



Invasive Alien Plant Species a Major Injunction threat to India's Biodiversity

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Abstract: *Invasive alien species are a major threat to native biodiversity, natural ecosystems and ecosystem services. The invasive species problem is growing in severity because of international trade and travel increase. The great increase in the introduction of aliens is that people are importing primarily for aesthetic reasons. Ornamentals are used generally to make their gardens more attractive. Often leads to a net increase in species richness in their destination. However, there are surprisingly few instances in which extinctions of resident species can be attributed to competition from new species. Species introduced from outside their natural range can be an economic boon, because they often seem to do better in their new home than in their place of origin. Plant invasion is a potent threat to the species diversity around the world during the 21st century after habitat loss. If this process of biological invasion is remained continuous for years to come then we can only transfer monocultures of species to our future generations. To preserve our indigenous species diversity, it is important to understand the process of plant invasions and their impact on species diversity in various habitats around the world.*

Keywords: *Alien species, ecosystem, indigenous species, monocultures, plant invasion.*

Introduction

Biodiversity, or biological diversity, is the variety of all species on earth. It is the different plants, animals and micro-organisms, their genes, and the terrestrial, marine and freshwater ecosystems of which they are a part. Biodiversity is both essential for our existence and intrinsically valuable in its own right. This is because biodiversity provides the fundamental building blocks for the many goods and services a healthy environment provides. These include things that are fundamental to our health, like clean air, fresh water and food products, as well as the many other products such as timber and fibre. In part because the value of biodiversity and the resulting ecosystem services are poorly understood by a lot of people, nature's "cogs and wheels" are going missing at an alarming rate — on the order of 100 to 1000 times the background rate, estimated from fossil records to be from one to ten species/year (Pimentel et al., 2001). Some estimates of current rates are much higher.

There have been five mass extinctions in the past 500 million years, the most recent about 65 million years ago (Raup and Sepkoski, 1982). The Millennium Ecosystem Assessment (2005) reports that there has been a substantial and largely irreversible loss in the earth's biodiversity, with some 10-30% of mammal, bird and amphibian species currently threatened with extinction, and 15 of 24 ecosystem services being degraded. Fortunately, it comes at a time when the earth probably contains more species than ever before (Rhode and Muller, 2005), and there's some redundancy built into the system. We can lose some species — some — before things start to really unravel. Biological invasion is a wide phenomenon seen across the globe. It happens when a non-native species is introduced to a new environment, and it spreads virulently to cause damage to native organisms. *Ricinus communis*, due to its invasive nature, now has spread across all the tropical regions, says the report.

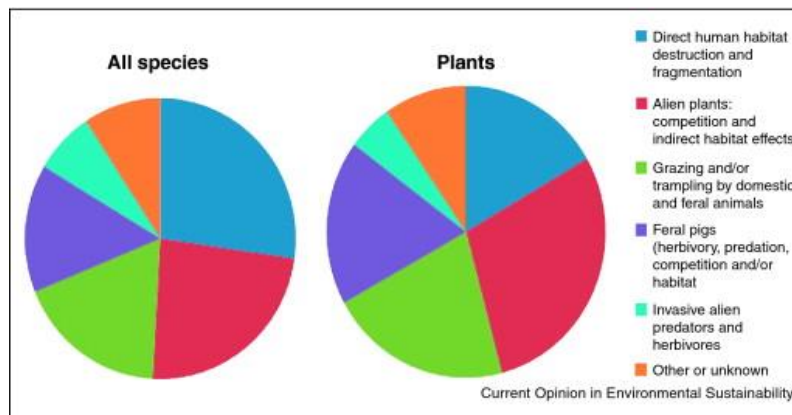


Fig.1: Environmental Sustainability

Biodiversity refers to the number and variety of species, of ecosystems, and of the genetic variation contained within species. Biodiversity is threatened by the sum of all human activities. It is useful to group threats into the categories of over-hunting, habitat destruction, and invasion of non-native species, domino effects, pollution, and climate change. Invasive alien species are now a major focus of international conservation concern and the subject of cooperative international efforts, such as the Global Invasive Species Programme (GISP), the IUCN SSC Invasive Species Specialist Group (ISSG) and the Cooperative Islands Initiative (CII). From the World Conservation Union - IUCN (2000) IUCN Guidelines for the Prevention of Biodiversity Loss caused by Alien Invasive Species means an alien species which becomes established in natural or semi-natural ecosystems or habitat, is an agent of change, and threatens native biological diversity.

