Biodiversity conservation as part of Plant Protection: the opportunities and challenges of risk analysis

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ABSTRACT

Until recently, the International Plant Protection Convention (IPPC) mandate was implemented rather narrowly to guard against plant pests that affect the primary sector. However, recent revisions have clarified its mandate to also deal with environmental impacts including risk analysis. One of the most important factors in identifying such risk of invasiveness is prior invasiveness elsewhere. International exchange of information on invasive alien species is crucial. Addressing environmental impacts from IAS creates several challenges. Possible solutions are discussed.

INTRODUCTION

Due to the ancient history of human settlement in Europe, alien species have naturalised and become “integrated” in many ecosystems. However, given the exponential increase in trade transport, and travel in the last century or two, there has been a tremendous increase in the introduction ("Introduction" refers to the movement by human agency, indirect or direct, of an alien species outside of its natural range. (CBD 2002) Note the difference with the concept of "introduction" under IPPC.) of species to ecosystems where they are alien ("Alien species" refers to an introduction outside the natural past or present distribution; (see CBD 2002.). For example, the presence of exotic plants in Portugal has increased probably more than 1000% during the last two centuries (Almeida et al 2003). Even though the majority of alien species may well be harmless, tremendous damage can result from others. Farmers have been fighting agricultural weeds and pests since the beginnings of agriculture but the problem of impacts on native species, habitats and ecosystem function has been brought to the world's attention relatively recently (e.g. Lowe et al 2000). Invasive alien species (IAS), as defined by the Convention on Biological Diversity (CBD) are those alien species whose introduction and/or spread threaten biological diversity (CBD 2002).

PREVENTION AND RISK ASSESSMENT

Invasive alien species constitute an insidious “biological pollution”. Unlike many other types of pollution, they are not diluted in time but, on the contrary, can expand in numbers, density and geographic spread - often exponentially. Prevention of IAS introduction is the first and most cost-effective option, from the point of view of environmental costs as well as direct monetary costs (Wittenberg et al. 2001).
Risk analysis plays an important role in the prevention of new IAS introductions across national boundaries by underpinning decision-making in compliance with international trade-related obligations. In the agricultural context of plant protection this has been relatively well developed over time but the environmental impacts have rarely been included in pest risk analysis or other sanitary or phytosanitary (SPS) measures. However, since 1999, the International Plant Protection Convention (IPPC) has been clarifying its role with regards to IAS (*sensu* CBD) that are plant pests. Revision of ISPM 5 (Glossary) and ISPM 11 (Pest Risk Analysis for Quarantine Pests) clarified the inclusion of environmental impacts. This has been reflected at the regional European level (Schrader 2003) and it is to be expected that in future more European national plant protection agencies will include environmental impacts in risk analysis (Unger 2003).

INFORMATION REQUIREMENTS: INVASIVENESS ELSEWHERE

The crucial question is how to predict which alien species would become problems if they were introduced and which would remain innocuous. A match of climate and habitat helps in predicting invasiveness, but many species are known to expand to other habitat types once outside their native range. Only one factor has a consistently high correlation with invasiveness: whether or not the species is invasive elsewhere (Wittenberg & Cock 2001). “The best predictor of which species will become problematic is whether or not a species has proven to be invasive elsewhere, especially under similar (climatic and geographic) conditions and in related ecosystems” (Simberloff 1999). Characteristics of the species itself in its native range (including reproductive and dispersal mechanisms, tolerance to environmental factors such as shade or salinity, life form or habit, such as climbing vine or an aquatic species, and adaptive mechanisms, such as the ability of a plant to fix nitrogen) are less accurate risk predictors for prevention although they are somewhat more useful for predicting rate and extent of spread if prevention failed and the alien species established. In short: knowledge of past invasiveness elsewhere is particularly important for IAS prevention.

