1. Details of Module and its structure

Module Detail	
Subject Name	Geography
Course Name	Geography 01 (Class XI, Semester - 1)
Module Name/Title	Biodiversity and Conservation – Part 1
Module Id	kegy_11601
Pre-requisites	Basic knowledge about the Atmospher
Objectives	After reading this lesson, learners will be able to know about : • Define and explain biodiversity, • Define hotspot and their need to protect it, • Differentiate genetic diversity, species diversity and ecosystem diversity, • Discuss the importance and ecological role of biodiversity, • Enlist and clarify the causes of biodiversity loss, • Describe the need to conserve biodiversity and • Explain the steps taken up in India to conserve the biodiversity.
Keywords	Biodiversity, Conservation of biotic life, Hotspots, Diversity, Biodiversity loss, Endangered species

2. Development Team

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INTRODUCTION:

Before the origin of life on the earth, it was a big desert. The lifeless earth was called the geosphere. There were only three spheres on the earth – lithosphere (ground), hydrosphere (water) and atmosphere (air).

Later life originated and evolved and a thin layer of life appeared. The first life appeared in the water body and it was single cellular. Later on multi-cellular life grew and in this way complex life system evolved. Respiration and photosynthesis of these life brought spectacular changes on the earth. This was how the biotic life was progressed on the earth. It created a new sphere termed as biosphere. Biosphere is that part of lithosphere, hydrosphere and atmosphere where all forms of life including tiny organisms, animals, plants and human beings live.

Weathering is the basis for the growth of nutrients in the soil. The richness of soil is the cause of diverse floral life. The main cause of the greater soil fertility is vegetation and climate of the area. Great floral life gives rise to great biodiversity. Diverse varieties of floral and faunal life including humans and microorganisms in any particular region/ habitat is known as biodiversity.

Whatever the biodiversity we find today is the result of 2.5 to 3.5 billion years of evolution. Before the advent of modern technology of humans, our earth supported more biodiversity than in any other period. Since, the emergence of technologically advance humans, biodiversity is on decline. Many of the species one after another is on the brink of extinction due to overuse of the land. The number of species globally vary from 2 million to 100 million. About 10 million is a conservative best estimate. New species are regularly discovered most of which are yet to be classified. For example, an estimate states that about 40 per cent of fresh water fishes from South America are not classified yet. Tropical forests are very rich in biodiversity.

Biodiversity is a system in constant evolution, from a view point of species, as well as from view point of an individual organism. The average half-life of a species is estimated at between one and four million years, and 99 per cent of the species that have ever lived on the earth are today extinct. Biodiversity is not found evenly on the earth. It is consistently richer in the tropics. As one approaches the Polar Regions, one finds larger and larger populations of fewer and fewer species.

Figure 1: Biodiversity, every type of living organisms of an area

Source: http://cdn.yourarticlelibrary.com/wp-content/uploads/2013/12/b697.jpg

Biodiversity itself is a combination of two words, Bio (life) and diversity (variety). In simple terms, biodiversity is the number and variety of organisms found within a specified geographic region. It refers to the varieties of plants, animals and micro-organisms, the genes they contain and the ecosystems they form. It relates to the variability among living organisms on the earth, including the variability within and between the species and that within and between the ecosystems. Biodiversity is our living wealth. It is a result of hundreds of millions of years of evolutionary history.

Biodiversity can be discussed at three levels:

1. Genetic diversity,
2. Species diversity and
3. Ecosystem diversity

1. Genetic Diversity

Genes are the basic building blocks of various life forms. Genetic biodiversity refers to the variation of genes within species. Groups of individual organisms having certain similarities in their physical characteristics are called species. Human beings genetically belong to the Homo sapiens group and also differ in their characteristics such as height, colour, physical appearance, etc. considerably. This is due to genetic diversity. This genetic diversity is essential for a healthy breeding of population of species.

2. Species Diversity

This refers to the variety of species. It relates to the number of species in a defined area. The diversity of species can be measured through its richness, abundance and types. Some areas are richer in species than others. Areas rich in species diversity are called hotspots of diversity (Figure 2).

