

## Plant invasion and environmental pollution: causes of concern

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Guest Editors

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Humans, like other organisms, modify their environment, but the degree to which humans have become capable of modifying their environment is unmatched by any other living organism on earth. One would be hard pressed to find today any environment in which human agency has not had a direct, indirect, or inadvertent impact, whether through land use and land cover change, via the introduction of alien species, or due to industrialization and the alteration of biogeochemical cycles. The introduction of alien species is one aspect of human agency that is dealt with in the collection of articles that follows. The other aspect of human agency dealt with in this collection of articles is a byproduct of industrialization, namely environmental pollution.

Invasions by alien species perhaps first captured the imagination of ecologists as a result of Elton's (1958) very prescient book, but it is really only in the last few decades that the effects of alien species invasions – long entrained – have really become manifest. In fact, the International Convention on Biological Diversity, in 2000, declared alien invasive species to be the second greatest threat to biodiversity after habitat fragmentation. Yet, despite the increasing international focus on invasive alien species, there was very little attention paid to them in India till only a few years ago. The first national workshop on invasive alien species in India was held as recently as 2004 (Raghubanshi *et al.* 2005), and was, in many ways, a call to action.

The collection of articles featured here, though small, nonetheless manages to capture a number of the issues surrounding invasive species that are of interest to ecologists. Sharma & Raghubanshi investigated the effects of habitat fragmentation on ecosystem invasibility. They also report the

effects of species invasion on vegetation composition, and on a critical ecosystem process, nutrient cycling. Two other articles look at community impacts of invasive species on taxa that have tended to receive less attention than plants, namely soil mycorrhizae (Shah *et al.*), and birds (Aravind *et al.*). Finally, Rashid & Reshi, and Raizada & Raghubanshi both investigated aspects of invasive species biology that have relevance to management. It is telling that three of the five articles (Aravind *et al.*, Raizada & Raghubanshi, and Sharma & Raghubanshi) focus on *Lantana camara*, perhaps the most ubiquitous and conspicuous invasive alien plant across much of tropical and subtropical India. The other two articles (Rashid & Reshi, and Shah *et al.*) deal with invasive species in temperate Kashmir, a region that is biogeographically quite distinct from the rest of the country. We hope the collection of articles featured here is merely the tip of the iceberg, with much more yet to come.

Rapid technological, industrial and agricultural advancement, coupled with increases in population growth, has triggered the deterioration of environmental quality throughout the world. Rapidly growing cities, more traffic on roads, growing energy consumption and waste production, and lack of strict implementation of environmental regulation are increasing the discharge of pollutants into air, water, and soil (Agrawal 2005; Sharma *et al.* 2009). The future development of most tropical countries is likely to only further aggravate the pollution problem. Environmental pollution not only causes unprecedented misery to human beings, but it also has negative effects on managed as well as natural ecosystems. Policies to reduce emissions are often costly to implement, and need to be balanced against a range of other

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economic and social priorities. The links between environmental quality and plants are important for agriculture, horticulture, and forestry. Understanding these links is especially important for management practices to sustain productivity under the threat of environmental pollution.

The articles under the section on environmental pollution cover a wide range of topics from the impact of ambient air pollution on plants, to food chain contamination, biomonitoring of heavy metals, and bioremediation. Tiwari *et al.* investigated the impact of ambient air pollutants on a vegetable crop using open-top chambers installed in a suburban area of a medium-sized city. They documented seasonal variations in plant adaptations to air pollutants. Mid-stream surface-water contamination in the river Ganga, at Varanasi, by atmospheric deposition of heavy metals has been reported by Pandey *et al.*, Singh *et al.* demonstrated that the use of waste water from a sewage treatment plant contaminates soil and vegetables, with serious implications for human health. Sharma & Agrawal have shown that zinc acts antagonistically on the uptake of cadmium, a non-essential heavy metal. Hence, zinc could be used at cadmium-contaminated sites to reduce its negative effects. Pandey & Upadhyay have suggested the use of *Pseudomonas fluorescens* for bioremediation of Direct Orange-102, a dye used in the textile industry. Anita Singh was given the Alice J. Murphy Outstanding Achievement Award for her paper on "Risk assessment of heavy metal toxicity through contaminated vegetables from waste water irrigated area".

This special issue of *Tropical Ecology* is composed of selected papers presented during two special sessions, one on invasive alien species, and

the other on environmental pollution, during the Tropical Ecology Congress held in Dehradun in December 2007. The Congress was jointly sponsored by the International Society for Tropical Ecology and H.N.B. Garhwal University. The themes, recommendations, and broad outcome of the Congress are included in Singh *et al.* (2009), and the first two special issues on biodiversity and remote sensing have already been published (Kushwaha *et al.* 2010; Rawat 2009). The Guest Editors express their gratitude to the Organizers of the Tropical Ecology Congress for the financial support to organize the session and to the International Society for Tropical Ecology for publishing this issue.

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