Hotspots: An Introduction and Role in Conservation

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Abstract

Biodiversity is integral to the direct benefits that humans receive from nature besides ecosystem services. However, human activities and the negative consequences of climate change are accelerating the loss of biodiversity. There are multiple indications of continuing decline in biodiversity in all three of its components – ecosystems, species and genes. In order to receive continuous ecosystem services and protect the species from extinction, 35 global biodiversity hotspots have been identified for conservation. It is nothing but a biogeographic region with significant levels of biodiversity that is threatened with destruction. The tropical island of Andaman and Nicobar is part of the global biodiversity hotspot having a large number of flora and fauna besides exhibiting great endemism. The recent assessment showed that the plant diversity of these islands comprises 3219 species under 1251 genera belonging to angiosperms, gymnosperms, pteridophytes, bryophytes, lichens and algae. Similarly 1463 species of fishes, 600 species of corals, 120 species of sponges, 290 species of butterflies, 300 species of birds and 36 species of mangroves were recorded. They are imperative for the livelihood of local people, a treasure for humankind; therefore, efforts should be made to strengthen the conservation efforts and preservation of threatened floral and faunal diversity of these islands.

Keywords

Biodiversity · Conservation · Biogeographic region · Bay islands · Ecosystem services

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C. Sivaperuman, K. Venkataraman (eds.), *Indian Hotspots*,
https://doi.org/10.1007/978-981-10-6983-3_1

1.1 Introduction

Concern over the loss of biodiversity and the recognition of its important role in supporting human well-being and ecosystem services has received worldwide attention. This resulted in global consensus on the conservation of biodiversity, the sustainable use of its components and the fair and equitable sharing of benefits arising out of the utilization of genetic resources. In general biodiversity or biodiversity is defined as the variety of the planet's living organisms and their interactions. It encompasses all of life's variation, expressed in genes, individuals, populations, species, communities and ecosystems.

Biodiversity is essentially a dynamic entity as the term defines and has changed throughout the history of life on Earth. The mechanisms responsible for biodiversity change are evolutionary processes of speciation and extinction, along with ecological processes over shorter time periods. This has been altered by anthropogenic activities, particularly modern human actions threatening biodiversity on a worldwide scale, over an extremely short geological time period. Such anthropogenic-centric threats to biodiversity are generally taxonomically specific exploitation, introduced species and genetic or behavioural degradation. These threats of biodiversity not only affect directly, but they can interact resulting in extinction of species and in some cases make them highly vulnerable. These threats combine with the community- and ecosystem-level threats of habitat degradation, fragmentation and destruction, pollution and global climate change leading to disruption and alteration of community and ecosystem structure and function.

There are several organizations involved in systematic assessment of current taxonomic extinction risk, most notably the International Union for the Conservation of Nature and Natural Resources (IUCN). Detailed information is available for well-known groups of organisms, including most vertebrates and flowering plants, and to a much lesser extent for invertebrates, other plants and fungi. Since 1600, at least 1.84% of mammals and 1.20% of bird species have become extinct. Present calculations estimate 25% of mammals and 12% of birds at risk of extinction with a probability of at least 10% over the next 100 years (Myers et al. 2000). In summary, species having small range or population sizes are at risk especially species that have become rare due to human activity.

1.2 Rationale for Conservation

Why should the human community be concerned about the loss of biodiversity? Although it had occurred during the evolutionary process, the rate of loss after industrialization is huge. Owing to biodiversity loss, we human beings lose the ultimate source of our crops and the genes we use to improve agricultural resilience, the inspiration for manufactured products and the basis of the structure and function of the ecosystems that support humans and all life on Earth (McNeely et al. 2009). Above and beyond material welfare and livelihoods, biodiversity also contributes to security, resiliency and freedom of choices and actions (Millennium Ecosystem

Assessment 2005). Conservation and protection of entire ecosystem, therefore, is a common concern and shared responsibility of human beings all over the world. Quantitative measures of biodiversity most often focus on a taxonomic unit, typically the species, although aspects of ecological diversity can also be measured. The most threatened areas of high species diversity on Earth have been labeled biodiversity hotspots and include mostly tropical rainforests, coastal areas and islands. For these reasons, these areas should receive high priority on conservation programmes.

In this context, high biodiversity or presence of number of species alone is an inadequate indication of conservation priority because several areas can share the same species. In contrast, areas with high levels of endemism are irreplaceable, particularly in island ecosystems. We must conserve these places because the unique species they contain cannot be saved elsewhere. In many cases, these areas are facing greater risk of disappearing because of human activities of different nature. As species become threatened and vanish, so too do the broader ecosystems and myriad benefits to human well-being that depend upon biodiversity. Bringing an end to global biodiversity loss requires that limited available resources be guided to those regions that need them most. The biodiversity hotspots do this based on the conservation planning principles of irreplaceability and vulnerability.

1.3 Biodiversity Hotspots

Biodiversity hotspots are a method to identify those regions of the world where attention is needed to address biodiversity loss and to guide investments in conservation. The idea was first developed by Norman Myers in 1988 to identify tropical forest 'hotspots' characterized both by exceptional levels of plant endemism and serious habitat loss, which he then expanded to a more global scope. In general hotspots are the richest and most threatened reservoirs of plant and animal life of the earth. Besides this, biodiversity hotspots have maximum number of endemic species.

Based on these logics and global implication of biodiversity loss, Conservation International adopted Myers' hotspots as its institutional blueprint in 1989, and in 1999, the organization undertook an extensive global review which introduced quantitative thresholds for the designation of biodiversity hotspots. According to Conservation International, to qualify as a hotspot, a region must meet two basic criteria. First it must contain at least 1500 species of vascular plants (> 0.5% of the world's total) as endemics, and secondly, it should have lost at least 70% of its original habitat. Biodiversity hotspot areas held as endemics about 44% of the world's plants and 35% of terrestrial vertebrates in an area that formerly covered only 11.8% of the planet's land surface. The habitat extent of this land area had been reduced by 87.8% of its original extent, such that this wealth of biodiversity was restricted to only 1.4% of Earth's land surface (Mittermeier et al. 1999). Biodiversity hotspots are global in extent; however, it is not rigid as new biodiversity hotspots are periodically added and can be included in the future based on scientific assessments of new regions. Changing circumstances such as sustained habitat loss or the discovery of new species may mean that areas previously not considered biodiversity hotspots could qualify in a future reassessment.

1.4 Global Biodiversity Hotspots

As explained in the previous section, large regions of the world containing exceptional concentrations of plant endemism and experiencing high rates of habitat loss have been identified as biodiversity hotspots and are presented in Table 1.1. Currently, 35 biodiversity hotspots have been identified, most of which occur in tropical forests (Fig. 1.1). They represent just 2.3% of Earth's land surface, but between them, they contain around 50% of the world's endemic plant species and 42% of all terrestrial vertebrates. Overall, hotspots have lost around 86% of their original habitat and also it is observed to be significantly threatened by extinctions induced by climate change.

