BIODIVERSITY: CONSERVATION AND FUTURE CHALLENGES

Devender Kumari*

Abstract

The present paper deals with biodiversity, its conservation and future challenges. Great diversity exists in different life forms on earth. We believe that effective conservation of biodiversity and maintenance of ecosystem process is essential for survival of mankind. Even though worldwide conservation efforts are increasing, yet biodiversity continue to decline. Over exploitation of species, invasive alien species, pollution, climate change, degradation, fragmentation, destruction of habitats etc. are key factor driving pressures on biodiversity. Moving beyond 2010, successful conservation approaches need to be reinforced and adequately financed.

Key Words: Biodiversity, conservation area networks, biodiversity threats and future challenges.

* Assistant Professor in Zoology, Pt. N.R.S. Govt. College, Rohtak, Haryana

Introduction

The biodiversity in its current sense began to be used in the early 1980's with interest in concept elevated by publications such as limits to growth, (Meadow DH Meadows DL, Rander J. and Behrens W W 1972), Use of the biodiversity has ranged from a focus on species richness to greater emphasis on ecological and genetic diversity (Norse EO, Mc Manus RE (1980). Origin of the world 'biodiversity' is often attributed to W.G. Rosen in 1985 during planning for the 'National Forum on Biodiversity 'which took place in America later that year (Hawksworth DL 1995). The proceedings of the forum were published by E.O. Wilson in 1988 in a book entitled 'Biodiversity' which is likely to have initiated the widespread use of word (Hamilton A.J. 2005). Initially the term was used more in political forums that scientific ones (Ghilarov A 1996), progressing over time to become a term used to symbolize the concept of the "richness of life on earth" (NOSS RF, 1994).

Edward O. Wilson (1988b) gave no precise scientific definition of "Biodiversity", but simply stated that: "Biological diversity must be treated more seriously as a global resource, to be indexed, used, and above all, preserved." This is symptomatic of a conservationist and taxonomist conception, regarding biodiversity as a global collection of species and genes.

After 1988, efforts are made to elaborate scientific definitions for example, Jeffrey A. McNeely et al. (1990, p.17) made the following proposal: "Biological diversity" encompasses all species of plants, animals and microorganisms and the ecosystem and ecological process of which they are parts. It is an umbrella term for the degree of nature's variety, including both the number and frequency of ecosystem, species or genes in a given assemblage (Anamya 2008).

"Biological diversity" simply stated, is diversity of life. As defined in the proposed US congressional Biodiversity Act, HR 1268 (1990). Biological means the full range of variety and variability within and among living organisms and the ecological complex in which they occur and encompasses ecosystem or community diversity, species and genetic diversity (Jensen D.B., Torn M. and Harte J. 1990).

UN convention on Biological Diversity defines Biodiversity as "the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystem and the ecological complexes of which they are a part; this includes diversity within species, between species, and of ecosystems" (UNEP 1992).

In 1994, the International Union for Biological Sciences (IUBs) organized in Paris an International forum called "Biodiversity, Science and Development". In their introduction, Francesco di Castri and Talal Younes (1996) tried to provide a rigorous definition of Biodiversity. Considering the "three levels approach" they pointed out the fact that previous definitions of biodiversity paid "little attention to the interactions within between and among various levels of Biodiversity." Stressing the fact that "interaction is the main intrinsic mechanism to shape the characteristic and functioning of Biodiversity" and considering that the interactions between the three levels of biodiversity are of hierarchical nature, forming the unique trilogy of biodiversity, they called for a general theory and for the development of transdisciplinary scientific field. Consequently they proposed a hierarchical definition : "A more sophisticated definition of biodiversity could be, therefore, the ensemble and the hierarchical interactions of the genetic, taxonomic and ecological scales of organization, at different levels of interactions. They concluded that "the real challenge lies in the possibility of taking into account the emerging properties that appear by interactions of the three diversities." (Astrid Schwarz, Kurt Jax 2011).

