Biyani's Think Tank

Concept based notes

Ecology and Environmental Biology

(Zoology-II)

[B.Sc. Part-III]

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Preface

I am glad to present this book, especially designed to serve the needs of the students. The book has been written keeping in mind the general weakness in understanding the fundamental concepts of the topics. The book is self-explanatory and adopts the "Teach Yourself" style. It is based on question-answer pattern. The language of book is quite easy and understandable based on scientific approach.

Any further improvement in the contents of the book by making corrections, omission and inclusion is keen to be achieved based on suggestions from the readers for which the author shall be obliged.

I acknowledge special thanks to Mr. Rajeev Biyani, *Chairman* & Dr. Sanjay Biyani, *Director* (*Acad.*) Biyani Group of Colleges, who are the backbones and main concept provider and also have been constant source of motivation throughout this Endeavour. They played an active role in coordinating the various stages of this Endeavour and spearheaded the publishing work.

I look forward to receiving valuable suggestions from professors of various educational institutions, other faculty members and students for improvement of the quality of the book. The reader may feel free to send in their comments and suggestions to the under mentioned address.

Author

Syllabus

Section-A
Ecology

1. Basic concepts in ecology, its meaning and history.
2. Concepts of limiting factors.
3. Ecosystem : Biotic and abiotic factors.
4. Ecosystem : Production consumption and be composition in an ecosystem : Concepts of food chain, food web, trophic structure, ecological pyramids.
5. Biogeochemical cycles of O2, CO2, H2O, N, P, and role of microbes.
6. Ecosystem : Its homeostatis. Functional aspects. Productivity concepts and its determination, Ecotone, Edge Effects, Niche.
7. Population Ecology : Density an methods of its measurement, natality, mortality, age ratio & distribution, pyramids, fluctuation, biotic potential, dispersal, growth forms, population interactions and propagation. Brief idea of demography.
8. Community Ecology : Characteristics of natural communities, structure, composition, stratification.
9. Ecological succession : Types and Patterns. Concept of climax. Details of xerosere and hydrosere successions.
10. Habitat Ecology : Brief account of Fresh water, marine, terrestrial and Esturarine water.
11. Major biomes and the world.
12. Ecology and Human Future : Growth rate, role of human kind in modifying natural communities in term of public health and welfare with respect to use of pesticides, conservation and pollution.

Section-B
Environmental Biology

1. Environment and its concepts. Global environment. Hydrosphere. Lithosphere.
2. Natural resources : Present status and future needs.

3. Conservation and Management of natural resources : Renewable (Forests. Wildlife, Water) and Non renewable (Water, soil, minerals and energy).
4. Environmental pollution I : General outline and various types of pollution of water air and soil.
5. Environmental pollution II : Sources and remedies for noise, radiation, industrial chemicals, aggrochemicals, insecticides and pesticides and household pollutants.
6. Green house effect, Ozone layer depletion, E1 Nino and La Nina Effects.
7. Radiation and Environment : Types of Radiation, Fall out, Effects of Radiation, Nuclear Accidents.
8. Basic concepts of bioaccumulation, biomagnification, biodegradation of pollutants.

Section-C
Environmental Biology-II

1. Wild Life Conservation : Vanishing and threatened animals and plants with special reference to Rajasthan, Wildlife management efforts by government and non government organizations.
2. Impact of Urbanization : Development and distribution of urban centers. Factors, problems and the solutions of urbanization : Brief idea of Human Population with special reference to India and Rajasthan.
3. Space ecology : Space problems and their solutions, space ecosystem, space colonization.

Ecology Environmental Science

Q.1 Define environment.

Ans. The **natural environment**, commonly referred to simply as the **environment**, is a term that encompasses all living and non-living things occurring naturally on Earth or some region thereof.

The concept of the *natural environment* can be distinguished by components:

- Complete ecological units that function as natural systems without massive human intervention, including all vegetation, animals, microorganisms, soil, rocks, atmosphere and natural phenomena that occur within their boundaries.
- Universal natural resources and physical phenomena that lack clear-cut boundaries, such as air, water, and climate, as well as energy, radiation, electric charge, and magnetism, not originating from human activity.

The natural environment is contrasted with the built environment, which comprises the areas and components that are strongly influenced by humans. A geographical area is regarded as a natural environment (with an indefinite article), if the human impact on it is kept under a certain limited level (similar to section 1 above.

Composition :

Earth science generally recognizes 4 spheres, the lithosphere, the hydrosphere, the atmosphere, and the biosphere[1] as correspondent to rocks, water, air, and life. Some scientiests include, as part of the spheres of the Earth, the cryosphere (corresponding to ice) as a distinct portion of the hydrosphere, as well as the pedosphere (corresponding to soil) as an active and intermixed sphere. Earth science (also known as geoscience, the geosciences or the Earth Sciences), is an all-embracing term for the sciences related to the planet Earth [2]. There are four major disciplines in earth sciences, namely geography, geology, geophysics and geodesy. These major disciplines use physics, chemistry, biology, chronology and mathematics to build a qualitative and quantitative understanding of the principal areas or *spheres* of the Earth system.

Geological activity :

A volcanic fissure and lava channel.

Main article: Geology :

The Earth's crust, or Continental crust, is the outermost solid land surface of the planet, is chemically and mechanically different from underlying mantles, and has been generated largely by igneous processes in which magma (molten rock) cools and solidifies to form solid land. Plate tectonics, mountain ranges, volcanoes, and earthquakes are geological phenomena that can be explained in terms of energy transformations in the Earth's crust, and might be thought of as the process by which the earth resurfaces itself. Beneath the Earth's crust lies the mantle which is heated by the radioactive decay of heavy elements. The mantle is not quite solid and consists of magma which is in a state of semi-perpetual convection. This convection process causes the lithospheric plates to move, albeit slowly. The resulting process is known as plate tectonics.[4][5][6][7] Volcanoes result primarily from the melting of subducted crust material. Crust material that is forced into the Asthenosphere melts, and some portion of the melted material becomes light enough to rise to the surface, giving birth to volcanoes![5]

Biomes

Map of Terrestrial biomes classified by vegetation.

Main article: Biome

Biomes are terminologically similar to the concept of ecosystems, and are climatically and geographically defined areas of ecologically similar climatic conditions such as communities of plants, animals, and soil organisms, often referred to *as* ecosystems. Biomes are defined based on factors such as plant structures (such as trees, shrubs, and grasses), leaf types (such as broadleaf and needleleaf), plant spacing (forest, woodland, savanna), and climate. Unlike ecozones, biomes are not defined by genetic, taxonomic, or historical similarities. Biomes are often identified with particular patterns of ecological succession and climax vegetation.

Wilderness

The High Peaks Wilderness Area in the 6,000,000-acre (2,400,000 ha) Adirondack Park.

Main article: Wilderness

Wilderness is generally defined as a natural environment on Earth that has not been significantly modified by human activity. The WILD Foundation goes into more detail, defining wilderness as: "The most intact, undisturbed wild natural areas left on our planet - those last truly wild places that humans do not control and have not developed with roads, pipelines or other industrial infrastructure."[26] Wilderness areas and protected parks are considered important for the survival of certain species, ecological studies, conservation, solitude, and recreation. Wilderness is deeply valued for cultural, spiritual, moral, and aesthetic reasons. Some nature writers believe wilderness areas are vital for the human spirit and creativity.

The word, "wilderness", derives from the notion of wildness; in other words that which is not controllable by humans. The word's etymology is from the Old English *wildeornes*, which in turn derives from *wildeor* meaning *wild beast* (wild + deor = beast, deer).[28] From this point of view, it is the wildness of a place that makes it a wilderness. The mere presence or activity of people does not disqualify an area from being "wilderness." Many ecosystems that are, or have been, inhabited or influenced by activities of people may still be considered "wild." This way of looking at wilderness includes areas within which natural processes operate without very noticeable human interference.

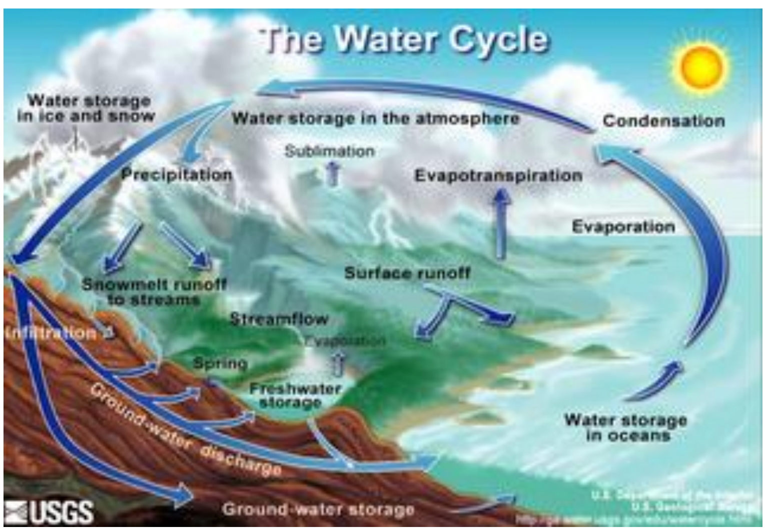
Q.2 Write a short note on biogeochemical cycles.

Ans. Biogeochemical cycles are:

- The **nitrogen cycle** is the biogeochemical cycle that describes the transformations of nitrogen and nitrogen-containing compounds in nature. It is a cycle which includes gaseous components.
- The **water cycle**, also known as the **hydrologic cycle**, describes the continuous movement of water on, above, and below the surface of the

Earth. Since the water cycle is truly a "cycle," there is no beginning or end. Water can change states among liquid, vapor, and ice at various places in the water cycle. Although the balance of water on Earth remains fairly constant over time, individual water molecules can come and go.

- The **carbon cycle** is the biogeochemical cycle by which carbon is exchanged among the biosphere, pedosphere, geosphere, hydrosphere, and atmosphere of the Earth.
- The **oxygen cycle** is the biogeochemical cycle that describes the movement of oxygen within and between its three main reservoirs: the atmosphere (air), the biosphere (living things), and the lithosphere (Earth's crust). The main driving factor of the oxygen cycle is photosynthesis, which is responsible for the modern Earth's atmosphere and life.



A commonly cited example is the water cycle.

In ecology and Earth science, a **biogeochemical cycle** or **nutrient cycle** is a pathway by which a chemical element or molecule moves through both biotic (biosphere) and abiotic (lithosphere, atmosphere, and hydrosphere) compartments of Earth. In effect, the element is recycled, although in some cycles there may be places (called *reservoirs*) where the element is accumulated or held for a long period of time. Water, for example, is always recycled through the water cycle, as shown in the diagram. The water undergoes evaporation, condensation, and precipitation, falling back to Earth clean and fresh. Elements, chemical compounds, and other forms of matter are passed from one organism to another and from one part of the biosphere to another through the biogeochemical cycles.[1]

Systems

All chemical elements occurring in organisms are part of biogeochemical cycles. In addition to being a part of living organisms, these chemical elements also cycle through abiotic factors of ecosystems such as water (hydrosphere), land (lithosphere), and the air (atmosphere). The living factors of the planet can be referred to collectively as the biosphere. All the nutrients—such as carbon, nitrogen, oxygen, phosphorus, and sulfur—used in ecosystems by living organisms operate on a **closed system**; therefore, these chemicals are recycled instead of being lost and replenished constantly such as in an open system.

The energy of an ecosystem occurs on an **open system**; the sun constantly gives the planet energy in the form of light while it is eventually used and lost in the form of heat throughout the trophic levels of a food web. Carbon is used to make carbohydrates, fats, and proteins, the major sources of food energy. These compounds are oxidized to release carbon dioxide, which can be captured by plants to make organic compounds. The chemical reaction is powered by the light energy of the sun. It is possible for an ecosystem to obtain energy without sunlight. Carbon must be combined with hydrogen and oxygen in order to be utilized as an energy source, and this process depends on sunlight. Ecosystems in the deep sea, where no sunlight can penetrate, can use sulfur. Hydrogen sulfide near hydrothermal vents can be utilized by organisms such as the giant tube worm. In the sulfur cycle, sulfur can be forever recycled as a source of energy. Energy can be released through the oxidation and reduction of sulfur compounds (e.g., oxidizing elemental sulfur to sulfite and then to sulfate).

Although the Earth constantly receives more light from the sun, it has only the chemicals from which it originally formed. The only way for Earth to obtain more nutrients is from occasional meteorites from outer space. Because chemicals operate on a closed system and cannot be lost and replenished the way energy can, these chemicals must be recycled throughout all of Earth's processes that use those chemicals or elements. These cycles include both the living biosphere and the nonliving lithosphere, atmosphere, and hydrosphere.