1.4.1 North and Central America

North and Central America play host to thousands of acres of important habitat. These are new world species known after European expansion.

1.4.2 South America

From Brazil's Cerrado to the Tropical Andes, South America has some of the richest and most diverse life on Earth.

1.4.3 Europe and Central Asia

From the Mediterranean Basin to the Mountains of Central Asia, these four hotspots are unique in their diversity.

1.4.4 Africa

This consists of a total of eight hotspots in the African continent which hold a diversity of plant and animal life, many of which are found nowhere else on Earth.

1.4.5 Asia-Pacific

Composed of large land areas as well as islands dotting the Pacific seas, these 14 hotspots represent important biodiversity. The forests of East Australia are the latest hotspot to have been added after research showed that the area fulfilled all criteria.

Table 1.1 Biodiversity hotspots of the world

Region	Hotspots
North and Central America	California Floristic Province
	Caribbean Islands
	Madrean Pine-Oak Woodlands
	Mesoamerica
South America	Atlantic Forest
	Cerrado
	Chilean Winter Rainfall-Valdivian Forests
	Tumbes-Chocó-Magdalena
	Tropical Andes
Europe and Central Asia	Caucasus
	Irano-Anatolian
	Mediterranean Basin
	Mountains of Central Asia
Africa	Cape Floristic Region
	Coastal Forests of Eastern Africa
	Eastern Afromontane
	Guinean Forests of West Africa
	Horn of Africa
	Madagascar and the Indian Ocean Islands
	Maputaland-Pondoland-Albany
	Succulent Karoo
Asia-Pacific	East Melanesian Islands
	Himalayan ranges
	Indo-Burma
	Japan
	Mountains of Southwest China
	New Caledonia
	New Zealand
	Philippines
	Polynesia-Micronesia
	Southwest Australia
	Forests of Eastern Australia (new)
	Sundaland
	Wallacea
	Western Ghats and Sri Lanka

1.5 Hotspots in India

India is a land of varied flora, fauna and biodiversity besides human race and hence recognized as one of the 17 mega diverse nations of the world. Two of India's great mountain ranges, viz. the Eastern Himalayas and the Western Ghats, have been designated among the world's 18 'hotspots' of biodiversity (Table 1.2). Forests in India are thick and wooded with the flora to back up the fabulous fauna which comprises some 15,000 species of plants. Evergreen forests in the north-east and along

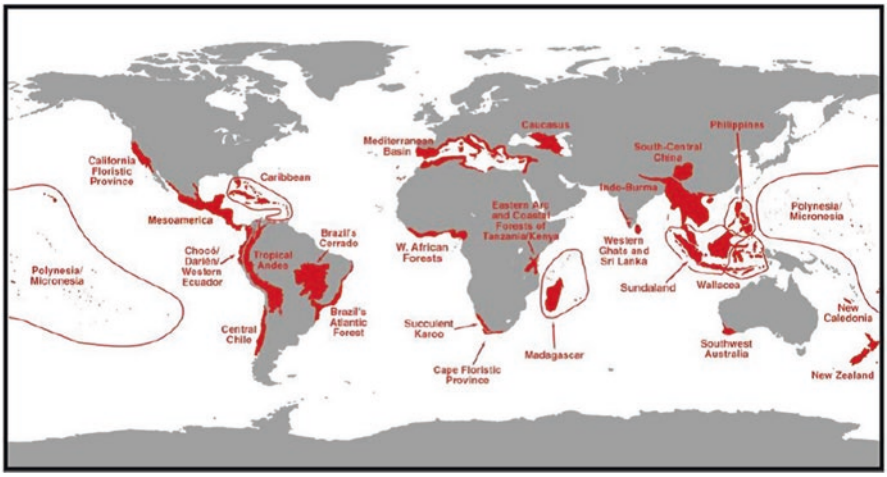

Fig. 1.1 Biodiversity hotspots (Source- www.conservation.org)

Table 1.2 Floral and faunal diversity of India as compared to the global diversity

Group	Number	% of world species
Amphibians	197	4.4
Birds	1224	12.6
Fishes	2546	11.7
Flowering plants	15,000	6.0
Mammals	350	7.6
Reptiles	408	6.2

Data sources: Indira Gandhi Conservation Monitoring Centre (IGCMC), New Delhi and IISc

the Western Ghats, moist and dry deciduous forests of the plains, swampy marshes of Bengal and Madhya Pradesh, pinewoods of the Himalayan foothills and the lagoons and estuaries down south each pave for a different ecosystem, sheltering unique forms of plant and animal life. India is home to several well-known large mammals including the Asian elephant, Bengal tiger, Asiatic lion, leopard and Indian rhinoceros, often ingrained culturally and religiously often being associated with deities. There are four biodiversity hotspots which harbour wide diversity of flora and fauna (Source: www.conservation.org; www.cepf.net). They are as follows:

1.5.1 Himalaya

This is very prominent hotspot and spread across the nations in Asia. It includes the entire Indian Himalayan region, Pakistan, Tibet, Nepal, Bhutan, China and Myanmar. The Eastern Himalayas is the region encompassing Bhutan, north-eastern

India and southern, central and eastern Nepal. The abrupt rise of the Himalayan Mountains from less than 500 m to more than 8000 m results in a diversity of ecosystems that range from alluvial grasslands and subtropical broadleaf forests along the foothills to temperate broadleaf forests in the mid-hills, mixed conifer and conifer forests in the higher hills and alpine meadows above the treeline. The Eastern Himalayan hotspot has nearly 163 globally threatened species (both flora and fauna) including the one-horned rhinoceros [vulnerable] and the wild Asian water buffalo [endangered]. There are an estimated 10,000 species of plants in the Himalayas, of which one-third are endemic and found nowhere else in the world. A few threatened endemic bird species such as the Himalayan quail, cheer pheasant and western tragopan are found here, along with some of Asia's largest and most endangered birds such as the Himalayan vulture and white-bellied heron. Mammals like the golden langur, the Himalayan tahr, the pygmy hog, langurs, Asiatic wild dogs, sloth bears, gaurs, muntjac, sambar, snow leopard, black bear, blue sheep, takin, the Gangetic dolphin, wild water buffalo and swamp deer call the Himalayan ranges their home.

