

HOW DIVERSE IS OUR BIODIVERSITY?

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Abstract

The biosphere, contact zone of land, water and air on earth surface supports millions of diverse life forms collectively referred to as biological diversity or biodiversity. About 10 million different species of organisms including micro-organisms, plants and animals have been estimated to exist on earth. Of these about 3,00,000 species are plants including algae, fungi, mosses and higher plants. So far, only a million species of animals and half a million of plants and microorganisms have been named. All life forms have been grouped into five kingdoms, namely Monera, Protista, Plantae, Fungi and Animalia. India is very rich in biodiversity with about 75,000 species of animals and 45,000 species of plants. About one fifth of the faunal wealth of India is estimated to be found in Arunachal Pradesh. Biodiversity is important for human beings. We obtain our food, medicine, clothing and building material from bio-resources. Certain organisms play pivotal roles in ecosystem. Many life forms are facing threat from irrational human activities, and we are in danger of losing the wonderful diversity of life that defines our planet. Extinction of one of these species could be devastating to the ecosystem and human being that use it.

The surface zone of the earth where land (the lithosphere), water (the hydrosphere) and air (the atmosphere) come in contact with each other support life and thus, is referred to as Biosphere. It extends a little above and below (a few hundred metre) the surface of the land and in water and air. However, most of the life forms are found near the contact zone of the three realms. Biosphere supports numerous forms of life ranging from microscopic bacteria to gigantic plants and animals, which constitute the biological diversity. Different types of ecosystem exist in biosphere. Different ecosystems harbor distinct sets of organisms, including

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microorganisms, plants and animals. Thus, each ecosystem differs in its contents of biological diversity.

The biological diversity or biodiversity is often defined as the total variety of and variability among living organisms and the ecological complexes they inhabit. It also includes the diversity of forms right from the molecular level through individual organisms, populations, communities, ecosystems, landscapes and biosphere. It encompasses viruses, bacteria, fungi and other microorganisms as well as animals and plants which exists on earth. Human beings are the part of this biodiversity. In simple words, biodiversity may be defined as the sum total of species richness i.e. the number of species of animals, plants and microorganisms occurring in a given habitat. The species is the basic unit and as applied to most animals may perhaps best be defined as interbreeding populations of individuals.

Biodiversity has three levels – genetic, species and ecosystem diversity. The genetic diversity refers to the variation of genes within the species. This includes distinct populations of the same species or genetic variation within population or varieties within a species. The species diversity refers to the variety of species within a region. However, the ecosystem diversity refers to different land forms or ecological areas. Various ecological areas include natural forests, mountains, plains rivers and wetlands, deserts, islands, and fresh water and marine systems, each of which supports different and specific flora and fauna.

Biodiversity as a Whole

The world harbors an estimated over 10 million different types of organisms including plants, animals and microorganisms (Table 1-4). Of these about 3,00,000 species are of plants including algae, fungi, mosses and higher plants (Myers *et al* 2000). So far, only a million species of animals and half a million of plants and microorganisms have been named and described (Mayr and Ashlock, 1991). Many new forms of life are yet to be researched and recorded. In addition, estimate for extinct species comes to about half a billion which arose, existed and declined and became extinct during last over 3000 million years of earth's history.

The number and kind of animals and plants are diverse. The diversity of flora and fauna has further numerous dimensions. Each species may be found existing in numerous different forms ranging from sexes, age classes to seasonal and ecological forms. Many organisms are unicellular (body consisting of a single cell) and other are multi-cellular (body consisting of numerous cells) of various shapes and sizes. A great variation in size of individual species may be found even in same ecosystem.

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For example, in a forest of redwood or Sequoia in North Western California the redwood trees are 110 mt tall and bacteria only 0.000001 mt long. Our seas and oceans harbor microscopic plankton and gigantic animals like whale, side by side. There exists a great variation in life span and reproductive behaviour among organisms. Some organisms live for few hours others for hundred of years. Some divide in just 30 minutes (bacteria) whereas other takes years to attain the reproductive age. Distribution and abundance of different groups of animals show vast variations. Some are represented by enormous number and others are extremely scarce. Larger animals are generally represented by fewer numbers than small animals.

There exists rich diversity not only on land but also in freshwater and in oceans down to the greatest depths. Life forms are found even at a depth of 3600 mt below the ocean surface. Many organisms have been reported surviving in deep sea bottom warm water vents. The water in these vents or cracks in sea bottom are super heated to temperatures above 300°C and under extremely high pressure, and rich in hydrogen sulphide. Even in this harsh habitat chemosynthetic sulphur bacteria and several other organisms are found.

