AR- 7162

M.Sc. Botany, Semester - II
LBT-202 / LBC-802: Ecology and Environment
Section A: Answer all the questions (2 X 10 = 20 Marks)

Scheme of Valuation/ Answers

1.

(i)	**a**
(ii)	**c**
(iii)	**b**
(iv)	**a**
(v)	**b**
(vi)	**c**
(vii)	**c**
(viii)	**b**
(ix)	**c**
(x)	**a**

2. Populations of two species may show the following types of interactions

Neutralism
Competition- direct interference
Competition –resource type
Amensalism
Parasitism
Predation
Commensalism
Protocooperation
Mutualism

3. **(a) Edge effects** refer to the changes in the population or community structure that occur at the point where two habitat types meet. Edge effects are especially pronounced in small habitat fragments where the edge effects may extend throughout the patch. Increasing edge effects allows more habitat structure to increase biodiversity within the area.*Edge* means the portion of an ecosystem near its perimeter, where influences of the adjacent patches can cause an environmental difference between the interior of the patch and its edge. This edge effect includes a distinctive species composition or abundance. For example, when a landscape is a mosaic of perceptibly different types, such as a forest adjacent to a grassland, the edge is the location where the two types adjoin. In a continuous landscape, such as a forest giving way to open woodland, the exact edge location is fuzzy and is sometimes determined by a local gradient exceeding a threshold, such as the point where the tree cover falls below thirty-five percent.

An **ecotone** is a transition area between two biomes.http://en.wikipedia.org/wiki/Ecotone - cite_note-1 It is where two communities meet and integrate.http://en.wikipedia.org/wiki/Ecotone - cite_note-2 It may be narrow or wide, and it may be local (the zone between a field and forest) or regional (the transition between forest and grassland ecosystems).http://en.wikipedia.org/wiki/Ecotone - cite_note-smith-3 An ecotone may appear on the ground as a gradual blending of the two communities across a broad area, or it may manifest itself as a sharp boundary line. Changes in the physical environment may produce a sharp boundary, as in the example of the interface between areas of forest and cleared land). Elsewhere, a more gradually blended interface area will be found, where species from each community will be found together as well as unique local species. Mountain ranges often create such ecotones, due to the wide variety of climatic conditions experienced on their slopes. They may also provide a boundary between species due to the obstructive nature of their terrain. Mont Ventoux in France is a good example, marking the boundary between the flora and fauna of northern and southern France. Most wetlands are ecotones.

(b) Life Form Classification Raunkiaer (1934)

One of the first to provide a comprehensive system of plant life form classification based on their adaptations for surviving the unfavorable season (winter cold or summer drought). Adaptations for survival linked to the protection afforded to the sensitive apical meristems. Recognized following groups:

Phanerophytes
Chamaephytes
Hemicryptophytes
Cryptophytes /geophyte
Therophytes
Aerophytes
Epiphytes

4. The main factors that affect the NPP are

a. Temperature
b. Moisture
c. Nutrient input
d. Solar radiation
e. Rainfall or precipitation
f. Evapo-transpiration
g. Leaf area index
h. Water availability
i. Soil type
j. Wind velocity etc any five

5. (a) Ecological Efficiency

The amount of energy reaching each trophic level depends on the net production of the producers at the base of the food chain and the extent of energy transfer at each trophic level. Some of the important efficiency

Assimilation efficiency: this is a measure of the efficiency with which a consumer extracts energy from the food ingested. This efficiency varies widely- 37% in grasshopper, 44% in elephant. The efficiency is low for herbivores (20 to 40 %) and high for the carnivores (upto 80%)

Utilization or Consumption efficiency: this represents the proportion of total productivity available at a trophic level that is actually consumed by the organisms of a succeeding trophic level. The utilization efficiency for net primary production by the herbivores varies from 1.5% to 2.5% in mature temperate deciduous forest, 28 to 60% in grazed grassland, 60 to 90 % in plankton communities of ocean water.

