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**Review Article**

## **STATUS OF BIODIVERSITY IN INDIA: ISSUES AND CHALLENGES**

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### **ABSTRACT**

India is a country of rich biological diversity, has over 91,200 species of animals and 45,500 species of plants in its ten bio-geographic regions. Besides, it is recognized as one of the eight Vavilovian centres of origin and diversity of crop plants, having more than 300 wild ancestors and close relatives of cultivated plants, which are still evolving under natural conditions. India is also a vast repository of traditional knowledge associated with biological resources. India ranks among the top ten species-rich nations and shows high endemism. India has four global biodiversity hot spots. The varied edaphic, climatic and topographic conditions and years of geological stability have resulted in a wide range of ecosystems and habitats in India. Unfortunately, as elsewhere on earth, Indian biodiversity is also threatened with destruction due to population pressures and ill-conceived developmental activities. The Government of India has become aware of the situation and has created wildlife sanctuaries, national parks and biosphere reserves for *in-situ* conservation of biodiversity and scientific organisations (gene banks) for *ex-situ* conservation.

**Keywords:** *Biodiversity, India*

### **INTRODUCTION**

India is situated north of the equator between 66°E to 98°E and 8°N to 36°N. It is bordered by Nepal, China and Bhutan in the north; Bangladesh and Myanmar in the east; the Bay of Bengal in the south east; the Indian Ocean in the south; the Arabian Sea in the west; and Pakistan in the north-west.

The varied edaphic, climatic and topographic conditions have resulted in a wide range of ecosystems and habitats such as forests, grasslands, wetlands, coastal and marine ecosystems, and deserts. The mountainous region covers an area close to 100 mha, arid and semi-arid zones are spread over 30 mha and the coastline is about 8000 km long.

India is a country of vast biodiversity. It has diverse biogeographical and climatic conditions, ranging from the cold and high Himalayas in the north to the hot and humid peninsula in the south, and from the wet, green, north-eastern forest to the dry north-western desert.

Vegetation ranges from the wet evergreen forest of the Western Ghats and the north-eastern hills to the dry deciduous forest of Central India and the thorny forest of the Thar Desert. About 61.5% of flora in India is endemic.

There are about 3,000 endemic species in the Himalayas and the Khasi Hills of north-eastern India and 2,000 in the Deccan Peninsula in the south. The richest area from the biodiversity point of view lies in the Silent Valley of Kerala in the Western Ghats and the north-eastern hills of Assam and Meghalaya.

### ***Biogeographical Zones of India***

India represents (i) Two 'Realms' – the Himalayan region represented by Palearctic Realm and the rest of the sub-continent represented by Malayan Realm; (ii) Five Biomes e.g. Tropical Humid Forests; Tropical Dry Deciduous Forests (including Monsoon Forests); Warm Deserts and Semi-deserts; Coniferous Forests; Alpine Meadows; and (iii) Ten biogeographic zones and Twenty-seven biogeographic provinces (Table-1).

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**Table 1: Biogeographical zones of India**

| S.N. | Biogeographical Zones | Biogeographical Provinces  | % of geographical area of India   |
|------|-----------------------|--|-----------------------------------|
| 1.   | Trans Himalaya        | 1A: Himalaya - Ladakh Mountains<br>1B: Himalaya - Tibetan Plateau<br>1C: Trans - Himalaya Sikkim   | 3.3<br>2.2<br><0.1                |
| 2.   | The Himalaya          | 2A: Himalaya - North West Himalaya<br>2B: Himalaya - West Himalaya<br>2C: Himalaya - Central Himalaya<br>2D: Himalaya - East Himalaya  | 2.1<br>1.6<br>0.2<br>2.5          |
| 3.   | The Indian Desert     | 3A: Desert - Thar<br>3B: Desert - Kutch  | 5.4<br>1.1                        |
| 4.   | The Semi Arid         | 4A: Semi - Arid - Punjab Plains<br>4B: Semi - Arid - Gujarat Rajputana   | 3.7<br>12.9                       |
| 5.   | The Western Ghats     | 5A: Western Ghats - Malabar Plains<br>5B: Western Ghats - Western Ghats Mountains  | 2.0<br>2.0                        |
| 6.   | The Deccan Peninsula  | 6A: Deccan Peninsular - Central Highlands<br>6B: Deccan Peninsular - Chotta Nagpur<br>6C: Deccan Peninsular - Eastern Highlands<br>6D: Deccan Peninsular - Central Plateau<br>6E: Deccan Peninsular - Deccan South | 7.3<br>5.4<br>6.3<br>12.5<br>10.4 |
| 7.   | The Gangetic Plains   | 7A: Gangetic Plain - Upper Gangetic Plains<br>7B: Gangetic Plain - Lower Gangetic Plains   | 6.3<br>4.5                        |
| 8.   | The Coasts            | 8A: Coasts - West Coast<br>8B: Coasts - East Coast<br>8C: Coasts - Lakshdweep  | 0.6<br>1.9<br><0.1                |
| 9.   | Northeast India       | 9A: North - East - Brahmaputra Valley<br>9B: North - East - North East Hills   | 2.0<br>3.2                        |
| 10.  | Islands               | 10A: Islands - Andamans<br>10B: Islands - Nicobars   | 0.2<br>0.1                        |

