

Fundamentals of Agrobiodiversity

Unwelcome guests – invasive alien species (IAS)

The globalisation of flora and fauna has changed biodiversity more significantly than any other phenomenon apart from species extinction. Human activity has introduced animals and plants to regions previously inaccessible to them. In some cases this has been an intentional process, while in others species have been introduced accidentally and frequently unnoticed at first.

Alien species can be found amongst animals, plants and micro-organisms. Alien or exotic animal species are known as 'neozoa', and plants as 'neophytes'. Not all succeed in becoming established or spreading to any great extent. Only a few give cause for concern in terms of the environment, the economy or human health, or have the potential to harm biological diversity. Such species are termed 'invasive'. The distinction between 'alien' and 'invasive' species is not always clear-cut and ultimately depends on the damage they cause.

The 'tens rule' suggests that of all the introduced species, about 10% escape to the wild. Of these, about 10% become established in their new environment. And a tenth of these in turn become invasive and pose an ecological, economic or health hazard. Although this rule has been challenged and modified several times, it nonetheless shows that comparatively few species become invasive. However, it is extremely difficult to predict whether or not a new species will become a pest due to the complex interactions of ecological systems.

Causes of the spread of invasive alien species

The underlying cause of the spread of invasive species is the increased mobility of society. The rise of global tourism and trade has meant that not only people and goods, but also plants, animals and micro-organisms are transported over large distances, and across geographical and climatological barriers to areas where they do not naturally occur.

Seeds can be carried unintentionally to other regions, in the mud adhering to vehicle wheels, in imported timbers or packaging materials. Travellers bring pathogens home with them or inadvertently transport insects or micro-organisms harbouring in their baggage or clothing. Carelessness is the major culprit of such inadvertent transfer of organisms, coupled with a lack of awareness of the potential impact.



The prevalence of wild-growing water hyacinth (*Eichhornia sp.*) can block the passage of boats and disrupt shipping.
Source:
Projektwerkstatt GmbH

Familiar examples of the **inadvertent introduction** of alien species are the brown rats which are decimating kiwi populations in New Zealand, the zebra mussel which attached itself to ships and has succeeded in colonising all of central Europe, and the water hyacinth which has clogged the surface of many waterways and made fishing and shipping impossible.

In contrast the **intentional introduction** of alien species is usually driven by economic considerations, such as the need to improve yields in agriculture, forestry, horticulture or fisheries, or the pursuit of leisure activities. Some ornamentals and crop plants escape gardens and agricultural areas and become established elsewhere. When new crop plants are introduced it is often impossible to predict whether they will become invasive. Numerous alien species of game animal have been deliberately introduced such as the common pheasant to central Europe and the rabbit to Australia. Most of these species need human care and protection to survive, but some have the potential to become entrenched in their new environment, building up stable populations and prevailing over their indigenous competitors.

Species of plants which need no more than the wind to pollinate and disperse their seeds spread extremely quickly. A fast growth habit, undemanding nature and short generation time favour the process, as does a tolerance to wet or dry conditions, heat or cold or high levels of soil salinity. When they encounter no natural enemies – such as certain insects – invading plant species are able to proliferate more quickly in their new environment than in their native habitat.

Habitats which have been disrupted by outside influences are susceptible to the colonisation and spread of invasive species. Although some species are quite capable of invading intact and resilient ecosystems, they are much more likely to infiltrate 'disturbed' habitats. For instance, they spread throughout farmland, grazing land, housing estates and roadsides. Human activity is constantly creating new ecological niches which are quickly populated by alien species.

Major changes in species composition and the local emergence of new species have also been linked to climate change. Any change in local climate, regardless of whether it becomes warmer or cooler, wetter or dryer, causes stress and decreases the ability of local species to compete. This situation encourages the infiltration of species which are better adapted to the new conditions. For instance, ornamentals that have been growing innocuously in certain areas for many years can suddenly become invasive when climatic changes cause the environmental conditions to become more favourable.

Ecological and economic impact

The economic impact of invasive species is substantial. In Europe alone the damage is estimated to run to at least EUR 10 billion per year – triggered by more than 11,000 alien plants, animals and micro-organisms. As only 10% of these species have so far been assessed in terms of economic impact, the actual damage is likely to be much greater.