BIO-WEALTH

Biodiversity is not distributed uniformly across the globe. It is substantially greater in some areas than the others. Generally, species diversity increases from the poles towards the tropics. A tropical moist forest covers only 5-7 percent of land but possesses 50% of world species. On the other hand, certain regions though may not have a high diversity, display a high degree of endemism.

Table 1 : Known and Estimated Diversity of Life on Earth

Form of Life	Known species	Estimated Total Species
Insects and other Arthropods	874,161	30 million species, extrapolated from surveys in forest canopy in Panama.
Higher Plants	248,400	Estimated range from 275,000 to

Form of Life	Known species	Estimated Total Species
		400,000 at least 10-15% species believed undiscovered.
Invertebrates (excludes arthropods)	116,873	True invertebrates may number millions of species
Lower Plants (Fungi and Algae)	73,900	Not available
Microorganisms	36,600	Not available
Fish	19,056	21,000 assuming that 10% fish remain undiscovered
Birds	9,040	Known species probably account for 98% of all birds.
Reptiles and Amphibians	8,962	Known species probably account for over 95% of all Reptiles and Amphibians.
Mammals	4,000	Known species account for over 95% of all mammals.
Total	1,390,992	10 million species is considered a conservative estimate if insect estimates are accurate, then total exceeds 30 million

Source: E.C. Wolf (1987), on the brink of extinction: Conserving the diversity of life. World Watch paper 78.

BIO-WEALTH OF INDIA

The India has been assigned the status of mega diversity nation along with 11 other countries, Australia, Brazil, China, Columbia, Equador, Indonesia, Medagascar, Malaysia, Mexico, Peru, and Zaire. India has diversified climatic conditions that vary from humid tropical western ghats and hot deserts of Rajasthan to diversified north east region of country from cold desert of Ladakh and Icy Mountains of Himalayas to warm Deccan Peninsular India, and central fertile plains, providing numerous microhabitats. India represents only 2.4% of total land area of the world. However in terms of biodiversity, its percent contribution is 10.53% of the known global diversity. The ministry of forest and environment reported that India have at present about 45,000 plants and 77,000 of animal species representing about 7% of world flora and 6.5% of world fauna respectively.

The India has over 108,276 species of Bacteria, fungi, plants, and animals already identified and described (See Table 2). Out of these, 21.2% species constitute fungi, flowering plants 13.9% and insecta 49.3%. In terms of the number of species, the insecta alone constitute nearly half of the biodiversity in India.

Table 2 : Number of species of Bacteria, fungi, plants and animals in India

Taxon	Number of Species	Percentage
Bacteria	850	0.8
Fungi	23000	21.2
Algae	2500	2.3
Bryophyta	2564	2.4
Pteridophyta	1022	0.9
Gymnosperm	64	0.1
Angiosperm	15000	13.9
Insecta	53430	49.3
Mollusca	5050	4.7
Pisces	2546	2.4
Amphibia	204	0.2
Reptilia	446	0.4
Aves	1228	1.1
Mammalia	372	0.3
Total	108276	100.00