*Source: Wildlife Research Institute of India, 2009*

### **Zone 1: Trans Himalaya**

Zone 1 covers an area of 186,200 km<sup>2</sup> in the cold and arid regions with sparse alpine steppe vegetation and several endemic species. It is home to communities of wild sheep and goats, the urial, ibex, wild yak and Tibetan ass, gazelle and antelope. Among the carnivores are the snow leopard, Tibetan wolf and the endemic pallas cat and smaller animals such as the marbled cat, pika and marmot. The brackishwater

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lakes and marshes have a good variety of avifauna, the most spectacular of which is the black-necked crane. The zone has two protected areas.

### **Zone 2: The Himalaya**

Zone 2 covers an area of about 236,000 km<sup>2</sup> in the Himalayas. It displays a wide altitudinal range and is among the richest zones in terms of species and habitat diversity - the sambar, muntjac, wild boar in the subtropical foothills, the musk deer, serow, goral, tahr, kokla and pheasant in the temperate, sub-alpine regions and the bharal, snow leopard, brown bear and snowcock in the alpine region. The zone has fifty-six protected areas. There are more endangered species in the Himalaya than anywhere else in India. The Sikkim stag may already have become extinct. The tahr, markhor and western tragopan may be facing extinction.

### **Zone 3: The Indian Desert**

Zone 3 is a highly fragile ecosystem and its biological richness may be lost very rapidly. The zone covers an area of 225,000 km<sup>2</sup>, of which about 89 km<sup>2</sup> is protected. The wild ass, a distinct sub-species, is restricted to the Rann of Kutch. This is also the only breeding site for flamingoes on the Indian subcontinent. It is home to the desert fox, desert cat, houbara, bustard and to some sandgrouse species. Other species are the chinkara, blackbuck, wolf, caracal and great Indian bustard.

### **Zone 4: The Semi-Arid**

Spread over 508,000 km<sup>2</sup> in the semi-arid regions, Zone 4 has two major tiger reserves. There are fifty-two protected areas covering 11,675 km<sup>2</sup>. The Gir lion, one of the very few endemic species in this zone, now needs a second home.

### **Zone 5: The Western Ghats**

A 1,500 km long mountain range with a wet western face and a dry eastern slope, the Western Ghats cover an area of about 159,000 km<sup>2</sup>. This zone consists of a diversity of forests, from evergreen to dry deciduous. The richest of India's evergreen forests are located here. It is a continually expanding "genetic storehouse" of India. The Western Ghats cover only 5% of India's land surface but contain more than a quarter (about 4,000) of the country's plant species.

About 1,800 of these species are endemic, many highly localised and extremely vulnerable due to increasing habitat destruction. This zone also has viable populations of most of the vertebrate species found in peninsular India, in addition to endemic species like the Nilgiri langur, the lion-tailed macaque, the Nilgiri tahr and the Malabar grey hornbill. Most of the amphibian species here too are endemic. The Travancore tortoise and cane turtle are restricted to small areas of the central Western Ghats. There are forty-four protected areas covering 15,935 km<sup>2</sup>.

### **Zone 6: The Deccan Peninsula**

Zone 6 covers 1,421,000 km<sup>2</sup> - about 43% of India's total land surface. Most of India's protected areas are in this zone. Most wildlife species - the tiger, leopard, sloth bear, gaur, sambar, chital, chowsingha, wild boar, etc. - are widespread throughout the whole zone. There are small relict populations of elephant, wild buffalo and barasingha. There are about 115 protected areas covering 4,610 km<sup>2</sup>.

### **Zone 7: The Gangetic Plain**

Centuries ago, Zone 7 had rich vegetal cover and diverse wildlife but both are now depleted with the extension of agriculture. The elephant, barasingha, blackbuck, gazelle, rhino and Bengal florican, which used to be numerous, have only relict populations surviving. In the many wetlands, lakes and swamps the waterfowl community (partly migratory) is exceptionally dense. Crocodile and freshwater turtle populations are also quite good. Spread over 359,000 km<sup>2</sup>, the zone has twenty-five protected areas.