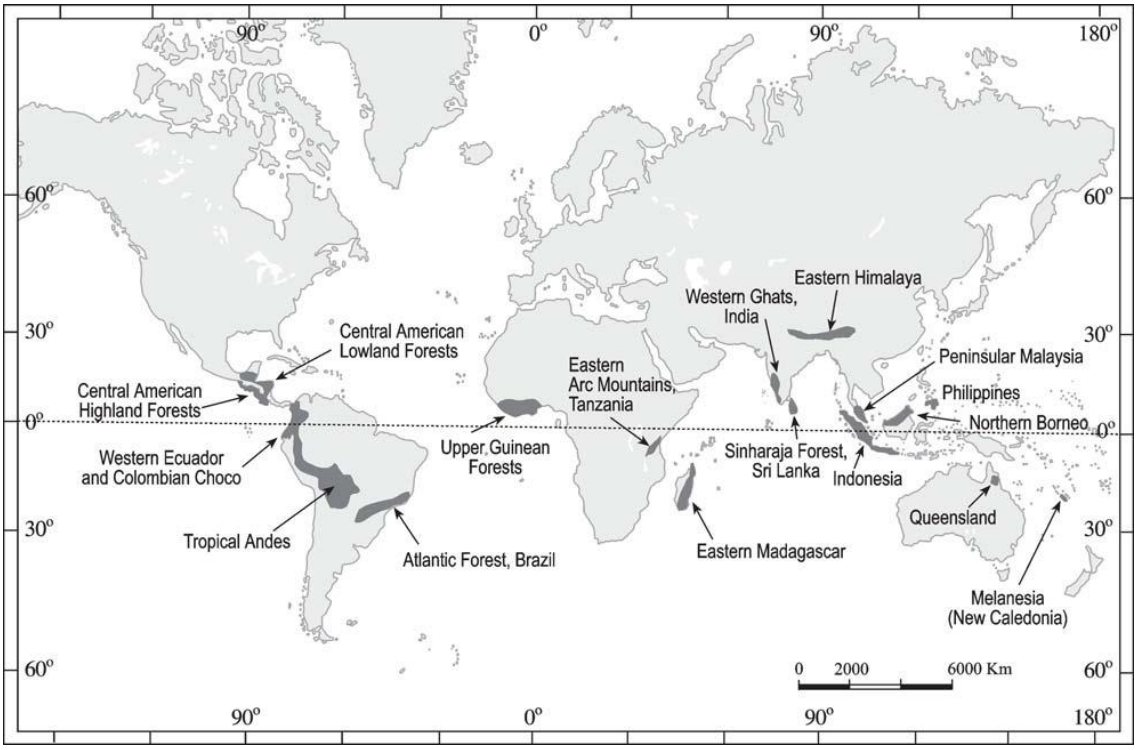


Figure 2: Ecological hotspots in the world

Source: NCERT textbook

3. Ecosystem Diversity

A system consisting of biotic and abiotic components is known as ecosystem. All these components in ecosystem are interrelated and interact with each other. Different types of ecosystems exist with varying ranges of environmental conditions where various plants and animal species have adapted through evolution. The broad differences between ecosystem types and the diversity of habitats and ecological processes occurring within each ecosystem type constitute the ecosystem diversity. The ‘boundaries ‘of communities (associations of species) and ecosystems are not very rigidly defined. Thus, the demarcation of ecosystem boundaries is difficult and complex.

Importance of Biodiversity

Biodiversity has contributed in many ways to the development of human culture and, in turn,

human communities have played a major role in shaping the diversity of nature at the genetic, species and ecological levels. Biodiversity plays the following roles: ecological, economic and scientific.

1. Ecological Role of Biodiversity

Species of many kinds perform some function or the other in an ecosystem. Nothing happens in an ecosystem without any reason. That means, every organism, besides extracting its needs, also contributes something of useful to other organisms. Can you think of the way we, humans contribute to the sustenance of ecosystems? Species capture and store energy, produce and decompose organic materials, help to cycle water and nutrients throughout the ecosystem, fix atmospheric gases and help regulate the climate. These functions are important for ecosystem function and human survival. The more diverse an ecosystem, better are the chances for the species to survive through adversities and attacks, and consequently, is more productive. Hence, the loss of species would decrease the ability of the system to maintain itself. Just like a species with a high genetic diversity, an ecosystem with high biodiversity may have a greater chance of adapting to environmental change. In other words, the more the variety of species in an ecosystem, the more stable the ecosystem is likely to be.