Reservoirs

Coal is a reservoir of carbon

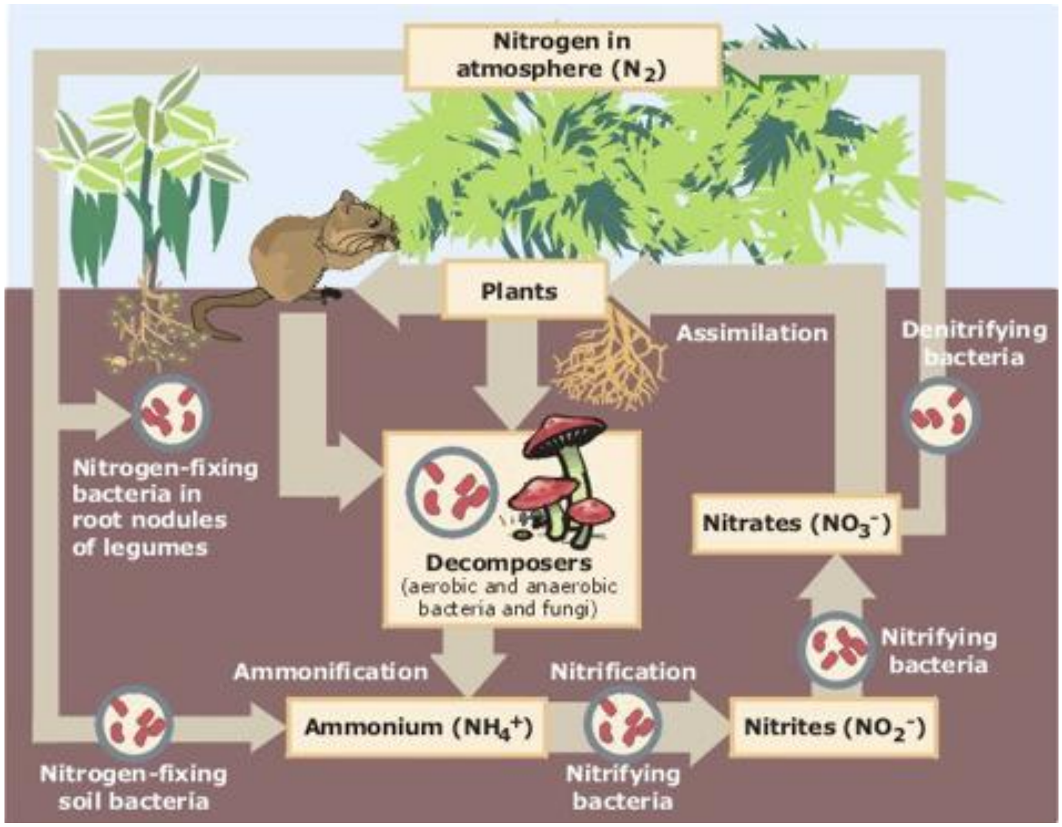
The chemicals are sometimes held for long periods of time in one place. This place is called a *reservoir*, which, for example, includes such things as coal deposits that are storing carbon for a long period of time.[3] When chemicals are held for only short periods of time, they are being held in *exchange pools*. Examples of exchange pools include plants and animals.[3] Plants and animals utilize carbon to produce carbohydrates, fats, and proteins, which can then be used to build their internal structures or to obtain energy. Plants and animals temporarily use carbon in their systems and then release it back into the air or surrounding medium. Generally, reservoirs are abiotic factors whereas exchange pools are biotic factors.[4] Carbon is held for a relatively short time in plants and animals in comparison to coal deposits. The amount of time that a chemical is held in one place is called its *residence*.[3]

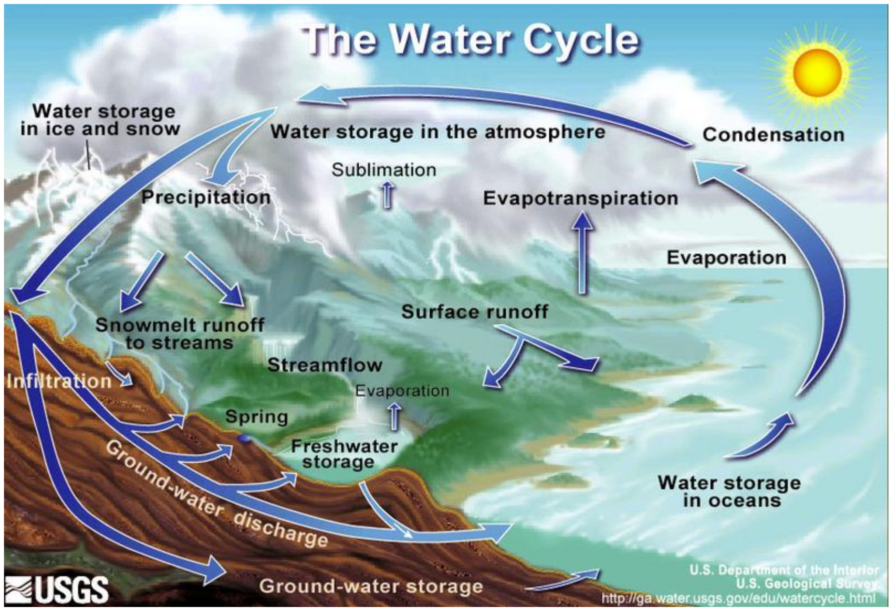
Important Cycles

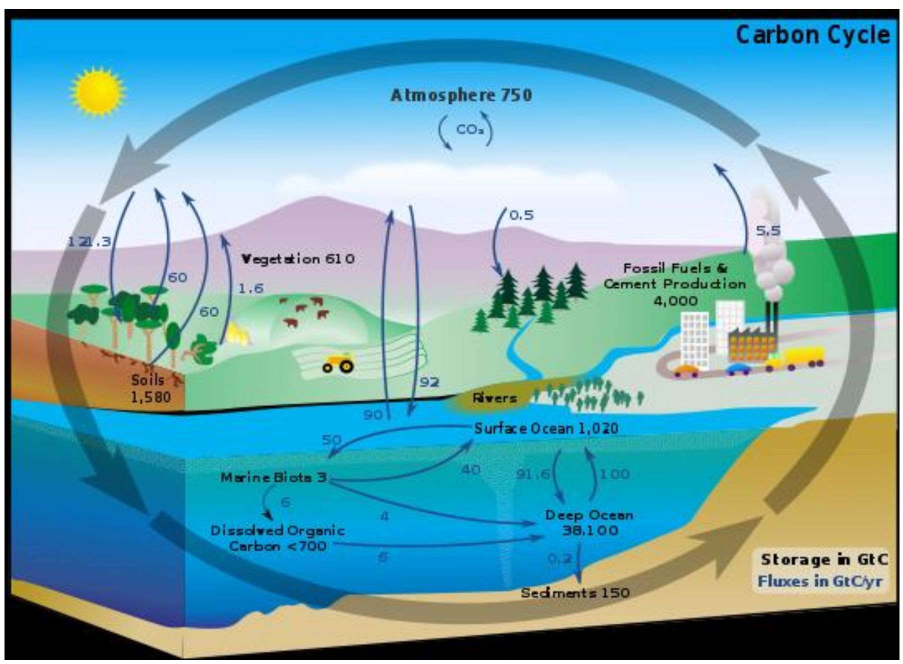
The most well-known and important biogeochemical cycles, for example, include the carbon cycle, the nitrogen cycle, the oxygen cycle, the phosphorus cycle, the sulfur cycle, and the water cycle. There are many biogeochemical cycles that are currently being studied for the first time as climate change and human impacts are drastically changing the speed, intensity, and balance of these relatively unknown cycles. These newly studied biogeochemical cycles include the mercury cycle[5] and the human-caused cycle of atrazine, which may affect certain species.

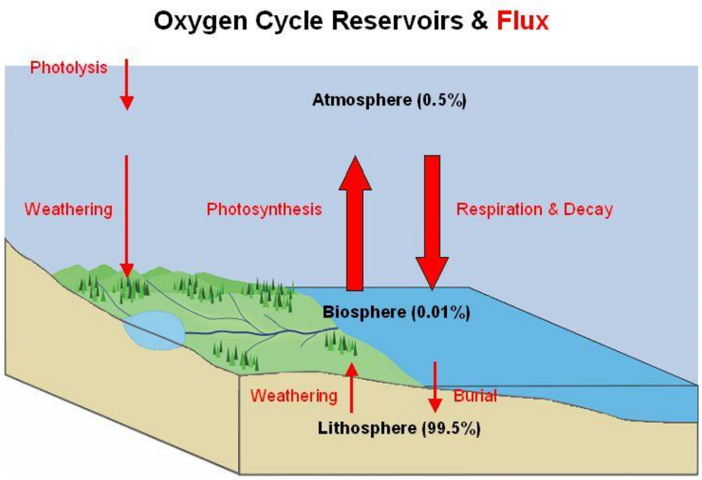
Biogeochemical cycles always involve equilibrium states: a balance in the cycling of the element between compartments. However, overall balance may involve compartments distributed on a global scale.

As biogeochemical cycles describe the movements of substances on the entire globe, the study of these is inherently multidiciplinary. The carbon cycle may be related to research in ecology and atmospheric sciences.[6] Biochemical dynamics would also be related to the fields of geology and pedology (soil study).


Nitrogen in atmosphere (N_2)
Plants
Assimilation
Denitrifying bacteria
Nitrogen-fixing bacteria in root nodules of legumes
Decomposers
(aerobic and anaerobic bacteria and fungi)
Nitrates (NO_3^-)
Nitrifying bacteria
Ammonification
Nitrification
Ammonium (NH_4^+)
Nitrites (NO_2^-)
Nitrogen-fixing soil bacteria
Nitrifying bacteria


The Water Cycle
Water storage in ice and snow
Water storage in the atmosphere
Condensation
Sublimation
Precipitation
Evapotranspiration
Evaporation
Surface runoff
Snowmelt runoff to streams
Streamflow
Infiltration
Evaporation
Spring
Freshwater storage
Water storage in oceans
Ground-water discharge
Ground-water storage
USGS
U.S. Department of the Interior
U.S. Geological Survey
http://ga.water.usgs.gov/edu/watercycle.html


Carbon Cycle
Atmosphere 750
CO₂
121.3
60
60
1.6
Vegetation 610
0.5
5.5
Fossil Fuels & Cement Production 4,000
Soils 1,580
92
90
Rivers
Surface Ocean 1,020
50
40
91.6
100
Marine Biota 3
6
4
Deep Ocean 38,100
Dissolved Organic Carbon <700
6
0.2
Sediments 150
Storage in GtC
Fluxes in GtC/yr



Q.3 Write an essay on natural resource

Ans. **Natural resources** (economically referred to as **land** or **raw materials**) occur naturally within environments that exist relatively undisturbed by mankind, in a natural form. A natural resource is often characterized by amounts of biodiversity existent in various ecosystems.

Natural resources are derived from the environment. Many of them are essential for our survival while others are used for satisfying our wants. Natural resources may be further classified in different ways.

Classification

On the basis of origin, resources may be divided into:

- **Biotic** - Biotic resources are the ones which are obtained from the biosphere. Forests and their products, animals, birds and their products, fish and other marine organisms are important examples. Minerals such as coal and petroleum are also included in this category because they were formed from decayed organic matter.
- **Abiotic** - Abiotic resources comprise of non-living things. Examples include land, water, air and minerals such as gold, iron, copper, silver etc.

Considering their stage of development, natural resources may be referred to in the following ways:

- **Potential Resources** - Potential resources are those which exist in a region and may be used in the future. For example, mineral oil may exist in many parts of India having sedimentary rocks but till the time it is actually drilled out and put into use, it remains a potential resource.
- **Actual Resources** are those which have been surveyed, their quantity and quality determined and are being used in present times. For example, the petroleum and the natural gas which is obtained from the Bombay High Fields. The development of an actual resource, such as wood processing depends upon the technology available and the cost involved. That part of the actual resource which can be developed profitably with available technology is called a reserve.

With respect to renewability, natural resources can be categorized as follows:

- **Renewable Resources** - Renewable resources are the ones which can be replenished or reproduced easily. Some of them, like sunlight, air, wind, etc., are continuously available and their quantity is not affected by human consumption. Many renewable resources can be depleted by human use, but may also be replenished, thus maintaining a flow. Some of these, like agricultural crops, take a short time for renewal; others, like water, take a comparatively longer time, while still others, like forests, take even longer.
- **Non-renewable Resources** - Non-renewable resources are formed over very long geological periods. Minerals and fossils are included in this category. Since their rate of formation is extremely slow, they cannot be replenished once they get depleted. Out of these, the metallic minerals can be re-used by recycling them. But coal and petroleum cannot be recycled.

Examples

Some examples of natural resources include the following:

- Agriculture—Agronomy is the science and technology of using plants for food, fuel, feed, and fiber.
- Air, wind and atmosphere
- Plants / Flora
- Animals / Fauna
- Wildlife
- Coal and Fossil fuels
- Forestry & Agroforestry
- Range and Pasture
- Soils
- Water, Oceans, Lakes and Rivers

Management :

Main article: Natural resource management

Natural resource management is a discipline in the management of natural resources such as land, water, soil, plants and animals, with a particular focus on how management affects the quality of life for both present and future generations. Natural resource management is interrelated with the concept of sustainable development, a principle which forms a basis for land management and environmental governance throughout the world.

In contrast to the policy emphases of Urban planning and the broader concept of Environmental management, Natural resource management specifically focuses on a scientific and technical understanding of resources and ecology and the life-supporting capacity of those resources.[3]

Depletion :

In recent years, the depletion of natural resources and attempts to move to sustainable development have been a major focus of development agencies. This is of particular concern in rainforest regions, which hold most of the Earth's natural biodiversity - irreplaceable genetic natural capital. Conservation of natural resources is the major focus of natural capitalism, environmentalism, the ecology movement, and green politics. Some view this depletion as a major source of social unrest and conflicts in developing nations.

Mining, petroleum extraction, fishing, hunting, and forestry are generally considered natural-resource industries. Agriculture is considered a man-made resource. Theodore Roosevelt, a well-known conservationist and former United States president, was opposed to unregulated natural resource extraction. The term is defined by the United States Geological Survey as "The Nation's natural resources include its minerals, energy, land, water, and biota.

Protection :

Conservation biology is the scientific study of the nature and status of Earth's biodiversity with the aim of protecting species, their habitats, and ecosystems from excessive rates of extinction.[5][6] It is an interdisciplinary subject drawing on sciences, economics, and the practice of natural resource management. The term *conservation biology* was introduced as the title of a conference held University of California at San Diego in La Jolla, California in 1978 organized by biologists Bruce Wilcox and Michael Soulé.

Habitat conservation is a land management practice that seeks to conserve, protect and restore, habitat areas for wild plants and animals, especially conservation reliant species, and prevent their extinction, fragmentation or reduction in range.[11] It is a priority of many groups that cannot be easily characterized in terms of any one ideology.

Define ecosystem :

An **ecosystem** is a natural unit consisting of all plants, animals and micro-organisms (biotic factors) in an area functioning together with all of the physical (abiotic) factors of the environment. Ecosystems can be permanent or temporary. An ecosystem is a unit of interdependent organisms which share the same habitat. Ecosystems usually form a number of food webs.

The High Peaks Wilderness Area in the 6,000,000-acre (2,400,000 ha) Adirondack Park is an example of a diverse ecosystem.

The term "ecosystem" was coined in 1930 by Roy Clapham to denote the combined physical and biological components of an environment. British ecologist Arthur Tansley later refined the term, describing it as "The whole system,… including not only the organism-complex, but also the whole complex of physical factors forming what we call the environment".[2] Tansley regarded ecosystems not simply as natural units, but as "mental isolates".[2] Tansley later[3] defined the spatial extent of ecosystems using the term "ecotope".

