the Commission[2], the Environment Council[3], the European Parliament[4], the Committee of the Regions[5] and the European Economic and Social Committee[6].

Building on this high-level support, the Commission issued a Communication "Towards an EU Strategy on Invasive Species"[7] in December 2008 ('the Communication'). This confirms the EC's commitment to take action on IAS and outlines four policy options ('the Options') to address identified threats to EU biodiversity, together with possible horizontal measures related to public awareness, research, funding and development cooperation (see Chapter 3). The final scope and content of the EU Strategy is due to be decided in the second half of 2009.

The Communication draws on recent analysis (Kettunen et al. 2009) which provides evidence that IAS have significant negative impacts at the EU-wide level upon the environment, key economic sectors and human well-being. According to available documented information, the damage caused and the necessary control measures are estimated to cost at least 12 billion EUR annually. However, the total monetary impacts are likely to be much higher.

The scale of such impacts is predicted to increase as demand for trade, transport and travel – activities that provide pathways for introduction or spread of potentially invasive species - expands within the EU and with the rest of the world. Impacts are likely to be aggravated by environmental pressures, including climate change.

The Communication also builds on policy analysis (Shine et al. 2008) which found that EC and Member State legal frameworks still do not adequately address IAS threats at the EU level and identified a range of policy measures and cross-cutting tools to support coordinated action for this purpose.

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[1] CBD. 2001. Status, impacts and trends of alien species that threaten ecosystems, habitats and species. Available online at: http://www.cbd.int/doc/meetings/sbstta/sbstta-06/information/sbstta-06-inf-11-en.pdf.

[2] Communication on Halting the Loss of Biodiversity by 2010 and Beyond and its associated Action Plan COM(2006) 216;

[3] Council conclusions on Halting the Loss of Biodiversity (COM(2006) 216), 18 December 2006; Council conclusions of 3 March 2008; Council conclusions on a mid-term assessment of implementing the EU Biodiversity Action Plan and Towards an EU Strategy on Invasive Alien Species (2953rd Environment Council meeting, Luxembourg, 25 June 2009).

[4] Report on Halting the Loss of Biodiversity by 2010, the Committee on the Environment, Public Health and Food Safety, European Parliament, 28.3.2007

[5] Opinion of the Committee of the Regions of 6 December 2006 on the Communication from theCommission: Halting the loss of biodiversity by 2010 – and beyond (COM(2006) 216 final), CdR159/2006 fin

[6] Opinion of the European Economic and Social Committee of 15 February 2007 on the Communication from the Commission on Halting the loss of biodiversity by 2010 - and beyond (COM(2006) 216 final),NAT/334 - CESE 205/2007 fin DE/Ho/hn

[7] EC Communication "Towards an EU Strategy on Invasive Species". Brussels, 3.12.2008 (COM (2008) 789 final). Available online at : http://ec.europa.eu/environment/nature/invasivealien/docs/1_EN_ACT_part1_v6.pdf.

1.2 Aim of this report

This report is the third component of a study for the European Commission to provide technical support for the development of an EU Strategy on IAS (see Box 1.1). Its specific focus is to look at the costs of actions in the four Options identified in the Communication. Some elements of the above-mentioned reports are referenced to provide context and to help compare the likely benefits, costs and other impacts of the Options. For detailed analysis, however, those reports should be consulted directly.

Box 1.1. Previous work carried out in the context of technical support to EU Strategy on IAS

Two complementary reports have already been submitted to the Commission under Service Contract No 070307/2007/483544/MAR/B2:

- Task 1 of the study provided detailed information on current damage and control costs of IAS in Europe (see Kettunen, M., Genovesi, P., Gollasch, S., Pagad, S., Starfinger, U., ten Brink, P. & Shine, C. 2009. *Technical support to EU strategy on invasive species (IAS) - Assessment of the impacts of IAS in Europe and the EU*. Institute for European Environmental Policy (IEEP), Brussels, Belgium)

- Task 2 of the study involved a comprehensive analysis of Community and Member State policy and practice and the range of IAS policy measures and packages available to the Commission (see Shine, C., Kettunen, M., Genovesi, P., Gollasch, S., Pagad, S. & Starfinger, U. 2008. *Technical support to EU strategy on invasive species (IAS) – Policy options to control the negative impacts of IAS on biodiversity in Europe and the EU*. Institute for European Environmental Policy (IEEP), Brussels, Belgium).

The data and synthesis provided by this report are intended to facilitate selection of the most appropriate and effective Option at the EU level and if appropriate, to support preparation of a proposal for consideration by Community institutions.

The report consists of the following sections:

- summary of current EU policy and practice regarding IAS (Chapter 2);
- presentation of the four Options set out in the Communication (Chapter 3);
- methods used for data collection and analysis (Chapter 4 and Annex 1);
- findings on cost/benefit data related to a range of policy measures for IAS (Chapter 5 and Annex 2);
- aggregated assessment of the overall costs, benefits and other impacts of each Option (Chapter 6);
- comparison of the Options in terms of their quantitative and qualitative impacts, supported by species-specific examples (Chapter 7 and Annex 4); and
- a summary of the analysis with justification of preferences (Chapter 8).

The terminology used in this report follows the definitions used in the Convention on Biological Diversity Guiding Principles for the Prevention, Introduction and Mitigation of Impacts of Alien Species that Threaten Ecosystems, Habitats or Species, unless otherwise indicated (see http://www.cbd.int/invasive/terms.shtml).

2 SUMMARY OF CURRENT EU PRACTICE REGARDING IAS

2.1 Community legislation and policies

The Communication recognises that existing EU legislation and policies already provide part of the solution to the IAS problem in the areas of plant health, animal health, limited aspects of wildlife trade and aquaculture, with additional measures under the birds, habitats, water framework and marine strategy framework Directives. In addition, the EU provides funding for IAS control through the LIFE programme, for general IAS research under the Research Framework Programmes and, to a limited extent, through the European Development Fund.[8] A detailed analysis of these instruments and trends in their application is provided in Shine et al. 2008 (the Task 2 report in the context of this study).

The Communication notes that the main pathways for IAS introduction are associated directly or indirectly with trade (an exclusive Community competence) and must be addressed at the EC's external frontier because, within the single market, introduced goods may circulate freely once placed on the Community market.

Identified weaknesses in the Community framework have not, except for aquaculture, been substantially addressed since the first audit of Community IAS-related frameworks in 2002[9]. The Communication highlights the continuing absence of:

- mechanisms to support harmonisation or consistency of approaches between neighbouring countries or countries in the same sub-region;
- any systematic formal requirement for risk analysis in connection with intentional introduction of non-native species that may affect biodiversity;
- regulation of accidental or negligent introductions at both Member State and Community level;
- any unified system to monitor and control IAS and their effects on European biodiversity.

Community legislation does not provide for differentiated screening of goods or consignments on the grounds of the vulnerability of the receiving territory. This limits the scope for applying stronger prevention policies in the EU's biodiversity 'hotspots', including islands and the European Outermost Regions which form an integral part of the single market.

In horizontal areas, the Community has made significant investments in large-scale IAS projects, including preparation of the DAISIE inventory and research programmes such as ALARM, IMPASSE and PRATIQUE. On the ground, however, IAS as an issue affecting EU biodiversity have extremely low visibility amongst

[8] §5.2, Communication: *Existing Tools for Tackling Invasive Species in Europe*.

[9] *Thematic Report on Alien Invasive Species*. 2003. 2nd EC Report to the CBD Conference of the Parties, 2003.

Europeans. In 2008, a scoping study carried out for the EU Biodiversity Communication Campaign 2008-2010 found low understanding of the general concept of biodiversity[10] and that only 2 per cent of general public respondents thought that IAS were an important threat to biodiversity[11] .

2.2 Member State frameworks

Analysis of current national frameworks in 26/27 Member States provides evidence of significant progress in many parts of the EU (see Shine et al. 2008). By end 2008, 12/27 had either formally adopted or were developing dedicated IAS Strategies or Action Plans.

However, operational coordination mechanisms between key sectors remain rare and the dominant pattern is still one of legal and institutional fragmentation and low dedicated capacity. There are wide variations in the scope, application and resourcing of regulatory and technical measures. Coverage of unintentional introductions and rapid response is particularly weak. National IAS information tools have been significantly expanded but outside the NOBANIS framework, are not interoperable.

The analysis revealed emerging differences in national practice which are directly relevant to the design of the future EU Strategy on IAS. These mainly relate to controlling trade and movement as part of prevention.

In the absence of a clear basis in Community law to prevent entry and spread of plants and animals invasive in their own right, a minority of Member States have adopted a legal basis for imposing unilateral trade-related restrictions on high-risk species (a 'black list' approach). Depending on the scientific basis underpinning such measures, these could potentially infringe the operation of the Single Market (quantitative restriction on imports, exports or goods in transit) unless justified on the grounds of protection of health and life of humans, animals or plants (Article 30 of the Treaty).

Whilst some Member States have invested in independent risk assessment capacity to justify national measures (and for other purposes e.g. to prioritise pathway and management interventions), others have:

- adopted measures with less robust scientific backing (there are no common Community criteria in place governing the use of risk assessment for IAS, except under the aquaculture Regulation, nor is there a 'quality control' mechanism to promote consistency or minimum standards for these national measures); or

- taken the deliberate decision not to adopt any trade/movement measures pending clarification of the legal position at Community level (there is significant legal

[10] Awareness was mainly connected to the loss of specific individual species: biodiversity loss was not perceived as a threat to ecosystem provision of goods/services and thus to economic well-being.

[11] Compared to pollution (27%), manmade disasters (27%), climate change (19%), intensified agriculture (13%) and land use/development (8%). Source: Scoping Study for an EU wide Communications Campaign on Biodiversity and Nature (Gellis Communications: Final report to the European Commission/DG ENV Contract 07-0307/2007/ 474126/MAR/A1) (survey conducted November 2007, results published March 2008).

uncertainty on what may or not may be enacted at national level consistent with the Treaty, linked to the small number of relevant judgments issued to date by the European Court of Justice).

If this trend continues, the number of inconsistencies between neighbouring territorial units looks set to increase. This may contribute to an uneven level of environmental protection across the EU and has implications for the transparency, effectiveness and efficiency of IAS prevention and monitoring efforts. To give two concrete examples:

- within Spain, the Autonomous Community of Valencia has banned the sale of the invasive water hyacinth but no equivalent measure is in place in adjacent units;

- trade in grey squirrels is prohibited in France and Switzerland but authorised in Italy (although its release into nature is prohibited).

National legislation, however robust, is also not able to limit the intentional movement of species to other parts of the Community where they are known to present invasiveness risks (e.g. ornamental aquatic species purchased in northern Europe and transported south; species acquired in continental Europe and transported to islands and Overseas Entities).

For this report, Member States with more advanced strategic frameworks proved the main sources of cost-benefit raw data. Their experience has also been used to inform qualitative discussion of what has been or could be done and what it could cost.

Building on this summary of existing practice, the next chapter outlines the different ways in which policy frameworks could be adapted for stronger action at EU level.

3 PRESENTATION OF THE POLICY OPTIONS TO BE ANALYSED

This chapter outlines the four Options for the future EU Strategy on IAS presented in the Communication, for which the respective costs, benefits and other impacts will be assessed and compared in this report.

The Options are of increasing intensity, ranging from minimal Community input to a package involving new legislation. The Communication describes them as follows:

- ***Option A: Business as usual***

  The "business as usual" option provides a reference point against which other options can be assessed. But clearly, if no action is taken, IAS will continue to become established in the EU with increased associated ecological, economic and social consequences and related costs.

- ***Option B: Maximising use of existing approaches and voluntary measures***

  The formal legal requirements would remain as they are today but there would be a conscious decision to proactively address IAS problems under existing legislation. This would imply carrying out risk assessments using existing institutions and procedures such as the European Food Safety Authority. Member States would voluntarily make IAS issues part of their border control function. A Europe-wide Early Warning and Information System based on existing activities could also be set up. The DAISIE inventory of IAS could be maintained and updated regularly. Species eradication plans would be developed and supported by national funds. Cross-sectoral stakeholder groups could be set up at appropriate levels to foster exchange of best practice, to develop targeted guidance and to help resolve conflicts of interest. Voluntary codes of conduct could be drawn up to encourage responsible behaviour by retailers, users and consumers.

- ***Option B+: Amending existing legislation***

  This option is similar to option B in most respects, but would include amendments to the existing legislation on plant/animal health to cover a broader range of potentially invasive organisms and extension of the list of 'ecological threat species' for which import and internal movement are prohibited under the Wildlife Trade Regulation. If this approach were followed, additional resources would need to be dedicated to IAS in the assessment process and in the border control activities carried out by Member States.

- ***Option C: Comprehensive, dedicated EU legal instrument***

  This option would involve the setting up of a comprehensive, dedicated legal framework for tackling IAS with independent procedures for assessment and intervention taking into account existing legislation. If it were considered desirable and cost effective, the technical aspects of the implementation could be centralized by a dedicated agency. Member States including the European Outermost Regions would be obliged to carry out controls at borders for IAS and to exchange information on IAS. Mandatory monitoring and reporting procedures and efficient rapid response mechanisms might also be established. While it is possible to envisage some EU funding being dedicated to support eradication and control actions, Member States could also fund these actions directly.

Each Option can be seen as a 'package' of individual measures. The Communication notes that component measures are not mutually exclusive, but could be combined. The overall focus and impact of each Option will depend on the final choice of components, level of stringency, implementation tools and timing.

Table 3.1 summarises the baseline scenario, i.e. the existing Community framework for IAS (Option A)[12]. Table 3.2 presents a list of the different IAS policy measures likely to be covered by the future EU Strategy, showing how the scope of the

[12] Detailed analysis of all relevant instruments and remaining gaps/inconsistencies is provided in Shine et al. 2008.

respective measures could vary between Options B, B+ and C according to the intensity of each Option. A detailed breakdown of each Option is set out in Annex 3.

Table 3.1 Option A: Baseline scenario (i.e. the existing Community framework)

Option A: Baseline scenario ***Business as usual - continuation with the ongoing implementation of existing instruments***	
Instrument	**Current scope and relevance**
Plant Health Directive (2000/29/EC)	Community-wide framework for prevention and control of specified 'harmful organisms' threatening plant health. No invasive alien plants (e.g. invasive plants with negative impacts on biodiversity) listed.
Animal health instruments	Set of Community instruments for prevention/control of terrestrial and aquatic animal diseases. Not applied to invasive animals that may impact native biodiversity.
Aquaculture Regulation (708/2007)	Only EC instrument exclusively focused on preventing intentional introductions of alien and locally absent species damaging to biodiversity. Distinguishes between introduction to open and closed facilities. MS are responsible for risk assessment and management based on standardised criteria in Annex (except for a list of exempted species) but Commission has decision-making power for introductions that could affect neighbouring MS. Supports precautionary principle through pilot release, contingency planning and monitoring measures. Caters for biogeographic variation. Does not affect application of existing EC plant/animal health legislation. Not applicable to keeping of ornamental aquatic animals/plants in pet-shops, garden centres, contained garden ponds or aquaria.
Wildlife Trade Regulation (338/97)	Legal basis to regulate intentional introduction into the Community of 'ecological threat' species and, as optional complement, their intra-Community holding/movement. Import of 4 invasive animal species currently prohibited.
Habitats and Birds Directives	Require MS to regulate intentional introductions to wild of non-native species that could damage biodiversity. MS have full discretion on scope of controls. Indirect management obligation for IAS affecting Natura 2000 sites. No explicit control rules.
Water Framework Directive (2000/60/EC)	No specific reference but IAS (taxonomic composition) could be considered when assessing ecological status of a water body. IAS monitoring covered in some guidance documents under Directive.
Marine Strategy Framework Directive (2008/56/EC)	IAS included in criteria for assessment of European marine waters to identify measures to achieve good environmental status.
Communication on an EU Forest Action Plan (COM(2006) 302 final)	Notes that global trade and climate change have increased potential vectors for harmful organisms and IAS: supports protection strategies, targeted risk assessments and research for harmful organisms/IAS affecting forest biodiversity.
EU Research Framework Programmes	IAS-related programmes qualify for funding. Major FP projects include DAISIE, ALARM, PRATIQUE, IMPASSE and EFFORTS.
LIFE+ Regulation (614/2007)	IAS control projects eligible under Nature & Biodiversity component (potentially under Information & Communication component). Used for control funding, notably on islands. Not adapted to prevention/rapid response.

Other funding mechanisms (eg EAFRD, structural and cohesion funds, development cooperation)	Could be used to address IAS but no earmarked IAS funding (although EAFRD includes IAS control in the requirements to keep land in Good Agricultural and Environmental Condition as part of cross-compliance).

Table 3.2 Indicative content of Options B, B+ and C, showing possible gradient of intensity[13]

Policy measure	Option B	Option B+	Option C
Baseline (legislation, policy)	Unchanged	Limited change	Major change
Coordination mechanism (EU/MS)	Voluntary/ informal	Existing committees Existing system of national focal points	Dedicated agency Dedicated network of IAS focal points
National strategic/action planning	Voluntary	Voluntary	Mandatory
Prevention (in addition to existing baseline requirements under EC law)			
Voluntary prevention measures	Encouraged	Encouraged	Possible EU support
Controls on introductions into the environment	Discretionary	No/limited change	Possible major change
Controls on introduction into captivity/containment	Discretionary	No/limited change	Possible major change
Controls on domestic holding, trade and movement	Discretionary	Coverage extended	Possible major change
Import pathway controls	Discretionary	Coverage extended	Comprehen sive
Export pathway controls	Discretionary	Possibility of extension	Extended
Border controls and inspections (airports, seaports, other)	Discretionary	Coverage extended (greater range of organisms)	Comprehen sive (pathway focus)
Cooperation with non-EU countries	Discretionary	Coverage extended	Formalised
Risk assessment procedures	Discretionary (based on existing)	Coverage extended (based on existing)	Independen t procedure, technical support & verification
Integration of IAS into EIA	Discretionary	Encouraged	Mandatory
Early detection and rapid response: creation of Early Warning and Information Exchange System			
Maintenance/interlinkage of inventories and databases	Voluntary	Voluntary	Mandatory
Surveillance and monitoring	Voluntary	Coverage extended	Mandatory
Information exchange	Voluntary	Coverage extended	Mandatory
Contingency planning	Voluntary	Coverage extended	Mandatory
Rapid response mechanisms	Voluntary	Coverage extended	Mandatory

[13] Based on the three-stage hierarchical approach (prevention, early detection & rapid eradication, long-term control and containment) used internationally and in the Commission Communication.

Emergency funding	No	Existing co-financing	New co-financing
Long-term control and containment			
Species action plans/ guidance	Voluntary	Voluntary	Coordinated for certain categories
Control/containment (plants)	Voluntary	Coverage extended	Mandatory for certain categories
Control/containment (animals)	Voluntary[14]	Only if significant change to animal health legislation	Mandatory for certain categories
Funding for control	No[15]	Existing co-financing	New/coordinated co-financing
Restoration	Voluntary	Voluntary	Integrated
Associated horizontal measures			
Communication and awareness	Voluntary	Voluntary	EC backing
Research programmes	Existing	Coverage extended	Coordinated with strategic priorities
EU funding instruments	Discretionary	Guidance on coverage of IAS under existing instruments	New (co-financing for priority threats)
EU development cooperation funds	Discretionary	Discretionary	Integrated
Capacity-building and infrastructure	Discretionary	Medium demand to implement legislative adjustments	High demand to implement new framework

4 APPROACH AND METHODS USED IN THE ANALYSIS

This chapter describes how data for this report was collected and used to develop recommendations for the Commission. The methodology used for the analysis involved the following steps:

- data collection on the policy measures outlined in Table 3.2 above (see section 4.1 below and results presented in Chapter 5);
- aggregation of data findings to assess the overall impacts of each Option (see section 4.2 below and results presented in Chapter 6);
- comparison of the different Options using standardised criteria for impact assessment as well as species-specific examples (see section 4.3 below and results presented in Chapter 7).

[14] For animals that affect plant health, mandatory control possible under plant health legislation.

[15] Except through existing solidarity funds, e.g. pinewood nematode.

Annex 1 provides further details of the methods used to obtain and analyse cost, benefit and qualitative data for this report.

4.1 Collection of data on individual policy measures

The first step of the analysis was to collect concrete information on costs and benefits of specific IAS-related measures from MS and a number of non-EU countries. These raw data, listed in Annex 2 and synthesised in Chapter 5, provide the basic 'building blocks' for the assessment and comparison of Options later in the report.

4.1.1 Scope of costs and benefits investigated

Introduced species are of critical importance for biological production systems that underpin European economies, provide a range of employment opportunities and are highly appreciated in society (e.g. ornamental and recreational use of plants, pet animals, exotic birds, game, fish for angling).

However, the subset of introduced species that have become invasive in Europe generate a range of negative economic, social and environmental impacts that outweigh their monetary and social benefits (see Kettunen et al. 2009). Biological invasions interfere with production processes and ecosystem services and affect a range of sectors, from agriculture, forestry, horticulture, fisheries, aquaculture, pleasure boating and public health to electricity generation, transportation, nature tourism and cultural heritage. Secondary market effects can take place through the domestic or international market of products and/or services affected by IAS. In a minority of identified cases, such effects can be economically beneficial e.g. where the IAS becomes subject of a targeted fishery such as the Red King Crab in northern Norway.

Policy measures to prevent and minimise these negative impacts carry a range of potential costs and benefits (summarised in Table 4.1):

- costs may include administration, implementation and enforcement costs, higher capital and running costs, potential delays in transport/trade flows, flow-on costs to the rest of the economy and opportunity costs;
- benefits may take the form of expected reduction in non-native species incursions, biodiversity benefits and the avoidance of potential economic, broader environmental and amenity damage.

Insights on the actual costs of impacts - and hence the benefits of avoided impacts - are given in the report by Kettunen et al. 2009 (i.e. the Task 1 report in the context of the overall study).

Certain costs and benefits are difficult to estimate since they do not have a market value. For example, benefit value incorporates psychological factors such as amenity and aesthetic attributes and level of inconvenience. Estimation of this type of value

requires non-market valuation (e.g. using stated or revealed preference methods). This was beyond the scope of this report.

Table 4.1 Costs and benefits related to IAS policy measures

<table>
<tr><th>Costs of measures</th><th>Benefits of measures</th></tr>
<tr><td colspan="2">Direct</td></tr>
<tr><td>Management and administration costs</td><td>Benefits (costs avoided)</td></tr>
<tr><td>Expenditure on prevention, eradication, containment, management, monitoring, information, restoration, research, administration, training and enforcement.

Cost items include: equipment, wages, infrastructure, inspection costs, transport, maintenance, information and training material, research equipment, etc.</td><td rowspan="3">Benefits through avoided damage/control such as:

• Maintenance or restoration of healthy ecosystems and populations of native species

• Avoided on-site production losses (losses to production in the area where the invasion has occurred) eg: decrease of yield and productivity, reduction of drought tolerance, increase of pest and disease damage, water shortage, sedimentation and siltation, reduced options for future production etc.

• Avoided clean up costs (species removal) and avoided damage to infrastructure</td></tr>
<tr><td>Opportunity costs (benefits lost)</td></tr>
<tr><td>Loss of benefits generated by invasive species through on-site production or direct use such as: agricultural and forestry yields, etc, trade outlets (e.g. pet shops, horticulture).</td></tr>
<tr><td colspan="2">Indirect</td></tr>
<tr><td>Opportunity costs (benefits lost)</td><td>Benefits (costs avoided)</td></tr>
<tr><td>Losses to other sectors and activities:

Effects and impacts on other enterprises, sectors and sites that depend on the invasive species such as: reduced employment, declining earning, reduced supplies of inputs and commodities, water storage, sedimentation and siltation, increased erosion, storm and flood damage, reduced options for the future production and consumption, etc.</td><td>Benefits to other sectors and activities

Avoided impacts on other enterprises, sectors, and sites that depend on the invaded ecosystem in terms of employment, earnings, supplies of inputs and commodities, prices of inputs and commodities, water services, storm and flood control, options for future production and consumption, etc.</td></tr>
</table>

Source: Adapted from Emerton and Howard, 2008.

4.1.2 Data sources and response rates

A range of methods were used and sources approached to obtain information in order to quantify – as far as possible in monetary terms – the costs, benefits and other impacts of IAS policy measures (). These included:

- questionnaires sent to environmental authorities in EU Member States, supported by follow-up contact;
- adapted questionnaires sent to authorities in selected non-EU jurisdictions with advanced or developing IAS policy frameworks, again with follow-up contact;

- direct contact with stakeholders, including industry federations, NGOs and IAS experts in and outside the EU;
- attendance at EU IAS expert group meetings and other IAS fora in Europe during 2008-2009;
- a comprehensive literature and website survey.

A range of useful information was obtained to support analysis of costs and benefits of policy measures: a full list of contributors is set out at the end of this report. However, significant gaps were noted in available data for a range of countries and measures. Many contributors in and outside the EU identified the lack of concrete cost-benefit information as a major constraint in their own work[16] and expressed interest in contributing to ongoing EU work in this area. In some cases, insights on the costs and benefits of measures from parallel policy areas (e.g. disease control, natural hazard management) were used to help address the main information gaps.

4.1.3 Approach to compiling and processing of data

The four Policy Options present a range of possibilities for evaluation as their mix of component measures may be varied. In keeping with the flexible approach endorsed by the Communication, a list of generic IAS policy measures was drawn up to provide a transparent data classification system. These follow the three-stage hierarchy and cover measures: to prevent introduction and spread; for early detection and rapid response; for control, management and restoration; and horizontal measures, including organisational coordination.

Raw data collected on costs was entered in the table in Annex 2 under the appropriate category of policy measure to provide a full data trail. The original data were, as applicable, converted into annual figures for costs and benefits and presented in Euro by using standard exchange rates as of 1 January 2009[17]. Additional information, where available, was entered (e.g. period when costs incurred, location, scale at which costs were incurred, responsible authority, breakdown of figures obtained).

Two established approaches were used to calculate annual figures (see Box 4.1). In cases where the time period when the costs occurred was known, an average exchange rate and inflator over this period were calculated). In cases where the time period was unknown, an annuity was created by dividing original figures by 14, which is the annuity factor using 4 per cent real discount and 20 year timescale. For species-specific examples used to illustrate the costs and benefits of different Policy Options (see 7.2), information on the area coverage (km^2) of their impacts (i.e. country or region) and the total known range of the IAS in question (retrieved from the DAISIE database) was used to extrapolate cost information to the broader EU level.

[16] E.g. the need to compile such data is one of the key recommendations enshrined in the Swedish National Strategy and Action Plan for Alien Species and the Danish Action Plan on Alien Invasive Species, published in December 2008 and February 2009 respectively.

[17] Daily OANDA rates, available online at: http://www.oanda.com.

Box 4.1. Methods used for data calculations

Creating an annual figure when time period for costs / benefits known: $FV = X(1+t)^t$ where FV is the future value, X the amount, i the interest (equal to 3%) and t the year.

Creating an annual figure when time period for costs / benefits unknown:
$NPV = \frac{C}{i} \times \left(1 - \frac{1}{(1+i)^t}\right)$ where NPV is the Net Present Value, C is the value of an annuity, i is the discount rate (equal to 4%) and t is the timescale (equal to 20 years).

Extrapolating costs and benefits at the EU level: the potential costs of a species in Europe have been calculated as: cost data (EUR/year)/area of impact (km^2) x known IAS range in Europe (km^2). When the data on area coverage (km^2) of the actual IAS impact was unknown we estimated a potential cost assuming that eradication is carried out on all the land.

The data obtained was found to vary widely and often came from very local sources. After examining the raw data, the report team therefore selected the most applicable and useful examples to illustrate possible costs in the EU context (i.e. what a given investment can actually deliver in terms of actions). These examples and supporting analysis are presented in Chapter 5 and referenced in subsequent chapters. Certain local data were also used to develop the IAS-specific examples in Chapter 7.2.

Because data is presented on a measure-by-measure basis, this makes it easier to identify the implications of Option components and, if appropriate, to vary the focus of an Option by adding or subtracting an individual measure.

4.2 Methods for analysing the overall impact of each Option

The second step of the analysis was to use the data findings to develop an aggregated assessment of the costs, benefits and other impacts of each Option (see Chapter 6).

Option A, as noted, represents the baseline (existing Community framework). The aim was to estimate the additional impacts that the other Options might involve in comparison to this baseline. For this purpose, a list of possible policy components incremental to the baseline was drawn up for Options B, B+ and C respectively, based on Table 3.2 in Chapter 3 (see Annex 3 for a more detailed breakdown).

For key components of each Option, possible cost figures were developed based on the team's interpretation of the findings in Chapter 5. These quantitative indicators were complemented by qualitative analysis of other impacts, particularly for measures for which little or no monetary data were available. This analysis took account of insights into IAS policy and practice provided in the report by Shine et al. 2008 (i.e. the Task 2 report in the context of the overall study) and the series of expert stakeholder consultations organised by the Commission[18].

[18] Five consultation meetings, attended by Member States, invited stakeholders and some authors of this report, were organised by DG ENV with input from other Directorates General, in June and October 2007, March and June 2008 and March 2009.

4.3 Criteria for comparing the different Options

The third step of the analysis was to compare the four Options, building on the detailed assessment of individual Options. This comparison provides the basis for developing and justifying recommendations to the Commission (see Chapter 8).

Two complementary approaches, as outlined below and presented in Chapters 7.1 and 7.2, were used to develop the overall comparative analysis. These approaches combined a 'big picture' synthesis (using scaled-up numbers which are inevitably less precise) with concrete examples drawn from robust local/national data.

Section 7.1 presents a general quantitative comparison of the environmental, economic, social and other impacts of the four Options. The criteria used to compare these impacts were based on formal guidance for impact assessment developed by the European Commission[19]. As adapted to the IAS context, these include:

- **general issues** (degree of legislative change required; potential of each Option to address the problems identified);
- **environmental issues** (level of environmental protection conferred by each Option through reduced IAS numbers, reduced damage to biodiversity and ecosystems, gains for ecosystem resilience against natural hazards and climate change and implications for global footprint/impacts outside the EU);
- **economic issues** (implications for business, transport, EU internal market and trade, public authorities, households/individuals and at national and global levels);
- **social issues** (implications for public confidence, public health, food security, jobs in the public and private sectors, recreation, cultural and amenity values and future generations);
- **administrative impacts**;
- **other issues** (practicability, clarity, consistency with EU international commitments, fairness and feasibility of enforcement).

