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**Elective Paper( EC-IC):Environmental Science**

**Topic-Biodiversity: Types, Importance and its Value**

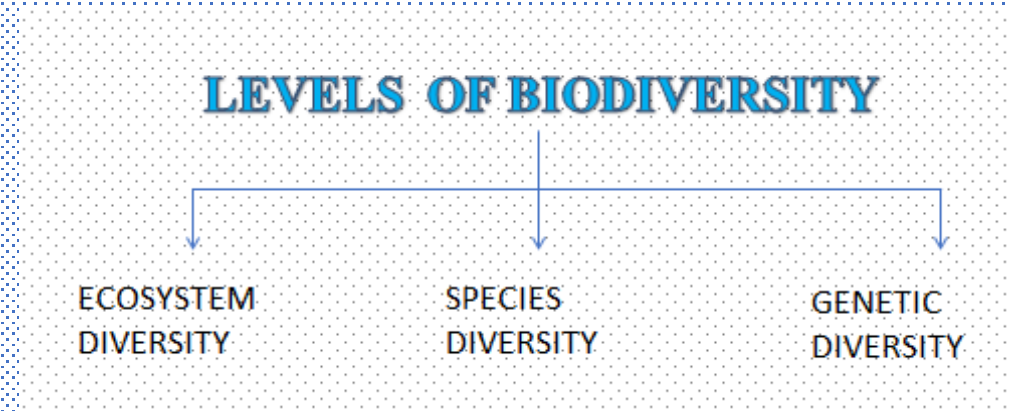
# BIODIVERSITY

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- Biological diversity encompasses all species of plants, animals, micro-organisms and the ecosystems and ecological processes of which they are parts.

OR

- Biodiversity or biological diversity simply means the variety and variability among living organisms and the ecological complexes in which they occur.





## SPECIES DIVERSITY

Species diversity refers to the variety of living organisms on earth and has been variously estimated to be between 5 and 50 million or more, though only about 1.4 million have actually been described. There are two constituents of species diversity:

**Species richness:** Number of different species present in an ecosystem.

**Species evenness:** Relative abundance of individuals of each of those species.

Generally, greater the species richness greater is the species diversity. However, number of individuals among the species may also vary resulting into differences in evenness, or equitability, and consequently in diversity.

APPROXIMATE NUMBER  
OF SPECIES WHICH  
HAVE BEEN DESCRIBED  
AND IDENTIFIED FROM  
ALL OVER THE WORLD

Group	Number of species
Higher plants	2,70,000
Algae	40,000
Fungi	72,000
Bacteria (including Cyanobacteria)	4,000
Viruses	1,550
Mammals	4,650
Birds	9,700
Reptiles	7,150
Fish	26,959
Amphibians	4,780
Insects	1,025,000
Crustaceans	43,000
Molluscs	70,000
Nematods and worms	25,000
Protozoa	40,000
Others	1,10,000





# GENETIC DIVERSITY

- Genetic diversity refers to the variation of genes within species ; the differences could be in alleles, in entire genes or in chromosomal structures.
- The genetic diversity enables a population to adapt to its environment and respond to natural selection.
- Genetic diversity within a species often increases with environmental variability.
- For example, each human being is very different from all others.

# ECOSYSTEM DIVERSITY

Ecosystem diversity relates to the variety of habitats biotic communities and ecological processes in the biosphere, as well as the tremendous diversity within ecosystems in terms of habitat differences and the variety of ecological processes.

Ecosystems cycle nutrients, water, oxygen, methane and carbon dioxide, and other chemicals such as sulphur, nitrogen and carbon.



