The Multiple Costs of Invasive Alien Species

Patrick ten Brink
Head of Environmental Economics Programme and Head of Brussels Office

Building on IAS presentations by Marianne Kettunen and Clare Shine
IEEP’s Biodiversity Programme

Building on joint work with
Shine C., Kettunen M., Genovesi, P., Essl, F., Gollasch, S., Rabitsch, W., Scalera, R., & Starfinger, U.

Non-indigenous species in the North-East Atlantic
Ostend 21 November 2013
1. Impacts of IAS and their costs
2. EU impacts abroad
3. EU Regulation and integration of IAS costs
4. Addressing IAS: value for money
Overview: IAS status, impacts and costs
Status: alien species in Europe


- **Over 45 000 invasion events documented**

- **10,677 alien species reported**
  - Terrestrial plants 6357 (60%)
  - Terrestrial invertebrates 2519 (24%)
  - Terrestrial vertebrates 370 (3%)
  - Fungi 84 (0.8%)
  - Aquatic inland 480 (4%)
  - Aquatic marine 1069 (10%)

- **1094 species / 11% with documented ecological impacts**

- **1347 species / 13% with documented economic impacts**
Trends: introductions & species numbers increasing

Increased possibilities for / rates of IAS introductions & spread:

- Travel
- Trade
- Land use changes
- Climate change
- ...

Established alien terrestrial invertebrates in Europe

IAS are increasing in all environments and among all taxonomic groups:
In Europe they increased by 76 per cent over the period 1970 to 2007 (Butchart et al, 2010) see also EEA 2013
IAS ecological impacts

IAS are widely recognized a major threat to biodiversity and ecosystem functioning
(Vitousek et al, 1997; Mack et al, 2000; van der Wal et al, 2008)

- **Competing with other organisms:** plants like Japanese knotweed (*Fallopia japonica* (Houtt.) Dcne.) or Giant hogweed (*Hercleum mantegazzianum*) compete with native plans causing changes to habitat structure

- **Predating on native organisms:** Predation by American mink (*Mustela vision*) has caused significant population declines of ground nesting birds and small mammals

- **Hybridising** with a related species or varieties, such as the North American grass *Spartina alterniflora* Loisel. a which hybridized with the European *Spartina maritima* (M.A. Curtis) Fern. and produced the very invasive hybrid *Spartina anglica* C.E. Hubbard, which has radically changed coastal mudflat habitats in e.g. Great Britain, Denmark and Germany

- **Causing extinction of native species:** crayfish plague (*Aphanomyces astaci* Schikora) is known to threaten local populations of native crayfish with extinction

- **Being toxic:** toxic algae blooms are caused by alien phytoplankton such as *Chattonella verruculosa* (Hara & Chihara)

- **Being a reservoir for parasites or a vector for pathogens:** *Gyrodactylus salaris*

- **Disrupting pollination:** *Impatiens glandulifera* Royle competes for pollinators such as bumblebees so reduces seed set in these other plants

- **Altering energy and nutrient flows:** alien plants, such as *Robinia pseudacacia* L., alter nutrient availability via nitrogen fixation

- **Altering the local food web:** when appearing in large densities Asian date mussel (*Musculista senhousia* (Benson, 1842)) can shift the community from suspension-feeding to primarily deposit-feeding

- **Altering the composition and functioning habitats and ecosystems:** Water hyacinth (*Eichhornia crassipes*) changes water flow by overgrowing and blocking water bodies.

**IAS a major threat affecting:**
- 30% of threatened birds
- 11% of threatened amphibians
- 8% of threatened mammals

**By Baillie et al. 2004**
### Impacts: ecosystem services in Europe

(# IAS analysed = 125)