Central to the ecosystem concept is the idea that living organisms interact with every other element in their local environment. Eugene Odum, a founder of ecology, stated: "Any unit that includes all of the organisms (ie: the "community") in a given area interacting with the physical environment so that a flow of energy leads to clearly defined trophic structure, biotic diversity, and material cycles (ie: exchange of materials between living and nonliving parts) within the system is an ecosystem."[4] The human ecosystem concept is then grounded in the deconstruction of the human/nature dichotomy and the premise that all species are ecologically integrated with each other, as well as with the abiotic constituents of their biotope.[*citation needed*]

Examples of ecosystems

- Agroecosystem
- Aquatic ecosystem
- Chaparral
- Coral reef
- Desert
- Greater Yellowstone Ecosystem
- Human ecosystem
- Large marine ecosystem
- Littoral zone
- Marine ecosystem
- Rainforest
- Savanna
- Subsurface Lithoautotrophic Microbial Ecosystem
- Taiga
- Terrestrial ecosystem
- Tundra
- Urban ecosystem

Introduction of new elements, whether biotic or abiotic, into an ecosystem tend to have a disruptive effect. In some cases, this can lead to ecological collapse or "trophic cascading" and the death of many species within the ecosystem. Under this deterministic vision, the abstract notion of ecological health attempts to measure the robustness and recovery capacity for an ecosystem; i.e. how far the ecosystem is away from its steady state.

Often, however, ecosystems have the ability to rebound from a disruptive agent. The difference between collapse or a gentle rebound is determined by two factors—the toxicity of the introduced element and the resiliency of the original ecosystem.

Ecosystems are primarily governed by stochastic (chance) events, the reactions these events provoke on non-living materials, and the responses by organisms to the conditions surrounding them. Thus, an ecosystem results from the sum of individual responses of organisms to stimuli from elements in the environment. The presence or absence of populations merely depends on reproductive and dispersal success, and population levels fluctuate in response to stochastic events. As the number of species in an ecosystem is higher, the number of stimuli is also higher. Since the beginning of life organisms have survived continuous change through natural selection of successful feeding, reproductive and dispersal behavior. Through natural selection the planet's species have continuously adapted to change through variation in their biological composition and distribution. Mathematically it can be demonstrated that greater numbers of different interacting factors tend to dampen fluctuations in each of the individual factors. Given the great diversity among organisms on earth, most ecosystems only changed very gradually, as some species would disappear while others would move in. Locally, sub-populations continuously go extinct, to be replaced later through dispersal of other sub-populations. Stochastists do recognize that certain intrinsic regulating mechanisms occur in nature. Feedback and response mechanisms at the species level regulate population levels, most notably through territorial behaviour. Andrewatha and Birch[13] suggest that territorial behaviour tends to keep populations at levels where food supply is not a limiting factor. Hence, stochastists see territorial behaviour as a regulatory mechanism at the species level but not at the ecosystem level. Thus, in their vision, ecosystems are not regulated by feedback and response mechanisms from the (eco)system itself and there is no such thing as a balance of nature.

If ecosystems are indeed governed primarily by stochastic processes, they may be more resilient to sudden change than each species individually. In the absence of a balance of nature, the species composition of ecosystems would undergo shifts that would depend on the nature of the change, but entire ecological collapse would probably be infrequent events.

The theoretical ecologist Robert Ulanowicz has used information theory tools to describe the structure of ecosystems, emphasizing mutual information (correlations) in studied systems. Drawing on this methodology and prior observations of complex ecosystems, Ulanowicz depicts approaches to determining the stress levels on ecosystems and predicting system reactions to defined types of alteration in their settings (such as increased or reduced energy flow, and eutrophication.[14]

Q.4 Write an essay on Biomes

Ans. Terrestrial biomes

Tundra

Taiga/boreal forests

Montane grasslands and shrublands

Temperate coniferous forests

Tropical and subtropical coniferous forests

Temperate broadleaf and mixed forests

Mediterranean forests, woodlands, and scrub

Tropical and subtropical moist broadleaf forests

Tropical and subtropical dry broadleaf forests

Temperate grasslands, savannas, and shrublands

Tropical and subtropical grasslands, savannas, and shrublands

Deserts and xeric shrublands

Flooded grasslands and savannas

Riparian

Wetland

Aquatic biomes

Pond

Littoral/intertidal zone

Mangrove forests

Kelp forest

Coral reef

Neritic zone

Continental shelf

Pelagic zone

Benthic zone

Hydrothermal vents

Cold seeps

Pack ice

Other biomes

Endolithic zone

Biomes are climatically and geographically defined areas of ecologically similar climatic conditions such as communities of plants, animals, and soil organisms,[1] and are often referred to as ecosystems. Biomes are defined by factors such as plant structures (such as trees, shrubs, and grasses), leaf types (such as broadleaf and needleleaf), plant spacing (forest, woodland, savanna), and climate. Unlike ecozones, biomes are not defined by genetic, taxonomic, or historical similarities. Biomes are often identified with particular patterns of ecological succession and climax vegetation (quasi-equilibrium state of the local ecosystem). An ecosystem has many biotopes and a biome is a major habitat type. A major habitat type, however, is a compromise, as it has an intrinsic inhomogeneity.

The biodiversity characteristic of each biome, especially the diversity of fauna and subdominant plant forms, is a function of abiotic factors and the biomass productivity of the dominant vegetation. In terrestrial biomes, species diversity tends to correlate positively with net primary productivity, moisture availability, and temperature.

Ecoregions are grouped into both biomes and ecozones.

A fundamental classification of biomes is into:

1. Terrestrial (land) biomes

2. Freshwater biomes

3. Marine biomes

Biomes are often known in English by local names. For example, a Temperate grassland or shrubland biome is known commonly as steppe in central Asia, prairie in North America, and pampas in South America. Tropical grasslands are known as savanna in Australia, whereas in Southern Africa it is known as veldt (from Afrikaans).

Sometimes an entire biome may be targeted for protection, especially under an individual nation's Biodiversity Action Plan.

Climate is a major factor determining the distribution of terrestrial biomes. Among the important climatic factors are:

* latitude: Arctic, boreal, temperate, subtropical, tropical.

* humidity: humid, semi-humid, semi-arid, and arid.

- Seasonal variation: Rainfall may be distributed evenly throughout the year or be marked by seasonal variations.

- Dry summer, wet winter: Most regions of the earth receive most of their rainfall during the summer months; Mediterranean climate regions receive their rainfall during the winter months.

* Elevation: Increasing elevation causes a distribution of habitat types similar to that of increasing latitude.

The most widely used systems of classifying biomes correspond to latitude (or temperature zoning) and humidity. Biodiversity generally increases away from the poles towards the equator and increases with humidity.

Biome Classification Schemes :

Biome classification schemes seek to define biomes using climatic measurements. Particularly in the 1970s and 1980s there was a significant push to understand the relationships between these measurements and properties of ecosystem energetics because such discoveries would enable the prediction of rates of energy capture and transfer among components within ecosystems. Such a study was conducted by Sims et al. (1978) on North American grasslands. The study found a positive logistic correlation between evapotranspiration in mm/yr and above ground net primary production in g/m^2/yr. More general results from the study were that precipitation and water use lead to aboveground primary production, solar radiation and temperature lead to belowground primary production (roots), and temperature and water lead to cool and warm season growth habit.[3] These findings help explain the categories used in Holdridge's bioclassification scheme, which were then later simplified in Whittaker's. The number of classification schemes and the variety of determinants used in those schemes, however, should be taken as a strong indicator that biomes do not all fit perfectly into the classification schemes created.

Holdridge Scheme :

The Holdridge classification scheme was developed by L. R. Holdridge, a botanist. It maps climates based on four categories:

* Average total precipitation (cm) on a lograrithmic scale
* Potential evapotranspiration ratio: the potential evapotranspiration divided by the precipitation; the ratio increases from humid to arid regions.
* Potential evapotranspiration
* Mean annual biotemperature (°C): calculated from monthly mean temperatures after converting any mean temperature to 0°C, based on the assumption that temperatures at or below freezing all have the same effect on plants, and delineating between -10°C and -30°C would yield unrealistic results.

In this scheme, climates are classified based on the biological effects of temperature and rainfall on vegetation under the assumption that these two abiotic factors are the largest determinants of the type of vegetation found in an area. Holdridge uses the 4 axis to define 30 so called "humidity provinces," which are clearly visible in the Holdridge diagram. While the scheme largely ignores soil and sun exposure, Holdridge did acknowledge that these, too, were important factors in biome determination.

Whittaker's Biome-type Classification Scheme :

Whittaker appreciated biome-types as a representation of the great diversity of the living world, and saw the need to establish a simple way to classify these biome-types. Whittaker based his classification scheme on two abiotic factors: Precipitation and Temperature. His scheme can be seen as a simplification of Holdridge's, one more readily accessible, but perhaps missing the greater specificity that Holdrige's provides.

Whittaker based his representation of global biomes on both previous theoretical assertions as well as an ever increasing empirical sampling of global ecosystems. Whittaker was in a unique position to make such a holistic assertion as he had previously compiled a review of biome classification.

The Whittaker Classification Scheme can be viewed at the following address: here

Key definitions for understanding Whittaker's Scheme

* **physiognomy**: The apparent characteristics, outward features, or appearance of ecological communities or species.
* biome: a grouping terrestrial ecosystems on a given continent that are similar in vegetation structure, physiognomy, features of the environment and characteristics of their animal communities
* formation: a major kind of community of plants on a given continent
* biome-type: grouping of convergent biomes or formations of different continents; defined by physiognomy
* formation-type: grouping of convergent formations

Whittaker's distinction between biome and formation can be simplified: formation is used when applied to plant communities only, while biome is used when concerned with both plants and animals. Whittaker's convention of biome-type or formation-type is simply a broader method to categorize similar communities. The world biome-types, as displayed on a world map, can be viewed at the following link: here

Whittaker's parameters for classifying biome-types

Whittaker, seeing the need for a simpler way to express the relationship of community structure to the environment, used what he called "gradient analysis" of ecocline patterns to relate communities to climate on a worldwide scale. Whittaker considered four main ecoclines in the terrestrial realm.

1. **Intertidal levels**: The wetness gradient of areas that are exposed to alternating water and dryness with intensities that vary by location from high to low tide
2. Climatic moisture gradient
3. Temperature gradient by altitude
4. Temperature gradient by latitude

Along these gradients, Whittaker noted several trends that allow him to qualitatively establish biome-types.

- The gradient runs from favorable to extreme with corresponding changes in productivity.
- Changes in physiognomic complexity vary with the favorability of the environment (decreasing community structure and reduction of stratal differentiation as the environment becomes less favorable).
- Trends in diversity of structure follow trends in species diversity; alpha and beta species diversities decrease from favorable to extreme environments.
- Each growth-form (i.e. grasses, shrubs, etc.) has its characteristic place of maximum importance along the ecoclines.
- The same growth forms may be dominant in similar environments in widely different parts of the world.

Whittaker summed the effects of gradients (3) and (4), to get an overall temperature gradient and combined this with gradient (2), the moisture gradient, to express the above conclusions in what is known as the Whittaker Classification Scheme. The scheme graphs average annual precipitation (x-axis) versus average annual temperature (y-axis) to classify biome-types.

Walter System :

The Heinrich Walter classification scheme was developed by Heinrich Walter, a German ecologist. It differs from both the Whittaker and Holdridge schemes because it takes into account the seasonality of temperature and precipitation. The system, also based on precipitation and temperature, finds 9 major biomes, with the important climate traits and vegetation types summarized in the accompanying table. The boundaries of each biome correlate to the conditions of moisture and cold stress that are strong determinants of plant form, and therefore the vegetation that defines the region.

I. **Equatorial**
- Always moist and lacking temperature seasonality
- Evergreen tropical rain forest

II. **Tropical**
- Summer rainy season and cooler "winter" dry season
- Seasonal forest, scrub, or savanna

III. **Subtropical**
- Highly seasonal, arid climate
- Desert vegetation with considerable exposed surface

IV. **Mediterranean**
- Winter rainy season and summer drought

- Sclerophyllous (drought-adapted), frost-sensitive shrublands and woodlands

V. Warm temperate

- Occasional frost, often with summer rainfall maximum
- Temperate evergreen forest, somewhat frost-sensitive

VI. Nemoral

- Moderate climate with winter freezing
- Frost-resistant, deciduous, temperate forest

VII. Continental

- Arid, with warm or hot summers and cold winters
- Grasslands and temperate deserts

VIII. Boreal

- Cold temperate with cool summers and long winters
- Evergreen, frost-hardy needle-leaved forest (taiga)

IX. Polar

- Very short, cool summers and long, very cold winters
- Low, evergreen vegetation, without trees, growing over permanently frozen soils

Bailey System :

Robert G. Bailey almost developed a biogeographical classification system for the United States in a map published in 1976. Bailey subsequently expanded the system to include the rest of South America in 1981 and the world in 1989. The Bailey system is based on climate and is divided into seven domains (Polar, Humid Temperate, Dry, Human, and Humid

Tropical), with further divisions based on other climate characteristics (subarctic, warm temperate, hot temperate, and subtropical; marine and continental; lowland and mountain).