### **Zone 8: The Coasts**

Zone 8 comprises mangrove vegetation and is biologically rich. Animal species include dugong and humpback whale, inshore dolphin, marine and estuarine turtles, and estuarine and saltwater crocodile. Avifauna include oceanic visitors. The Sunderbans Sanctuary on the east coast is a tiger reserve with India's highest population of tigers. Together with Bangladesh this is one of the world's largest protected mangrove ecosystems.

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### **Zone 9: North-east India**

Zone 9 is the biogeographical gateway for much of India's flora and fauna. This zone is one of the richest in biological resources, both endemic and others. The Brahmaputra valley contains extensive areas of natural vegetation - swamps, grasslands and fringe forests. The elephant, rhinoceros, buffalo, swamp deer, hog deer, pygmy hog and hispid hare are the wildlife of the zone. The diversity in plant communities and species is extremely high. The animal communities are also diverse. In fact, smaller carnivores exhibit a richness not seen anywhere else in the world. India's highest populations of elephants are here. The region also forms an important flyway on the route of migratory birds to and from Siberia and China. There are seventeen protected areas covering 1,880 km<sup>2</sup>.

### **Zone 10: Islands**

Andaman and Nicobar are a group of 348 islands which are biologically immensely rich. About 2,200 species of higher plants are found, of which 200 are strictly endemic. The avifauna comprises 225 distinctive species, of which 112 are endemic. This zone is India's richest in fish and coral communities. On these islands, there are one hundred protected areas covering 708 km<sup>2</sup>.

### **Distribution of Forest in India**

India is endowed with vast forest resources. Forests play a vital role in social, cultural, historical, economic and industrial development of the country and in maintaining its ecological balance. They are the resource base for sustenance of its population and a storehouse of biodiversity. Other land use practices, such as agriculture and animal husbandry are benefitted by forests. Realizing the crucial role of forests in maintaining the ecological balance and socio-economic development, the National Forest Policy, 1988 aims at maintaining a minimum of 33% of country's geographical area under forest and tree cover. The forests in the country have been classified into 16 major types and 251 subtypes on the basis of climatic and edaphic features. Distribution of diverse forest types across the country is presented in Table-2.

**Table 2: Diversity and distribution of major forest types in India**

| <b>Major Groups</b>         | <b>Type and Group</b>                | <b>Area (m ha)</b> | <b>% of forest area</b> |
|-----------------------------|--------------------------------------|--------------------|-------------------------|
| Tropical Forests            | Wet evergreen forest                 | 4.5                | 5.8                     |
|                             | Semi-evergreen forest                | 1.9                | 2.5                     |
|                             | Moist deciduous forest               | 23.3               | 30.3                    |
|                             | Littoral and swamp forest            | 0.7                | 0.9                     |
|                             | Dry deciduous forest                 | 29.4               | 38.2                    |
|                             | Thorn forest                         | 5.2                | 6.7                     |
|                             | Dry evergreen forest                 | 0.1                | 0.1                     |
| Sub-tropical Forests        | Subtropical broad leaved hill forest | 0.3                | 0.4                     |
|                             | Sub tropical pine forest             | 3.7                | 5.0                     |
|                             | Sub tropical dry evergreen forest    | 0.2                | 0.2                     |
| Temperate Forests           | Montane wet temperate forest         | 1.6                | 2.0                     |
|                             | Himalayan moist temperate forest     | 2.6                | 3.4                     |
|                             | Himalayan dry temperate forest       | 0.2                | 0.2                     |
| Sub-alpine & Alpine Forests | Sub-alpine forest                    | -                  | -                       |
|                             | Moist alpine scrub                   | 3.3                | 4.3                     |
|                             | Alpine scrub                         | -                  | -                       |

*Source: Indian Council of Forestry Research and Education (ICFRE), 2000*

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### **The Biodiversity of India**

#### **Animal Diversity**

There are about 91,200 species of animals in India, from tiny protozoans to large mammals. Among the 397 species of mammals, nearly 30 are endemic, of which 19 are primates. Among the 458 species of birds, 42 are endemic. The reptile fauna comprises over 245 species of snakes, 171 species of lizards, 41 species of turtles and 3 species of crocodiles. The amphibian fauna comprises 248 species of salamanders, caecilians, frogs and toads. There is a high degree of endemism in this group and out of 153 endemics, 84 occur in the Western Ghats and 20 in the north-east (Table-3). The Indian fauna has been enriched by the migration of birds from Siberia and other parts of Europe, and animals from Nepal, Burma, Bhutan, Malaysia and Bangladesh.

