

Biodiversity and Conservation

Abstract

There is a great furry all over the word about the existence of life on Earth due to biodiversity deterioration .This paper provide the insight view about biodiversity and its conservation via National parks, Sanctuaries, Botanical Gardens, Biosphere reserves, seed banks, Pollen banks.

Keywords: Biodiversity, Conservation, In Situ, Ex Situ, Cryopreservation, National Parks, Sanctuaries.

Introduction

We know that Earth formed 4.5 billion years ago and life begins 3.5 billion years ago. Thus from simple to complex organisms are formed and resulted in a great variety of microorganisms, algae ,fungi ,plants and animals in the biosphere. Till today 1.7 million species were estimated and identified on Earth. Diversity is present at each level i.e. at molecular, species and ecosystem level. In this paper I have discussed about biodiversity and various methods of its conservation especially in India. Biodiversity is essential for the survival of every living being. It fulfil the need of food, feed, shelter, medicines, fibers and also have ethical, cultural and recreation value for human beings. Methods of In situ and Ex situ conservation has been adopted for Biodiversity conservation. In India there is tradition of saving life from the beginning

Aim of the Study

The main aim of this article is about the types, kinds of biodiversity and various methods and techniques of its conservation.

Review of Literature

Alok Kumar Chandrakar, discuss on biodiversity and conservation and its various methods in 2015 but I have studied current techniques and methods. I have discussed on biosphere reserves, national parks,wildlife sanctuaries. 1 Rames, B.R explains biodiversity and its diversification along with evolution.As evolution takes place, various types of organisms were formed and thus variety and kind of organism increases. DR. Prashant, M.S., Hoselti B.B explain that biodiversity is also due to domesticated plants and animals. Due scientific techniques various breeds of animals are produced.Biological diversity is types of animals in various biogeographical regions. Dhama P.S., Dr. Chopra G., DR. Shrivastva.H.N says that In situ conservation also include domesticated animals in animal husbandry and plants which are grown in agricultural and horticulture. By crossing wild animals and plants new types can be produced. National Parks are safe sites for animal protection in which no activities are allowed except some with permission but not at the cost of life of animals .Conservation Reserves are larger areas in which in which animals are safe. Ramsar sites include the wet areas which are also source of diversity. Hot spots are areas of endemism and high diversity in a particular area and also the rate of extinction is also high. So if this area is protected than a larger amount of biodiversity is conserved. Ex situ conservation include Zoological parks, Botanical gardens, seed banks and many modern techniques like tissue culture, cryopreservation, in vitro fertilization, pollen banks etc. which are very efficient.

Discussion on Biodiversity and Conservation-

What is Biodiversity

Biodiversity is a shortened form of words 'Biological' and 'diversity' and given by W.G. Rosen in 1985. The UN Convention on Biological Diversity(CBD) for the first time in Earth Summit at RIO De Janerio (Brazil) in 1992 draw attention towards biodiversity and define it as :-

Biological diversity means the variability among living organisms from all sources including interalia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part; this includes diversity with species, between species and ecosystem. Biodiversity refers to the variability among living organisms, the ecological complexes in which they occur and the way in which they interact with each



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other and their environment. At present, biodiversity is the result of series of turnovers in the ratio of evolution and extinction since the geological past⁽¹⁾

Levels of Biodiversity

Vast diversity exists from macromolecules in cells to biome. But three levels of biodiversity are important:

Genetic Diversity

It is the diversity at gene level within a species or total number of genetic characteristics in the genetic makeup of a species. It is the variations of genes within species. There are various varieties of mangoes (1,000), rice (950,000), wheat etc. Similarly human beings named biologically *Homo sapien sapiens* has 30,000-35,000 genes and have various races like Mongloid, Nagrito, Protoaustraloid etc. If an organism has greater genetic diversity, then more it can tolerate environmental disturbances. If no genetic diversity within a species, then if an epidemic occur, then all individuals of the species will die up.

Species Diversity

The total number of species within a particular area is referred to as species diversity. It is the most commonly used level for describing the biodiversity of countries. It is also expressed as species richness and species evenness.

Species Richness

It is the number of species found in a community per unit area.

Species Evenness

It is ratio of one species population over total number of organisms across all species in he given genome. If species evenness less, then their one species show dominance to other. For example 40 fox and 400 dogs and here dogs are dominant. But if 40 fox and 45 dogs, then it show more evenness If more number of species ,kinds of species and number of individuals per species lead to greater diversity.