The guiding objective was to assess the Options against the above criteria, supported by evidence collected in qualitative, quantitative and monetary terms depending on availability, to form an evidence trail and facilitate judgement as to the costs and benefits of the Options.

Section 7.2 supports this analysis with species-specific examples to compare the predicted impacts and effectiveness of each Option in addressing concrete IAS threats. The species were selected on the basis of their relevance for the issue of IAS in Europe and according to the availability of data on cost of damage, cost of prevention/control and current spread in the EU (based on Kettunen et al. 2009, i.e. the Task 1 report in the context of the overall study).

[19] European Commission's Impact Assessment Guidelines (EC, 2009a); Annex to the European Commission Impact Assessment Guidelines (EC, 2009b).

5 COSTS AND BENEFITS OF INDIVIDUAL POLICY MEASURES

This chapter summarises the main findings on the raw data compiled for this report. Findings on costs are structured according to the three-stage hierarchy (5.1 - 5.3), followed by horizontal measures (0). Findings on benefits are discussed in 5.5. Section 5.6 sets out short conclusions.

Each section contains a discussion of costs identified for each category of policy measure; full details, citations and additional examples are contained in

Annex 2. The examples considered to be most relevant to the EU context are summarised in a short synthesis table at the end of each section and cross-referenced in Chapters 6 and 7 (assessment and comparison of the four Options).

5.1 Findings on prevention measures

Measures to prevent introduction and spread of IAS need to address six principal types of pathway: deliberate release; accidental escape; spread as contaminants in traded products (e.g. alien seeds in shipments of cereals; parasites and disease agents in live organism trade for e.g. aquaculture or stocking purposes); spread as hitchhikers on vessels and vehicles; use of corridors (e.g. roads, waterways); and unaided spread. Risks of introduction vary by pathway and by category of species.

Cost data collected on prevention measures for this report were the second biggest, after long-term control and containment, in terms of information received. Measures on which data were obtained include:

- voluntary prevention measures (e.g. information campaigns, codes of conduct);
- regulatory prevention measures (e.g. controls on trade and movement, operation of border control, inspection and quarantine services); and
- risk assessment (e.g. pest/pathway risk analysis, targeted research).

5.1.1 Voluntary prevention measures

These include formal and informal initiatives and may be targeted at different audiences (e.g. importers, producers, retailers and/or consumers). Evidence collected indicates that the cost range varies widely depending on scale of application and level of complexity but remains very low in comparison to IAS impact costs.

Information campaigns

At Member State level, identified one-off costs start at just over 13,000 EUR (original cost: £10,000 in 1999) for an industry-led campaign on ornamental fish and aquatic plants focused at point of sale (Ornamental Aquatic Trade Association, UK). At NGO level, costs obtained varied widely according to scale. Local initiatives can be very low-cost (e.g. information days on specific threats can cost under 350 EUR) whereas orchestrated campaigns over a wide area cost significantly more.

At the scale of a large US State (California), the PlantRight collaborative programme[20] between NGOs, public gardens and arboreta, scientists, and government agencies spends about 200,000 EUR per year on a programme to prevent invasive plant introductions through horticulture.

[20] Designed by the Steering Committee of California Horticultural Invasives Prevention (Cal-HIP) partnership to communicate the need to move away from invasive plants in the gardening and landscaping trade

Costs rise steeply for ongoing government-backed prevention campaigns for IAS impacting on public health (e.g. for *Ambrosia artemisiifolia*, nearly 120,000 EUR in France) and on biosecurity generally (e.g. in Australia, quarantine awareness programmes cost 2.11 million EUR per year during the period 2000-2005).

Codes of conduct/practice

At the national level, the development of the 2006 Code of Practice on Japanese knotweed for England and Wales cost about 39,000 EUR at current rates (£32,000 in 2006, of which expert and staff time accounts for nearly two-thirds)[21].

At the regional level, the ICES Code of Practice on the Introductions and Transfers of Marine Organisms[22] (reissued in 2005) has directly influenced the design of subsequent legislation, including the EU aquaculture Regulation. Total cost of revision and updating this Code over 3 years is estimated at 75-100,000 EUR (one-off: equivalent annual cost 33,000 EUR/year).

The pan-European Code of Conduct on Horticulture and Invasive Alien Plants, developed by EPPO and the Council of Europe to address a pathway unregulated at EU level, cost 22,000 EUR to develop over 2 years, including stakeholder consultations (equivalent annual cost 11,000 EUR/year). At a wider scale, development of an industry-specific toolkit for the global pet trade will cost 52,500 EUR (US$75,000) in 2009 (net of printing and physical distribution).

Lessons learnt in developing voluntary codes[23] show that to be fully effective, they should be combined with information campaigns and widely disseminated (to avoid the 'best-kept secret' phenomenon). This increases the cost but also the likelihood of measurable long-term behaviour change. Integrated programmes that combine sectoral codes development with targeted media campaigns and training (see Box 5.1) may thus be more cost-effective over time.

Box 5.1. Inherit: Increase awareness to curb horticultural introductions of invasive plants in Belgium

The proposed nation-wide programme (candidate for EU LIFE+ funding) will run from 2010-2013. Total budget is just over 1 million EUR[24] (i.e. 334,000 EUR per year). The project objective is to raise awareness of the environmental risks of invasive alien plants (IAPs) along the ornamental horticulture supply chain in Belgium through actions targeted at professionals (estimated 2560 organisations or

[21] Under amendments to UK legislation, legal powers now exist for IAS Codes of Practice to be approved by the Secretary of State for the Environment and used as evidence in court proceedings when applicable. Ministerial approval is expected for the Japanese knotweed Code of Practice in 2009 (Trevor Renals, Environment Agency, pers.comm.).

[22] ICES covers the North Atlantic countries including US, Canada and some Baltic States (Code is capable of wider application).

[23] See generally proceedings of EPPO/Council of Europe Workshop on the Code of Conduct on Horticulture and Invasive Alien Plants (Oslo, 4-5 June 2009) at www.eppo.org.

[24] Under LIFE+ Communication (National or transnational communication or awareness-raising campaigns related to nature protection or biodiversity matters), an EC financial contribution of 501,482€ has been requested.

individuals)[25], amateur gardeners (an estimated 400,000 regularly consult gardening magazines and TV programmes) and horticulture teachers. Preparatory work includes assessment of the economic value of IAPs to Belgium's horticulture sector[26], development of a voluntary code of conduct on IAP and horticulture, development and publishing of communication material and targeted awareness-raising.

Intended project benefits (i.e. measurable changes of attitude) include:

- endorsement of the voluntary code by at least 20 per cent professionals in horticulture federations and 60 per cent public green space managers;
- organisation of annual IAP-related training in at least 50 per cent of Belgium's horticultural schools;
- doubling of the number of gardeners with good knowledge of invasive plants;
- at least 10 per cent of amateur gardeners aware of the voluntary code and knowing that invasive plants may be substituted by harmless alternative plants.

Source: Etienne Branquart, Belgian Biodiversity Platform, pers.comm.

Labelling/environmental certification and accreditation schemes

Labelling can be deployed at point of sale to provide guidance to retailers and consumers, usually backed by information materials. Certification schemes have a more formal basis and are delivered through professional federations or international standard-setting/accreditation organisations (e.g. ISO standards): they can be designed both to reduce the environmental and possibly social impact of participating companies in a specific sector and to maintain/improve the industry's image (shared marketing and promotions, logos, branding). Certification may provide for accreditation of suppliers and regular independent audits with the possibility of sanctions in the event of non-compliance[27].

No IAS-specific schemes were identified during research for this report. However, there are existing and future opportunities to integrate IAS risk reduction measures into certification/accreditation schemes e.g. for horticulture, forestry and biofuels[28]. New Zealand operates an accreditation and training scheme for approval of persons to undertake pest interceptions by inspecting low-risk containers at approved transitional facilities[29].

For horticulture, costs of environmental/social certification in the Netherlands vary according to complexity and scope. Up-front development costs of a certification scheme (adapted to growers and to traders) are 30,000-40,000 EUR. Accreditation costs for the certification bodies are around 10,000 EUR for the first year and 2,500 EUR in the subsequent three years of the accreditation period. The cost range

[25] E.g. nurserymen, garden centre managers, wholesalers, garden contractors, landscape architects and public green managers.

[26] The use of 'black' and 'watch' list plant species identified by the Belgian Forum on Invasive Species and their relative importance within sales figures will be quantified on the basis of a survey of the catalogues of plant growers and suppliers within horticulture federations and through professional consultations.

[27] *Id*, note 23.

[28] See e.g. Woods, J and Chavez-Diaz, R. 2007. The Environmental Certification of Biofuels. Discussion Paper 2007-6. OECD/International Transport Forum, December 2007.

[29] http://www.biosecurity.govt.nz/regs/trans#operators

for auditing is around 600–1500 EUR for a relatively small company (i.e. the simplest certification scheme costs at least 600 EUR per year). These figures exclude company time and possible need for external consultancies[30].

Costs of developing industry-led programmes to address plant biosecurity/IAS issues were provided by the Nursery & Garden Industry Australia, The total cost of developing the Nursery Industry Accreditation Scheme (NIASA) is estimated at AUS $200,000 (around 116,000 EUR). The annual fee associated with NIASA audit varies between states: industry members pay an average of AUS $440 - $520 (255 – 320 EUR) and non-members AUS $720 - $880 (418 – 510 EUR). The total cost of developing the programme for Biosecure Hazard Analysis & Critical Control Points (HACCP) certification was around $75,000 (43,500 EUR). Some states include BioSecure HACCP certification in fees for NIASA at no additional charge: others charge an additional fee up to $120 per annum.

The Forest Stewardship Council (FSC) certification scheme includes monitoring and control of exotic forestry species in its global criteria[31]. Some costs of FSC certification, inspection and audit (covering all criteria) were obtained from the US where the estimated average unit area cost is 0.76 EUR/ha per year (US$ 0.5-20 per acre in 2005). No EU-specific cost figures were obtained, but some rough estimates can be developed based on the information from the US. In Sweden, for example, nearly 50 per cent of the forest estate is FSC certified (10.4 million ha out of 22.8 million ha). Thus, a national FSC scheme for Sweden incorporating alien forestry species (all aspects of certification) could be estimated to cost just under 8 million EUR per year.

The examples above show that voluntary prevention measures carry very low costs compared to IAS impacts. However, key questions relate to effectiveness (evaluating how far such measures contribute to prevention objectives) and lack of enforceability. At present, only the codes with statutory backing (e.g. UK) and formal certification schemes provide opportunities for verification and possible sanctions[32].

5.1.2 Regulatory prevention, including quarantine and border services

The Communication specifies that to reduce or prevent further introductions by trade-related pathways, it would be necessary to step up controls and inspections at borders in conjunction with an assessment procedure for determining the acceptability or otherwise of importations of new commodities. Such approaches would need to be informed by exchange of information between competent bodies working on IAS prevention and control[33].

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[30] George Franke, International Association of Horticultural Producers, and Ron Bleijswijk, MPS-ECAS Certficiation, pers.comm.

[31] C6.9: "The use of exotic species shall be carefully controlled and actively monitored to avoid adverse ecological impacts". Participating countries set more specific standards adjusted to national conditions, which may include planting limits (i.e. prevention or restriction on afforestation with alien species).

[32] e.g. UK legislation prohibits planting or causing Japanese knotweed to spread in the wild and regulates disposal of all waste containing Japanese knotweed. In 2005, a national housebuilder was prosecuted for unauthorised disposal by a subcontractor of waste, which constituted a breach of Duty of Care obligations under the national Code of Conduct. The contractor was fined £4,500 (plus prosecution costs) and the company director personally fined £2,000. (source : UK Environment Agency).

[33] Communication, section 5.1: *Strategies to tackle Invasive Species: the three-stage hierarchical approach.*

General prevention costs

General cost figures obtained for this report are not directly comparable because their scale and sectoral focus vary and because the term 'prevention' is often used to cover associated control activities. However, they provide an indicator of current investment levels and, at the higher level, what the scale of needed expenditure could be as part of a more systematic approach.

Relatively few MS were able to communicate 'system' costs of operating IAS prevention: data obtained ranged from 140,000 EUR per year (Poland - IAS) to 8.65 million EUR per year (UK – plant pests and diseases[34]). In the US, one estimate of the annual cost of general IAS prevention puts the cost at about 147 million EUR in 2007.

Sweden provided the most useful comparative data on the 'buying power' of different levels of investment in prevention (see Box 5.2).

Box 5.2. Comparative prevention costs assessed for Sweden[35]

'Low ambition' policy costs:
Cost of inventories, risk analysis plus eradication of species that are introduced but not established in Sweden: 5 species/year at 1-2 million Skr/year (0.46-0.93 million EUR per year or average cost per species 0.69 million EUR per year per species).
Total cost range of 1.6 – 2.45 million EUR per year.

'Medium ambition' policy costs:
In addition to the above, additional environmental monitoring and measures to eradicate/control 5 IAS/year that are already established in Sweden (Skr15 m/year per species).
Total cost 10.3 – 11.09 EUR per year

'High ambition' policy costs:
In addition to the above, inventories, risk analysis and measures for eradication or control of an additional 5 established IAS/year (total of 10 species) with a cost of Skr70 m/year per species.
Total cost 67.1 – 67.9 million EUR per year.

To put these numbers in perspective, the UK partial prevention figure (plant pests and diseases) is significantly less than one EUR per person/year, the US number, while higher, is still below one $ per person/year[36] and the Swedish medium and high-ambition figures range from just over one EUR per person/year to around 7.25 EUR per person/year[37].

The Swedish IAS Strategy also provides a cost-benefit ratio comparing cost of prevention for two species versus probable costs in the event of establishment:

[34] Global figure (2005) on preventing entry of non-native plant pests and diseases, eradicating or controlling them in England.

[35] Naturvårdsverket. 2008. National Strategy and action plan for alien species. Swedish Environmental Protection Agency. Naturvårdsverkets rapport 5910.

[36] Based on a population figure of 306.6 million (http://www.census.gov/population/www/popclockus.html).

[37] Based on a population figure of 9.25 million on 31 December 2008 (Statistics Sweden http://www.scb.se/).

- Pinewood nematode *(Bursaphelenchus xylophilus)*: cost of preventing entry 0.13 million EUR per year, probable costs if became established in Sweden 47.25 million EUR per year (i.e. 0.27 per cent);
- Raccoon dog *(Nyctereutes procyonoides)*: cost of preventing entry per year 0.1 million EUR per year; probable costs if became established in Sweden 2.73 million EUR (i.e. 3.66 per cent).

Non-EU examples of cost-benefit ratios support the economic case for prevention. The South Australia fruit fly prevention programme costs 1.98 million EUR per year, compared to the assessed benefit of protecting the horticulture industries from plant pests and diseases such as fruit fly, locusts and phylloxera (236.96 million EUR per year) (i.e. less than 1 per cent). In the US, sea lamprey prevention/control costs around 10.8 million EUR per year for assessed benefits of 328 million EUR per year (i.e. 3.3 per cent).

Controls on introductions, movement and trade

No stand-alone data was obtained on costs of domestic IAS prevention (intentional introductions to the wild or into captivity/containment; domestic trade and movement controls). These activities obviously generate costs (operation of permit procedures, environmental inspections, enforcement) but these are hard to distinguish from overall costs of regulatory systems for nature conservation. In some legal systems, fees charged and/or fines for violations can be used to recover costs of such services.

In one Italian region (Lombardia), penalties for unlawful introduction of alien invertebrates, herbs or plants into the natural environment include a fine of 200-2000 EUR per offence[38]. The penalty scale may be very much higher under dedicated national legislation: in Japan, offences related to regulated invasive species are punishable for individuals with a prison term of up to three years and/or a fine of around 22,000 EUR (three million Yen) and for corporations (eg releasing their bees into the wild) a fine of up to 750,000 EUR (one hundred million yen)[39].

Border controls and inspection systems

Prevention measures applied at international borders (i.e. the EC's external borders) generate costs related to import/export pathway controls and border inspections. Data was obtained on system costs (operation of administrative services), 'unit' costs to importers/transporters and pathway costs.

Most concrete data were supplied by non-EU jurisdictions. The American system, like the Community framework, mainly relies on phytosanitary and zoosanitary instruments. The US federal Animal and Plant Health Inspection Service (APHIS)

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[38] Regional Law n° 10/31 of March 31 2008.

[39] The Invasive Species Act 2005 (www.env.go.jp/en/nature/as.html) prohibits, without the minister's permission, the import, transfer, release, breeding, raising, planting, storing and carrying of IAS listed by regulations under the Act (currently 101 taxa, from vascular plants to mammals: list excludes domesticated species such as cats and goats). The Act also provides the legal basis for the control of IAS, including eradication (Sukigara. 2009).

budget for IAS control is estimated as just over 220.1 million EUR per year with military quarantine costing the Ministry of Defence an estimated 30.1 million EUR per year[40]. These figures, even though likely to be non-exhaustive, represent expenditure of less than one EUR per person/year.

Higher per capita costs are incurred in Australia which operates a comprehensive biosecurity system at international borders. The Australian Quarantine and Inspection Service (AQIS), run under the Department of Agriculture, Fisheries and Forestry, handles comprehensive external biosecurity through controls *inter alia* on arriving international passengers, cargo, mail, animals, plants and animal and plant products. Total expenditure for AQIS in 2005/2006 was AUS$ 335 million, of which AUS$213 million was incurred by six Quarantine Border Programmes (i.e. around 130 EUR at today's rates per person/year on specific quarantine programmes)[41]. Projections show that the costs of running these programmes are likely to increase for 2009/10[42]. AQIS is part funded by the Department of Agriculture, Fisheries and Forestry, part by Customs and part through costs recovered from the industry (around 55 per cent of its budget is funded this way).

Many jurisdictions charge for inspections, cargo clearance, passenger clearance, quarantine procedures and import permits. These unit costs are directly met by the importer, transporter or individual passenger. In Germany, the cost of obtaining an import/export permit under the Wildlife Trade Regulation (WTR) is 41 EUR (import) and 25 EUR (export) but this figure does not incorporate any element for risk assessment.

Data on charging systems to fund dedicated biosecurity programmes were obtained from two jurisdictions.

In New Zealand, declaration of 'quarantine risk goods' is obligatory upon arrival. Non-compliance can attract an instant fine of 90 EUR (NZ$200) and in legal proceedings, a fine of up to 45,000 EUR (NZ$100,000) and/or up to five years in prison. Charges are imposed[43] for inspections and biosecurity clearance of goods (including containers, used vehicles and machinery); organism identification; offshore inspection of ships; approval of permits; and approval, inspection and audit of transitional and containment facilities (e.g. laboratories). In 2006, the border control charging system was revised and new levies introduced to improve cost recovery, streamline procedures and reduce compliance costs. Charges for 2009/2010 include:

- application for a permit under import health standards (47 EUR/NZ$105 per application);
- inspector time (45 EUR/NZ$100 per hour[44]);

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40 Figure covers nine-month period of processing personnel and equipment through ports of embarkation in Kuwait (2004), cleaning of equipment, inspection of military hardware and quarantine for six military transport aircraft and their cargo for 24 hours.

41 Import Clearance, Airports, International Mail, Seaports, Northern Australia Quarantine Strategy and Detector Dog programmes respectively.

42 Based on a population of 21.8 million (Australia Bureau of Statistics http://www.abs.gov.au/AUSSTATS). For complementary information, see: http://www.budget.gov.au/2005-06/ministerial/html/daff-02.htm.

43 Biosecurity Act 1993; Biosecurity (Costs) Regulations 2006.

44 The GB Non-Native Species Secretariat applies a generic standard daily rate of £500 per day net of travel and subsistence ie £62.50 per hour (73 EUR/hour).

- vehicle inspections (7-22.5 EUR/NZ$15–50);
- Biosecurity Risk Screening Levy charged on qualifying import entries and cargo documentation to recover costs of primary screening of import documentation: collected by Customs Service and passed to Ministry of Agriculture and Forestry (1.8 EUR - NZ$4);
- Shipping Container Levy (9 EUR/NZ$20 per container containing goods; 4.5 EUR/NZ$10 per empty container);
- Gypsy Moth Levy (0.3 EUR/NZ 65 cents)[45].

In Hawaii, new legislation (2008)[46] imposes a service fee on importers of 0.35 EUR/US 50 cents per thousand pounds of incoming cargo, regardless of cargo type or port of origin. The transportation company is responsible for collecting the fee and forwarding proceeds to the transport authority at port of disembarkation, for deposit in a dedicate Pest Inspection, Quarantine and Eradication Fund. Estimated revenues generated by the tax are around 5 million EUR/US$7 million per year[47]. The fee was imposed regardless of cargo type (i.e. risk level) but 2009 amendments will exclude low risk cargos (liquid bulk freight, cement bulk freight) from the charge.[48]

Federal APHIS quarantine fees in the US to cover agricultural quarantine inspection are: 4 EUR per commercial truck (75 EUR/year with a purchased transponder); 4 EUR per international airline passenger arrival; 50 EUR/arrival of commercial aircraft; and 349 EUR for commercial vessels (100 net tons or more)[49].

Pathway prevention costs were identified for shipping, which provides vectors for unintentional introductions through e.g. ballast water and bio-fouling of vessels. These relate to sampling, port infrastructure, random inspections and cleaning costs (see Box 5.3)

Box 5.3. Costs relevant to prevention and management of marine pathway risks at EU level[50]

The EU has approximately 1200 commercial ports, of which 600 are important for merchant shipping. In 2008, 22,752 vessels produced **694,500 vessel movements (calls) to EU ports** (EMSA, 2009). This number includes vessel calls between different EU ports (relevant since secondary introductions of alien species need to be taken into account). This averages **57,875 vessel calls per month**/around **1902 vessel calls per day** (an increase of 5.8 per cent of vessel calls to EU ports over 2007).

45 http://www.biosecurity.govt.nz/regs/imports/changes-in-levy-rates accessed on 29 June 2009.

46 Inspection, Quarantine, and Eradication Service Fee and Charge (HRS 150A- 5.3). This covers aviation and marine cargo and repeals a 2007 measure imposing a fee of US$1 per 20-foot container, applicable to containerized marine shipments only.

47 Based on the Hawaii Department of Business, Economic Development and Tourism Data Book 2005 which notes that 38,431,961 pounds of cargo arrive daily, and assuming that all air and marine freight is subject to this fee (source: testimony of Hawaii Board of Land and Natural Resources to Senate Committee on Ways and Means, 2008).

48 Hawaii Revised Statutes 150A- 5.3; http://www.capitol.hawaii.gov/session2009/bills/HB1433_.pdf, accessed 29 June 2008.

49 U.S. Dept of Agriculture Animal and Plant Health Inspection Service (APHIS). 2007. Plant Protection&Quarantine factsheet.

50 All cost figures in this box supplied by David and Gollasch, GoConsult, pers.comm.: full citations given in Annex 2.

Costs associated with implementing technical standards aligned with the Ballast Water Management (BWM) Convention may be measured by port, by route, by vessel and/or by inspection:

- costs per vessel of on-board ballast water treatment systems: 460,000–1.09 million EUR (capital cost of 200 m3/h - 2000 m3/h plant);
- cost of a one-off comprehensive port baseline survey (needed about once every 5 years: estimated ca. 100,000 EUR per port[51]);
- cost of Port State control (compliance assessments with the standards set forth in the IMO Ballast Water Management Convention): sampling costs range from 540 EUR (instantaneous) to 1,620 EUR (average sampling event for compliance monitoring), plus cost of sample analysis with expert biological support (450 EUR). Additional costs may include the collection of ballast water reporting forms, data analysis and storage.

Inspection could be carried out through as part of regular vessel selection under the Paris Memorandum or Understanding procedure[52] (at least 25 per cent of vessels targeted) or be targeted for BWM purposes.

Costs associated with hull-fouling (not yet subject to binding international rules):

- sampling costs (1200-2400 EUR per event);
- maritime vessel cleaning costs: range from 1.3 EUR/m2 (routine docking) to 4 EUR/m^2 (outside routine docking) (i.e. 13,755-42,310 EUR per cleaning of a Panamax vessel with approx. 10,500 m^2 of underwater surface outside a regular docking event)
- inland waterway vessel cleaning costs: same pro rata rate but lower docking expenses as underwater surfaces are smaller (e.g. average 1800 m^2).

Identified cost-benefit ratios again provide strong support for prevention in aquatic ecosystems where an organism that establishes can spread very rapidly. In the Great Lakes (US/Canada), one estimate puts the cost of preventing new introductions at less than 20 per cent of the overall cost of ecosystem protection and restoration (494 million EUR compared to 2.85 billion EUR over 5 years[53]). A separate study estimated total losses resulting from ship-borne invasive species in the Great Lakes at 285 million EUR per year (losses to consumer surplus, wildlife watching, raw water users, sport fishing and commercial fisheries[54]. Currently, boat owners, fishing outfits and recreationalists are left to absorb cleaning costs (Stoett and Mohammed 2009).

5.1.3 Risk assessment and management

Risk assessment is required or supported under several international or EC instruments to justify regulatory measures that may affect trade. At the non-regulatory level, it plays a key role in prioritisation and targeting of available resources and in screening detected material to determine the appropriate level of response.

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51 Essential to support risk assessment of biological invasions: required for some management purposes (e.g. exemption of ballast water management requirements is based on risk assessment and comparison of donor and recipient waters of ballast water operations).

52 Paris Memorandum of Understanding 2008. Port State Control on Course for Safer Shipping, Annual report 2007. Secretariat Paris Memorandum of Understanding on Port State Control, Hague, p. 51.

53 Windle et al, 2008

54 www.invasivespeciesinfo.gov; Lodge and Finnoff, 2008.

At EU level, the European Food Safety Authority's (EFSA) budget in 2008 was 65.9 million EUR for a mandate that covers risk analysis and delivery of scientific options to support development of EC measures, including operation of Specialist Panels covering animal health and welfare, plant health and the environment.

The European Centre for Disease Prevention and Control (ECDC) allocates 1.92 million EUR per year to scientific advice, of which 0.1 million EUR is used to produce guidelines, risk assessments and public answers/work with MS, 0.48 million EUR to provide authoritative scientific advice and 0.75 million EUR to promote and coordinate research for evidence base/identification of future threats.

Only one Member State provided system cost data. The Great Britain Non-Native Risk Assessment Mechanism costs around 96,000 EUR (£85,000) per year net of Secretariat time. Estimated costs for developing plant risk assessment systems varied from 86,000 EUR[55] (Plantlife, UK) to 300,000 EUR over 3 years (Germany).

Under Australia's import risk analysis system, 2.76 million EUR per year is spent on risk assessment and management related issues, including weed risk analysis. At the industry level, the Australian Nursery and Garden Industry Association has developed a BioSecure Hazard Analysis and Critical Control Points module to assess biosecurity hazards and responsibilities and manage identified risks but specific costs were not identified for this item[56].

The cost of individual risk assessments varies according to the organism/commodity and the level of assessment (in-depth or rapid screening). At EU level, the estimated cost under the aquaculture Regulation of drawing up the application and one risk assessment (one month) is 10,000 EUR. In the US, a four-month preliminary risk screening for 2,241 identified imports of potentially invasive plants and animals was estimated at 20,000 EUR.

Detailed cost indicators were obtained for New Zealand which operates a commodity-based system of Import Health Standards (IHS) for all risk goods[57]. Costs for IHS development vary according to scope (range of potential hazards), amount of information available (scientific[58], existing internationally-agreed standards[59]) and public interest. Risk analysis is usually the major component of developing an IHS (see Box 5.4).

Box 5.4. Indicative cost and time for developing three levels of Import Health Standards in New Zealand

- 'Small': up to 2250 EUR (NZ$5,000) and 1-5 days (risk assessment)[60]; 13,500 EUR (NZ

[55] Covers total cost of screening, design and trialling of questionnaire/analysis, compilation of species lists and expert services.

[56] See generally Environmental Accreditation scheme, Nursery and Garden Industry Australia (http://www.ngia.com.au/).

[57] Issued under section 22(1), Biosecurity Act 1993. IHS are required for commodities ranging from species, plant and animal produce and derivatives and anything that may harbour organisms that are biosecurity risks, including vehicles. The term 'risk goods' covers anything that it is reasonable to suspect may constitute, harbour or contain an organism that may cause unwanted harm to natural or physical resources or human health in New Zealand.

[58] e.g. Protocols to prevent international movement of mosquitoes are available, widely understood and implemented c.f. for bio-fouling, there is limited scientific information available because research is still in its early stages.

[59] e.g. World Animal Health Organisation animal health codes; international standards for phytosanitary measures (ISPMs).

[60] e.g. assessing a specific commodity against an existing appropriate risk analysis; minor amendment to an IHS or treatment.

$30,000) and two months to finalise a small IHS phase;

- 'medium': 22,500-45,000 EUR (NZ$50,000-100,000) and up to a year[61] (risk analysis); 22,500-45,000 EUR (NZ$50,000-100,000) for IHS phase;

- 'large': 135,000 EUR (NZ$300,000) and up to two years[62] (risk analysis) plus 45,000-68,000 EUR (NZ$100,000- $150,000) for IHS phase (may be higher and slower where government to government negotiations are involved).

The IHS funding system was revised in 2006 to expand resources over time (only 10 per cent of new requests could be progressed under the previous work programmes). The revisions aim to improve transparency, support prioritisation[63], match available public resources to the highest priority work and encourage private funding by applicants for lower priority requests, using external resources.