Source: BSI and ZSI 1994

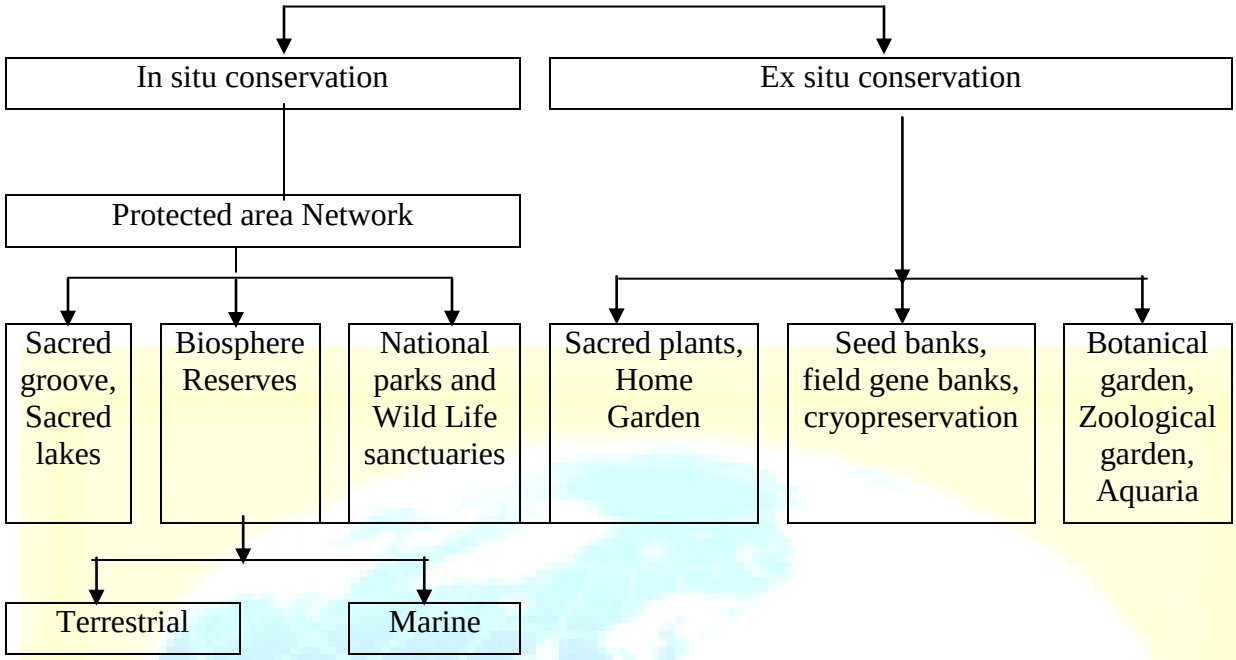
Conservation of Biodiversity

"The management for the benefit of all life of the biosphere so that it may yield sustainable benefit to present generation while maintaining its potential to meet the needs and aspirations of the future generations."

Objectives of Biodiversity Conservation

- To maintain essential ecological processes and life supporting system.
- To preserve biological diversity.
- To ensure that utilization of species and ecosystem is sustainable (Sharma P.D. 2007).

BIODIVERSITY CONSERVATION



Major Strategies of Biodiversity Conservation

Strategies	Work Element
1. In situ	To establish protected area network, with appropriate management practices, corridors to link fragments, restore degraded habitats within and outside protected areas.
2. Ex situ	Establish Botanical and Zoological gardens, conservation stands; banks of germplasm, pollen, seed, seedlings, tissue culture, gone and DNA etc.
3. Reduction of Biotic pressure	Reduce anthropogenic pressure on natural populations by cultivating them elsewhere.
4. Rehabilitation	Identify and rehabilitate threatened species; launch augmentation and reintroduction.

In situ Conservation Strategies

It emphasizes protection of total ecosystems for conservation of overall biodiversity of genes, populations, species communities and the ecological process. It includes protection of a group of typical ecosystems through a network of protected areas as recognized by UNEP and

World Conservation Union (IUCN). UNEP has recognized 6 management categories of protected areas.

Category I(a) : Strict Nature Reserve

The nature reserves represent the protected areas managed mainly for science. Area of land and/or sea processing some outstanding ecosystems, geological or physiological features/species, available primarily for scientific research and environmental monitoring.

Category I(b): Wilderness Area

These are protected areas managed mainly for wilderness protection. Large area of unmodified or slightly modified land/or sea, retaining its natural characters and influence, without permanent or significant habitation, which is protected and managed so as to preserve its natural condition.

Category II: National Park

The protected area managed mainly for ecosystem protected and recreation. Natural area of land and/or sea, designated to (a) protect the ecological integrity of one or more ecosystems for present and future generations, (b) provide a foundation for spiritual, scientific, educational, recreational and visitor opportunities, all of which must be environmentally and culturally compatible.

Category III: Natural Monument

These are protected areas managed mainly for conservation of specific natural features. Area containing one or more specific natural/cultural feature which is of outstanding value because of its inherent rarity, and aesthetic qualities.

Category IV: Habitat Management Area

These are protected areas managed for conservation through management intervention. Area of land/or sea subject to active intervention for management purposes so as to ensure the maintenance of habitats, to meet the requirement of specific species.

