Life : Complexity and Diversity

5. Distribution of Diversity

Madhav Gadgil

Madhav Gadgil is with the Centre for Ecological Sciences, Indian Institute of Science and Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore. His fascination for the diversity of life has prompted him to study a whole range of life forms from paper wasps to anchovies, mynas to elephants, goldenrods to bamboos.

Diversity of life is unevenly distributed over the surface of the earth; especially rich are the tropics, mountainous regions and island archipelagos. Lying at the trijunction of Africa, temperate Eurasia and tropical Southeast Asia and enjoying a great diversity of environmental regimes, India ranks about the 10th amongst nations in terms of its diversity of species.

Hotspots of Diversity

All parts of the globe are obviously not equally rich in the diversity of life. On land, the tropics are far more diverse, on the sea bottom, the cold, unchanging depths of oceans are especially rich. Malaysia and Norway have almost identical geographical areas of around 32 million ha, roughly 10% of India's. But while Malaysia has 12000 species of higher plants, Norway has only 1600. Malaysia has 158 species of frogs, salamanders and their relatives; and 268 species of reptiles. Norway has only 5 species of each group. Malaysia has 501 species of birds and 264 species of mammals while Norway has 264 species of birds and only 54 of mammals. The much greater variety of tropical life has been attributed to a variety of reasons; greater productivity, year round occurrence of conditions favourable to life and lower levels of the impact of ice ages in the geological past. All these factors have led to higher levels of species packing in the tropical latitudes.

Species turnover levels are particularly high where the environmental regimes change rapidly.

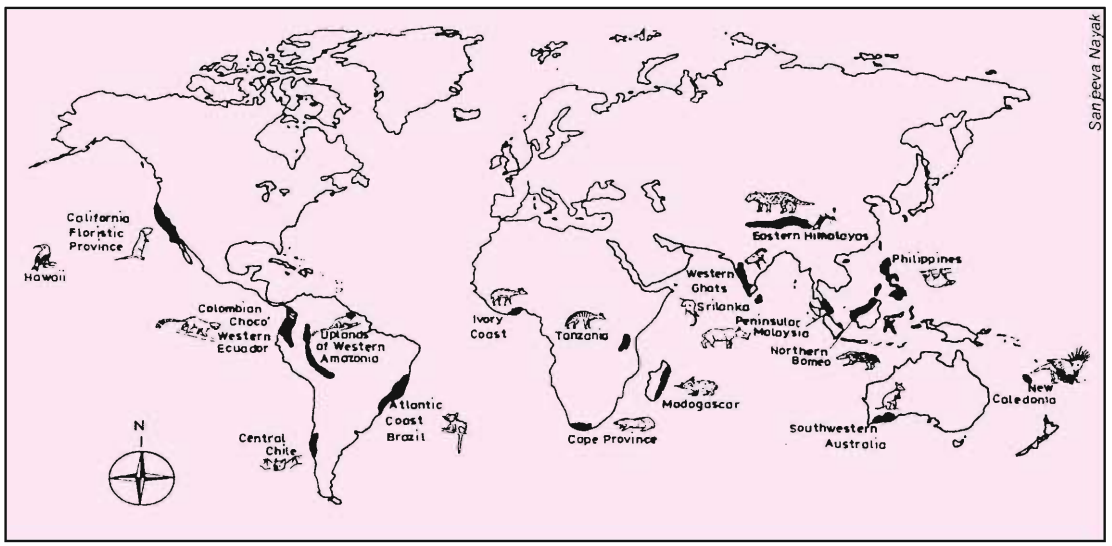
Species turnover, replacement of one set of species by another, is the second component of species diversity. Species turnover levels are particularly high where the environmental regimes change rapidly as at the seashore. In terms of broader land regions, mountain tracts are apt to have high levels of species

turnover. This explains why mountainous tracts like our own Western Ghats and Eastern Himalaya as well as the Eastern Arc Mountain of Tanzania figure among the world's *hot spots* of biological diversity (*Figure 1*).

Figure 2 The island continent of Australia is particularly rich in the number of endemic groups. The distribution of this red kangaroo, along with many other species of marsupial mammals is restricted to Australia.

An excellent measure of geographical turnover, the third component of species diversity is the proportion of species unique to a region. Species restricted to a given region are said to be *endemic* to that region. Islands by virtue of their long isolation are especially rich in endemic species. Australia leads all countries of the world in the number of endemic species of mammals (210) and reptiles (605) (*Figure 2*). It is next only to Indonesia, another island nation in the number of endemic birds (349). Indonesia in turn is second in the world in the number of endemic mammals (165), leading all other countries in the number of endemic birds (356). The island of Madagascar has 67 endemic species of mammals, 97 endemic species of birds, 231 endemic species of reptiles and 142 endemic species of frogs and their relatives.

Figure 1 Biological treasure troves. Eighteen hot spots have been identified as regions on land that harbour a large number of species exclusive to the region and in great danger of extinction from human activities. This identification is however far from complete, and focuses on forests and Mediterranean scrublands and leaves out lakes, rivers and coral reefs. The Indian subcontinent includes two of these hot spots; namely, Western Ghats and Eastern Himalaya.