Ecosystem Diversity

It refers to the difference among groups of organisms in different physical settings. It is the place where an organism or a population naturally occur. The ecosystem diversity the variety of species within different ecosystems and variety of ecosystem found within a biogeographical or political boundary. Biodiversity include not only wild animals and plants but also domesticated plants and animals and microbial biodiversity⁽²⁾ It is related to the different types of ecosystem/habitats ,terrestrial (forest, grassland, desert etc.), aquatic-Fresh water (lotic, lentic, wetlands marine, swamps) and marine .It has three types as follows:-

Alpha Diversity (Within Community Diversity)

It is the diversity within a particular ecosystem and expressed by species richness.

Beta Diversity (Between Community)

It is the comparison of diversity between ecosystems.

Gamma Diversity

It is a measure of overall diversity for the different ecosystems within a region.

Patterns of Diversity

Tropical forests are regarded as the richest in biodiversity. More than half of the species on the

Earth live in tropical forests which is only 7% of the total land surface. In tropics conditions were optimum and perturbations are less .Also productivity in tropics is highest .As we move from equator to poles biodiversity declines .India is one of the 17 megadiversity centers.

Biodiversity of the World and India

IUCN-International Union for Conservation of Natural resources report says that 1.75 million species are present on the Earth which were identifies and classified .Actual number of species may be 7 million according to Roberts May. Some estimates 20-30 million species. Of all known species 70% are animals and 22% are plants. In animals, insects are 70% of all animals. India has 2.4% of land area of total world geographical area but accounts for 8.1% biodiversity of the world and 18% human population dwell in India .India represents—

1. Two realms- (a) Himalayan region represented by Palearctic realm (b)Malayan realm
2. Five biomes
3. Ten biogeographical zones
4. 25biogeographical provinces⁽³⁾

Approximate Number of Plant Species Identified and Described in India and World

Group Name	Number of species		% of India to World
	In India	In world	
Bacteria	850	8050	10.56
Virus	-	15504	-
Algae	6500	40,000	16.25
Fungi	14500	72,000	20.14
Lichen	2000	35,000	
Bryophyte	2850	17,000	16.76
Pteridophyta	1100	13025	8.4
Gymnosperms	64	980	6.53
Angiosperm	17500	2,70,000	6.48

(P.S.Dhami, Dr.G. Chopra, DR.H.N. Shrivastva - 'A Text book of Biology')

Number of Fungi species in the world are more than the combined total of species of fishes, Amphibia, Reptiles and Mammals.

Approximate Number of Animal Species Identified and Described in India and World

Name of group	Number of species	
	In India	In World
Protista	2577	31,290
Mollusca	5070	81,000
Arthropods	68,389	9,90,000
Other Invertebrates	8,329	1,30,200
Protochordata	119	2,106
Pisces	2,546	30,000
Amphibian	209	6,199
Reptilian	456	8,240
Aves	1,232	9,956
Mammals	390	5,416
Total	89,317	12,94,407

(Source: MoEF1999; IUCN Red List 2007)

Biodiversity Conservation

Biodiversity is the result of organic evolution through 3.5 million years. A species once lost is lost for over some. Experts estimate that 30% of all

species on the earth will be extinct by 2050. within 20 years 25% of all mammals will extinct. One species will extinct in 20 minutes. So this biodiversity should be conserved for the survival of living beings .UN designated 2011-2020 as the United Nations Decade on Biodiversity.⁴

The management of man's use of the biosphere is such a way that maximum benefit accrues from it to present generation while maintaining its potential to meet the requirement of the future generations i.e. the technique of deriving maximum advantage from the biosphere without in any way degrading it.

Conservation Strategies

A world Conservation strategy for judicious use of living resources are as:-

1. The wild life should be protected in natural habitats as well as in artificial habitats under human control such as Zoological Parks and botanical gardens.
2. The threatened species should be given preference over the others in the conservation programme .Among these, the endangered species should get priority over the vulnerable and the later over the rare species.
3. The life supporting system (air, water, land) should be properly managed and conserved.
4. The habitats of wild relatives of useful plants and animals should be preserved in protected areas.
5. The critical habitats (feeding areas, breeding grounds, resting sites) of wild animals should be kept intact to ensure their safe growth and multiplication.
6. The ecosystem rather than a single species should be preserved.
7. The ecosystem and the species should not be exploited beyond their productive capacities
8. International trade in wild plants and animals and their products should be regulated by stringent law.
9. Hunting should be regulated.
10. National Parks and sanctuaries should be setup to protect wild life and to ensure its multiplication.
11. Children should be inspired to love animals. They should be taken to Zoos, shown movies of wild life particularly of baby animals and encouraged to look after pets.