**Table 3: Animal diversity in India**

| <b>Group</b> | <b>World<br/>(number of species)</b> | <b>India<br/>(number of species)</b> | <b>(%) in India</b> |
|--------------|--------------------------------------|--------------------------------------|---------------------|
| Mammals      | 4629                                 | 397                                  | 8.58                |
| Birds        | 8,400                                | 458                                  | 5.45                |
| Reptiles     | 5817                                 | 460                                  | 7.91                |
| Amphibians   | 5150                                 | 248                                  | 4.81                |
| Fishes       | 23,400                               | 5749                                 | 24.56               |
| Insects      | 867391                               | 61151                                | 7.04                |
| Molluscs     | 66535                                | 5072                                 | 7.62                |

Source: National Biodiversity Action Plan, 2011

#### **Plant Diversity**

It is estimated that about 45,500 species of plants occur in India. Vascular plants, mainly flowering plants (angiosperms), comprise 17,527 species, of which more than 6% are thought to be endemic (There are 250,000 species of angiosperms throughout the world). The rest are non-flowering plants, comprising pteridophytes, bryophytes, lichens, algae, fungi, and bacteria etc. (Table-4).

**Table 4: Plant diversity in India**

| <b>Group</b>   | <b>World<br/>species)</b> | <b>(number of<br/>India<br/>species)</b> | <b>(number of<br/>% in India</b> |
|----------------|---------------------------|--|----------------------------------|
| Virus/Bacteria | 8,050                     | 850                                      | 10.6                             |
| Algae          | 40,000                    | 7175                                     | 17.9                             |
| Fungi          | 72,000                    | 14,500                                   | 20.1                             |
| Lichens        | 13,500                    | 2223                                     | 16.4                             |
| Bryophytes     | 14500                     | 2500                                     | 17.2                             |
| Pteridophytes  | 10,000                    | 1,200                                    | 12.0                             |
| Gymnosperms    | 650                       | 67                                       | 10.3                             |
| Angiosperms    | 2,50,000                  | 17,527                                   | 7.0                              |

Source: Botanical Survey of India, 2011

The endemic species and genera are largely concentrated in two principal biogeographical regions - the Himalayas (about 4,200 species) and peninsular India (about 2,600 species). Nearly 1,000 plant species are endangered. India alone has given nearly 167 economically important plants whose centre of origin/diversity lies in India, along with their 320 species of wild relatives and landraces (traditional varieties).

#### **Genetic Diversity in Crop Plants**

The Indian subcontinent is floristically rich, with plants of diverse economic uses (Table-5)

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**Table 5: Diversity of plant use in India**

| Economic Uses      | Number of Species |
|--------------------|-------------------|
| As food plant      | 1,200             |
| As fodder plant    | 2,200             |
| As fuel and timber | 1,000             |
| As medicinal herbs | 3,000             |
| As fibre plants    | 150               |
| As spices          | 120               |
| As oil seed plants | 100               |

*Source: National Biodiversity Action Plan, 2011*

Due to the rich mosaic of ethnic cultures and a rich heritage of civilization, India possesses one of the richest centres of crop plant variability, landraces and progenitors in the world. Over 320 species, considered to be the wild relatives of economically important plants, are also reported on the Indian subcontinent. Rich genetic diversity is available in many cereal crops, legumes, oilseeds, vegetables, spices and condiments, fibre crops, fruits, medicinal and aromatic plants and also in nutritive grasses and useful trees. The Indian gene centre has a rich diversity of crop plants of both native and exotic species. Over 160 species of cultivated and 320 of wild related types occur in different agro-ecological regions. A wide range of agro-ecological regions and ethnic variations, interlinked with traditional agriculture, has generated enormous landrace diversity in India (Table-6).

**Table 6: Agro-ecological regions of crop diversity in India**

| Agro-ecological Regions | Crops  |
|-------------------------|--|
| Western Himalaya        | <ul style="list-style-type: none"> <li>• Barley, wheat, maize, buckwheat, amaranth, prosomillet, finger millet</li> <li>• French bean, soyabean, lentil, black gram, peas</li> <li>• Pumpkin, cucumber, Alliums pp., ginger, Brassicae</li> <li>• Pome, stone, soft and nut fruits</li> </ul>  |
| Eastern Himalaya        | <ul style="list-style-type: none"> <li>• Barley, maize, buckwheat, amaranth, finger millet, foxtail millet</li> <li>• French bean, soyabean, cowpea, black gram, peas, scarlet bean</li> <li>• Pumpkin, cucumber, Alliums pp. ginger, chayote, tree tomato, Brassicae</li> <li>• Pome and stone fruits</li> </ul>  |
| North-Eastern Region    | <ul style="list-style-type: none"> <li>• Rice, maize, sorghum, finger millet, foxtail millet, job's tears</li> <li>• French bean, soyabean, pigeonpea (perennial), black gram, rice bean, Dolichos bean, winged bean</li> <li>• Pumpkin, chayote, cucumber, okra, eggplant, chilli/capsicum spp., Pointed gourd, ash gourd</li> <li>• Taros, yams</li> <li>• Citrus-Lime/lemon/orange/grape fruit, banana</li> </ul> |