<table>
<thead>
<tr>
<th>Type of ecosystem service (ES) affected by IAS</th>
<th>Number of species per impact type</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Negative</td>
<td>Positive</td>
</tr>
<tr>
<td><strong>Provisioning Services</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Food and fibre</td>
<td>54</td>
<td>6</td>
</tr>
<tr>
<td>Fuel</td>
<td>-</td>
<td>(1)</td>
</tr>
<tr>
<td>Fresh water</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>57</td>
<td>7</td>
</tr>
<tr>
<td><strong>Regulating services</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Air quality maintenance</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>Water regulation (eg flood prevention, timing and magnitude of runoff, aquifer recharge)</td>
<td>13</td>
<td>-</td>
</tr>
<tr>
<td>Erosion control</td>
<td>8</td>
<td>3</td>
</tr>
<tr>
<td>Water purification / quality maintenance and waste management</td>
<td>4</td>
<td>2 (1)</td>
</tr>
<tr>
<td>Regulation of human / animal / plant diseases (i.e. IAS is a vector for disease)</td>
<td>13</td>
<td>-</td>
</tr>
<tr>
<td>Fire resistance (change of vegetation cover leading to increased fire susceptibility)</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>Other: human health other than diseases (e.g. allergies and injuries)</td>
<td>16</td>
<td>-</td>
</tr>
<tr>
<td>Other: destruction of infrastructure</td>
<td>4</td>
<td>-</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>60</td>
<td>7</td>
</tr>
<tr>
<td><strong>Cultural services</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cultural / natural heritage values</td>
<td>9</td>
<td>-</td>
</tr>
<tr>
<td>Aesthetic / cultural value, recreation and ecotourism</td>
<td>40</td>
<td>9</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>49</td>
<td>9</td>
</tr>
</tbody>
</table>

Recent EEA report (2012) concurs that there are multiple IAS impacts on:

- Biodiversity
- Ecosystem services,
- Human health, and
- Economic activities

Building on 28 “flagship species”
Early illustrative economic estimates: Environmental & economic costs of IAS in US, UK, Australia, South Africa, India:

- over US$ 314 billion in damage / year or US$ 240 /cap/year

  By Pimentel et al. 2001, Pimentel et al. (2005)

Sweden: 13 IAS damage and actual control costs estimate at:

~ 1620 and 5080 million SEK/yr
= 181 to 567 MEUR/yr or 19 to 63 EUR /capita/yr

  Gren et al., 2009

In Canada – annual timber losses due to IAS are estimated at 61 million m3, equivalent to CND$720 millions/ year (~540 million EUR/year) in financial losses to stumpage, royalties and rent revenues.

Impacts: economic impacts estimates: examples

In Canada – annual timber losses due to IAS are estimated at 61 million m$^3$, equivalent to CND$720 millions/ year (~540 million EUR/year) in financial losses to stumpage, royalties and rent revenues.


Canary Islands (Lanzarote) 2004: 100 Million Pilgrom Crickets (Desert Locusts) landed on the coast of the Canary Islands due to the south-eastern winds.

The crickets devoured around 1% of crop land and a significant amount of pesticides were used against them, causing damage to endemic species.

See Sauter et al., 2013: Impact of Climate Change on EU Islands
Impacts: estimated economic impacts Europe

- **Documented costs**: **12.5 billion EUR / year**
  - Damage: 9.6 billion EUR
  - Control: 2.8 billion EUR

- Documented costs that could be identified for economic sectors: **6 billion EUR / year** (of 12.5 billion EUR / year)

- **Extrapolated costs**: **20 billion EUR / year**

**Inputs into European Commission’s impact assessment (IA) supporting EU Regulation on IAS**

*By Kettunen et al. 2009, 136 species analysed*

*Costs of 26 species (EUR / km²) extrapolated for their total range in Europe*

This is an estimate building on past costs occurred - It should be seen as **indicative order-of-magnitude values to illustrate scale of potential future costs**. Actual future costs will of course depend on impacts and measures taken to reduce them.

<table>
<thead>
<tr>
<th>Taxa / biome of IAS</th>
<th>SUM of known costs in EU (million EUR / year)</th>
<th>No of cases / species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fungus &amp; bacteria (freshwater/terrestrial)</td>
<td>1909</td>
<td>4 / 2</td>
</tr>
<tr>
<td>Freshwater invertebrate</td>
<td>147</td>
<td>7 / 6</td>
</tr>
<tr>
<td>Freshwater vertebrate</td>
<td>0.1</td>
<td>3 / 3</td>
</tr>
<tr>
<td>Freshwater plant</td>
<td>25</td>
<td>13 / 9</td>
</tr>
<tr>
<td>Marine invertebrate</td>
<td>33</td>
<td>2 / 2</td>
</tr>
<tr>
<td>Marine vertebrate</td>
<td>no info</td>
<td>no info</td>
</tr>
<tr>
<td>Marine plant</td>
<td>19</td>
<td>2 / 2</td>
</tr>
<tr>
<td>Terrestrial invertebrate</td>
<td>1473</td>
<td>14 / 10</td>
</tr>
<tr>
<td>Terrestrial vertebrate</td>
<td>4822</td>
<td>42 / 18</td>
</tr>
<tr>
<td>Terrestrial plant</td>
<td>3740</td>
<td>34 / 10</td>
</tr>
<tr>
<td>Various taxa/species</td>
<td>198</td>
<td>2</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>12369</strong></td>
<td><strong>124 / 62</strong></td>
</tr>
</tbody>
</table>
Impacts: conclusions