Methods of Conservation of Biodiversity

Plans of biodiversity conservation has been started by IUCN, UNESCO, world bank and national agencies. There are two approaches of biodiversity conservation i.e. In situ (on site) and ex situ (off site)

In Situ Conservation

It is the most appropriate method to maintain species of wild animals and plants in their natural habitats. This approach includes protection of total ecosystem through a network of protected areas. In situ conservation also include the introduction of plants and animals species back into agricultural, horticultural and animal husbandry practices so that they are cultivated and reproduced for their reuse by the farmers.⁽⁵⁾ In situ conservation of biodiversity is beneficial for that it is cheaper and convenient. As plants and animals live in their natural habitat, so that

they could face natural adverse conditions and become resistance to that one and survive well. It helps in maintaining populations of endemic species; sub species and varieties and prevent introduction of exotic species. The natural habitats for conservation of wild plants and animals include-

Protected Areas of India

Protected areas are those in which human occupation or at least the exploitation of resources is limited .Different protected areas are as:-National Parks, Wildlife Sanctuary conservation Reserves, Community Reserves and Marine Protected areas.

National Parks

National parks in India are IUCN category II protected areas. India's first National park was established in 1936 as Halley National Park, now known as Jim Corbet National Park, Uttarakhand. As of July 2017, there are 103 national parks in India covering an area of 40,500Km comprising 1.23% of India's total surface area. An area whether within a sanctuary or not, can be notified by state Govt. to be constituted as a National park, by reason of its ecological, faunal, floral, geomorphological or Zoological association or importance needed to for the purpose of protecting or propagating or developing wildlife there in or its environment. No human activities permitted inside the national park except for the ones permitted by the chief wildlife Warden of the state under the conditions given in CHAPTER IV, WPA 1972.⁽⁶⁾

Wild Life Sanctuary

Sanctuary means an area declared whether under section 26(A)⁵ or sect 38, or deemed ,under sub section (3) of section 66 to be declared as Wildlife Sanctuary. A sanctuary is a protected area for the conservation of only animals and human activities like harvesting of timber, collecting minor forest products and private ownership rights are allowed as long as they do not interfere with well-being of animals. Boundaries of sanctuaries are not well defined and controlled biotic interference is permitted.

There are in total 544 wild life sanctuaries in India as on January,2018 covering an area of 118931.80km² which is 3.62% of total Geographical area of India⁽⁷⁾

Conservation Reserves and Community Reserve of India

Conservation reserves and community reserves in India are terms denoting protected areas of India which typically act as buffer zones to or connectors and migration corridors between established national parks, wildlife sanctuaries and reserved and protected forests of India. Such areas are designated as conservation areas if they are uninhabited and completely owned by the Government of India but used for subsistence by communities and community areas if part of the land are privately owned.

These protected area categories were first introduced in the Wildlife (Protection) Amendment Act of 2002 – the amendment to the Wildlife Protection Act of 1972. These categories were added because of reduced protection in and around existing or proposed

protected areas due to private ownership of land, and land use⁽⁸⁾

Community reserves of India are 46 in numbers. Conservation reserves of India are 76 in number

Protected areas OF India as from 2000-2018

year	No. of National parks	Area of National Park in km ²	No. of National parks	Area of National Park in km ²	No. of National parks	Area of National Park in km ²	No. of National parks	Area of National Park in km ²	No. of National parks	Total Area Under Protected areas in km ²
2000	89	37593.94	489	117881.68	-	-	-	-	578	155475.63
2006	96	38183.01	506	120244.39	-	-	-4	42.87	606	158470.27
2007	98	38219.72	510	120543.95	4	20.69	7	94.82	619	158879.19
2008	99	39232.58	513	122135.33	4	20.69	45	1259.84	661	162651.45
2009	99	39232.58	513	122135.33	4	20.69	45	1259.84	661	162651.45
2010	102	40074.46	516	122585.56	4	20.69	47	1382.28	669	164062.99
2011	102	40074.46	517	122615.94	4	20.69	52	1801.29	675	164512.37
2012	102	40074.46	524	123548.33	4	20.69	56	1998.15	686	165741.62
2013	102	40074.46	526	124234.52	4	20.69	57	2017.94	689	166347.6
2014	103	40332.89	525	116254.36	4	20.69	60	2037.11	692	158645.05
2015	103	40500.13	531	117607.72	26	46.93	66	2344.53	726	160499.31
2106	103	40500.13	537	118005.30	26	46.93	67	2349.38	733	160901.74
2107	103	40500.13	543	118917.71	45	59.66	73	2547.19	764	162024.69
2018	103	40500.13	544	118931.80	46	72.61	76	2567.95	769	162072.49