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|                              |   |
|------------------------------|---|
|                              | <ul style="list-style-type: none"><li>• Tea, tree cotton, jute, kenaf and mesta, large cardamom, ginger, long pepper, sugarcane</li></ul>   |
| Gangetic Plains              | <ul style="list-style-type: none"><li>• Rice, sorghum, barnyard millet, little millet/<i>Panicum</i></li><li>• Chickpea, cowpea, mung bean</li><li>• Okra, eggplant, bitterground, <i>cucumis</i> spp., <i>Luffa</i> spp.</li><li>• Jackfruit, mango, lemon/lime, orange, jujube, Indian gooseberry/<i>Emblica</i>, jumun/<i>Syzygium</i>, melons</li><li>• Linseed, niger, sesame, <i>Brassicaceae</i></li><li>• Sugarcane, mulberry</li></ul> |
| Indus Plains                 | <ul style="list-style-type: none"><li>• Durum wheat, pearl millet</li><li>• Moth bean, cluster bean, chickpea, black gram</li><li>• Okra, <i>Cucumis</i> spp.</li><li>• Jujube, Khirni/<i>Mimosa</i>, Phalsa/<i>Grewia</i></li><li>• Sesame, Taramira/<i>Eruca</i>, Cotton</li></ul>  |
| Eastern Peninsular           | <ul style="list-style-type: none"><li>• Rice, sorghum, finger millet, pearl millet, foxtail millet, little millet, prosomillet, kodo millet</li></ul>   |
| Region/E.Ghats/              | <ul style="list-style-type: none"><li>• Black gram, green gram, cowpea, horse gram, Mucuna, pigeonpea, <i>Dolichos</i> bean, rice bean</li></ul>  |
| Deccan                       | <ul style="list-style-type: none"><li>• Taros, yams, elephant-food yam</li><li>• Banana, mango, lemon/lime, jackfruit</li><li>• Niger, <i>Brassicaceae</i>, sesame</li><li>• Ginger, turmeric, chilli, kenaf, sugarcane, coconut, cotton</li></ul>  |
| Western Peninsular           | <ul style="list-style-type: none"><li>• Rice, sorghum, finger millet, small millet/<i>Panicum</i></li></ul>   |
| Region/Western Ghats/Malabar | <ul style="list-style-type: none"><li>• Black gram, green gram, cowpea, pigeonpea, <i>Dolichos</i> bean, horse gram, sword bean</li></ul>   |
| The Islands Regions          | <ul style="list-style-type: none"><li>• Okra, eggplant, cucumber, chilli/<i>Capsicum</i></li><li>• Taros, yams, elephant-foot yam</li><li>• Jackfruit, banana, lime/lemon, orange, jumun/<i>Syzygium</i></li><li>• Sugarcane, black pepper, turmeric, ginger, coconut, arecanut, cotton</li><li>• Coconut, breadfruit, chilli, taros, yams, <i>Xanthosoma</i></li></ul>   |

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Source: [http://www.biodiversityinternational.org/publications/Web\\_version/I74/ch06.htm](http://www.biodiversityinternational.org/publications/Web_version/I74/ch06.htm)

### **Genetic Diversity in Livestock**

India, endowed with varied forms of animal genetic resources, is traditionally considered as an important rearing centre for domesticated animals. India has vast resources of livestock (485 million) and poultry (489 million), which play a vital role in rural livelihood security. In terms of population, India ranks first in buffaloes, second in cattle and goats, third in sheep, fourth in ducks, fifth in chicken and sixth in camels in the world. The genetic resources of farm animals in India are represented by a broad spectrum

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of native breeds of cattle, buffaloes, goats, sheep, swine, equines, camel and poultry. There are around 140 listed breeds of livestock and poultry in India, with 30 breeds of cattle, 10 of buffalo, 42 of sheep, 20 of goat, 3 of pig, 6 of horse and pony, 8 of camel and 18 of poultry. Besides, there are breeds of yak, mithun, ducks, quails and several nondescript populations.

### **The Erosion of Biodiversity in India**

The loss of biodiversity and the extinction of species in India are alarming. Because of intense population pressure and ill-conceived developmental activities more and more species are becoming endangered and are at risk of becoming extinct (Table-7,8,9). The hunting leopard (*Acinonyx jubatus*) is already extinct. The last three hunting leopards were shot dead in 1947 in Bastar.