- IAS have negative impacts in Europe / the EU (ecological & socio-economic, costs to economic sectors including agriculture, fisheries, forestry, infrastructure and health ... )

- Some socio-economic impacts also positive - but they are often accompanied with negative impacts on biodiversity

- The European / EU cost estimates developed are likely to be conservative & underestimates of real costs – due to limited data / data gaps

- Given the rate of invasions, negative impacts (e.g. costs) likely to increase in the future
EU impacts abroad
Different pathways – roles and responsibilities?
Impacts abroad

- On EU’s overseas territories/outermost regions
- Islands are particularly sensitive to IAS
- Trade and tourism creates significant IAS risks and important to avoid impacts
- Also risks to other all third countries

The Introduction of IAS is considered to be a major factor leading to the loss of island biodiversity in overseas territories.

A very high proportion of post 1600 extinctions have been of island species

Groombridge 1992

This raises question on roles and responsibilities: EU internal, & global responsibility & what the costs of different measures might be, and their value for money & where can what measures at what point in the IAS pathways address risks?
Actions and value for money
Key tools & measures considered in IAS policy response

The three (four) stage hierarchy

- Prevention
- Early detection and rapid response
- Control and management
- Ecosystem restoration

Cross-cutting tools

- Risk assessment and species lists
- Research and information exchange
- Financial mechanisms

Horizontal measures

- Institutional and regional coordination
- Communication, awareness and partnerships
- Accountability and compliance

Shine, C. et al. 2010. Analysis of the impacts of policy options/measures to address IAS.
**Action: multi-level governance addressing multi-stakeholders**

**Different pathways & stakeholder involvement**
- Forestry
- Agriculture
- Fisheries
- Game
- Horticulture
- Pet & aquarium species trade
- Research
- Customs
- Permitting agents, inspectors
- Shipping ...

**Different competences → different administrative levels**
- EU
- National
- Regional
- Local
- Land owner
- Business
- Citizens
- + global & bilateral cooperation

---

**Already some existing legislative tools at EU (e.g. EFSA, PHR, WTR, HD et al.) and National levels + implementation on the ground.**

**But gaps in IAS coverage.**

**Already some significant national efforts (e.g. UK, Sweden, Finland), but IAS challenge far from addressed across Member States**

**Significant cost-efficiencies in coordinated / common approaches**

---

EFSA (European Food Safety Authority); PHR (Plant Health Regime); WTR (Wildlife Trade Regulation); HD (Habitats Directive)
CHAPTER I GENERAL PROVISIONS

Art. 4: List of invasive alien species of Union concern (max 50)
Art. 5: Risk assessment and delegated acts (EU or MS)

CHAPTER II PREVENTION

Art. 7: Ban on invasive alien species of Union concern
Art. 9: Emergency measures
Art. 10: Restrictions on the intentional release of IAS of MS concern (permits et al)

CHAPTER III EARLY DETECTION AND RAPID ERADICATION

Art. 11: Action plans on the pathways of invasive alien species (T+18m)
Art. 12: Surveillance system (T+18m)
Art. 13: Official controls at the Union borders (inspections et al) (T+12 m)
Art. 15: Rapid eradication at an early stage of invasion

CHAPTER IV MANAGEMENT OF INVASIVE ALIEN SPECIES THAT ARE WIDELY SPREAD

Art. 17: Management measures (12 months after IAS inclusion in Art 4 list)
Art. 18: Restoration of the damaged ecosystems

CHAPTER V FINAL PROVISIONS

Art. 19: Reporting (T+3 years)
Art. 24: Administrative measures and sanctions (MS: must be effective, proportionate & dissuasive.
Effective policy response / framework also cost effective

→ Cost of policy action < cost of inaction

→ Cost of prevention < cost of control

In the majority of cases, invasions are only reversible at high cost (Andersen et al, 2004). Prevention should always be the preferred management option where feasible.
Example: IAS prevention EUR < damage EUR

Estimated costs of policy measures to prevent (mainly via awareness raising / info campaigns) the spread of common ragweed (A. artemisiifolia) across the non-invested area in the EU, in comparison to costs of damage extrapolated to cover species’ current range in Europe.