In the marine realm the intake and discharge of ballast water to maintain the stability of shipping vessels has added a new dimension to the spread of alien species. It is estimated that the global merchant fleet carries about 10 billion tonnes of ballast water each year, transporting about 7,000 waterborne organisms around the world every day. The North American comb jellyfish was accidentally introduced to the Black Sea in this way, almost eradicating stocks of anchovy and sprats, and inflicting catastrophic and permanent damage on the local fishing industry. The Chinese mitten crab spread to numerous areas in the same way; the damage it has caused to riparian zones, fishing equipment and industrial infrastructure in Germany alone is estimated at EUR 80 million.

Along with the comb jellyfish and the mitten crab, the list of 100 of the World's Worst Invasive Alien Species includes the Asian tiger mosquito which, aided by climate change, is spreading across Europe, particularly Italy. This unwelcome bloodsucker can transmit pathogens such as the West Nile virus, and trigger dengue and chikungunya fever.

Lantana camara, a native of tropical America, has made rapid inroads into wide areas of Asia in recent years, becoming a dreaded weed which attacks both natural and agricultural ecosystems. In the forest it forms dense, bushy undergrowth that inhibits the growth of the natural vegetation, thus decreasing biodiversity. It also threatens fields, pastures and gar-



Cultivation of the 'energy plant' *Jatropha curcas* in Cameroon.

Source: FairTradeFuel.org

dens as it poses a risk to coffee, palm oil, coconut and cotton plantations. It has overrun entire sandalwood plantations in India. *Lantana* is not only hazardous to other plants, but also animals. It contains toxic substances which lead to digestive disorders and reduced milk yield in grazing animals. *Lantana camara* is rarely afflicted by disease, needs little water and tolerates extreme heat.

Black wattle *Acacia mearnsii* is very popular throughout many regions of the world. It is native to Australia, but for economic reasons it became established in Asia, Africa and South America long ago. It is a fast-growing tree with the ability to fix nitrogen in the soil. Its bark is a commercial source of tannin which is used for tanning leather, and its wood can be processed into charcoal or simply used as firewood. However, black wattle also suppresses indigenous vegetation and rapidly spreads across grazing land and riparian zones, extracting large amounts of water from the soil. After bushfires the black wattle is usually the first species to germinate, crowding out the later growth of natural vegetation. The current trend of extracting energy from plant matter increases the risk of colonisation by potentially invasive alien species. For instance, *Jatropha curcas* is widely cultivated as an energy crop: although not yet listed as an invasive species, its undemanding nature and tolerance to drought make it highly suspect. For this reason Australia, following the precautionary principle, has already banned the cultivation of *Jatropha*. Recent studies indicate that a very large number of tropical and subtropical species which are suitable for bioenergy production have invasive potential.

A current topic of heated debate is whether the genes of transgenic plants can spread and stimulate the development of invasive species. The hybridisation of genetically modified crops with wild plants of related species could – theoretically – produce species with competitive advantages such as drought or herbicide resistance which are difficult to control. This development however is still considered hypothetical.

Case study: Parthenium hysterophorus



Photo: Forest & Kim Starr

Parthenium hysterophorus is an invasive weed native to the Gulf of Mexico area. Having spread over large areas of Asia, Africa and Australia during the past 50 years, it is steadily developing into a worldwide problem. Its leaves and blooms contain parthenin, a toxin that suppresses the germination and growth of crop plants such as barley, wheat and pea, leading to yield losses of up to 30%. *Parthenium* weed decreases pasture productivity by inhibiting forage plants. Cattle grazing on land with *Parthenium* exhibit lower growth rates.

International aid efforts can also contribute to the spread of invasive species. *Parthenium hysterophorus* weed (see box) was unwittingly introduced to Africa in shipments of grain sent to Ethiopia as emergency relief.

Containing invasive species

There are two ways to contain invasive species: prevention and limitation of spread. Prevention is much more cost-effective and includes public education, risk assessment and early warning systems for new species, legal regulations and controls, quarantine and treatment of fresh imports, and even trade restrictions and bans. Furthermore, stable, rich ecosystems are less vulnerable to invasive species than species-poor systems. The same holds true for cultivated landscapes where a rich (agro)biodiversity can help to prevent, or at least restrict, the rampant spread of invasive species.

Once an invasive species has become established, measures must be taken to completely eradicate it, contain it in certain areas or reduce its population to an acceptable level. In most cases total elimination is not possible: this is usually limited to small areas, being very costly in terms of money and manpower. The cost of a 3-year campaign to permanently eradicate Japanese knotweed (*Fallopia japonica*) in Great Britain,

for example, is estimated to exceed EUR 2 billion. By contrast, selective measures to check the further spread, minimise potential damage in extremely valuable habitats, or to control species which have recently appeared are often worthwhile and appropriate.