Table 1: Number of known species in different animal groups, distributed throughout the World

Animal Groups	Approximate Number
<u>Non-Chordates</u>	
Protozoa	30,000
Sponges	5,000
Cnidaria	9,000
Platyhelminthes	13,000
Nematyhelminthes	15,000
Annelida	9,000
Mollusca	60,000
Arthropoda	9,00,000(Insecta-7,50,000)
Echinodermata	6,000
<u>Chordates</u>	
Fishes	25,000
Amphibians	4,780
Reptiles	7,800
Birds	9,880
Mammals	4,800

Table 2: Number of known species in different plant groups, distributed throughout the world.

Plant Groups	Approximate Number
Fungi	1,00,000
Algae	14,000
Bryophytes	25,000
Vascular Plants	
Fern	10,000
Gymnosperms (Seed plants without fruit)	900
Angiosperms (Flowering Plants)	2,50,000
Monocots	50,000
Dicots	2,00,000

Table 3: Number of species & subspecies in different Animal groups found in India.

Animal Groups	Approximate Number
<u>Non-chordates</u> (including all groups)	+70,000 Species
<u>Chordates</u>	
Fishes	2,500 Marine & Freshwater species and sub-species
Amphibia	200 Species
Reptilia	450 Species
Birds	2,000 Species and sub-species
Mammals	850 Species and sub-species

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Table 4: Number of known species in different plant groups found in India

Plant Groups	Approximate Number
Fungi	12,480
Algae	1,676
Lichens	1,940
Bryophytes	2,843
Vascular Plants	
Fern	1,012
Gymnosperms	64
Angiosperms	15,000

Origin and Diversification of Biodiversity on Earth

Life originated on earth about 3500 million years ago. In this process numerous species arose from simpler to complex, and the richness of our biodiversity is the result of this continuous process of organic evolution. The life first originated in water and later spread to land and air. Evidences of evolution can be found in fossils. There is enough fossil evidence to show that complex organisms came after simpler ones during geologic time. Older geological formations reveal fossils of simpler organisms. The microfossils of organisms with resemblance to modern-day bacteria and photosynthetic Cyanobacteria can be found in earth's oldest fossil-bearing geological formations. Such simple organisms are believed to be the ancestor of all present complex forms of life.

Different groups of organisms evolved at different phases of geologic history. First prokaryotic organisms (organisms without nucleus) came in existence and thereafter about 1500 million years ago eukaryotic (organism having cells with nucleus) organisms originated from the existing prokaryotic organisms. Fossil records depict that organisms comparable to various metazoan species originated during Cambrian period, some 570 million years ago. Vertebrates evolved during early Paleozoic times, 400 million years or more ago. Fishes appeared first and amphibians from fishes. Similarly reptiles evolved from amphibians, and birds and mammals from reptiles. Many vertebrates evolved simultaneously in numerous separate lines and gave rise to numerous species during a particular stretch of geologic time (Dobzhansky, 1970; Dobzhansky *et al.*, 1976).

The process of diversification of life on earth is going on for the last 3500 million years. It is a continuous but extremely slow process. The diversification is

still in progress and will continue in future too. Species change slowly over generations. Accumulation of these changes leads to the formation of new species in due course of time.

Classification of Biodiversity

Obviously biodiversity requires a system of classification for systematic grouping and naming of organisms, and their better understanding. Earlier all organisms were grouped into two kingdoms – Plant kingdom and Animal kingdom, including all plants and all animals, respectively. Later a new five-kingdom arrangement of organisms was proposed by Whittaker (1969) considering the three important criteria of the organisms: complexity of cell structure, complexity of the organisms body, and mode of obtaining nutrition. In the five kingdom arrangement, the subdivisions of the old two kingdoms were redistributed among three additional kingdoms. The five kingdoms, as proposed by Whittaker (1969) are Monera (group of all prokaryotic organisms viz. Bacteria), Protista (unicellular prokaryotes), plantae (all kinds of plants – producers), fungi (multi-cellular decomposers) and Animalia (multi-cellular consumers).