As per the IUCN Red List, 2008, India has 43 globally threatened faunal species, which is approximately 4.9% of the world's total number of threatened faunal species. The number of threatened faunal species in different categories which are listed in the WPA and the Appendices of CITES, and Convention on Migratory Species (CMS) are given in (Table-7).

**Table 7: Threatened Indian species**

| Group       | Schedules of I WPA |    |     |    |   | Appendices of CITES |    |     |   | Appendices of CMS |    |
|-------------|--------------------|----|-----|----|---|---------------------|----|-----|---|-------------------|----|
|             | I                  | II | III | IV | V | I                   | II | III | I | I/II              | II |
| Mammals     | 16                 | 6  | 1   | -  | - | 56                  | 31 | 5   | 4 | 4                 | 10 |
| Birds       | 10                 | -  | -   | 23 | - | 87                  | 55 | 5   | 4 | 18                | -  |
| Reptiles    | 10                 | -  | -   | 1  | - | 10                  | 8  | -   | 1 | 4                 | -  |
| Amphibia    | 18                 | 11 | -   | 28 | - | -                   | -  | -   | - | -                 | -  |
| Pisces      | -                  | 2  | -   | -  | - | -                   | 3  | -   | - | -                 | -  |
| Crustacea   | -                  | -  | -   | -  | - | -                   | -  | -   | - | -                 | -  |
| Mollusca    | 3                  | -  | -   | -  | - | -                   | -  | -   | - | -                 | -  |
| Hymenoptera | -                  | -  | -   | -  | - | -                   | -  | -   | - | -                 | -  |
| Lepidoptera | -                  | -  | -   | -  | - | -                   | -  | -   | - | -                 | -  |
| Odonata     | 1                  | -  | -   | -  | - | -                   | -  | -   | - | -                 | -  |
| Anoplura    | -                  | -  | -   | -  | - | -                   | -  | -   | - | -                 | -  |
| Total       | 58                 | 19 | 1   | 52 | - | 153                 | 97 | 10  | 9 | 26                | 10 |

Source: [www.wii.gov.in/inianfauna/globally%20threatened%20indian%20fauna.pdf](http://www.wii.gov.in/inianfauna/globally%20threatened%20indian%20fauna.pdf)

As per the IUCN Red List, 2008, India has 246 globally threatened floral species which constitute approximately 2.9% of the World's total number of threatened floral species (8457). In the Western Ghats alone, 100 species of flowering plants are seriously threatened. The Botanical Survey of India has so far listed may plants species from different parts of the country under various categories, such as extinct, possibly extinct, endangered, vulnerable and rare (Table-8).

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**Table 8: Some threatened plant species of India**

| <b>Species</b>                  | <b>Habitat</b>   | <b>Ecological Status</b> |
|---------------------------------|------------------|--------------------------|
| <i>Abies pindrow</i>            | Himalayas        | Endangered               |
| <i>Aconitum kerox</i>           | Himalayas        | Rare                     |
| <i>Astragalus strobiliferus</i> | Himalayas        | Vulnerable               |
| <i>Atropa acutminata</i>        | Himalayas        | Endangered               |
| <i>Balanophora dioica</i>       | Himalayas        | Endangered               |
| <i>Colchicum luteum</i>         | Himalayas        | Vulnerable               |
| <i>Cyathea gigantea</i>         | Himalayas        | Indeterminate            |
| <i>Dianthus coschemiricus</i>   | Himalayas        | Rare                     |
| <i>Dioscorea deltoidea</i>      | Himalayas        | Rare                     |
| <i>Drosera burmannivahi</i>     | Khasi Hills      | Endangered               |
| <i>Magnolia griffithii</i>      | Himalayas        | Vulnerable               |
| <i>Nepenthes khasiana</i>       | Khasi Hills      | Endangered               |
| <i>Orchis latifolia</i>         | Western Himalaya | Endangered               |
| <i>Angelica glauca</i>          | Western Himalaya | Endangered               |
| <i>Polygonum alpinum</i>        | Western Himalaya | Endangered               |
| <i>Polygonum verticillatum</i>  | Western Himalaya | Endangered               |
| <i>Curculigo orchoides</i>      | Western Ghats    | Endangered               |
| <i>Tinospora malabarica</i>     | Western Ghats    | Endangered               |
| <i>Commiphora mukul</i>         | Western Ghats    | Endangered               |
| <i>Boswellia cordifolia</i>     | Western Ghats    | Endangered               |
| <i>Sesamum indicum</i>          | Western Ghats    | Endangered               |
| <i>Tarminalia pallida</i>       | Western Ghats    | Endangered               |
| <i>Osmunda regalis</i>          | Himalayas        | Indeterminate            |
| <i>Rauwolfia serpentina</i>     | Western Ghats    | Critical                 |
| <i>Rhododendron dalhousiae</i>  | Western Ghats    | Endangered               |
| <i>Vanda coeruleo</i>           | Western Ghats    | Critical                 |
| <i>Commiphora wightii</i>       | Thar Desert      | Endangered               |
| <i>Gnetum ula</i>               | Western Ghats    | Rare                     |
| <i>Ginkgo biloba</i>            | Himalayas        | Critical                 |
| <i>Santalum album</i>           | Western Ghats    | Endangered               |
| <i>Dioscorea deltoides</i>      | Himalayas        | Rare                     |
| <i>Delphinium denudatum</i>     | Himalayas        | Rare                     |
| <i>Acorus calamus</i>           | Himalayas        | Vulnerable               |
| <i>Saussurea lappa</i>          | Himalayas        | Indeterminate            |
| <i>Podophyllum hexandrum</i>    | Himalayas        | Rare                     |
| <i>Diplomeris hirsuta</i>       | Himalayas        | Rare                     |
| <i>Ephedra gerardiana</i>       | Western India    | Endangered               |
| <i>Picrorhiza kurroa</i>        | Himalayas        | Endangered               |
| <i>Oryza nivara</i>             | Western Ghats    | Endangered               |
| <i>Swertia chirayita</i>        | Himalayas        | Endangered               |
| <i>Juniperus communis</i>       | Western Himalaya | Endangered               |
| <i>Citrus assamensis</i>        | Eastern Himalaya | Endangered               |
| <i>Drosera pettata</i>          | Western Ghats    | Critical                 |
| <i>Vigna mungo</i>              | Western Ghats    | Vulnerable               |
| <i>Dolichos bracteatus</i>      | Western Ghats    | Vulnerable               |