- 100 Polar Domain
- 120 Tundra Division
- M120 Tundra Division - Mountain Provinces
- 130 Subarctic Division
- M130 Subarctic Division - Mountain Provinces

200 Humid Temperate Domain

- 210 Warm Continental Division
- M210 Warm Continental Division - Mountain Provinces
- 220 Hot Continental Division
- M220 Hot Continental Division - Mountain Provinces
- 230 Subtropical Division
- M230 Subtropical Division - Mountain Provinces
- 240 Marine Division
- M240 Marine Division - Mountain Provinces
- 250 Prairie Division
- 260 Mediterranean Division
- M260 Mediterranean Division - Mountain Provinces

300 Dry Domain

- 310 Tropical/Subtropical Steppe Division
- M310 Tropical/Subtropical Steppe Division - Mountain Provinces

WWF system :

A team of biologists convened by the World Wide Fund for Nature (WWF) developed an ecological land classification system that identified fourteen biomes,[8] called major habitat types, and further divided the world's land area into 867 terrestrial ecoregions. Each terrestrial Ecoregion has a specific EcoID, fomat XXnnNN (XX is the Ecozone, nn is the Biome number, NN is the individual number). This classification is used to define the Global 200 list of ecoregions identified by the WWF as priorities for conservation. The WWF major habitat types are:

- Tropical and subtropical moist broadleaf forests (tropical and subtropical, humid)
- Tropical and subtropical dry broadleaf forests (tropical and subtropical, semi-humid)
- Tropical and subtropical coniferous forests (tropical and subtropical, semi-humid)
- Temperate broadleaf and mixed forests (temperate, humid)
- Temperate coniferous forests (temperate, humid to semi-humid)
- Boreal forests/taiga (subarctic, humid)
- Tropical and subtropical grasslands, savannas, and shrublands (tropical and subtropical, semi-arid)
- Temperate grasslands, savannas, and shrublands (temperate, semi-arid)
- Flooded grasslands and savannas (temperate to tropical, fresh or brackish water inundated)
- Montane grasslands and shrublands (alpine or montane climate)
- Tundra (Arctic)
- Mediterranean forests, woodlands, and scrub or Sclerophyll forests (temperate warm, semi-humid to semi-arid with winter rainfall)

- Deserts and xeric shrublands (temperate to tropical, arid)
- Mangrove (subtropical and tropical, salt water inundated)

Freshwater biomes :

According to the World Wildlife Fund, the following are classified as freshwater biomes:

1- Large lakes

2- Large river deltas

3- Polar freshwaters

4- Montane freshwaters

5- Temperate coastal rivers

6- Temperate floodplain rivers and wetlands

7- Temperate upland rivers

8- Tropical and subtropical coastal rivers

9- Tropical and subtropical floodplain rivers and wetlands

10- Tropical and subtropical upland rivers

11- Xeric freshwaters and endorheic basins

12- Oceanic islands

Realms or Ecozones (terrestrial and freshwater, WWF)

1- NA Nearctic

2- PA Palearctic

3- AT Afrotropic

4- IM Indomalaya

5- AA Australasia

6- NT Neotropic

7- OC Oceania

8- AN Antarctic

Marine biomes :

Marine biomes (major habitat types), Global 200 (WWF)

Biomes of the coastal & continental shelf areas (Neritic zone - List of ecoregions (WWF)):

- Polar
- Temperate shelves and sea
- Temperate upwelling
- Tropical upwelling
- Tropical coral[10]

Realms or Ecozones (marine, WWF) :

- North Temperate Atlantic
- Eastern Tropical Atlantic
- Western Tropical Atlantic
- South Temperate Atlantic
- North Temperate Indo-Pacific
- Central Indo-Pacific
- Eastern Indo-Pacific
- Western Indo-Pacific

- South Temperate Indo-Pacific
- Southern Ocean
- Antarctic
- Arctic
- Mediterranean

Other marine habitat types :

- Hydrothermal vents
- Cold seeps
- Benthic zone
- Pelagic zone (trades and westerlies)
- Abyssal
- Hadal (ocean trench)

Q.5 Write an essay on Air pollution

Ans.

Air pollution from World War II production.

Opaque air seen in Santiagos skyes is smog, major pollution problem

Air pollution is the introduction of chemicals, particulate matter, or biological materials that cause harm or discomfort to humans or other living organisms, or damages the natural environment, into the atmosphere.

The atmosphere is a complex, dynamic natural gaseous system that is essential to support life on planet Earth. Stratospheric ozone depletion due to air pollution has long been recognized as a threat to human health as well as to the Earth's ecosystems.

Pollutants

Before flue gas desulfurization was installed, the emissions from this power plant in New Mexico contained excessive amounts of sulfur dioxide.

An air pollutant is known as a substance in the air that can cause harm to humans and the environment. Pollutants can be in the form of solid particles, liquid droplets, or gases. In addition, they may be natural or man-made.

Pollutants can be classified as either primary or secondary. Usually, primary pollutants are substances directly emitted from a process, such as ash from a volcanic eruption, the carbon monoxide gas from a motor vehicle exhaust or sulfur dioxide released from factories.

Secondary pollutants are not emitted directly. Rather, they form in the air when primary pollutants react or interact. An important example of a secondary pollutant is ground level ozone — one of the many secondary pollutants that make up photochemical smog.

Note that some pollutants may be both primary and secondary: that is, they are both emitted directly and formed from other primary pollutants.

About 4 percent of deaths in the United States can be attributed to air pollution, according to the Environmental Science Engineering Program at the Harvard School of Public Health.

Major primary pollutants produced by human activity include:

- Sulfur oxides (SO_x) - especially sulfur dioxide, a chemical compound with the formula SO_2. SO_2 is produced by volcanoes and in various industrial processes. Since coal and petroleum often contain sulfur compounds, their combustion generates sulfur dioxide. Further oxidation of SO_2, usually in the presence of a catalyst such as NO_2, forms H_2SO_4, and thus acid rain.[2] This is one of the causes for concern over the environmental impact of the use of these fuels as power sources.
- Nitrogen oxides (NO_x) - especially nitrogen dioxide are emitted from high temperature combustion. Can be seen as the brown haze dome above or plume downwind of cities.Nitrogen dioxide is the chemical compound with the formula NO_2. It is one of the several nitrogen oxides. This reddish-brown toxic gas has a characteristic sharp, biting odor. NO_2 is one of the most prominent air pollutants.
- Carbon monoxide - is a colourless, odourless, non-irritating but very poisonous gas. It is a product by incomplete combustion of fuel such as natural gas, coal or wood. Vehicular exhaust is a major source of carbon monoxide.
- Carbon dioxide (CO_2) - a greenhouse gas emitted from combustion but is also a gas vital to living organisms. It is a natural gas in the atmosphere.
- Volatile organic compounds - VOCs are an important outdoor air pollutant. In this field they are often divided into the separate categories of methane (CH_4) and non-methane (NMVOCs). Methane is an extremely efficient greenhouse gas which contributes to enhanced global warming. Other hydrocarbon VOCs are also significant

greenhouse gases via their role in creating ozone and in prolonging the life of methane in the atmosphere, although the effect varies depending on local air quality. Within the NMVOCs, the aromatic compounds benzene, toluene and xylene are suspected carcinogens and may lead to leukemia through prolonged exposure. 1,3-butadiene is another dangerous compound which is often associated with industrial uses.

- Particulate matter - Particulates, alternatively referred to as particulate matter (PM) or fine particles, are tiny particles of solid or liquid suspended in a gas. In contrast, aerosol refers to particles and the gas together. Sources of particulate matter can be man made or natural. Some particulates occur naturally, originating from volcanoes, dust storms, forest and grassland fires, living vegetation, and sea spray. Human activities, such as the burning of fossil fuels in vehicles, power plants and various industrial processes also generate significant amounts of aerosols. Averaged over the globe, anthropogenic aerosols—those made by human activities—currently account for about 10 percent of the total amount of aerosols in our atmosphere. Increased levels of fine particles in the air are linked to health hazards such as heart disease, altered lung function and lung cancer.
    - Toxic metals, such as lead, cadmium and copper.
    - Chlorofluorocarbons (CFCs) - harmful to the ozone layer emitted from products currently banned from use.
    - Ammonia (NH_3) - emitted from agricultural processes. Ammonia is a compound with the formula NH_3. It is normally encountered as a gas with a characteristic pungent odor. Ammonia contributes significantly to the nutritional needs of terrestrial organisms by serving as a precursor to foodstuffs and fertilizers. Ammonia, either directly or indirectly, is also a building block for the synthesis of many pharmaceuticals. Although in wide use, ammonia is both caustic and hazardous.

- Odors — such as from garbage, sewage, and industrial processes
- Radioactive pollutants - produced by nuclear explosions, war explosives, and natural processes such as the radioactive decay of radon.

Secondary pollutants include:

- Particulate matter formed from gaseous primary pollutants and compounds in photochemical smog .Smog is a kind of air pollution; the word "smog" is a portmanteau of smoke and fog. Classic smog results from large amounts of coal burning in an area caused by a mixture of smoke and sulfur dioxide. Modern smog does not usually come from coal but from vehicular and industrial emissions that are acted on in the atmosphere by sunlight to form secondary pollutants that also combine with the primary emissions to form photochemical smog.
- Ground level ozone (O_3) formed from NO_x and VOCs. Ozone (O_3) is a key constituent of the troposphere (it is also an important constituent of certain regions of the stratosphere commonly known as the Ozone layer). Photochemical and chemical reactions involving it drive many of the chemical processes that occur in the atmosphere by day and by night. At abnormally high concentrations brought about by human activities (largely the combustion of fossil fuel), it is a pollutant, and a constituent of smog.
- Peroxyacetyl nitrate (PAN) - similarly formed from NO_x and VOCs.

Minor air pollutants include:

- A large number of minor hazardous air pollutants. Some of these are regulated in USA under the Clean Air Act and in Europe under the Air Framework Directive.
- A variety of persistent organic pollutants, which can attach to particulate matter.

Persistent organic pollutants (POPs) are organic compounds that are resistant to environmental degradation through chemical, biological, and photolytic processes. Because of this, they have been observed to persist in the environment, to be capable of long-range transport, bioaccumulate in human and animal tissue, biomagnify in food chains, and to have potential significant impacts on human health and the environment.

Sources :

Controlled burning of a field outside of Statesboro, Georgia in preparation for spring planting

Sources of air pollution refer to the various locations, activities or factors which are responsible for the releasing of pollutants in the atmosphere. These sources can be classified into two major categories which are:

Anthropogenic sources (human activity) mostly related to burning different kinds of fuel

- "Stationary Sources" include smoke stacks of power plants, manufacturing facilities (factories) and waste incinerators, as well as furnaces and other types of fuel-burning heating devices
- "Mobile Sources" include motor vehicles, marine vessels, aircraft and the effect of sound etc.
- Chemicals, dust and controlled burn practices in agriculture and forestry management. Controlled or prescribed burning is a technique sometimes used in forest management, farming, prairie restoration or greenhouse gas abatement. Fire is a natural part of both forest and grassland ecology and controlled fire can be a tool for foresters. Controlled burning stimulates the germination of some desirable forest trees, thus renewing the forest.
- Fumes from paint, hair spray, varnish, aerosol sprays and other solvents

- Waste deposition in landfills, which generate methane.Methane is not toxic; however, it is highly flammable and may form explosive mixtures with air. Methane is also an asphyxiant and may displace oxygen in an enclosed space. Asphyxia or suffocation may result if the oxygen concentration is reduced to below 19.5% by displacement
- Military, such as nuclear weapons, toxic gases, germ warfare and rocketry

Natural sources :

- Dust from natural sources, usually large areas of land with little or no vegetation.
- Methane, emitted by the digestion of food by animals, for example cattle.
- Radon gas from radioactive decay within the Earth's crust. Radon is a colorless, odorless, naturally occurring, radioactive noble gas that is formed from the decay of radium. It is considered to be a health hazard. Radon gas from natural sources can accumulate in buildings, especially in confined areas such as the basement and it is the second most frequent cause of lung cancer, after cigarette smoking.
- Smoke and carbon monoxide from wildfires.
- Volcanic activity, which produce sulfur, chlorine, and ash particulates.

Emission factors :

Main article: AP 42 Compilation of Air Pollutant Emission Factors

Air pollutant emission factors are representative values that attempt to relate the quantity of a pollutant released to the ambient air with an activity associated with the release of that pollutant. These factors are usually expressed as the weight of pollutant divided by a unit weight, volume, distance, or duration of the activity emitting the pollutant (e.g., kilograms of particulate emitted per megagram of coal burned). Such factors facilitate estimation of emissions from various sources of air pollution. In most cases, these factors are simply averages of all available data of acceptable quality, and are generally assumed to be representative of long-term averages.

The United States Environmental Protection Agency has published a compilation of air pollutant emission factors for a multitude of industrial sources.[2] The United Kingdom, Australia, Canada and many other countries have published similar compilations, as well as the European Environment Agency.[3][4][5][6][7]

Indoor air quality (IAQ) :

A lack of ventilation indoors concentrates air pollution where people often spend the majority of their time. Radon (Rn) gas, a carcinogen, is exuded from the Earth in certain locations and trapped inside houses. Building materials including carpeting and plywood emit formaldehyde (H_2CO) gas. Paint and solvents give off volatile organic compounds (VOCs) as they dry. Lead paint can degenerate into dust and be inhaled. Intentional air pollution is introduced with the use of air fresheners, incense, and other scented items. Controlled wood fires in stoves and fireplaces can add significant amounts of smoke particulates into the air, inside and out[8]. Indoor pollution fatalities may be caused by using pesticides and other chemical sprays indoors without proper ventilation.

Carbon monoxide (CO) poisoning and fatalities are often caused by faulty vents and chimneys, or by the burning of charcoal indoors. Chronic carbon monoxide poisoning can result even from poorly adjusted pilot lights. Traps are built into all domestic plumbing to keep sewer gas, hydrogen sulfide, out of interiors. Clothing emits tetrachloroethylene, or other dry cleaning fluids, for days after dry cleaning.

Though its use has now been banned in many countries, the extensive use of asbestos in industrial and domestic environments in the past has left a potentially very dangerous material in many localities. Asbestosis is a chronic inflammatory medical condition affecting the tissue of the lungs. It occurs after long-term, heavy exposure to asbestos from asbestos-containing materials in structures. Sufferers have severe dyspnea (shortness of breath) and are at an increased risk regarding several different types of lung cancer. As clear explanations are not always stressed in non-technical literature, care should be taken to distinguish between several forms of relevant diseases. According to the World Health Organisation (WHO), these may defined as; asbestosis, *lung cancer*, and *mesothelioma* (generally a very rare form of cancer, when more widespread it is almost always associated with prolonged exposure to asbestos).

Biological sources of air pollution are also found indoors, as gases and airborne particulates. Pets produce dander, people produce dust from minute skin flakes and decomposed hair, dust mites in bedding, carpeting and furniture produce enzymes and micrometre-sized fecal droppings, inhabitants emit methane, mold forms in walls and generates mycotoxins and spores, air conditioning systems can incubate Legionnaires' disease and mold, and houseplants, soil and surrounding gardens can produce pollen, dust, and mold. Indoors, the lack of air circulation allows these airborne pollutants to accumulate more than they would otherwise occur in nature.