Source: The funding and management system for biosecurity import health standards (December 2008). http://www.biosecurity.govt.nz/files/regs/imports/applicants-ihs-guide.pdf

Risk assessment costs for marine pathways (ballast water) are estimated at 25,000 EUR per route[64]. The cost per port of a Decision Support System (DSS) to assist Port State Control officers to target highest-risk vessels for sampling is around 75,000 EUR[65]. Based on this and the INTERREG North Sea Project *Ballast Water Opportunity*, the cost of preparing an EU-wide Decision Support System could be around 10 million EUR (preliminary assessment of one-off cost). This could be prepared as a module for integration into the EU Safe Sea Net. Implementation costs per port authority of implementing a Safe Sea Net could be around 10,000 EUR (e.g. installation of modules at local level, training responsible officers).

Policy-focused research on risk assessment can generate more efficient and standardised techniques for wider application. Costs of EU-backed research include:

- 1.37 million EUR for PORT CHECK (2004-2007): development of a generic tool to speed up and simplify detection and identification of quarantine organisms at points of entry that may otherwise impact on cross-border trade[66];

- 4.1 million EUR for PRATIQUE (Enhancement of Pest Risk Analysis Techniques): addresses data gaps across the EU, development of reliable

[61] e.g.imports of new types of fresh vegetable from specific countries.

[62] e.g. for import of live finches from Europe, 18 months to reach external technical review of the draft risk analysis.

[63] New Zealand's Integrated Risk Management Framework sets out criteria to make it possible to able to compare and prioritise demands for resources across the national biosecurity system: these include Strategic (consistency with government goals), Net benefit (for the country), Technical (difficulty of the work), Acceptability (of the result for Europeans) and Practicality (eg availability of suitable resources).

[64] Risk assessment is required under the BWM Convention prior to the exemption of any route from on-board ballast water treatment systems. Each port may determine whether it accepts route-specific exemptions: if so, the shipping company has to pay the costs of the route-specific risk assessment. For exempted routes, the shipper does not need to install ballast water treatment systems (ca. 500k per vessel) (source: David and Gollasch, pers.comm).

[65] Port of Koper, Slovenia, 2004-2007 (Matej David pers. comm..).

[66] FP6 combined RTD/demonstration project for development of tools and procedures to allow EU member state Plant Health laboratories and inspection services to perform molecular diagnostic assays "on-site" and at points of entry to contribute to a reduced risk of import and export of harmful organisms. Project outcomes were designed to directly support implementation of the plant health Directive 2000/29 (http://ec.europa.eu/research/fp6/ssp/port_check_en.htm).

techniques that take account of uncertainty and improved efficiency and practicality for end-users[67].

Outside the EU, a three-year pathway risk study on hull-fouling (New Zealand) costs around 1.37 million EUR (NZ$<3 million). Mediterranean authorities have described this as "effort-intensive but surprisingly inexpensive considering the detailed data that is generated and the multiplicity of its uses"[68].

In conclusion, the examples of prevention and risk assessment expenditures above show significant variations but even at the highest levels of ambition (e.g. Australia), costs remain low both on a per capita basis and in relation to assessed costs of IAS damage and control. Table 5.1 presents a short synthesis of the most relevant examples identified with regard to the EU context.

Table 5.1 Examples of costs for prevention measures

Policy measure	Examples of costs identified (in EUR)
Voluntary prevention	
Information campaigns	• Small-scale: < 15,000 • Medium-scale (public health/sector specific): 120-200 per year • Large-scale (quarantine awareness):> 2 million per year (one country)
Codes of conduct/practice	• Average time spent: 1-3 years • Total cost national/regional codes: 22,000-100,000 (11,000-33,000/year) • Integrated code, communication and training package: 334,000 per year
Certification	• Horticulture certification: development > 30,000; initial accreditation 10,000; annual auditing 600-1500 EUR. • FSC certification: estimated average 0.76 EUR/ha
Regulatory prevention	
General system costs	• Ranges identified per capita[69]: under 1 EUR - > 7 EUR per person/year • Cost-benefit ratios for prevention/control if species established: >0.3 per cent-3.3 per cent (based on 2 EU and 2 non-EU examples) • Range identified per one MS (Sweden) across range of activities to prevent introduction/further spread: Low ambition: 1.6 – 2.45 m per year; Medium ambition: 10.3 – 11.09 m per year; High ambition: 67.1-67.9 m per year.
Domestic (internal) controls	No specific data on costs.

[67] The PRATIQUE project involves a review of cost-benefit analysis (CBA) methods for eradication and containment worldwide and the production of a CBA protocol. The project coordinator indicated during research for this study that it would be very difficult to extract cost figures for pest/ pathway risk analysis development and production overall because these analyses vary immensely in time, length and effort required (R.Baker, pers.comm).

[68] UNEP-MAP RAC/SPA 2008.

[69] All per capita comparisons should be taken as purely indicative, due to differences in the scope of key terms (e.g.'prevention'), the remit of the respective organisations which supplied costs and possible overlaps between sets of data obtained. Figures shown are all net of possible contributions through cost-recovery mechanisms (e.g. industry contributions).

Border control and inspection services: general	• Plant/animal health quarantine/inspection system: I EUR per person/yr • More comprehensive biosecurity system: 5 EUR per person/year • Hourly rates: 45 EUR (NZ) to 73 EUR (based on UK standard day rate) • Import permit fee net of risk assessment: 41-47 • Unit inspection charges: 4-350, depending on size of vehicle • Biosecurity Risk Screening Levy: < 2 EUR per screening of import/ cargo documentation • Cargo levies: 4.5-9 EUR per shipping container; 0.35 centimes per 1000 pounds net weight freight
Border control and inspection services: ports and shipping	• On-board treatment of ballast water: 0.49-1 million • Port baseline survey c.a.100,000 EUR per port • Sampling costs per event: 40-1620 (ballast water); 1200-2400 hull-fouling
Risk assessment/ management	
General risk assessment and management	• EFSA budget: 65.9 million/year • ECDC targeted scientific advice: 1.92 million/year • GB national risk assessment scheme: 96,000/year • Australia import risk analysis expenditure: 2.76 million/year
Pest/pathway risk analysis	• Unit cost for commodity risk assessment, from EU and NZ: small-scale (2250); medium (10,000-45,000); large: >100,000. • Rapid preliminary risk screening event: 20,000 • Development of EU port decision-support system: 10 million (one off) • Cost per port authority (incl. training): 10,000 EUR (one off)
Research on risk assessment techniques	• 1.37-4.1 m (multinational programme into detection and/or risk assessment techniques)

Source: based on figures and range of literature summarised in Annex 2.

5.2 Findings on early detection and rapid response measures

Early detection and rapid response are critical elements of the future EU IAS Strategy, forming the next line of defence where prevention fails. The Communication identifies the need for effective monitoring programmes, coupled with an early warning mechanism to inform other potentially affected areas as quickly as possible and to exchange information on potential eradication strategies.

Costs were identified for monitoring and surveillance, database/inventory compilation and, to a lesser extent, reporting systems, contingency planning and rapid response. These are summarised below, followed by cost indicators for setting up a dedicated European body for early warning and information exchange.

5.2.1 General costs

Within the EU, system costs can be inferred from the parallel sector of public health protection. The European Centre for Disease Prevention and Control's (ECDC) annual budget for **preparedness and response** is just under 1 million EUR, covering:

- development of an integrated early warning system about emerging disease threats in Europe (0.68 million EUR);
- strengthening MS and EU preparedness for communicable diseases (0.3 million EUR).

The ECDC budget for **surveillance** (2.19 million EUR per year) covers:

- reporting standards and integrated data collection network (1.44 million EUR);
- analysis of trends of public health importance (0.31 million EUR);
- reporting trends and fostering transfer to public health action (0.18 million EUR);
- quality assurance/data control and comparability between MS (0.26 million EUR).

Outside the EU, the US APHIS budget for IAS monitoring in 2007 was nearly 214 million EUR per year, matched by a similar budget for IAS emergency programmes. South Africa has recently established such a programme but for specific biodiversity objectives (see Box 5.5).

Box 5.5 Early Detection and Rapid Response Programme (South Africa National Biodiversity Institute)

For an annual cost of around 890,000 EUR (R10million), the Programme coordinates surveillance for emerging invasive alien plants, identification of new invasions, facilitation of risk assessment, rapid response[70] and effective information management, initiating relevant research, communications strategy and securing permanent financial support.

Funding from the Working for Water Programme is secured for 2008-2010. The Programme employs 13 staff (three national coordination unit personnel and three regional coordination teams with taxonomic support)[71]. The 2009-2010 budget allocates around 90,000 EUR (R1million) to training and 110,000 EUR (R 1.25 million) to rapid response activities (ie 10 per cent and 12.5 per cent respectively of total budget).

5.2.2 Monitoring and surveillance

Costs vary according to programme scale. Voluntary programmes, often run by specialist NGOs or institutions, operate at relatively low cost with costs limited to professional support and office overheads. Data obtained ranged from around 3500 EUR per year (Royal Horticultural Society's online recording and data monitoring

[70] SANBI's mandate covers early detection, identification and verification and risk assessment and response planning but not implementation of rapid response to eradicate or control invasive alien plant outbreaks. This will need to be the responsibility of another entity (SANBI Business Plan, Early Detection and Rapid Response Programme, 31 March 2008 (final)).

[71] Philip Ivey, South Africa Early Detection Programme National Coordinator, pers.comm.

scheme, UK[72]) to just over 1 million EUR per year (US, cost of 200-strong volunteer force for zebra mussel monitoring, including watercraft inspection, in Minnesota).

Government agency-supported environmental monitoring programmes range from 0.25 million EUR per year (Sweden: programme covers new sampling sites, updating species lists, educational materials) to just over 1.52 million EUR per year (South Africa: monitoring and measurement of benefits, including long-term hydrological monitoring). In Belgium, the proposed Alien Alert programme for early detection and rapid response will require 1-2 FTE employees in addition to personnel already involved in biodiversity monitoring[73].

Investment in surveillance, monitoring and rapid response is much higher for pests affecting plant, animal and/or human health than those affecting biodiversity. In France, the cost to the Ministry of Health of monitoring two IAS in 2008 was at least 524,000 EUR (410,000 EUR for the mosquito *Aedes albopictus* and 113,750 EUR for *Ambrosia artemisiifolia*). The highest species-specific figure identified in the raw data was 2.2 million EUR per year (New Zealand: monitoring of tussock moth, *Orgyia thyellina)*.

In Italy, detection of the invertebrate pest *Anoplophora chinensis* in 2000 led, on the grounds of its agricultural impacts, to rapid eradication with a high-profile public awareness campaign costing over 1.2 million EUR. In contrast, eradication of grey squirrel has not been initiated despite documented impacts, due to the cost implications for the regional government (around 300,000 EUR) and concerns about possible infringement of free trade[74].

5.2.3 Database/inventory compilation and information exchange

Data compiled show the economies of scale that can be obtained by regional sharing of information/expertise. Europe-wide, setting up the DAISIE dedicated information system cost 3.45 million EUR of which the EU contributed 2.4 million EUR. At the level of a single MS, start-up costs of national IAS inventories range from 150,000 EUR (Great Britain) to 546,000 EUR (Latvia) and ongoing maintenance costs are around 300,000 EUR (Swedish Species Information Centre, 2 FTE positions). On a smaller scale, the cost to scientific institutions of setting up online information recording systems is relatively low (up to 5000 EUR, based on data from Belgium's Harmonia information system and the Royal Horticultural Society, UK) as is site mapping for IAS threats (around 17,000 EUR per year for PlantLife UK).

Higher costs attach to running an integrated database that combines species and site information to inform management and resource allocation. In South Africa,

[72] Where pests new to Britain are discovered, the information is passed on the Plant Health and Seeds Inspectorate (Defra) which leads prevention efforts against the establishment of new pests and diseases of plants.

[73] Etienne Branquart, Belgian Biodiversity Platform, pers.comm.

[74] Source: Piero Genovesi, *Instituto superiore per la protezione e la ricerca ambientale*, pers.comm.

development and maintenance of the Working for Water Programme database costs around 1.68 million EUR per year[75].

The natural hazard management sector, where well-established systems are in place for sharing information/equipment and rapid response, provides evidence of cost savings resulting from regional cooperation and pooling of information with cost savings amounting to nearly a third of expenditure (see Box 5.6).

Box 5.6 Cost reduction linked to cooperation between National Meteorological and Hydrological Services (as part of a regional project oriented towards EUMETNET cooperation)

"If the National Meteorological and Hydrological Services of seven countries of South Eastern Europe (Albania, Bosnia and Herzegovina, Croatia, the Former Yugoslav Republic of Macedonia, Moldova, Montenegro and Serbia) were strengthened individually, country by country, and without better cooperation with national aviation weather services, the cumulative investment needs (hardware plus operational costs; without interest) are estimated at about €90.3 million over five years. However, if regional cooperation and data sharing could be carried out, and the hardware was designed to allow for cooperation with the rest of Europe, the total investment needs for these seven countries could be reduced to approximately €63.2 million."

Source: 'Strengthening the Hydrometeorological Services in South Eastern Europe', South Eastern Europe Disaster Risk Mitigation and Adaptation Programme (2008), p.xi (available from http://www.preventionweb.net/).

5.2.4 Reporting systems

Only limited data were obtained on inter-government IAS reporting systems. The NOBANIS network (interlinkage of databases and information exchange in North Europe/Baltic) costs about 50,000 EUR per year for secretariat services: the time of country focal points is provided free but may be limited by other commitments.

Maintenance of the EPPO Alert List for Invasive Alien Plants, and other related tasks, is estimated at 75 per cent of one FTE position.

5.2.5 Contingency planning and rapid response

Monetary data obtained were extremely limited, outside the general systems costs mentioned in 5.2.1. However, the positive cost-benefit ratio of rapid eradication can be demonstrated through a comparison of European and non-EU responses to the same marine invasive species (see Box 5.7).

Box 5.7. Comparison of rapid response and delayed action for one marine invasive species

In the Mediterranean, failure to respond rapidly to detection of *Caulerpa taxifolia* in 1984 (coverage $1m^2$) enabled the marine algae to proliferate (31ha by 1991, 12,140ha by 2001 across Spain, France,

[75] Includes baseline mapping, updated every five years, to support planning and prioritisation of invasive plant clearance as well as staffing, equipment, and training.

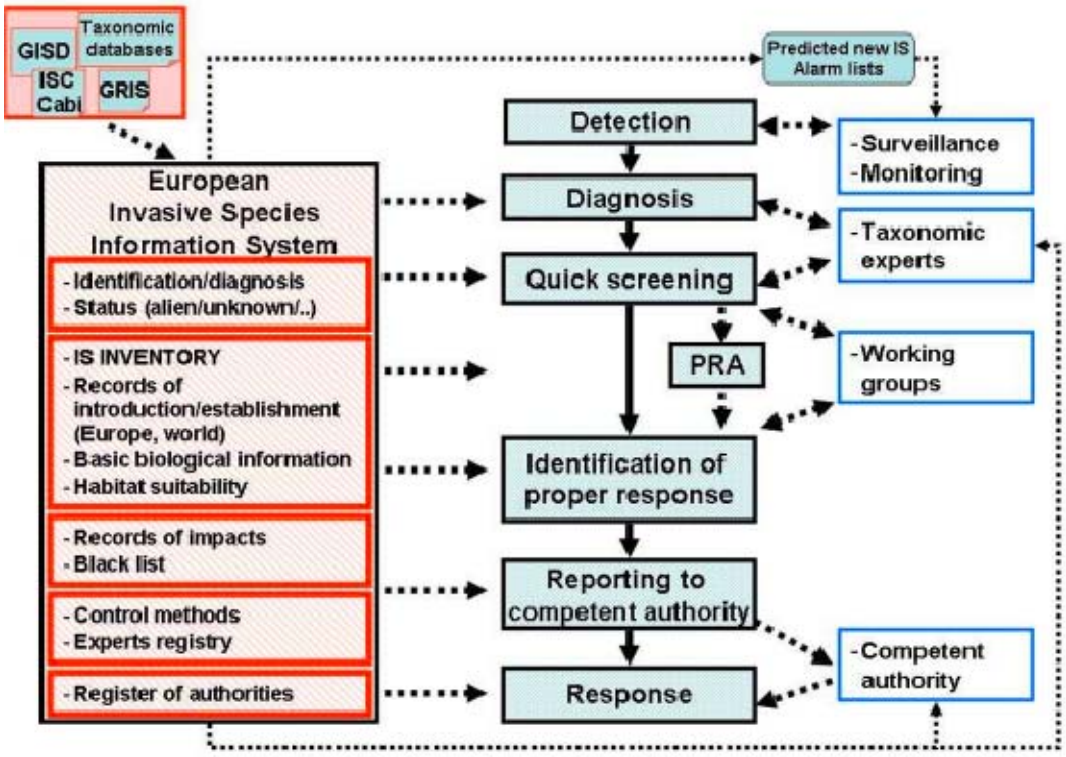
Italy, Croatia and Tunisia) with negative impacts on native phytobenthos species and also tourism, commercial and sport fishing and recreational activities such as diving. Eradication is no longer feasible although a Mediterranean network was set up to coordinate efforts to restrict expansion of range (total cost 968,000 EUR, co-funded by LIFE Programme 1996-1999 (Control of the Expansion of Caulerpa taxifolia in the Mediterranean: see http://ec.europa.eu/environment/life/).

In California (US), an infestation of *Caulerpa taxifolia* was detected in 2000 and based on prior contingency planning that took the Mediterranean impacts into account, eradication started 17 days later. A coordination group was created (Southern California *Caulerpa* Action Team), comprised of representatives of the national Marine Fisheries service, regional water quality control board, electrical supply company and the Departments of Fish and Game and of Agriculture. Successful eradication cost 2.5 million EUR (Anderson 2005, see also yearly status reports prepared by Merkel & Associates 2001-2006).

5.2.6 Cost range for a dedicated EU Early Warning and Information System

In 2008, the European Environment Agency commissioned a feasibility study, *Towards an early warning and information system for invasive alien species threatening biodiversity in Europe*. The study's findings (Genovesi et al. 2009) support the establishment of a European dedicated technical scientific body, responsible for implementing and maintaining a European information system on alien species and supporting early detection and rapid response (see Figure 1).

Figure 1: Structure of an Early Warning and Rapid Response framework (EEA feasibility study: Genovesi et al, 2009)



The study notes that a dedicated body carrying out the above functions could take various forms (a scientific panel, observatory or European centralised agency or, at a lower level, a network of experts and/or scientific institutions from individual European countries). It provides a cost indicator for five separate models:

(A) **European framework based on a network of national authorities** (based on the GB Non Native Species Secretariat approach). Status quo, with full subsidiarity: costs paid by national authorities: low synergy or regional economies of scale. Cost estimate based on data from GB, Estonia and Sweden, scaled up to EU-27.

(B) **Non-institutional European technical-scientific panel** (DAISIE approach). Advisory partnership among scientific experts and institutions and/or government agencies, supported by 2 FTE and part-time specialist contractors. Cost estimate based on DAISIE, with a reduction to take account of existing inventories but additional resources to address data gaps (e.g. in the Balkan countries).

(C) **European dedicated technical structure, based on clear political mandate** (based on US National Invasive Species Council approach). Observatory on invasive species established through formal policy decision by EC and/or MS. Would host European information system to support coordinated decision-making and management and assist MS in the enforcement of policies consistent with EC general directions. No mandatory powers. Cost estimate (scaled up from EPPO) is based on 7-10 FTE (of which 5-7 are specialists) and

part-time specialist contractors, to be funded through national voluntary contributions (as in EPPO system) or with EC contributions.

(D) **EC dedicated technical structure, with legal basis, and institutional, logistic and financial continued support.** Agency established under new or revised EC legislation, following ECDC precedent[76]. This could take the form of a European Agency on Invasive Species with a more limited mandate (detection of new incursions, species identification, risk assessment, identification of appropriate response and timely communication to competent authorities). The Agency could play a part-regulatory role, depending on legislative adjustments linked to future EU Strategy on IAS. It would act as an independent scientific body, working in close collaboration with EC, national authorities and other competent bodies (EPPO, EFSA, etc) and be linked to other European alert systems (e.g. animal health, food safety, EPPO). In the first phase (lower cost, mainly met by Community), it could involve permanent staff of 30-40 FTEs (including 10-15 scientific experts, 3-5 IT experts and part-time specialist contractors). There could be scope in the second phase to consider extension of tasks and capacity to address prevention and management[77].

(E) **EC central authority, based on new/revised legal tool** (based on New Zealand approach). Comprehensive biosecurity framework and policy convergence of sectors dealing with environmental protection and agriculture, human, plant and animal health i.e. reshaping of existing EU legal and institutional architecture. Full cost of system covering all aspects of biosecurity (extrapolated from New Zealand cost of 70-75 million EUR/year or 0.13 per cent GDP) is very high but could largely be realised through reallocation and optimisation of existing budgets in the health, agriculture and trade sectors.

Table 5.2 Cost indicators for dedicated European technical body to support information exchange, early detection and rapid response

Policy measure	Basis for calculation of possible cost/year	Indicator of aggregate cost (EU-27)
A: Network of national authorities	>400,000 EUR per Member State	>10 million EUR/year
B: Non-institutional advisory panel	500-700,000 EUR based on adjustment to DAISIE figures	500-700,000 EUR/year
C: European Observatory on IAS	Scaled up from EPPO staffing for early warning/rapid response	1.5-2 million EUR/year
D: European Agency on IAS	Based on ECDC cost figures, applied to a more limited technical mandate	3-6 million EUR/year
	Fuller mandate, modelled on ECDC, covering prevention and management aspects (possible second phase)	50 million EUR/year

[76] Established pursuant to EC Regulation 851/2004, with a mandate to identify, assess and communicate current and emerging threats to human health from communicable diseases.

[77] As per proposals for European Centre for Invasive Species Management, see Hulme et al, 2009.

E: European Biosecurity Authority	New Zealand budget for all aspects of biosecurity policy (ie also covers prevention and management aspects: 70-75 million EUR/year (0.13 per cent GDP)	10 billion EUR/year

Source: adapted from feasibility study prepared for the EEA (Genovesi et al, 2009).

The indicative costs provided by the EEA feasibility study are estimates based on scaling up to EU-27. There could be opportunities to reduce certain costs by approaching the EWS issue through regional agreements at the level of shared ecosystems (e.g. North Sea countries might establish one joint body to do the work to reduce duplication of effort and thus substantially cut costs[78]).

Both the concrete examples of early detection and rapid response costs earlier in this section and the cost estimates for dedicated EWS systems show significant variations, depending on scope and intensity. However, even at the very highest level of ambition (e.g. model of New Zealand centralised biosecurity framework), the provisional operating costs would be considerably less than already-documented IAS control and damage costs in Europe.

5.3 Findings on long-term control and containment

The Communication states that where IAS are both established and widespread, coordinated eradication or control programmes overseen and possibly financially supported by a central body would be desirable.

Data on IAS control and management costs are more easily available than for other types of policy measure (see e.g. Kettunen et al. 2009). However, the cost of action varies widely depending on the problem being tackled, making it difficult to develop generalised indicators of cost ranges.

EU direct funding for IAS control through the LIFE mechanism totalled 44 million EUR between 1992-2006 (188 projects). This averaged a rate of 12 IAS-related projects each year, for an average cost of 230,000 EUR each. Alien plants were addressed by 62.6 per cent of LIFE-funded control projects, alien animals by 27.8 per cent and both groups by 9.6 per cent of projects (Scalera 2008).

IAS control may also be funded through other EU mechanisms (e.g. several MS make use of opportunities under the European Agricultural Fund for Rural Development, see Shine et al. 2008). However, cost information on individual projects is not available on EC web sites nor – in most cases - on sites maintained by the competent national/regional authorities.

Generally, data obtained highlight the potentially huge costs of control across all taxonomic groups and thus confirm the case for prevention/rapid eradication compared to long-term control or containment. Brief examples from three taxonomic groups are given below: full details of raw data obtained, including for marine plants

[78] Stephan Gollasch, pers.comm.

and aquatic invertebrates, are set out in Annex 2.

5.3.1 Terrestrial plants

Japanese knotweed (*Fallopia japonica*) affects several Member States. In the UK, the estimated annual cost of eradication is 1.2 billion EUR (updated from 2003 cost figure of £1.54 billion/year). One indicator of how costs rise exponentially if intervention is delayed comes from Wales, where a three-year eradication programme would have cost about 59 million EUR (£53.3 million) if started in 2001 but around 84 million EUR (£76 million) if started in 2007[79].

Knotweed control costs impact directly on land owners/occupiers and developers. The cost range identified per $100m^2$ varied from 1286–2250 EUR (tree or herbaceous plantations, Belgium) to about nearly 187,000 EUR for development land in the UK (scaled up from £52,785 per $30m^2$ building plot). UK developers are now required to prepare Knotweed Management Plans as an essential component of duty of care obligations under the UK Code of Practice. Annual control costs at railways in Germany averaged around 6.25 million EUR per year in 2003. The cost of clearing the Olympic Games site in east London is estimated at about 72 million EUR.

Other plants triggering significant costs to infrastructure providers include alien Heracleum species e.g. in 2007, the cost to Latvia's public highway authority of clearing *Heracleum sosnowskyi* from motorway verges was around 1.25 million EUR. In the Netherlands, IAS control efforts over 30 years on 100,000 ha woodland (mainly *Prunus serotina*) have cost 1 billion EUR (i.e. 3.33 million EUR/year), sourced *inter alia* through land management payments under rural development funds.

Some data points to IAS clearance programmes being associated with social programmes for unemployed persons. Within the EU, the *Ambrosia artemisiifolia* programme around Berlin (900 sq. km) employs 120 people on unemployment benefit who receive token additional payment of 1.5 EUR/hour for monitoring and manual removal. The programme, which combines awareness raising and communication, costs about 300,000 EUR per year.

5.3.2 Aquatic plants

For aquatic species, the rate of spread can be particularly rapid and the financial and technical challenges of control proportionately greater. Examples given below cover species problematic to multiple MS that are not currently subject to regulatory control at EU level.

[79] Defra. 2007. Impact Assessment of the Order to ban sale of certain non-native species under the Wildlife & Countryside Act 1981. Available at: http://www.defra.gov.uk/wildlife-countryside/pdf/wildlife-manage/non-native/impact-assessment-order.pdf.

Removal and control of two aquatic plants (and the zebra mussel) in Ireland cost 200,000 EUR in 2008[80]. Control of floating pennywort (*Hydrocotyle ranunculoides*) costs the Netherlands an average 3 million EUR per year.

In France, one region (Picardie) spends 18 FTE days per year on controlling Water primrose (*Ludwigia grandiflora*). The UK has determined that eradication of this species is possible and estimates total costs at around 40,000 EUR over four years (source figure: just under £35,000. Following initial action, annual control costs have now decreased from £8,000 in 2008 to £4,000 in 2009).

Water hyacinth *(Eichhornia crassipes)* is considered one of the world's 100 Worst IAS[81]: it is now spreading in southern parts of the EU (Iberian Peninsula) and present in at least one Outermost Region. Known control costs in the EU include:

- 14.7 million EUR over 3 years to remove 200,000 tonnes (Guadiana River, Spain) i.e. 4.9 million EUR/year or about 1.8 million EUR annual costs per km^2;
- 280,000 EUR over 18 months for a single municipality (Agueda, Portugal);
- 20,000 EUR plus one FTE position: annual cost of developing control programme over a minimum of 2 years (island of La Réunion, France).

In the US, the estimated cost of controlling water hyacinth is around 7 per cent of the estimated benefits of such control (0.31 million EUR/4.22 million EUR per year)[82].

5.3.3 Terrestrial vertebrates

Substantial data are available on the costs and benefits of controlling invasive mammals, many of which were intentionally introduced through trade (see examples of Muskrat *Ondratra zibethicus* and grey squirrel *Sciurus carolinensis* in 7.2). In England, an investment of 0.46 million EUR per year in grey squirrel control is estimated to generate benefits roughly ten times that amount (4.7 million EUR per year) in terms of avoided damaged to broadleaf timber value[83].

Several MS invest significant public funds to control common problem species eg. for Coypu (*Myocastor coypus*), one-off eradication costs range from 2.6-3.4 million EUR (Italy and UK) and annual control costs are 0.8m (Netherlands). For American mink (*Mustela vison*), control costs in four MS range from 0.12 million EUR (Estonia) to 1.65m (UK – full eradication from Scottish island group).

Control costs for invasive birds may also be extremely high. The EU contributed over 1.8 million EUR to Spain and the UK for the period 2005-2010 to support eradication of ruddy duck *Oxyura jamaicensis* (estimated total cost to the UK is 3.5 million EUR). In France, the *Office National de la Chasse et de la Faune Sauvage* employs 24 agents to control wild animals (not limited to IAS) that damage biodiversity and

[80] Curly Waterweed *(Lagarosiphon major)*, floating pennywort *Hydrocotyle ranunculoides* and zebra mussels *(Dreissena polymorpha*).

[81] Global Invasive Species Database.

[82] Office of Technology Assessment 1993 figure, cited in McNeely 2004

[83] Andrew Kendal (Grey Squirrel Control Programme), pers comm.

other sectors. In 2008, costs to one region (FTE time and monetary resources) of invasive bird control covered:

- sacred ibis *Threskiornis aethiopicus* (1.2 FTE and 12,000 EUR per year to kill 3000 birds);
- ruddy duck *Oxyura jamaicensis* (0.5 FTE and 5000 EUR per year to kill 93 birds);
- Canada geese *Branta canadensis* (0.3 FTE and 3000 EUR per year).

The vulnerability of islands to biological invasions is well recognised. Data on control and restoration costs are available for some EU Overseas Entities (see Box 5.8).

Box 5.8. Cost of IAS control in UK Overseas Territories (RSPB 2007)

This study costed actions to protect island biodiversity and endemic species[84]. IAS-relevant costs related to:

- **Habitat and Site Management** (clearing invasive plants, restoration of native vegetation, provision of visitor facilities);
- **Control of Introduced Mammals** (removal of introduced predators such as rats and cats, control of rabbits and loose livestock which cause damage to ecosystems).

Resource requirements were expressed in terms of units for which costs could be assessed, e.g. hectares of habitat to be restored; number of site management plans to be developed; number of conservation officers employed; number and size of islands for predator eradication programmes; number of person-days of monitoring/research work etc. Local information was supplemented by an international review of biodiversity cost data to identify standard unit costs where necessary e.g. for types of activity dependent on imported expertise (e.g. invasive alien predator control).