2. Economic Role of Biodiversity

For all humans, biodiversity is an important resource in their day-to-day life. One important part of biodiversity is ‘crop diversity’, which is also called agro-biodiversity. Biodiversity is seen as a reservoir of resources to be drawn upon for the manufacture of food, pharmaceutical, and cosmetic products. This concept of biological resources is responsible for the deterioration of biodiversity. At the same time, it is also the origin of new conflicts dealing with rules of division and appropriation of natural resources. Some of the important economic commodities that biodiversity supply to humankind are food crops, livestock, forests, fish, medicinal resources, etc.

3. Scientific Role of Biodiversity

Biodiversity is important because each species can give us some clue as to how life evolved and will continue to evolve. Biodiversity also helps in understanding how life functions and the role of each species in sustaining ecosystems of which we are also a species. This fact

must be drawn upon every one of us so that we live and let other species also live their lives.

It is our ethical responsibility to consider that each and every species along with us have an intrinsic right to exist. Hence, it is morally wrong to voluntarily cause the extinction of any species. The level of biodiversity is a good indicator of the state of our relationships with other living species. In fact, the concept of biodiversity is an integral part of many human cultures.

Loss Of Biodiversity

There are many causes responsible for the loss of biodiversity but the main ones are as follows:

The Rise in Human Population: From 1950 to 2011, world population has increased from 2.5 billion to 7 billion. This growth in human population has increased the rate of consumption of natural resources. To meet the needs of food, clothes, housing and many other things, humans resort to deforestation and destruction of forests and grasslands. The natural landscape has been cleared for agriculture, townships, and many other things of their use. It has accelerated the loss of species and habitation in different parts of the world. Tropical regions which occupy only about one-fourth of the total area of the world, contain about three fourth of the world human population. Over exploitation of resources and deforestation has become rampant to fulfil the needs of large population. As these tropical rain forests contain 50 per cent of the species on the earth, destruction of natural habitats have proved disastrous for the entire biosphere.

Natural Calamities: Natural calamities such as earthquakes, floods, volcanic eruptions, forest fires, droughts, etc. cause damage to the flora and fauna of the earth, bringing change in the biodiversity of respective affected regions.

Pollution: Urbanization and industrialization has been accelerated to accommodate the ever increasing population and to cater to their needs and requirements. This has resulted in water, soil and air pollution. Pollution, especially, of water pollution is extremely injurious to wildlife. Tons of smoke and effluents from industries is being added to the environment making it harmful for all forms of life on the earth. Pesticides used in agriculture are also harmful. These pesticides and other pollutants such as hydrocarbons and toxic heavy metals destroy the weak and sensitive species.

Climate change: Global warming is also considered to be a major potential threat to global biodiversity in the future. For example, coral reefs - which are biodiversity hotspots - will be lost within the century if global warming continues at the current trend. In 2004, an international collaborative study was carried out on four continents which estimated that 10 percent of species would become extinct by 2050 because of global warming. It is estimated that up to 35% of the world terrestrial carnivores would be at higher risk of extinction by 2050 due to the climate change and the changes in land-use pattern. Climate change has already started affecting bear populations on the sea ice of the Arctic, near the North Pole.

Introduction of Exotic Species: Species which are not the natural inhabitants of the local habitat but are introduced into the system are called exotic species. There are many examples when a natural biotic community of the ecosystem suffered extensive damage because of the introduction of exotic species. For example, the water hyacinth has created problem for many nations. Similarly many plants and animals brought from islands or other nations have threatened the endemic plants and animals growing locally. For example, Kudzu also called Japanese arrow root is a group of plants in the pea family. It is an edible plant, introduced from Southeast Asia to Canada and USA has threatened biodiversity there in certain areas. It is so because this plant climbs over trees or shrubs and grows so rapidly that it kills them by heavy shading.

Hunting and Poaching: In a country like India, hunting and poaching has been one of the main means of entertainment for centuries for people of princely states and during the colonial period. Even hunting tigers and other wild animals was a leisure activity for the British in India where large number of animals were killed just for fun and pleasure. During the last few decades, some animals like tigers, elephants, rhinoceros, crocodiles, minks and birds were hunted mercilessly by poachers for their horns, tusks, hides, etc. It has resulted in the rendering of certain types of organisms as endangered category. The International Union of Conservation of Nature and Natural Resources (IUCN) have classified the threatened species of plants and animals into three categories for the purpose of their conservation. These are as follows:

1. Endangered Species

It includes those species which are in danger of extinction in near future. The IUCN publishes information about endangered species world-wide as the Red List of threatened species. For

example, in 2012, the Red List published by IUCN included 3079 animals and 655 plant species as endangered (EN) worldwide. African penguin, Asian elephant, Asiatic lion, blue whale, common chimpanzee, giant panda, Japanese crane, Goliath frog, green sea turtle and hyacinth macaw etc. are the examples of endangered species (Figure 3, 4 and 5).