1.5.2 Indo-Burma

The Indo-Burma region lying east of Himalayan hotspot also encompasses several countries of Asia. It includes entire north-eastern India, except Assam and the Andaman group of islands (and Myanmar, Thailand, Vietnam, Laos, Cambodia and southern China). Much of this region has been deteriorating rapidly in the past few decades. This region is home to several primate species such as monkeys, langurs and gibbons with populations numbering only in the hundreds. Many of the species, especially some freshwater turtle species, are endemic. Almost 1300 bird species exist in this region including the threatened white-eared night heron [endangered], the grey-crowned crocias [endangered] and the orange-necked partridge [near threatened]. It is estimated that there are about 13,500 plant species in this hotspot, with over half of them endemic. Ginger, for example, is native to this region.

1.5.3 Sundaland

Sundaland is a region in South East Asia that covers the western part of the Indo-Malayan archipelago. It includes Thailand, Malaysia, Singapore, Brunei and Indonesia. India is represented by the Nicobar Islands. The United Nations declared the islands a world biosphere reserve in 2013. The islands have a rich terrestrial and marine ecosystem that includes mangroves, coral reefs and seagrass beds. The marine biodiversity includes several species such as whales, dolphins, dugongs, turtles, crocodiles, fishes, prawns, lobsters, corals and seashells which exhibit the most spectacular diversity in the world. The primary threat to this biodiversity comes from over-exploitation of marine resources. In addition, the forests on the island also need to be protected.

1.5.4 Western Ghats and Sri Lanka

This includes the entire Western Ghats in India (and Sri Lanka). The Western Ghats, also known as the 'Sahyadri Hills', encompasses the mountain forests in the south-western parts of India and highlands of south-western Sri Lanka. The entire extent of hotspot was originally about 182,500 km^2, but due to tremendous population pressure, now only 12,445 km^2 or 6.8% is in pristine condition. The wide variation of rainfall patterns in the Western Ghats, coupled with the region's complex geography, produces a great variety of vegetation types. These include scrub forests in the lowly ingrained shadow areas and the plains, deciduous and tropical rainforests up to about 1500 m and a unique mosaic of montane forests and rolling grasslands above 1500 m. In Sri Lanka, diversity ranges from dry evergreen forests to *Dipterocarpus* dominated rainforests to tropical montane cloud forests. The important populations include Asian elephant, Nilgiri tahr, Indian tigers, lion-tailed macaque [all endangered], Indian giant squirrel [least concern], etc.

1.6 Biodiversity Hotspot: A Case Example of the Andaman and Nicobar Islands

1.6.1 Physical Setting

The Andaman and Nicobar Islands, India, an archipelago of over 572 islands, islets and rocky outcrops lie as a long and broken chain in the Bay of Bengal between 6′ and 14′ north latitude and 92′ and 94′ east longitude (Fig 1.2). Stretched over an area of more than 700 km north to south with the total geographical area of 8249 km^2, these undulating islands are covered with dense forests and endless variety of indigenous and exotic flora and fauna. The island has elevations of continuous submerged ridges, which extend almost unto Australia. On the eastern side of the ridge lie Sumatra, Java, Bali and other islands of Indonesia. The Andaman group of islands is separated from Nicobar group by the Ten Degree Channel. Ranges of low hills running north–south and enclosing valleys are the characteristic topographic feature of the Andaman Islands, while the Nicobar group is generally flat except Great Nicobar and the Nancowry group, which are hilly. The soil of the Nancowry group is porous coral sand, which quickly absorbs the rainwater, leaving hardly any stagnation. The island receives more than 3100 mm of total annual rainfall, and the relative humidity ranges from 75% to 95% depending on the season. Favourable climate and soils besides very limited human intervention paved the way for the rich and diverse flora and fauna of these islands as it is seen today.

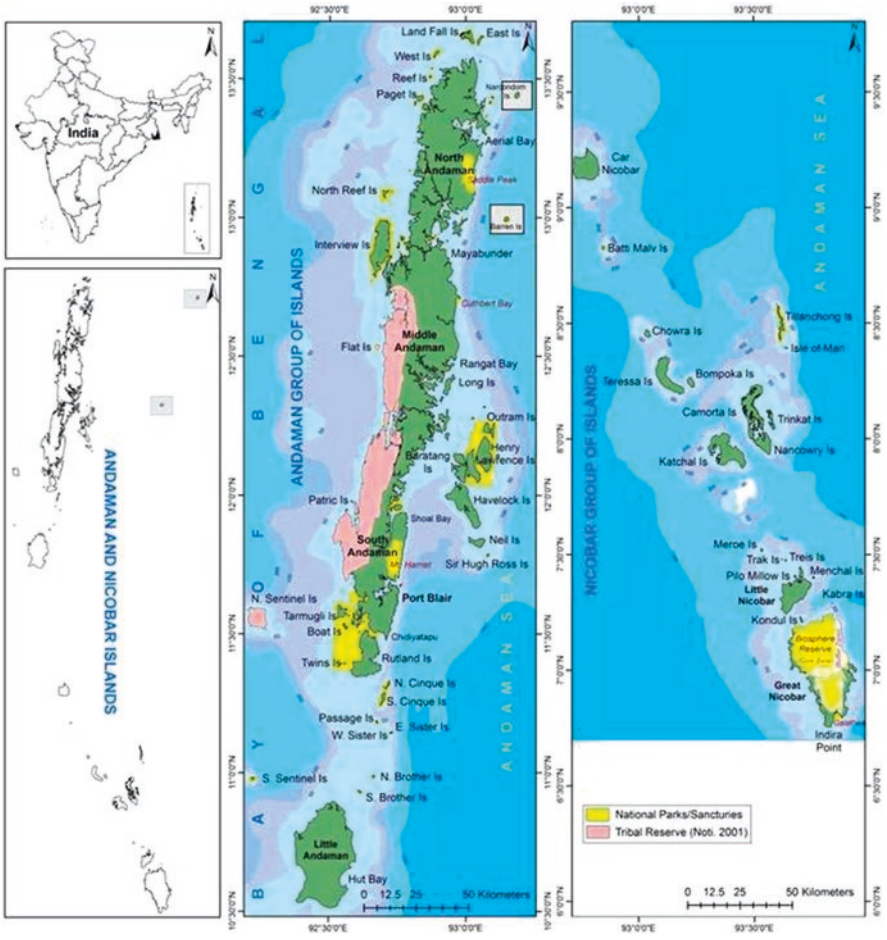

Fig. 1.2 Location of the Andaman and Nicobar Islands

1.6.2 Diversity of Aboriginals

There are six aboriginal groups, viz. the Great Andamanese, Onges, Jarawas, Sentinelese, Nicobarese and Shompens, of which the first four are Negrito hunter-gatherers inhabiting some of the Andaman Islands while the last two are of Mongoloid race and live in the Nicobar Islands. These aboriginal people widely use plants in day-to-day sustenance and some endemic flora for medicinal purposes. The earliest record of flora of this biodiversity-rich island is found in 'Report on the vegetation of the Andaman Islands' (Kurz 1870) in which the various vegetation types, influence of the season upon the vegetation and peculiarities of flora of the Andaman Islands are outlined.