In addition, given that similar IAS problems are repeatedly faced in different parts of the world, sharing information and expertise internationally on the ecology, impacts and management of IAS is also critical for the management of established IAS. The Invasive Species Specialist Group of IUCN (the World Conservation Union) is involved in developing and maintaining The Global Invasive Species Database and several other tools for such international information exchange. (De Poorter & Browne 2005)

CHALLENGE: SCOPE AND COMPLEXITY OF ENVIRONMENTAL IMPACTS

The environmental impacts caused by IAS are wide ranging and often more complex and surprising than the impacts of, for example, agricultural weeds. For example:

- “Dual personality species”: alien species that are desirable and commercially important in parts of the landscape but damaging invaders elsewhere, for instance in Protected Areas (Rouget et al 2002).
- Time lags: an established alien species may show no signs of being invasive for years or decades, before rapidly expanding in range and abundance and becoming invasive (Crooks & Soulé 1999).
• Indirect impacts on native species can be surprising: in the South African St Lucia Protected Area Chromolaena odorata, an invasive plant, has been linked to Nile crocodiles’ sex ratio changes. (Leslie & Spotila 2001).

• Interactions between two alien species (that do not cause environmental impacts when they occur on their own) can trigger invasiveness: e.g. the arrival of a pollinator for an invasive plant, or of a vector for an alien pathogen.

• Invasion by one alien species can facilitate and accelerate further invasion by other species – sometimes reaching the level of ‘invasional meltdown’ (see box).

• Alien species, over time, may exhibit evolutionary adaptation to their new environment (Cox 2004).

• Effects of invasion are being compounded by global climate change and habitat change (Mooney & Hobbs 2000)

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**Invasional meltdown:** Alien crazy ants Anoplolepis gracilipes have formed extensive super colonies on Christmas Island (Australia) since the mid-1990s. Red crabs (Gecarcoidea natalis) are highly vulnerable to these crazy ants. This has manifold further consequences for the dynamics and structure of the native forest, including deregulation of seedling recruitment, seedling species composition, litter breakdown and density of litter invertebrates. Due to the crab’s migratory nature, effects also result, in areas not (yet) invaded by the crazy ant. In addition, mutualism between this invasive ant and introduced/cryptogenic scale insects has amplified and diversified rain forest impacts (O’Dowd et al 2001). On top of this, crazy ant invasion has facilitated the invasion of native rainforest by the giant African land snail (Achatina fulicata), woody alien weeds and alien cockroaches (Green et al, 2001).

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**Solutions**

Precautionary principle: Intentional introductions, efforts to identify and prevent unintentional introductions, and other prevention or mitigating decisions should be based on the precautionary principle. Precautionary measures are advocated, required or allowed by several international instruments, including the CBD, the Biosafety Protocol and the SPS agreement. The preamble of the CBD states that a lack of full scientific certainty shall not be used as a reason to postpone measures to avoid or minimise a threat of significant reduction or loss of biodiversity (see also Cooney 2004). Precaution is particularly relevant to IAS because of the inherent scientific uncertainty when trying to predict impacts on biodiversity. In the context of alien species, unless there is a reasonable likelihood that an introduction will be harmless, it should be treated as likely to be harmful (IUCN 2000). Or, every alien species needs to be managed as if it is potentially invasive, until convincing evidence indicates that it presents no such threat (McNeely et al 2001)

Wide ranging stakeholder involvement and consultation: Wide consultation including with other agencies, industry, NGOs, community groups and the research community increases the likelihood that all relevant matters are covered in risk analysis.

Promoting the use of native species: It has been stressed over and over that prevention is the key to addressing IAS problems. An important aspect of prevention is to reduce the need (or
want) for introduction of new alien, potentially invasive, species, by encouraging the use of alternatives: either less risky alien species, or native species. Promotion of the use of native species, could be considered (e.g. in gardening, erosion control, aquaculture, forestry, and in aid and development assistance programmes).