Source: National Wildlife Database Cell, Wildlife Institute of India

(ENVIS Center on Wildlife & Protected Areas, MoEF and Climate Change ,Govt of India)

Biosphere Reserves of India

Biosphere reserves are sites established by countries and recognized under UNESCO's Man and the Biosphere Programme to promote development based on local community efforts and sound science.. The purpose of biosphere reserve is to conserve in situ all forms of life , along with its support system, in its totality ,so that it could serve as a referral system for monitoring and evaluating changes in the natural ecosystem. MoEF-Ministry of Environment and forestry provided financial assistance to the respective state Govt. for conservation and management of these Biosphere Reserves. Ten of the eighteen Biosphere Reserves are a part of the World Network of Biosphere Reserves based on UNESCO Man and the Biosphere Programme (MAB) list ⁽⁹⁾. In India Nilgiri biosphere reserve was the first reserve declared on 1.9.1986

Biosphere reserve is divided into three zones:

Core Zone

It is strictly protected ecosystem in which no human activity is allowed.

Buffer Zone

Limited human activities like scientific research, monitoring, training and education are allowed.

Transitional or Manipulation Zone

In it greatest activities are allowed.

Biosphere Reserve has mainly four objective-conservation, research, education and local involvement.

World Heritage Sites

UNESCO's World Heritage sites is a place listed by the United Nations Educational, Scientific Cultural Organization as of special cultural or physical significance. World Heritage is the designation for places on Earth that are of great universal value to humanity and as such, have been listed on the World Heritage List to be protected for future generations appreciation and enjoyment.

Mangrooves and Coral Reefs

The National Environment Policy -2006 recognizes that mangroves and coral reefs are important coastal environmental resources. They provide habitat for marine species, protection from extreme weather events and a resource base sustainable tourism. Mangroves area is 4500km² and coral reef area is 2375 km² in India.

Ramsar Wetland Sites

The convention of Ramsar Sites entered into force in India on 1st February 1982.India has 26 Ramsar sites with a surface area of 6,89,131 hectares. Ramsar names as on Ramsar City in Iran where convention for conservation of wetlands takes place on 02nd february.1971. So 02nd February is celebrated as World Wetland day each year. Wetland includes all lakes & rivers ,underground aquifers, swamps and marshes, wet grassland, peatlands , oases, estuaries, deltas and tidal flats, mangroves and other coastal area ,coral reefs and all human made sites such as fish ponds ,rice paddies and salt pans. ⁽¹⁰⁾ The Ramsar Convention is an international treaty for the conservation and sustainable utilization of wetlands, recognizing the fundamental ecological functions of wetlands and their economic, cultural, scientific, and recreational value.

Ramsar Wetlands Sites of India

S.No.	Name of Site	State Location	Date of Declaration	Area In km ²
1	Asthamudi Wetland	Kerala	19.8.2002	1860
2	Bhitarkanika Mangroves	Orissa	19.8.2002	525
3	Bhoj Wetlands	Madhya Pradesh	19.8.2002	31
4	Chandertal Wetland	Himachal Pradesh	8.11.2005	38.56
5	Chilka Lake	Orissa	01.10.1981	1140
6	Ddepor Beel	Assam	19.08.2002	4.14
7	East Calcutta Wetlands	West Bengal	19.8.2002	378
8	Harike Lake	Punjab	23.03.1990	86
9	Hokera Wetland	Jammu and Kashmir	08.11.2005	13.75
10	Kanlli Lake	Punjab	22.01.2002	14.84
11	Keoladeo Ghana NP	Rajasthan	01.10.1981	28.73
12	Kolleru Lakelotak Lake	Andhra Pradesh	19.08.2002	673
13	Lotak Lake	Manipur	23.03.1990	945
14	Nalsarovar Bird Sanctuary	Gujarat	24.09.2012	120
15	Point Calimere	Tamil Nadu	19.08.2002	17.26
16	Pong Dam Lake	Himachal Pradesh	19.08.2002	307.29
17	Renuka Wetland	Himachal Pradesh	08.11.2005	-
18	Ropar lake	Punjab	22.01.2002	41.36
19	Rudrasagar Lake	Tripura	08.11.2005	2.40
20	Sambhar Lake	Rajasthan	23.03.1990	736
21	Sasthamkotta lake	Kerala	19.08.2002	11.3
22	Surinsar –Mansar lake	Jammu and Kashmir	08.11.2005	3.50
23	Tsomoriri lake	Jammu and Kashmir	19.08.2002	120
24	Vembanad Kol wetland	Kerala	19.08.2002	4583
25	Upper Ganga River (Brijghat to Narora Stretch)	Uttar Pradesh	08.11.2005	265.90
26	Wular Lake	Jammu and Kashmir	23.03.1990	173
Total Area (sq.km.)				12119.03