Growth or production efficiency: It is production at trophic level divided by assimilation at trophic level in percentage. It is a measure of efficiency with which the assimilated energy is incorporated into the protoplasm. It ranges from 1% in endothermic birds and mammals, 10% in ectotherms like fish, 60% in invertebrate carnivores.

Ecological growth efficiency: it is a ratio between production at trophic level to the ingestion at vtrophic level in percentage. For example, 1.9% in ground squirrel and 14.77 % in grasshopper and spiders.

(b) Ecological Pyramids

A **pyramid of biomass** is a representation of the amount of energy contained in biomass, at different trophic levels for a given point in time. The amount of energy available to one trophic level is limited by the amount stored by the level below. Because energy is lost in the transfer from one level to the next, there is successively less total energy as you move up trophic levels. In general, we would expect that higher trophic levels would have less total biomass than those below, because less energy is available to them.

Pyramid of numbers, represents the number of organisms in each trophic level. For the oceans, the bottom level would be quite large, due to the enormous number of small algae. For other ecosystems,

the pyramid of numbers might be inverted: for instance, if a forest's plant community was composed of only a handful of very large trees, and yet there were many millions of insect grazers which ate the plant material.
Pyramid of energy, shows rates of production rather than standing crop. Algal populations can double in a few days, whereas the zooplankton that feed on them reproduce more slowly and might double in numbers in a few months, and the fish feeding on zooplankton might only reproduce once a year. Thus, a pyramid of energy takes into account the turnover rate of the organisms, and ***can never be inverted***.

6. The most powerful technique is to conserve biodiversity is to preserve habitat.

- Biodiversity banking
- Gene banks
- Location-specific approaches

Focusing on limited areas of higher potential biodiversity promises greater immediate return on investment than spreading resources evenly or focusing on areas of little diversity but greater interest in biodiversity.
A second strategy focuses on areas that retain most of their original diversity, which typically require little or no restoration. These are typically non-urbanized, non-agricultural areas. Tropical areas often fit both criteria, given their natively high diversity and relative lack of development.
Biodiversity is taken into account in some political and judicial decisions:

- The relationship between law and ecosystems has great impact on consequences for biodiversity. It is related to private and public property rights. It can define protection for threatened ecosystems, but also some rights and duties (for example, fishing and hunting rights).
- Law regarding species is more recent. It defines species that must be protected because they may be threatened by extinction..
- Laws regarding gene pools are new but domestication and plant breeding methods are not new, but advances in genetic engineering has led to tighter laws covering distribution of genetically modified organisms, gene patents and process patents.http://en.wikipedia.org/wiki/Biodiversity - cite_note-118#cite_note-118 Governments struggle to decide whether to focus on for example, genes, genomes, or organisms and species.

Global agreements such as the **Convention on Biological Diversity**, give sovereign national rights over biological resources (not property). The agreements commit countries to conserve biodiversity, develop resources for sustainability and share the benefits resulting from their use.
Biodiverse countries that allow bioprospecting or collection of natural products, expect a share of the benefits rather than allowing the individual or institution that discovers/exploits the resource to capture them privately. Bioprospecting can become a type of biopiracy when such principles are not respected.
In-situ and ex-situ conservation
Conservation can broadly be divided into two types:
In-situ: Conservation of habitats, species and ecosystems where they naturally occur. This is in-situ conservation and the natural processes and interaction are conserved as well as the elements of biodiversity. In-situ conservation is not always possible as habitats may have been degraded and there may be competition for land which means species need to be removed from the area to save them.
Protected areas: National park, Natural monuments, Managed areas & landscapes, marine protected areas, Biosphere reserves, etc.
Ex-situ: The conservation of elements of biodiversity out of the context of their natural habitats is referred to as ex-situ conservation. Zoos, botanical gardens, conservation stands, field gene bank and seed banks are all example of ex-situ conservation. *In vitro* Seed-gene bank, tissue culture and DNA bank, pollen bank, restoration of endangered species etc.