Source: National Biodiversity Action Plan, 2011

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**Table 9: Some threatened animal species of India**

| Common Name                 | Scientific Name                    | Habitat               | Ecological Status |
|-----------------------------|------------------------------------|-----------------------|-------------------|
| Lion tailed macaque         | <i>Macaca silenus</i>              | Western Ghats         | Endangered        |
| Slow loris                  | <i>Loris tardigradus</i>           | Nilgiris              | Vulnerable        |
| Slender loris               | <i>Nycticebus coucang</i>          | North-east            | Endangered        |
| Nilgiri langur              | <i>Presbytis johni</i>             | Western Ghats         | Vulnerable        |
| Hoolock gibbon              | <i>Hylobates hoolock</i>           | North-east            | Rare              |
| Great Indian bustard        | <i>Chariotes nigriceps</i>         | East coast            | Endangered        |
| Great pied hornbill         | <i>Buceros bicornis</i>            | Western Ghats         | Rare              |
| Siberian crane              | <i>Grus leucogeranus</i>           | Migratory (Bharatpur) | Critical          |
| Blacknecked crane           | <i>Grus nigricollis</i>            | Ladakh                | Rare              |
| Pink head duck              | <i>Rhodonessa caryophyllaceae</i>  | Whole India           | Extinct           |
| Peacock pheasant            | <i>Polyplectron bicalcaratum</i>   | Himalayas             | Critical          |
| Crocodile                   | <i>Crocodylus porosus</i>          | East coast            | Endangered        |
| Monitor lizards             | <i>Varnus spp.</i>                 | Whole India           | Endangered        |
| Green sea turtle            | <i>Chelonia mydas</i>              | Indian Ocean          | Endangered        |
| Great Indian python         | <i>Python spp.</i>                 | North-east            | Endangered        |
|                             |                                    |                       | Critical          |
| Asiatic lion                | <i>Panthera leo persica</i>        | Gir Forest            |                   |
| Snow leopard                | <i>Panthera uncia</i>              | Himalayas             | Endangered        |
| Tiger                       | <i>Panthera tigris</i>             | Whole India           | Vulnerable        |
| Leopard cat                 | <i>Felis bengalensis</i>           | Whole India           | Vulnerable        |
| Desert cat                  | <i>Felis libyca</i>                | Thar Desert           | Endangered        |
| Hispid hare                 | <i>Caprolagus hispidus</i>         | Assam                 | Vulnerable        |
| Giant flying squirrel       | <i>Petaurista candidulus</i>       | Himalayas             | Endangered        |
| Grizzled giant squirrel     | <i>Ratufa macroura</i>             | South India           | Rare              |
| Malabar large spotted civet | <i>Viverra megaspila civettina</i> | Western Ghats         | Endangered        |
| Indian wild ass             | <i>Equus hemionus khur</i>         | Rann of Kutch         | Endangered        |