The earlier control measures are implemented, the more effective they are likely to be. For this reason it is important to carefully monitor potentially invasive species and to prevent their spread without delay. As it is difficult to make predictions and assess the risk they pose, alien species should not be introduced at all if there is any element of doubt (precautionary principle).

National and international regulatory framework

The problematic nature of invasive species was first addressed comprehensively by the 1992 Convention on Biological Diversity (CBD). Article 8h of the CBD requires that each contracting party should, as far as possible and appropriate, prevent the introduction of, control or eradicate alien species which threaten ecosystems, habitats or species. The Convention's Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA) has produced a set of recommendations for invasive species, which advocates:

- preventing the entry of new species,
- putting early detection and urgent measures in place to address species that are not yet established,
- mitigating the impact of established species, and
- introducing programmes to raise public awareness of the problem.

At the 9th session of the Conference of the Parties to the CBD in Bonn in May 2008, the parties evaluated their national endeavours to contain the spread of invasive alien species. Most nations have made international commitments to limit the threat they pose, but only about half have adopted corresponding legislation. Even fewer are taking appropriate action.

Numerous international regimes and regional bodies are also addressing the topic of 'invasive species'. About 40 binding agreements have been established, as well as a range of non-binding recommendations and technical guidelines. Of most relevance to plants is the International Plant Protection Convention (IPPC) that serves to control the infiltration and spread of organisms that are harmful to plants and plant products. It refers to all organisms which damage plants, either directly or indirectly. So far 19 standards for plant protection measures have been adopted, and these have also been accepted by the World Trade Organization in its Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement).

Implications for technical cooperation

Development cooperation can influence the spread of invasive alien species through the areas of precaution, monitoring, control and capacity development. Projects in the fields of environmental policy, resource conservation and management, trade, private sector promotion, health and food aid would all lend themselves to this purpose. Specific tasks could also include the support of partners in the following areas:

- Formulating a normative framework for the import and export of goods which could, intentionally or unintentionally, promote the spread of invasive species;
- Reinforcing mechanisms to control the importation of potentially invasive species (customs inspections, purity testing of seeds and food imports, quarantine measures, etc.);
- Promoting national and international information systems for invasive species;
- Producing and refining risk assessments prior to the importation of alien species for agricultural and forestry purposes, and introducing procedures to monitor the spread and impact of new alien species;

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- Introducing measures to reduce populations of invasive species, particularly in protected areas and other ecologically vulnerable areas, as well as cultivated land;
- Introducing measures to conserve biological diversity in natural ecosystems, and land cultivated for agriculture and forestry;
- Raising awareness of the hazards posed by invasive species.

Further information:

Convention on Biological Diversity: A comprehensive summary of documents on activities related to invasive species within the framework of the Convention (including those of the Subsidiary Body on Scientific, Technical and Technological Advice SBSTTA, and the decisions of the Conference of the Parties) is available at www.cbd.int/invasive.

Global Invasive Species Database (GISD): The GISD was developed by the Invasive Species Specialist Group (ISSG) of the Species Survival Commission of the IUCN-World Conservation Union and is updated on an ongoing basis. GISD also compiles the list of 100 of the World's Worst Invasive Alien Species. www.issg.org/database.

Global Invasive Species Programme (GISP): An international partnership dedicated to addressing the global threat of invasive species. For more information see www.gisp.org.

Global Strategy on Invasive Alien Species. <http://www.gisp.org/publications/brochures/globalstrategy.pdf>.

IUCN – Invasive Species Specialist Group: www.issg.org.

Köck, W. (2004): *Invasive gebietsfremde Arten. Stand und Perspektiven der Weiterentwicklung und Umsetzung der CBD-Verpflichtungen unter besonderer Berücksichtigung der Umsetzung in Deutschland* [Invasive alien species. Status and outlook of the development and implementation of CBD commitments, with special reference to their implementation in Germany]. In: Wolff, N., Köck, W. (Hrsg.): *10 Jahre Übereinkommen über die biologische Vielfalt – Eine Zwischenbilanz* [The CBD ten years on – an interim evaluation]. Umweltrechtliche Studien – Studies on Environmental Law 33: 107-125.

McNeely, J. A., Mooney, H. A., Neville L. E., Schei, P. J., Waage, J. K. (eds.) (2001): *Global strategy on invasive alien species*. Scope, CAB International & IUCN (Global Invasive Species Programme).

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