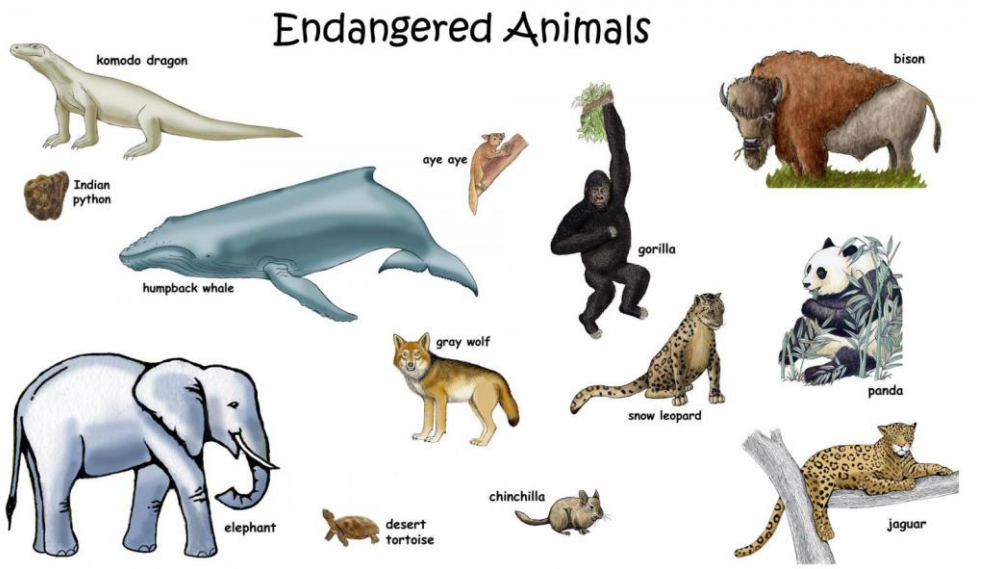


Figure 3: Some endangered animals

Source:http://allpicts.in/download/13952/2017/01/Picture_of_Endangered_Animals_with_Names_for_Wallpaper_1-1600x900.jpg/

Figure 4: Some more endangered animals

Source:http://1.bp.blogspot.com/-G8ADmyk6cFI/T5JfHoqNUcI/AAAAAAAAABg/pewRhCQYYkE/s1600/class7.gif

2. Vulnerable Species

This includes the species which are likely to be in danger of extinction in near future if the factors threatening to their extinction continue. Survival of these species is not assured as their population has reduced greatly. Vulnerability is caused by the destruction or loss of habitat. Currently, there are 4728 animals and 4914 plants grouped as vulnerable. Red panda, King Fisher in India, the European bison are the examples of some vulnerable species of animals while Silver Tree (grows in Newlands Forest) and Ailanthus latissimus or tree of heaven found in Central China and Taiwan are the examples of vulnerable plant species.

Figure 5: Some endangered plant species

Source:http://images.mapsofindia.com/my-india/2016/06/endangered-plant-species-in-india.jpg

3. Rare Species

Population of these species is very small in the world. They are confined to limited areas or thinly scattered over a wider area. Primula Denticulate found in Swat Valley in Pakistan, Fossa in England, Gouldian Finch in Australia and Maltese Tiger are the examples of some rare species (Figure 6).



Primula Denticulata (Pakistan) Fossa (England) Gouldian Finch (Australia)

Figure 6: Some rare species

CONSERVATION OF BIODIVERSITY:

Biodiversity is important for human existence. All forms of life are so closely interlinked that disturbance in one gives rise to imbalance in the others. If species of plants and animals become endangered, they cause degradation in the environment, which may threaten the existence of human beings itself.

There is an urgent need to educate people to adopt environment friendly practices and reorient their activities in such a way so that our development is harmonious with other life forms and is sustainable. There is an increasing consciousness for conservation with sustainable use is possible only with the involvement and cooperation of local communities and individuals. For this, the development of institutional structures at local levels is necessary. The critical problem is not merely the conservation of species nor the habitat but the continuation of process of conservation.

