The Nilgiri Biosphere Reserve and its role in conserving India's biodiversity

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Biodiversity is used as a general term for species, habitat and genetic diversity[1]. The earth's biodiversity comprises of at least 1.5 million identified species distributed in its major biomes. Recent estimates however suggest that there are 10 million species of organisms on earth today[2]. These organisms are taxonomically distributed in five kingdoms, viz. Monera (single-celled prokaryotes, e.g. bacteria), Protista (single-celled eukaryotes, e.g. euglena), Fungi (multicellular heterotrophs, e.g. mushrooms), Plantae (multicellular autotrophs, e.g. algae, mosses, ferns and flowering plants) and Animalia (multicellular heterotrophs with movement, e.g. sponges, worms, insects and vertebrates). The geographical distribution of earth's biodiversity is influenced primarily by climate and thus about 5.0 million species are found in the warm and wet tropical regions of the world. It is this remarkable tropical diversity that biologists and conservationists are often more concerned about.

India's biodiversity

India is a tropical country and recognized as one of the megadiversity centres today. Of the 1.5 million species of identified organisms, 0.2 million (13.0%) are known from India[3]. This is remarkable as India covers just 2.0% of the earth's land area. As with the rest of the earth's surface, this biodiversity is however clumped within the warm and wet regions of India. Thus the humid Western Ghats and the Eastern Himalayas—Assam provinces are the richest in biological species.

India's biodiversity is largely threatened by the rising human population. Setting aside large areas as wildlife or nature preserves to the exclusion of man has not proved very effective[1,4,5]. The UNESCO's Man and Biosphere Programme that came into being in 1976 mooted the declaration of major regional landscapes as biosphere reserves. The primary aim of such reserves is to maintain, through an intergovernmental network, the earth's biodiversity in harmony with the co-existing humans. While biosphere reserves are protected areas where *in situ* conservation of biodiversity is attempted they are also maintained for scientific research and monitoring, consideration of rural development and local resource use problems as well as environmental education and training[6].

Of the seven biosphere reserves thus declared in India during the 1980s, four including the Nilgiri Biosphere Reserve (NBR) in the Western Ghats, Nokrek and Namdapha Biosphere Reserves in the Eastern Himalayas–Assam province and the Great Nicobar Biosphere Reserve in the Nicobars are representative of the warm and wet tropical biome. However, with regards vegetation, the tropical rainforests (in the strict sense) are restricted to the NBR and the Great Nicobar Biosphere Reserve[3]. Further, the NBR is a large and topographically complex landscape while those in Northeast India are smaller. The Great Nicobar is an island.

The Nilgiri Biosphere Reserve

The NBR is located in southwest India, north of the Palghat Gap between 10°45′–12°5′N lat. and 76°10′–77°10′E long. The hills in the NBR are ancient. Geological evidence suggests that the underlying rocks are archaean—about two billion years old. Topographic variation ranging from low lying valleys in the west to mountains over 2000 m (2695 m being the highest) and a flat elevated table land of nearly 800–1000 m above sea level in the east has resulted in rather diverse climatic-vegetation zones. Thus we find dry scrub jungles, dry and moist deciduous forests, tropical evergreen and semievergreen forests and the montane *sholas* with the associated grasslands on this landscape of 5600 km^2 (see Figure 1).

Biodiversity and endemism in the NBR

The NBR is one of the most carefully studied of landscapes with regards the macro-organisms in India. Thus we know that 20% of all angiosperm species, 15% of butterflies and 23% of all vertebrates, excluding the marine species, in India are found in the NBR[7–9]. Such biodiversity is noteworthy since the NBR is just equal to 0.15% of India's land area (Table 1).

The NBR is remarkable for its endemic species too. Of the 3000 species of angiosperms known, 82 (2.7%) are exclusive to this landscape[7]. Except two species (*Mycalesis oculus* and *Ypthima ypthimoides*) that are restricted to south of the Palghat Gap, all other species of butterflies endemic to South India are also found in the NBR. Endemism in Indian butterflies is itself however not very significant[8]. Amongst the 285 species of vertebrates endemic to the Western Ghats, 156 (55%) are found in the NBR[10] (Table 2). These include 39 species of fishes, 31 amphibians, 60 reptiles, 14 birds and 12 mammals[10–17]. Interestingly, of the 25 species of vertebrates exclusive to the NBR, 23 are of fish, amphibians and reptiles. These include twelve species of fish, *Danio neilgheriensis*, *Puntius dubius*, *Puntius melanostigma*, *Puntius wynaadensis*, *Osteobrama neilli*, *Osteocheilus brevidorsalis*, *Garra mcclellendi*, *Noemacheilus guentheri*, *Noemacheilus sinuatus*, *Noemacheilus striatus*, *Mystus punctatus* and *Glyptothorax annandalei*, four species of amphibians, *Ichthyophis longicephalus*, *Bufo silentvalleyensis*, *Ansonia rubigina* and *Micrixalus thampii* and seven species of reptiles, *Cnemaspis wynadensis*, *Cnemaspis sisparensis*, *Scincella bilineatus*, *Tiphlops tindalli*, *Rhabdops olivaceous*, *Melanophidium bilineatum* and *Plecturus guentheri*[10,13,16,18,19]. The other vertebrates endemic to the NBR are a laughing thrush *Garrulax cachinnans* and a mouse *Mus famulus*[10,14].