(Source: Ministry of Environment & Forests, Government of India)

Sacred Forests and Sacred Lakes

India has a great cultural and religious history of protection of Biodiversity. People worship and protect Plants Animals because they considered them sacred. illustrated as- Khasi and Jaintia hills of Meghalaya Sarguja, Chanda and Bustar areas of Madhya Pradesh, Western Ghat region of Maharashtra and Karnataka, Araveli hills of Rajasthan⁽¹¹⁾. Tribals have built temples and do not allow to even cut a single branch of tree in these sacred grooves. Similarly many aquatic lakes are also serving as a protection mechanism for aquatic life. Khecheopalri lake in Sikkim. Their flora and fauna are thus Naturally preserved.

Wild life Projects in India

Various projects have been taken to protect wildlife from extinction and increase their numbers.

Lion Project

In Gir forests of Gujarat in Saurashtra Peninsula, in 1972 Lion project was started for protecting Asiatic lion *Panthera lion persica* found only in India in Asia.

Project Tiger

Project Tiger was launched by Govt. of India in the year 1973 to save the endangered species of Tiger in the country. Starting from a reserve in 1976 but upto 2016 the number is grown up to 50. A total area of 71027.10km² is covering these projects tiger reserves.

Crocodile Breeding Project

It was started on 01.04.1975 on advice of Dr.H.R. Bustard for conservation and breeding of crocodile.

Himalayan Musk Deer Project started at Kedarnath, Uttarakhand.

Project Hangul

Launched at Dachigam sanctuary in Jammu and Kashmir.

Hot Spots

On priority basis attempts have been made to identify tropical areas of the world that have rich biodiversity and high levels of endemism and are under immediate threat of species extinction and habitat destruction. So called Hot Spots for preservation (IUCN/UNEP1986). Mayer identified 12 Hotspots that together include 14% of world plant species in only 0.2% of its total land surface.⁽¹²⁾ There are 35 Hot spots in world out of which four are in India.

Ex Situ Conservation

In situ conservation is not a viable option for many rare species. Ex situ conservation means conservation of biological diversity, components outside their natural habitats. It involves cultivation of rare plants or rearing of threatened animals outside of their natural habitats and also holding of Plants and animals species in botanical gardens, Zoological gardens and arboretums or store them in the form of seeds in seed bank (gene bank) or some other

suitable form by means of tissue culture techniques.¹³ Ex situ conservation is a costly process and these are reared in laboratories and faces less environmental stresses .So these preserved species have less genetic diversity.

Zoological Parks

The central Zoo Authority of India is the governing Authority of all Zoos in India. A Zoological park or Zoo is a facility in which animals are kept within enclosures displayed to people and in which they may also breed .Safari parks allow visitors to drive through them and come in close proximity to animals.¹⁴ The aim of Zoos and safari parks is to have a contact of animals and visitors and create in the mind of people a thinking of care ,love and protection of wild animals. Zoos are also used for breeding purposes of endangered species and then reintroducing them into the wild. First Zoo in India was established in Madras in the year 1855.

Botanical Gardens

It is the place where plants especially ferns, conifers and flowering plants are grown and displayed for the purpose of research and education. Botanical gardens that are specialize in trees are called arboreta.