Conclusion of study: IAS-related costs to meet biodiversity priorities in UK Overseas Territories, in addition to existing local expenditure for biodiversity conservation, amount to nearly 19 million EUR/year (£16.1 million) between 2007 and 2011 (see breakdown in Annex 2).

In 2007-2009, the EU-funded project 'Increase in the regional capacity to reduce the impacts of invasive species in the Overseas Territories of the United Kingdom in the South Atlantic' allocated nearly 575,000 EUR to demonstration control/eradication projects (495,000 EUR from EDF funding plus RSPB contribution of 80,000 EUR).

5.3.4 Restoration

Costs of ecosystem restoration and species replanting may form an integral part of IAS management since its ultimate goal is to ensure the conservation of native habitats and species (Scalera 2008). However, no stand-alone monetary data for restoration following IAS incursion were obtained from EU Member States.

Outside the EU, US Department of Agriculture data (2008) provide some examples of the types of cost item involved in restoration:

[84] Pitcairn has more endemic species than people. Tristan da Cunha has one globally threatened bird species for every 30 residents.

- provision of locally-acquired native plant materials to commercial growers for re-vegetation of denuded/disturbed areas (total cost for 27 Plant Material Centres, 0.78 million EUR per year or around 29,000 EUR per Centre);
- one FTE position per Centre (cost around 22,000 EUR per year plus travel and overhead costs of 7000 EUR per year)[85].

A fuller comparison of control and restoration costs/benefits can be drawn from the US Emerald Ash Borer Programme[86] (replacement of native ash trees damaged by an invasive invertebrate with other small shade trees). These data illustrate the range of interests affected by major invasions harmful to trees (similar to Dutch elm disease in Europe) and the relative scale of costs involved:

- estimated cost of damage to landscape plantings and woodlots in Michigan: 8.36 billion EUR (US$ 11.6 billion in 2003);
- cost of removing and disposing of 1-4 million dead or dying ash trees in Ohio: average 1.38 billion EUR (source estimate US$700 million-2.9 billion);
- potential cost to the Ohio forest-products industry due to destruction of ash trees 147 million EUR (US$207 million);
- average removal cost per tree for private property owners: 285 EUR;
- projected total costs of removing and replacing trees in one city with 30,000 population[87]: 107,000 EUR over 5 years (US$ 153,000 or approximately US$1 per inhabitant/year).

In conclusion, the examples presented above and the raw data in Annex 2 show the open-ended cost of long-term control across all taxonomic groups. Costs are currently met by individuals, resource users and a range of authorities, including environmental, health, agriculture and infrastructure providers and municipalities. Table 5.3 presents selected examples of costs to different types of stakeholder.

Table 5.3 Examples of costs of IAS control, management and restoration

Policy measure	Examples of unit costs identified/cost to stakeholders (in EUR)
EU funding for IAS control	• 230,000 EUR average contribution per project
Control/containment programmes (plants) in EU	• Area clearance costs for knotweed: 1286-187,000 EUR/ha • Annual costs to infrastructure and/or land management: 1.25-3.33 million • Annual cost of established aquatic invasive plants: 200,000-4.9 million
Control/containment programmes (animals) in EU	• Cost /benefit ratio of grey squirrel control in UK: 1:10 • One-off eradication programme costs (2.6-3.4 million) c.f. ongoing annual control costs for same species (0.8 million) • EU contribution to controlling one invasive bird affecting several MS: 300,000 EUR/year for 5 years • Incremental costs to 5 EU Overseas Countries and Territories of IAS control and improved prevention: ca 18.8 million/year

[85] Diaz-Soltero, H. 2008. U.S. Department of Agriculture. Report to the Invasive Species Advisory Council.

[86] *Agrilus planipennis* or *Agrilus marcopoli*. See Windle et al, 2008.

[87] Source: Sandusky City Management Plan 2006–2011, cited in Windle et al 2008.

Restoration	• Cost of a plant material centre to increase native plant species supply: 29,000/year • Average cost of damaged tree removal to a property owner: 285 EUR • Cost to a municipality of tree removal and replacement: 70 centimes per habitant/year.

Source: based on figures and range of literature summarised in Annex 2.

5.4 Findings on horizontal measures

Horizontal measures include a range of actions essential to strengthening of IAS policies, including communication and awareness, strategic planning, coordination and governance, research, training and capacity building.

5.4.1 Communication and awareness

Monetary data obtained on education and public awareness campaigns covered one-off costs (production and distribution of materials) and longer-term programme costs that included a more active outreach element.

One-off costs for production and distribution of materials included:

- at the higher end, visibility and educational materials under the EU-funded South Atlantic Invasive Species project cost 79,920 EUR (five islands, 2008) and development of an online handbook on invasive alien plants cost 40,000 EUR (Germany, 2002-3);
- at the lower end, it cost 5,700 EUR to produce and distribute information materials on *Heracleum sosnowskyi* for limited roll-out (10,000 copies: Latvia, 2007).

Many other information materials have been developed within the EU (e.g. on good practices to avoid dumping hobby aquaria in the wild, moving pleasure boats without cleaned hulls between lakes or dumping bait worms) but specific costs were not obtained for these initiatives.

The cost of collecting baseline information on public awareness and understanding of IAS issues in England (essential to measure progress and evaluate benefits derived from strategy implementation) was 152,000 EUR (£130,000) in 2009[88]. The survey also covers buying and use trends for key sectors e.g. horticulture, angling.

A cost indicator for government agency-based communication can be found in the disease control sector. The ECDC's total health communication budget is 2.57 million EUR per year. This comprises specific budget lines for different target audiences:

- support to MS health communication capacities (0.83 million);

[88] *IAS public attitudes survey in England*. Undertaken to implement Key Action 9.1, GB Invasive Non-Native Species Framework Strategy. Survey results available online at http://www.nonnativespecies.org.

- scientific/technical output to professional audience (1.21 million);
- coordinated communication of key messages and information to the media and public (0.53 million).

Few data were available on the benefits of communication and awareness but this should change as attitude surveys become available to provide a baseline for comparison. Our study found one example from the US on increased 2005 profits to soybean producers due to information sharing and awareness campaigns by government, industry and technical partners. The very wide estimated benefit range spanned 0.04-1 EUR/hectare (6.4 cents-US$1.64) and 8-209 million EUR total sector benefit (US$11-299 million), depending on assumptions[89].

5.4.2 Development of IAS Strategies and Action Plans

Cost of IAS strategy/action plan development were obtained at different scales:

- at the pan-European level, the Council of Europe's European Strategy on Invasive Alien Species cost 57,000 EUR to develop over three years;
- at Member State level, costs ranged from 2-3 years FTE for one employee (Denmark) to 48,000 EUR per year over 2 years (Great Britain: total cost £82,000 over 2 years, net of Secretariat costs of £25,000);
- at Overseas Entity level, the estimated cost to the French government of developing a comprehensive IAS Strategy for all French overseas territories[90] is 1.55 million EUR per year from 2009 (excluding financial participation by local administrations).
- at a smaller scale, development of a regional strategy for the five South Atlantic UK Overseas Territories will cost around 91,000 EUR (£78,000).

Strategy development generally requires a formal review and possible adjustment of legal frameworks. Known costs range from 100,000 EUR (review of nature-related legislation in one region in Belgium) to 234,000 EUR (development of IAS regulatory framework in Canada over 10 years).

5.4.3 Coordination mechanisms

IAS coordination systems range from informal open-ended structures to dedicated biosecurity agencies with a formal mandate.

Costs of cross-sectoral stakeholder consultation were obtained from the UK. The annual cost of the GB IAS Stakeholder Forum is around 8000 EUR (£7000, paid out of the Secretariat budget) while setting up and running issue-specific working groups to develop targeted action plans costs 37,000-45,000 EUR per year (£48,300-58.300

[89] USDA, 2009, Program of Research on the Economics of Invasive Species Management; Fisc al 2003-2008 Activities. Available at http://www.ers.usda.gov/Publications/AP/AP034/AP034.pdf

[90] Includes four Outermost Regions and seven Overseas countries and territories across three oceanic regions.

over 18 months)[91].

Annual costs of running a dedicated national IAS Secretariat or equivalent are fairly comparable: 260,00 EUR (£230,000) (Great Britain, 1.6 FTEs), 257,000 EUR (Sweden, 2 FTEs), 152,000 EUR (Canada, IAS programme administration) and 153,000 EUR (South Africa, monitoring of programme implementation). Sweden estimates the cost of IAS focal points in other sectoral authorities (7 additional FTEs) at 0.57 million EUR per year i.e. EUR 81,000 per position.

At EU level, it would be possible to calculate costs of different levels of coordination from parallel sectors. Under a less formal/transitional mechanism, the lowest costs would attach to coordination based on an Open Method of Communication approach (e.g. development of guidance, annual meetings). Medium-level costs would attach to an inter-service or sectoral committee meeting monthly (e.g. following the precedent of the Standing Committees on Plant/Animal Health). For mechanisms involving the creation or designation of a dedicated agency, the indicators presented in 5.2 above[92] suggest a figure nearer 50 million EUR/year,

5.4.4 Research

Cost data is readily available on IAS-related research inside and outside the EU. Under EU Framework Programmes on Research and Technological Development (FP4, 5 and 6), 88 million EUR was spent on 90 IAS-related research projects between 1994-2006 (ie average of about 8 million EUR per year/1 million EUR per research project) (Scalera, 2008)[93].

Within this total, the data most relevant to this report concern targeted research to support policy development and implementation, through e.g. refinement of decision-making methodologies and techniques to support efficient prioritisation of management interventions. Recent or current EU projects of this type include:

- DAISIE (Delivering Alien Invasive Species In Europe);
- INCOFISH (data tool that addresses all fish species, including IAS);
- ALARM (Assessing Large-scale environmental Risk with tested Methods);
- IMPASSE (Environmental impacts of alien species in aquaculture);
- PRATIQUE (Enhancement of Pest Risk Analysis Techniques);
- EUPHRESCO (Coordination of European Phytosanitary (Statutory Plant Health) Research[94]);
- PORT CHECK: pathway level; and
- EFFORTS (Effective Operations in Ports).

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[91] Respectively the Rapid Response Working Group (includes only Government employees so all time already paid for) and the Media & Communications Working Group (government and non-government membership).

[92] Based on the *Feasibility study for a Europe-wide early warning and information system* (Genovesi et al, 2009),

[93] The breakdown was roughly as follows: 35.5% of projects (35 million EUR) focused on plant health ; 10% (18.7 million EUR) focused on animal health and the spread of epizooties (in some cases of interest also for human health) ; 33.7% focused on specific species or group of species, some of which are known IAS : *Mustela vison*, *Sciurus carolinensis*, *Rana catesbeiana*, *Arion vulgaris* and *Heracleum mantegazzianum*.

[94] 0.23 million EUR spent on cooperative research into *Ambrosia artemisiifolia* by four European countries in 2008-9/

At Member State level, data indicate that the highest research spending occurs in countries committed to strengthening their IAS policy frameworks (e.g. Sweden, research at species level estimated at 1.84 million EUR per year; Ireland, research at ecosystem level on IAS in Irish water bodies, 0.28 million EUR per year; Germany, research on biocontrol, 0.29 million EUR per year; UK, research by Highways Agency on Noxious Weed Control, 29,000 EUR per year (£50,000 in 2 years)).

Non-EU data support this finding. In South Africa, over 2.75 million EUR per year is spent on research and development to prioritise implementation of the Working for Water Programme, including for biocontrol. Canada's Department of Fisheries and Oceans spends an estimated 1.99 million EUR per year on IAS scientific activities, including risk assessment, research, rapid response planning and monitoring.

The scale of research benefits to society may be huge. Austria's nation-wide research project on control of *Ambrosia artemisiifolia* cost about 0.23 million EUR per year (duration three years): if its findings prove successful, predicted benefits are worth 88 million EUR per year in terms of avoided negative impacts on public health[95].

5.4.5 Training and capacity-building

Capacity-building includes training, information and materials to help authorities (airport, port and customs officials, environment inspectorates) to carry out their duties efficiently and cost-effectively.

Agency data obtained included the ECDC budget for training (1.72 million EUR per year). In the US, about 91,000 EUR per year was spent over six years (total US$ 640,000) on studies to address US Department of Agriculture programme needs and build the capacity of nearly 2000 institutions to address invasive species issues. In Australia, annual spend on Extension and Advisory Education Structures linked to operation of quarantine services is equivalent to 1.49 million EUR per year (AUD2.46 in 2000/1).

Project-level data included training workshops and production of biosecurity guidelines/protocols under the South Atlantic Invasive Species project (total cost 32,880 EUR).

In conclusion, costs of horizontal measures show fairly comparable levels of investment in the Member States with most advanced IAS frameworks: this can provide an indicator for the possible cost of more consistent approaches across the EU. Table 5.4 presents a short synthesis of the most relevant examples identified with regard to the EU context.

[95] i.e. annual costs for the treatment of allergy and asthma symptoms. Source: Ragweed2: A nation-wide project to develop control measures of the allergenic plant (*Ambrosia artemisiifolia*). Presentation by Univ.-Prof. Dr. Gerhard Karrer (Project Manager), Universität für Bodenkultur, Vienna. Available at: http://www.noe-lak.at/inh/dwn/20090310RagweedKarrer.pdf.

Table 5.4 Examples of costs for horizontal measures

Policy measure	Examples of unit costs identified (in EUR)
Communication and awareness	• One-off: cost range 5,000 (small-scale); 40,000–80,000 (more ambitious) • Survey on IAS attitudes and consumer buying patterns: 150,000 • EU agency comprehensive communication budget: 2.5 million/year
Strategy/action plan development	• Average time: 2-3 years • Total cost of producing IAS strategy: 50,000-100,000 • Ambitious programme covering multiple oceanic regions with capacity support: 1.5 million per year. • Cost of IAS legislative review: 100,000->230,000.
Coordination mechanisms	• Informal cross-sectoral: 8000/year • Secretariat running costs: 150,000-250,000/year • Cost of IAS focal points in other departments: < 80,000 per position • Cost of a dedicated EU IAS Agency: ca 50 million/year
Research	• Average EU contribution to IAS-related research: 8 million/year • Cost range of national IAS research budgets: 250,000-2.75 million/year
Training and capacity-building	• High-level agency training budget: 1.5-1.75 million/year • Cost of developing training materials for roll-out: ca 30,000/year.

Source: based on figures and range of literature summarised in Annex 2.

5.5 Findings on benefits

Research carried out for this report found relatively little concrete data on the benefits of specific individual measures, particularly those related to prevention.

This is unsurprising given that benefits are usually presented in broad terms of impacts avoided as a result of management intervention: in other words, they are not precisely aligned with a single policy measure. For this reason, this report mainly expresses evidence on the benefits of IAS measures in terms of avoided damage/control costs, using mainly the data from Kettunen et al. 2009 referenced in the Communication.

Whilst it is often possible to identify the authority/stakeholder who pays for IAS interventions, the beneficiaries of such actions are often more diffuse and widespread. They are likely to include a range of public and private interests, be located in several Member States and beyond EU borders and encompass future generations.

It is important but difficult to calculate potential future benefits that could arise as a result of more robust IAS policies. These could include new business and employment opportunities linked to development of new markets and technical

innovation (e.g. pest control techniques, substitution policies, uses based on alternative non-invasive species). As IAS-related standards are progressively incorporated into corporate social responsibility systems, forward-looking businesses will be able to view appropriate practices as another factor in their sustainability efforts (Duan 2009).

Experience gained in Japan following the adoption of dedicated IAS legislation provides examples of how business can respond to a stricter regulatory baseline (see Box 5.9).

Other examples of regulation acting as a catalyst to technological development include e.g. development of cost-effective and environmentally acceptable ballast water treatment techniques (see Box 5.10).

Box 5.9: Business adaptation to IAS regulation: tomatoes and the bumble bee in Japan

Tomatoes account for 10 per cent of Japan's vegetable production, worth up to 1.48 billion EUR per year (200 billion yen). In 1991, the alien bee *Bombus terrestris* was introduced from the Netherlands as a pollinator and nearly half the country's greenhouse tomato farming switched to this species for labour-saving pollination. The species was regulated under the Invasive Alien Species Act in 2006 following assessment of hybridisation risks and damage to native ecosystems, including endangered plants, if bees escaped from the greenhouses. The IAS regulation requires farmers to install screens in their greenhouses to prevent escapes into the wild (corporate fine maximum 750,000 EUR). Examples of business adaptation to the regulations include:

- Kagome (food manufacturer): from May 2005, the company switched its eight directly-managed farms to cultivation methods using native *Bombus ignitus*. As this species is slower moving, encouraged development of mass breeding techniques, developed production knowhow to increase pollination efficiency and eventually established a cultivation method using the native bees;
- Aleph (operator of a hamburger restaurant chain): since 2004, distributes educational materials on IAS issues to farmers (anti-escape measures) and leaflets to customers. In 2008, an agreement was concluded with contract farmers supplying its company-owned restaurants to stop use of any kind of bees and shift to wind- or oscillation-based pollination (Fujita 2009).

In parallel, makers of agricultural material have developed new types of net to minimise escape risks and these are now widely used. Local governments distribute an information manual through their websites and citizen monitoring networks have been formed (Sukigara. 2009).

The nationwide business association, Nippon Keidanren, has developed biodiversity guidelines which call on businesses to: "not only reduce effects of business activities on biodiversity but actively engage in activities bringing substantial effects on the conservation of biodiversity and contributing to society" and "make every effort for the implementation of such activities, to take account of endangered species, rare species and invasive alien species." (Kusakari 2009).

Box 5.10 Opportunities linked to IAS prevention: the example of ballast water treatment

A recent report (WWF, July 2009) estimates the global figure for direct economic loss to society for damage caused by marine invasive species at around US$ 7 billion per year. Given that international shipping transports around ten billion tonnes of ballast water each year, the WWF estimate calculates the cost per tonne of untreated ballast water as equivalent to about 70 US cents.

The report indicates that up to 80 manufacturing firms, water treatment companies and maritime businesses have undertaken research and development of ballast water treatment technologies since

2000 with the support of some shipping and shipbuilding companies around the world. Twenty treatment systems are currently undergoing the Convention's approval process. If approved, a treatment system may be placed on the market.

The estimated cost of equipping a new ship with treatment technology may be up to 40% cheaper than retrofitting that ship with the same technology later in its life cycle. This provides an economic incentive for ship owners to ensure that new ships are fitted with technology even before this becomes mandatory when the Ballast Water Management Convention enters into force. The WWF report suggests that a wider roll-out of water treatment methods facilitated by the entry into force of the Convention could lower costs to only 4 US cents per tonne of treated water - less than 6% of the annual costs of not addressing the issue of the damaging spread of marine pests.

Source: WWF (2009) Silent Invasion – The spread of marine invasive species via ships' ballast water.

5.6 Conclusions on costs and benefits data

The main finding from the evidence obtained is that the costs of measures to prevent or minimise IAS damage to biodiversity tend to be quite low in terms of per capita expenditure. The examples of costs identified in sections 5.1-0, for which source data is set out in Annex 2, are significantly less than many investment-heavy directives developed at EU level.

In parallel, there is ample evidence of positive cost-benefit ratios that demonstrate that the cost of preventive action is lower than the cost of delayed action, which may lead to long-term resource commitments for control and ongoing management and monitoring. This finding applies across terrestrial, freshwater and marine ecosystems.

6 ASSESSMENT OF THE IMPACTS OF EACH POLICY OPTION

This chapter analyses the implications of the four Policy Options presented in the Communication (see Chapter 3), based on an aggregated assessment of the costs, benefits and other impacts of possible component measures.

For Options B, B+ and C (i.e. changes to the existing Community framework), the analysis is structured around the incremental measures over baseline that would be likely to form part of each policy packages (see Table 3.2). These include vertical (three-stage hierarchy) and horizontal measures of progressively greater intensity, following the cumulative approach adopted in the Communication.

For each Option, a synthesis table of possible benefits and costs is first presented, supported by concrete examples of possible costs taken from Chapter 5[96]. This is supported by textual analysis of the main incremental measures, followed by an

[96] Quantitative indicators of possible benefits are not allocated per measure for the reasons set out in 5.5 i.e. that benefit-related information mainly consists of avoided costs of damage and control and is not specific to individual policy measures.

overall assessment of each Option, including consideration of feasibility and effectiveness.[97]

As noted in the Communication, the mix and ambition of component measures could be varied within each Option. Our approach aims to provide maximum transparency on the respective implications of different actions within each policy package.

6.1 Option A (Business as usual)

The existing Community framework (summarised in Table 1, Chapter 3) provides the baseline scenario for this analysis.

Baseline costs (i.e. how much it costs now to implement existing IAS policy measures in the EU) were not evaluated for this report. However, it is clear that Option A is the least onerous option, given that no additional public expenditure and human and technical resources would be required for its implementation.

Option A would not affect the trade, transport and travel/tourism practices that have facilitated the entry and spread of IAS to date. The economic and social benefits associated directly or indirectly with species trade and movement (profits and employment opportunities associated with e.g. the pet trade, horticulture and other sectors) would therefore be unaffected.

However, Option A is not cost-neutral. Given current trends associated with globalisation, taking no additional action would allow the exponential increase in biological invasions to continue, leading to increased negative impacts on society (e.g. public health impacts), the economy and the environment (costs of damage and control). Maintenance of the status quo would not address the implications of climate change on distribution and spread of existing introduced species.

Available monetary data, although recognised as insufficient, already points to the high cost of IAS damage and control to Europeans (at least 12 billion EUR per year of which over 5.3 billion EUR per year involves direct damage costs to economic operators: see Table 6.1). These figures are known to be a gross underestimate[98] as:

- cost data was lacking or under-represented for some sectors (forestry, fisheries, water resource management, tourism: see Kettunen et al. 2009);
- potential economic and environmental impacts are unknown for almost 90 per cent of the alien species found in Europe (Hulme et al. 2009).

[97] Building on the evaluation carried out in Shine et al., 2009 (i.e. the Task 2 report in the context of the overall study), other background literature and the series of expert stakeholder consultations organised by the Commission.

[98] Annual IAS costs to other regions are estimated at US$ 136 billion (United States) and in regions where less data is available, US$15 billion (China) and about US$ 200 billion (Asia-Pacific region: this figure considered a gross under-estimation) (all figures cited in Sajeev and Sankaran, 2009).

Table 6.1 Costs of IAS damage to key economic sectors in the EU (without extrapolation: adapted from Kettunen et al. 2009)

Economic sectors	Costs of damage (million EUR/year)
Agriculture	5084.2
Fisheries / aquaculture	241.6
Health (excluding human diseases mentioned below) 99	69.5
Total	**5395.3**

Option A contributes to an uneven level of environmental protection across the EU. Member States that are committed to taking action against IAS threats to biodiversity would continue, as per the current trend (see 2.2), to develop domestic measures in the absence of any leverage to promote higher and more consistent standards across the EU. The current uncertainty relating to adoption of domestic measures that may affect intra-Community trade and movement would continue, with implications for the efficiency of action at both government and industry levels. Option A would not improve the existing low visibility of IAS issues at decision-maker and other levels.

For these reasons, Option A would not enable the EU to address existing and predicted impacts of IAS in Europe. As noted in the Communication, IAS would continue to become established in the EU with increased associated ecological, economic and social consequences and related costs.

6.2 Option B (Maximise use of existing instruments and voluntary measures)

Option B involves no legislative change but would:

- raise the profile of IAS at the EU level;
- encourage systematic use of existing instruments, procedures and early warning and information activities;
- foster a more supportive context for MS- or industry-led initiatives.

For Option B, the incremental measures proposed in the Communication are:

- proactive use of existing legislation to address IAS problems
- voluntary inclusion of IAS in border control functions
- Early Warning and Information System based on existing activities
- maintenance and updating of DAISIE inventory
- national funding of species eradication plans
- cross-sectoral stakeholder groups
- voluntary prevention (codes of conduct)

Table 6.2 summarises the main elements that could form part of this policy package, which are then discussed in further detail.

99 * Costs of epidemic animal and human diseases excluded, see table 10 below

Table 6.2 Summary of estimated impacts of Option B in comparison to baseline

Policy measure	Likely intensity under Option B	BENEFITS	COSTS (in EUR)
Baseline (legislation, policy) unchanged			
Prevention (in additional to existing baseline requirements under EC law)			
Voluntary prevention measures	Encouraged (MS)	**No guaranteed benefits re: reducing number / impacts of IAS at EU / MS level** Some possible benefits re: • increased interceptions at borders; • increased awareness in target audiences; • enhanced cooperation between industry and government stakeholders; • mainstreaming of IAS in formal standards and certification schemes; • changed supply/use patterns of IAS	**No obligatory costs to EU / MS** Voluntary costs could include: *Information campaigns* Small-scale: 1,000 - 15,000 EUR one-off Medium level (public health/sector-specific): 120,000 - 200,000 EUR/year *Codes of conduct* National/regional: 22,000-100,000 EUR total cost over 1-3 years *Border controls* Based on plant/animal health inspection and quarantine/'low ambition' general prevention: <1 EUR/year per person *Risk assessment* > 96,000 EUR / year national mechanism for technical support/ consistency
Controls on introductions into the environment	Discretionary		
Controls on introduction into captivity/containment	Discretionary		
Controls on domestic holding, trade and movement	Discretionary		
Import pathway controls	Discretionary		
Export pathway controls	Discretionary		
Border controls and inspections	Discretionary		
Cooperation with non-EU countries	Discretionary		
Risk assessment procedures	Discretionary		
Integration of IAS into EIA	Discretionary		
Early detection and rapid response (EDRR): creation of Early Warning and Information Exchange System (EWS)			

Maintenance/interlinkage of inventories and databases	Voluntary	**No guaranteed benefits re: reducing the number / impacts of IAS at EU / MS level** Some possible benefits re: • cooperation between neighbouring MS; • increased voluntary monitoring	**No obligatory costs to EU / MS** Voluntary costs could include: • EWS based on DAISIE approach: 500,000-700,000 EUR/year; and/or • Network of national authorities >10 million EUR/year if extended to EU-27
Surveillance and monitoring	Voluntary		
Information exchange	Voluntary		
Contingency planning	Voluntary		
Rapid response mechanisms	Voluntary		
Emergency funding	No		
Long-term control and containment			
Species action plans/ guidance	Voluntary	**No guaranteed benefits re: reducing the number / impacts of IAS at EU / MS level** Some possible benefits re: • transboundary cooperation • sharing best management practice	**No obligatory costs to EU / MS** Current LIFE IAS-related projects: 230,000 EUR average contribution/project Examples of voluntary costs could include: • Area clearance costs (for knotweed: 1286-187,000 EUR/ha) • Annual costs to infrastructure and/or land management for knotweed: 1.25-3.33 million EUR / year • Animal eradication (2.6-3.4 million EUR one-off) c.f. annual control (0.8 million EUR / year) for coypu • Plant material centre to increase native species supply: 29,000 EUR/year based on US • Average cost of damaged tree removal to a property owner: 285 EUR
Control/containment (plants)	Voluntary		
Control/containment (animals)	Voluntary		
Funding for control	No		
Restoration	Voluntary		
Associated horizontal measures			

Communication and awareness	Voluntary	**No guaranteed benefits re: reducing the number / impacts of IAS at EU / MS level.** Some possible benefits re: • public support for policy goals • administrative efficiency • outputs of targeted research • mainstreaming through existing funds	**No obligatory costs to EU / MS** Voluntary costs could include: • One-off communication campaigns: 5,000 EUR (small); 40,000–80,000 EUR (medium) • Survey on IAS attitudes/consumer and user behaviour: 150,000 EUR based on GB • Strategy development: 50,000-100,000 EUR (one country); major programmes + actions for EU islands 1.5million/year (islands) based on France • Legislative review: 100,000-230,000 EUR, based on Belgium and Canada • Informal cross-sectoral stakeholder forum: 8000 EUR/year based on GB • Secretariat running costs: 150,000-250,000 EUR/year • Average EU contribution to IAS-related research: 8 million EUR / year • Cost range of national IAS research budgets: 250,000-2.75 million EUR/year
Coordination mechanism (EU)	Voluntary		
Coordination mechanism (MS)	Voluntary/ informal		
National strategic/action planning	Voluntary		
Research programmes	Existing		
EU funding instruments	Discretionary		
EU development cooperation funds	Discretionary		
Capacity-building and infrastructure	Discretionary		

Option B is a high-subsidiarity/low concrete action approach focused on voluntary efforts by Member States. Costs, benefits and effectiveness would be contingent on the level and scope of take-up at national and sub-national level. Commitment of additional EU resources would be minimal, except as specified below.

The main Option B incremental measures over baseline are discussed below.

- **proactive use of existing legislation to address IAS problems**

Under Option B, there would be no required additional costs related to trade/transport pathway controls because the key instruments under which the Community has exclusive competence to list organisms for regulation (plant/animal health, WTR) would remain unchanged. The aquaculture Regulation, in force since 1 January 2009, already requires investment in national risk assessment capacity.

The only legislative activity generating costs would be at national level and have a domestic focus, without a requirement for transboundary consultation. Discretionary regulatory action could be taken under the birds and habitats Directives which are implemented and enforced in different ways across the EU, but no extra costs were identified for this activity. Additional IAS monitoring costs in freshwater and marine ecosystems would be incurred through full application of the water framework and marine strategy framework Directives. Measures to reduce IAS risks through mainstreaming in e.g. forest and renewable energy policies could reduce opportunities for some economic stakeholders.

- **risk assessment using existing institutions and procedures**

Option B encourages Member States to invest in more and improved risk assessments but does not commit additional Community resources. Costs of preparing risk assessments (e.g. to justify proposals for listing species under the plant health Directive) have to be met at national level.

The cost of a dedicated decision support mechanism in one EU Member State could be around 96,000 EUR (based on Great Britain Risk Assessment Mechanism) which would amount to around 2.6 million EUR/year scaled up to EU-27. This cost covers expert technical support for prioritising risks and screening assessments but not the actual preparation of risk assessments.

The cost of an individual risk assessment varies according to complexity. Cost ranges in the low-medium ambition band are 2,500-10,000 EUR (the latter figure was used as a cost indicator for risk assessment under the aquaculture Regulation).