AQUATIC ECOSYSTEM



GRASSLAND ECOSYSTEM



DESERT ECOSYSTEM



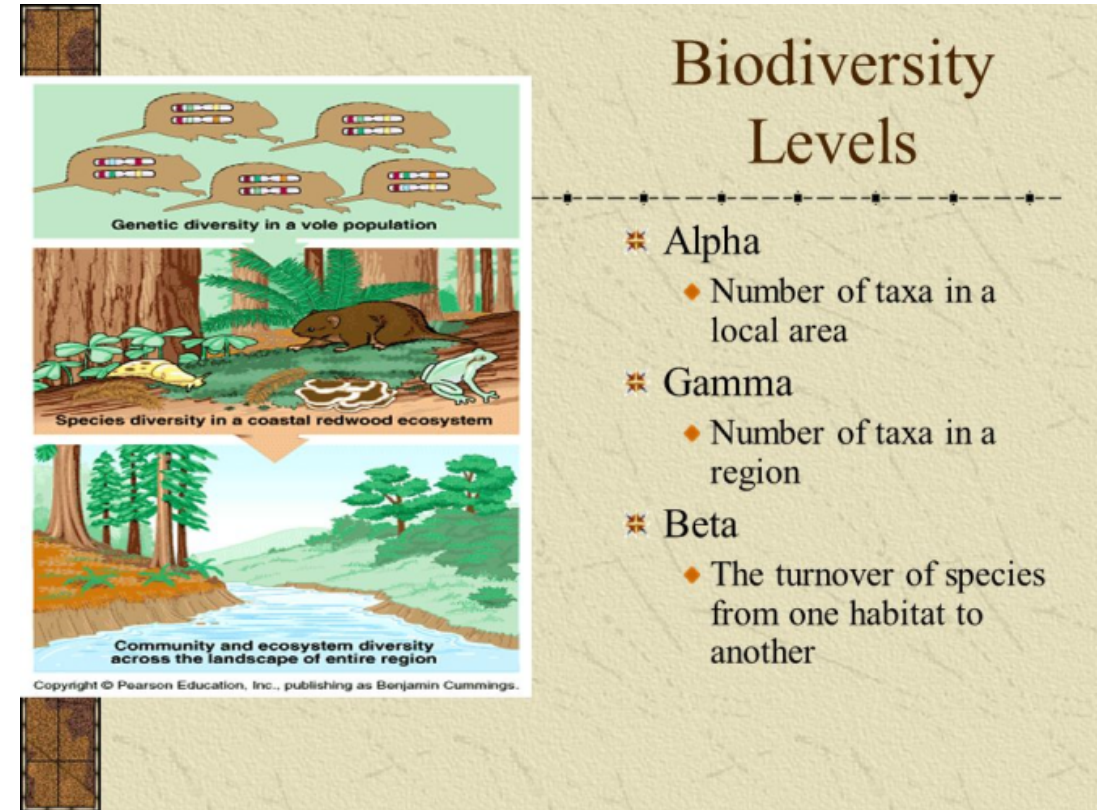
# MEASUREMENT OF BIODIVERSITY

Whittaker(1972) described three terms for measuring biodiversity over spatial scales:

**Alpha Diversity** : Alpha diversity refers to the diversity within a particular area or ecosystem and is usually expressed by the number of species (i.e. **species richness**) in that ecosystem. This diversity is on a small scale, generally of the size of one ecosystem.

**Beta Diversity** : This is the diversity of species between two ecosystems and usually measured as the amount of species changes between the ecosystems.. It is at a larger scale and compare the diversity between two separate entities that are often divided by a clear geographical barrier like a river or a mountain ridge.

**Gamma Diversity**: Gamma diversity is a measure of the overall diversity for the different ecosystems within a region. **Hunter(2002)** defines gamma diversity as “geographic-scale species diversity”.