Health effects :

The World Health Organization states that 2.4 million people die each year from causes directly attributable to air pollution, with 1.5 million of these deaths attributable to indoor air pollution.[9] "Epidemiological studies suggest that more than 500,000 Americans die each year from cardiopulmonary disease linked to breathing fine particle air pollution. . ."[10] A study by the University of Birmingham has shown a strong correlation between pneumonia related deaths and air pollution from motor vehicles.[11] Worldwide more deaths per year are linked to air pollution than to automobile accidents.[citation needed] Published in 2005 suggests that 310,000 Europeans die from air pollution annually.[citation needed] Direct causes of air pollution related deaths include aggravated asthma, bronchitis, emphysema, lung and heart diseases, and respiratory allergies.[citation needed] The US EPA estimates that a proposed set of changes in diesel engine technology (*Tier 2*) could result in 12,000 fewer *premature mortalities*, 15,000 fewer heart attacks, 6,000 fewer emergency room visits by children with asthma, and 8,900 fewer respiratory-related hospital admissions each year in the United States.[citation needed]

The worst short term civilian pollution crisis in India was the 1984 Bhopal Disaster.[12] Leaked industrial vapors from the Union Carbide factory, belonging to Union Carbide, Inc., U.S.A., killed more than 2,000 people outright and injured anywhere from 150,000 to 600,000 others, some 6,000 of whom would later die from their injuries.[citation needed] The United Kingdom suffered its worst air pollution event when the December 4 Great Smog of 1952 formed over London. In six days more than 4,000 died, and 8,000 more died within the following months.[citation needed] An accidental leak of anthrax spores from a biological warfare laboratory in the former USSR in 1979 near Sverdlovsk is believed to have been the cause of hundreds of civilian deaths.[citation needed] The worst single incident of air pollution to occur in the United States of America occurred in Donora, Pennsylvania in late October, 1948, when 20 people died and over 7,000 were injured.[13]

The health effects caused by air pollutants may range from subtle biochemical and physiological changes to difficulty in breathing, wheezing, coughing and aggravation of existing respiratory and cardiac conditions. These effects can result in increased medication use, increased doctor or emergency room visits, more hospital admissions and premature death. The human health effects of poor air quality are far reaching, but principally affect the body's respiratory system and the cardiovascular system. Individual reactions to air pollutants depend on the type of pollutant a person is exposed to, the degree of exposure, the individual's health status and genetics.[*citation needed*]

A new economic study of the health impacts and associated costs of air pollution in the Los Angeles Basin and San Joaquin Valley of Southern California shows that more than 3800 people die prematurely (approximately 14 years earlier than normal) each year because air pollution levels violate federal standards. The number of annual premature deaths is considerably higher than the fatalities related to auto collisions in the same area, which average fewer than 2,000 per year [14].

Diesel exhaust (DE) is a major contributor to combustion derived particulate matter air pollution. In several human experimental studies, using a well validated exposure chamber setup, DE has been linked to acute vascular dysfunction and increased thrombus formation.[15][16] This serves as a plausible mechanistic link between the previously described association between particulate matter air pollution and increased cardiovascular morbidity and mortality.

Effects on cystic fibrosis :

A study from 1999 to 2000 by the University of Washington showed that patients near and around particulate matter air pollution had an increased risk of pulmonary exacerbations and decrease in lung function.[17] Patients were examined before the study for amounts of specific pollutants like *Pseudomonas aeruginosa* or *Burkholderia cenocepacia* as well as their socioeconomic standing. Participants involved in the study were located in the United States in close proximity to an Environmental Protection Agency.[*clarification needed*] During the time of the study 117 deaths were associated with air pollution. A trend was noticed that patients living closer or in large metropolitan areas to be close to medical help also had higher level of pollutants found in their system because of more emissions in larger cities. With cystic fibrosis patients already being born with decreased lung function everyday pollutants such as smoke emissions from automobiles, tobacco smoke and improper use of indoor heating devices could add to the disintegration of lung function.[18]

Effects on COPD :

Chronic obstructive pulmonary disease (COPD) include diseases such as chronic bronchitis, emphysema, and some forms of asthma.[19]

A study conducted in 1960-1961 in the wake of the Great Smog of 1952 compared 293 London residents with 477 residents of Gloucester, Peterborough, and Norwich, three towns with low reported death rates from chronic bronchitis. All subjects were male postal truck drivers aged 40 to 59. Compared to the subjects from the outlying towns, the London subjects exhibited more severe respiratory symptoms (including cough, phlegm, and dyspnea), reduced lung function (FEV_1 and peak flow rate), and increased sputum production and purulence. The differences were more pronounced for subjects aged 50 to 59. The study controlled for age and smoking habits, so concluded that air pollution was the most likely cause of the observed differences.[20]

It is believed that much like cystic fibrosis, by living in a more urban environment serious health hazards become more apparent. Studies have shown that in urban areas patients suffer mucus hypersecretion, lower levels of lung function, and more self diagnosis of chronic bronchitis and emphysema.[21]

The Great Smog of 1952 :

Early in December 1952, a cold fog descended upon London. Because of the cold, Londoners began to burn more coal than usual. The resulting air pollution was trapped by the inversion layer formed by the dense mass of cold air. Concentrations of pollutants, coal smoke in particular, built up dramatically. The problem was made worse by use of low-quality, high-sulphur coal for home heating in London in order to permit export of higher-quality coal, because of the country's tenuous postwar economic situation. The "fog", or smog, was so thick that driving became difficult or impossible.[22]. The extreme reduction in visibility was accompanied by an increase in criminal activity as well as transportation delays and a virtual shut down of the city. During the 4 day period of fog, at least 4,000 people died as a direct result of the weather.[23]

Effects on children :

Cities around the world with high exposure to air pollutants have the possibility of children living within them to develop asthma, pneumonia and other lower respiratory infections as well as a low initial birth rate. Protective measures to ensure the youths' health are being taken in cities such as New Delhi, India where buses now use compressed natural gas to help eliminate the “pea-soup” smog.[24] Research by the World Health Organization shows there is the greatest concentration of particulate matter particles in countries with low economic world power and high poverty and population rates. Examples of these countries include Egypt, Sudan, Mongolia, and Indonesia. The Clean Air Act was passed in 1970, however in 2002 at least 146 million Americans were living in areas that did not meet at least one of the “criteria pollutants” laid out in the 1997 National Ambient Air Quality Standards.[25] Those pollutants included: ozone, particulate matter, sulfur dioxide, nitrogen dioxide, carbon monoxide, and lead. Because children are outdoors more and have higher minute ventilation they are more susceptible to the dangers of air pollution.

Health effects in relatively "clean" areas :

Even in areas with relatively low levels of air pollution, public health effects can be substantial and costly. This is because effects can occur at very low levels and a large number of people can potentially breathe in such pollutants. A 2005 scientific study for the British Columbia Lung Association showed that a 1% improvement in ambient PM2.5 and ozone concentrations will produce a $29 million in annual savings in the region in 2010[26]. This finding is based on health valuation of lethal (mortality) and sub-lethal (morbidity) effects.

Reduction efforts :

There are various air pollution control technologies and land use planning strategies available to reduce air pollution. At its most basic level land use planning is likely to involve zoning and transport infrastructure planning. In most developed countries, land use planning is an important part of social policy, ensuring that land is used efficiently for the benefit of the wider economy and population as well as to protect the environment.

Efforts to reduce pollution from mobile sources includes primary regulation (many developing countries have permissive regulations),[*citation needed*] expanding regulation to new sources (such as cruise and transport ships, farm equipment, and small gas-powered equipment such as lawn trimmers, chainsaws, and snowmobiles), increased fuel efficiency (such as through the use of hybrid vehicles), conversion to cleaner fuels (such as bioethanol, biodiesel, or conversion to electric vehicles).

Control devices :

The following items are commonly used as pollution control devices by industry or transportation devices. They can either destroy contaminants or remove them from an exhaust stream before it is emitted into the atmosphere.

- **Particulate control** :
  - Mechanical collectors (dust cyclones, multicyclones)
  - Electrostatic precipitators An electrostatic precipitator (ESP), or electrostatic air cleaner is a particulate collection device that removes particles from a flowing gas (such as air) using the force of an induced electrostatic charge. Electrostatic precipitators are highly efficient filtration devices that minimally impede the flow of gases through the device, and can easily remove fine particulate matter such as dust and smoke from the air stream.
  - Baghouses Designed to handle heavy dust loads, a dust collector consists of a blower, dust filter, a filter-cleaning system, and a

dust receptacle or dust removal system (distinguished from air cleaners which utilize disposable filters to remove the dust).

- o Particulate scrubbersWet scrubber is a form of pollution control technology. The term describes a variety of devices that use pollutants from a furnace flue gas or from other gas streams. In a wet scrubber, the polluted gas stream is brought into contact with the scrubbing liquid, by spraying it with the liquid, by forcing it through a pool of liquid, or by some other contact method, so as to remove the pollutants.

Q.6 Define water pollution with its sources and effects.

Ans. **Water pollution** is the contamination of water bodies such as lakes, rivers, oceans, and groundwater. All water pollution affects organisms and plants that live in these water bodies and in almost all cases the effect is damaging either to individual species and populations but also to the natural biological communities. It occurs when pollutants are discharged directly or indirectly into water bodies without adequate treatment to remove harmful constituents.

Introduction :

Water pollution is a major problem in the global context. It has been suggested that it is the leading worldwide cause of deaths and diseases,[1][2] and that it accounts for the deaths of more than 14,000 people daily.[2] In addition to the acute problems of water pollution in developing countries, industrialized countries continue to struggle with pollution problems as well. In the most recent national report on water quality in the United States, 45 percent of assessed stream miles, 47 percent of assessed lake acres, and 32 percent of assessed bay and estuarine square miles were classified as polluted.

Water is typically referred to as polluted when it is impaired by anthropogenic contaminants and either does not support a human use, like serving as drinking water, and/or undergoes a marked shift in its ability to support its constituent biotic communities, such as fish. Natural phenomena such as volcanoes, algae blooms, storms, and earthquakes also cause major changes in water quality and the ecological status of water. Water pollution has many causes and characteristics.

Water pollution categories :

Surface water and groundwater have often been studied and managed as separate resources, although they are interrelated.[4] Sources of surface water pollution are generally grouped into two categories based on their origin.

Point source pollution :

Point source pollution refers to contaminants that enter a waterway through a discrete conveyance, such as a pipe or ditch. Examples of sources in this category include discharges from a sewage treatment plant, a factory, or a city storm drain. The U.S. Clean Water Act (CWA) defines point source for regulatory enforcement purposes.[5] The CWA definition of point source was amended in 1987 to include municipal storm sewer systems, as well as industrial stormwater, such as from construction sites.

Non-point source pollution :

Non-point source (NPS) pollution refers to diffuse contamination that does not originate from a single discrete source. NPS pollution is often accumulative effect of small amounts of contaminants gathered from a large area. The leaching out of nitrogen compounds from agricultural land which has been fertilized is a typical example. Nutrient runoff in stormwater from "sheet flow" over an agricultural field or a forest are also cited as examples of NPS pollution.

Contaminated storm water washed off of parking lots, roads and highways, called urban runoff, is sometimes included under the category of NPS pollution. However, this runoff is typically channeled into storm drain systems and discharged through pipes to local surface waters, and is a point source. However where such water is not channeled and drains directly to ground it is a non point source.

Groundwater pollution :

Interactions between groundwater and surface water are complex. Consequently, groundwater pollution, sometimes referred to as groundwater contamination, is not as easily classified as surface water pollution.[4] By its very nature, groundwater aquifers are susceptible to contamination from sources that may not directly affect surface water bodies, and the distinction of point vs. nonpoint source may be irrelevant. A spill of a chemical contaminant on soil, located away from a surface water body, may not necessarily create point source or non-point source pollution, but nonetheless may contaminate the aquifer below. Analysis of groundwater contamination may focus on soil characteristics and hydrology, as well as the nature of the contaminant itself.

Causes of water pollution :

The specific contaminants leading to pollution in water include a wide spectrum of chemicals, pathogens, and physical or sensory changes such as elevated temperature and discoloration. While many of the chemicals and substances that are regulated may be naturally occurring (calcium, sodium, iron, manganese, etc.) the concentration is often the key in determining what is a natural component of water, and what is a contaminant.

Oxygen-depleting substances may be natural materials, such as plant matter (e.g. leaves and grass) as well as man-made chemicals. Other natural and anthropogenic substances may cause turbidity (cloudiness) which blocks light and disrupts plant growth, and clogs the gills of some fish species.

Many of the chemical substances are toxic. Pathogens can produce waterborne diseases in either human or animal hosts. Alteration of water's physical chemistry include acidity (change in pH), electrical conductivity, temperature, and eutrophication. Eutrophication is the fertilization of surface water by nutrients that were previously scarce.

Pathogens :

A manhole cover blown off by a sanitary sewer overflow.

Coliform bacteria are a commonly-used bacterial indicator of water pollution, although not an actual cause of disease. Other microorganisms sometimes found in surface waters which have caused human health problems include:

- *Cryptosporidium parvum*
- *Giardia lamblia*
- *Salmonella*
- *Novovirus* and other viruses
- Parasitic worms (helminths).

High levels of pathogens may result from inadequately treated sewage discharges.[10] This can be caused by a sewage plant designed with less than secondary treatment (more typical in less-developed countries). In developed countries, older cities with aging infrastructure may have leaky sewage collection systems (pipes, pumps, valves), which can cause sanitary sewer overflows. Some cities also have combined sewers, which may discharge untreated sewage during rain storms.

Pathogen discharges may also be caused by poorly-managed livestock operations.

Chemical and other contaminants :

Muddy river polluted by sediment. Photo courtesy of United States Geological Survey.

Contaminants may include organic and inorganic substances.

Organic water pollutants include:

- Detergents
- Disinfection by-products found in chemically disinfected drinking water, such as chloroform
- Food processing waste, which can include oxygen-demanding substances, fats and grease
- Insecticides and herbicides, a huge range of organohalides and other chemical compounds

- Petroleum hydrocarbons, including fuels (gasoline, diesel fuel, jet fuels, and fuel oil) and lubricants (motor oil), and fuel combustion byproducts, from stormwater runoff[12]
- Tree and bush debris from logging operations
- Volatile organic compounds (VOCs), such as industrial solvents, from improper storage. Chlorinated solvents, which are dense non-aqueous phase liquids (DNAPLs), may fall to the bottom of reservoirs, since they don't mix well with water and are denser.
- Various chemical compounds found in personal hygiene and cosmetic products.

Inorganic water pollutants include:

- Acidity caused by industrial discharges (especially sulfur dioxide from power plants)
- Ammonia from food processing waste
- Chemical waste as industrial by-products
- Fertilizers containing nutrients--nitrates and phosphates--which are found in stormwater runoff from agriculture, as well as commercial and residential use[12]
- Heavy metals from motor vehicles (via urban stormwater runoff)[12][13] and acid mine drainage
- Silt (sediment) in runoff from construction sites, logging, slash and burn practices or land clearing sites

Macroscopic pollution—large visible items polluting the water—may be termed "floatables" in an urban stormwater context, or marine debris when found on the open seas, and can include such items as:

- Trash (e.g. paper, plastic, or food waste) discarded by people on the ground, and that are washed by rainfall into storm drains and eventually discharged into surface waters

- Nurdles, small ubiquitous waterborne plastic pellets
- Shipwrecks, large derelict ships

Thermal pollution :

Thermal pollution is the rise or fall in the temperature of a natural body of water caused by human influence. A common cause of thermal pollution is the use of water as a coolant by power plants and industrial manufacturers. Elevated water temperatures decreases oxygen levels (which can kill fish) and affects ecosystem composition, such as invasion by new thermophilic species. Urban runoff may also elevate temperature in surface waters.