EFSA (total operating budget 65.9 million EUR/year) provides for oversight of risk assessments but not their preparation. To date EFSA has not approved any risk

assessment for a specific IAS[100] so it is difficult to identify costs associated with submitting an assessment for EFSA scrutiny.
Over time, costs of individual assessments could be reduced as the results of EU-backed targeted research (eg PRATIQUE, PORTCHECK, IMPASSE) are rolled out. To realise these benefits, however, investment in specialist training would be needed to increase the number of available risk assessors.

- **voluntary inclusion of IAS in border control functions**

Border control systems based on conventional plant/animal health objectives (i.e. primarily targeted at excluding organisms damaging to the primary production sector) cost up to 1 EUR/year per person (subject to the caveats noted in 5.1.2). This figure is broadly equivalent to the 'low-ambition' IAS system cost developed by Sweden.

Member States would need to invest in capacity-building and training at points of entry and guidance tools to increase voluntary targeting of IAS in border controls. The lack of an EU-wide approach would increase costs by removing opportunities for economies of scale (data from the parallel sector of natural hazard management suggested a cost saving potential of nearly one third through a regionally coordinated approach).

- **Early Warning and Information System based on existing activities**
- **maintenance and updating of DAISIE inventory**

An EWS system aligned with Option B (low level of ambition) involves a purely voluntary mechanism aligned with well-established models like the EPPO reporting system and NOBANIS. These are networks of national focal points (technical or government-appointed) that communicate information and alerts through the electronic reporting system when new IAS are detected. Costs are borne by Member States through provision of staff time/expertise: where staff have multiple duties, availability for EWS tasks cannot be guaranteed. Costs of such systems are low (50,000 EUR or >1 FTE).

The EEA feasibility study (see 5.2.5) estimated that a low-intensity Europe-wide Early Warning and Information System could cost around 500,000-700,000 EUR/year. This figure is based on maintenance and updating of the DAISIE database, with a reduction to take account of existing inventories but additional resources to address data gaps e.g. in the Balkan countries.

A network of separate national mechanisms could have high costs if not coordinated to provide economies of scale. The EEA study estimated that an EU-27 network of national authorities supporting IAS inventories/information portals, with associated FTE requirements, could cost around 10 million EUR/year.

[100] In November 2007, the EU Standing Committee on Plant Health (SCPH) rejected listing of *Lysitichon americanus* and *Hydrocotyle ranuncoloides* under Directive 2000/29, based on EFSA's review of the Pest Risk Assessments conducted through EPPO. Concerns were raised by several MS particularly in relation to *Hydrocotyle ranuncoloides*, which appeared to have proven an immediate risk to several MS. EPPO was asked to reconsider both PRAs before any further steps were taken and submitted its revised recommendations in spring 2009 (source : Ebbe Nordbo, Danish Plant Directorate, pers.comm).

Under Option B, contingency planning and rapid response would be funded by Member States. No European data on specific costs was obtained.

- **national funding of species eradication plans**

Option B leaves Member States discretion for IAS control and management except where required to safeguard Natura 2000 sites. Incremental costs over baseline would depend on the level of action at national/subnational level. As data in Annex 2 indicates, costs of control programmes are potentially enormous (e.g. up to 4.9 million EUR/year for invasive aquatic plants). Integration of IAS action plans into existing machinery for biodiversity planning and restoration could provide benefits through streamlining. Any benefits from investments in control programmes could be undercut if neighbouring States failed to take equivalent measures.

Option B would not provide additional EU resources (budgets fixed to 2013) but Member States could leverage existing IAS funding opportunities under EU financial mechanisms such as the LIFE+ programme, EAFRD etc. The Community could develop practical guidance for this purpose[101].

- **cross-sectoral stakeholder groups and other coordination**

Informal coordination is low-cost in relation to possible benefits (improved networking, goodwill, exchange of know-how). Dedicated staff and premises are not usually needed if an existing institution provides basic secretariat support: most liaison is electronic and travel/ meeting costs are limited. The cost range identified is 8000 EUR (GB IAS Stakeholder Forum, one annual meeting) to 11,000 EU (EU-wide group with higher travel costs e.g. EPPO Code of Conduct).

The return on this investment can be leveraged if groups are linked to other IAS policy initiatives (e.g. voluntary codes, professional/industry federations, national IAS Secretariat).

Formalised coordination through an IAS Secretariat (or dedicated FTE positions) costs between 150,000-250,000 EUR per Member State.

- **voluntary prevention (codes of conduct)**

Codes usually have a sector-specific focus and are addressed to particular target audiences. Like any non-binding measure, they have advantages of flexibility, are non-cumbersome and encourage partnerships between e.g. industry, NGOs, inter-governmental organisations, Member States and technical institutions.

Codes can fill a policy niche where there is uncertainty on risk (i.e. hard to justify regulation), a species is too widely disseminated for its import to be regulated or it can encourage innovation in advance of possible legislation. They can facilitate application of a biogeographic approach[102].

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[101] Following the approach taken in Miller, C., Kettunen, M. & Torkler, P. 2007. Financing Natura 2000 Guidance Handbook, Revised version June 2007. European Commission, Brussels. 112 pp.

[102] E.g. PlantRight (California) lists 'Regional Invasives' and proposes 'Alternative Plants' for each of five major regions of California. (www.plantright.org).

Costs range from very low (>15,000 EUR) to significant annual investment (120,000-200,000 EUR). Lessons learnt[103] suggest that codes require properly-funded communication, education and dissemination for optimum long-term effectiveness. The real cost of strong codes/awareness-raising may thus be much higher than these figures suggest.
IAS risks can be addressed through industry certification/accreditation schemes. These approaches are higher ambition measures (see 6.2-6.3).

- **voluntary horizontal measures**

Costs identified for low-medium education and awareness-raising activities range from 5000 EUR/year to 40,000-80,000 EUR/year. These are likely to be most effective as part of a structured communication strategy that requires information on baseline attitudes to monitor progress and respond to identified gaps. The cost of a national IAS attitudes survey was around 150,000 EUR in 2009 (Great Britain).

Member States that have not already done so could develop national IAS Strategies. One-off costs of strategy development range from 50,000-100,000 EUR, to which costs of legislative review may need to be added (100,000-230,000 EUR). Strategy costs may be much higher for scattered territories including some practical interventions (1.5 million EUR/year committed by French government in 2009 to develop IAS Strategy for its Overseas Territories).

Under Option B, additional research (outside EU RTD Framework Programmes) would have to be funded by Member States, The cost range identified for IAS research budgets in countries with advanced frameworks varied from 250,000 - 2.75 million EUR/year.

Broader assessment of Option B

Option B recognises that Member States progress at different rates and supports flexible implementation according to national priorities and perceived needs. It promotes a bottom-up approach that could stimulate innovation by industry and other stakeholders. Associated costs are of a fairly low order of magnitude.

To have any chance of delivering meaningful results across the EU, Option B would need to be associated with ambitious communication and awareness-raising with a special focus on EU regions where political and public commitment to action is low. No Community resources would be allocated for this purpose or to help Member States build capacity for border control. Approaches to risk assessment would remain mainly discretionary and current discrepancies would continue at national level.

Option B would not secure action at the EC's external frontiers on trade and related activities that are an area of exclusive Community competence. It would not remove legal uncertainty regarding adoption of national measures that potentially infringe

[103] See generally proceedings of EPPO/Council of Europe Workshop on the Code of Conduct on Horticulture and Invasive Alien Plants (Oslo, 4-5 June 2009) at www.eppo.org

operation of the single market or reduce the vulnerability of biodiversity hotspots such as islands, especially the Outermost Regions. The package is thus inconsistent with DAISIE findings, which demonstrated a direct link between the increase of trade and the increase in IAS.

Option B does not address contingency planning, rapid response or consistent approaches to management across the EU. It would not reliably contribute to horizon scanning for potential IAS and emerging pathways, including consideration of climate change, because its early warning and information exchange is minimally-resourced without any formal reporting requirements.

Whilst voluntary approaches should be actively encouraged under any future EU IAS Strategy, relying exclusively on uncoordinated best efforts would seriously limit the benefits accruing from Option B. Projected investments would not lead to significant reduction of current IAS impact levels in the EU.

6.3 Option B+ (Adapt existing legislation)

Option B+ is a more robust and ambitious version of Option B that would require:

- amendment of all three main Community instruments (or groups of instruments) currently addressing IAS issues;
- increased funding for delivery by Member States.

For Option B+, the incremental measures over baseline would include:

- the elements identified under Option B, in some cases at higher intensity;
- changes to existing legislation on plant/animal health to cover a broader range of potentially invasive organisms;
- extension of the list of 'ecological threat species' for which import and internal movement are prohibited under the Wildlife Trade Regulation;
- dedication of additional resources to IAS in the assessment process and in Member State border control activities.

Table 6.3 summarises the main elements that could form part of this policy package which are then discussed in further detail.

Table 6.3 Summary of estimated impacts of Option B+ in comparison to baseline

Policy measure (possibility)	Likely intensity under Option B+	BENEFITS	COSTS
Prevention (in additional to existing baseline requirements under EC law)			
Voluntary prevention measures	Encouraged (MS)	As for Option B	**No obligatory / additional costs** (for figures, as per Option B) Additional voluntary costs could include: • Integrated code/communication/education package (for one MS): 330,000 EUR/year over 3 years • Certification start-up: 30-40,000 EUR + initial accreditation 10,000 EUR; annual audit 600-1500 EUR • FSC certification: estimated average 0.76 EUR/ha
Controls on introductions into the environment	No/limited change	As for Option B	**No obligatory costs to EU / MS** Additional voluntary costs as for Option B
Controls on introduction into captivity/containment	No/limited change	As for Option B	**No obligatory costs to EU / MS** Additional voluntary costs as for Option B
Controls on domestic holding, trade and movement	Coverage extended	**Benefits would include controlling / reducing the numbers and impacts of IAS by preventing the arrival of new IAS in the EU.** Specific benefits would include:	**Foreseen moderate additional costs at the EU level and moderate / significant additional costs at MS level, depending on level of extended coverage.** *General system costs* • Operating a national system for plant pests and diseases

Import pathway controls	Coverage extended	• Early and efficient reaction to the possible arrival of IAS • Reduced risk posed by IAS (e.g. biodiversity, health, economic sectors), specially for IAS new to the EU • Reduced cost of IAS negative impacts and the control and eradication of IAS • Increased public confidence on public authorities to deal with IAS appropriately	(UK) 8.65 million EUR / year, i.e. less than 1 EUR / person / year • Operating a medium ambition prevention system (SE estimate) 10.3 – 11.09 million EUR / year, i.e. about 1 EUR / person / year • Penalty ranges for IAS-related offences under dedicated legislation, based on IT and Japan: 200-2000 EUR/offence to 22,000 EUR (individual) / 750,000 EUR (corporations) and/or three years prison *Border control and inspection* • The US federal Animal and Plant Health Inspection Service (APHIS) budget for IAS control: about 220 million EUR / year with military quarantine costing the Ministry of Defence an estimated 30 million EUR /year, represent expenditure of <1 EUR / person/year. • Costs of import – export permits: around 25 – 50 EUR / permit (DE and Australia) • Quarantine inspection fees to cover costs of inspections: between 1 – 350 EUR depending on item/vehicle checked (New Zealand and US) • Costs of marine pathway control: sampling costs 540 - 1,600 EUR / port plus cost of sample analysis 450 EUR • Costs for IAS control for vessels: 14,000 EUR (min costs for hull-fouling / vessel) –1 million EUR (max costs for on-board ballast water treatment systems / vessel) *Risk assessment* • Total cost of developing risk assessment systems for invasive alien plants range from 86,000 EUR (Plantlife,
Export pathway controls	Possibility of extension		
Border controls and inspections (airports, seaports, other)	Coverage extended (greater range of organisms)		
Cooperation with non-EU countries	Coverage extended		

Risk assessment procedures	Coverage extended		UK) - 300,000 EUR (DE, over 3 years) within the EU • Unit cost ranges for species/commodity risk assessments, based on EU and NZ cost ranges, go from small-scale (2250 EUR) to medium (10,000-45,000 EUR) to large (>100,000 EUR for major commodity pathway) • Cost of port baseline survey c.a.100,000 EUR per port • Route-specific risk assessment costs for marine pathways (ballast water) are estimated at 25,000 EUR / route Additional voluntary costs could include: • Cost of developing scientific advice for risk assessment based on the European Centre for Disease Prevention and Control (ECDC): about 2 million EUR / year
Integration of IAS into EIA	Encouraged		
Early detection and rapid response: creation of Early Warning and Information Exchange System			

Maintenance/interlinkage of inventories and databases	Voluntary	**Benefits would include controlling / reducing the numbers and impacts of IAS by preventing the establishment of IAS in the EU.** Specific benefits would include: • Early and efficient reaction to detect and eradicate IAS • Possibilities for forward looking planning, e.g. preventive actions at neighbouring MS • Improved possibilities for cross-border cooperation and coordination between different authorities (E.g. EU and national level) • Available resources immediately available for rapid emergency action • Generally, reduced risk and costs posed by IAS and increased public confidence	**Increased costs due to extended coverage.** *General early warning & information* • European Observatory on IAS: 1.5-2 million EUR/year (based on EEA feasibility study, 2009) • European Agency on IAS: 3-6 million EUR/year (limited technical mandate) (based on EEA feasibility study, 2009) *Surveillance and monitoring* • European Centre for Disease Prevention and Control's (ECDC) budget for surveillance 2.2 million EUR / year • US APHIS budget for IAS monitoring about 214 million EUR / year (2007) • Start-up costs of national IAS inventories 0.15 EUR (Great Britain) – 0.55 EUR (Latvia), ongoing maintenance costs 0.3 EUR / year (SE). *Rapid response and emergency funding* • European Centre for Disease Prevention and Control's (ECDC) budget for preparedness and response about 1 million EUR / year • US APHIS budget for IAS emergency programmes about 200 million EUR / year
Surveillance and monitoring	Coverage extended		
Information exchange	Coverage extended		
Contingency planning	Coverage extended		
Rapid response mechanisms	Coverage extended		
Emergency funding	Existing co-financing		
Long-term control and containment			
Species action plans/ guidance	Voluntary	**Only limited benefits likely, i.e. improved control of some invasive plants under the plan health Directive.**	**Increased costs due to additional requirements for control and containment of some species listed under the plant (and possibly animal) health legislation.** Current estimates on the costs of control / eradication
Control/containment (plants)	Coverage extended		
Control/containment (animals)	Only if significant change to animal		

	health legislation		programmes for IAS range from thousands – millions EUR / year (see Chapter 5)
Funding for control	Existing co-financing		
Restoration	Voluntary		
Associated horizontal measures			
Communication and awareness	Voluntary	**Only limited benefits likely, i.e. increased support to IAS research and capacity building initiatives.**	**No obligatory / additional costs** Additional voluntary costs could include: • Display of information and communication (airports, ports and harbours: quarantine awareness programmes around 2 million EUR / year (Australia)
Coordination mechanism (EU)	Existing committees		**No obligatory / additional costs** • Additional voluntary costs could include establishing a position for an IAS coordination point in relevant EU DGs (81,000 EUR / year / position (see below)
Coordination mechanism (MS)	Existing system of national focal points		**No obligatory / additional costs** Additional voluntary costs could include: • Establishing a position for an IAS coordination point in relevant MS departments (81,000 EUR / position (SE)) • Establishing a national body for IAS coordination (150,000 – 260,000 EUR / year (Canada, South-Africa, Great Britain, Sweden)
National strategic/action planning	Voluntary		**No obligatory / additional costs**
Research programmes	Coverage extended		Research supporting pathway control and risk assessments: • 1.37 million EUR for PORT CHECK (2004-2007): detection and identification of quarantine organisms at

			points of entry; • 4.1 million EUR for PRATIQUE (Enhancement of Pest Risk Analysis techniques): development of reliable risk assessment techniques that take account of uncertainty and improve efficiency See also costs under Option B.
EU funding instruments	Guidance on coverage of IAS under existing instruments		**No obligatory / additional costs**
EU development cooperation funds	Discretionary		**No obligatory / additional costs**
Capacity-building and infrastructure	Medium		**Some increased costs due to demand to implement legislative adjustments** Costs of capacity building • ECDC budget for training: 1.7 million EUR / year • IAS capacity building in the US Dep. Of Agriculture: 91,000 EUR / year was spent over six years (total US$ 640,000) • Extension and Advisory Education Structures linked to operation of quarantine services in Australia around 1.5 million EUR / year

Option B+ combines the non-legislative components of Option B with extended coverage of IAS issues under three EU legislative instruments. The following summary of incremental measures over baseline/Option B builds on the analysis in section 6.2 above.

- **voluntary measures**

Voluntary measures consistent with Option B+ level of intensity could include technical standards and best practices to address IAS risks through e.g. ISO standards and industry labelling, certification and HACCP schemes. More formal schemes of this kind can provide for monitoring by an independent authority and mutually agreed voluntary sanctions in the event of non-compliance (e.g. fines, withdrawal of certification, expulsion from federation). Schemes with status and credibility provide an incentive for reputable suppliers/producers to participate (i.e. customer/client preference for companies with associated logo). In general, they are also best-placed to incorporate responsible practices into their professional training schemes[104].

Certification costs in horticulture and forestry in Table 6.3 above could be scaled up to provide an indication of possible costs per sector at country or EU-wide level.

An integrated programme combining substitution policies ('green list' non-invasive species), targeted communication and educational materials could cost around 330,000 EUR per year, based on Belgium's proposed InvHorti programme (see 5.1.1).

- **amendments to existing legislation on plant/animal health**

The Council Conclusions recognise that the existing EU phytosanitary and pest management regulatory principles and legal instruments are not applicable to a wide range of IAS, which may be introduced intentionally or unintentionally, and to other biodiversity threats, but that these principles could serve as a baseline for an IAS strategy framework (§36).

Opportunities to mainstream IAS into plant/animal health frameworks already exist as the Community (through DG SANCO) is evaluating and consolidating these two regimes. However, feasibility and cost implications are quite different for each field.

EU animal health instruments only apply to IAS if they provide vectors for disease (e.g. wild birds that could carry avian flu). The *Action Plan for the implementation of the EU's Animal Health Strategy*[105] proposes development of a single EU Animal Health law and reinforced border biosecurity by 2010 to "address the health of all animals in the EU kept for food, farming, sport, companionship, entertainment and in zoos; wild animals and animals used in research where there is a risk of them transmitting disease to other animals or to humans; and the health of animals transported to, from and within the EU". This disease focus is consistent with global (OIE) standards and mirrored in national frameworks. To address animals potentially invasive in their own right (e.g. pets, terrarium and aquarium species, live bait, hitchhiking non-parasitic animals etc.), the EU legislative revision would involve

[104] See generally proceedings of EPPO/Council of Europe Workshop on the Code of Conduct on Horticulture and Invasive Alien Plants (Oslo, 4-5 June 2009) at www.eppo.org.

[105] COM(2008) 545 of 10 September 2008.

radical expansion of scope. This would require major institutional shift, professional training, capacity-building (including for taxonomy) and education materials.

Feasibility of integration would be higher for plant health legislation. Since 2000, the global and regional (IPPC/EPPO) framework has explicitly addressed risks to wild plants and the natural environment through certain international phytosanitary standards. On 1 June 2009, the Commission launched a 12-month evaluation of the Community plant health regime to take account of e.g. relevant treaty developments, globalisation and changed expectations from society, erosion of the scientific expertise underpinning the existing Community regime and the establishment of EFSA. Based on the evaluation, a Community plant health strategy will be developed[106].

It is premature to try to second-guess costs arising from changes to legislation that is being separately evaluated at the time of writing. From an IAS perspective, such changes would need to provide a clear legal basis to fill identified gaps e.g. to address IAS impacts on human health, on ecosystem function such as clogging of waterways by invasive plants, and in natural and urban areas as well as primary production areas.

Institutional costs would not be significantly increased if the revised legislation was implemented through the existing Standing Plant/Animal Health Committees. However, membership would need to be adjusted to include specialist representation on biodiversity-related aspects of implementation.

- **extension of the list of 'ecological threat species' under the Wildlife Trade Regulation (WTR)**

The WTR, designed to implement CITES, is species-specific and focused on intentional introductions. Intra-Community controls on holding and movement may not be adopted independently of import bans. The existing WTR thus does not support a biogeographic approach or differentiated treatment for EU islands, including Outermost Regions[107]. Its remit does not cover monitoring, rapid response or control.

For the WTR to function as a strong prevention tool, incremental costs would include:

- introduction of a risk assessment procedure;
- EWS linkage to support horizon-scanning for emerging risks through species trade;
- a more rapid decision-making process;
- amendment to support a biogeographic approach.

Costs of species identification and assessment could be reduced to the extent that groundwork has already been done at Europe-wide level (2007 metalist of species to be excluded from trade, proposed under the Bern Convention on the basis of DAISIE findings[108]). There is also no need for new institutional machinery.

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106 http://ec.europa.eu/food/plant/strategy/index_en.htm.

107 One of the four listied ecoogical threat species *O.jamaicensis* is native in Guadeloupe and Martinique,

108 Genovesi, P. and Scalera, R. 2007. Towards a black list of invasive alien species entering Europe through trade, and proposed responses. Convention on the Conservation of European wildlife and natural habitats.T-PVS/Inf (2007). 43 p.

- **additional resources for IAS in the risk assessment process**

Far more new plant species currently enter the EU than are subject to screening for potential risks. To address current scale of IAS impacts, significant expansion of assessment capacity would be required.

In addition to the costs under Option B (see 6.2), identified total costs of developing specific risk assessment systems for invasive alien plants range from 86,000-300,000 EUR within the EU. Unit cost ranges for species/commodity risk assessments, based on EU and NZ cost ranges, go from small-scale (2250 EUR) to medium (10,000-45,000 EUR) to large (>100,000 EUR). The highest figures are more likely to be associated with larger commodity-based assessments presenting a broader range of hazards. All figures are net of the cost of additional processes needed to develop regulations (e.g. import health standards, EIA).

Under Option B+, risk assessments would still be led by Member States with EFSA providing oversight of content. To speed up the process and facilitate wider and more uniform use of risk assessment, the EU could support additional costs such as:

  - decision-making support e.g. ECDC annual contribution to targeted scientific advice is around 2 million/year;
  - additional policy-focused research to deliver cost savings and efficiency gains through improved risk assessment techniques; and
  - specialist training support for risk assessors.

- **additional resources for IAS in Member State border control activities**

Existing border control machinery would be unchanged under Option B+ although the range of organisms addressed would be expanded and Customs officials would have additional species to intercept through the WTR. Significant expansion of coverage would require additional inspections (systemic and random), capacity-building and training for airport authorities, port authorities and customs officials, including in taxonomy[109].

Additional resources would be needed for communication and information display at airports, ports and harbours. At a high intensity level, Australian quarantine awareness programmes cost 2.11 million EUR per year during 2000-2005.

- **early detection and rapid response**

The Council Conclusions support a jointly developed information system for early warning and rapid response to provide for developing and updating specific lists of IAS, linking European lists to international lists and cooperation on biosecurity and control measures within and beyond the EU (§37).

[109] Swedish contributors to this report indicated that the Swedish Customs representatives had found that controlling even a minimum of CITES listed species was beyond their capacity and did not consider it possible to control incoming alien species (noting that by far the greatest influx of goods came from within the EU).

Under Option B+, measures highlighted as voluntary under Option B would need formal backing to ensure effective predictive systems. Of the cost ranges proposed under the EEA feasibility study (see 5.2.5), the medium-intensity model would involve the creation of an Observatory on invasive species at an estimated cost of 1.5-2 million EUR/year. This cost figure is scaled up from the EPPO alert system already used in the plant health sector and at EU-27 level, would require 7-10 FTE of which 5-7 are specialists. It could be financed through national contributions (as in the EPPO system) or with EC contributions.

Under Option B+, co-financing between EU and MS would be possible for contingency planning, rapid response and control for harmful organisms regulated under the amended plant/animal health instruments. There would be no additional Community funding or leverage for action for other categories of IAS, irrespective of whether they have transboundary impacts.

Broader assessment of Option B+

Option B+ would use existing strong Community mechanisms to address pathways for unintentional and intentional introductions and spread into and within the EU. The adjusted WTR would play a complementary prevention role to prohibit intentional introductions of a black list of ecological threat species, with the option of special controls at points of entry into islands, including EU Outermost Regions.

A key feasibility concern relates to inter-agency coordination. Option B+ retains the conventional split between plant/animal health and nature conservation-type legislation. Based on experience around the world, the difficulties of enlarging institutional focus beyond the primary production sector (agriculture, forestry) should not be underestimated.

Option B+ does not demand new institutional machinery as coordination procedures are in place through the EC-MS network of focal points and regular committee meetings. However, without high-level commitment to strategic coordination, IAS with biodiversity-related impacts would still have low priority compared to those directly threatening economic interests. Costs could arise from confusion over respective responsibilities and mandates, leading to delayed initiation of eradication efforts. It could therefore be necessary to set up a formal funded cross-sectoral mechanism (e.g. along the lines of the US National Invasive Species Council).

Although the Communication only mentions three key instruments, several other Community instruments could be adjusted to strengthen the basis for action on IAS. However, a piecemeal approach to adjustment could be just as time-consuming as development of dedicated legislation with considerably less gains for IAS visibility across the EU.

Option B+ has medium to potentially very high resource implications for the Community and MS. Its ability to address current and future IAS impacts is directly linked to the scope of legislative expansion and the resources invested in additional capacity for assessment and border controls. However, its narrower scope means that it could not efficiently address some types of impact. For example, the Option is not

well suited to monitoring or reducing damage/control costs generated in marine ecosystems, water catchments or by already widespread plants and existing invasive animals nor does it support integrated ecosystem restoration.

6.4 Option C (Comprehensive dedicated EU legal instrument)

Option C is the most ambitious package envisaged in the Communication and goes furthest to supporting an integrated approach to biosecurity at EU level.

For Option C, the incremental measures proposed in the Communication are:

- development of a comprehensive, dedicated legal framework;
- independent assessment and intervention procedures;
- possibility of a dedicated agency to centralise technical aspects of implementation;
- mandatory exchange of information and controls at borders for IAS;
- mandatory monitoring and reporting procedures;
- efficient rapid response mechanisms;
- possibility of EU funding to support eradication and control actions, alongside direct funding by Member States.

Table 6.4 summarises the main elements that could form part of this policy package which are then discussed in further detail.