# IMPORTANCE OF BIODIVERSITY

- Genetic diversity
- Protect freshwater resources
- Speed recovery from natural disasters
- Maintaining balance of the ecosystem
- Sustainability and growth



- Provision of food security
- Adaptation to different habitats
- Provision of biological resources
- Promote soils formation and protection
- Maintain food chain in the nature

by Narjess Hamecha-Daniels

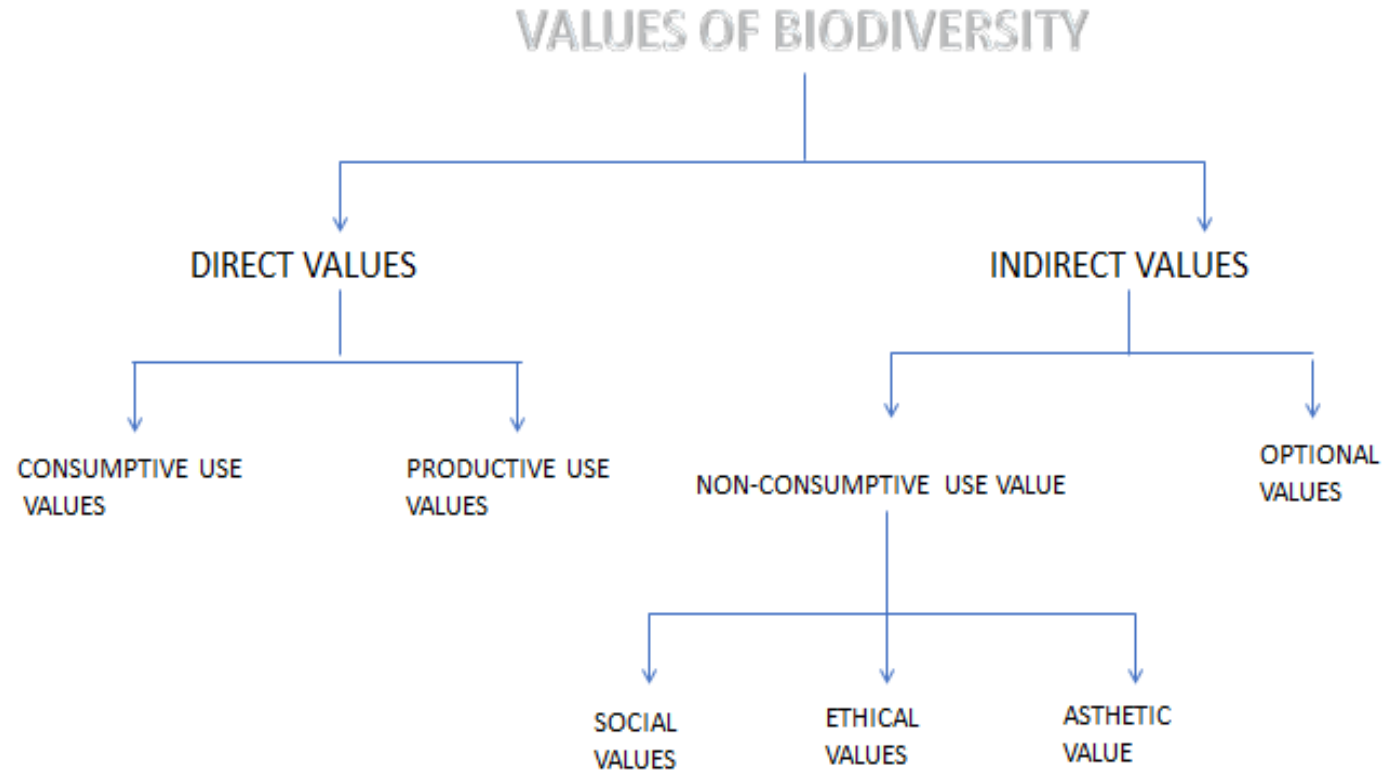
THE BENEFITS  
AND SERVICES  
PROVIDED BY  
ECOSYSTEMS

## ASSESSING THE VALUE OF BIOLOGICAL RESOURCES

### Three main approaches have been used for determining the value of biological resources:

- Assessing the value of nature's products such as firewood fodder and game meat that are consumed directly, without passing through a market (“**consumptive use value**”).
- Assessing the value of products that are commercially harvested, such as game meat sold in a market, timber, fish, ivory and medicinal plants ( “**productive use value**” ).
- Assessing indirect values of ecosystem functions, such as watershed protection, photosynthesis, regulation of climate and production of soil ( “**non-consumptive use value**”), along with the intangible values of keeping options open for the future and simply knowing that certain species exist ( “**option value**” and “**existence value**” , respectively).

