Unwelcome guests

The threat of invasive species to tropical forests

By William J. Jackson and Geoffrey W. Howard

IUCN

bill.jackson@iucn.org

geoffrey.howard@iucn.org

Crowding out: *Toona ciliata* invading a pine plantation in eastern Africa. *Photo: IUCN*

The movement of species from one place to another by humans is possibly as old as the history of humans, but the modern era has seen unprecedented deliberate and accidental movement of species at a scale of monumental proportions. As Harold Mooney put it "… the consequences of the biotic exchange are staggering when you tally up what the biotic world looks like now in comparison with recent past" (Mooney *et al.* 2005).

Biological invasions occur when species of animals, plants and micro-organisms are introduced into an ecosystem and they harm their new ecosystem. The term invasive species is used to distinguish them from introduced or exotic species that do no measurable harm to an ecosystem. Thus the conditions of introduction and harm to an ecosystem need to be met in order for a species to be considered invasive.

The Convention on Biological Diversity (CBD) uses the term invasive alien species to describe species whose introduction and/or spread outside their natural past or present distribution threatens biological diversity. The term 'alien' relates to the introduction of a species to an ecosystem and does not mean the species is exotic to a country or a region. Alien species may include alien genotypes such as the varieties or subspecies of the same species introduced from elsewhere. Invasiveness relates to an ecosystem not to political or administrative boundaries.

Because an invasive species occurs outside its original ecosystem it often faces less competition, fewer diseases, and lower predator pressure and other forms of 'control'. It is thus able to flourish and acquire "a competitive advantage following the disappearance of natural obstacles to its proliferation, which allows it to spread rapidly and to conquer novel areas within recipient ecosystems in which it becomes a dominant population" (Valery *et al.* 2008).

In tropical forests, invasive plants can compete with native species for space, light, nutrients and/or water. They often exhibit fast rates of growth, short times between generations, competitiveness, high production of propagules, and adaptability to differing climatic and other conditions such as soils. Invasive plants, animals and micro-organisms can be parasitic, cause mechanical damage to trees and interfere with the reproductive capacity of indigenous plants and animals. Invasive species can be plant pests or vectors of pathogens which are often responsible for tree diseases. Furthermore, invasive species can alter the functioning of forest ecosystems by, for example, altering natural fire regimes and disrupting hydrological cycles.

A quick look at the International Union for Conservation of Nature's Red List of Threatened Species (www.iucnredlist.org) shows that invasive species are one of the primary threats to biodiversity. Invasive species can impact directly on human well-being, for example on human health and by causing changes to biodiversity and consequently to the flow of ecosystem goods and services used by humans, thus affecting human infrastructure, development and livelihoods. Whilst data does not allow analysis of the threat to forest species, it is reasonable to assume that invasive species represent a substantial problem for tropical forests and, by implication, a serious threat to social and economic well being of people.

Types of forest invasion

Invasion of alien species into healthy tropical forests is not common, but there are increasing reports of invasions in secondary and disturbed forests. Our experience in Africa is that notorious invaders such as *Lantana camara* are beginning to appear even in lightly disturbed natural forests, brought in by frugivorous birds first establishing in forest

clearings and then in denser vegetation, with a tendency to become strangling climbers that ascend many meters into forest trees (see photo). Lantana can form single-species thickets and impact a wide area and range of species through the allelopathic properties of its leaves as well as the dense shade it provides.

Another invader, spreading across central, eastern and southern African forests is the Australian Black Wattle (*Acacia mearnsii*). This plant spreads easily along roads (see photo next page) and can enter relatively closed forest where it can replace native species.

There is much debate about the likelihood of increasing invasion of native forests because some believe that a multispecies forest is innately resistant to plant invasion; others disagree. However, it is clear that disturbance, including by forest roads and forest harvesting and clearing, increases the likelihood of plant invasions (see for e.g. Fine 2002; Malik and Husain 2007). Logging tracks and log loading areas enable many plant invaders to initiate entry into a forest. Poor hygiene practices including failure to properly clean and disinfect logging and road construction machinery is another major vector for invasive plants and micro-organisms.