1.6.3 Vegetation Diversity

The flora of Nicobar Islands is closely allied to that of Sumatra and Malaysia as in the case of its geographical relations. Tropical broad-leaved evergreen forests are prominent here. Agricultural activities have pressured these forests to a limited extent. According to Champion and Seth (1968), the vegetation of these islands is broadly classified into (i) beach forests, (ii) mangrove forests, (iii) wet evergreen forests, (iv) semi-evergreen forests, (v) moist deciduous forests and (vi) grasslands (Table 1.3). Pandey and Diwakar (2008) published an integrated check-list for the flora of the Andaman and Nicobar Islands, which reports 2654 plant taxa, including 228 intraspecific taxa under 1083 genera in 237 families belonging to 4 different plant groups, viz. bryophytes, pteridophytes, gymnosperms and angiosperms:

- An updated data on the flora revealed that the island harbours a total of 2662 plant taxa, comprising 2519 species, 33 subspecies, 104 varieties and 6 forma under 1110 genera in 238 families belonging to bryophytes, pteridophytes, gymnosperms and angiosperms (Murugan and Kamble 2012).
- Bryophytes are represented by 58 species and 3 varieties, under 32 genera and 16 families (Lal 2005). Pteridophytes are consisting of 129 species, 1 subspecies and 9 varieties under 62 genera belonging to 38 families (Dixit and Sinha 2001).
- Gymnosperms are represented by 7 species and 2 varieties under 4 genera and 3 families. Besides, the islands also harbour 383 species of lichens under 84 genera and 30 families.
- Angiosperms are the predominant plant group in the Andaman and Nicobar Islands. They are represented by 2314 species, 31 subspecies, 89 varieties and 6 forma under 1011 genera in 181 families, constituting 92% of entire flora of the Andaman and Nicobar Islands.
- Only 3 genera, viz. Nicobariodendron, Pseudodiplospora and Sphyranthera, and about 315 species belonging to 187 genera and 74 families are endemic to the union territory, constituting about 10% of the flora (Singh et al. 2014).
- Algae are represented by 182 species belonging to 84 genera in 32 families.

The details of dominant plant species belonging to different forest types and its distribution are given in Table 1.3. Each forest type has different layers, and in each layer, very specific and well-adapted plant species are found in which most of them are endemic to these islands.

Flora of the Andaman group shows relevant difference from that of the Nicobar region. The *Pterocarpus* and *Dipterocarpu*s sp. found as dominant species in the Andaman Islands are not encountered in the Nicobar Islands. *Cyrtandra* and *Stemonurus* belonging to family Icacinaceae, *Spathoglottis* of Orchidaceae and many other endemic species occur only in the Nicobar Islands. Another important aspect of Andaman vegetation reveals that around 11% of the total geographical area of the island is covered with mangroves. The islands contribute nearly 0.25% of the total eco-rich area of the Indian subcontinent. A total of 105 national parks and wildlife sanctuaries cover 18.54% of the total protected area network in the country (Anon 2015). The South Andaman forests have a profuse growth of epiphytic

Table 1.3 Forest types and dominant tree species of the Andaman and Nicobar Islands

Forest type	Distribution	Dominant trees
Andaman giant evergreen forests	Present in small areas near the banks of the larger streams, where soils are deep alluvium	*Dipterocarpus alatus*, *Artocarpus chaplasha L.*, *Artocarpus gomeziana*, *Dipterocarpus gracilis*, *Calophyllum soulattri*, *Sideroxylon longipetiolatum*, *Amoora wallichii*, *Pterocymbium tinctorium*
		In the lower storey can be found *Pometia pirulata*, *Mesua ferrea*, etc. Climbers present are *Dinochloa andamanica*, *Gnetum scandens* and a variety of canes
Andaman tropical evergreen forests	Throughout the Andaman Islands typically as caps to the hills with moist deciduous forests on the slopes. Locality factors: rainfall of over 3000 mm, well distributed and sufficiently retentive deep soil with good internal drainage	*Dipterocarpus grandiflorus*; *D. pilosus*; *Artocarpus chaplasha*; *A. gomeziana*; *Calophyllum soulattri*; *Planchonia andamanica*; *Hopea odorata*; *Endospermum chinense*; *Sideroxylon longipetiolatum*; *Xanthochymus andamanicum*; *Myristica andamanica*; *M. glaucescens*; *Baccaurea sapida*; *Croton argyratus*; *Pterospermum aceroides*; *Anaxagorea luzeniensis*, etc.; *Dinochloa andamanica*; *Calamus palustris*; *Gnetum scandens*; *Ancistrocladus extensus*
Southern hilltop tropical evergreen forests	A more or less inferior addition of the tropical wet evergreen, not more than 10 m high in extreme cases Distribution on the upper slopes and tops of hills and sometimes on steep slopes lower down	*Dipterocarpus costatus*, *Mesua ferrea*, *Canarium manii*, *Harpullia cupanioides*, *Hopea andamanica*, *Cratoxylum formosum*, *Euphorbia trigona* and *Euphorbia epiphylloides. Memecylon caeruleum*, *Cryptocarya ferrarsi* and some small bamboo and Phoenix species
Andaman semi-evergreen forest	The chief characteristic is the immature alluvial soil sufficiently old and raised above flood level to be able to progress to the climatic climax, but with a good subsoil water supply and well-drained soil	**I Storey** *Dipterocarpus alatus*, *D. pilosus*, *Pterygota alata*, *Pterocymbium tinctorium*, *Sterculia campanulata*, *Tenninalia bialata*, *Tenninalia procera*, *Albizia chinensis*, *A. lebbeck*, *Calophyllum soulattri*, *Salmalia insignis*, *Artocarpus lakoocha*, *A. chaplasha*, *Pterocarpus dalbergioides*
		II Storey *Lagerstroemia hypoleuca*, *Dillenia pentagyna*, *Dracontomelum mangiferae. Pometia pinnata*, *Myristica* spp., *Pisorua excelsa*, *Litsea panamonja*, *Xanthophyllum andamanicum*
		II.a Storey Usually no bamboos, *Oxytenanthera* spp.
		III Storey *Saprosma tematum*, *Moosa andamaruca*, *Micromelum pubescens*, *Clerodendrum viscosum*, *Leea indica*, *Clinogyne grandis*

(continued)

Table 1.3 (continued)