VALUES OF BIODIVERSITY



# 1. DIRECT VALUES



Direct values are concerned with enjoyment or satisfaction received directly by consumers of biological resources.



They can be relatively easily observed and measured, often by assigning prices to them.



For example we can use plants as food or for deriving medicines in the laboratory.



Direct values are further classified into consumptive use value and productive use value



# CONSUMPTIVE USE VALUE

The value of nature's product that are consumed directly such as firewood, fodder and meat. In other words the product which are consumed directly without passing through a market. Consumptive use values seldom appears in national income amount

The most important consumptive use is that some rural communities closest to the forests or other natural areas can prosper through the sustainable harvesting of wildlife species.

Hunting, direct-consumption (e.g. collection of berries, mushrooms, herbs ,plants) are all "consumptive uses".

The biodiversity contained in the ecosystem provides forest dwellers with all their daily needs such as food, building material, fodder, medicines and a variety of other products.

Fisher folks are completely dependent on fish and know where and how to catch fish and other edible animals and plants.

Tribal communities who directly gather resources from the forest ecosystems are directly or indirectly linked to the biological variety present in the biosphere.

Urban communities generally use the greatest amount of goods and services, which are all indirectly drawn from natural ecosystem.

Biological diversity is also essential for preserving ecological processes.

in Ghana, about 75% of population depends largely on traditional sources of protein including fish, insect, caterpillar, maggots and snails.



# PRODUCTIVE USE VALUE

## PRODUCTIVE USE VALUE

Productive use values are assigned to products that are commercially harvested for exchanging in formal markets and is therefore often the only value of biological resources that is reflected in national income accounts.

Productive use value derived from animal and plants:

ANIMAL	ANIMAL PRODUCTS
Silk-worm	Silk
Sheep	Wool
Elephants	Tusk
Fish and animal	Food

Plant & Animal Product	Industry
Wood	Paper and pulp industry
Cotton	Textile industry
Fruits and vegetables	Food industry
Leather	Leather industry

**Wild biological resources also contribute to the production of domesticated resources in several ways:**

- Wild genetic resource are used to improve established domesticates.
- Rangeland and wild forage species contribute to livestock production.
- Wild species- especially of plants- serve as sources of new domesticates.
- Wild pollinators are essential to many crops, and wild enemies of pest help control their depredations on crops.
- The biotechnologist uses bio-rich areas to ‘prospect’ and search for potential genetic properties in plants or animals that can be used to develop better varieties of crops.
- For the pharmacist, biological diversity is the raw material from which new drugs can be identified from plant or animal products.
- For industrialists, biodiversity is a rich storehouse to develop new products.
- For the agricultural scientist, the biodiversity is the basis for developing better crops.