Monera includes all kinds of bacteria. They are microscopic (1 to a few microns in length) and their cells do not contain a nucleus. Monerans are found almost every where on earth surface – in hot springs, on the underside of icebergs, in deep ocean floor, in deserts and on or within many other life forms. They are found in various shapes – rod-shaped, spherical, filamentous, spiral, etc. Protista includes various kinds of unicellular eukaryotes. They contain nucleus and other organelles. Some members of protista, such as phytoplanktons are producers, whereas others live as predators and parasites. All multicellular photosynthetic plants are grouped in Plantae. They are found on land, on sea shores and in lakes, streams and oceans. Main groups are algae, mosses, ferns and seed plants with or without flowers. Fungi are multicellular decomposers. They are saprophytic and live on decaying plant and animal matters. Yeasts, moulds, mushrooms etc. belong to this kingdom. Animalia is the kingdom of multicellular consumers. This kingdom includes all forms of animals, non-chordates and chordates. They include sponges, cnidarians (hydra and jelly fishes), flat, round or segmented worms, snails and other molluscs, arthropods, starfishes, fish, amphibians, reptiles, birds and mammals. Animal kingdom is the most diverse in terms of the number of species. Over a million species of animals are known, of these three quarters are insects and rest one quarter includes all other animal species.

India – a Land of Megadiversity

India is among the 12 mega-diversity countries in the world. It is very rich in biodiversity with about 75,000 species of animals and 45,000 species of plants. Among the wild fauna, India houses 340 species of mammals, 1200 species of birds, 420 species of reptiles, 140 species of amphibians, 2100 species of fishes, 4000 of molluscs, 5000 of insects apart from other invertebrates. Among flora are 15000 species of flowering plants, 5000 of algae, 1600 of lichens, 20,000 of fungi, 2700 of bryophytes and 600 of pteridophytes.

Regions such as North-East, Western ghats, North-Western and Eastern Himalayas and Andaman and Nicobar Islands harbor very rich floral and faunal diversity and a good number of them are endemic species. Owing to very rich biodiversity of Indian subcontinent, two hot spots, the Indo-Burma and Western Ghats/Sri Lanka (out of 25 hot spots identified recently in world for priority conservation of biodiversity (Myers *et al.*, 2000)) have been identified including parts of the Indian territory. The Indo-Burma hot spot harbours about 13,500 species of plants and 2,185 species of vertebrates (excluding fishes). Of these 7000 plant species and 528 vertebrate species have been considered endemic. The Western Ghat/Sri Lanka hot spot harbours 4780 species of plants and 1073 species of vertebrates, including 2180 species of endemic plants and 355 species of endemic vertebrates (Myers *et al.*, 2000).

North-East India - Mega-Centre of Biodiversity

The North-East India is one of the important megacentres of biological diversity. It includes a variety of ecosystems ranging from tropical wet evergreen, moist deciduous, sub-alpine, alpine forests and grass lands to fresh waters, rivers, lakes, and swamp and marshy wet lands. These diverse ecosystems have equally diverse range of biodiversity.

About one fifth of the faunal wealth of India is estimated to be found in Arunachal Pradesh. The state harbours as many as 5500 species of flowering plants out of the estimated 15000 species in India. About 1000 species of Orchids occur in India, and of these Arunachal Pradesh is the home of some 500 species (Puri *et al.*, 1995). The species richness of non-flowering plant groups: ferns, mosses and liverworts, lichens, fungi and algae is also very high. Similarly faunal diversity of Arunachal Pradesh is very high. Preliminary survey in Namdapha Biosphere reserve revealed more than 96 species of mammals, 233 of birds, 76 fishes, 25 amphibians and a large numbers of reptiles. The number of invertebrate species is difficult to

assess and that could be in several thousand 2500 sq. km area of Namdapha is so rich that as many as 75 genera of land mammals are found out of 176 genera known from India (Puri *et al.*, 1995).

A total of 5536 species of animals have been recorded from Meghalaya. The largest group of species belongs to insects comprising of 3624 species. Among the vertebrates, Meghalaya has 139 species of mammals, 541 species of birds, 94 species of reptiles, 33 species of Amphibia and 152 species of fish, many of them being endangered (Hattar, 1999). Preliminary survey of *Drosophila* fauna in Assam, Meghalaya, Manipur and Nagaland revealed more than 25 species, which is far below the actual number of *Drosophila* species distributed in the region (*cf* Singh, 1987). Other states of the region are also rich in biodiversity. However, studies to record various plant and animal species are yet to be undertaken.

Why to Preserve Biodiversity?

Human beings depend on bio-resources for almost all the food supply, 'half of its medicines, much of its clothing and in some region virtually all of its fuel and building material and as well as, of course, an important part of its mental and spiritual welfare' (Fitter, 1987).