Category V: Protected Landscape/Seascape

The protected area managed mainly for landscape/seascape conservation and recreation. Area of land with coast and sea as appropriate, where the interaction of people and nature over time has produced an area of distinct character with significant aesthetic, ecological, cultural value and often with high biological diversity.

Category VI: Managed Resource Protected Area

In this case protected area is managed mainly for sustainable use of natural ecosystem. Area containing unmodified natural system, managed to ensure long term protection and maintenance of biological diversity, while at the same time providing a sustainable flow of products and services to meet community needs.

Terrestrial Protected Areas: Examples of protected areas are National parks and Wildlife Sanctuaries. The UN has recognized 102, 102 protected areas covering more than 18.8 million/cm^2. Number of protected areas has increased substantially from 9214 in 1962 to 102, 102 during 2003.

There are 41997 protected areas around the world which fulfill the norms of IUCN categories (Chape et al 2003). Parts of protected areas which have already been degraded may require rehabilitative actions to restore them to a fully functional state. Fragmentation of natural ecosystem within and outside of protected areas due to agricultural development, Forestry and urbanization has resulted into a matrix of modified ecosystem within which small remnants of natural ecosystem remain. Corridors of natural vegetation linking these small fragments are needed to enhance the probability of movement of native species around the landscape to fulfill their resource and habitat development.

Marine Protected Areas: Since 1986, IUCN has been promoting establishment of global system of marine protected areas (MPAs). These are areas of intertidal and subtidal region taken together with their overlying water and associated flora and fauna, which have reserved by law or other effective means to protect it (IUCN 1992). According to world database on protected areas, 4116 protected areas in the UN list contain marine and coastal elements, covering 4.3 million km^2. Largest marine protected area is the Great Barrier Reef Marine Park (345, 400 km^2) in Australia.

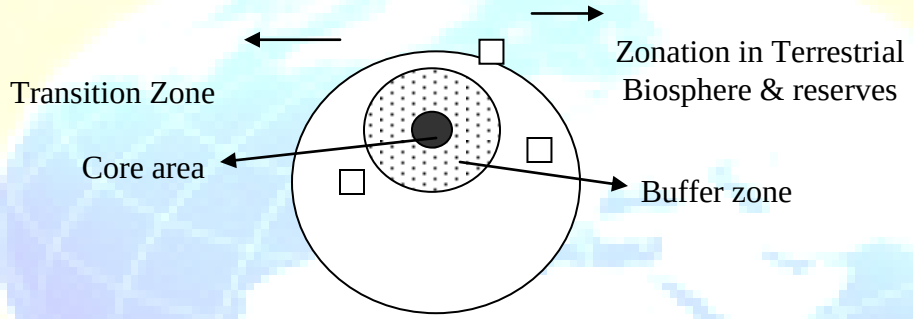
The main objectives of marine protected areas are :

- Protection and Restoration of depleted population of marine organisms.
- Protection of endangered species and critical habitats.
- Conserving and restoring marine ecosystem health for effective fishing management.
- To maintain bio-diversity and ecological processes of marine and coastal ecosystem.

- To use marine resource in sustainable equitable way for restoration of degraded marine and coastal areas.

Large marine ecosystems (LMEs) approach is now being adopted for evaluating fish stocks, stocker's competitors and predators. There are 49 LMEs on the margins of world oceans which also cover most productive marine fisheries.

Biosphere Reserves: are a special category of protected areas where in people are integral component of the system. Concept of Biosphere reserves was launched in 1975 as a part of the UNESCO's Man and Biosphere programme dealing with conservation of ecosystem and genetic resources contained there in. A Biosphere Reserve consists of core, buffer and transition zones.



Functions of Biosphere Reserves are:

1. **Conservation**: To ensure conservation of landscapes, ecosystems, species and genetic resources.
2. **Development**: To promote economic development, this is culturally, socially and ecologically sustainable.
3. **Scientific Research, Monitoring and Education**: The aim is to provide support for research, monitoring, education and information exchange related to local, national and global issues of conservation and development.