7. A **biodiversity hotspot** is a biogeographic region with a significant reservoir of biodiversity that is under threat from humans.

The concept of biodiversity hotspots was originated by Norman Myers in two articles in "The Environmentalist" (1988) & 1990 revised after thorough analysis by Myers and others in "Hotspots: Earth's Biologically Richest and Most Endangered Terrestrial Ecoregions".
To qualify as a biodiversity hotspot on Myers 2000 edition of the hotspot-map, a region must meet two strict criteria: it must contain at least 0.5% or 1,500 species of vascular plants as endemics, and it has to have lost at least 70% of its primary vegetation.http://en.wikipedia.org/wiki/Biodiversity_hotspot - cite_note-4 Around the world, 25 areas qualify under this definition, with nine other possible candidates. These sites support nearly 60% of the world's plant, bird, mammal, reptile, and amphibian species, with a very high share of endemic species.

Indian subcontinent has three hotspots

- Eastern Himalaya
  Eastern Himalaya is situated between Central Nepal in the west to Myanmar in the east, occupying southeast Tibet in China, Sikkim, North Bengal, Bhutan and North-East India. The area has been declared a biodiversity hotspot by Conservation International. The climate of Eastern Himalaya is characterized by cool summer and chilly winter. The hot season commences about the middle of April, reaches its maximum in the month of June and lasts till the end of August. The average temperature generally recorded is 20 C. The average rainfall in the area is about 500mm. Snowfall is a usual phenomenon in the higher altitudes.
- Indo-Burma, India and Myanmar
  Indo-Burma is a biodiversity hotspot designated by Conservation International, which extends from eastern India and southern China across Southeast Asia, and includes Australia, but excluding the Malay Peninsula. The Conservation International hotspot includes all of the World Wildlife Fund's Indochina Bioregion, but also includes the Meghalaya subtropical forests, which the WWF includes in its Indian Subcontinent Bioregion.
  The hotspot includes portions of eastern India (including the Andaman and Nicobar Islands), southernmost China, most of Myanmar (excluding the northern tip), most of Thailand (excluding the southern tip), and all of Cambodia, Laos, and Vietnam.
  The hotspot encompasses 33 terrestrial eco-regions, which include tropical and subtropical moist broadleaf forests, tropical and subtropical dry broadleaf forests, tropical and subtropical coniferous forests, temperate broadleaf and mixed forests, and mangroves.
- Western Ghats
  The **Western Ghats** or the **Sahyādri** constitute a mountain range along the western side of India. It is a UNESCO World Heritage Site and is one of the eight "hottest hotspots" of biological diversity in the world.http://en.wikipedia.org/wiki/Western_Ghats - cite_note-1 It is sometimes called the Great Escarpment of India.[2] The range runs north to south along the western edge of the Deccan Plateau, and separates the plateau from a narrow coastal plain along the Arabian Sea. A total of thirty nine properties including national parks, wildlife sanctuaries and reserve forests were designated as world heritage sites - twenty in Kerala, ten in Karnataka, five in Tamil Nadu and four in Maharashtra.
  The range starts near the border of Gujarat and Maharashtra, south of the Tapti river, and runs approximately 1,600 km (990 mi) through the states of Maharashtra, Goa, Karnataka, Tamil Nadu and Kerala ending at Kanyakumari, at the southern tip of India.
  These hills cover 160,000 km^2 (62,000 sq mi) and form the catchment area for complex riverine drainage systems that drain almost 40% of India. The Western Ghats block rainfall to the Deccan Plateau.http://en.wikipedia.org/wiki/Western_Ghats - cite_note-5 The average elevation is around 1,200 m (3,900 ft).http://en.wikipedia.org/wiki/Western_Ghats - cite_note-APMN-6
  The area is one of the world's ten "Hottest biodiversity hotspots" and has over 5000 species of flowering plants, 139 mammal species, 508 bird species and 179 amphibian species; it is

likely that many undiscovered species live in the Western Ghats. At least 325 globally threatened species occur in the Western Ghats.

