

Island Biodiversity and their Threats

Ashutosh Tripathi, Sanjay Mishra and D. K. Chauhan

Department of Botany, University of Allahabad, Allahabad-211002
*Email: ashu.evs@gmail.com, sanjaymishra_alld@yahoo.co.in

Introduction

Islands are generally considered center of biodiversity, due to very high rates of endemism (9.5 and 8.1 times higher than continents for vascular plants and vertebrates, respectively) (Kier *et al.*, 2009). Islands anchorage remarkably high numbers of endemic species, with 15% of bird, reptile and plant species in only 3% of the world's land area. About 67% of the centers of marine endemism and 70% coral reef hotspots are centered on islands, 47% of endemic bird areas, 25% of the terrestrial global ecoregions, 30% of the biodiversity hotspots and 40% of alliance for zero extinction sites are islands (Menon *et al.*, 2010). Human populations are also significant with some 500 million people on islands, mostly dependants on local natural resources either directly or indirectly through tourism based economies.

There are many natural and anthropogenic factors which are posing serious threats to the biodiversity of islands and are not only site specific or local but also global threats to which many islands are prone and are in immense pressure to sustain their ecosystem services.

Threats to island biodiversity

Many endemic species of islands are threatened, due to many natural and anthropogenic factors such as invasive species, climate change, natural and environmental disasters, land degradation and marine pollution etc.

1. Habitat destruction, fragmentation and modification

Habitat destruction is the process in which natural habitat becomes functionally not capable to support the species present. It is currently ranked as the primary cause of species extinction worldwide. In a destroyed habitat, the plants, animals, and other organisms occupying the habitat have a reduced carrying capacity so that populations turn down and extinction becomes more likely. Increased urbanization and development of residential buildings reducing the nesting habitats of animals, waste water discharge from coastal industry,

shrimp farms and other forms of coastal development, trawling and the use of push nets and dragnets and mining in these areas are some of major causes for habitat related threats.

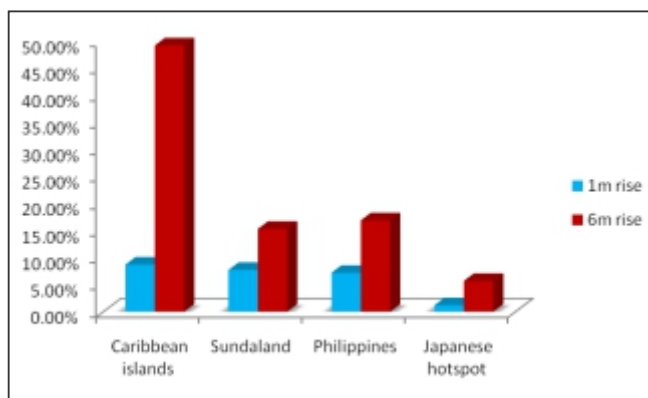
2. Introduced and invasive species

Because of the lack of natural competitors, islands are more prone to invasion by alien species and predators that control populations in their native ecosystems. Islands often have unfilled ecological niches because of the distance from colonizing populations, which also increase the chance of successful invasions. Introduced or invasive species start competition and predation on native species and thus affect their survival. Invasion is a very complex process and could be dangerous as it not only creates competition for food and survival but invasion may also spread disease and pest which further become dangerous for the native plants and animals.

Improved and increased trade, tourism and transportation are major vectors, and ship ballast water, hull fouling, cargo containers and packaging materials, imported food species such as fish, horticultural/plant imports, waste material, military activities, and biological agents to combat pests are some common vectors that introduce alien species to island natural ecosystems.

3. Global warming, sea level rise and climate change

Global rise in sea levels is one of the most threatening consequences of global warming and is a major threat for ecosystems surrounded by seas. Numerous studies suggest statically greater sea level rise of 0.5 to 2.3 m by the end of this century (Nicholls & Cazenave, 2010; Traill *et al.*, 2011). Such increases could lead to the immersion or total submersion of very large portions of many low-elevation islands, and thus threatening the most dramatic consequences for local biodiversity. This may affect plants, freshwater shes, amphibians, reptiles, birds and mammals inhabiting the islands of the world.



Scenario of projected sea level rise on Island's submergence
(As described by Bellard *et al.*, 2013)

The impact of climate change on island flora and fauna will be differences in photosynthetic potential, changes in rainfall posing risk of fire, and drought, spread of certain diseases, and many weeds, inundation of breeding and nesting sites, and seawater intrusion into fresh groundwater sources, migration of animals and plants and bleaching in coral reefs etc (Walton *et al.*, 1991).

4. Pollution

Pollution can suffocate marine life, cause harmful algal blooms and hypoxic zones, and alter food web dynamics. Its biodiversity implications include potential nitrification of low-lying vegetation communities, and introduction of pathogens. Various islands

Table: Some examples of different threats to island biodiversity and their effects