Table 6.4 Summary of estimated impacts of Option C in comparison to baseline

Policy measure (possibility)	Likely intensity under Option C	BENEFITS	COSTS
Prevention (in additional to existing baseline requirements under EC law)			
Voluntary prevention measures	Possible: EU support	**Benefits would include: highest contribution to avoiding/reducing current IAS impacts in EU (Kettunen et al. 2009).** Specific benefits would include: • Early and efficient reaction to the possible arrival of IAS • Reduced risk posed by IAS (e.g. biodiversity, health, economic sectors), especially for IAS new to the EU • Reduced cost of IAS negative impacts and the control and eradication of IAS • Increased public confidence on public authorities to deal with IAS appropriately	**Foreseen significant additional costs at the EU and MS level due to extended coverage.** *Voluntary approaches: costs as per* Options B and B+ *General system costs* • Operating a high-ambition prevention system (SE estimate) 67.1 – 67.9 million EUR / year, i.e. about 7 EUR / person / year • Penalty ranges under dedicated IAS legislation as under Option B+ *Border control and inspection* • Cost of comprehensive biosecurity system based on Australia: 130 EUR / person/ year with about 55 per cent cost recovery from industry (updated from 2005/6 budget) • Costs of permit under biosecurity import health standards based on New Zealand: about 50 EUR / permit • Penalty range for non-declaration of quarantine risk goods based on New Zealand: 90 EUR (on the spot fine) to 45,000 EUR and/or five year prison sentence • Hourly inspection rates based on New Zealand and UK general charging rates: 45-73 EUR
Controls on introductions into the environment	Possible major change		
Controls on introductions into the environment	Possible major change		
Controls on introduction into captivity/containment	Possible major change		
Controls on domestic holding, trade and movement	Possible major change		

Import pathway controls	Comprehensive		• Quarantine inspection fees to cover costs of inspections: as under Option B+ • Biosecurity levies on incoming freight based on New Zealand and Hawaii: 4.5-9 EUR per shipping container; 0.35 centimes per 1000 pounds net weight freight • Biosecurity Risk Screening Levy for checking import documentation based on New Zealand: < 2 EUR • Cost of marine pathway control: as under Option B+ • Costs of IAS control for vessels: as under Option B+ *Risk assessment* • Cost of operating import risk analysis system based on Australia: 2.76 m EUR / year • Cost of developing EU-wide Decision Support System to assist Port State Control officers to target high-risk vessels for sampling: 10 million EUR (cost/port of 75,000 EUR) • Cost of training/implementation per port authority: 10,000 EUR • Cost of comprehensive pathway risk study for hull-fouling based on New Zealand: 1.37 million EUR • Unit risk assessment cost range as under Option B+ • Route-specific risk assessment costs as under Option B+ • Port baseline survey costs as under Option B+ • Cost of rapid preliminary plant risk screening event based on US: estimated at 20,000 EUR
Export pathway controls	Extended		
Border controls and inspections (airports, seaports, other)	Comprehensive (pathway focus)		
Cooperation with non-EU countries	Formalised		
Risk assessment procedures	Independent procedure, technical support & verification		
Integration of IAS into EIA	Mandatory		
Early detection and rapid response: creation of Early Warning and Information Exchange System			

Maintenance/interlinkage of inventories and databases	Mandatory	**Benefits would include maximum contribution to controlling / reducing the numbers and impacts of IAS by preventing the establishment of IAS in the EU.** Specific benefits would include: • Early and efficient reaction to detect and eradicate IAS • Possibilities for forward looking planning, e.g. preventive actions at neighbouring MS • Improved possibilities for cross-border cooperation and coordination between different authorities (e.g. EU and national level) • Available resources immediately available for rapid emergency action • Generally, reduced risk and costs posed by IAS and increased public confidence	**Increased costs due to extended coverage.** *Dedicated body supporting early warning & information as part of a broader mandate* • European Agency on IAS (based on EEA feasibility study, 2009): 50 million EUR/year for technical and part-regulatory mandate covering prevention and management aspects • Comprehensive European Biosecurity Authority based on New Zealand (70-75 million EUR/year or 0.13 per cent GDP): equivalent to 10 billion EUR/year at EU-27 *Surveillance and monitoring* • Surveillance and monitoring costs as under Option B+ • Cost of dedicated monitoring team for zebra mussel based on one US State: 1 million EUR / year • Cost of additional capacity to operate Alien Alert-type programme based on Belgium: 1-2 FTE positions • Start-up costs of national IAS inventories as under Option B+ • Cost of an integrated database to support management and resource allocation based on South Africa: 1.7 million EUR/year *Rapid response and emergency funding* • Unit costs for early detection and rapid response programmes as under Option B+ • Cost of a national Early Detection and Rapid Response programme with biodiversity focus based on South Africa: 0.9 million EUR / year • Total cost of contingency planning/emergency response and follow-up monitoring for marine invasive species
Surveillance and monitoring	Mandatory		
Information exchange	Mandatory		
Contingency planning	Mandatory		
Rapid response mechanisms	Mandatory		

Emergency funding	New co-financing		incursions based on US: 2.5 million EUR
Long-term control and containment			
Species action plans/ guidance	Coordinated for certain categories	**High benefits likely through strategic prioritisation and coordination to control IAS of Community concern, consistent with the ecosystem and biogeographic approaches.**	**Increased costs to EC and MS due to additional requirements for control and containment of some species listed under new IAS legal instrument** Current estimates on the costs of control / eradication programmes for IAS range between ten thousand – millions EUR / year (see Chapter 5)
Control/containment (plants)	Mandatory for certain categories		
Control/containment (animals)	Mandatory for certain categories		
Funding for control	New/coordinated co-financing		
Restoration	Integrated		
Associated horizontal measures			
Communication and awareness	EC backing	**High benefits likely through coordinated EU-wide programmes to raise profile of IAS and increase support for research and capacity building initiatives.**	**Increased costs due to extended coverage** • professional communication budget based on the European Centre for Disease Control: 2.57 million EUR / year; • quarantine awareness programmes as under Option B+
Coordination mechanism (EU)	Dedicated agency		**Increased costs due to extended coverage.** • European Agency on IAS (see under EWS above) • Establishing a position for an IAS coordination point in relevant EU DGs (as under Option B+)
Coordination mechanism (MS)	Dedicated network of IAS focal points		**Obligatory / additional costs could include**:

			• establishing a national body for IAS coordination (as under Option B+); • establishing a position for an IAS coordination point in relevant MS departments (as under Option B+)
National strategic/action planning	Mandatory		**Obligatory / additional costs could include:** • Strategy development: 50-100,000 EUR (one country)/major programmes + actions for EU islands 1.5million/year • Legislative review: 100,000-230,000 EUR
Research programmes	Coordinated with strategic priorities		Research supporting border / pathway control and risk assessments: • 1.37 - 4.1 million EUR for large-scale EU research programmes (as under Option B+) • other research costs as under Option B • cost of targeted research for nationwide control and ecosystem restoration based on South Africa 2.75 million EUR / year
EU funding instruments	New (co-financing for priority threats)		**Obligatory / additional costs linked to developing of a funding instrument to support contingency planning, rapid response and prioritised control programmes**
EU development cooperation funds	Integrated		**No obligatory / additional costs** Integration of IAS criteria into assessment systems for external assistance and development cooperation
Capacity-building and infrastructure	High demand to implement new framework		**Increased costs due to demand to implement legislative adjustments** Costs of capacity building scaled up from figures under Option B+

Option C represents the most ambitious of the four policy packages proposed under the Communication. It proposes a dedicated legal framework that could regroup and target currently scattered legislative provisions and cover all categories of IAS. Depending on design, it would be possible to exclude harmful organisations and/or animal pathogens regulated under existing legislation[110] as well as species covered by the aquaculture Regulation.

Possible incremental costs, taking account of cost examples already presented for Options B and B+ above, are outlined below.

- **obligatory border controls and inspections, including in Outermost Regions**

The types of costs incurred are similar though higher than for a robust version of Option B+ i.e. strengthened capacity for inspection and quarantine at borders and better coverage particularly of pathways for unintentional introduction.

The magnitude of costs can only be generally assessed. The highest level of identified costs attach to integrated biosecurity programmes in New Zealand and Australia (which apply a presumption of exclusion unless commodities are authorised for entry). For example, per capita expenditure on six Australian Quarantine and Inspection Service (AQIS) programmes (arriving passengers, cargo, mail, animals, plants and animal and plant products) is around 130 EUR / person/ year, of which about 55 per cent is recovered from industry.

Most parts of the world, including the EU, Japan, US and Canada, use 'black list' approaches which apply regulatory controls only to listed organisms (i.e. presumption of entry unless listed, based on assessment of risk). At the scale and complexity of EU continental territory, this is likely to be a more feasible approach but only if very efficient procedures were in place for rapid adjustment of regulatory lists in line with emerging risks. A differentiated approach could be considered for islands within the EU and Outermost Regions that are vulnerable to species entering through trade pathways, including from other parts of the EU single market[111].

Costs could also be calculated per major port/airport e.g. on the basis of one FTE per major point of entry with responsibility for disseminating guidance and protocols and overseeing consistent implementation. Additional recruitment might not always be necessary where airports and ports already operate environmental management systems consistent with international norms. However, recruitment and training would be needed for Member States with weaker border control and quarantine systems.

An EU communication programme should include materials for display at airports, ports and harbours to raise travellers' awareness and encourage voluntary compliance.

- **dedicated agency to centralise technical aspects of implementation and support independent procedures for assessment and intervention**

Many costs identified in Chapter 5 are sourced from a few Member States developing separate systems. The return on this type of investment could be significantly

[110] Depending on outcomes of ongoing revisions of these frameworks, see discussion of Option B+ in 6.3 above.

[111] See Council Conclusions §34.

improved at EU-27 level by setting up a strong central body to increase consistency and quality of decision-making and management actions to address IAS impacts.

The European Agency on Invasive Alien Species (high ambition version as proposed through the EEA feasibility study, see 5.2.6) would have the strong foundation and technical capacity to meet these needs. The proposal is loosely modelled on the European Centre for Disease Control, established under dedicated legislation[112], and could involve an annual budget of around 50 million EUR/year. This funding level would ensure adequate staff, mandate and financial resources for the Agency to provide: state of the art scientific information; oversee mandatory monitoring, reporting, contingency planning and response procedures; carry out independent technical evaluation; provide decision-making support to the Community and national authorities and play a part-regulatory role addressing prevention and management aspects; work in close collaboration with other competent bodies (EPPO, EFSA, regional seas organisations, etc.); and be linked to other European alert systems (e.g. animal health, food safety, EPPO).

Option C would require a mandatory risk assessment procedure and common criteria to guide applicants, justify decisions reached, consider transboundary and broader EU impacts and facilitate prioritisation of resources. Based on the ECDC model, the Agency's budget allocation for developing targeted scientific guidance would be around 2 million EUR/year but higher investment levels could well be needed. Additional costs might include e.g. 10 million EUR (one-off) to develop an EU Decision Support System to assist Port State Control officers to assess and prioritise ballast water risks and sampling strategies and up to 2 million EUR to fund technical training for its implementation.

The EEA feasibility study also estimated possible cost of full policy convergence and overhaul of EU institutional architecture. The cost of developing a biosecurity authority aligned with the New Zealand approach could be up to 10 billion EUR[113], which would largely be realised through reallocation and optimisation of existing budgets in the health, agriculture and trade sectors. This figure is still below the conservative estimate of current IAS impacts in the EU (see 6.1). However, such massive institutional reorganisation would require very high political and administrative commitment over a lengthy period.

Costs to Member States of developing IAS strategies and coordination systems/focal points are listed under Option B, derived from Member States that have already committed resources to such activities.

- **efficient rapid response mechanisms**
- **EU funding to support eradication and control actions**

Option C would change the current fully discretionary approach to IAS response in the EU (except for plant/animal health organisms and Natura 2000 sites) to make it possible to require action for specified IAS of Community concern. Measures could

[112] Established pursuant to EC Regulation 851/2004, with a mandate to identify, assess and communicate current and emerging threats to human health from communicable diseases. See e.g. proposals for European Centre for Invasive Species Management (Hulme et al, 2009).

[113] Full cost of comprehensive New Zealand system covering all aspects of biosecurity: 70-75 million EUR/year or 0.13% GDP.

be partly modelled on existing legislation (plant/animal health Directives, aquaculture Regulation) that support contingency planning, monitoring, emergency responses and management of incursions based on a biogeographical or locally-adapted approach.

The co-financing mechanisms under these Directives would be adapted as appropriate to support consistent action in the Member States concerned. Specific costs would be associated with development of contingency planning protocols, equipment and trained staff, possibly supported by dedicated rapid response teams at an appropriate subregional level and for islands. For emergency responses, funding streams would need to be available up-front as for plant, animal and human health alerts.

- **horizontal measures**

Option C costs would include an ambitious communication, education and outreach programme to explain the IAS problem to Europeans and justify the need for action and any possible restrictions. Cost figures could be obtained by scaling up higher range figures explained under Option B. There would be good opportunities for economies of scale through initiatives at EU-27 level to target common audiences (e.g. importers, distributors, retailers) and consumers, although locally-specific materials would also remain important.

Development of a strategic research programme to identify emerging risks and support more efficient and cost-effective interventions implies, as a minimum, continuing investment in output-orientated projects (e.g. for PRATIQUE, PORTCHECK and IMPASSE, average annual cost is around 1 million EUR / year / project). Additional costs are difficult to assess. They could to a certain extent be supported through the new EU Agency on IAS, which would be mandated to improve and speed up access to IAS research findings within and beyond the EU.

Broader assessment of Option C

Option C would give the highest visibility to IAS as an EU priority issue and go furthest to support integration of IAS considerations across the full range of relevant EU and national policies, consistent with Council Conclusions in June 2009.

The cost of its component measures could be of a higher magnitude than under Option B+, given its broader coverage and the up-front investment required in technical capacity-building, border infrastructure and improved rapid and longer-term response mechanisms. By way of example, the high-ambition figure presented under Sweden's IAS Strategy (covering the three-stage hierarchy and some horizontal measures) suggested possible per capita costs of around 7.25 EUR per person/year. Scaled up to EU-27 and an estimated total population of 500 million, without making any allowance for economies of scale, this could represent an annual investment of 3.7 - 4 billion EUR/year at 2009 rates. This is still significantly lower than the current cost estimates for IAS impacts (Kettunen et al. 2009).

However, the net benefits of Option C would be likely to be much higher than benefits under Option B or B+. A dedicated instrument with top-level political backing would harness a greater range of efforts to substantially reduce IAS impacts

to the EU over time and make better use of other EU funding mechanisms (e.g. more targeted use of EAFRD funds) and cost-recovery mechanisms. This means that projected investment levels indicated above (purely indicative figure) should not be interpreted as an incremental cost figure because many aspects could be delivered or part-supported through better targeting of existing mandates and resources.

In conclusion, this chapter has analysed each of the four Options separately, seeking to provide insights on what possible component measures would be likely to involve in terms of Community and Member State commitment and benefits. It has also identified many areas of complementarity between the Options and indicated some of the areas in which content could be varied to adjust the overall impact.

The next chapter brings together this parallel analysis to compare the overall impacts of the four Options (7.1) and to show through species-specific examples how existing IAS problems would be tackled under the respective Options (7.2).

7 COMPARISON OF THE POLICY OPTIONS

Chapter 7 compares the impacts of the four Options in the Communication, building on the discussion of individual Options in Chapter 6 as well as the technical analysis carried out in Kettunen et al. (2009) and Shine et al. (2008).

It consists of two parts:

- section 7.1 sets out a general comparison of the environmental, social and economic impacts of the four Options, including concrete examples based on the raw data in Annex 2 as summarised in Chapter 5;

- section 7.2 presents species-specific examples, based on local contextual information obtained for this report, to compare the practical implications of Options B, B+ and C for high-risk IAS already established in parts of the EU.

7.1 General comparison of environmental, social and economic impacts

This section presents the comparison of the policy options in the form of a synthesis table with explanatory notes. As noted (section 4.3), the analysis combines a partial quantitative approach with a qualitative approach that builds on a mix of monetary, quantitative and qualitative understanding as presented in the earlier chapters and Annex 1. The ranking system used for the impacts under consideration takes Option A (business as usual) as the baseline (starting point). For each type of impact considered, a qualitative score has been entered in each cell in accordance with the following classification system[114].

[114] The criteria used to conduct this comparison of impacts are based on the criteria that have been employed in previous impact assessment studies carried out by IEEP for the EC.

Table 7.1 Comparison of assessed impacts of the four Options

List of considered impacts	Option A: Business as usual	Option B: Maximise use of existing approaches	Option B+: Amend/ Adapting existing legislation	Option C: Comprehensive, dedicated EU legal instrument
General issues				
Legislative changes required?	No	No	Yes	Yes
Does the Option adequately target the IAS problem (known impacts & risks)?	No	Partly	Partly	Yes
Environmental issues				
Level of reduction in IAS species numbers	---	- to +	+ to ++	+++
Reduce damage to biodiversity & ecosystems	--	- to +	+ to ++	+++
Gains for ecosystem resilience (e.g. natural hazards / climate change)	---	-	+	+++
Global footprint / impacts outside EU	--	--	+	++
Economic issues				
Impact on production sectors (i.e. costs / avoided costs of damage by IAS)	---	--	- to ++	+++
Impact on business (i.e. costs of compliance, opportunity costs due to restrictions)	0	-	--	---
Impact on business: competitiveness	-- to 0	-- to 0	- to +	- to +++
Impact on transport & infrastructure[115]	- to 0	-- to 0	- to +	-- to +
Impact on EU internal market & trade	- to 0	- to 0	--	---
Impact on public authorities (budget; resources)	- to 0	-to 0	- to +	- to ++
Households / individuals: avoided damage / costs of damage avoided	0	0	0 to +	+++
National level: avoided damage / costs of damage avoided	0	0	0 to +	+++

[115] This varies widely between different types of business.

Global level: avoided damage / costs of damage avoided	0	0	0 to +	++
Social issues				
Confidence of public in environmental control / security	---	--	++	+++
Impact on public health	---	0 to +	++	++
Impact on food security	- to 0	0 / +	+	++
Number of jobs – public authorities	0	0	0 to +	+++
Number of jobs – in sector affected	0	- to 0	-- to 0	--
Impact on recreation	---	-	+	++
Impacts on cultural & amenity values	---	-	+	++
Impacts on future generations	---	0	+	+++
Administrative impacts				
Administrative costs / burden	No	Minor	Yes	Yes
Other issues: Practicability, enforceability & governance				
Practicability: is it practical to implement?	N/A	Yes	Partly	Partly
Is it understandable (politicians & public)	N/A	Yes	Yes	Yes
Consistency with international commitments[116]	No	No	Y/N	Yes
Does it address issues re: fairness, distribution of costs etc.	No	No	Partly	Yes
Is it enforceable?	N/A	Yes	Yes	Yes

+++	very beneficial effect (i.e. maximum costs avoided)
++	substantial beneficial effect
+	slight beneficial effect
-	negative effect
--	substantial negative effect
---	very negative effect (i.e. maximum costs incurred)
0	no effect
N/A	not applicable
Y/N	yes/no

Where there are other external influencing factors, a range is used e.g. '0 to –' or '+ to –'.

[116] On the assumption that any measures revised or adopted are fully compatible with the international trade regime under WTO agreements.

7.1.1 Findings on general issues

- *Legislative changes required?*[117]

Option A (business as usual) requires no legislative changes at Community or Member State level. Option B involves no new Community legal requirements but would support discretionary legislative change at Member State level to strengthen implementation of existing EC frameworks and mechanisms relevant to IAS. Differences of approach at national level could increase without any additional leverage at Community level.

Option B+ relies on adjustment to three key EU instruments (plant/animal health Directives, Wildlife Trade Regulation) to address a broader range of harmful organisms and ecological threat species. The scale of legislative adjustment required would range from relatively minor (WTR) to radical (animal health). In-depth evaluation and legislative revision are currently under way for the Community plant and animal health regimes under separate processes.

Option C would require development of a new legal instrument to incorporate and strengthen currently scattered IAS-related provisions and fill gaps through new measures and funding provisions. However, much of the groundwork to identify and prioritise necessary changes has already been completed through two extensive reviews[118] linked to this study. The legislative process could also be streamlined by aligning key provisions, where appropriate, with tried and tested approaches already used in existing Community legislation on plant/animal health and aquaculture.

- *Does the Option adequately target the IAS problem (known impacts & risks)?*

Option A (baseline) does not adequately focus on existing and future IAS risks. Option B could support this broad focus only to a limited extent by raising decision-maker awareness and improving early warning and information exchange. However, its voluntary/best efforts design could not reliably deliver improved horizon-scanning, rapid response or coordinated action on shared problem species.

Option B+ could strengthen targeting of IAS impacts and risks under Community instruments and procedures governing plant/animal health and wildlife trade. However, this would require a major shift of focus to go beyond long-established priorities (control of pests and diseases to safeguard primary production sectors) to address threats to the non-managed environment and ecosystem function. As proposed, the Option would not address several types of IAS impacts and risks e.g. to marine ecosystems.

Option C would establish strong explicit goals to address environmental, social and economic impacts of IAS in the EU and support actions to identify, monitor and respond to emerging risks, including factors linked to climate change.

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[117] See Annex 3 for a more detailed breakdown of possible legislative changes under the Policy Options.

[118] e.g. Miller et al, 2006; Shine et al, 2009.

7.1.2 Environmental impacts

- *Level of reduction in IAS species numbers*

Under Option A, IAS numbers in the EU would continue to increase at an exponential rate. Option B could contribute to reducing the demand for and use of some IAS in some target sectors, based on voluntary avoidance/substitution initiatives and unilateral efforts in some Member States. However, it could not mandate action on trade-related pathways or reinforce screening and inspections at the Community's external borders which means that the rate of IAS introduction and spread would continue to increase.

Both Options B+ and C could make a substantial contribution to reducing IAS species numbers, subject to appropriate investment in border control infrastructure, knowledge tools and capacity to detect and respond rapidly to new incursions. However, the level of potential reduction would depend on the scope of the legislative changes. As proposed, Option B+ would be unlikely to reduce IAS in marine and freshwater ecosystems or to address certain categories of organisms e.g. alien plant genotypes, invasive animals that are not pests of plants. Only Option C would explicitly support action for all IAS in all categories, including invasive animals (see Example 1).

Example 1: Cost-benefit ratio for action on an invasive animal

In Sweden, the cost of preventing entry of Raccoon dog *(Nyctereutes procyonoides)* is estimated at 100,000 EUR/year compared to 2.73 million EUR probable costs if it became established (i.e. 3.66 per cent).

Source: Naturvårdsverket. 2008. National Strategy and action plan for alien species. Swedish Environmental Protection Agency. Naturvårdsverket rapport 5910

- *Reduce damage to biodiversity & ecosystems*

Under both Option A and B, the main leverage to reduce ecological damage would be through more proactive application of existing Community instruments and policies (e.g. birds and habitats Directive, forestry and renewable energy policies, water framework Directive, marine strategy framework Directive). However, they would not have high enough political backing or visibility to drive integration of IAS considerations into key Community policy areas affecting the environment, natural resources and ecosystem function (c.f. Council Conclusions §6, §12, §20 and §38).

Option B would encourage voluntary efforts by stakeholders, including Member States, to avoid damaging practices and manage national or local threats to biodiversity. However, it would not enable a strategic or biogeographical approach to IAS management at an EU-wide level.

Option B+ could make a strong contribution in terrestrial ecosystems – and possibly freshwater ecosystems – but only if the robust control and management provisions of the plant/animal health Directives were applied to invasive plant and animal organisms that damage native species and ecosystems (see Example 2). Amendments under the WTR could prevent entry of certain ecological threat species but would not address management of already-introduced species. None of these instruments have a restoration component.

Option C would include protection of biodiversity and ecosystem function in its primary objective and support an integrated response to IAS threats, including native habitat restoration and species recovery, based on the ecosystem approach.

Example 2: Impacts and control costs of an invasive bird affecting several Member States

Option C would be best suited to leverage efforts to tackle an invasive bird such as sacred ibis (*Threskiornis aethiopicus*). This species was originally introduced into zoos where it was allowed to breed and fly freely, leading to its escape and establishment. It has ecosystem impacts (predation on threatened insects, batrachians and protected colonies of terns and herons), health/social impacts (foraging in rubbish dumps and slurry pits), has established feral populations in parts of France (from a single source, over 5000 in 30 years) and is now present in Italy, the Netherlands and the Canary Islands. In 2008, a single French region spent 1.2 FTE and 12,000 EUR per year to kill 3000 birds.

Source: DAISIE database (www.europe-aliens.org)

- *Gains for ecosystem resilience (e.g. natural hazards / climate change)*

Option A involves no additional actions to increase ecosystem resilience. Option B is nationally-driven and would not address the EU's current fragmented approach to IAS policy delivery. Its leverage would be too weak to tackle large-scale environmental pressures that need to be addressed at least at the sub-regional level (i.e. across jurisdictional borders within the EU). However, it could make a limited contribution at the local level based on voluntary efforts. For example, the Republic of Ireland and the UK (Northern Ireland) cooperate on an all-Ireland basis to strengthen monitoring and management of IAS risks in shared inland water systems.

Option B+ strongly supports a biogeographical approach through plant/animal health frameworks. Its criteria for listing harmful organisms could potentially be adjusted to take account of predicted effects of climate change on the future spread of IAS caused by the shifting of biota and changes *inter alia* in agriculture and forestry practices (Council Conclusions §38). It would be unlikely to contribute to increased resilience of freshwater and marine ecosystems.

Option C would deliver highest gains for resilience by integrating measures for ecosystem-based monitoring and climate change mitigation into its comprehensive framework. It could provide strong leverage for IAS risks to be systematically addressed in natural systems through the WFD, MFD and flood risks Directive.

- *Global footprint / impacts outside EU*

The Community has responsibilities as an exporter of potential IAS through trade and transport pathways and through its policies for external assistance and development cooperation. The Council Conclusions call for Environmental Impact Assessments and Strategic Environmental Assessments to be undertaken systematically and with due regard for biodiversity in relation to environmentally-sensitive aid operations funded by Member States and the Commission (§12).

Neither Option A nor B would require consideration of IAS risks beyond EU borders. Option B+ has a very strong basis for addressing sanitary risks through pre-clearance protocols and export certification for trading partners but these have an organism focus (pest/disease risks) and are not primarily concerned with the environmental vulnerability of a receiving territory. The WTR's ecological threat provisions only cover species imports into the EU: there is no legal basis for screening species exports to see if they could be potentially invasive in the country of destination.

Option C could be designed to address external responsibilities and support consideration of IAS in environmental assessment procedures, consistent with the CBD Guiding Principles and the Council Conclusions. Risk management protocols could be developed to minimise unintentional translocation of IAS through development, humanitarian relief and military operations to other parts of the world, The Option could also raise the profile of IAS as an issue that directly affects livelihoods and economic development opportunities and promote EU/Member State support for integrated IAS management programmes (see Example 3).

Example 3: Combining poverty reduction with IAS management and ecosystem restoration

The Working for Water Programme in South Africa (http://www.dwaf.gov.za/wfw/) pioneered approaches to combine IAS control with rural economic and social development. The original economic justification for this programme was linked to a cost/benefit analysis of water diversion by invasive plants. Invasive plant clearance now costs about 31 million EUR per year and has delivered stream flow gain for South African water catchments of between 4–10 per cent of Mean Annual Flow (equivalent to roughly filling an average sized dam every two years i.e. 53–130 billion litres). Other non-quantified benefits related to primary production (20 per cent of land cleared was in high agriculturally productive areas) and conservation (20 per cent in areas of biodiversity importance).[119] Participants in the Programme have access to health and child care and receive professional training.

7.1.3 Findings on economic impacts

The different types of economic impact covered by Table 7.1 are discussed together, Option by Option, to provide a clear picture of the likely magnitude of expected impacts even though specific monetary data is generally not available.

Sectors that make use of introduced species provide a very broad range of employment opportunities for Europeans, from the production of our food to the

[119] Questionnaire response, Mr Ahmed Khan, Deputy Director: Strategic Services, Working for Water Programme.

supply of much appreciated species for private enjoyment (e.g. ornamental and recreational use of plants, pet animals, exotic birds, game, fish for angling) (see Example 4).

Example 4: Employment and economic issues for sectors making use of introduced species: some examples

Retail sales of pets and related goods in the UK are estimated to be £3 billion/year, with an estimated rise to £3.4 billion/year by 2013. In the UK 10,000-14,000 persons are directly employed in the industry. This figure rises to at least 50,000 across Europe[120].

Restricting sales of exotic species has direct economic implications for the pet trade. In Italy, the import ban on *Trachemys scripta elegans* (required under the Wildlife Trade Regulation) led to seizure of about 23,000 specimens with an economic value of 296,000 EUR between 1999-2000 (Fiori and Avanzo 2002).

Hunting of pheasant (an introduced species) is estimated to contribute about 390 million EUR / year to the UK hunting sector (source: Federation of Associations for Hunting and Conservation of the EU) which is considerably higher than identified costs of damage to agriculture from this species in the wild (around 2.5 million EUR / year in Germany as cited in Kettunen et al. 2009).

Under Options A and B, given the findings under 7.1.2, production sectors would continue to suffer from loss in agricultural yield, forest productivity, landscape quality and so on. Control and damage costs to key economic stakeholders, infrastructure providers, other public authorities, landowners and individuals would continue to grow exponentially in the absence of sufficiently robust policies at the level of the EU. Distribution of such costs would remain uneven with no or few cost-recovery mechanisms in place. The burden for meeting the costs of damage/control would lie at national or local level, regardless of where the original introduction occurred or who was responsible. Both public and private investments could be undermined by failure to manage IAS across a jurisdictional border.

The main positive impact to business and other stakeholders under Options A and B would be the continuing freedom to import, trade, cultivate, breed and release introduced species (subject to existing restrictions) without additional costs or delay associated with prior risk assessment and regulatory decision-making. The introduction of trade and/or production restrictions under Options B+ or C would carry costs, although these would need to be assessed by sector on the basis of the species or commodities to be regulated.

On the other hand, inaction or insufficient action is likely to affect the longer term competitiveness of some business sectors through e.g. closure of markets to contaminated commodities. In addition, there are potential costs to business associated with inconsistent approaches in different Member States. Trade bans on IAS in some countries but not others might increase uncertainties for economic actors in the context of the single market. Uneven transport-related requirements could have a similar impact. For example, the current absence of an EU-backed approach to standards for managing ballast water risks means that the same vessel could be found compliant with ballast water management standards in one Member State but not

[120] Keith Davenport, Ornamental Aquatic Trade Association, pers. comm.

necessarily in another, depending on the sampling strategy chosen.

Option B – as well as Option B+ and C – can provide significant potential benefits for forward-looking businesses that invest in voluntary approaches to reduce IAS risks e.g. through industry certification/accreditation schemes, positive branding through codes of conduct and other marketing tools. Such approaches are mainly low-cost and over time, are likely to place participating businesses at a competitive advantage as public awareness and concern grows in respect of IAS risks. For example, some comparative advantages may arise by ensuring risk-free products (e.g. uncontaminated bird seed) through reputable schemes.

Voluntary approaches are fully compatible with adjustment or adoption of stronger regulatory measures under Options B+ or C. Concerned stakeholders have a direct incentive to demonstrate high standards of industry practice to ensure that restrictions that could impact trade and production are kept to the minimum and are only adopted if proportionate to the risks identified. Research for this study found that countries with ambitious formal IAS frameworks were also the countries most committed to collaborative voluntary measures developed with industry and other stakeholders[121].

Cost savings may be available to businesses that invest in best practice, new technologies and substitution policies in advance of possible regulation (see e.g. case studies from Japan in section 5.5). Public authorities may also derive benefits from taking the lead on IAS avoidance strategies (see Example 5).

Example 5: Buying power and influence of local authorities in plant production and horticulture

Stakeholders directly affected by IAS impacts and avoidance strategies include local authorities. In France, where the value of the national plant production market is estimated at 1.6 billion EUR / year, local authorities have a major economic stake both as producers and users of plants (estimated 8-10 per cent of global value of the industry, including direct responsibility for around 6 per cent of plant production: source Onhiflor).

One municipality on the Mediterranean coast (Sète) has developed a decision support system to promote use of native and/or non-invasive plants instead of regionally invasive plants. The scheme is voluntary but has been progressively integrated into all planning policies and public contracts, which means that architects, landscape planners and other urban and green space operators must comply with its recommendations to have access to publicly-funded projects or to obtain other types of planning consent. The scheme is currently being scaled up for regional and ultimately national application, with provision for adapting the species list to different bioclimatic conditions elsewhere in France.[122]

Under Options B+ and C, the EU would play a larger role in funding IAS prevention and management measures. This would facilitate sharing of costs and benefits more

[121] See Franke, G. The industry view on importance and advantages of Codes of Conduct (Proceedings of EPPO/Council of Europe Workshop on the Code of Conduct on Horticulture and Invasive Alien Plants (Oslo, 4-5 June 2009), available for download at http://archives.eppo.org/MEETINGS/2009_conferences/code_of_conduct/05_franke/index.html.

[122] See Brot, F, Ehret, P. and Mandon, I. Initiatives in the South of France: from involvement of the nursery industry toward voluntary codes of conducts for local authorities (Proceedings of EPPO/Council of Europe Workshop on the Code of Conduct on Horticulture and Invasive Alien Plants (Oslo, 4-5 June 2009), available for download at http://archives.eppo.org/MEETINGS/2009_conferences/code_of_conduct/11_brot/index.html).

evenly across all Member States. It would also deliver a greater return on investment by using economies of scale and a coordinated biogeographic approach to reduce the overall cost burden. These Options are the only policy packages capable of delivering EU-backed mechanisms for mandatory rapid response which has sound economic justification (see Example 6).