However, not all species that are introduced will become invasive and many invasive species take a long time to become invasive, a process known as lag time or 'sleeper' invasive species. The phenomenon of sleeper invasive species occurs when plants that have been long established in an ecosystem, but have not spread widely, begin to spread. Sometimes the lag time can be many years, decades or even centuries. Examples of sleeper invasive species include toona (*Toona ciliata*) in central Africa and neem (*Azadirachta indica*) in parts of west Africa and coastal east Africa. In Australia *Mimosa pigra* (mimosa), which existed in low numbers for 70 years, has recently become a major problem in the Northern Territory (CSIRO 2010).

Sleeper invasive species are expected to become an increasing problem as a result of climate change and as more areas become degraded in one way or another and the stability or resilience of ecosystems erodes (e.g. Alston and Richardson 2006; Dukes *et al.* 2009). Indeed, global change will likely increase the rate of biological invasions across the board (Dukes and Mooney 1999). Accordingly, managers need to recognize that climate change is likely to increase the threat of invasive species to both forest production and biodiversity conservation to an enormous extent (see Mainka and Howard 2010).

In tropical forest plantations three types of forest invasion occur – one originates from within the new ecosystem itself, a second is when an invader affects the exotic species, and third is from a species of the same origin as the exotic plantation and has "caught up with it" in its new ecosystem. This applies to all manner of invasive species - plants, pests and diseases.

In the first case indigenous species can become invasive in the new ecosystem created by the plantation. This phenomenon is usually seen by managers as plantation weeds and pests, but it is a form of invasion as their persistence affects productivity. Native species of vine, climber and scrambling shrubs often take advantage of the new conditions of a plantation and cause damage – specifically because they have a new habitat.

Climber: *Lantana camara* growing 7 m up an indigenous tree near Victoria Falls, Zambia. *Photo: IUCN*

The second type of invasion occurs when an introduced species disturbs forest growth and productivity. This includes diseases and their vectors, pests such as wood borers and defoliators and competing plants. In tropical eastern Africa some pine plantations are being invaded by toona (*Toona ciliata*) that was introduced decades ago from Asia and widely planted as a shade tree in parks (see photo previous page). In addition, plantation species themselves can become invasive. According to ITTO and IUCN (2009) some tree species widely used in plantations and agroforestry schemes have the potential to become invasive, for example *Azadirachta indica, Cedrela odorata* and *Leucaena leucocephala*. Forest managers would do well to keep in mind that exotic tree species may have the capacity to become invasive and when new tree species are being considered it is possible to guard against their becoming invasive in the future with a proper risk assessment (e.g. Gordon *et al.* 2008).

The third type of invasion in plantations is when pests or disease species from the original ecosystem of the planted trees appear. These species can cause considerable damage to both plantations and surrounding natural forest and trees on farmlands. For example, *Phoracantha* species from

Invader: *Acacia mearnsii* along a forest road in eastern Africa; vehicle access roads are important pathways for the spread of alien plants. *Photo: IUCN*

Australia are serious borer pests of eucalypts in Africa. In their native Australia they are considered minor pests, but in many temperate and tropical regions they have been known to kill healthy trees (FAO 2007).

Management of forest invasions

Dealing with biological invasions should be a basic element of good forest management. However, the reality is that not all forest managers regularly ensure inspections of their estates for invading species, and even when they do the information available to identify species, the risks they pose and the options for response is often inadequate.

Early detection, identification and rapid management action to address invasive species before they become well established are the best lines of defense. There are various established means for extinguishing new invasions and information is readily available from such sources as the IUCN, Invasive Species Specialist Group Global Invasive Species Database (www.issg.org), the Global Invasive Species Programme (GISP) (www.gisp.org) and several tropical forest invasive species networks including the Asia Pacific Forest Invasive Species Network (www.apfisn.net) and the Forest Invasive Species Network for Africa (www.fao.org/forestry).