A wide variety of plants and animals are used by man in one or other way. The human population is growing at an alarming rate. To support the growing population we require more food, more medicine and so on. So far, man has cultivated only 150 species of plants to a wide extent. But great majority of global population is said to be fed by only 15 plant species. However, about 75,000 other edible plants exist. In order to feed our growing population there is necessity to utilize and manage some of these edible plants in a sustainable way. If we drive a plant into extinction we may be eliminating a potentially useful plant. On the other hand, widely cultivated species need constant infusion of wild genes to keep up the vigor and combat against pests and diseases. Certainly, it is the floral diversity where we will search answer to the growing food problem.

Many plants have chemicals in them that are used as medicines. Now, man is inclined more towards searching cure of ailments from natural products. A survey has revealed that India alone has more than 8000 species of medicinal plants. Currently Indian export of herbal materials and medicines is estimated about 446 crores, which can go up to 3000 crores by 2005. And, if careful planning is done it can go up to 10,000 crore by 2010. But so far very little has been done towards sustainable use of medicinal plants. Unfortunately, most of the medicinal plants are collected by

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destructive harvesting without paying attention of their replenishment. Due to disappearance of forest habitats stocks of wild medicinal plants are going down day-by-day. And, there is every possibility of their disappearance, if proper attention is not paid well in time.

The faunal resources are another area which can provide solutions to some of the man's problems. The animal germplasm has only been modestly used. There is immense scope for their utilization in live stock improvement for better productivity (Ghosh, 1987). Besides, many species can be utilized for production of food, medicine, clothing and other useful materials. Many species we know little about may be useful to us. Once they are eliminated however, we have lost the opportunity to use them for our own ends. As human population continues to increase, the need for different kinds of food plants and animals will increase.

Certain organisms in some ecosystem appear to play key or pivotal roles. Extinction of one of these species could be devastating to the ecosystem and human that use it. Diversity enhances community resistance to biological invasion (Elton, 1958). It is believed that ecosystem rich in biological diversity is better able to resist invasions by exotic species. It has been suggested long ago that exotic species should have a harder time taking root in a diverse ecosystem, because a whole web of species should more efficiently tie up such critical resources as nutrients, light and water than would a single species, leaving fewer resources for the invader.

All species have a fundamental right to exist without being needlessly eliminated by unthinkable activities of man. The human species is just one of the millions of species that exist on earth. It has no right to eliminate other species. Human survival depends upon co-existence with other life forms.

Can We Afford Further Damage to Our Biodiversity?

During the last century, many plants and animal species have either become extinct or reached at the verge of extinction. Currently 12.5% of all plant species are threatened with immediate extinction. World-wide some 273 species of animals and plants face extinction, solely as a result of trade. Millions of live animals are shipped around the world every year to supply the pet trade. Fur, leather and ivory are also traded in vast quantities. Similarly many medicinal plant species are also at the verge of extinction due to their over commercial exploitation. The number of threatened species is increasing day-by-day and if proper, immediate and strict measures are not taken, there is every possibility of their extinction in near future.

We are in danger of losing the wonderful diversity of life that defines our planet. Half of all the species in the world could become extinct in the next 100 years, if the current trend persists. There is an urgent need to change the current trend and conserve the biodiversity of this planet, which took million of years to carve and shape the present day life forms. Man's activities, directly or indirectly have already caused irreparable damage. Hence, we can not afford any further damage to our precious wealth of biodiversity. Various steps have already been taken for *in situ* and *ex-situ* conservation of biodiversity. Declaration of biosphere reserves (Table 5), national parks, sanctuaries and ecodevelopment parks are appreciable steps in the long way of *in situ* conservation of biodiversity.

Table 5: Ten Biosphere reserves declared in India for *in situ* conservation of Biodiversity

Biosphere reserve	Area Covered (Approx. Km ²)	State
Great Nicobar	885	Andaman & Nicobar Islands
Kaziranga	37,823	Assam
Manas	2,837	Assam
Mannar Gulf	555	Tamil Nadu
Namdapha	7,000	Arunachal Pradesh
Nanda Devi	2,600	Uttar Pradesh
Nilgiri	5,520	Karnataka, Talmil Nadu, Keral
Nokrek	160	Meghalaya
Sundarbans	9,630	West Bengal
Uttarakhand(Valley of flowers)	3,941	Uttar Pradesh

Some one rightly pointed out that the natural beauties of a country, its varied flora and fauna are an asset to its people. This asset urgently needs to be protected and preserved to their own advantage and to the advantage of future generations. Nature has endowed India with a magnificent asset of rich flora and fauna, an asset which cannot fail to be generally appreciated by its people if they are led to know something of its worth and interest.

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