Thermal pollution can also be caused by the release of very cold water from the base of reservoirs into warmer rivers.

Transport and chemical reactions of water pollutants :

Most water pollutants are eventually carried by rivers into the oceans. In some areas of the world the influence can be traced hundred miles from the mouth by studies using hydrology transport models. Advanced computer models such as SWMM or the DSSAM Model have been used in many locations worldwide to examine the fate of pollutants in aquatic systems. Indicator filter feeding species such as copepods have also been used to study pollutant fates in the New York Bight, for example. The highest toxin loads are not directly at the mouth of the Hudson River, but 100 kilometers south, since several days are required for incorporation into planktonic tissue. The Hudson discharge flows south along the coast due to coriolis force. Further south then are areas of oxygen depletion, caused by chemicals using up oxygen and by algae blooms, caused by excess nutrients from algal cell death and decomposition. Fish and shellfish kills have been reported, because toxins climb the food chain after small fish consume copepods, then large fish eat smaller fish, etc. Each successive step up the food chain causes a stepwise concentration of pollutants such as heavy metals (e.g. mercury) and persistent organic pollutants such as DDT. This is known as biomagnification, which is occasionally used interchangeably with bioaccumulation.

Large gyres (vortexes) in the oceans trap floating plastic debris. The North Pacific Gyre for example has collected the so-called "Great Pacific Garbage Patch" that is now estimated at 100 times the size of Texas. Many of these long-lasting pieces wind up in the stomachs of marine birds and animals. This results in obstruction of digestive pathways which leads to reduced appetite or even starvation.

Many chemicals undergo reactive decay or chemically change especially over long periods of time in groundwater reservoirs. A noteworthy class of such chemicals is the chlorinated hydrocarbons such as trichloroethylene (used in industrial metal degreasing and electronics manufacturing) and tetrachloroethylene used in the dry cleaning industry (note latest advances in liquid carbon dioxide in dry cleaning that avoids all use of chemicals). Both of these chemicals, which are carcinogens themselves, undergo partial decomposition reactions, leading to new hazardous chemicals (including dichloroethylene and vinyl chloride).

Groundwater pollution is much more difficult to abate than surface pollution because groundwater can move great distances through unseen aquifers. Non-porous aquifers such as clays partially purify water of bacteria by simple filtration (adsorption and absorption), dilution, and, in some cases, chemical reactions and biological activity: however, in some cases, the pollutants merely transform to soil contaminants. Groundwater that moves through cracks and caverns is not filtered and can be transported as easily as surface water. In fact, this can be aggravated by the human tendency to use natural sinkholes as dumps in areas of Karst topography.

There are a variety of secondary effects stemming not from the original pollutant, but a derivative condition. An example is silt-bearing surface runoff, which can inhibit the penetration of sunlight through the water column, hampering photosynthesis in aquatic plants.

Measurement of water pollution :

This article **is missing citations or needs footnotes**. Please help add inline citations to guard against copyright violations and factual inaccuracies. *(August 2008)*

See also: Water quality :

Environmental Scientists preparing water autosamplers.

Water pollution may be analyzed through several broad categories of methods: physical, chemical and biological. Most methods involve collection of samples, followed by specialized analytical tests. Some methods may be conducted *in situ,* without sampling, such as temperature. Government agencies and research organizations have published standardized, validated analytical test methods to facilitate the comparability of results from disparate testing events.[15]

Sampling :

Sampling of water for physical or chemical testing can be done by several methods, depending on the accuracy needed and the characteristics of the contaminant. Many contamination events are sharply restricted in time, most commonly in association with rain events. For this reason "grab" samples are often inadequate for fully quantifying contaminant levels. Scientists gathering this type of data often employ auto-sampler devices that pump increments of water at either time or discharge intervals.

Sampling for biological testing involves collection of plants and/or animals from the surface water body. Depending on the type of assessment, the organisms may be identified for biosurveys (population counts) and returned to the water body, or they may be dissected for bioassays to determine toxicity.

Physical testing :

Common physical tests of water include temperature, solids concentration and turbidity.

Chemical testing :

Water samples may be examined using the principles of analytical chemistry. Many published test methods are available for both organic and inorganic compounds. Frequently-used methods include pH, biochemical oxygen demand (BOD), chemical oxygen demand (COD), nutrients (nitrate and phosphorus compounds), metals (including copper, zinc, cadmium, lead and mercury), oil and grease, total petroleum hydrocarbons (TPH), and pesticides.

Biological testing :

Biological testing involves the use of plant, animal, and/or microbial indicators to monitor the health of an aquatic ecosystem.

Control of water pollution :

Domestic sewage :

In urban areas, domestic sewage is typically treated by centralized sewage treatment plants. In the U.S., most of these plants are operated by local government agencies. Municipal treatment plants are designed to control conventional pollutants: BOD and suspended solids. Well-designed and operated systems (i.e., secondary treatment or better) can remove 90 percent or more of these pollutants. Some plants have additional sub-systems to treat nutrients and pathogens. Most municipal plants are not designed to treat toxic pollutants found in industrial wastewater.[16]

Cities with sanitary sewer overflows or combined sewer overflows employ one or more engineering approaches to reduce discharges of untreated sewage, including:

- utilizing a green infrastructure approach to improve stormwater management capacity throughout the system[17]
- repair and replacement of leaking and malfunctioning equipment[11]
- increasing overall hydraulic capacity of the sewage collection system (often a very expensive option).

A household or business not served by a municipal treatment plant may have an individual septic tank, which treats the wastewater on site and discharges into the soil. Alternatively, domestic wastewater may be sent to a nearby privately-owned treatment system (e.g. in a rural community).

Industrial wastewater :

Dissolved air flotation system for treating industrial wastewater.

Some industrial facilities generate ordinary domestic sewage that can be treated by municipal facilities. Industries that generate wastewater with high concentrations of conventional pollutants (e.g. oil and grease), toxic pollutants (e.g. heavy metals, volatile organic compounds) or other nonconventional pollutants such as ammonia, need specialized treatment systems. Some of these facilities can install a pre-treatment system to remove the toxic components, and then send the partially-treated wastewater to the municipal system. Industries generating large volumes of wastewater typically operate their own complete on-site treatment systems.

Some industries have been successful at redesigning their manufacturing processes to reduce or eliminate pollutants, through a process called pollution prevention.

Heated water generated by power plants or manufacturing plants may be controlled with:

- cooling ponds, man-made bodies of water designed for cooling by evaporation, convection, and radiation
- cooling towers, which transfer waste heat to the atmosphere through evaporation and/or heat transfer
- cogeneration, a process where waste heat is recycled for domestic and/or industrial heating purposes.

Agricultural wastewater :

Riparian buffer lining a creek in Iowa

Nonpoint source controls :

Sediment (loose soil) washed off fields is the largest source of agricultural pollution in the United States.[7] Farmers may utilize erosion controls to reduce runoff flows and retain soil on their fields. Common techniques include contour plowing, crop mulching, crop rotation, planting perennial crops and installing riparian buffers.

Nutrients (nitrogen and phosphorus) are typically applied to farmland as commercial fertilizer; animal manure; or spraying of municipal or industrial wastewater (effluent) or sludge. Nutrients may also enter runoff from crop residues, irrigation water, wildlife, and atmospheric deposition. Farmers can develop and implement nutrient management plans to reduce excess application of nutrients.

To minimize pesticide impacts, farmers may use Integrated Pest Management (IPM) techniques (which can include biological pest control) to maintain control over pests, reduce reliance on chemical pesticides, and protect water quality.

Confined Animal Feeding Operation in the United States

Point source wastewater treatment :

Farms with large livestock and poultry operations, such as factory farms, are called *concentrated animal feeding operations* or *confined animal feeding operations* in the U.S. and are being subject to increasing government regulation.[21][22] Animal slurries are usually treated by containment in lagoons before disposal by spray or trickle application to grassland. Constructed wetlands are sometimes used to facilitate treatment of animal wastes, as are anaerobic lagoons. Some animal slurries are treated by mixing with straw and composted at high temperature to produce a bacteriologically sterile and friable manure for soil improvement.

Construction site stormwater :

Silt fence installed on a construction site.

Sediment from construction sites is managed by installation of:

- erosion controls, such as mulching and hydroseeding, and
- sediment controls, such as sediment basins and silt fences.

Discharge of toxic chemicals such as motor fuels and concrete washout is prevented by use of:

- spill prevention and control plans, and
- specially-designed containers (e.g. for concrete washout) and structures such as overflow controls and diversion berms.

Urban runoff (stormwater) :

Retention basin for controlling urban runoff

Effective control of urban runoff involves reducing the velocity and flow of stormwater, as well as reducing pollutant discharges. Local governments use a variety of stormwater management techniques to reduce the effects of urban runoff. These techniques, called best management practices (BMPs) in the U.S., may focus on water quantity control, while others focus on improving water quality, and some perform both functions.

Pollution prevention practices include low impact development techniques, installation of green roofs and improved chemical handling (e.g. management of motor fuels & oil, fertilizers and pesticides).[26] Runoff mitigation systems include infiltration basins, bioretention systems, constructed wetlands, retention basins and similar devices.[27][28]

Thermal pollution from runoff can be controlled by stormwater management facilities that absorb the runoff or direct it into groundwater, such as bioretention systems and infiltration basins. Retention basins tend to be less effective at reducing temperature, as the water may be heated by the sun before being discharged to a receiving stream.[25]:p. 5-58

Regulatory framework :

In developed countries, the primary focus of legislation and efforts to curb water pollution for the past several decades was first aimed at point sources. As many point sources have been effectively regulated—principally factories and sewage treatment plants—greater attention has been placed on controlling municipal and industrial stormwater discharges, and NPS contributions.[29]

Q.7 Write an essay on noise pollution?

Noise pollution (or **environmental noise**) is displeasing human-, animal- or machine-created sound that disrupts the activity or balance of human or animal life. A common form of noise pollution is from **transportation**, principally motor vehicles.[1] The word *noise* comes from the Latin word *nausea* meaning seasickness.

The source of most noise worldwide is transportation systems, motor vehicle noise, but also including aircraft noise and rail noise.[2][1] Poor urban planning may give rise to noise pollution, since side-by-side industrial and residential buildings can result in noise pollution in the residential area.

Other sources are car alarms, emergency service sirens, office equipment, factory machinery, construction work, groundskeeping equipment, barking dogs, appliances, power tools, lighting hum, audio entertainment systems, loudspeakers and noisy people.

Human health effects :

Main article: Noise health effects

Noise health effects are both health and behavioural in nature. The unwanted sound is called noise. This unwanted sound can damage physiological and psychological health. Noise pollution can cause annoyance and aggression, hypertension, high stress levels, tinnitus, hearing loss, sleep disturbances, and other harmful effects. Furthermore, stress and hypertension are the leading causes to health problems, whereas tinnitus can lead to forgetfulness, severe depression and at times panic attacks.

Chronic exposure to noise may cause noise-induced hearing loss. Older males exposed to significant occupational noise demonstrate significantly reduced hearing sensitivity than their non-exposed peers, though differences in hearing sensitivity decrease with time and the two groups are indistinguishable by age 79. A comparison of Maaban tribesmen, who were insignificantly exposed to transportation or industrial noise, to a typical U.S. population showed that chronic exposure to moderately high levels of environmental noise contributes to hearing loss.

High noise levels can contribute to cardiovascular effects and exposure to moderately high levels during a single eight hour period causes a statistical rise in blood pressure of five to ten points and an increase in stress and vasoconstriction leading to the increased blood pressure noted above as well as to increased incidence of coronary artery disease.

Noise pollution is also a cause of annoyance. A 2005 study by Spanish researchers found that in urban areas households are willing to pay approximately four Euros per decibel per year for noise reduction.

Environmental effects :

Noise can have a detrimental effect on animals by causing stress, increasing risk of death by changing the delicate balance in predator/prey detection and avoidance, and by interfering with their use of sounds in communication especially in relation to reproduction and in navigation. Acoustic overexposure can lead to temporary or permanent loss of hearing.

An impact of noise on animal life is the reduction of usable habitat that noisy areas may cause, which in the case of endangered species may be part of the path to extinction. One of the best known cases of damage caused by noise pollution is the death of certain species of beached whales, brought on by the loud sound of military sonar.

Noise also makes species communicate louder, which is called Lombard vocal response. Scientists and researchers have conducted experiments that show whales' song length is longer when submarine-detectors are on. If creatures don't "speak" loud enough, their voice will be masked by anthropogenic sounds. These unheard voices might be warnings, finding of prey, or preparations of net-bubbling. When one species begins speaking louder, it will mask other species' voice, causing the whole ecosystem to eventually speak louder.

European Robins living in urban environments are more likely to sing at night in places with high levels of noise pollution during the day, suggesting that they sing at night because it is quieter, and their message can propagate through the environment more clearly. Interestingly, the same study showed that daytime noise was a stronger predictor of nocturnal singing than night-time Light pollution, to which the phenomenon is often attributed.

Zebra finches become less faithful to their partners when exposed to traffic noise. This could alter a population's evolutionary trajectory by selecting traits, sapping resources normally devoted to other activities and thus lead to profound genetic and evolutionary consequences.

Mitigation and control of noise :

Technology to mitigate or remove noise can be applied as follows:

There are a variety of strategies for mitigating roadway noise including: use of noise barriers, limitation of vehicle speeds, alteration of roadway surface texture, limitation of heavy vehicles, use of traffic controls that smooth vehicle flow to reduce braking and acceleration, and tire design. An important factor in applying these strategies is a computer model for roadway noise, that is capable of addressing local topography, meteorology, traffic operations and hypothetical mitigation. Costs of building-in mitigation can be modest, provided these solutions are sought in the planning stage of a roadway project.

Aircraft noise can be reduced to some extent by design of quieter jet engines, which was pursued vigorously in the 1970s and 1980s. This strategy has brought limited but noticeable reduction of urban sound levels. Reconsideration of operations, such as altering flight paths and time of day runway use, have demonstrated benefits for residential populations near airports. FAA sponsored residential retrofit (insulation) programs initiated in the 1970s has also enjoyed success in reducing interior residential noise in thousands of residences across the United States.

Exposure of workers to Industrial noise has been addressed since the 1930s. Changes include redesign of industrial equipment, shock mounting assemblies and physical barriers in the workplace.

Noise Free America, a national anti-noise pollution organization, regularly lobbies for the enforcement of noise ordinances at all levels of government.