Species	Area	Causes of loss
Greyback-Blackbutt (<i>Drypetes deplanchei</i>)	Lord Howe Island	Fragmentation due to clearing
Flesh-footed Shearwater (<i>Puffinus carneipes</i>)	Australian Islands	Habitat loss due to coastal developmental activities
Dugong (<i>Dugong dugon</i>), Irrawaddy Dolphin (<i>Orcaella brevirostris</i>), green turtle (<i>Chelonia mydas</i>)	Andaman & Nicobar Island	Shrimp farms, trawling push nets and dragnets damaging sea grass meadows
Invasive or introduced species	Area	Effects
Black rats (<i>Rattus rattus</i>); brown rats (<i>Rattus norvegicus</i>)	Christmas Island,	Reduction in birds (<i>Turdus poliocephalus</i> and <i>Promethes sterrha</i>)
Spotted Deer (<i>Axis axis</i>)	Andman and Nicobar island	Affecting forest regeneration, causing crop damage
Lygodium microphyllum	Northern Everglade	Devastating smaller vegetations and seedlings
Species	Area	Effects of climate change
Swamp mahogany (<i>Eucalyptus robusta</i>)	North Keppel Island	Differences in photosynthetic rates
Varanus panoptes	Lizard Island	Migration
Loggerhead turtle (<i>Caretta caretta</i>), flatback turtle (<i>Natator depressus</i>)	Australian island	Nesting and hatching has been affected
Red-footed booby (<i>Sula sula</i>)	Hawaii Island	Failure in feeding and breeding success
Pollution types		Effects of pollutions
Eutrophication		Harmful algal blooms, oxygen depletion
Chemical pollution		Disrupt hormone balances, and fish reproduction
Plastics		Disrupt ocean food web dynamics
Herbicides and pesticides		Egg shell thinning

are facing extreme danger due to different kinds of pollution induced due to many anthropogenic and developmental activities.

There are varied sources of pollution on islands such as, organic pollutants from sewage, wastewater from aquaculture, offshore oil and mining, radio-nuclides, plastic marine debris, toxic dumping and oil spills, eutrophication, harmful algal blooms, oxygen depletion, disease outbreaks due to pollution, chemical pollution from mining or toxic dumping and their bioaccumulations, oil spills; forming thin, toxic films over large areas of water, plastics and other floating debris, persistent organic pollutants, herbicides and pesticides etc. (Gobler and Sunda, 2012; Howarth and Marino, 2006; Robert *et al*, 1985).

5. Hunting and collection of native plants

Hunting for the food and because of their predation on crops many bird species are in danger on Islands. For example White Gallinule (*Porphyrio albus*) and the White-throated Pigeon (*Columba vitiensis godmanae*), on Lord Howe Island (Hutton, 2003). Many traditional activities of collecting plants and seeds have impact upon native flora and fauna. Such as collecting rare native palm seed, cutting Pandanus (*Pandanus forsteri*) foliage and fern and orchid collection may have a detrimental effect on population numbers.

6. Human interactions and interaction of native species

Occasionally the human settlements near the islands and their transport activities cause accidental damage to some animal species on many islands. Another form of human interaction could be the involvement of various research projects which also may represent a minor threat to species or biodiversity of islands. Rare plant surveys, invertebrate survey, etc pose some kind of threats are always present during these processes. Various prey-predator interactions on islands often cause loss of one species. For example, *Strepera graculina crissalis* preys on the chicks of the Vulnerable White Tern on some of the Australian islands.

Conclusion

Islands are self-contained ecosystems so that it is possible to isolate it from many threat factors. A broad management plan specific to each island must be used for the better conservation approaches which should have a protection plan for existing native vegetation, good quarantine policy, revegetation programs of priority sites, on-ground eradication and control programme of weeds, monitoring the impacts of climate change, captive breeding and reintroduction plans and community awareness campaigns. Following these with the scientific approach will do something to save the nature's most important biodiversity spots on the earth.

References

- Bellard, C., Camille Leclerc and Franck Courchamp, 2013, Impact of sea level rise on the 10 insular biodiversity hotspots, *Global Ecology and Biogeography*.
- Kier, G., Holger Kreft, Tien Ming Lee, Walter Jetz, Pierre L. Ibisch, Christoph Nowicki, Jens Mutke and Wilhelm Barthlott, 2009. A global assessment of endemism and species richness across island and mainland regions, *PNAS, USA*, vol. 106 no. 23, 9322–9327.
- Gobler, C.J. and W.G. Sunda. 2012. Ecosystem disruptive algal blooms of the brown tide species, *Aureococcus anophagefferens* and *Aureocoumbra lagunensis*. *Harmful Algae* 14: 36–45.
- Howarth, R. W. and R. Marino. 2006. Nitrogen as the limiting nutrient for eutrophication in coastal marine ecosystems: Evolving views over three decades. *Limnol. Oceanogr.*, 51(1, part 2): 364–376.
- Hutton, I., 2003, Management for birds on Lord Howe Island, Report to the Department of Environment and Conservation, Sydney.
- Menon, S., Soberon, J., Li, X. & Peterson, T. 2010, Preliminary global assessment of terrestrial biodiversity consequences of sea-level rise mediated by climate change. *Biodiversity and Conservation*, 19, 1599–1609.
- Nicholls, R.J. & Cazenave, A. 2010, Sea-level rise and its impact on coastal zones. *Science*, 328, 1517–1520.
- Robert A. Pastorok and Gordon R. Bilyard, 1985; Effects of sewage pollution on coral-reef communities, *Marine Ecology Progress Series*.
- Traill, L.W., Perhans, K., Lovelock, C.E., Prohaska, A., McFallan, S., Rhodes, J.R. & Wilson, K. (2011) Managing for change: wetland transitions under sea-level rise and outcomes for threatened species. *Diversity and Distributions*, 17, 1225–1233.
- Walton, D. W., Reville, B., George, A., Just, J., Forbes, M., Fagg, M., & Longmore, R. (eds), 1991, Kowarri 2: Plant Invasions: The Incidence of Environmental Weeds in Australia, Australian National Parks and Wildlife Service, Canberra.