



Institute for  
European  
Environmental  
Policy

## The Economic costs of Invasive Alien Species (IAS)

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***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.

*Biodiversity's Ticking Time Bomb:  
Understanding and Addressing the Problem of Invasive Species in Europe  
European Parliament, 21 February 2013*



# Presentation Structure

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- 1. Impacts of IAS and their costs**
- 2. EU impacts abroad**
- 3. Addressing IAS: value for money**

A close-up photograph of a flowering plant with vibrant purple buds and partially open flowers. The leaves are a deep, glossy green and have an elliptical shape. The background is slightly blurred, showing more of the same plant. A semi-transparent white rectangular box is overlaid in the center of the image, containing the text.

Overview: IAS status, impacts and costs



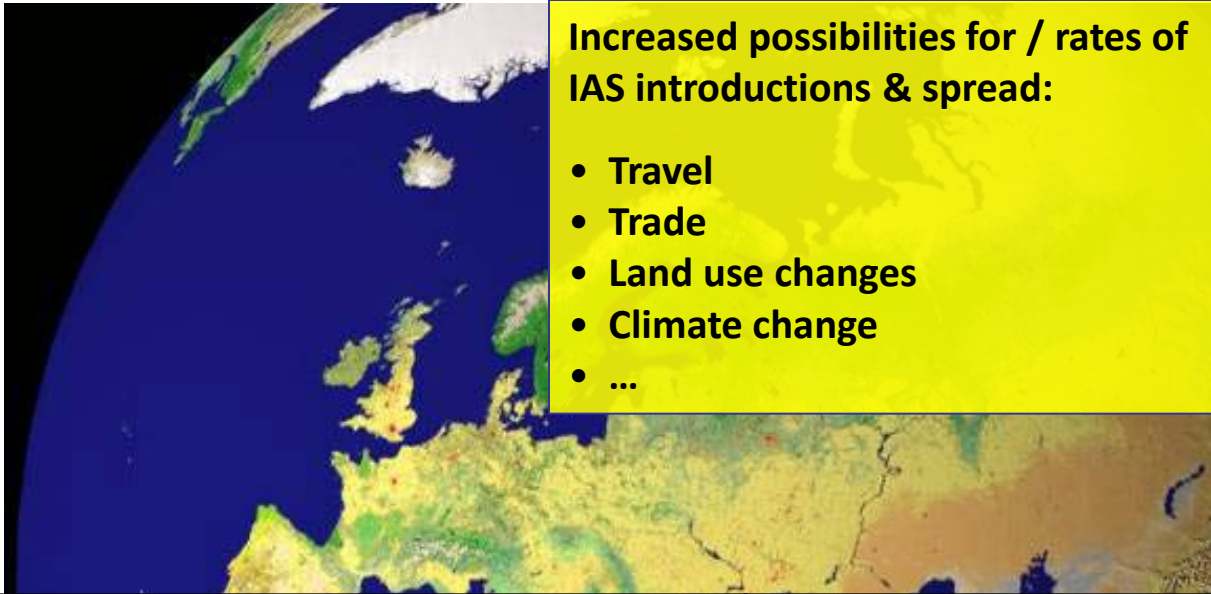
# Status: alien species in Europe

## DAISIE: IAS inventory for Europe (2004-2008)

- 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

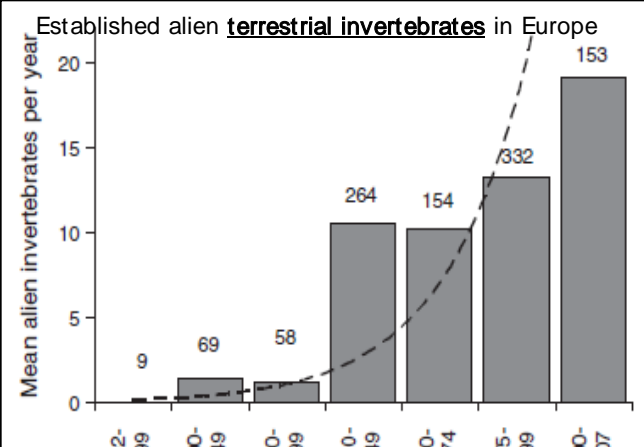
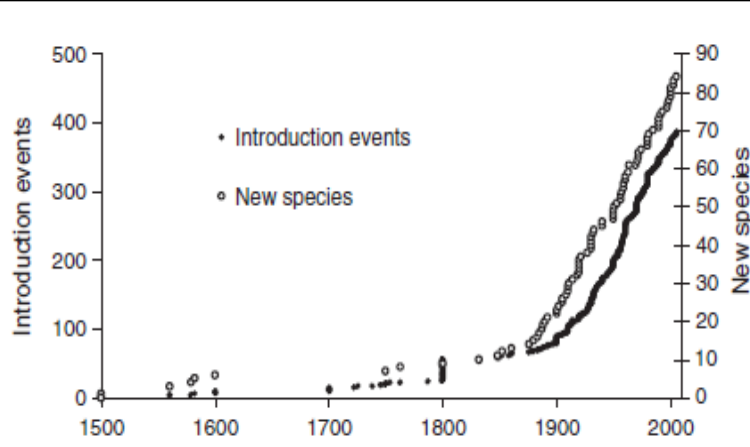
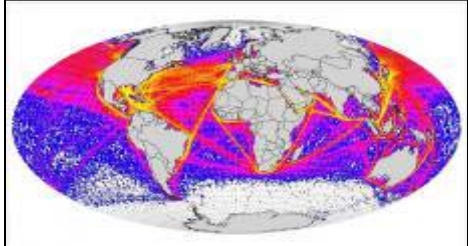


# Trends: introductions & species numbers increasing



**Increased possibilities for / rates of IAS introductions & spread:**

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



**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 plants causing changes to habitat structure
- **Predating on native organisms:** Predation by American mink (*Mustela vison*) 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. 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 and so reduces seed set in these other plants)
- **Altering energy and nutrient flows:** alien plants, such as *Robinia pseudoacacia*
- **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

Baillie et al. 2004



# Impacts: ecosystem services in Europe (# IAS analysed = 125)



Type of ecosystem service (ES) affected by IAS	Number of species per impact type		
	Negative	Positive	Both + & -
<b>Provisioning Services</b>			
Food and fibre	54	6	16
Fuel	-	(1)	-
Fresh water	3	1	-
<b>Total</b>	<b>57</b>	<b>7</b>	<b>16</b>