A. **Conservation Efforts at International level:**

1. **Convention of Biodiversity:** The Government of India along with 155 other nations has signed the Convention of Biodiversity at the Earth Summit held at Rio de Janeiro, Brazil in June 1992. The world conservation strategy has suggested the following steps for biodiversity conservation:

- Efforts should be made to preserve the species that are endangered.
- Prevention of extinction requires proper planning and management.
- Varieties of food crops, forage plants, timber trees, livestock, animals and their wild relatives should be preserved;
- Each country should identify habitats of wild relatives and ensure their protection.

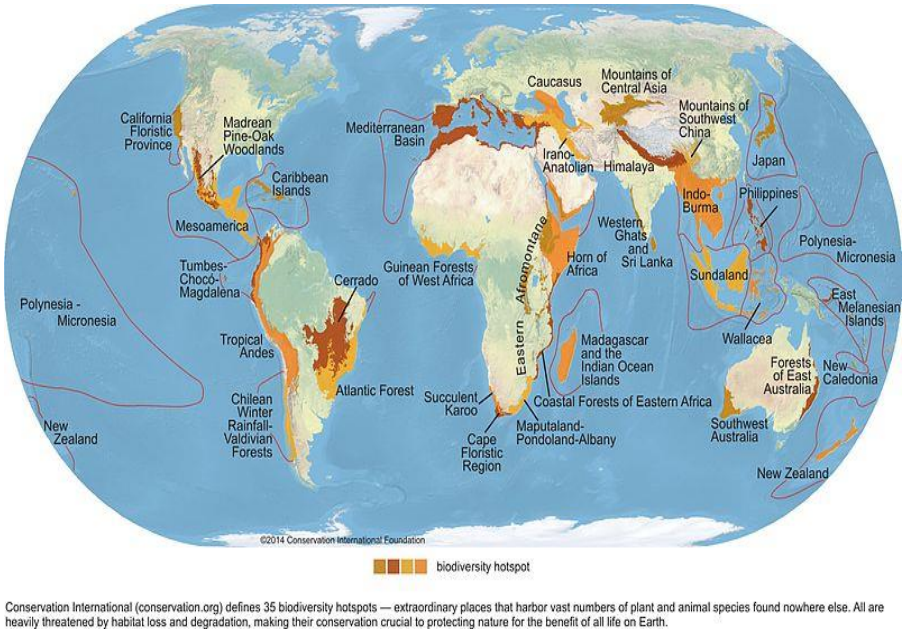
- Habitats where species feed breed, rest and nurse their young ones should be safeguarded and protected.
- International trade in wild plants and animals should be regulated.

2. Convention on Trade in Endangered Species: In 1970, an agreement was signed between 118 countries in which restrictions were imposed on international trade in items obtained from endangered species. For example, teeth of elephant are the source of ivory, for which elephants are hunted illegally throughout the world. Therefore, this convention also put many restrictions on illegal hunting of elephants in many countries of Africa.

3. UN Global Biodiversity Assessment: It suggested following four proposals to protect biodiversity:

- The policies encouraging biodiversity and preventing its loss should be given proper encouragement.
- People who live near areas of high biodiversity or depend on hunting of wildlife for their food needs alternative sources of food should be arranged and their needs should not be ignored.
- Keeping in view the needs of wildlife, steps should be taken accordingly for their conservation. The migratory birds cannot just remain secure in any national park; their migration routes should also be protected.
- Emphasis should be laid on biodiversity in its proper form.

4. Critical Ecosystem Partnership Fund (CEPF): It is a global program that provides funding and technical assistance to non-governmental organizations and other private sector partners to protect critical ecosystems. It has also identified 34 hotspots of biodiversity; the Earth's biologically richest but most endangered areas and focuses on them for their conservation**.** It gives 15 crore US dollar to developing countries to protect the Earth's richest regions of plant and animal diversity including: biodiversity hotspots, high-biodiversity wilderness areas and important marine regions. For example, India has received the assistance of Rs 6.5 crores for starting Himalayan National Park in Himachal Pradesh to conserve biodiversity. Not only this, as of March 2013, it has provided support to more 1800 civil society groups working locally to conserve hotspots in Africa, Asia, and Latin America (Figure 7)



Conservation International (conservation.org) defines 35 biodiversity hotspots — extraordinary places that harbor vast numbers of plant and animal species found nowhere else. All are heavily threatened by habitat loss and degradation, making their conservation crucial to protecting nature for the benefit of all life on Earth.