India has been christened one of the world's top twelve megadiversity nations.

Compare this with India, five times as large in land area, with 38 endemic species of mammals, 69 endemic species of birds, 156 endemic species of reptiles and 110 endemic species of frogs and their relatives.

A Megadiversity Country

On the world stage India is one of the richest nations in terms of biological diversity (*Figures 3 and 4*). We owe this to India's position in the tropical, subtropical latitudes with their inherent wealth of life. We owe this to the mountain chain of Himalaya that has created a great range of environmental regimes on the northern border, and the Thar desert that has created another gradient of rapid environmental change in the northwest. We also owe this to our possession of islands like Andamans, Nicobars and Lakshadweep with their own sets of endemic species. We owe this to India's position near the tri-junction of Eurasia, Southeast Asia and Africa. India has therefore been christened one of the world's top twelve megadiversity nations.

India supports 15000 species of flowering plants, 5000 of them exclusive to us. In contrast, Brazil the world's richest has 55,000 species of flowering plants; amongst our Asian neighbours China

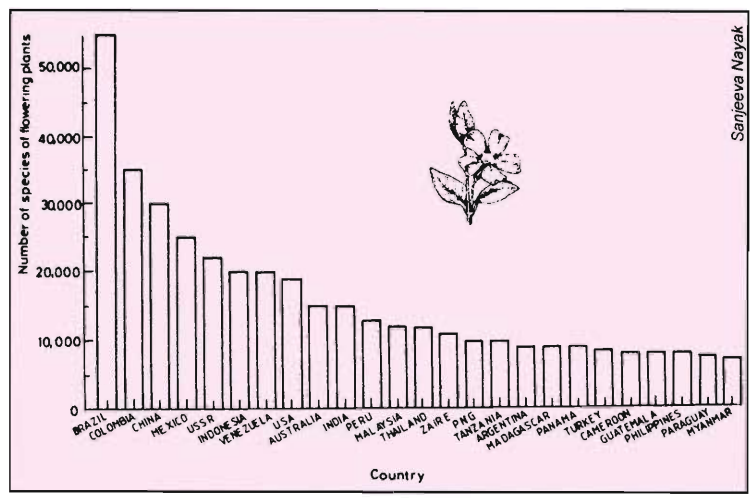


Figure 3 Brazil with its extensive tracts of tropical rain forests leads the world, while India ranks 10th in the total number of flowering plants.

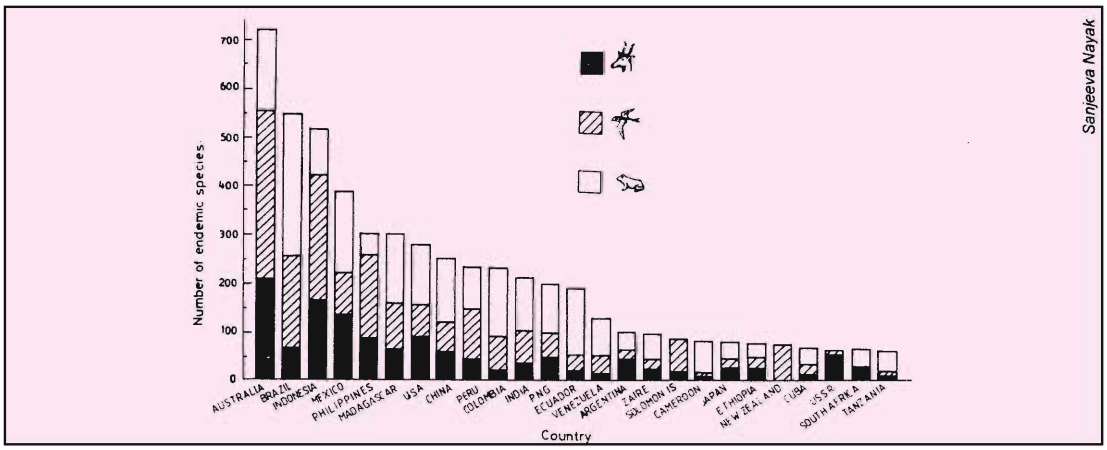


Figure 4 The island continent of Australia leads the world, while India ranks 11th in the total number of endemic species of amphibians, birds and mammals.

has 30,000 and Indonesia 20,000. India has 317 species of mammals, 38 of them exclusive to us. Indonesia leads the world with 515, 165 of them endemic, with both China and Brazil having 394 each. India has 969 species of birds, 69 of them endemic. The central American nation of Colombia leads the world with 1721 species; Indonesia has 1519 and China 1100. India has 389 species of reptiles, 156 exclusive to us, Mexico leads the world with 717, with 368 endemic; but as many as 616 of Australia's 700 species of reptiles are exclusive to that island continent. Of our neighbours Indonesia has 511 and China 282 species of reptiles. India does relatively well in terms of frogs, salamanders and their kith and kin. We have 206 species of amphibians, 110 of them endemic. Brazil is way ahead with 502, with 294 of them being endemic. Indonesia has 270 with 100 endemics and China 190 with 131 endemics.