# COMMONLY USED MODERN DRUGS DERIVED PLANT SOURCES:

SOURCE: 'THE DIVERSITY OF  
LIFE' EDWARD O. WILSON

DRUG	PLANT SOURCE	USE
Atropine	Belladonna	Anticholinergic: reduces intestinal pain in diarrhoea.
Bromelain	Pineapple	Controls tissue inflammation due to infection.
Caffeine	Tea, Coffee	Stimulant of the central nervous system.
Camphor	Camphor tree	Rebefacient: increases local blood supply.
Cocaine	Cocao	Analgesic and local anesthetic: reduces pain and prevents pain during surgery.
Codeine	Opium poppy	Analgesic: reduces pain.
Morphine	Opium poppy	Analgesic: controls pain.
Colchicine	Autumn crocus	Anticancer agent.
Digitoxin	Common foxglove	Cardiac stimulant used in heart diseases.
Diosgenin	Wild yams	Source of female contraceptive: prevents pregnancy.
L-Dopa	Velvet bean	Controls Parkinson's Disease which leads to jerky movements of the hands
Ergotamine	Smut-of-rye or ergot	Control of haemorrhage and migraine headaches.
Glaziovine	ocotea glaziovii	Antidepressant: Elevates mood of depressed patients.
Gossypol	Cotton	Male contraceptive.
Indicine N-oxide	heliotropium indicum	Anticancer agent.
Menthol	Mint	Rubefacient: increases local blood supply and reduces pain on local application.
Monocrotaline	Cotolaria sessiliflora	Anticancer agent.
Papain	Papaya	Dissolves excess protein and mucus, during digestion.
Penicillin	Penicillium fungi	General antibiotic, kills bacteria and controls infection by various micro-organisms.
Quinine	Yellow cinchona	Antimalarial.
Reserpine	Indian snakeroot	Reduces high blood pressure.
Scopolamine	Thorn apple	Sedative.
Taxol	Pacific yew	Anticancer (ovarian).
Vinblastine, vincristine	Rosy periwinkle (Vinca rosea) (Sadaphali)	Anticancer agent: Controls cancer in children.

## 2. INDIRECT VALUES

- Indirect values , which deal primarily with the functions of ecosystem, do not normally appear in the nation's accounting system.
- They tend to reflect the value of biological diversity to society locally or at large rather than to individuals or corporate entities.
- Indirect values are further classified into: **OPTIONAL VALUE** and **NON-CONSUMPTIVE USE VALUE**.

# NON CONSUMPTIVE USE VALUE

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- **The non consumptive value( indirect values) of ecosystem functions are:**
- Photosynthetic fixation of solar energy, transferring this energy through green plants into natural food chains, and thereby providing the support system for species that are harvested.
- Ecosystem functions involving reproduction, including pollination, gene flow, cross-fertilization; maintenance of environmental forces and species that influence the acquisition of useful genetic traits in economic species; and maintenance of evolutionary processes, leading to constant dynamic tension among competitors in ecosystems.
- Maintaining water cycles, including recharging ground water, protecting watersheds, and buffering extreme water conditions( such as flood and drought).
- Regulation of climate, at both macro and micro-climatic levels.
- Soil production and protection of soil from erosion, including protecting coastlines from erosion by the sea.
- Storage and cycling of essential nutrients, e.g. carbon. Nitrogen, and oxygen, and maintenance of the oxygen-carbon-dioxide balance.
- Adsorption and breakdown of pollutants, including the decomposition of organic wastes, pesticides, and air and water pollutants.
- Provision of recreational-aesthetic, sociocultural, scientific, educational and historic values of natural environments.
- **Non-consumptive use value is further classified into: *SOCIAL, RELIGIOUS & CULTURAL VALUES, ETHICAL VALUES, AESTHETIC VALUE.***

# 1.SOCIAL, RELIGIOUS & CULTURAL VALUES

These are the values associated with the social life, customs, religions, and spiritual aspects of the people.

The biodiversity has to a great extent been preserved by traditional societies that valued it as a resource and appreciated that its depletion would be a great loss to their society.

The consumptive and productive value of biodiversity is closely linked to social concerns in traditional communities.

'Ecosystem people' value biodiversity as a part of their livelihood as well as through cultural and religious sentiments.

A great variety of crops have been cultivated in traditional systems and this permitted a wide range of produce to be grown and marketed throughout the year and acted as an insurance against the failure of one crop.

Many plants and animals have ritual significance. For example, in some part of India such as Gujarat, Sami is used in sacrificial fires.

Among auspicious flowers offered in temples are *Hibiscus* offered to the goddess Kali and *Datura* flowers to lord Shiva.