**CHALLENGE: ECOLOGICAL BOUNDARIES – NOT POLITICAL ONES**

An alien species is defined in relation to whether it is in its natural range or not. In other words, the concepts of alien and native relate to ecological boundaries rather than country boundaries. This has two ramifications: firstly, a species can be an alien and a harmful invasive alien within the same country where it is native. Secondly: an alien species introduced into one nation may be in a position to easily spread to neighbouring nations because there are no bio-geographical barriers between the countries, or through secondary, unintentional human mediated introductions (e.g. transport). An example of the latter is the introduction of *Cactoblastis cactorum* as a biocontrol agent against prickly pear in the Caribbean. Once in that area, it was unintentionally spread to the USA where it is now threatening native Mexican species of *Opuntia* (*Platyopuntia*) (Soberón *et al* 2001).

**Solutions**

Prevention of movement across ecological boundaries within one country: There must be procedures to prevent introduction of IAS within a country, across a bio-geographical boundary, e.g. from mainland to islands, between watersheds or across mountain ranges.

Regional approach to Risk Analysis: Risk analysis at the national level should include the risks of spread to neighbouring or nearby countries. This will likely require cooperation with agencies in the countries concerned. In addition, Regional risk analysis should be considered and developed (e.g. to decide on whether a species will be introduced into Europe at all).

**CHALLENGE: FRAGMENTATION AND GAPS IN NATIONAL MANDATES**

IAS are found in all taxonomic groups: they include introduced fungi, algae, mosses, ferns, higher plants, invertebrates, fish, amphibians, reptiles, birds and mammals. Currently, at national level, the application of SPS measures is usually limited to the mandates of IPPC, OIE etc. and as a result many components of the nation’s environment are not adequately covered. For instance, what government agency has the mandate to implement SPS measures to protect native invertebrates or wild native birds?

Another challenge is that in many countries, national agencies do not coordinate their activities, and do not share information adequately. This can lead to a situation where one agency promotes an alien species (e.g. for erosion control) while another agency needs to spend taxpayer’s money eradicating it because it is invading Protected Areas.
Solutions

Mandates of relevant government agencies should be widened. All taxa of IAS should be subject to SPS measures as required, and all components of the environment should be adequately protected. This may require some “thinking outside the square”. An example is the New Zealand Import Health Standard for spiders on table grapes (http://www.biosecurity.govt.nz/imports/plants/procedures/spiders-grapes.htm), which was developed to protect native invertebrates. Adequate resourcing for agencies should be ensured.

Cooperation between different government agencies is crucial. While there is no single “recipe”, one of the most important aspects is to achieve leadership and coordination of national efforts, to achieve cooperation between different agencies, and to ensure appropriate participation of all stakeholders (including non-governmental ones). This may include the establishment of one national lead agency for all IAS issues, including primary production, environment/conservation, fisheries, human health, (e.g. New Zealand (http://www.biosecurity.govt.nz), or an overall coordinating agency (e.g. USA (http://www.invasivespecies.gov/council/mp.pdf)) that coordinates the various other agency activities at a national level.

CONCLUSION

National Plant Protection Organisations can play an important role in conservation by addressing the environmental impacts of invasive alien species that are within their mandate. They are in a good position to set an example and influence others. However, to adequately address IAS at the national level, relevant government agencies will generally need to widen their mandate(s) so that all taxa of alien species can be subject to SPS measures, and all environmental components can be protected from impacts. Resourcing for such agencies should be ensured and be adequate. Agencies will also need to develop close cooperation with each other and with key stakeholders. Prevention of IAS introductions needs to target not only national boundaries, but also Regional (multi country) and local (within country) ones. Precaution needs to be applied throughout IAS management, so that all alien species are managed as if potentially invasive, until convincing evidence indicates that they presents no such threat. Finally, an overall change of attitude is required, reducing the need for new introductions, using native species wherever possible in the development of aquaculture, forestry horticulture, etc.

REFERENCES


Rouget M; Richardson D; Nel J; Van Wilgen B (2002). Commercially important trees as invasive aliens: Towards spatially explicit risk assessment at a national scale. Biological Invasions 4(4), 397-412.


Shine C; Williams N; Gündling L (2000). A Guide to Designing Legal and Institutional Frameworks on Alien Invasive Species. IUCN Environmental Law Centre: Gland, Switzerland, Cambridge, UK and Bonn, Germany.