Review of literature

Invasion by the species cause extensive effects on the habitats they invade, like impact on indigenous species diversity, soil nutrient composition, altering forest fire cycles and loss of productivity of invading ecosystems. It also becomes a threat to endangered or threatened plant species around the world (Pimentel et al., 2005). Alien species that can rapidly achieve high densities may have greater establishment success (Kolar and Lodge, 2001) and dominate invaded communities to the exclusion of indigenous species (Ortega and Pearson, 2005). In India especially NW Himalaya *Ageratum conyzoides* L., *Parthenium hysterophorus* L., *Lantana camara* L. and *Eupatorium adenophorum*

Sp. (Syn. *Ageratina adenophora* (Spreng.) R. M. King and H. Rob.) are major invaders and causing huge loss to indigenous species diversity in this part of the world (Dogra et al., 2009, 2010).

According to McGeoch et al. (2010) the number of documented cases of IAS in many countries is a significant underestimate, because its value is negatively affected by country development status and positively by research effort and information availability. Pyšek et al. (2008) found a strong bias in the regions of the globe where research is being done, with notably lower representation of developing countries. In fact Africa (with the exception of South Africa) and Asia were severely understudied (Pyšek et al., 2008). In a search conducted by Nuñez and Pauchard (2009) on published papers in the subject areas of ecology and biodiversity conservation, they found that only 15.8% of all the papers related to exotic species had authors from developing countries and only 6.5% had authors solely from developing countries. In view of the increased threat of alien plant species, this paper presents an insight into the type of plant invasions and their impact on species diversity throughout the world in the last century.

Methodology

The approach employed was to review the published information available from a variety of sources including the web, journal articles, and other sources, on the impacts and management of invasive plants in general with a focus on some selected invasive plants in Africa. We selected some of the most problematic invasive plants in East Africa, based on their abundance and impact,

namely feverfew (*Parthenium hysterophorus* L.), mesquite (*Prosopis juliflora* (Sw.) DC), trifid weed (*Chromolaena odorata* (L.) R.M.King & H.Rob), and lantana (*Lantana camara* L). We also collated information on the chemical, mechanical and biological control of these species and made recommendations with regard to an integrated management strategy.

Results and Discussions

Human actions are the primary means of invasive species introductions. The invasive species generally have dramatic and negative effect on the other species and even entire ecosystem. The Impact of Invasion cause Loss of Biodiversity, Decline of Native Species (Endemics), Habitat Loss, Introduced pathogens Reduce crop and stock yields, besides, Degradation of marine and freshwater ecosystems. This biological invasion constitutes the greatest threat to biodiversity, and it has already had devastating consequences for the planet and challenges for the conservation managers eg., Banana bunchy top virus (BBTV) *Suncus murinus*.

Causes of Invasion

Invasion occurs in two categories. Intentional and unintentional introduction. Prevention efforts should begin at the place of origin or export of the IAS. At the place of import – at the border, measures need to be taken to prevent unwanted introductions, e.g. border controls, quarantine measures. Measures should cover both, import to the EU from third countries and trade between MS.