Forest type	Distribution	Dominant trees
Andaman moist deciduous forests	The underlying rock is chiefly rather hard coarse-grained sandstone with bands of shale and conglomerate, and the soil, which is often shallow, is a sandy or clayey loam of light yellow colour	**I Storey** *Pterocarpus dalbergioides*, *Terminalia bialata*, *T. manii*, *T. procera*, *Canarium euphyllurn*, *Pterocymbium tinctorium*, *Tetrameles nudiflora*, *Chukrasia tabularis*, *Albizia lebbeck*, *Lagerstroemia hypoleuca*
		II Storey *Lannea coromandelica*, *Adenanthera pavonina*, *Dillenia pentagyna*, *Diospyros marmorata*, *Saccopetalum tinctorium, Sageraea elliptica*, *Cratoxylon formosum*, *Semecarpus kurzii*, *Cinnamomum* spp., *Pterospermum aceroides*
		III Storey *Oxytenanthera nigrociliata*, *Rambusaschizo stachyoides*, *Pleiopermium alaturn*, *Ganthium gracilipes*, *Ixora grandifolia*
		IV Storey
		Byttneria andamanensis
		V Storey *Delima sarmentosa*, *Acacia pennata*, *Entada phaseoloides, Calamus species*
Littoral forests – beach and dune forest	All round the coast wherever a fair width of sandy beach occurs	**I Storey** *Manilkara littoralis*
		II Storey *Pongamia pinnata*, *Morinda citrifolia*, *Erythrina variegata* var. *orientalis*, *Calophyllum inophyllum*, *Terminalia catappa*, *Barringtonia asiatica*, *Cordia subcordata*
		III Storey *Thespesia populnea*, *Hibiscus tiliaceus*, *Pandanus tectorius*
		IV Storey *Ipomoea pes-caprae*, *Crinum asiaticum*, *Vigna retusa*, *Scaevola frutescens*
		V Storey *Mucuna gigantea*, *Colubrina asiatica*, *Caesalpinia bonducella*
Mangrove forest (tidal swamp forest)	Typically a closed evergreen forest of moderate height, composed of trees specially adapted to survive on tidal mud which is permanently wet with saltwater and submerged during every tide. Stilt roots are very typical (notably in *Rhizophora*), so also are leathery entire leaves and vivipary. In the river deltas along the edge of the waterways and sheltered muddy coasts	*Rhizophora amucronata*, *R. candelaria* (outer edge), *Bruguiera conjugata*, *B. parviflora* (just behind), *Avicennia officinalis*, *Ceriops tagal*, *Kandelia candel*, *Xylocarpus moluccensis*, *Sonneratia caseolaris*, *Excoecaria*, etc.

vegetation, mostly ferns and orchids due to favourable climatic and edaphic conditions. The Middle Andaman mostly harbours moist deciduous forests and diverse mangrove patches. North Andaman is characterized by the wet evergreen type, with plenty of woody climbers. In contrast, deciduous forests common in the Andaman Islands show rare occurrence in the Nicobar Islands. The central and southern islands of the Nicobar group have evergreen forest as the dominant vegetation type.

1.6.4 Faunal and Marine Biodiversity

From the Andaman and Nicobar Islands, 1463 species of fishes, 300 species of corals, 120 species of sponges, 215 species of butterflies, 68 species of birds and 34 species of mangroves are documented (Raghunathan 2015) (Table 1.4).

Table 1.4 Faunal and marine biodiversity of the Andaman and Nicobar Islands

SI. No.	Faunal group	World	India	A N Islands	Endemic	% of endemic
1.	Sponges	5100	519	112	5	7.14
2.	Helminthes (marine flatworm)	400	19	19	–	
3.	Corals	700	600	600	–	–
4.	Earthworms	4000	585	21	7	33.33
5.	Leeches	500	59	10	–	–
6.	Polychaetes	8000	428	186	–	–
7.	Arachnids	120	21	14	–	–
8.	Gastrotricha	2500	88	32	6	18.75
9.	Chinorincha	100	10	4	2	50.00
10.	Crustaceans	24,375	2970	607	56	9.22
11.	Spiders and scorpions	35,810	1352	113	28	45.16
12.	Centipedes	3000	100	17	–	–
13.	Millipedes	7500	162	5	–	–
14.	Insects	86,7391	59,353	2274	485	21.5
15.	Molluscs	–	–	–	–	–
	Land	15,000	950	110	75	68.18
	Freshwater	8765	284	51	12	23.52
	Marine	56,235	32,751	1422	2	0.2
	Opisthobranchia	6500	180	180	–	–
16.	Siphonculates	202	38	25	–	–
17.	Echinoderms	6226	765	430	2	0.59
18.	Fishes	21,723	2546	1484	2	0.14
19.	Amphibians	550	219	23	3	16.66
20.	Reptiles	5817	456	104	23	25.55
21.	Aves	9026	1232	284	105	36.97
22.	Mammals	4629	390	62	33	55.00
		11,04,169	1,06,115	8425	6	–

Sivaperuman and Raghunathan (2012)

1.6.5 Birds

The Andaman and Nicobar Islands are one of the Endemic Bird Areas of the world (Stattersfield et al. 1998) due to their high endemism (Rasmussen and Anderton 2012), which could be attributed to their geographical isolation from mainland India (Das 1999; Andrews 2001). A total of 293 species of birds have been reported so far from these islands (Sivaperuman and Raghunathan 2012), of which 158 are identified as wetland-associated birds (Table 1.5).

1.6.6 Butterfly Diversity

These islands have a rich diversity of butterflies. Zoogeographically, the butterfly fauna of the islands can be classified into six major groups, (1) wide-ranging fauna, (2) similar to Myanmar fauna, (3) similar to Malayan fauna, (4) fauna common to the Andamans and Nicobar Islands, (5) endemic to the Andaman Islands and (6) endemic to the Nicobar Islands. Wide-ranging taxa showing affinities with Indian