<b>Regulating services</b>			
Air quality maintenance	-	2	-
Water regulation (eg flood prevention, timing and magnitude of runoff, aquifer recharge)	13	-	-
Erosion control	8	3	2
Water purification / quality maintenance and waste management	4	2 (1)	-
Regulation of human / animal / plant diseases (i.e. IAS is a vector for disease)	13	-	-
Fire resistance (change of vegetation cover leading to increased fire susceptibility)	2	-	-
Other: human health other than diseases (e.g. allergies and injuries)	16	-	-
Other: destruction of infrastructure	4	-	-
<b>Total</b>	<b>60</b>	<b>7</b>	<b>2</b>
<b>Cultural services</b>			
Cultural / natural heritage values	9	-	-
Aesthetic / cultural value, recreation and ecotourism	40	9	14
<b>Total</b>	<b>49</b>	<b>9</b>	<b>14</b>



# The main types of impacts caused by Invasive Alien Species: EEA report:

<http://www.eea.europa.eu/publications/impacts-of-invasive-alien-species>



EEA Technical report | No 16/2012

The impacts of invasive alien species in Europe

ISSN 1725-2237

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”

**Table 3.1** The main types of impact caused by IAS separated into 4 main categories, and the 28 'flagship' species selected to describe such impacts

Impact	Subsection	Species account
Impacts of IAS on biodiversity	Competing with local species	American mink Bullfrog
	Predating local species	Brook trout Common slider
	Transmitting or causing diseases or harm to local species	Red swamp crayfish Chytrid fungus
	Hybridising with native species	Canada goose Ruddy duck
	Affecting habitats ecosystem engineering or modifying or changing habitats	Rabbit Killer alga
Impacts of IAS on ecosystem services	Interfering with supporting services	Japanese knotweed Ice plant
	Interfering with provisioning services	Pontic rhododendron Spanish slug
	Interfering with regulating services	Water hyacinth Yellow-legged hornet
	Interfering with cultural services	Killer shrimp Tree of heaven
	Impacts of IAS on human health	Disease vectors
Health impacts		Common ragweed Giant hogweed
Impacts of IAS on economic activities	Damaging infrastructure	Coypu Zebra mussel
	Damaging landscapes	Red palm weevil Horse-chestnut leaf-miner
	Damaging agriculture	Grey squirrel Rose-ringed Parakeet