Some of the World's Worst Invasive Alien Indian Species

- ***Acacia mearnsii* (shrub):** *Acacia mearnsii* is a fast growing leguminous (nitrogen fixing) tree. Native to Australia, it is often used as a commercial source of tannin or a source of fire wood for local communities. It threatens native habitats by competing with indigenous vegetation, replacing grass communities, reducing native biodiversity and increasing water loss from riparian zones.
- ***Ardisia elliptica* (tree):** *Ardisia elliptica* is a shade tolerant evergreen tree whose fast growth and attractive fruit made it a popular ornamental plant in the past. It has escaped from private and public gardens to invade natural areas. Due to high reproductive output and high shade-tolerance, carpets of seedlings can form underneath adult trees. High seed viability (99%) and seed consumption by both avian and mammalian frugivores can lead to rapid spread across a landscape.
- ***Arundo donax* (grass):** Giant reed (*Arundo donax*) invades riparian areas, altering the hydrology, nutrient cycling and fire regime and displacing native species. Long ‘lag times’ between introduction and development of negative impacts are documented in some invasive species; the development of giant reed as a serious problem in California may have taken more than 400 years. The opportunity to control this weed before it becomes a problem should be taken as once established it becomes difficult to control.
- ***Clidemia hirta* (shrub):** The invasive shrub *Clidemia hirta* is a problem in tropical forest understories in its introduced range, where it invades gaps in the forest, preventing native plant species from regenerating. The spread of *Clidemia hirta* has been linked to soil disturbances, particularly that caused by the wild pig, another invasive species.
- ***Eichhornia crassipes* (aquatic plant):** Originally from South America, *Eichhornia crassipes* is one of the worst aquatic weeds in the world. Its beautiful, large purple and violet flowers make it a popular ornamental plant for ponds. It is now found in more than 50 countries on five continents.
- ***Polygonum cuspidatum* Sieb. & Zucc. (shrub):** *Polygonum cuspidatum* is an herbaceous perennial native to Japan. It has been introduced to Europe and North America as an ornamental and is also used

to stabilise soil, especially in coastal areas. It requires full sun and is found primarily in moist habitats but also grows in waste places, along roadways and other disturbed areas.

- ***Hedychium gardnerianum*** (herb): *Hedychium gardnerianum* is a showy ornamental which grows over a metre tall in wet climates and grows from sea level to an altitude of 1700 metres. It forms vast, dense colonies and chokes the understorey vegetation. It can also block stream edges, altering water flow. It is dispersed by birds over short distances and by man over long distances (in garden waste or via the horticultural industry). Even small root fragments will re-sprout, making it difficult to control.
- ***Imperata cylindrica*** (grass): Native to Asia, cogon grass (*Imperata cylindrica*) is common in the humid tropics and has spread to the warmer temperate zones worldwide. Cogon grass is considered to be one of the top ten worst weeds in the world.
- ***Lantana camara*** (shrub): *Lantana camara* is a significant weed of which there are some 650 varieties in over 60 countries. It is established and expanding in many regions of the world, often as a result of clearing of forest for timber or agriculture. It impacts severely on agriculture as well as on natural ecosystems. The plants can grow individually in clumps or as dense thickets, crowding out more desirable species.
- ***Leucaena leucocephala*** (tree): The fast-growing, nitrogen-fixing tree/shrub *Leucaena leucocephala*, is cultivated as a fodder plant, for green manure, as a windbreak, for reforestation, as a biofuel crop etc. *Leucaena* has been widely introduced due to its beneficial qualities; it has become an aggressive invader in disturbed areas in many tropical and sub-tropical locations and is listed as one of the '100 of the World's Worst Invasive Alien Species'. This thorn less tree can form dense monospecific thickets and is difficult to eradicate once established. It renders extensive areas unusable and inaccessible and threatens native plants.
- ***Ligustrum robustum*** (shrub): *Ligustrum robustum subsp. walkeri* is a highly invasive weed in the Mascarene Archipelago in the Indian Ocean. It was introduced to Mauritius over a century ago and to La Réunion Island in the 1960s. On the oceanic islands that it has invaded, it disrupts primary forest regeneration and threatens native floral biodiversity. Its high fruit production, due to a lack of natural enemies in regions where it has invaded, has been cited as one reason for its high invasiveness.
- ***Lythrum salicaria*** (herb): *Lythrum salicaria* is an erect perennial herb with a woody stem and whirled leaves. It has the ability to reproduce prolifically by both seed dispersal and vegetative propagation. Any sunny or partly shaded wetland is vulnerable to *L. salicaria* invasion, but disturbed areas with exposed soil accelerate the process by providing ideal conditions for seed germination.
- ***Melaleuca quinquenervia*** (tree): The broad-leaved paperbark tree or melaleuca (*Melaleuca quinquenervia*) can reach heights of 25 meters and hold up to 9 million viable seeds in a massive canopy-held seed bank. This fire-resistant wetland-invader aggressively displaces native sawgrass and pine communities in south Florida, alters soil chemistry and modifies Everglades ecosystem processes. *Melaleuca* is notoriously difficult to control, however, bio-control (integrated with herbicidal and other methods) holds promising alternative to traditional control methods.
- ***Mikania micrantha*** (vine, climber): *Mikania micrantha* is a perennial creeping climber known for its vigorous and rampant growth. It grows best where fertility, organic matter, soil moisture and humidity are all high. It damages or kills