Legal status :

Governments up until the 1970s viewed noise as a "nuisance" rather than an environmental problem. In the United States there are federal standards for highway and aircraft noise; states and local governments typically have very specific statutes on building codes, urban planning and roadway development. In Canada and the EU there are few national, provincial, or state laws that protect against noise.

Noise laws and ordinances vary widely among municipalities and indeed do not even exist in some cities. An ordinance may contain a general prohibition against making noise that is a nuisance, or it may set out specific guidelines for the level of noise allowable at certain times of the day and for certain activities.

Dr. Paul Herman wrote the first comprehensive noise codes in 1975 for Portland, Oregon with funding from the EPA (Environmental Protection Agency) and HUD (Housing and Urban Development). The Portland Noise Code became the basis for most other ordinances for major US and Canadian metropolitan regions.

Most city ordinances prohibit sound above a threshold intensity from trespassing over property line at night, typically between 10 p.m. and 6 a.m., and during the day restricts it to a higher sound level; however, enforcement is uneven. Many municipalities do not follow up on complaints. Even where a municipality has an enforcement office, it may only be willing to issue warnings, since taking offenders to court is expensive.

The notable exception to this rule is the City of Portland Oregon which has instituted an aggressive protection for its citizens with fines reaching as high at $5000 per infraction, with the ability to cite a responsible noise violator multiple times in a single day.

Many conflicts over noise pollution are handled by negotiation between the emitter and the receiver. Escalation procedures vary by country, and may include action in conjunction with local authorities, in particular the police. Noise pollution often persists because only five to ten percent of people affected by noise will lodge a formal complaint. Many people are not aware of their legal right to quiet and do not know how to register a complaint.

Explain biomagnification in detail.

Biomagnification, also known as **bioamplification** or **biological magnification**, is the increase in concentration of a substance, such as the pesticide DDT, that occurs in a food chain as a consequence of:

- Persistence (slow to be broken down by environmental processes)
- Food chain energetics

- Low (or nonexistent) rate of internal degradation/excretion of the substance (often due to water-insolubility)

Although sometimes used interchangeably with 'bioaccumulation,' an important distinction is drawn between the two, and with bioconcentration, it is also important to distinct between sustainable development and overexploitation in biomagnification.

- **Bioaccumulation** occurs *within* a trophic level, and is the increase in concentration of a substance in certain tissues of organisms' bodies due to absorption from food and the environment.
- **Bioconcentration** is defined as occurring when uptake from the water is greater than excretion (Landrum and Fisher, 1999)

Thus bioconcentration and bioaccumulation occur within an organism, and biomagnification occurs across trophic (food chain) levels.

Lipid, (lipophilic) or fat soluble substances cannot be diluted, broken down, or excreted in urine, a water-based medium, and so accumulate in fatty tissues of an organism if the organism lacks enzymes to degrade them. When eaten by another organism, fats are absorbed in the gut, carrying the substance, which then accumulates in the fats of the predator. Since at each level of the food chain there is a lot of energy loss, a predator must consume many prey, including all of their lipophilic substances.

For example, though mercury is only present in small amounts in seawater, it is absorbed by algae (generally as methylmercury). It is efficiently absorbed, but only very slowly excreted by organisms (Croteau et al., 2005). Bioaccumulation and biomagnification result in buildup in the adipose tissue of successive trophic levels: zooplankton, small nekton, larger fish etc. Anything which eats these fish also consumes the higher level of mercury the fish have accumulated. This process explains why predatory fish such as swordfish and sharks or birds like osprey and eagles have higher concentrations of mercury in their tissue than could be accounted for by direct exposure alone. For example, herring contains mercury at approximately 0.01 ppm and shark contains mercury at greater than 1 ppm (EPA 1997).

Current status

In a review of a large number of studies, Suedel et al. (1994) concluded that although biomagnification is probably more limited in occurrence than previously thought, there is good evidence that DDT, DDE, PCBs, toxaphene, and the organic forms of mercury and arsenic do biomagnify in nature. For other contaminants, bioconcentration and bioaccumulation account for their high concentrations in organism tissues. More recently, Gray (2002) reached a similar conclusion. However, even this study was criticized by Fisk et al., (2003) for ignoring many relevant studies. Such criticisms are spurring researchers to study carefully all pathways, and Croteau et al. (2005) recently added Cadmium to the list of biomagnifying metals.

The above studies refer to aquatic systems. In terrestrial systems, direct uptake by higher trophic levels must be much less, occurring via the lungs.

This critique of the biomagnification concept does not mean that we need not be concerned about synthetic organic contaminants and metal elements because they will become diluted. Bioaccumulation and bioconcentration result in these substances remaining in the organisms and not being diluted to non-threatening concentrations. The success of top predatory-bird recovery (bald eagles, peregrine falcons) in North America following the ban on DDT use in agriculture is testament to the importance of biomagnification.

Substances that biomagnify :

There are two main groups of substances that biomagnify. Both are lipophilic and not easily degraded. Novel organic substances are not easily degraded because organisms lack previous exposure and have thus not evolved specific detoxification and excretion mechanisms, as there has been no selection pressure from them. These substances are consequently known as 'persistent organic pollutants' or POPs.

Metals are not degradable because they are elements. Organisms, particularly those subject to naturally high levels of exposure to metals, have mechanisms to sequester and excrete metals. Problems arise when organisms are exposed to higher concentrations than usual, which they cannot excrete rapidly enough to prevent damage. These metals are transferred in an organic form.

Explain bioaccumulation :

This article includes a list of references, related reading or external links, but **its sources remain unclear because it lacks inline citations.** Please improve this article by introducing more precise citations where appropriate. *(February 2008)*

Bioaccumulation refers to the accumulation of substances, such as pesticides, or other organic chemicals in an organism. Bioaccumulation occurs when an organism absorbs a toxic substance at a rate greater than that at which the substance is lost. Thus, the longer the biological half-life of the substance the greater the risk of chronic poisoning, even if environmental levels of the toxin are not very high.

Bioaccumulation explains why chronic poisoning is a common aspect of environmental science in the workplace. Repeated exposure to very low levels of toxins in these environments can be lethal over time.

Bioconcentration is a related but more specific term, referring to uptake and accumulation of a substance from water alone. By contrast, bioaccumulation refers to uptake from all sources combined (e.g. water, food, air, etc.)

Examples

An example of poisoning in the workplace can be seen from the phrase "as mad as a hatter". The process for stiffening the felt used in making hats involved mercury, which forms organic species such as methylmercury, which is lipid soluble, and tends to accumulate in the brain resulting in mercury poisoning.

Other lipid (fat) soluble poisons include tetra-ethyl lead compounds (the lead in leaded petrol), and DDT. These compounds are stored in the body's fat, and when the fatty tissues are used for energy, the compounds are released and cause acute poisoning.

Strontium-90, part of the fallout from atomic bombs, is chemically similar enough to calcium that it is utilized in osteogenesis, where its radiation can cause damage for a long time.

Naturally produced toxins can also bioaccumulate. The marine algal blooms known as "red tides" can result in local filter feeding organisms such as mussels and oysters becoming toxic; coral fish can be responsible for the poisoning known as ciguatera when they accumulate a toxin called ciguatoxin from reef algae.

Some animal species exhibit bioaccumulation as a mode of defense; by consuming toxic plants or animal prey, a species may accumulate the toxin which then presents a deterrent to a potential predator. One example is the tobacco hornworm, which concentrates nicotine to a toxic level in its body as it consumes tobacco plants. Poisoning of small consumers can be passed along the food chain to affect the consumers later on. Other compounds that are not normally considered toxic can be accumulated to toxic levels in organisms. The classic example is of Vitamin A, which becomes concentrated in carnivore livers of e.g. polar bears: as a pure carnivore that feeds on other carnivores (seals), they accumulate extremely large amounts of Vitamin A in their livers. It was known by the native peoples of the Arctic that the livers should not be eaten, but Arctic explorers have suffered Hypervitaminosis A from eating the bear livers (and there has been at least one example of similar poisoning of Antarctic explorers eating husky dog livers). One notable example of this is the expedition of Sir Douglas Mawson, where his exploration companion died from eating the liver of one of their dogs.

Write an essay on ecological succession :

Succession after disturbance: a boreal forest one (left) and two years (right) after a wildfire.

Ecological succession, a fundamental concept in ecology, refers to more-or-less predictable and orderly changes in the composition or structure of an ecological community. Succession may be initiated either by formation of new, unoccupied habitat (*e.g.*, a lava flow or a severe landslide) or by some form of disturbance (*e.g.* fire, severe windthrow, logging) of an existing community. Succession that begins in areas where no soil is initially present is called primary succession, whereas succession that begins in areas where soil is already present is called secondary succession.

The trajectory of ecological change can be influenced by site conditions, by the interactions of the species present, and by more stochastic factors such as availability of colonists or seeds, or weather conditions at the time of disturbance. Some of these factors contribute to predictability of successional dynamics; others add more probabilistic elements. In general, communities in early succession will be dominated by fast-growing, well-dispersed species (opportunist, fugitive, or r-selected life-histories). As succession proceeds, these species will tend to be replaced by more competitive (k-selected) species.

Trends in ecosystem and community properties in succession have been suggested, but few appear to be general. For example, species diversity almost necessarily increases during early succession as new species arrive, but may decline in later succession as competition eliminates opportunistic species and leads to dominance by locally superior competitors. Net Primary Productivity, biomass, and trophic level properties all show variable patterns over succession, depending on the particular system and site.

Ecological succession was formerly seen as having a stable end-stage called the climax (see Frederic Clements), sometimes referred to as the 'potential vegetation' of a site, shaped primarily by the local climate. This idea has been largely abandoned by modern ecologists in favor of nonequilibrium ideas of how ecosystems function. Most natural ecosystems experience disturbance at a rate that makes a "climax" community unattainable. Climate change often occurs at a rate and frequency sufficient to prevent arrival at a climax state. Additions to available species pools through range expansions and introductions can also continually reshape communities.

Many species are specialized to exploit disturbances. In forests of northeastern North America trees such as *Betula alleghaniensis* (Yellow birch) and *Prunus serotina* (Black cherry) are particularly well-adapted to exploit large gaps in forest canopies, but are intolerant of shade and are eventually replaced by other (shade-tolerant) species in the absence of disturbances that create such gaps.

The development of some ecosystem attributes, such as pedogenesis and nutrient cycles, are both influenced by community properties, and, in turn, influence further community development. This process may occur only over centuries or millennia. Coupled with the stochastic nature of disturbance events and other long-term (e.g., climatic) changes, such dynamics make it doubtful whether the 'climax' concept ever applies or is particularly useful in considering actual vegetation.

History of the theory :

The idea of ecological succession goes back to the 14th century. The French naturalist Adolphe Dureau de la Malle was the first to make use of the word *succession* about the vegetation development after forest clear-felling. In 1859 Henry David Thoreau wrote an address called "The Succession of Forest Trees" in which he described succession in an Oak-Pine forest.

Henry Chandler Cowles, at the University of Chicago, developed a more formal concept of succession. Inspired by the studies of Danish dunes done by Eugen Warming, Cowles studied vegetation development sand dunes on the shores of Lake Michigan (the Indiana Dunes). He recognized that vegetation on sand-dunes of different ages might be interpreted as different stages of a general trend of vegetation development on dunes, and used his observations to propose a particular sequence (sere) and process of primary succession. His paper, "The ecological relations of the vegetation of the sand dunes of Lake Michigan" in 1899 in the Botanical Gazette is one of the classic publications in the history of the field of ecology.

The Indiana Dunes on Lake Michigan, which stimulated Cowles' development of his theories of ecological succession.

Understanding of succession was long dominated by the theories of Frederic Clements, a contemporary of Cowles, who held that successional sequences of communities (*seres*), were highly predictable and culminated in a climatically determined stable climax. Clements and his followers developed a complex taxonomy of communities and successional pathways (see article on Clements).

A contrasting view, the Gleasonian framework, is more complex, with three items: invoking interactions between the physical environment, population-level interactions between species, and disturbance regimes, in determining the composition and spatial distribution of species. It differs most fundamentally from the Clementsian view in suggesting a much greater role of chance factors and in denying the existence of coherent, sharply bounded community types. Gleason's ideas, first published in the early 20th century, were more consistent with Cowles' thinking, and were ultimately largely vindicated. However, they were largely ignored from their publication until the 1800s.

About Frederic Clements' distinction between primary succession and secondary succession, Cowles wrote (1911).

This classification seems not to be of fundamental value, since it separates such closely related phenomena as those of erosion and deposition, and it places together such unlike things as human agencies and the subsidence of land.

Beginning with the work of Robert Whittaker and John Curtis in the 1950s and 1960s, models of succession have gradually changed and become more complex. In modern times, among North American ecologists, less stress has been placed on the idea of a single climax vegetation, and more study has gone into the role of contingency in the actual development of communities.

Types of succession

Primary and secondary succession :

See also: Primary succession, Secondary succession, and Cyclic succession

If the development begins on an area that has not been previously occupied by a community, such as a newly exposed rock or sand surface, a lava flow, glacial tills, or a newly formed lake, the process is known as primary succession.

Secondary succession: trees are colonizing uncultivated fields and meadows.

If the community development is proceeding in an area from which a community was removed it is called secondary succession. Secondary succession arises on sites where the vegetation cover has been disturbed by humans or animals (an abandoned crop field or cut-over forest), or natural forces such as water , wind storms, and floods. Secondary succession is usually more rapid as the colonizing area is rich in leftover soil, organic matter and seeds of the previous vegetation. In case of primary succession everything has to develop anew.

Seasonal and cyclic succession :

Unlike secondary succession, these types of vegetation change are not dependent on disturbance but are periodic changes arising from fluctuating species interactions or recurring events. These models propose a modification to the climax concept towards one of dynamic states.

Causes of plant succession :

Autogenic succession can be brought by changes in the soil caused by the organisms there. These changes include accumulation of organic matter in litter or humic layer, alteration of soil nutrients, change in pH of soil by plants growing there. The structure of the plants themselves can also alter the community. For example, when larger species like trees mature, they produce shade on to the developing forest floor that tends to exclude light-requiring species. Shade-tolerant species will invade the area.

Allogenic changes are caused by external environmental influences and not by the vegetation. For example soil changes due to erosion, leaching or the deposition of silt and clays can alter the nutrient content and water relationships in the ecosystems. Animals also play an important role in allogenic changes as they are pollinators, seed dispersers and herbivores. They can also increase nutrient content of the soil in certain areas, or shift soil about (as termites, ants, and moles do) creating patches in the habitat. This may create regeneration sites that favor certain species.