Example 6: Economic benefits from publicly-funded contingency planning and rapid response

Australia (1999): Researchers conducting surveys as part of a ballast water risk assessment discovered the black-striped mussel *Mytilopsis sallei* (a similar fouling organism to the zebra mussel *Dreissena polymorpha*) in three Darwin yacht marinas. Predicted impacts if it became established included ongoing costs of removal from vessels, outlet pipes and other structures and colonisation impacts on the Northern Territory's pearling industry, valued at 167.3 million EUR/year at 2009 rates (AUS $225 million/year in 1999).

Existing fisheries legislation provided powers to enter, seize and, if necessary, destroy private property. Two days after notification, the infected marina was declared a national disaster area, emergency containment measures were introduced and legislation adopted to authorise non-specific chemical treatment of marine waters. The successful eradication cost about 1.6 million EUR at 2009 rates (AUS $2.2 million in 1999) i.e. one-off expenditure was about one per cent of predicted damage costs to industry in a single year and would represent a vastly lower percentage if the cumulative damage costs over time are taken into account.

Source: adapted from Case Study 5.23, Wittenberg and Cock (eds.) 2001

Sweden (2008): For Pinewood nematode *(Bursaphelenchus xylophilus)*, economic assessment during preparation of the national IAS Strategy indicated that cost of preventing entry would be 0.13 million EUR per year, compared to probable costs if it became established in Sweden of around 47 million EUR per year i.e. around a quarter of one per cent.

Source: Naturvårdsverket. 2008. National Strategy and action plan for alien species. Swedish Environmental Protection Agency. Naturvårdsverket rapport 5910.

The EU could also take the lead on researching and implementing effective cost recovery mechanisms to support biosecurity funding. Such mechanisms would be fairest and most equitable – and more likely to be acceptable to affected economic players – if the charging structure was tailored to the level of threat associated with a particular pathway or vector.

7.1.4 Findings on social impacts

Option A would not reduce any type of social impacts associated with IAS. Option B could not secure concrete change on these issues at EU level, but it could contribute to enhanced public confidence and improved recreational experiences by informing and engaging target audiences. It could also lead to small-scale employment opportunities through initiatives linked to local/national management programmes, communication programmes and trade diversification.

Options B+ and C would deliver much greater benefits to society mainly because, if properly implemented, they have the capacity to deliver on jobs, public health,

recreation and environmental protection. Option B+ could make a very strong case for increased confidence in food security but unless significantly broadened, might not address human health impacts associated with invasive plants such as ambrosia (see 7.2). Because it covers a narrower range of threats and impacts, it would have lower leverage to secure social benefits.

In comparison to Option B+, Option C could provide additional social benefits by addressing a wider range of IAS risks. These could include e.g. reducing flood risks by supporting control of invasive species that contribute to river bank erosion; ensuring that invasive plants are not selected for planting as biofuels or for renewable energy; improving landscape quality through integrated restoration projects; and providing greater reassurance with regard to responsible mitigation strategies for climate change. In consequence, Option C is likely to make a much stronger contribution to inter-generational equity because it will store up fewer costs for future generations.

These findings are fully compatible with ongoing international policy studies which note that research and employment opportunities may be generated by a strict avoidance regime. "IAS are now seen by many as a serious national security issue, and this should induce public funding to help industries deal with the preventive side of the problem. Industries need to educate their employees and consumers about the harmful impact of IAS, making it clear that prevention can, in the long run, save jobs and money" (Stoett and Mohammed 2009).

7.1.5 Findings on administrative and other impacts

Option A involves no new administrative actions or costs. Under Option B, Member States would continue to meet virtually all costs of IAS actions and would be free to decide whether or not to take on new administrative burdens and financial commitments. Action would be locally driven and could be fully adapted to local and national priorities.

Option B+ has major administrative and capacity implications within the EC and might prove difficult to implement efficiently because it maintains the current fragmented approach to IAS policy delivery. To overcome foreseeable problems linked to weak coordination, it would be necessary to establish or strengthen some kind of cross-sectoral coordination mechanism. The simplest version of this might involve an Open Method of Communication-type approach but in all likelihood a mechanism with high-level political backing would probably be needed to ensure adequate treatment of biodiversity risks.

Option C involves the highest level of administrative impacts but also, by far, the largest benefits for governance through coordination and policy mainstreaming. It would go furthest to clarify roles and responsibilities at Community and Member State levels (confusion over respective mandates delays responses and thus leads to higher costs of intervention). It has potential for efficiency gains (ie cost savings) because it would provide a streamlined framework for Member States and subnational governments to address domestic and inter-state issues. More efficient information

delivery and improved assessment of risks, through decision support services provided by a dedicated central agency, would make it easier to target any restrictive measures more precisely and thus ensure greater proportionality.

In terms of practicability, regulatory adjustment (Option B+) and adoption of a new instrument (Option C) would both take considerable time, However, the Community could initiate some key activities very rapidly under Option B+ and, in particular, under Option C. These could include a high-quality communication programme and strong support for further development of industry-backed voluntary certification schemes and code development. Experience gained with the longest-established voluntary approaches suggests that these play a catalyst role in progressive formalisation of IAS regimes e.g. the ICES Code inspired the EU aquaculture Regulation and the IMO's voluntary standards and Globallast Programme led to the adoption of the Ballast Water Management Convention.

Enforceability is a notoriously complex area in IAS policy because of the number of people and pathways involved and because it is not feasible or socially desirable to police many of the activities that contribute to IAS introduction and spread. It is essential to have meaningful penalties in place and applied for offences under biosecurity legislation: some examples of best practice in this area are given in 5.1.2. In a broader perspective, however, both Options B+ and C could be used to support development of equitable cost recovery mechanisms and to support research into adapted use of environmental liability schemes.

7.2 Species-specific examples for comparing the different Policy Options[123]

A number of IAS-specific examples, developed based on existing information and extrapolated over species' current European range, indicate that the possible costs of policy inaction at the European level would be significantly higher than potential costs of preventive action. For example, common ragweed (*A. artemisiifolia*) is known to be a highly allergenic species and several examples of its negative impacts on human health in Europe already exist. If common ragweed were to become even more densely spread and cause allergies through out its current European range the human health related costs caused by the invasion of could amount to over 80 million EUR / year. In comparison, this is 20 times higher than estimated costs of implementing preventive measures (i.e. coordinating a national campaign and organising an annual event for awareness raising) across the area that still remain non-infested in the EU (Figure 2).

Similarly, the possible annual costs of damage (e.g. costs of damage to river banks and dams, and damage to aquaculture) by muskrat (*O. zibethicus*) at its present range could amount to up to 250 million EUR where as the estimated costs of control and eradication remain below 30 million EUR per year (Figure 3). Furthermore, the damage cost by grey squirrel (*S. carolinensis*) to timber production and the costs to hydropower plants due to the infestation of water hyacinth could be several times

[123] The original data for the case studies are contained in Annex 2 (part 3).

higher than the costs of control (11 million vs. 1 million EUR / year and 33 million vs. 18 million EUR / year, respectively) (Figures 4 and 5).

Available cost information on IAS-specific policy measures support the general understanding that control and eradication of already-established IAS can come with high costs, in particular when compared to the costs of preventive measures. For example, the costs of controlling water hyacinth along a 75 km stretch of the Guadiana River in Spain (0.2 km^2) amounted to over 14 million EUR in 2005-2008 (EPPO 2008, Téllez et al. 2008). This indicates about 1.8 million EUR annual costs per km^2 (Figure 5). In comparison, the cost of measures to prevent the spread of an invasive weed could be less than 1.3 million EUR / year for the whole of EU (estimated based on the information on common ragweed, see Table 5 in Annex 4).

Figure 7.1. Estimated costs of policy measures to prevent the spread of common ragweed (*A. artemisiifolia*) across the non-invested area in the EU, in comparison to costs of damage (i.e. health costs) extrapolated to cover species' current range in Europe. See Annex 4 for detailed calculations.

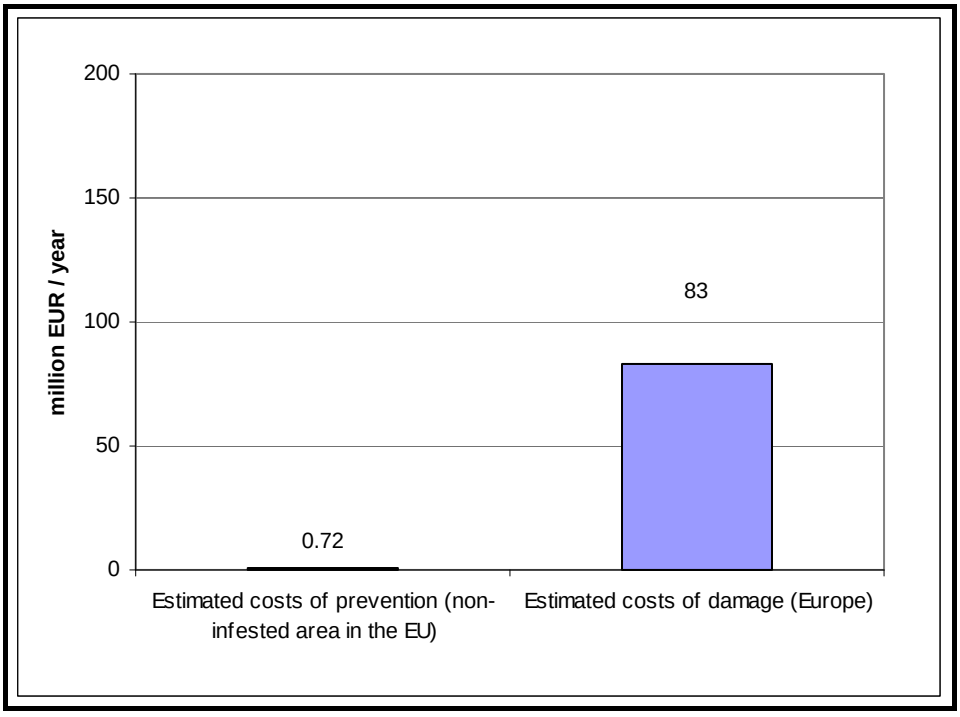


Figure 7.2. Estimated costs of policy measures to control and eradicate muskrat (*O. zibethicus*) in comparison to costs of damage, extrapolated to cover species' current range in Europe. See Annex 4 for detailed calculations.

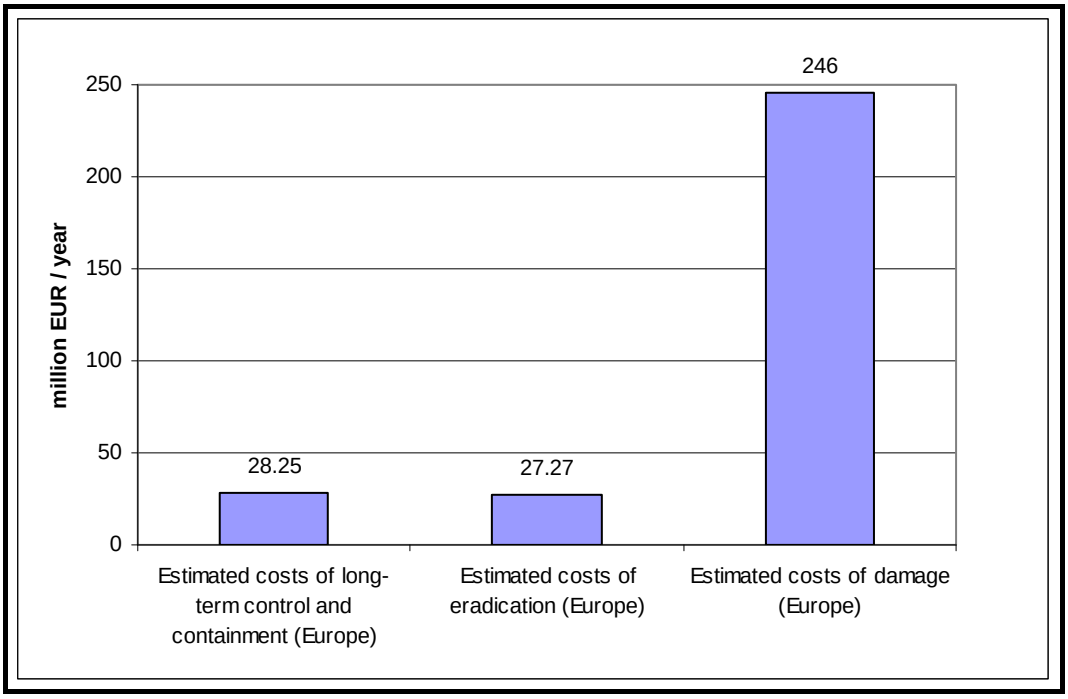


Figure 7.3. Estimated costs of policy measures to control grey squirrel (*S. carolinensis*) in comparison to costs of damage, extrapolated to cover species' current range in Europe. See Annex 4 for detailed calculations.

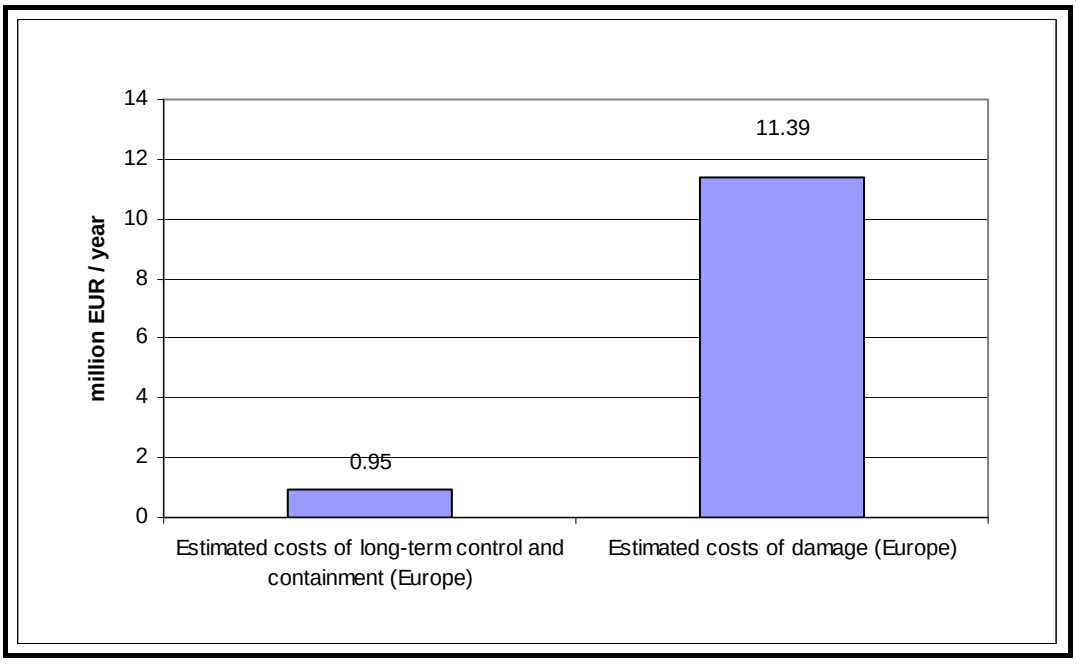
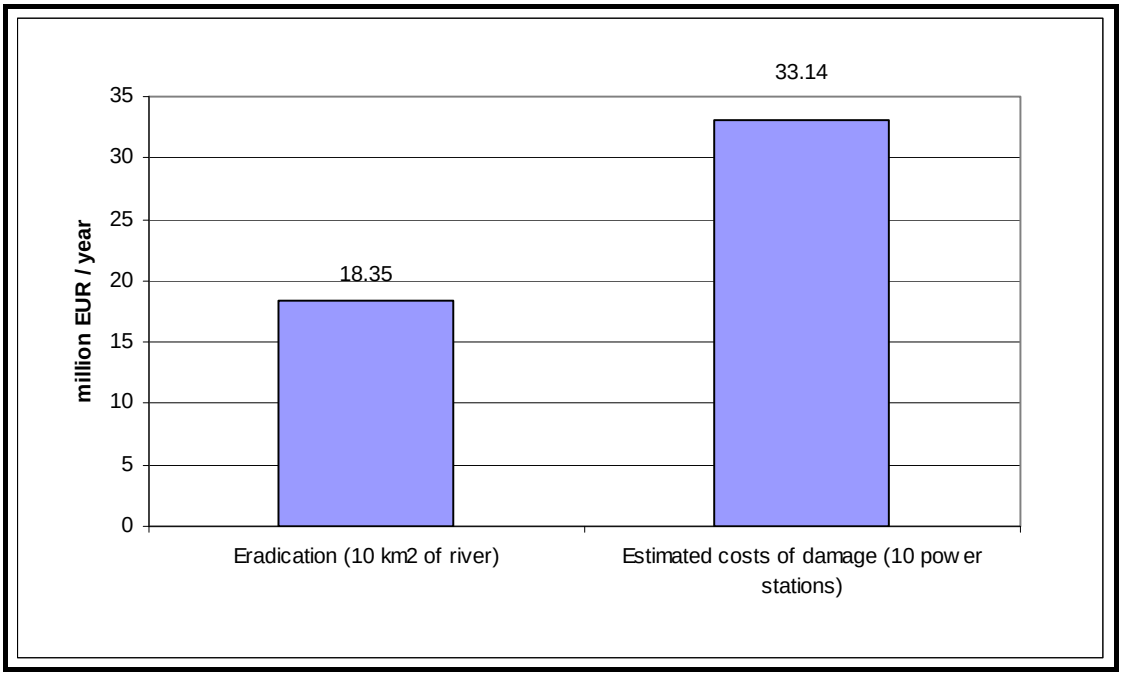


Figure 7.4. Estimated costs of eradicating water hyacinth (*E. crassipes*) compared to costs of damage to hydropower stations. See Annex 4 for detailed calculations.



The species discussed above would be addressed very differently under the respective Policy Options. Under Option B, all interventions would be led by Member States on a voluntary basis and all costs would be met at national level. Trade-related pathways would remain unregulated which means that the grey squirrel could continue to be freely sold in Italian regions whilst French and Swiss authorities across the border take the opposite approach. IAS impacts to human health would continue to fall outside the scope of the plant health Directive – and an invasive alien plant would not constitute a disease under ECDC - which means that there would be no Community-driven leverage to coordinate control of Ambrosia despite its affecting a growing number of Member States with very high public health costs.

Under Option B+, the potential to list Ambrosia as a harmful organism under the plant health Directive is doubtful because it is likely to be considered too widespread. Therefore, options for controlling the further spread of this species and limiting its negative impacts under Option B+ might remain limited. The case for listing water hyacinth under the plant health Directive is stronger because the species is currently limited to parts of the Iberian peninsula and one Outermost Region. Available figures support the case for concerted action. Water hyacinth is considered to be one of the world's 100 Worst IAS with populations capable of doubling in as little as twelve days[124]. It was prohibited from sale in Portugal in 1974, is lawfully sold elsewhere in the EU but has just been listed for a trade ban in a single Spanish Autonomous Community (Valencia). EPPO has conducted a full PRA and recommended its Members to regulate it for trade (equivalent non-binding recommendation adopted by

[124] Global Invasive Species Database.

Parties to the Bern Convention) but the species is not listed under the plant health Directive. Whilst available data does not make it possible to quantify precise costs of delayed action, it is clear from the level of known potential control costs (1.8 million EUR annual costs per km^2 cleared in one Spanish river) that every month's delay will increase economic impacts to the bodies responsible for control.

In parallel or as an alternative, water hyacinth could be listed as an 'ecological threat species' under the Wildlife Trade Regulation to prevent further entry into the EU as well as movement and holding at an intra-Community level. However, this would carry no additional requirements as regards monitoring, reporting and control.

Under Option C, depending on the design of legislation, all four species could be designated as species of Community concern under one or more annexes and as appropriate, be subject to targeted measures to regulate trade or other introduction pathways, mandatory monitoring and reporting and depending on area/circumstances, coordinated response actions with possible funding support. An overarching Community information and communication campaign would contribute to building understanding and support for the objectives of proportionate action undertaken.

8 SUMMARY OF ANALYSIS AND JUSTIFICATION OF PREFERENCES

In general, the Community should only present a legislative option and/or commit extra resources if the issue is significant, EU-wide, not adequately dealt with through existing legislation and purely national approaches are unlikely to offer a sufficient solution. Based on the evidence compiled for this study, the IAS issue passes all four of these tests and justifies a high-intensity response with backing of Community institutions and Member States.

- The gravity of the issue to the EU, even making allowances for insufficient data, has been evidenced through the Task 1 study for this report (Kettunen et al. 2009) and formally recognised by the Commission through the Communication.

- The scale and geographic extent of the problem is documented both at EU and Europe-wide level. The DAISIE database confirms that all taxonomic groups and all types of European ecosystem, including shared waterways and regional seas, are affected. Some of Europe's most important areas for biodiversity (islands) are the worst affected by IAS impacts.

- The inadequacy of the existing framework has been widely researched and accepted, including in the Communication. Mechanisms are not in place to support comparable levels of implementation and investment across Member States or to address a wide range of pathway and vector risks.

- The variability of IAS distribution and impacts means that many management measures will be taken at local or national level. However, national approaches, even if significantly strengthened, cannot adequately address IAS threats in the

context of the single market. Coordinated EU action is necessary in key sectors that are closely integrated at EU level through the single market and common policies (e.g. agriculture, water, biodiversity, fisheries).

- At the continental scale, Europe's numerous land borders and shared ecosystems make unilateral approaches inefficient and cost-ineffective. Coordinated EU action is needed to tackle crossborder impacts of IAS (e.g. in river and sea basins and biogeographic regions).

- The justification for Community action is equally strong for European islands. The need for regional coordination to protect island biodiversity against IAS impacts is formally recognised in international policy frameworks[125], yet islands that are legally part of EU territory – including Outermost Regions – do not have explicit powers to prevent entry even of known high-risk IAS.

The difficulty of obtaining monetary data on policy costs or benefits (i.e. damage avoided) has been noted in this report. Nevertheless, the data compiled (see Annex 2 and Chapter 5) indicates that the costs of an ambitious policy option would be a fraction of the possible benefits (i.e. the costs that society will continue to face if nothing is done or too little is done too late). This can be clearly illustrated based on the example of one Member State for which solid cost estimates were prepared during the development of the national IAS strategy (see Box 8.1).

Box 8.1. Comparing benefits and costs of IAS policies: the example of Sweden

Documented damage costs to the EU are at least 12 billion EUR/year (Kettunen et al. 2009 as referenced in the Commission Communication (COM (2008) 789 of 3.12.2008).

If these total costs are divided by EU-27, the notional estimated cost of IAS impacts per Member State at present could be around 470 million EUR/year (ignoring differences in size of country). If this total were divided by all countries in Europe (i.e. by 50), the notional estimated cost of IAS impacts per country would be around 250 million EUR/year. This very simplified calculation produces an estimated IAS impact range of 250-470 million EUR/year per country at present.

This impact range can be compared to the range of costs of prevention, monitoring and targeted eradication and control evaluated for one Member State (Sweden). Based on a gradient of ambition, these figures were as follows:

Low ambition: 1.6 – 2.45 million EUR / year (e.g. including the costs of a national secretariat, a national IAS monitoring system, and risk analysis and prevention / early eradication / control measures for five species introduced but not yet established in the country);
Medium ambition: 10.3 – 11.1 million EUR / year (as above, with additional budget for research and risk analysis and control measures for five species already established in the country);
High ambition: 67.1-67.9 million EUR / year (as above, with a budget for risk analysis and control measures for five additional species already established in the country).

Based on the 'high ambition' level of investment and the lowest IAS impact figure, costs of IAS action would amount to around 27 per cent of benefits (estimated 67.9 million EUR / year costs incurred c.f. 250 million EUR / year benefits in terms of costs avoided).

[125] Eg CBD Programme of Work on Island Biodiversity, CBD Decision IX.4, Bern Convention recommendation 91/2002.

If that impact figure were adjusted to the level of one Member State, costs of IAS action would amount to around 14 per cent of benefits (estimated 67.9 million EUR / year costs incurred c.f. 470 million EUR / year benefits in terms of costs avoided).

As noted in the Task 1 report, the impact figure of 12 billion EUR is accepted as a gross underestimate. This suggests that as more information on IAS impacts in Europe becomes available, the real cost-benefit ratio in favour of robust prevention is likely to be even more favourable.

For example, if the baseline impact figure of 12 billion EUR/year were increased to 20 billion EUR/year (which is probably still conservative), the impact per Member State would be 740 million EUR/year (20 billion/27 Member States) and 400 million EUR/year per European country (20 billion/50 European countries).

Points for further consideration:

Without more detailed analysis (e.g. development of specific extrapolation methods), it is not possible to quantify future developments in the ratio of costs of action to benefits of action (i.e. avoided IAS costs). However, it appears likely that a high ambition framework would go furthest to decrease IAS risks and that, over time, administrative costs could be gradually reduced:

- Task 3 evidence from e.g. Sweden and the United Kingdom suggests that investment in management of established IAS can be reduced from a first phase of intensive control to maintenance/monitoring at lower levels;

- costs of setting up a new institutional structure (e.g. an IAS secretariat or monitoring system) are usually higher than ongoing maintenance and running costs, although no specific data on this was available;

- economies of scale available through regionally coordinated approaches and information resources could reduce duplication and reduce the overall cost and administrative burden over time.

The more detailed species-specific examples in Chapter 7.2 also indicate that the possible costs of policy inaction at the European level would be significantly higher than the potential costs of preventive action.

The following recommendations take account of the Council Conclusions which provide strong support for a robust EU framework on IAS, including:

- a jointly developed information system for early warning and rapid response;
- improved cooperation on biosecurity and control measures within and beyond the EU;
- integration of IAS considerations into key Community policy areas affecting the environment, natural resources and ecosystem function; and
- consideration of predicted effects of climate change on the future spread of IAS caused by the shifting of biota and changes *inter alia* in agriculture and forestry practices.

Based on the findings of this study, it is recommended that the formal impact assessment carried out by the Commission should be based on Option C.

The study team's analysis suggests that Option C is the only policy package that could deliver the necessary visibility, coverage, coordination, resourcing and horizon-

scanning for all types of IAS risks and impacts. Option C could have prevented a large proportion of the current costs of IAS damage and control in Europe and would also be likely to make the biggest contribution to reducing new species arrivals in the future.

Indicative costs of taking action to address IAS threats, even at the highest level of ambition identified, would be much lower than the costs of inaction over the medium to long term. Improved IAS prevention at source, into and within the Community would bring clear economic, environmental and social benefits by anticipating potential impacts and minimising threats to ecosystems, human health, economy and infrastructure. In addition, Option C would provide the strongest basis for an integrated approach to maintain and restore healthy and effectively functioning ecosystems. This could provide additional benefits by increasing the resilience of European ecosystems to IAS impacts, taking account of complementary EU policies for climate change adaptation[126].

Depending on design, Option C could make it possible to:

- cover all ecosystems and taxonomic groups;
- link and streamline currently fragmented areas of Community action;
- support pre-emptive and cost-effective action;
- leverage rapid response and consistent approaches to shared threats;
- formalise cross-border consultation on intentional introductions;
- promote mainstreaming of IAS across all relevant policy areas;
- maximise returns for IAS from existing Community and Member State investments under other EU financial mechanisms;
- promote economies of scale and avoid duplication.

Option C would also be fully compatible with voluntary prevention and approaches based on enhanced corporate social responsibility. The most desirable way to tackle IAS threats is to build awareness, encourage changes in behaviour and support voluntary compliance. Actions of this kind should be considered as fundamental to achieving Community objectives on IAS. They could be actively encouraged during the first phase of implementation, pending development of a dedicated legal framework.

Proceeding with Option C would not exclude the development in parallel of key Option B+ elements. The Community plant health framework is currently undergoing major revision to secure future alignment with best global practice and standards. These possible changes provide additional opportunities for synergy and alignment with specific IAS measures.

[126] White Paper "Adapting to climate change in Europe – options for EU action" (COM (2009) 147 final) adopted by the European Commission on 1 April 2009.

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CONTRIBUTORS TO THE STUDY

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EU government and agency representatives:

Austria: Franz Essl (Federal Environment Agency), Wolfgang Rabitsch (Biodiversity and Nature Conservation); **Belgium:** Olivier Beck (Brussels Institute for Management of the Environment), Emmanuel Delbart (Laboratory of Ecology-FUSAGx), Claire Collin (Direction Generale Environnement-Affaires Internationales, Federal Public Service of Public Health, Food Chain Security and Environment), Catherine Debruyne (Direction de la Nature, Ministry of the Walloon Region); **Cyprus:** Lefkios Sergides (Ministry of Agriculture, Natural Resources and Environment); Denmark: Ebbe Nordbo (National Plant Protection Organisation); Hans Erik Svart (Ministry of Environment, Danish Forest and Nature Agency); **Finland:** Harry Helmisaari (Finnish Environment Institute), Johanna Niemivuo-Lahti (Ministry of Agriculture and Forestry); **France:** Hélène Menigaux and Michel Perret (Ministère de l'écologie, de l'énergie, du développement durable, et de l'aménagement du territoire); **Germany:** Frank Klingenstein (Federal Agency for Conservation (BfN), Uwe Starfinger (Technische Universität Berlin); **Hungary:** István Dancza and Ágnes Vozár (Ministry of Environment and Water); **Italy:** Eugenio Dupré and Pier Luigi Fiorentino (Nature Protection Directorate, Ministry of the Environment, Land and Sea); **Latvia:** Vilnis Bernards (Ministry of Environment); **Lithuania**: Sigutė Ališauskienė (Ministry of Environment); **Slovenia:** Peter Skoberne and Branka Tavzes (Ministry of the Environment and Spatial Planning); **Spain:** Carmen Álvarez (Department of Protection of Species, Balearic Islands Government); **Sweden:** Helena Höglander and Melanie Josefsson (Swedish Environmental Protection Agency), Tor-Bjorn Larsson (formely of European Environment Agency); **United Kingdom:** Richard Baker and Ray Cannon (Food and Environment Research Agency), Niall Moore (GB Non-native Species Secretariat), Huw Thomas (Department for Environment, Food and Rural Affairs).