other plants by cutting out the light and smothering them. A native of Central and South America, *M. micrantha* was introduced to India after the Second World War to camouflage airfields and is now a major weed. It is also one of the most widespread and problematic weeds in the Pacific region. Its seeds are dispersed by wind and also on clothing or hair.

- ***Spartina anglica*** (grass): *Spartina anglica* is a perennial salt marsh grass which has been planted widely to stabilize tidal mud flats. Its invasion and spread leads to the exclusion of native plant species and the reduction of suitable feeding habitat for wildfowl and waders.
- ***Spathodea campanulata*** (tree): The African tulip tree (*Spathodea campanulata*) is an evergreen tree native to West Africa. It has been introduced throughout the tropics, and, has naturalised in many parts of the Pacific. It favours moist habitats and will grow best in sheltered tropical areas. It is invasive in Hawaii, Fiji, Guam, Vanuatu, the Cook Islands and Samoa, and is a potential invader in several other tropical locations.
- ***Sphagneticola trilobata*** (herb): Although *Sphagneticola trilobata* is the accepted name for this species, it is widely known as *Wedelia trilobata*. *Sphagneticola trilobata* is native to the tropics of Central America and has naturalised in many wet tropical areas of the world. Cultivated as an ornamental, it readily escapes from gardens and forms a dense ground cover, crowding out or preventing regeneration of other species. In plantations, it will compete with crops for nutrients, light and water, and reduce crop yields.
- ***Ulex europaeus*** (shrub): *Ulex europaeus* is a spiny, perennial, evergreen shrub that grows in dense and impenetrable thickets which exclude grazing animals. It is common in disturbed areas, grasslands, shrub lands, forest margins, coastal habitats and waste places. *Ulex europaeus*

alters soil conditions by fixing nitrogen and acidifying the soil.

Invasive herbs in India

- ***Asparagus densiflorus*** (herb): *Asparagus densiflorus*, commonly known as asparagus fern, is not a true fern. It reproduces by seed. *A. densiflorus* is known to invade a variety of habitats and its impacts include smothering of forest understory and ground cover and preventing the regeneration of canopy species.
- ***Chromolaena odorata*** (herb): *Chromolaena odorata* is a fast-growing perennial shrub, native to South America and Central America. It has been introduced into the tropical regions of Asia, Africa and the Pacific, where it is an invasive weed. Also known as Siam weed, it forms dense stands that prevent the establishment of other plant species. It is an aggressive competitor and may have allelopathic effects. It is also a nuisance weed in agricultural land and commercial plantations.
- ***Cirsium arvense*** (herb): *Cirsium arvense* is an herbaceous perennial in the Aster family. It occurs in nearly every upland herbaceous community within its range, and is a particular threat in grassland communities and riparian habitats. *C. arvense* is shade intolerant and can tolerate soils with up to 2% salt content. It grows on all but waterlogged, poorly aerated soils, including clay, clay loam, silt loam, sandy loam, sandy clay, sand dunes, gravel, limestone, and chalk, but not peat. It spreads primarily by vegetative means, and secondarily by seed. The seeds spread as a contaminant in agricultural seeds in hay and in cattle and horse droppings and on farm machinery. It produces an abundance of bristly-plumed seeds that are easily dispersed by the wind and they may also be transported by water.