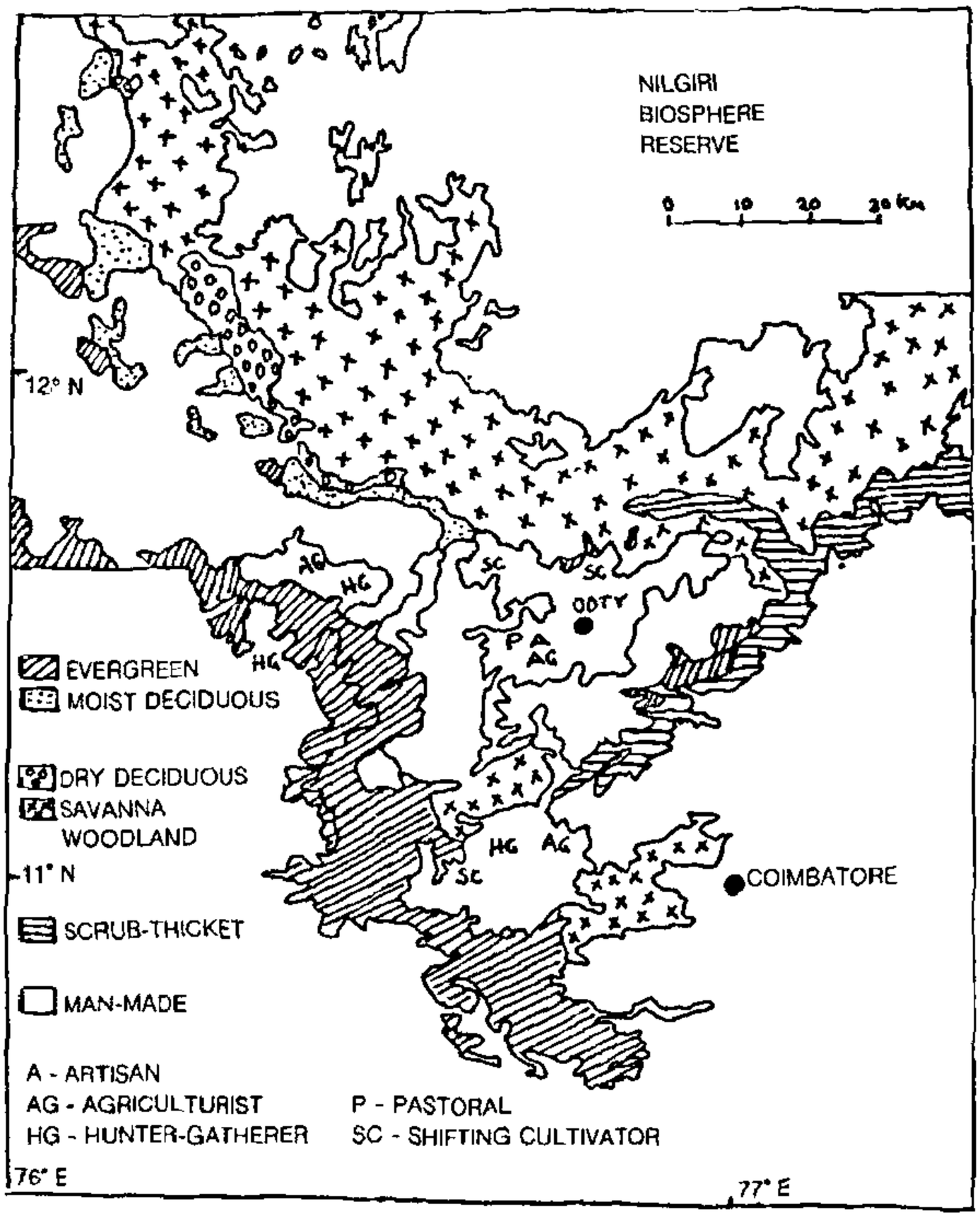

Figure 1.

Table 1. Comparison of the biodiversity of India and NBR with regards the well-known groups of organisms

Organisms	Number of species India	NBR	%
Angiosperms	15000	3000	20.0
Butterflies	1977	300	15.0
Fish (Freshwater)	742	100	13.5
Amphibians	205	49	24.0
Reptiles	428	120	28.0
Birds	1237	342	28.0
Mammals	372	74	20.0

Table 2. A summary of the vertebrate fauna of the NBR

Class	No. families	Species endemic to W. Ghats	Percentage[a]
Pisces	16	39	46.4
Amphibia	6	31	35.6
Reptilia	19	60	67.4
Aves	55	14	93.3
Mammalia	15[b]	12	100.0

[a], Percentage calculated against the number of species endemic to the Western Ghats.
[b], Grouped as rodents, primates, etc.