# Impacts: economic impacts estimates: examples

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Known environmental and economic costs of IAS in the US, UK, Australia, South Africa, India:

- over US\$ 314 billion in damage / year
- US\$ 240 per capita / year

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

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

*Kremer-Nozic E., Wilson B., and Arther L. (2000)*

In the Black Sea the comb jellyfish IAS (predators) contributed to the fall in **anchovy landings from hundreds of thousands of tons to tens of thousands of tons per year** by the end of the 1980s, with a loss of **150,000 jobs**.

*Lubchenco, (1997) and Harbison and Volovik, (1994)*



# 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**

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

\* Costs of 26 species (EUR / km<sup>2</sup>) 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.

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



# Impacts: conclusions

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- 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

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- **On EU's own overseas territories / outermost regions**
- **Islands are particularly sensitive to IAS**
- **Trade and tourism creates significant IAS risks and hence 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, and global responsibility  
& what the costs of different measures might be, and their value for money**



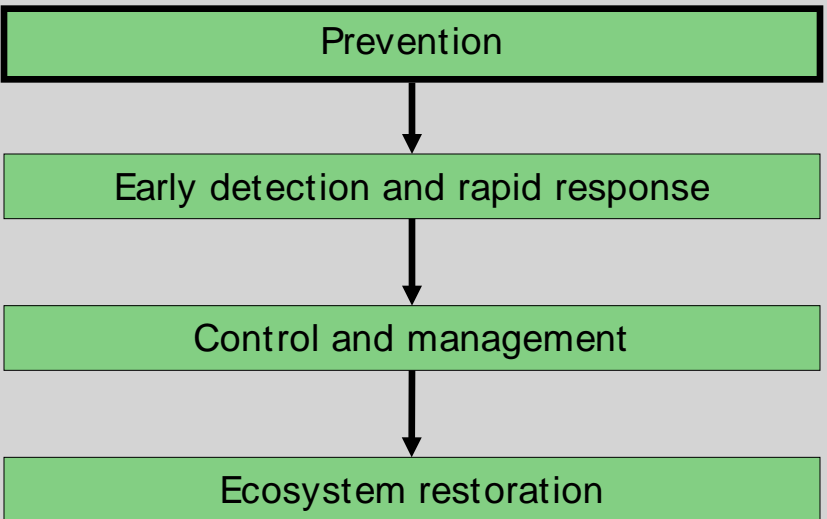
Actions and value for money



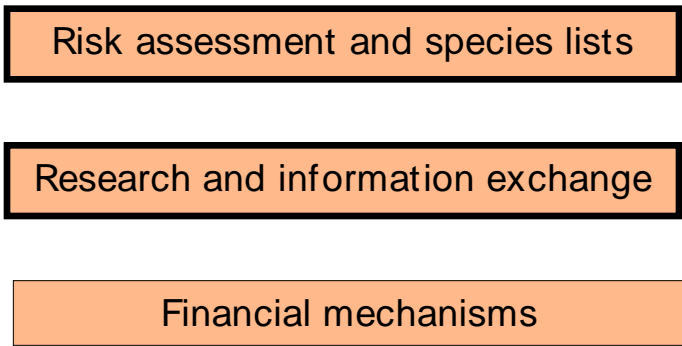


# Key elements of IAS policy response

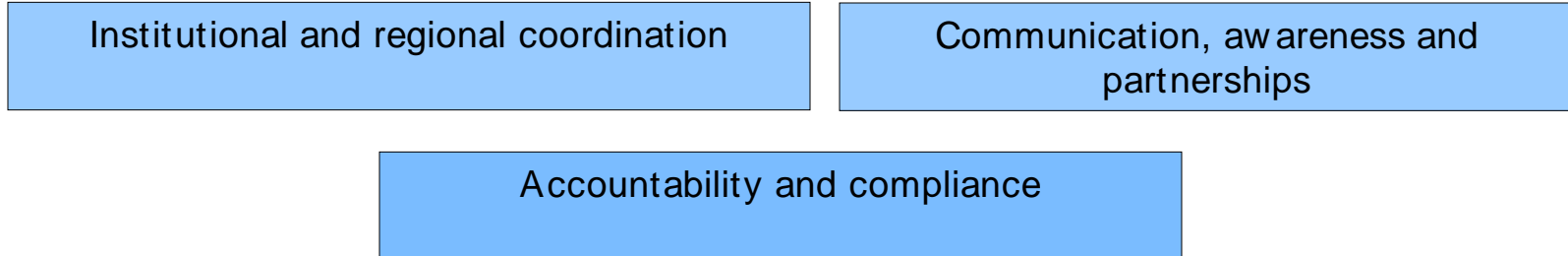
## The three (four) stage hierarchy



## Cross-cutting tools



## Horizontal measures



# Action: multi-level governance addressing multi-stakeholders



## Different pathways & stakeholder involvement

- Forestry
- Agriculture
- Fisheries
- Game
- Horticulture
- Pet & aquarium species trade
- Research
- Customs
- Shipping ...

## Different competences → different administrative levels

- EU
- National
- Regional
- Local
- Land owner ...
- + 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**



# Outcome of a successful policy response

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**Effective policy response / framework also cost effective**

→ **Cost of policy action < cost of inaction**

→ **Cost of prevention < cost of control**

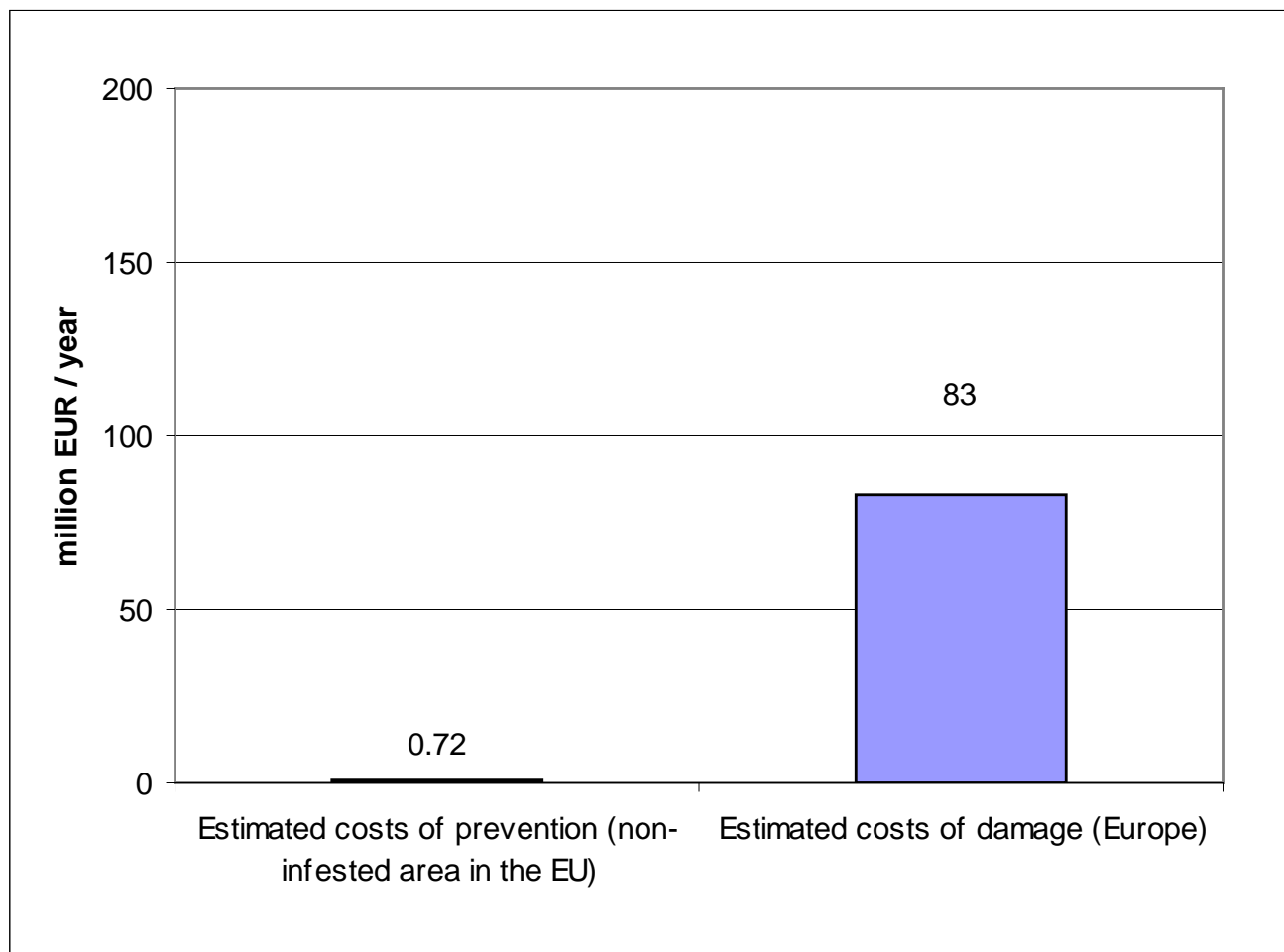
**In the majority of cases, invasions are only reversible at high cost** (Andersen et al, 2004).  
**Prevention should always be the preferred management option where feasible**