Till August, 2004, there were 440 Biosphere reserves located in 97 countries around the world (UNESCO 2004). One of the approach to conserve marine biodiversity is to identify biodiversity hotspots that are worth protection, (Robert et al. 2002; Hooker and Gerber 2004).

The marine reserves are those areas which are closed to all fishing and have a great potential as conservation tool. Protection from fishing leads to rapid increase in biomass, abundance and average size of exploited organisms and also increases species diversity.

Ex situ Conservation Strategies

It include Botanical gardens, Zoos, conservation stands and field gene banks as well as pollen, seed, seedling, tissue culture and DNA banks, etc. All these approaches help conserve species and population diversity outside the natural Habitat.

Seed Gene Banks

For storing the seeds in seed gene bank, the seeds are cleaned and dehydrated prior to storage. Then cooled at 20°C, seeds are germinated periodically to obtain fresh seeds. Seed gene banks are the easiest way to store germplasm of wild and cultivated plants at low temperature in cold rooms. Preservation of genetic resources is carried out in field gene banks under normal growing conditions in case of those plants which do not produce seeds. A Russian scientist N.I. Vavilov pioneered plant genetic collections (1887-1943). The N.I. Vavilov institute of Plant industry (VIR) in St. Petersburg, Russia houses one of the most important gene banks in the world. The Food and Agriculture Organization of United nations (FAO) and the world information and Early warning systems on plant genetic resources (WIEWS) Lists 1308 gene bank world wide, which conserve about 6.1 million accessions, including major crops, minor crop species as well as trees and wild plants (Haussmann et al. 2004). The International Plant Genetic Resources Institute (IPGRI) is the world largest organization and devoted to conservation and use of Agricultural biodiversity.

In Vitro Gene Banks

These are short and medium term storage for range of crops, woody species, fruit trees and horticulture species using tissue culture technique. In vitro conservation, especially by cryopreservation in liquid nitrogen at a temperature –196°C, is particularly useful for conserving vegetative propagated crops like potato. It is an expensive technique, therefore limited amount of genetic diversity can be maintained in vitro.

DNA Storage: DNA from nucleus, mitochoridria, and chloroplasts are now routinely extracted and immobilized into nitrocellulose sheets. However, there are problem with gene isolation, cloning and transfer which do not allow regeneration of the whole plants.

Botanical Garden and Zoos: Conservation of Bio-diversity in Botanical Gardens is already in practice. There are more than 1500 Botanical gardens and arboreta (where specific tree and shrub species are cultivated), in the world containing more than 80,000 species. Similarly there are

more than 800 professionally managed zoos around the world with about 3000 species of mammals, birds, reptiles and Amphibians.

Restoration of Endangered Species

It is extremely difficult and expensive process. This require species specific plans and knowledge of ecology and reproductive biology of species.

The strategies for restoration include:

i) Reintroduction programmes

ii) Augmentation programmes

iii) Introduction programmes

(Miller et al. 1995, See Singh and Khurana 2002)

Sustainable use and Public Participation

The long term conservation of biodiversity can be ensured by creating public awareness about the value of biodiversity and allocating them a greater share of benefits from conservation. Ecotourism, recreation and education can also help in sustainable use and management of biodiversity (Lindberg and Howkins, 1993), creating public awareness on various aspects of biodiversity conservation at village level, district and state level is necessary for involvement of people in effective conservation of biodiversity.

A contingent valuation survey of Khangchendzonga national park of Sikkim Himalaya and the sacred khecheopalri lake has revealed the value of ecotourism for management and conservation of biodiversity hot spots as well as for improving living standards of local inhabitants in India (Maharana et al., 2000).

Costs of Conserving Biodiversity

In 2002, Five international organizations spent a substantial amount on conserving biodiversity – the world bank, global environment facility, the world conservation union and the nature conservancy. Half of this amount was spent in the united states, according to a new research from a team of US university researchers and global conservation organizations. Biodiversity related aid has been falling from Development Assistance Committee (DAC) of the Organization of Economic Cooperation and Development (OECD).