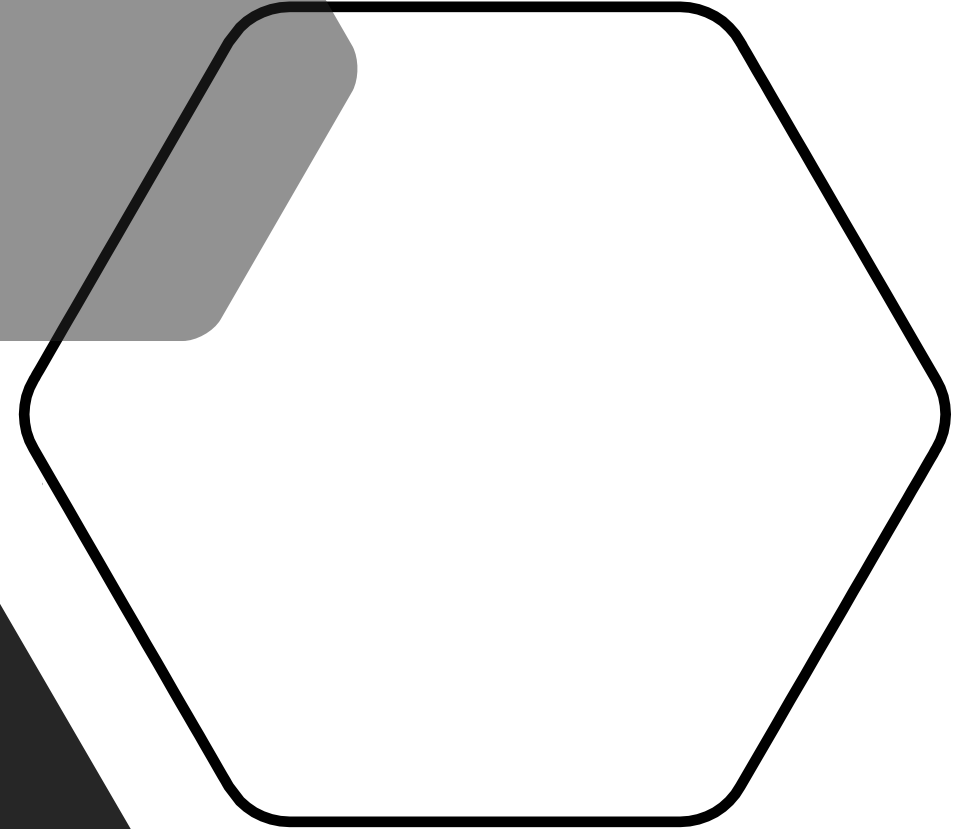
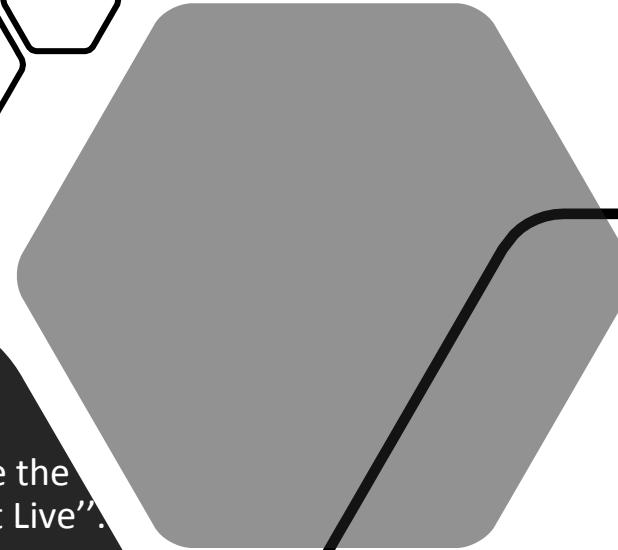
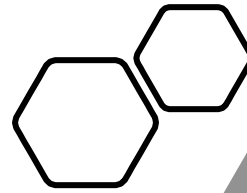
Many culture of human beings are closely related to many species of plants and animals. e.g. Hindus identify owls as the transport of goddess Lakshmi.