Non-EU government and agency representatives:

Australia: Michael Cole and Carol Cribb (Product Integrity, Department of Agriculture, Fisheries and Forestry (DAFF)); **Canada:** Françoise Labonté (Fisheries and Oceans Canada); **New Zealand:** Derek Belton (Ministry of Agriculture and Forestry (MAF)), Shyama Pagad (IUCN SSC Invasive Species Specialist Group Regional Office for the Pacific); **South Africa:** Ahmed Khan and Guy Preston (*Working for Water Programme*Department of Water Affairs & Forestry), Philip Ivey (South African National Biodiversity Institute); **United States:** Lori Williams (National Invasive Species Council, US); **Switzerland:** Corinne Vonlanthe (Swiss Federal Office for the Environment (FOEN)).

Industry stakeholders, NGOs, IAS experts and other contributors:

Linda Berglund (WWF-Sweden), Ron Bleijswijk (MPS-ECAS Certification, The Netherlands), Etienne Branquart (Belgian Biodiversity Platform), Sarah Brunel (EPPO), Christiana Conser (PlantRight and Cal-HIP, USA), Keith Davenport (Ornamental Aquatic Trade Association Ltd), Katharina Dehnen-Schmutz (University of Warwick, UK), Otto Doering (Department of Agricultural Economics, Purdue University, USA), Eladio Fernandez-Galiano (Council of Europe), George Franke (International Association of Horticultural Producers), Pam Fuller (USGS/BRD Non-indigenous Aquatic Species Program, Florida Integrated Science Centre), Andrew Halstead (The Royal Horticultural Society, UK), Peter T. Jenkins (Defenders of Wildlife), Anthony Kachenko (Nursery & Garden Industry Australia), Marion

Karmann (Forest Stewardship Council), Andrew Kendall (Grey Squirrel Control Programme), Angus Middleton (Federation of Associations for Hunting & Conservation of the EU (FACE)), John Mumford (Centre for Environmental Policy, Imperial College, London), Liz Radford (Plantlife), Jamie Reaser (Pet Industries Joint Advisory Council), Alan Smith (Forest Stewardship Council), Yohann Soubeyran (IUCN France), Clare Stringer (Royal Society for the Protection of Birds, UK) and Peter Whittle (Cooperative Research Centre for National Plant Biosecurity, Australia).

Annex 1 Details of data collection methods and response rates

a. Data sources

A range of methods were used and sources approached to obtain information on monetary values and other costs, benefits and other impacts of IAS policy measures. These include:

- a literature survey (e.g. scientific publications, available expert reports, grey literature and internet sources) was carried out. Websites of government departments, organisations and research institutes working on IAS and related issues in and outside of the EU were also extensively searched for relevant information.

- the literature survey was complemented by questionnaires sent to EU Member States and to selected jurisdictions with advanced or developing IAS policy frameworks (Australia, Canada, New Zealand, South Africa, Switzerland and USA), including plant and health, and environmental authorities in these countries, as well as to international organisations and individual experts (see List of Contributors above).

- direct contact with recognised IAS experts in some EU Member States and other jurisdictions aimed at obtaining additional practical insights.

- proceedings of the IAS Expert Group meetings conducted by the Commission were particularly useful in providing information on concerns and priorities.

- the previous reports prepared in the context of this study (Kettunen et al. 2009; Shine et al. 2008) also provided information on monetary values on the cost of IAS control/damage, the benefits of eradicating IAS and the cost of related measures (administration and application) and on existing and/ or proposed legislation on IAS in the EU and other selected countries.

b. Literature

The main literature used to define the methodology was as follows:

- the European Commission's Impact Assessment Guidelines (EC, 2009a);
- the Annex to the European Commission Impact Assessment Guidelines (EC, 2009b);
- standard frameworks for policy analysis (e.g. Hoghood and Gunn, 1984; Bardach, 2000).

The methodology also builds on the contractors' experience with support for impact assessments for the European Commission, including the IMPEL Practicability and Enforceability Checklist (IEEP 2006).

c. Questionnaire

Questionnaires were sent out to EU Member States[127], selected countries with advanced or developing IAS policy frameworks (Australia, Canada, New Zealand, South Africa, Switzerland and the USA), including plant and health authorities and environmental authorities in these countries, as well as to selected international organisations and IAS experts. This is the version of the questionnaire sent to EU MS:

***Towards an EU Strategy on Invasive Species*:**

Short questionnaire for Member States

As you know, the European Commission is carrying out preliminary work to develop an EU Strategy on invasive alien species (IAS). Technical support is provided by a team led by the Institute for European Environmental Policy (IEEP) and including the UNEP World Conservation Monitoring Centre (UNEP-WCMC). The team has already submitted two draft studies to the Commission on (1) assessment of the impacts of IAS in Europe and the EU and (2) policy options to minimise the negative impacts of IAS on biodiversity in Europe and the EU. These two reports were used as input to the EC Communication *Towards an EU Strategy on Invasive Species*, adopted on 3.12.2008[128] and its accompanying impact assessment report[129].

Under the third component of the technical support contract, UNEP-WCMC and IEEP are now preparing a detailed cost-benefit analysis of the alternative policy options outlined in the above Communication. This study requires specific quantified and numerical data on the costs and benefits of IAS policy measures already put in place in different countries to enable us to make objective and well-founded policy recommendations to the Commission.

UNEP-WCMC has therefore developed a short questionnaire addressed to Member States and to other selected countries with advanced IAS policy frameworks (such as the Australia, Canada, USA, New Zealand and South Africa). We would greatly appreciate your co-operation in responding to this questionnaire. For convenience, we attach the summary of existing policy measures in your country kindly provided during the preparation of the second component of this project.

1. Has there been an evaluation of existing and/or proposed measures for prevention and/or control of invasive alien species in your country or subnational region and if yes, what measures were evaluated?

2. If so, do you have information on the cost and benefits of implementing such measures (e.g. administrative costs related to development and implementation of the measure, costs of border control, monitoring, enforcement, staff and training requirements, equipment, information systems, inter-agency coordination etc)?

3. What are the identified benefits (in particular, monetary benefits) of each policy measure/approach/tool covered by the evaluation (e.g. benefits to economic sectors, society, biodiversity, costs of damage avoided etc)?

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127 For each of the 27 EU MS, the questionnaire was accompanied by the updated summary of existing national policy measures prepared for the Task 2 report in the context of this study (Shine et al. 2008).

128 EC Communication "Towards an EU Strategy on Invasive Species". Brussels, 3.12.2008 Com (2008) 789. Available online at : http://ec.europa.eu/environment/nature/invasivealien/docs/1_en_act_part1_v6.pdf

129 EC Annex to the Communication towards an EU Strategy on Invasive Species impact .Brussels, 3.12.2008. Available online at: http://ec.europa.eu/environment/nature/invasivealien/docs/1_en_impact_assesment_part1_v3.pdf

4. Which sectors and groups were identified as affected by each policy measure/approach/tool and how were they affected? Are any figures on costs/benefits for these respective sectors or groups available?

5. Which of these policy measures/approaches/tools were considered to work well in your respective countries/areas?

6. Which approaches/tools/measures were considered to be ineffective, insufficient or too complex or costly to implement?

We are aware that some of this information may be difficult to obtain or be held by other authorities and organisations (such as plant and animal health agencies, customs authorities and the commercial sector) in your country. We would therefore be grateful if you could copy this questionnaire to any other stakeholders who may be able to provide additional relevant information.

Please complete and return this form to: Abisha Mapendembe [abisha.mapendembe@unep-wcmc.org] by Friday 20th February 2009.

Please let us know if you require any additional information regarding this work.

Please include your name, e-mail and phone number

Thank you!

Annex 2 Raw data on the costs and benefits of IAS measures

PLEASE SEE THE ACCOMPANYING EXCEL FILE.

Annex 3 Detailed presentation of Policy Options and their possible components

Option A: Baseline scenario ***Business as usual - continuation with the ongoing implementation of existing instruments***	
Instrument	**Current scope and relevance**
Plant Health Directive (2000/29/EC)	Community-wide framework for prevention and control of specified 'harmful organisms' threatening plant health. No invasive alien plants (e.g. invasive plants with negative impacts on biodiversity) listed.
Animal health instruments	Set of Community instruments for prevention/control of terrestrial and aquatic animal diseases. Not applied to invasive animals that may impact native biodiversity.
Aquaculture Regulation (708/2007)	Only EC instrument exclusively focused on preventing intentional introductions of alien species damaging to biodiversity. Distinguishes between introduction to open and closed facilities. MS responsible for risk assessment and management based on criteria in Annex. Commission has decision-making power for introductions that could affect neighbouring MS. Caters for biogeographic variation. Does not affect application of existing EC plant/animal health legislation. Not applicable to keeping of ornamental aquatic animals/plants in pet-shops, garden centres, contained garden ponds or aquaria.
Wildlife Trade Regulation (338/97)	Legal basis to regulate intentional introduction into the Community of 'ecological threat' species and, as optional complement, their intra-Community holding/movement. Import of 4 invasive animal species currently prohibited.
Habitats and Birds Directives	Require MS to regulate intentional introductions to wild of non-native species that could damage biodiversity. MS have full discretion on scope of controls. Indirect management obligation for IAS affecting Natura 2000 sites. No explicit control rules.
Water Framework Directive (2000/60/EC)	No specific reference but but IAS (taxonomic composition) could be considered when assessing ecological status of a water body. IAS monitoring covered in some guidance documents under the Directive.
Marine Strategy Framework Directive (2008/56/EC)	IAS included in criteria for assessment of European marine waters to identify measures to achieve good environmental status.
Communication on an EU Forest Action Plan (COM(2006) 302 final)	Notes that global trade and climate change have increased potential vectors for harmful organisms and IAS and supports protection strategies, targeted risk assessments and research for harmful organisms/IAS affecting forest biodiversity.
EU Research Framework Programmes	IAS-related programmes qualify for funding. Major FP7 projects include ALARM, PRATIQUE, IMPASSE and EFFORTS.
LIFE+ Regulation (614/2007)	IAS control projects eligible under Nature & Biodiversity component (potentially under Information & Communication component). Used for control funding, notably on islands. Not adapted to prevention/rapid response.
Other funding mechanisms (eg EAFRD, structural and cohesion funds, development cooperation)	Could be used to address IAS but no earmarked IAS funding (although EAFRD includes IAS control in the requirements to keep land in Good Agricultural and Environmental Condition as part of cross-compliance). Limited examples of national/regional application for IAS (mainly control).

Option B
Maximising the use of existing legal instruments together with voluntary measures
The formal legal requirements would remain as they are today but there would be a conscious decision to proactively address IAS problems under existing legislation. This would imply carrying out risk assessments using existing institutions and procedures such as the European Food Safety Authority. Member States would voluntarily make IAS issues part of their border control function. A Europe-wide Early Warning and Information System based on existing activities could also be set up. The DAISIE inventory of IAS could be maintained and updated regularly. Species eradication plans would be developed and supported by national funds. Cross-sectoral stakeholder groups could be set up at appropriate levels to foster exchange of best practice, to develop targeted guidance and to help resolve conflicts of interest. Voluntary codes of conduct could be drawn up to encourage responsible behaviour by retailers, users and consumers. (Communication (2008) 789 final, §6.B)

Category of policy component	Indicative policy component	Comment & opportunities for implementation
General	No legislative change to baseline	No change to e.g.: • Plant Health Directive or animal health instruments • Aquaculture Regulation or Wildlife Trade Regulation • Habitats and Birds Directives • Water Framework Directive or Flood Risks Directive • Marine Strategy Framework Directive • Renewable Energy Directive
	No policy change to baseline	No change to existing major instruments
	No additional/dedicated Community funding	No change to funding instruments finalised for 2007-13: • LIFE+ Regulation • EAFRD, EFF, Structural & Cohesion Funds • Development cooperation instruments
	Voluntary coordination	• Within Commission (inter-service) ENV, COPHS (EPPO) • Between Commission and Member States • Within and between Member States • Between stakeholder groups
	Voluntary development of national strategy/action plan	
Prevention	Voluntary prevention measures	
	Information campaigns	May be initiated by EC or Member States (jointly or individually). Scope for EC to support translation and wider dissemination of existing codes and other initiatives
	Codes of conduct/best practice	
	Product/source certification	
	Regulatory prevention measures*	* Measures in this category require a legislative basis. Under Option B, these are termed 'discretionary' because Member States are free to determine the scope and focus of such

		measures (subject to already applicable Community legislation)
	Discretionary controls on direct introductions into the environment	Scope to promote more consistent implementation of existing legislation through EC guidance on: • IAS provisions in Habitats/Birds Directives (sectoral exemptions; consideration of IAS risks in EIAs); • Renewable Energy Directive (introduction of potentially invasive plants for biofuel cultivation that could impact biodiversity).
	Discretionary controls on introductions into captivity/containment	
	Discretionary controls on domestic holding, trade and movement	Scope to promote legal clarity through EC guidance on designing national measures consistent with operational rules and procedures for Single Market.
	Discretionary import pathway controls	
	Discretionary export pathway controls	
	Discretionary border controls and inspections	Variable investment and IAS focus, depending on Member State
	Discretionary risk assessment procedures	Scope for EC guidance to promote: • consistency with RA procedures under existing EC legislation • proactive use of existing institutions eg European Food Safety Authority
Early detection and rapid response	Early Warning and Information Exchange System (EWS)*	* The components below represent a low-intensity version of the EWS. Higher intensity options are shown under Options B+ and C below
	Voluntary maintenance and interlinkage of inventories	• at EU level (maintenance of DAISIE, subject to funding) • at Member State level
	Voluntary surveillance and monitoring	Scope to develop guidance under WFD/FRD/MSFD on: • consideration of IAS in ecological status assessments • consideration of IAS in inland water/marine environmental planning
	Voluntary information exchange	• voluntary network(s) of Member State focal points • voluntary interaction with EU agencies • informal circulation of management guidance • possible support at university/research institution level
	Voluntary contingency planning	Costs borne by Member States that choose to take action
	Voluntary rapid response mechanisms	
Long-term control and containment	Discretionary control/containment programmes	Conditional on: • Member State legislation and/or biodiversity plans; • availability of funds (LIFE+/national); • for transboundary IAS, commitment and capacity of neighbouring MS/MS in same sub-

	Voluntary restoration	region. Scope to develop EC guidance on prioritising control activities, including for species too widespread to be eradicated.
Horizontal measures	Voluntary public awareness activities	• incorporation of IAS into EU Biodiversity Communication Campaign • use of LIFE+ Information & Communication component • maintenance and extension of DG ENV IAS page • Member State initiatives
	Research programmes	• continued research under existing programmes • cevelopment of best practice guidance on risk assessment. • facilitated links to open-access online journals addressing IAS
	Discretionary use of existing EU funding instruments	Scope to develop guidance on using existing funds to support IAS prevention/control in the following areas: • biodiversity conservation • awareness building • agriculture, forestry and ecosystem management • projects with a transboundary dimension
	Discretionary use of existing development cooperation instruments	Scope to develop guidance on best practice to address: • IAS risks associated with export-related/ development activities • IAS as a livelihood issue (climate change adaptation, desertification) within EC-backed programmes.
	Capacity-building and infrastructure	Member State voluntary actions have resource implications for Customs, plant/animal health inspection, quarantine and environment services.

Option B+
Adapting existing legislation
This option is similar to option B in most respects, but would include amendments to the existing legislation on plant/animal health to cover a broader range of potentially invasive organisms and extension of the list of 'ecological threat species' for which import and internal movement are prohibited under the Wildlife Trade Regulation. If this approach were followed, additional resources would need to be dedicated to IAS in the assessment process and in the border control activities carried out by Member States (Communication (2008) 789 final, §6.B+)

Category of policy component	**Indicative policy component**	**Comment & opportunities for implementation**
General	No legislative change to baseline unless specified	As under Option B except as specified below.
	No policy change to baseline unless specified	As under Option B except as specified below.
	No additional/dedicated Community funding	As under Option B except as specified below.

	Stronger sectoral coordination	• Remains voluntary within Commission (inter-service) • Formalised between Commission and Member States for IAS affecting plant/animal health, through existing committees/national authorities • Outside the plant/animal health sector, remains voluntary within and between Member States
	Voluntary development of national strategy/action plan	
Prevention	Voluntary prevention measures	
	Information campaigns	As under Option B
	Codes of conduct/best practice	
	Product/source certification	
	Regulatory prevention measures*	* Measures in this category require a legislative basis. Under Option B+, certain measures are still left to the discretion of each Member State and will continue to depend on national legislation.
	Discretionary controls on direct introductions into the environment	• scope to review annexes to the Habitats and Birds Directives to modify protection status of species invasive in some parts of the EU • non-legislative alternative: guidance to MS on granting exemptions where an EU-protected species is invasive on national territory
	Discretionary controls on introductions into captivity/containment	
	Coverage extended: controls on direct introductions into the environment	The following measures could be introduced via amendment of legislation/species annexes as follows: • plant health Directive, to cover a broader range of potentially invasive organisms (eg invasive aquatic plants) • animal health instruments, to cover invasive animals that are not pests of plants or animal pathogens • Wildlife Trade Regulation, to expand list of ecological threat species subject to import ban and enable regulation of holding and movement independent of an import ban (eg to prevent entry of potential IAS to biodiversity-rich islands within the EU, including Outermost Regions)
	Coverage extended: controls on intra-Community holding and movement	
	Coverage extended: import pathway controls	
	Coverage extended: export pathway controls	
	Cooperation with non-EU neighbour countries on border controls	e.g. through formal agreements defining common intents
	Coverage extended: border control and inspection functions	• applicable to organisms/pathways covered by amended legislation, including in EU

		Outermost Regions. • would require additional resources dedicated to IAS in the border control activities carried out by MS
	Coverage extended: risk assessment procedures	• applicable to organisms/pathways covered by amended legislation. • would require additional resources dedicated to IAS in risk assessment procedures under existing plant/animal health legislation • WTR amendment needed to mandate risk assessment prior to listing of ecological threat species • involves use of existing institutions for oversight (eg EFSA)
	Coverage extended: environmental assessment	• amend criteria in annexes to environmental integration legislation (EIA, SEA, SIA) to explicitly address IAS/pathway risks • cross-border impacts of potential IAS to be considered as part of national and regional decision-making processes
Early detection and rapid response	Early Warning and Information Exchange System*	* The indicative components below represent a medium-intensity version of the EWS that does not involve dedicated legislation
	Institutional support for maintenance and interlinkage of inventories	As under Option B, but could be formalised through EU-designated technical agency, with secured financing. Options include: • harmonisation of data format and terminology used in national inventories to ensure interoperability • formal links with international information tools to address potential IAS not yet present in Europe
	Coverage extended: surveillance and monitoring	• limited to organisms/pathways covered by amended plant/animal health legislation (Wildlife Trade Regulation does not cover detection and response). • would require efficient linkage to EWS to ensure effective horizon-scanning for potential IAS affecting biodiversity. • use of existing alert and notification systems (eg EUROPHYT)
	Coverage extended: information exchange	
	Coverage extended: contingency planning	
	Rapid response mechanisms	
	Emergency funding	Use of existing co-financing mechanisms under plant/animal health instruments
Long-term control and containment	Coverage extended: control/containment for listed species	• limited to organisms/pathways covered by amended plant/animal health legislation (Wildlife Trade Regulation does not cover control) which supports a biogeographic approach • could be complemented by voluntary management guidance and species-specific action plans
	Funding for control (Co-financing mechanism)	Use of existing co-financing mechanisms under plant/animal health instruments

	Voluntary restoration	As under Option B
Horizontal measures	Voluntary public awareness activities	As under Option B
	Research programmes	As under Option B
	Targeted use of existing EU funding instruments	Existing co-financing mechanisms for plant/animal health are applied to address IAS prevention/control
	Discretionary use of existing development cooperation instruments	As under Option B
	Capacity-building and infrastructure	Main cost of implementation would fall on plant/animal health sector: implications for mandates, training, border control and quarantine

Option C
Comprehensive, dedicated EU legal instrument
This option would involve the setting up of a comprehensive, dedicated legal framework for tackling IAS with independent procedures for assessment and intervention taking into account existing legislation. If it were considered desirable and cost effective, the technical aspects of the implementation could be centralized by a dedicated agency. Member States including the European Outermost Regions would be obliged to carry out controls at borders for IAS and to exchange information on IAS. Mandatory monitoring and reporting procedures and efficient rapid response mechanisms might also be established. While it is possible to envisage some EU funding being dedicated to support eradication and control actions, Member States could also fund these actions directly (Communication (2008) 789 final, §6.C)

Category of policy component	**Indicative policy component**	**Comment**
General	Objectives: • to prevent the introduction into, establishment and/or spread in the EU of alien species that will or are likely to cause environmental or economic harm or harm to human, animal or plant health; • to ensure prompt and effective circulation of information to avoid delay and possible population expansion	• complements existing plant/animal health and aquaculture legislation and extends pathway/vector coverage; • implementation to be linked to species-based annexes, with fast-track procedure for amendment; • applicable to terrestrial, freshwater and marine ecosystems
	Creation of dedicated EU agency	Centralises technical aspects of implementation (EXPAND)
	Member State designation of competent authority	Functions as focal point on IAS issues with the Commission
	Mandatory national strategy/action plan	
Prevention	Voluntary prevention measures	
	Information campaigns	As under Option B
	Codes of conduct/best practice	
	Product/source certification	
	Regulatory prevention measures	

	Controls on direct introductions into the environment	Legislation establishes minimum common procedures for: • risk assessment • prior authorisation, operation of permit system • prior consultation on possible transboundary impacts • consideration of biogeographic regions within EU • contingency planning as condition of permit
	Controls on introductions into captivity/containment	
	Controls on domestic trade and movement	
	Import pathway controls	Legislation establishes standardised Community rules for: • pre-import (prevention at source) screening; • import risk protocols (supported by species lists)
	Export pathway controls	ADD
	Comprehensive border control and inspections	Including in European Outermost Regions
	Comprehensive independent risk assessment procedures	• conducted/validated by dedicated EU agency • take existing EC legislation into account • expand risk assessment of key pathways • development of harmonised technical standards • applicable to IAS control techniques
	Comprehensive environmental assessment	As under Option B+
Early detection and rapid response	Mandatory Early Warning and Information Exchange System, with Europe-wide coverage	Legislation establishes minimum standards for: • baseline assessment of IAS on national territory • monitoring • reporting and information exchange
	Mandatory contingency planning	As a minimum, required for IAS of Community concern with possibility of co-financing
	Rapid response mechanisms	
	Emergency funding	
Long-term control and containment	Mandatory control/containment for listed species	Legislation establishes minimum common procedures for: • IAS of Community concern (eg known high-risk; potentially affect more than one MS; threaten species/ habitats/ ecosystems protected or managed under EC legislation). • coordinated management strategies for listed IAS, based on a biogeographic approach supported by annexes
	Co-financing mechanism	

	Restoration	Mainstreamed into relevant policy areas and budget lines to extent feasible to support integrated approach.
Horizontal measures	Community-wide public awareness campaign	
	Dedicated research programme	
	Dedicated financial mechanism	• co-financing to support rapid response, eradication and control actions for IAS of Community concern across biogeographic regions • could be partially generated by cost-recovery mechanisms to support incremental costs of implementation EXPAND
	Capacity-building	EU support for training of e.g. border control staff

Annex 4 Species specific data used in Chapter 7.2.

Table 1. Estimated costs of common ragweed *(A. artemisiifolia)* extrapolated to its current range / possible range in Europe.

Estimated costs of policy measures							Total potential costs / species in Europe (million EUR / year)	Original source of data
Measure	**Annual costs**	**Unit for annual costs**	**Area impacted**	**Costs per km2 (million EUR / year)**	**Assumed area impacted**	**Total potential costs (million EUR / year)**		
Prevention - organising annual information days at national level	0.01	million EUR / year	39,550	0.00000025	2,677,539	0.68	**0.72**	Cost of organising annual *A. artemisiifolia* information days in Switzerland (2006-2008) (sFr 6500 / year) and coordination of the national *A. artemisiifolia* campaign programme in Germany (3 man months / year with average cost of 2000 EUR / month). **Source:** Dr. Corinne Vonlanthen(Swiss Federal Office for the Environment (FOEN)) pers. comm and Uwe Starfinger, Julius Kühn Institute - Federal Research Centre for Cultivated Plants, pers. comm.
Prevention - coordination of national campaign programme	0.006	million EUR / year	348,452	0.00000002	2,677,539	0.05		
Long-term control and containment	0.00016	million EUR / hecrate	n/a	0.02	1,517,500		**24,280.00**	Costs of controlling *A. artemisiifolia* (e.g. costs of chemical control in maize fields HUF15,000 - 20,000 / ha / year and costs of chemical control in sunflower fields HUF20,000 – 30,000 / ha / year) in Hungary in 2007. **Source**: Dr István Dancza, Ministry of Environment and Water State Secretary for nature and Environment Protection, pers. comm.

Estimated costs of damage	**83**	Costs of controlling *A. artemisiifolia* to health (allergies) in Germany and in Sweden based on Reinhardt et a. 2003 and Gren et al. 2003. **Source:** Based on calculations by Kettunen et al. 2009

* Area impacted refers to the total land area of a country
** Total land area of EU minus area already infected by common ragweed.
*** Current European range from DAISIE database

Table 2. Estimated costs of muskrat (*O. zibethicus*) extrapolated to its current range in Europe.

Estimated costs of policy measures						**Total potential costs / species in Europe (million EUR / year)**	**Original source of data**
Measure	**Annual costs (million EUR)**	**Area impacted***	**Costs per km^2 (million EUR / year)**	**Average costs per km^2 (million EUR / year)**	**DAISIE area km^2**		
Long-term control and containment	4.14000	348,452	0.0000119	n/a	2,377,500	**28.25**	Costs of controlling muskrat in Germany EUR 2.96 - 4.36 m in 2003. **Source**: As in Kettunen et al. 2009, original data by Reinhardt et al. 2003
Eradication (UK)	3.400	241,637	0.000014071	0.000011469	2,377,500	**27.27**	Costs of eradicating muskrat in the UK (in 1930s) and Germany (2006) (£ 2 million and 3 million EUR respectively). **Source:** As in Kettunen et al. 2009, original data by Reinhardt et al. 2003 and H. Thomas (Defra) pers. comm.
Eradication (DE)	3.090	348,452	0.000008868				

Estimated costs of damage	**246**	Costs of damage by muskrat in the Netherlands and Germany (e.g. damage costs on river banks and dams, damage to aquaculture) **Source**: calculated based on database by Kettunen at al. 2009, original data from van der Wijden et al. 2007, DAISIE database and Reinhardt et al. 2003)

* Area impacted refers to the total land area of a country

Table 3. Estimated costs of grey squirrel (*S. carolinensis*) extrapolated to its current range in Europe.

Estimated costs of policy measures					**Total potential costs / species in Europe (million EUR / year)**	**Original source of data**
Measure	**Annual costs (million / km²)**	**Area impacted***	**Costs per km² (million EUR / year)**	**DAISIE area km²**		
Long-term control and containment	n/a	n/a	0.0000035	270,000	**0.95**	Cost of controlling grey squirrels in woodlands **Source**: Andrew Kendall pers comm.
Estimated costs of damage	**Annual costs (million EUR)**	**Area impacted**	**Costs per km2 (million EUR / year)**	**DAISIE area km2**	**11.39**	Loss of broad leaf timber in the UK (£4,566,000 per yr) **Source:** Andrew Kendall pers comm.
	5.5	130,395	0.0000422	270,000		

* Area impacted refers to the total land area of a country

Table 4. Estimated costs of eradicating water hyacinth (*E. crassipes*) compared to costs of damage to hydropower stations.

Estimated costs of policy measures			Total potential costs / species in Europe (million EUR / year)	Original source of data
Measure	**Costs per km^2 (million EUR / year)**	**Assumed area impacted (km^2)**		
Eradication	1.835000	10	**18.35**	Cost of eradication of water hyacinth in Guardiana River, Spain in 2005-2008 (14,68 million EUR total costs for 75 km / 200 ha of river) **Source:** EPPO. 2008. Pest Risk Analysis for Water Hyacinth (Eichhornia crassipes) in Spain and Téllez et al. 2008. The Water Hyacinth, Eichhornia crassipes: an invasive plant in the Guadiana River Basin (Spain). Aquatic Invasions (2008) Volume 3, Issue 1: 42-53.
Estimated costs of damage	**Costs per hydropower station (million EUR / year)**	**Assumed area impacted**	**33.14**	Cost due to water hyacinth in 2007 - 2008 on the Victoria Falls Power Station (USD 946,822) Source: EPPO. 2008. Pest Risk Analysis for Water Hyacinth (Eichhornia crassipes) in Spain and Téllez et al. 2008. The Water Hyacinth, Eichhornia crassipes: an invasive plant in the Guadiana River Basin (Spain). Aquatic Invasions (2008) Volume 3, Issue 1: 42-53.
	0.3313877	100		

Table 5. Estimated costs of preventative measures against common ragweed (*A. artemisiifolia*) extrapolated for the whole of EU.

Estimated costs of policy measures							Total potential costs / species in Europe (million EUR / year)	Original source of data
Measure	**Annual costs**	**Unit for annual costs**	**Area impacted***	**Costs per km^2 (million EUR / year)**	**EU land area**	**Total potential costs (million EUR / year)**		

Prevention - organising annual information days at national level	0.01	million EUR / year	39,550	0.00000025	4,195,039	1.06	**1.13**	Cost of organising annual *A. artemisiifolia* information days in Switzerland (2006-2008) (sFr 6500 / year) and coordination of the national *A. artemisiifolia* campaign programme in Germany (3 man months / year with average cost of 2000 EUR / month). **Source:** Dr. Corinne Vonlanthen(Swiss Federal Office for the Environment (FOEN)) pers. comm and Uwe Starfinger, Julius Kühn Institute - Federal Research Centre for Cultivated Plants, pers. comm.
Prevention - coordination of national campaign programme	0.006	million EUR / year	348,452	0.00000002	4,195,039	0.07		

* Area impacted refers to the total land area of a country