Human communities

Amidst the rich biodiversity in the NBR, there are several primitive endogamous communities also. These humans are more or less completely dependent on the natural resources available within the reserves. Much before the Western influence, the Nilgiris were impacted by these human communities who were largely pastoral, hunter-gatherer and shifting cultivators. Currently, there are Todas (pastoral) and Kotas (artisanal) in the Upper Nilgiris. Hunting-gathering Cholanaikers, Kattunaikers, Kurumbas, Sholegas, Mudugas and Paniyas are settled along the western and southern lower elevations. Agricultural communities including Badagas, Chettis, Mullu Kurumbas and Irulas are more scattered within the biosphere reserve. Irulas, Sholegas and Kurumbas practise some amount of shifting cultivation even today.

Monitoring biodiversity

As pointed out by Solbrig[6] inventorying biodiversity is the first step to monitoring Biosphere Reserves. The NBR is a good example in this regard and probably the only reserve in India with a fairly well-documented biodiversity. The NBR comprises of the intensively explored Silent Valley, Mukurti, Nagarhole and Bandipur National Parks and Mudumalai and Wynaad Wildlife Sanctuaries, which have already been declared as conservation areas. However, these preserves were aimed at maintaining and protecting the large vertebrates such as elephants, tigers, gaur, Nilgiri tahr and species of primates including the Nilgiri langur and liontailed macaque. Little effort has been directed towards preserving the lower vertebrates and invertebrates. While we do not know the exact number of invertebrates except the butterflies in the NBR we do know that of its 684 species of vertebrates 269 (39%) are lower vertebrates including fish, amphibians and reptiles. These have nevertheless received little attention. In a recent study of stream invertebrates it was found that pollution from the estates uphill in the Nilgiris can affect aquatic life much below even in seemingly undisturbed areas such as Pykara, Bhavani and Moyar rivers (Thomas Burton, pers.

commun.). Similar subtle disturbances can affect species of aquatic vertebrates, especially amphibians[20].

Westman[1] suggests the identification of 'critical-link' species in monitoring biodiversity. These species are often insignificant in terms of biomass and place in the food web. Such species are also frequently microorganisms, soil and litter invertebrates and the lower vertebrates. Very little is known about these organisms even in such well-studied landscapes as the NBR. Except probably the exploratory studies done in Silent Valley by the Zoological Survey of India[21] and the studies of butterflies such as that of Larsen[8], nothing is virtually known about the invertebrate fauna of this species-rich reserve. Emphasis has been on larger mammals and birds[22]. The only study that points out the need to study insects as indicators in environmental monitoring is that of Daniels[23]. More intensive studies including the whole range of organisms in the species-rich NBR would make it a model biosphere reserve for the entire tropical world.

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NEWS

Report on the discussion meeting on Icosahedral Symmetry in Materials

The meeting was held during 1–3 February 1993 at the Jawaharlal Nehru Centre for Advanced Scientific Research, Indian Institute of Science, Bangalore and was attended by nearly 60 scientists from India and abroad. The discussions covered a wide range of topics and materials ranging from fullerenes to viruses including quasicrystals and had authoritative presentations on the formation, structure, stability and properties of fullerenes and quasicrystals.

The meeting began with a discussion of viruses with icosahedral symmetry (M. R. N. Murthy and M. V. Hosur, India) and proceeded to deal with structure (H. Terrones, Mexico and C. S. Sundar, India), properties (O. N. Srivastava and K. C. Rustagi, India) and coordination chemistry of fullerenes (V. Krishnan, India). A majority of papers were devoted to quasicrystalline phases in ternary alloys and dealt with their occurrence, mechanisms of formation and stability (A. P. Tsai, Japan, R. S. Tiwari, K. Chattopadhyay, A. K. Srivastava, Alok Singh and C. M. Chittaranjan (all from India)), microstructure (V. S. Ragunathan, India), defects and grain boundaries (S. Ranganathan, G. V. S. Sastry, R. Ramasamy, T. Roy *et al.* (all from India)), and transport properties of quasicrystals (T. V. Ramakrishnan, D. Bahadur, Sangam Banerji, N. P. Lalla *et al.*). The study of the structure of quasicrystals both from the point of view of experiments and theoretical modelling received attention (Alok Singh, R. K. Mandal, M. K. Sanyal and R. Chidambaram). The generation of quasiperiodic 2D lattices and their description were dealt by S. Banerjee, S. Baranidharan and P. Ramachandra Rao. Mathematical modelling of fullerenes and mobility edges in