That is where India stands, quite high in the wealth of total number of living species; although not at the very top. Overall we are close to the tenth in the pecking order of biodiversity of nations. Within the country too diversity of species is not evenly distributed. Parts of the country are especially rich due to a variety of natural causes; others less so. On top of that, of course, some parts have been secondarily enriched, or more often impoverished by human intervention. As mentioned above, two of India's great mountain ranges, Eastern Himalaya and the

Eastern Himalaya and the Western Ghats have been designated two of the world's eighteen hotspots of biodiversity.

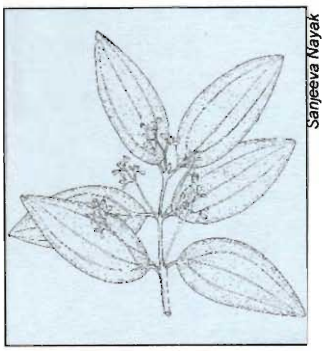


Figure 5 The hill chain of Western Ghats is particularly rich in spice plants. One such is** Cinnamomum sulphoratum **restricted to this part of the world.

Western Ghats have been designated two of the world's eighteen hotspots of biodiversity. They qualify for this honour by virtue of the fact that Eastern Himalaya has some 3500 endemic species of higher plants, 20 endemic species of reptiles, 25 endemic species of amphibians; while the Western Ghats have 1600 endemic species of flowering plants, 7 endemic species of mammals, 91 endemic species of reptiles, 84 endemic species of amphibians (*Figures 5, 6 and 7*). Furthermore, as far as India is concerned it shares many of the species endemic to Eastern Himalaya with other countries, especially Nepal, Bhutan, China and Myanmar. From that perspective then the Western Ghats whose species are shared only with Sri Lanka are for us very much the most significant region from the perspective of biological diversity. Andaman and Nicobar islands are the third most significant area with 144 species of flowering plants and 75 species of land snails occurring nowhere else in the world.

To what degree does India share its wealth of living diversity with other countries? Some clues may be obtained by looking at waterbirds, perhaps the best known group of all organisms.

Figure 6 (bottom left) The sprightly black and orange flycatcher is endemic to Western Ghats.

Figure 7 (bottom right) Western Ghats and Sri Lanka constitute the centre of diversification of legless amphibians or caecilians. This species,** Ichthyophis beddomei **is restricted to the Western Ghats.

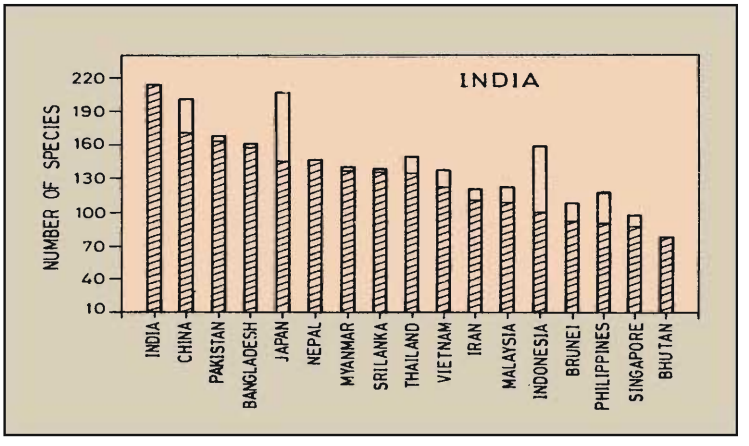


***Figure 8** The total numbers of waterbird species and species shared (cross-hatched) with India amongst India's 16 Asian neighbours.*

Regular censuses of waterbirds have been held every year in most Asian countries since 1987. These provide excellent information on the distribution of 326 species of such birds in 17 Asian countries. India harbours the largest number, 213 of these 326 species, Japan comes next with 206, landlocked Bhutan has the smallest number, 80. *Figure 8* shows the total number of species present in these 17 countries and the number of species shared with India. As might be expected, of all its neighbours, India has the largest proportion of species present in Bhutan; while China leads our neighbours in the number of Indian species present in that country.

China leads our neighbours in the number of Indian species present in that country.

Suggested Reading

- **V H Heywood (Ed.)** ***Global Biodiversity Assessment.*** **United Nations Environment Programme. Cambridge University Press, Cambridge. pp. 1140, 1995.**
- **World Conservation Monitoring Centre .** ***Global Biodiversity : Status of the Earth's Living Resources.*** **Chapman and Hall, London. pp.585, 1992.**

Address for Correspondence
Madhav Gadgil
Centre for Ecological Sciences
Indian Institute of Science
Bangalore 560 012, India.

In *Scientific American*, 1940 ... The frontiers of visibility have been pushed to an ever greater distance with the development of the electron microscope. (From *Scientific American*, September 1995)