Regular monitoring of forests for new plants, animals and/or damage is essential to recognizing a biological invasion when it first appears. Established invasions are extremely difficult to manage – although a combination of mechanical, chemical and biological control approaches may work with time. The *Guiding Principles for the Prevention, Introduction and Mitigation of Impacts of Alien Species that Threaten Ecosystems, Habitats or Species* of the CBD are helpful in this respect (CBD 2002) as is other guidance from the CBD and GISP (CBD 2001; Wittenberg and Cock 2001).

The ITTO/IUCN (2009) *Guidelines for the conservation and sustainable use of biodiversity in tropical timber production forests* (see Sayer and Boedhihartono, p.11) recognize the importance of managing for invasive species including that forestry operations can encourage the introduction and spread of invasive alien species and measures should be taken to minimize this risk and to ensure that plantation forestry does not facilitate the introduction of invasive species.

At national level, any deliberate introduction of new species should be subject to a risk assessment to assess potential invasiveness of the new species to forest management and local community interests. The International Plant Protection Convention, IPPC develops regulations for prevention and management of all pests (animals, plants or pathogens) of plants.

We have the tools to recognize, prevent and manage invasive species and information and training is available. We need to ensure these measures are applied if we are to address the seriousness of threats to nature and people from biological invasions.

References

Alston, K.P. and Richardson, D.M. 2006. The roles of habitat features, disturbance, and distance from putative source populations in structuring alien plants invasions at the urban/wildland interface on the Cape Peninsular, South Africa. *Biological Conservation* **132**:183-198.

CBD (Secretariat of the Convention on Biological Diversity). 2001. *Assessment and management of alien species that threaten ecosystems, habitats and species*. CBD Technical Series No. 1, 135pp.

CBD (Secretariat of the Convention on Biological Diversity). 2002. Quoted on http://www.cbd.int/decision/ cop/?id=7197

CSIRO. 2010. http://www.csiro.au/org/ps2eo.html (accessed 10 May 2010).

Dukes, J.S, Pontius, J., Orwig, D, Garnas, J.R. *et al.* 2009. Responses of insect pests, pathogens and invasive plant species to climate change in the forests of northeastern North America: what can we predict? *Canadian Journal of Forestry Research* **39**: 231-248.

Dukes, J.S. and Mooney, H. A. 1999. Does global change increase the success of biological invaders? *TREE* **14**:135-139.

FAO. 2007. Quoted on http://www.fao.org/forestry/13573-1-0.pdf (accessed 27th June 2010).

Fine, P.V. 2002. The invisibility of tropical forests by exotic plants. *Journal of Tropical Ecology* **18**:687-705.

Gordon, D.R, Onderdonk, D.A., Fox, A.M., Stocker, R.K. and Gantz, C. 2008. Predicting invasive plants in Florida using the Australian weed risk assessment. *Invasive Plant Science and Management* **1**:178-195.

ITTO and IUCN. 2009. *ITTO/IUCN guidelines for the conservation and sustainable use of biodiversity in tropical timber production forests*. ISBN 4-902045-41-9. 120pp.

Mainka, S.A. and Howard, G.W. 2010. Climate change and invasive species: double jeopardy. *Integrative Zoology* **5**:102-111.

Mooney, H., Mack, R., McNeely, J., Neville, L., Schei, P. and Waage, J. 2005. *Invasive alien species: A new synthesis.* Island Press. Scientific Committee on Problems of the Environment (SCOPE) Series Vol. 63 368 pp. ISBN: 9781559633628.

Malik, R.N, and Husain, S.Z. 2007. *Broussonetia papyrifera* (L.): an environmental constraint on the Himalayan foothills vegetation. *Pakistan Journal of Botany* **39**(4): 1045-1052.

Valery, L., Fritz, H., LeFeuvre, J-C and Simberlof, D. 2008. In search of a real definition of the phenomenon of biological invasion. *Biological Invasions* **10**:1345-1451.

Wittenberg, R. and Cock, M.J.W. 2002. *Invasive alien species: A toolkit of best prevention and management practices*. CABI (on behalf of GISP). 228 pp.