Shine, C. et al. 2010. Analysis of the impacts of policy options/measures to address IAS.
Example: IAS action EUR < damage EUR

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.

Shine, C. et al. 2010. Analysis of the impacts of policy options/measures to address IAS.
Overall estimates of costs and benefits

IAS costs of no additional action: yearly estimate

- Documented costs: **12.5 billion EUR / year**
  - Damage: 9.6 billion EUR
  - Control: 2.8 billion EUR

- Extrapolated costs*: **20 billion EUR / year**

* Costs of 26 species (EUR / km²) extrapolated for their total range in Europe

By Kettunen et al. 2009, 136 species analysed

Costs of addressing IAS (related to policy options studied in 2010 report)

**40 to 190 million EUR / year for EU+MS**
(range: low effort to high effort)

- EU level info and early warning system
- National on the ground monitoring
- National risk assessments
- Permitting and inspection re intentional introductions
- Inspections for unintentional introductions
- Management control of IAS of EU concern
- Et al.

See Shine et al 2010

These were 2009 and 2010 estimates – important input to IA.

Costs of inaction and benefits of action often go to different stakeholders

Note that the estimated costs of addressing IAS should not be taken as costs associated with the final proposal given some differences in policy measures.
Summary

- IAS impacts important: biodiversity, health, economic activity (& public budgets)
- EU has own interest to act (inc. outermost regions) & responsibilities (3rd countries)
- Prevention can be very cost effective, as can early action
- Existing measures on IAS do not address the whole challenge > new measures needed
- Need co-ordination/cooperation for effective action, and keep costs down
- EU level role important to complement MS efforts – Regulation COM(2013) 620
- EU proposal in front of EP now – assessments of costs of inaction on IAS and cost of measures to reduce risks key to the Regulation’s progress
- Numbers can never be precise, but clear benefits > costs & fit-for-purpose in EU’s IA
- Specific cases invaluable to complement macro-assessments & communicate importance
- The potential to avoid biodiversity impacts as well as wider socio-economic costs depends on negotiations, on complementary Member State actions & implementation.
Thank you for your attention!

Patrick ten Brink  ptenbrink@ieep.eu  
With thanks to Marianne Kettunen, IEEP Biodiversity Team,  Mkettunen@ieep.eu

IEEP is an independent not for profit institute dedicated to advancing an environmentally sustainable Europe through policy analysis, development and dissemination. 
For further information see:  http://www.ieep.eu  
Follow us on twitter: IEEP_EU

For more information about IEEP’s work on IAS, please visit:  www.ieep.eu  or contact Marianne Kettunen who is leading IEEP’s work in this area:  Mkettunen@ieep.eu
Additional information sources


**JRC:** EASIN (European Alien Species Information Network) [http://easin.jrc.ec.europa.eu/use-easin](http://easin.jrc.ec.europa.eu/use-easin)

**DAISIE:** [http://www.europe-aliens.org/index.jsp](http://www.europe-aliens.org/index.jsp)


**IEEP Reports**


Institute for European Environmental Policy (IEEP)

- IEEP is an **independent research organisation** concerned with policies affecting the environment in Europe and beyond
  - **Research and consultancy** on the development, implementation and evaluation of environmental and environment-related policies in Europe
  - **Policy advise and intelligence**
  - **Capacity-building**

- Interdisciplinary staff including lawyers and natural and social scientists

- **Key research areas:**
  - Governance (including the reform and greening of EU budget and related funding instruments)
  - Agriculture and land management
  - Biodiversity
  - Climate change and energy
  - Resources use, waste and chemicals
  - Water, marine and fisheries; and
  - Environmental Economics (green economy, value of nature, EHS/MBI et al,)