Figure 7: Global Biodiversity Hot Spots

Source: https://commons.wikimedia.org/wiki/File:Biodiversity_Hotspots_Map.jpg

B. **Biodiversity Conservation Efforts in India:**

1. **Customs in India have been strongly influenced by conservation efforts:** In Hindu religion most of the gods and goddesses have wild animals as their mounts. For example, Nandi-the bull for Lord Shiva, Swan for Saraswati, Lion for Durga, rat for Ganesha etc. They are also associated with many sacred trees. There are many different species of plants which are worshiped, preserved and protected. Tulsi, peepal, and birch are the examples of such species. In addition to this, the Bishnoi of Rajasthan also worships the Khejri tree and wild animals such as neelgai, chinkara, and peacock and even ready to sacrifice their lives to protect these animals. In Mizoram, tribals have also protected holy grooves.

2. **Wildlife Protection Act, 1972:** To protect, preserve and propagate the variety of species within natural boundaries, the Government of India passed the Wild Life (Protection) Act, 1972, under which national parks and sanctuaries were established and biosphere reserves declared.

3. **Medicinal Gardens:** Government of India has set up medicinal gardens also. For example, many plants from different parts of the world are preserved in Jamia Hamdard University in Delhi. Though these gardens are set up for research purposes but in these gardens many plant and insects are also preserved.

4. **National Biodiversity Authority** has been set up at Chennai.

5. **National Forest Commission:** It was set up in 2002 to review and assess India's policy and law, its effect on India's forests and to make recommendations to achieve sustainable forest and ecological security in India. This commission gave many recommendations such as

    a. The Forest Rights Bill is likely to be harmful to forest conservation and ecological security. Now this bill is a law since 2007.
    b. Power to declare ecologically sensitive areas must be with each Indian state.
    c. Government should reform regulations and laws that ban felling of trees and transit of wood within India. Sustainable agro-forestry and farm forestry must be encouraged through financial and regulatory reforms, particularly on privately owned lands.

6. India's national forest policy expects to invest US$26.7 billion by 2020, to pursue nationwide afforestation coupled with forest conservation, with the goal of increasing India's forest cover from 20% to 33%.

HOT SPOTS AND THEIR CONSERVATION

There are some countries which are situated in the tropical region. They possess a large number of the world’s species diversity. They are called mega diversity centres. There are 12 such countries namely Mexico, Columbia, Ecuador, Peru, Brazil, Democratic Republic of Congo, Madagascar, China, India, Malaysia, Indonesia and Australia in which these centers are located (Figure 7). Others countries were also included and the number has gone to 17. The newly added are Papua New Guinea, South Africa, USA, Congo, Philippines and Venezuela. In order to concentrate resources on those areas that are most vulnerable. The International Union for the Conservation of Nature and Natural Resources (IUCN) has identified certain areas as biodiversity hotspots. A biodiversity hotspot is a biogeographic region with significant levels of biodiversity that is under threat

from humans. These hotspots are defined according to their vegetation. Plants are important because these determine the primary productivity of an ecosystem. Most of the hotspots rely on species-rich ecosystems for food, firewood, cropland, and income from timber. For example, in Madagascar about 85 percent of the plants and animals are found nowhere else in the world. Other hotspots in wealthy countries are facing different types of pressures. The islands of Hawaii have many unique plants and animals that are threatened by introduced species and land development.

Conservation initiatives

Many organisations at international level are working to conserve biodiversity hotspots.

- Critical Ecosystem Partnership Fund is one of them which provide funds and technical help to protect the Earth's richest regions of plants and animal diversity.
- Other than this, the World Wide Fund for Nature has initiated a system known as the Global 200 Ecoregions aiming to select priority Ecoregions for conservation.
- Bird life International is working towards "Endemic Bird Areas" and has identified more than 11000 important bird areas all over the world while Plant life International is aiming to identify important plant areas and is coordinating with several organisations around the world.
- National Geographic Society has prepared a world map of the hotspots and metadata for the biodiversity hotspots including the endangered fauna in each hotspot.
- Alliance for Zero Extinction is another organisation working on the most threatened endemic species of the world.

Summary

Biodiversity adds colours to human life. The life would be boring and meaningless without it. It is just like a bank which benefits us in many ways. Therefore, just like we save money in order to secure our future needs, biodiversity must be preserved properly to get our needs and requirements fulfilled.