The 2010 Target

In the 2002 world Summit on sustainable development, the international community pledged to slow down the rate of global biodiversity loss by 2010. Member states of UN convention on biodiversity are in the process of agreeing a series of targets and indicators to help measure progress towards this target. They include effectively conserving at least 10% of worlds ecological region, improving the status of threatened species that ensuring no species of wild flora and fauna is endangered by international trade; providing new and additional financial resources and technology to developing countries to help them meet their conservation commitments. (Bhatia A.L. 2012).

Challenges Beyond 2010

The United Nations convention on Biological diversity (CBD), agreed at the 1992 UN conference on environment and development, is one of the most widely ratified treaties in the world. Since 2002, 193 parties to the CBD have committed themselves to substantially rates of biodiversity loss by 2010; this goal was later endorsed by world Summit on sustainable development and incorporated into UN Millennium Development goals in 2005 (Abigail Entwistle). There is an increasing array of national, regional and international policy mechanisms aimed at biodiversity conservation i.e. 87% signatories to the CBD have now developed National biodiversity strategies and Action plans and thus have framework for trackling biodiversity loss at national scales (Ian Hodge). Conservation biology has become a recognized academic discipline, with its own Journals and post graduate courses, although most of its capacity remains concentrated in the developed world (Bhasker vira) despite recent growth in developing world professional training programmes (Sethik R., 2009). Yet biodiversity continues to decline, even though worldwide conservation efforts are increasing. The scope and achievements of these efforts are reviewed and key challenges are outlined.

The conservation paradigms, practices and policies have shifted over time and have been variably successful (Adam W.M. 2004). Ecological restoration is increasingly applied world wide (Nellemann C., Corcoran E. 2010). Actions for species, such as targeted habitat management, removal of invasives, captive breeding and reintroduction have yielded notable success; among many examples; at least 16 bird species extinctions have been prevented by such means between 1994 and 2004 (Butchart S.H.M., Statlersfield A.J. 2006).

Since 1992 the global network of protected areas has continued to grow steadily, increasing, yearly by an average 2.5% in total area and 1.4% in numbers of sites, by 2006 covering more than 24 million km2 in about 133,000 designated sites (Butchart S.H.M., et. al 2010). Landscape scale approaches to reducing biodiversity loss have become increasingly important, especially in wealthier countries (Sanderson E.W. 2002).

Many other approaches to biodiversity conservation have been developed, especially those linked to economic benefits, some of these help meet the opportunity costs of conservation, which would otherwise preclude conservation choices among poor rural communities. Despite these efforts biodiversity loss is not slowing down. Recent assessment shows a continued, steady overall decline in wild species population sizes and in the extent, condition and connectivity of many habitats, with accelerating levels of extinction risk and steady decline in the benefits people derives from biodiversity. Pressures on biodiversity continue to increase i.e. over exploitation of species, invasive alien species, pollution, climate change, degradation fragmentation, and destruction of habitats (Butchast S.H.M. et. al. 2010).

Agriculture is expanding land use in about 70% of countries at the expanse of biodiversity. (Michael R.W. Rands) Much of global timber trade is based on illegal logging that destroys biodiversity rich habitats. Oversabstruction of water for agriculture, industry, and domestic demands contributes to shifts in agricultural pattern; this imposes greater pressure on biodiversity in other location. Increasing demand for vegetable oils – for food, cosmetics biofuels – has put further pressure on biodiversity. Remaining terrestrial biodiversity is confined to fragmented patches separated by expanding cultivation, infrastructure, residential and industrial development. Biodiversity also faces new pressure and novel threats (2010). Anthropogenic climate change and rising human resource demands will pose interlinked challenges. Climate change may force species to shift their ranges and disrupt ecological communities (Maclean L.M.D. et. al. 2008, Hole D.G. et al. 2002). Enhanced levels of atmospheric CO_2 also threaten corals through ocean acidification (Kleypas J.A., Yates K.K. 2009). On the top of these well known threats are others that are less well understood, including possible threats from micro plastic pollution, nanosilver, biochar, and artificial life (Sutherland W.J. et al. 2010).