Table 1.5 Birds of the Andaman and Nicobar Islands

S.No.	Common name	Scientific name	Distribution
1.	Andaman teal	*Anas albogularis*	Andaman Islands
2.	Andaman crake	Rallina canningi	Andaman Islands
3.	Andaman wood pigeon	*Columbo palumboides*	Andaman Islands
4.	Andaman cuckoo-dove	*Macropygia rufipennis*	Andaman Islands
5.	Andaman barn owl	*Tyto deroepstorffi*	Andaman Islands
6.	Andaman hawk-owl	*Ninox affinis*	Andaman Islands
7.	Hume's hawk-owl	*Ninox obscura*	Andaman Islands
8.	Andaman scops owl	*Otus balli*	Andaman Islands
9.	Andaman nightjar	*Caprimulgus andamanicus*	Andaman Islands
10.	Narcondam hornbill	*Aceros narcondami*	Andaman Islands
11.	Andaman woodpecker	*Dryocopus hodgei*	Andaman Islands
12.	Andaman cuckooshrike	*Coracina dobsoni*	Andaman Islands
13.	Andaman bulbul	*Pycnonotus fuscoflavescens*	Andaman Islands
14.	Andaman shama	*Copsychus albiventris*	Andaman Islands
15.	Andaman flowerpecker	*Dicaeum virescens*	Andaman Islands
16.	Andaman white-headed starling	*Slurnia erythropygia*	Andaman Islands
17.	Andaman treepie	*Dendrocitta bayleii*	Andaman Islands
18.	Nicobar sparrowhawk	*Accipiter butleri*	Nicobar Islands
19.	Great Nicobar serpent eagle	*Spilornis klossi*	Nicobar Islands
20.	Nicobar megapode	*Megapodius nicobariensis*	Nicobar Islands
21.	Nicobar imperial pigeon	*Ducula nicobarica*	Nicobar Islands
22.	Nicobar parakeet	*Psittacula caniceps*	Nicobar Islands
23.	Nicobar scops owl	*Otus alius*	Nicobar Islands
24.	Nicobar bulbul	*Hypsipetes nicobariensis*	Nicobar Islands
25.	Nicobar jungle-flycatcher	*Rhinomyias nicobaricus*	Nicobar Islands

Table 1.6 Endemic subspecies of the Andaman and Nicobar Islands

Family	Subfamily	Andaman	Nicobar
Papilionidae	Papilioninae	12	9
Pieridae	Pierinae	10	11
Lycaenidae	–	58	34
Riodinidae	–	1	–
Nymphalidae	Nymphalinae	34	19
	Danainae	8	17
	Amathusiinae	2	–
	Satyrinae	7	6
Hesperiidae	–	38	13
Total	–	170	109

mainland elements form 10% of the total fauna and are rare in these islands. Half the taxa are endemic to these islands (Table 1.2) and 20% of the species are common to both groups of islands (Khatri 1993). The remaining taxa show similarities with Myanmar and Malayan elements (Table 1.6).

1.6.7 Important Indigenous Livestock Germplasm

Main livestock in these islands are cattle, buffalo, goat, pig, poultry, a few horses and rabbits also. Cattle (28.93% of total livestock) are mainly Desi, crossbred and Trinket cattle (feral); the buffaloes (5.04% of total livestock) are mostly Desi. Goat constitutes 39.74% of total livestock and mostly owned by settlers and Nicobari tribes. The indigenous ones are the Teressa goat and the Barren Island goat. Pig constitutes 23.02% of total livestock and is mostly owned by tribes and settlers. Indigenous ones are mainly the Nicobari pig, Andaman wild pig and Desi pig. Poultry (88.28% of total livestock including poultry) comprises of Nicobari fowl, naked neck, frizzled fowl and barred Desi. Out of 37 islands, 12 islands have no livestock and another 4 islands have a population less than 200 in number. Livestock is almost exclusively comprised of indigenous varieties (Desi), i.e. non-descript, which are about 80% with very few improved varieties (19th Livestock census-2012).

1.7 Endemism

The island biodiversity has huge endemism which is depicted in Fig. 1.3. Out of 8425 species of fauna, 8464 species are endemic and more than 60% of biodiversity have been reported from marine habitat. The main terrestrial mammals are the long-tailed macaque, wild boar, civets and several species of bats, rats and shrews. From the faunistic point of view, the most interesting feature is the absence of large mammals and the presence of a considerable number of endemics among the inland

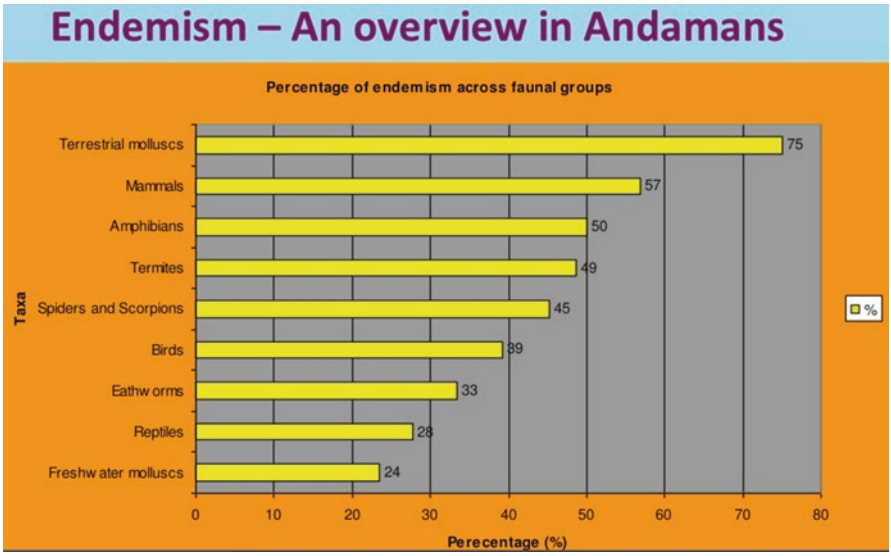

Fig. 1.3 An overview of endemism found in the Andaman Islands

vertebrates (Ellis et al. 2000). *Sphyranthera* sp. belonging to the family Euphorbiaceae and *Pubistylis* sp. belonging to the family Rubiaceae show genetic-level endemism. The Andaman Islands have five mammal species that are strictly endemic to the ecoregion (*Crocidura andamanensis*, *Crocidura jenkinsi*, *Rhinolophus cognatus*, *Rattus stoicus* and *Crocidura hispida*). All five species listed are threatened (categories vulnerable and above) (IUCN 2001).

1.8 The Great Nicobar Biosphere Reserve

Great Nicobar is the largest of the Nicobar Islands in the Indian Union Territory of Andaman and Nicobar Islands which covers an area of 1045 km^2 (Fig. 1.4). It lies about 482 km south of Port Blair and about 145 km north of Sumatra. The island lies in a phytogeographically strategic location, being in the low-latitude region, and experiences tropical climate with mean annual temperature of 22–32 °C, relative humidity of 82% and rainfall of 300–380 cm. The island has several rivers, including the Alexandra, Amrit Kaur, Dogmar and Galathea. Virtually all rivers flow in a southern or south-westerly direction, which is indicative of the general slope of the terrain across the island. The island harbours rich germplasm resources due to which the government of India declared 85% of the island as a biosphere reserve in 1989. In the year 2013, it was included in the list of Man and Biosphere programme of UNESCO to promote sustainable development based on local community effort and sound science.