# Example: IAS prevention EUR < damage EUR



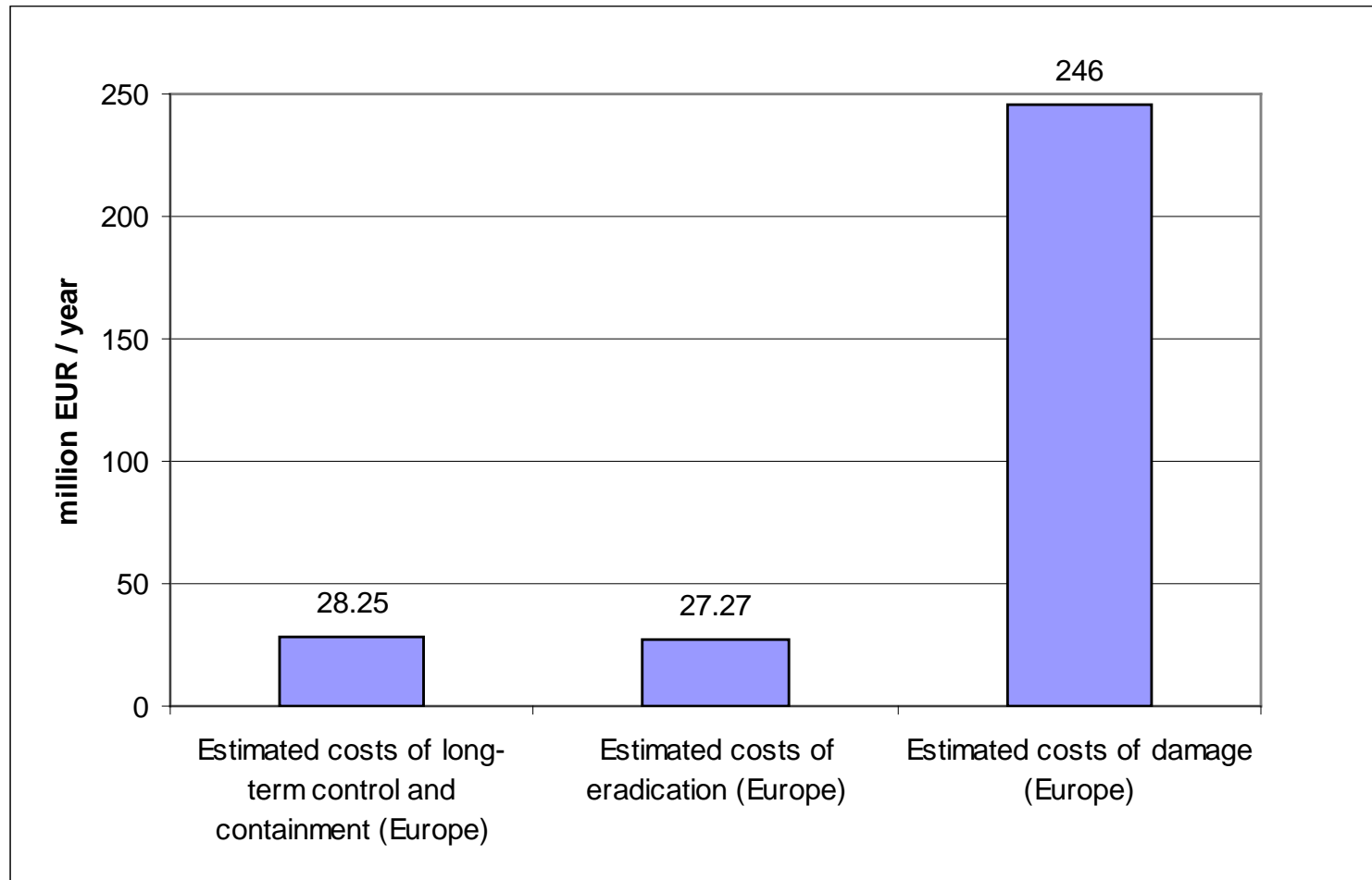
Estimated costs of policy measures to **prevent** (mainly via awareness raising / info campaigns) **the spread of common ragweed** (*A. artemisiifolia*) across the non-invaded area in the EU, in comparison to costs of damage extrapolated to cover species' current range in Europe.