Many religions identify themselves with such plants and animals which renders to them a cultural or spiritual value.

In a majority of Indian villages and towns, plants like Tulsi, Pipal, Khejri and various other trees are planted, which are considered sacred and worshipped by the people.

Thus, Biodiversity has distinct social value, attached with different societies.

## 2.ETHICAL VALUES



- Ethical value of biodiversity are based on that all form of life have the right to exist on Earth. It is based on the concept of “Live and Let Live”.
- Ethical arguments assert that humans have a duty to protect species based on their intrinsic value, unrelated to human needs.
- People must learn to live within the ecological constraints of the planet.
- Must learn to minimize the environmental damage and take responsibility for their action.
- The well-being of future generations is a social responsibility of the present generation. Therefore, the present generation should limit its consumption of non-renewable resources to the level that is necessary to meet the basic needs of society.
- International boycotts of furs, teak and ivory are the good examples of moral justification.
- There are several cultural, moral and ethical values which are associated with the conservation of biodiversity.

### 3. AESTHETIC VALUES



Knowledge and an appreciation of the presence of biodiversity for its own sake is another reason to preserve it.



Quite apart from killing wildlife for food, it is important as a tourist attraction.



Biodiversity is a beautiful and wonderful aspect of nature. For example listening birds song and watching spider web is magnificent and fascinating.



The aesthetic values of our natural ecosystems and landscapes contribute to the emotional and spiritual well-being of a highly urbanized population.



Poets, writers and artists from various cultures have given expression to the aesthetic appeal of plants and animals.



People from far and wide spend a lot of time and money to visit wilderness area where they can enjoy the aesthetic beauty or value of biodiversity and is commonly referred to as eco-tourism.




Examples of aesthetic rewards include bird watching, pet keeping, gardening etc.





# OPTIONAL VALUE

- Option value is a means of assigning a value to risk aversion in the face of uncertainty. It keeps future possibilities open for their uses.
  - There are several plant species which are edible and superior than those which are currently in use ;e.g. Katemfe, a plant found in S. Africa, produces protein that are 1,600 times sweeter than sucrose.
  - The plants and animals conserved may spread into surrounding areas where they may be able to cropped at some future date or may eventually contribute genetic material to domestic crops or livestock.
  - There is a possibility that we may have some potential cure for AIDS and Cancer existing within depths of oceans or in a tropical forest.
  - Thus protecting natural habitat can therefore be seen as means for nation's, especially those in the species rich tropics, to keep at least part of their biological resources intact for the future benefit of their population.
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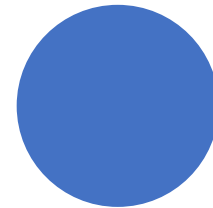
# SCIENTIFIC VALUE

- Biodiversity is of great scientific value. For example many species of plants and animals are the subject of our research.
- Natural areas provide excellent living laboratories for valuable research into ecology and evolution.
- Through research on plants, insects and animals, we made medicines, hybrid plants, engineering design and many other things that are of immense value to human beings. For example, the design of Velcro is developed from cockle-burrs which cling fast to clothing as we walk in the woods.

- It is concerned with protection of wildlife, charismatic animals such as lion, panda, birds etc. in direct way to contribute money to organizations.
- Many people argue that 'existence value' based on simply knowing that a species exist, is a sufficient reason to protect and preserve it.
- They might hope that their descendants may derive some benefit from the existence of species, or may just find satisfaction in knowing that the ocean hold whales, the Himalayas have snow leopards.
- This right to exists was also stated in the U.N. General Assembly World Charter for Nature, 1982.

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# EXISTENCE VALUE



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**THANKS**