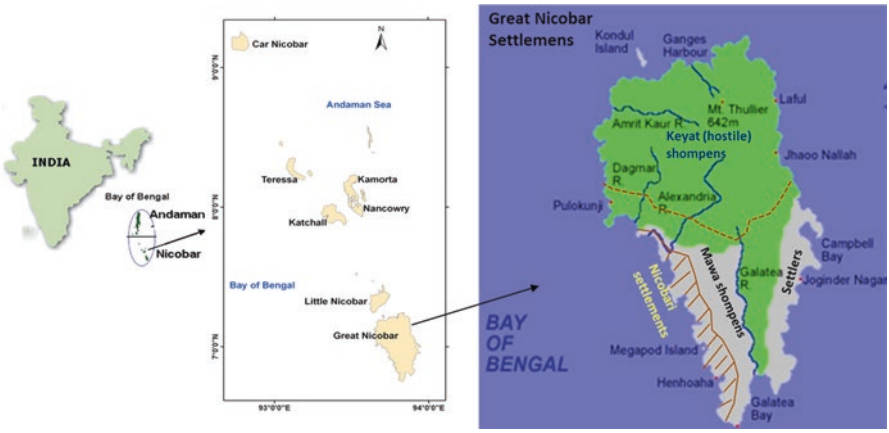

Fig. 1.4 Location of the Great Nicobar biosphere reserve a part of the A&N Hotspot

The Great Nicobar biosphere reserve contains a diverse amount of life that is very important to the biodiversity of the region. Great Nicobar is also home to the natives, the Shompens. These natives were thought to have migrated from the Malaysian regions and occupied the area for over 2000 years. They are divided up into two groups. One group of Shompens inhabits the coastal regions of the island, while the other lives mainly in the interior area of the island. The Shompens survive by hunting and gathering food sources from the forest and often fish in the coastal waters. The Shompens know a lot of information about the island that help them to survive.

The flora on Great Nicobar Island is very diverse. Orchids, which are flowering plants, contribute to the great biodiversity on Great Nicobar. They thrive well on the island because of the tropical climate. The island is known to harbour 27 genera, 32 species and 4 varieties of important orchids. The moist weather produces great habitat for the species to grow and reproduce, which is why there are so many found throughout the biosphere reserve. The island has over 32 species of orchids, four of which are considered rare and endemic. For example, *Eria bractescens* and *Phalaenopsis speciosa* are two orchids that are considered rare and found only in that region (Gupta et al. 2004). The marine life surrounding Great Nicobar also contributes to the diversity of the flora on the biosphere reserve. There are many different species of algae, seagrass and mangroves that inhabit the coastlines. The substrate and water temperature contribute to the growth of these marine flora. Common algae species found off the coast are *Turbinaria* ornata, *Halimeda* and *Cladophora* species (Jagtap 1992). The island does consist of a more diverse amount of flora that includes trees, flowers and plants. The flora on Great Nicobar contributes to a large percent of biodiversity on the island.

The Great Nicobar biosphere reserve is home to different kinds of animals. Most of these animals are native to the island, while others are more common animals. The Nicobar tree shrew is endemic to India. It lives in subtropical or tropical dry

forests and is threatened by habitat loss. Great Nicobar is also home to other endemic mammals like the Andaman wild pig and other mammals like the crab-eating macaque, the palm civet, fruit bats, squirrels, rats, blue whales and dugongs. Many birds live on the island as well. The Nicobar megapode, or Nicobar scrub fowl, is a bird found in some of the Nicobar Islands. Another bird endemic to India is the South Nicobar serpent eagle, a bird of prey. They live in subtropical or tropical moist lowland forests. They are becoming rare due to habitat loss. Nicobar parakeets are parrots confined to the Nicobar Islands. They are the largest of the 'true parakeets' at 60 cm. Very little is known about the ecology and conservation status of the Nicobar parakeet. Great Nicobar is also home to other birds like the white-bellied sea eagle, common parakeets, green imperial pigeons, the swiftlet, the myna, the jungle fowl, common parrots, the racket-tailed drongo and the koel. Different species of reptiles and crustaceans live in Great Nicobar as well. Saltwater crocodiles, giant leatherback turtles, Malayan box turtles, reticulated pythons and water monitor lizards are the kinds of reptiles one could find in Great Nicobar. Great Nicobar is also known as home to the giant robber crabs.

1.9 Biodiversity Conservation

In spite of its importance and awareness on biodiversity, the last few decades have witnessed a steady increase in the extinction rate of flora and fauna all over world. Therefore, conservation of biodiversity and its habitats is of utmost importance for the survival of man. Conservation of biodiversity leads to conservation of essential ecological diversity to preserve the continuity of food chains. At the same time, the genetic diversity of plants and animals is preserved. It ensures the sustainable utilization of life support systems on Earth. It provides a vast knowledge of potential use to the scientific community. A reservoir of wild animals and plants is preserved, thus enabling them to be introduced, if need be, in the surrounding areas. Biodiversity provides immediate benefits to the society such as recreation and tourism; besides, it serves as an insurance policy for the future.

1.9.1 Threats to Biodiversity

Biodiversity in India and in the tropical islands, viz. forests, grasslands, wetlands, mountains, deserts and marine ecosystems, is threatened by different anthropogenic activities apart from climate change impact. One of the major causes for the loss of biodiversity has been the depletion of vegetative cover in order to expand agriculture. Since most of the biodiversity-rich forests also contain the maximum mineral wealth and also the best sites for water impoundment, mining and development projects in such areas have often led to destruction of habitats. Poaching and illegal trade of wildlife products too have adversely affected biodiversity. Some of the major threats to biodiversity which are managed under the biodiversity hotspots are:

- Habitat destruction: Huge pressure from the world's rapidly increasing population put pressure on the wild habitat. Therefore, it is important to protect habitat in order to protect biodiversity within it.
- Global climate change: Change in the physical condition affects the biotic elements of ecosystems resulting in consequential biotic change. These are addressed in the biodiversity hotspots.
- Habitat fragmentation: This results from human activity which reduces the ability of habitat to support species.
- Pollution: Introduction of pollutants such as nutrient overloading with nitrate fertilizer as well as more immediately harmful chemicals affects the biodiversity.
- Over-exploitation: This includes the illegal wildlife trade, as well as overfishing, logging of tropical hardwood, etc. These ecosystem-destructive activities are effectively addressed in the hotspots.
- Pest and disease: Reduction in habitat causing high population densities encourages occurrence and spread of diseases.

1.9.2 Conservation in the Andaman and Nicobar Islands

The present-day drastic changes in the environment and habitat due to population explosion and unmanaged developmental activities are so unnatural that the species are not getting full liberty of time and space for their survival and adaptive radiation, therefore resulting in loss of biodiversity, which is a global crisis. It is high time that our natural wealth be preserved from loss. In this context, hotspots are not formally recognized or governed areas. However, the identification of an area as a biodiversity hotspot increases the likelihood of conservation investment. In addition, other designations for biodiversity conservation are likely to be present within these broad areas which may have more formal management structures.