- ***Mimosa pudica*** (herb): *Mimosa pudica* is native to South America, but has become a pan-tropical weed. It was introduced to many countries as an ornamental plant and is still widely available for sale. *Mimosa pudica* has become a pest in forest plantations, cropland, orchards and pasture. *Mimosa pudica* is used as a medicinal plant in many regions.
- ***Parthenium hysterophorus*** (herb): *Parthenium hysterophorus* is an annual herb that aggressively colonises disturbed sites. Native to Mexico, Central and South America, *Parthenium hysterophorus* was accidentally introduced into several countries including Australia, India, Taiwan and Ethiopia. In some areas it has become an extremely serious agricultural and rangeland weed. *Parthenium hysterophorus* is also known to be allergenic to some people and consumption by livestock can taint meat.
- ***Salvinia molesta*** (aquatic plant, herb): *Salvinia molesta* is a floating aquatic fern that thrives in slow-moving, nutrient-rich, warm, freshwater. A rapidly growing competitive plant, it is dispersed long distances within a waterbody (via water currents) and between waterbodies (via animals and contaminated equipment, boats or vehicles). *Salvinia molesta* is cultivated by aquarium or pond owners and it is sometimes released by flooding, or by intentional dumping. *Salvinia molesta* may form dense vegetation mats that reduce water-flow and lower the light and oxygen levels in the water.

Invasive Grasses in India

- ***Cenchrus clandestinus*** (grass): *Cenchrus clandestinus* (*Pennisetum clandestinum*) is a creeping, mat-forming grass that originates from tropical eastern Africa. It gets its common name, kikuyu grass, from the fact that it is native to the area in which the Kikuyu tribe live. *C. clandestinus* is an aggressive invader of pasture, crops and natural areas. It spreads via an extensive network of rhizomes and

stolons, and smothers all other vegetation. It is difficult to control manually, but the use of herbicides can yield good results.

- ***Imperata cylindrica*** (grass): Native to Asia, cogon grass (*Imperata cylindrica*) is common in the humid tropics and has spread to the warmer temperate zones worldwide. Cogon grass is considered to be one of the top ten worst weeds in the world. Its extensive rhizome system, adaptation to poor soils, drought tolerance, genetic plasticity and fire adaptability make it a formidable invasive grass. Increases in cogon grass concern ecologists and conservationists because of the fact that this species displaces native plant and animal species and alters fire regimes.

The threat from invasive alien species is considered second only to habitat loss, fragmentation and degradation. The major invasive alien plant species include *Lantana camara*, *Eupatorium odoratum*, *Eupatorium adenophorum*, *Parthenium hysterophorus*, *Ageratum conyzoides*, *Mikania micrantha*, *Prosopis juliflora* and *Cytisus scoparius*. Invasive climbers like *Mikania* have overrun and strangled native species in the Himalayas and the Western Ghats. Aquatic invasive species such as Water hyacinth (*Eichhornia spp.*) and *Salvinia* have choked several freshwater ecosystems, depriving native species of sunlight, oxygen and nutrients.

Conclusion

Invading species are identified as being indigenous to regions other than the area being invaded, there is essentially no biological difference between the process of invasion and the process of colonisation or recolonisation of areas by native plants. Inter-specific competition and other interactions ultimately regulate community structure and species diversity in natural communities. They also regulate the success and failure of invading species. The life histories of the invaders are strongly constrained by the frequency of disturbance. Most serious effects of invading plants occur when they alter the environment they invade.

Endemism and invasions represent ecological phenomena at extremes of several contexts of evolutionary and ecological process. The environmental conditions that allow the evolution and survival of endemic species, namely low rates of competitive displacement and low frequency of major disturbances, also allow high diversity plant communities with many endemic species to be easily invaded by exotic species. Fortunately the same conditions also prevent the invading species from dominating the community and reducing species diversity unless the invasion is accompanied by a change in the disturbance regime of the community.

Ecosystems in productive environments are quite resistant to invasion under natural conditions of low disturbance frequencies. The properties of the species that influence their ability to resist invasion or survive in the presence of exotic species of competitors or predators are largely the result of their evolutionary history. The vulnerability of island species to extinction caused by competition or by predation by introduced predators is responsible for most of the extinctions that have occurred as a result of phenomenal increase in the transport and dispersal of species by human activities.

The serious health and economic problems caused by a small percentage of introduced species certainly demand aggressive action, including efforts to prevent the spread of these species and to eradicate them in regions where they are already a threat. Some new species, such as introduced predators on islands, are clearly capable of exterminating resident species, and most ecologists would probably regard such extinctions as undesirable and hence support the use of society's resources to protect these species.

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