8. **(a)** Acid rain is rain consisting of water droplets that are unusually acidic because of atmospheric pollution - most notably the excessive amounts of sulfur and nitrogen released by vehicle, fossil fuel combustion and industrial processes. Acid rain is also called acid deposition because this term includes other forms of acidic precipitation such as snow.

Causes of Acid Rain

Acid deposition can occur via natural sources like volcanoes but it is mainly caused by the release of sulfur dioxide and nitrogen oxide during fossil fuel combustion. When these gases are discharged into the atmosphere they react with the water, oxygen, and other gases already present there to form sulfuric acid, ammonium nitrate, and nitric acid. These acids then disperse over large areas because of wind patterns and fall back to the ground as acid rain or other forms of precipitation.

Effects of Acid Rain

There are several important impacts of acid deposition on both natural and man-made environments. Aquatic settings are the most clearly impacted by acid deposition though because acidic precipitation falls directly into them. Both dry and wet deposition also runs off of forests, fields, and roads and flows into lakes, rivers, and streams.

Acids can accrue and lower the overall pH of the water body. Acid deposition also causes clay soils to release aluminum and magnesium further lowering the pH in some areas.

Acid deposition can significantly impact forests. As acid rain falls on trees, it can make them lose their leaves, damage their bark, and stunt their growth. By damaging these parts of the tree, it makes them vulnerable to disease, extreme weather, and insects. Acid falling on a forest's soil is also harmful because it disrupts soil nutrients, kills microorganisms in the soil, and can sometimes cause a calcium deficiency. Trees at high altitudes are also susceptible to problems induced by acidic cloud cover as the moisture in the clouds blankets them.

Damage to forests by acid rain is seen all over the world.

(b) Greenhouse effect

The **greenhouse effect** is a process by which thermal radiation from a planetary surface is absorbed by atmospheric greenhouse gases, and is re-radiated in all directions. Since part of this re-radiation is back towards the surface and the lower atmosphere, it results in an elevation of the average surface temperature above what it would be in the absence of the gases. Solar radiation at the frequencies of visible light largely passes through the atmosphere to warm the planetary surface, which then emits this energy at the lower frequencies of infrared thermal radiation. Infrared radiation is absorbed by greenhouse gases, which in turn re-radiate much of the energy to the surface and lower atmosphere. The mechanism is named after the effect of solar radiation passing through glass and warming a greenhouse, but the way it retains heat is fundamentally different as a greenhouse works by reducing airflow, isolating the warm air inside the structure so that heat is not lost by convection.

Greenhouse gases

By their percentage contribution to the greenhouse effect on Earth the four major gases are:https://en.wikipedia.org/wiki/Greenhouse_effect - cite_note-realclimate.org-21
water vapor, 36–70%; carbon dioxide, 9–26%; methane, 4–9%; ozone, 3–7%

The major non-gas contributor to the Earth's greenhouse effect, clouds, also absorb and emit infrared radiation and thus have an effect on radiative properties of the atmosphere.[22]

Role in climate change

Strengthening of the greenhouse effect through human activities is known as the enhanced (or anthropogenic) greenhouse effect.https://en.wikipedia.org/wiki/Greenhouse_effect - cite_note-23 This increase in radiative forcing from human activity is attributable mainly to increased atmospheric carbon dioxide levels.https://en.wikipedia.org/wiki/Greenhouse_effect - cite_note-24 According to the latest Assessment Report from the Intergovernmental Panel on Climate Change, "most of the observed increase in globally averaged temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic greenhouse gas concentrations".https://en.wikipedia.org/wiki/Greenhouse_effect - cite_note-25