The Andaman and Nicobar Islands have species assemblages not found elsewhere in India, and they are thus very important for conservation. For fulfilling conservation processes 6 national parks and 94 wildlife sanctuaries covering 708 km^2. have already been created in the islands. Of the existing protected area system, 500 km^2. is terrestrial representing 6% of islands combined area of 8327 km^2. These areas help to conserve the food resources of tribes and provide them medicine and habitat. In addition they possess most valuable genetic resources which are highly valued in the changing climate regime. It also provides several ecosystem services, particularly carbon sequestration and climate change mitigation.

1.9.3 The Strategy

The future strategies for the conservation of biodiversity and sustainable development must be adopted as follows:

- Fundamental shift in development planning
- Empower local community to participate in decisions regarding the use of natural resources. This must be based on the twin principles of sustainability and equality
- Proper forest management based on sound environmental principles
- Environment-friendly agricultural strategies
- Strict legal sanctions for preventing loss of biodiversity, habitat protection and control of excessive exploitation of biological resources
- Creation of awareness among islanders of the hazards of biodiversity loss
- Human resource development

The proper adaptation of above-mentioned strategies can not only help in biodiversity conservation but also play a very important role in the development of natural resources on the line of sustainable development.

1.10 Conclusion

The world has been witnessing biodiversity loss at an alarming rate which causes most serious concern. Biodiversity provides unmatched ecosystem services, and its economic value is enormous. It is the most fundamental element of green economic development and sustains humanity. On the other hand, the study of species distribution and its concentration across the globe shows that biodiversity is not evenly distributed on our planet. It is heavily concentrated in certain areas which have exceptionally high concentrations of endemic species. On the other hand, many of these areas are the areas at greatest risk because of biodiversity loss at alarming rates. Threats to terrestrial and aquatic biodiversity are diverse and persistent, and in some cases, it has been increasing. The biodiversity hotspots, for example, are a set of 35 regions of high endemism that collectively has lost more than 85% its original habitat extent. Bringing an end to global biodiversity loss requires that limited available resources be guided to conservation and green economic development in those regions that need it most.

Andaman and Nicobar Islands are hotspot of biodiversity both terrestrial and aquatic, which is a part of global biodiversity hotspots. In an attempt to conserve its formerly rich fauna, the government of India passed the Wildlife Protection Act of 1972, published Schedule I and II of endangered species and imposed a total ban on international trade in several flora and fauna. Great Nicobar biosphere reserve was established so as to conserve biodiversity while promoting environmentally sound development around these areas. It is also utmost essential to respect, preserve and maintain traditional knowledge of the sustainable use of biodiversity with the involvement of indigenous peoples and local communities. Apart from functioning as gene pools, the diverse biota from such hotspot areas can play an important role as indicators of complex environmental changes.

References

Andrews HV (2001) Threatened herpetofauna of the Andaman and Nicobar Islands. In: Bambaradeniya CN, Samarasekara VN (eds) An overview of the threatened herpetofauna of South Asia. IUCN Sri Lanka and Asia Regional Biodiversity Programme, Colombo, pp 39–47

Anon (2015) Forest statistics. Department of Environment and Forest, Andaman and Nicobar Islands, p 125

Champion HG, Seth SK (1968) The revised forest types of India. CSIR, New Delhi

Conservation International: www.conservation.org

Das I (1999) Note worthy collection of mammals from Mount Harriet, Andaman Island, India. J South Asian Nat Hist 4(2):181–185

Dixit RD, Sinha BK (2001) Pteridophytes of Andaman and Nicobar Islands. Bishen Singh Mahendra Pal Singh, Dehra Dun

Ellis JL, Yoganarasimhan SN, Gurudeva MR, Ramanujam P (2000) Prioritization of biodiversity rich sites of conservation significance in the Andaman and Nicobar Islands. In: Singh S, Sastry ARK, Mehta R, Uppal V (eds) Setting biodiversity conservation priorities for India. WWF-India, New Delhi, pp 75–79

Gupta S, Porwal MC, Roy PS (2004) Orchid diversity of Great Nicobar biosphere reserve. Curr Sci 86(10):1372–1374

http://www.bsienvis.nic.in/Database/BiodiversityHotspotsinIndia_20500.aspx

IUCN (2001) IUCN red list categories and criteria: version 3.1. IUCN Species Survival Commission. IUCN, Gland/Cambridge, UK

Jagtap TG (1992) Marine flora of Nicobar group of islands in Andaman Sea. Indian J Mar Sci 21:56–58

Khatri TC (1993) Butterflies of the Andaman and Nicobar Islands: conservation concerns. J Res Lepidoptera 32:170–184

Kurz S (1870) Report on the vegetation of the Andaman Islands. Office of the Superintend of Government Printing, Calcutta

Lal J (2005) A check-list of Indian mosses. Bishen Singh Mahendra Pal Singh, Dehra Dun

Mcneely JA, Mittermeier RA, Brooks TM, Boltz F, Ash N (2009) The wealth of nature. CEMEX, Arlington

Millennium Ecosystem Assessment (2005) Ecosystems and human well-being: biodiversity synthesis. Island Press, Washington, DC

Mittermeier RA, Myers N, Gil PR, Mittermeier CG (1999) Hotspots: Earth's biologically richest and most endangered terrestrial ecoregions. Cemex, Conservation International and Agrupacion Sierra Madre, Monterrey

Murugan C, Kamble MY (2012) A species of Tylophora from Andaman and Nicobar Islands. Rheedea 22(2):83–87

Myers N, Mittermeier RA, Mittermeier CG, da Fonseca GAB, Kent J (2000) Biodiversity hotspots for conservation priorities. Nature 403:853–858

Pandey RP, Diwakar PG (2008) An integrated check list of flora of Andaman and Nicobar Islands, India. J Econ Taxon Bot 32(2):403–500

Raghunathan C (2015) Littoral faunal diversity of Great Nicobar island. Rec zool Surv India, Occasional Paper No., 369: 1–172 (Published by the Director, Zool. Surv. India, Kolkata)

Rasmussen PC, Anderton JC (2012) Birds of South Asia: the Ripley guide, vol 1 & 2. Smithsonian Institution and Lynx Editions. Washington, DC/Barcelona, pp 1–378, 1–683

Singh LJ, Murugan C, Singh P (2014) Plant genetic diversity of endemic species in the Andaman and Nicobar Islands: a conservation perspective. In: Kumar P (ed) Island biodiversity. Uttar Pradesh State Biodiversity Board, Lucknow, pp 49–57

Sivaperuman C, Raghunathan C (2012) Fauna of the protected areas of Andaman and Nicobar Islands. Published by the Director, ZSI, Kolkata, pp 1–26

Stattersfield AJ, Crosby MJ, Long A, Wege DC (1998) Endemic bird area of the world. Priorities for biodiversity conservation. Bird Life International, Cambridge