Seed Banks

The Un's Food and Agriculture Organization estimated that 75% of crop biodiversity has been lost from the world's fields .India is reckoned to have had over 100,000 varieties of rice a century ago, it now has only few thousands. Seed bank is type of gene bank where seeds of different crops and rare plants species are stored for future use. Seed banks are created to maintain and protect biodiversity, where samples of all species are collected and stored. In case seed reserves elsewhere are destroyed, the seed bank is opened to provide seeds to farmers at defined quantities for growing plants.⁽¹⁵⁾ Indian Govt. established the National Seeds Corporation in 1963 both at the national level and in every state working under the Ministry of Agricultural. National Seeds Corporation undertakes production, processing and marketing of agriculture seeds .ICAR- Indian Council for Agriculture Research also involved in seeds production and distribution .Several private and voluntary organizations have also setup seed banks across the country like Navdanya, Annadana Seed and Soil Savers, Green Foundation, Sahaja Samrudha and Deccan Development Society.¹⁶

Tissue Culture Technique

A technique of growing cells/tissues/organs in sterilized nutrient media under a septic conditions Explant is the part of plant used for culture which may be root tip, shoot bud, Anther Embryo, Ovule, Ovary etc. Under tissue culture micropropagation is a technique in which Virus free plants are obtained. This technique is of very fruitful for plants having:-

1. Recalcitrant seeds
2. No seeds formed like banana, sugarcane.
3. Good characteristics genotype is to be preserved.
4. Large genotype can be preserved in a small area of culture vessels.

Cryopreservation

In animals, parts like sperms, ova, embryonic tissues or whole embryo can be preserved in liquid nitrogen at -196⁰C called Cryopreservation. These can be used for propagation later when needed. For this special equipments, techniques and trained men power is required. Plants parts can also be preserved by cryopreservation.

Captive breeding, Pollen Banks and In vitro Fertilization are the modern technique of Biodiversity conservation.

Conclusion

Biodiversity is vital for our natural ecosystems. Biodiversity importance can be explained by Rivet Popper Model in which the ecosystem is taken as an aeroplane in which if every passenger took away one part (which is like a species) initially the situation is not serious but which part of plane is lost is of great concern. If wings are stolen then the ecosystem will collapse .These are the 'keystone species' which have a great effect on the ecosystem .Each and every species has a effect in ecosystem and its biodiversity .So we should conserve the biodiversity even at individual level .We should take oath not to purchase poached animals parts and products It is also the need of the hour to educate and create awareness in the society about wild life and its importance. No biodiversity no life on Earth. Live and let live .We have the moral duties not to kill other life forms on Earth. In our society in earlier days, conservation of biodiversity was on peak. King Shiva protect a bird from a predator by giving his own body weight equal to the weight of the bird. Also in our society plants and animals are treated as sacred and linked to God/Goddess. Rat is considered as vehicle of lord Ganesha. Internationally various steps have been taken to conserve biodiversity.

References

- 1 Ramesh, B.R.. *French Institute of Pondicherry,P.B. NO.033,11 saint Louise Street, Pondicherry," Biodiversity conservation and management"-ISSN 0564-3295*
- 2 DR. Prashant ,M.S., Hoselti B.B., *Elements of Environment science , Prateeksha Publication, Jaipur*
- 3 Dhami P.S., Dr . Chopra G., DR. Shrivastva .H.N. - 'A Text book of Biology'
5. <http://en.m.wikipedia.org>
6. Dhami P.S., Dr . Chopra G., DR. Shrivastva .H.N. - 'A Text book of Biology'
- <http://en.m.wikipedia .org/list of national parks in India>
7. *Wildlife sanctuaries in India- http://www.natureconservation.in*
8. *ENVIS Center on Wildlife &Protected Areas, MoEF and Climate Change ,Govt of India*
9. *Biosphere reserves in India- http://natureconservation.in*
10. *wetland sites in India- www.pmfias.com/Ramsar wetland sites in india*
11. Dhami P.S., Dr . Chopra .G, DR. Shrivastva .H.N. - 'A Text book of Biology'

12. Chandrakar, Alok Kumar, M.Phil, Central University of Gujarat, Sect.30,Gandhinagar-Biodiversity Conservation in India
13. Sharma, P.D.(1998) -Ecology and Environment,ISBN-81-7133-380 X
14. Zoological parks in India - <http://en.in.wikipedia.org/zoo>
15. Author-Thirumagal J. on net
16. Seed banks in India - [www.ecodeaz.com/seed banks](http://www.ecodeaz.com/seedbanks)