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|                            |                              |                  |            |
|----------------------------|------------------------------|------------------|------------|
| Kashmir stag               | <i>Cervus calphus hanglu</i> | Kashmir          | Endangered |
| Swamp deer                 | <i>Cervus duvancelli</i>     | Central India    | Rare       |
| Brow-antlered deer         | <i>Cervus eldi eldi</i>      | Manipur          | Critical   |
| Musk deer                  | <i>Moschus moschus</i>       | Himalayas        | Critical   |
| Mouse deer                 | <i>Tragulus meminna</i>      | South India      | Rare       |
| Himalayan ibex             | <i>Capra ibex</i>            | Himalayas        | Endangered |
| Wild dog                   | <i>Cuon alpinus</i>          | Central India    | Rare       |
| Indian wolf                | <i>Canis lupus</i>           | Whole India      | Endangered |
| Desert fox                 | <i>Vulpes vulpes</i>         | Thar Desert      | Endangered |
| Wild Asiatic water buffalo | <i>Bubalus bubalis</i>       | Assam            | Rare       |
| Wild yak                   | <i>Bos grunniens</i>         | Ladakh           | Vulnerable |
| Indian bison               | <i>Bos gaurus</i>            | Whole India      | Endangered |
| Gangetic dolphin           | <i>Platanista gangetica</i>  | Ganges           | Vulnerable |
| Asiatic elephant           | <i>Elephas maximus</i>       | Whole India      | Vulnerable |
| Greater Indian rhino       | <i>Rhinoceros unicornis</i>  | Assam and Bengal | Endangered |
| Pygmy hog                  | <i>Sus scrofa</i>            | North-East       | Rare       |
| Red panda                  | <i>Ailurus fulgens</i>       | Himalayas        | Rare       |
| Himalayan brown bear       | <i>Ursus arctos</i>          | Himalayas        | Rare       |
| Blue sheep                 | <i>Pseudovis nahoor</i>      | Himalayas        | Vulnerable |
| Western tragopan           | <i>Tragopan nelano</i>       | Himalayas        | Rare       |
|                            | <i>Tragopan cephala</i>      |                  |            |

Source: National Biodiversity Action Plan, 2011

Other wildlife species of India which are at risk are the Himalayan quail and Himalayan newt from the Western Himalayas, the white-winged wood duck and Garo Hills tree toad from North-East India, the coconut crab from the Andaman and Nicobar Islands, the Himalayan dragonfly from the Himalayas, the forest owl from the Satpura Hills, and the Malabar tree toad and the Nilgiri tahr from the Western Ghats.

It is estimated that the Western Ghats, considered to be the biological treasure of India, have more than 6,000 species of flowering and non-flowering plants. More than 700 species of flowering plants of the Western Ghats have become rare. The Western Ghats are home to some of the world's rare animals and birds species, such as the lion-tailed macaque (*Macaca silenus*), the Nilgiri langur (*Presbytis johni*), Nilgiri tahr (*Hemitragus hylocrius*), grizzled giant squirrel (*Ratufa macroura*), Malabar giant squirrel (*Ratufa indica*), flying squirrel (*Petaurus candidulus*), Malabar pied hornbill (*Buceros bicornis*) and the great Indian hornbill (*Buceros* spp.). The lion-tailed macaque, Nilgiri langur and the Nilgiri tahr are

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endemic to the Western Ghats and are not found in the world anywhere else. They are highly endangered and face the threat of extinction.

The Botanical Survey of India has compiled three volumes of the Red Book of Indian Plants, which identify 622 threatened plant species, including 132 highly endangered species which are facing extinction. Another twenty-four plant species are possibly already extinct, not having been sighted since the turn of the century.

### **Conclusion**

In ancient India, biodiversity conservation was synonymous with the preservation of big cats and large mammals. But, now there is an urgent need to give attention to smaller animals like the musk deer, fish, frogs, turtles, butterflies and earthworms. In addition, higher plants, particularly trees and medicinal herbs, orchids, agricultural and non-agricultural micro-organisms, blue-green algae and marine organisms, also need protection.

Mere legal sanctions will also not help. It is essential for the conservation of biodiversity in India that there has to be a mass awakening among people and support from government and non-government organisations. A realisation of the importance of biodiversity for human survival and welfare has to be built up systematically among the people, showing what it means to the present generation and, more importantly, to future generations. Biodiversity conservation does not mean only propagation of the given species in a limited protected area in national parks and wildlife sanctuaries. It also requires the rehabilitation of given species in a second home - ecologically similar habitats still available elsewhere in the biosphere. It is extremely risky to have the sole surviving population of an endangered species in only one area. A single catastrophic event could lead to its extinction. Therefore, the concept of biodiversity conservation should be in totality, involving plants, animals, man and also the micro-organisms on which they live and on which they depend for their very survival.

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