# 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.



# 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**

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

\* Costs of 26 species (EUR / km<sup>2</sup>) extrapolated for their total range in Europe

## Costs of addressing IAS

**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*

# Summary

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- IAS impacts important: biodiversity, health and economic activity
- EU has own interest to act (inc. outermost regions) & responsibilities (third countries)
- Risk and scale of IAS impacts can only be expected to grow in the future
- Prevention can be cost effective, as can early action
- Existing measures on IAS do not address the whole challenge
- Need new measures to address the gaps / remaining challenges
- Need co-ordination/cooperation for effective action, and keep costs down
- EU level role important to complement national efforts



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**Thank you for your attention !**

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**For more information about IEEP's work on IAS, please visit: [www.ieep.eu](http://www.ieep.eu) or contact Marianne Kettunen who is leading IEEP's work in this area: [Mkettunen@ieep.eu](mailto:Mkettunen@ieep.eu)**



# Additional information sources



**European Commission:** [http://ec.europa.eu/environment/nature/invasivealien/index\\_en.htm](http://ec.europa.eu/environment/nature/invasivealien/index_en.htm)

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

**DAISIE:** <http://www.europe-aliens.org/index.jsp>

**EEA:** <http://www.eea.europa.eu/publications/impacts-of-invasive-alien-species>

<http://www.eea.europa.eu/publications/streamlining-european-biodiversity-indicators-sebi>

## IEEP Reports

Shine, C., Kettunen, M., Genovesi, P., Essl, F., Gollasch, S., Rabitsch, W., Scalera, R., Starfinger, U. and ten Brink, P. 2010. *Assessment to support continued development of the EU Strategy to combat invasive alien species*. Final Report for the European Commission. Institute for European Environmental Policy (IEEP), Brussels, Belgium. <http://www.ieep.eu/work-areas/biodiversity/invasive-alien-species/2011/02/assessment-to-support-continued-development-of-the-eu-strategy-to-combat-invasive-alien-species>

Shine, C., Kettunen, M., ten Brink, P., Genovesi, P. & Gollasch, S. 2009a. *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.

Shine, C., Kettunen, M., Mapendembe, A., Herkenrath, P. Silvestri, S. & ten Brink, P. 2009b. *Technical support to EU strategy on invasive species (IAS) – Analysis of the impacts of policy options/measures to address IAS*. Final report for the European Commission. Institute for European Environmental Policy (IEEP) (Brussels, Belgium) and UNEP-WCMC (Cambridge) . 101 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 module report for the European Commission). Institute for European Environmental Policy (IEEP), Brussels, Belgium. 104 pp. + Annexes.

Miller, C., Kettunen, M. & Shine, C. 2006. *Scope Options for EU Action on Invasive Alien Species (IAS)*.

# Institute for European Environmental Policy (IEEP)

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  - Biodiversity
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  - Resources use, waste and chemicals
  - Water, marine and fisheries; and
  - Environmental Economics (green economy, value of nature, EHS/MBI et al,)