The UN has declared 2010 the international year of biodiversity and has agreed to hold a special session of this years general assembly devoted to biodiversity, partly in context of reviewing progress in achieving the millennium development goals.

At the 10th conference of the parties of CBD (Nagoya, Japan, October, 2010), Government will not only access whether, they met the 2010 biodiversity target but are expected to adopt a new strategic plan containing a vision for 2050 and new biodiversity targets to be achieved by 2020.

Three interconnecting priorities are proposed to address the continued global loss of biodiversity.

i) To manage biodiversity as a public good,

ii) To integrate biodiversity into public and private decision-making

iii) to create enabling conditions for policy implementation.

CONCLUSION

We are yet far from including biodiversity in our conventional measures of well being, which focus on wealth creation and internationally recognized estimates of GDP (Layard R. 2010). Furthermore, the current recession only strengthens the emphasis on growth. Conservation strategies, in concert with other environmental policies, must address intractable and unpalatable issues.

In both developed and emerging economies, we need to reduce the carbon and material through put demanded by current patterns of production and consumption if we are to create viable and democratically acceptable trajectories of contraction and convergence in resources use. In parallel, we must recognize that successful human development agendas are underpinned by functional ecosystems, and by biodiversity.

REFERENCES

Adams W.M., Against Extinction: The Story of Conservation (Earthscan, London, 2004).

Agrawal K.C. (1999), Environmental Biology, New Delhi, p.197.

Anamaya (2008), Ecology, environment and resources conservation, First Reprint pp. 543-44.

Bhatia, A.L. (2012), Text book of Environmental Biology, New Delhi, p.384.

Butchart S.H.M., Stattersfield A. J., Collar N.J. Oryx 41, 266 (2006).

Butchart S.H.M. et al., Science 328, 1164 (2010); published online 29 April 2010,

Ghilarov A., (1996) what does "Biodiversity" mean scientific problem or convenient myth? Trends in ecology and evaluation 11: 304-06.

Global Biodiversity look 3 (Secretariat of the convention on Biological diversity, Montreal, 2010).

Hamilton A.J., (2005) species diversity or biodiversity, Journal of environmental management 75:89-92.

Hawksworth DL, (1995) Biodiversity: Measurement and estimation, Chapman & Hall, Oxford, U.K.

Hole D.G. et al. Ecol. Lett. 5, 525, (2002).

Jensen D.B., Torn M. and Harte, J. our own hands: A strategy for conserving Biologically Diversity in California, 1990.

Kleypas J.A., Yates K.K., Oceanography 22, 108 (2009).

Lemoine N., Bohning-Gaese K., Conserv. Biol. 14, 2489(2008).

Maclean I.M.D. et al. Glob Change Biol. 14, 2489 (2008).

Meadows DH, Meadows DL, Rander J, Behrens W W (1972) the limits to growth, Universe books, New York, USA.

Norse EA, Mc Manus RE (1980) Ecology and living resources biological diversity, In: Quality C on E(ed) Environmental quality 1980, Council Environmental Quality, Washington D.C., US, pp. 31-80.

Noss R.F., Cooperrider AY (1994) Saving Nature's Legacy: Protecting and Restoring biodiversity T_2-A_2 : 416.

Rana S.V.S. (2009), Essentials of Ecology and environmental science. pp.212,213.

Reaping the Benefits (Royal Society, London, 2009)

Sanderson E. W., Redford K. H., Vedder A., Coppolitio P. B., Ward S. E., Landsc, Urban Plan, 58, 41 (2002).

Schwarz Astric (2011), Ecology Revisited Reflecting on Concept Advancing Science, Springer Dordrecht Heidelberg, London, New York. pp.17-18.

Sharma P.D. (2007), Ecology and Environment, Tenth Revised Edition.

Sharma P.D.(A) 1998. Seventh edition, p.368.

Sutherland W.J. et. al. Trends ECOR. Evo. 25, 1, (2010).

United Nations, Millennium Development Goal Indicator (http:llunstats.un.org/usd/mdg/ Host.aspx?) Content = indicator/official (List htm 2008).