Climatic factors may be very important, but on a much longer time-scale than any other. Changes in temperature and rainfall patterns will promote changes in communities. As the climate warmed at the end of each ice age, great successional changes took place. The tundra vegetation and bare glacial till deposits underwent succession to mixed deciduous forest. The greenhouse effect resulting in increase in temperature is likely to bring profound Allogenic changes in the next century. Geological and climatic catastrophes such as volcanic eruptions, earthquakes, avalanches, meteors, floods, fires, and high wind also bring allogenic changes.

Clement's theory of succession/Mechanisms of succession :

F.E. Clement (1916) developed a descriptive theory of succession and advanced it as a general ecological concept. His theory of succession had a powerful influence on ecological thought. Clement's concept is usually termed classical ecological theory. According to Clement, succession is a process involving several phases:

1. **Nudation**: Succession begins with the development of a bare site, called Nudation (disturbance).
2. **Migration**: It refers to arrival of propagules.
3. **Ecesis**: It involves establishment and initial growth of vegetation.

4. **Competition**: As vegetation became well established, grew, and spread, various species began to compete for space, light and nutrients. This phase is called competition.
5. **Reaction**: During this phase autogenic changes affect the habitat resulting in replacement of one plant community by another.
6. **Stabilization**: Reaction phase leads to development of a climax community

Q.8 What is "ecological succession"?

Ans. "Ecological succession" is the observed process of change in the species structure of an ecological community over time. Within any community some species may become less abundant over some time interval, or they may even vanish from the ecosystem altogether. Similarly, over some time interval, other species within the community may become more abundant, or new species may even invade into the community from adjacent ecosystems. This observed change over time in what is living in a particular ecosystem is "ecological succession".

Q.9 Why does "ecological succession" occur?

Ans. Every species has a set of environmental conditions under which it will grow and reproduce most optimally. In a given ecosystem, and under that ecosystem's set of environmental conditions, those species that can grow the most efficiently and produce the most viable offspring will become the most abundant organisms. As long as the ecosystem's set of environmental conditions remains constant, those species optimally adapted to those conditions will flourish. The "engine" of succession, the cause of ecosystem change, is the impact of established species have upon their own environments. A consequence of living is the sometimes subtle and sometimes overt alteration of one's own environment. The original environment may have been optimal for the first species of plant or animal, but the newly altered environment is often optimal for some other species of plant or animal. Under the changed conditions of the environment, the previously dominant species may fail and another species may become ascendant.

7. Ecological succession may also occur when the conditions of an environment suddenly and drastically change. A forest fires, wind storms, and human activities like agriculture all greatly alter the conditions of an environment. These massive forces may also destroy species and thus alter the dynamics of the ecological community triggering a scramble for dominance among the species still present.

Q.10 Are there examples of "ecological succession" on the Nature Trail?

Ans. Succession is one of the major themes of our Nature Trail. It is possible to observe both the on-going process of succession and the consequences of past succession events at almost any point along the trail. The rise and the decline of numerous species within our various communities illustrates both of the types of motive forces of succession: the impact of an established species to change a site's environmental conditions, and the impact of large external forces to suddenly alter the environmental nature of a site. Both of these forces necessarily select for new species to become ascendant and possibly dominant within the ecosystem.

Some specific examples of observable succession include:

1. The growth of hardwood trees (including ash, poplar and oak) within the red pine planting area. The consequence of this hardwood tree growth is the increased shading and subsequent mortality of the sun loving red pines by the shade tolerant hardwood seedlings. The shaded forest floor conditions generated by the pines prohibits the growth of sun-loving pine seedlings and allows the growth of the hardwoods. The consequence of the growth of the hardwoods is the decline and senescence of the pine forest. (Observe the dead pine trees that have fallen. Observe the young hardwoods growing up beneath the still living pines).

2. The raspberry thickets growing in the sun lit forest sections beneath the gaps in the canopy generated by wind-thrown trees. Raspberry plants

require sunlight to grow and thrive. Beneath the dense shade canopy particularly of the red pines but also beneath the dense stands of oaks, there is not sufficient sunlight for the raspberry's survival. However, in any place in which there has been a tree fall the raspberry canes have proliferated into dense thickets. You may observe this successional consequence of macro-ecosystem change within the red pine stand and all along the more open sections of the trail. Within these raspberry thickets, by the way, are dense growths of hardwood seedlings. The raspberry plants are generating a protected "nursery" for these seedlings and are preventing a major browser of tree seedlings (the white tailed deer) from eating and destroying the young trees. By providing these trees a shaded haven in which to grow the raspberry plants are setting up the future tree canopy which will extensively shade the future forest floor and consequently prevent the future growth of more raspberry plants!

3. The succession "garden" plot. This plot was established in April, 2000 (please see the series of photographs on the "Succession Garden Plot" page). The initial plant community that was established within the boundaries of this plot was made up of those species that could tolerate the periodic mowing that "controlled" this "grass" ecosystem. Soon, though, other plant species became established as a consequence of the removal of the stress of mowing. Over time, the increased shading of the soil surface and the increased moisture retention of the undisturbed soil-litter interface allowed an even greater diversity of plants to grow and thrive in the Succession Garden. Eventually, taller, woody plants became established which shaded out the sun-loving weed community. In the coming years we expect tree seedlings to grow up within the Succession Garden and slowly establish a new section of the forest.

Q.11 How are humans affected by ecological succession?

Ans. Ecological succession is a force of nature. Ecosystems, because of the internal species dynamics and external forces mentioned above, are in a constant process of change and re-structuring. To appreciate how ecological succession affects humans and also to begin to appreciate the incredible time and monetary cost of ecological succession, one only has to visualize a freshly tilled garden plot. Clearing the land for the garden and preparing the soil for planting represents a major external event that radically re-structures and disrupts a previously stabilized ecosystem. The disturbed ecosystem will immediately begin a process of ecological succession. Plant species adapted to the sunny conditions and the broken soil will rapidly invade the site and will become quickly and densely established. These invading plants are what we call "weeds". Now "weeds" have very important ecological roles and functions (see, for example, the "Winter Birds" discussion), but weeds also compete with the garden plants for nutrients, water and physical space. If left unattended, a garden will quickly become a weed patch in which the weakly competitive garden plants are choked out and destroyed by the robustly productive weeds. A gardener's only course of action is to spend a great deal of time and energy weeding the garden. This energy input is directly proportional to the "energy" inherent in the force of ecological succession. If you extrapolate this very small scale scenario to all of the agricultural fields and systems on Earth and visualize all of the activities of all of the farmers and gardeners who are growing our foods, you begin to get an idea of the immense cost in terms of time, fuel, herbicides and pesticides that humans pay every growing season because of the force of ecological succession.

Q.12 Does ecological succession ever stop?

Ans. There is a concept in ecological succession called the "climax" community. The climax community represents a stable end product of the successional sequence. In the climate and landscape region of the Nature Trail, this climax community is the "Oak-Poplar Forest" subdivision of the Deciduous Forest Biome. An established Oak-Poplar Forest will maintain itself for a very long period of time. Its apparent species structure and composition will not appreciably change over observable time. To this degree, we could say that ecological succession has "stopped". We must recognize, however, that any ecosystem, no matter how inherently stable and persistent, could be subject to massive external disruptive forces (like fires and storms) that could re-set and re-trigger the successional process. As long as these random and potentially catastrophic events are possible, it is not absolutely accurate to say that succession has stopped. Also, over long periods of time ("geological time") the climate conditions and other fundamental aspects of an ecosystem change. These geological time scale changes are not observable in our "ecological" time, but their fundamental existence and historical reality cannot be disputed. No ecosystem, then, has existed or will exist unchanged or unchanging over a geological time scale.

Q.13 What do you understand by continental drift

Ans. Continental drift geological theory that the relative positions of the continents on the earth's surface have changed considerably through geologic time. Though first proposed by American geologist Frank Bursley Taylor in a lecture in 1908, the first detailed theory of continental drift was put forth by German meteorologist and geophysicist Alfred Wegener in 1912. On the basis of geology, biology, climatology, and the alignment of the continental shelf rather than the coastline, he believed that during the late Paleozoic and early Mesozoic eras, about 275 to 175 million years ago, all the continents were united into a vast supercontinent, which he called Pangaea. Later, Pangaea broke into two supercontinental masses—Laurasia to the north, and Gondwanaland to the south. The present continents began to split apart in the latter Mesozoic era about 100 million years ago,

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As additional evidence Wegener cited the unusual presence of coal deposits in the South Polar regions, glacial features in present-day equatorial regions, and the jigsaw fit of the opposing Atlantic continental shelves. He also pointed out that a plastic layer in the earth's interior must exist to accommodate vertical adjustments caused by the creation of new mountains and by the wearing down of old mountains by erosion (see continent). He postulated that the earth's rotation caused horizontal adjustment of rock in this plastic layer, which caused the continents to drift. The frictional drag along the leading edges of the drifting continents results in mountain building.

Wegener's theory stirred considerable controversy during the 1920s. South African geologist A. L. Dutoit, in 1921, strengthened the argument by adding more exacting details that correlated geological and paleontological similarities on both sides of the Atlantic. In 1928, Scottish geologist Arthur Holmes suggested that thermal convection in the mantle was the mechanism that drove the continental movements. American geologist David Griggs performed scale model experiments to show the mantle movements.

The theory of continental drift was not generally accepted, particularly by American geologists, until the 1950s and 60s, when a group of British geophysicists reported on magnetic studies of rocks from many places and from each major division of geologic time. They found that for each continent, the magnetic pole had apparently changed position through geologic time, forming a smooth curve, or pole path, particular to that continent. The pole paths for Europe and North America could be made to coincide by bringing the continents together.

Q.14 What is Liebig's law of minimum?

Ans. Liebig's law of the minimum The concept first stated by J. von Liebig in 1840, that the rate of growth of a plant, the size to which it grows, and its overall health depend on the amount of the scarcest of its essential nutrients that is available to it. This concept is now broadened into a general model of limiting factors for all organisms, including the limiting effects of excesses of chemical nutrients and other environmental factors.

Q.15 What is Shelford's law of tolerance?

Ans. Shelford's law of tolerance A law, proposed by V. E. Shelford, that states that the presence and success of an organism depend upon the extent to which a complex of conditions are satisfied. The absence or failure of an organism can be controlled by the qualitative or quantitative deficiency or excess or any one of several factors which may approach the limits of tolerance for that organism.

□□□

1. The study of interaction between living organism and their environment is called:
A.)Phytogeography B.)Ecology
C.)Phytosociology D.)Ecosystem (B)
2. Ecology is the study of the relationship of:
A.)Organism & environment B.)Man & environment
C.)Soil & water D.)Man & animals
(A)
3. Who first correctly defined the term ecology?
A.)Taylor B.)Tansley
C.)Haeckel D.)Odum (C)
4. Auto ecology means the study of:
A.) soil on vegetation B.) Ecology of individual organism
C.)Precipitation on vegetation D.) Temperature on vegetation
(B)
5. Synecology is the study of:
A.)Biotic community B.)Individual species
C.)Study of environment D.)None (A)
6. What type of soil present in Gangetic basin?
A.) Eolian B.)Alluvial
C.) Sedimentary D.) Clay
(B)
7.) Water logging occurs in:
A.) Sandy soil B.) Gravel oil
C.) Loamy oil D.) Clay oil (D)
8.) A fertile soil is likely to have a pH value of:
A.)3-4 B.) 8-9
C.) 6-7 D.) 10-11 (C)

9.) Humus is an example of:
A.) Crystalloids B.) Organic colloids
C.) Pedogenesis D.) Laterisation
(B)
10.) Soil particles determine their:
A.) Soil flora B.) Eolian
C.) Residual D.) Colluvial (C)
11.) All living organism on the earth constitute:
A.) Biosphere B.) Biome
C.) Ecosystem D.) Community
(A)
12.) The living organism on or around earth constitute:

A.) Biosphere B.) Biome
C.) Community D.)Biocoenosis
(B)

13.) The food chain will not begin in the absence of:
A.) Consumer B.) Producer
C.) Decomposer D.) Producer & consumer (B)

14.) Food chain are met within the:
A.) Sea B.) Forest
C.) Cities D.) All the above

15.) What do green plants form:
A.) Primary producers B.) Primary consumers
C.) Secondary consumers D.) Decomposers (A)

16.) Those belong to the category of primary consumers are:
A.) insect & cattles B.) Snakes & frogs
C.) Fishes D.)Eagles (C)

17.) If kite feed on mice and mice feed on grass,the kite must be:
A.) Secondary producer B.) Primary producer
C.) Primary consumer D.) Secondary consumer (D)

18.) Hydrological cycle is under the control of:
A.) Grassland B.) Forests
C.) Planktons D.) Epiphytes (B)

19.) Carbon is present in the rocks as:
A.) carbon element B.) Carbonate
C.) Carbohydrate D.) Carbonic acid (B)

20.) Which of the following is involved in sedimentary cycle?
A.) Carbon B.) Nitrogen
C.) Hydrogen D.) Sulphur (D)

21.) Global water cycle involves the participation of:
A.) Algae B.) Bacteria
C.) Forest trees D.) None of these
(D)

22.) The place where two major communities meet and blend together is called:
A.) Ecotone B.) Population
C.) Biome D.) Territory (C)

23.) The birth rate in developing countries is:
A.)10 B.) 20
C.) 3 D.) 40 (D)

24.) Sympatric speciation occurs most commonly in:
A.) Mammals B.) Birds

C.) fishes D.) Plants (D)

25.) The seral communities developing on a water body are known as:
A.) Hydro sere B.) Hydrophytes
C.) Hydrosphere D.) Hydrologic cycle (A)
26.) The plants growing in saline condition are:
A.) Physiological xerophytes B.) Xerophytes
C.) Physical xerophytes D.) hydrophytes
(A)
27.) Desert plants are generally:
A.) Succulents B.) Heterophyllous
C.) Herbaceous D.) Viviparous
(A)
28.) The upper part of sea water mainly contains:
A.) Nektons only B.) Planktons only
C.) Nektons & planktons both D.) None of the above
(B)
29.) A plankton is:
A.) Layers of aquatics B.) Sea scum
C.) Floating vegetation D.) Floating microscopic plants & animals (D)
30.) Which biome is treeless:
A.) Savannah B.) Chaparrals
C.) Temperate D.) Tundra (D)
31. Teak plant grow naturally in:
A.) Deciduous forests B.) Evergreen forests
C.) Thorny- shrbn forests D.) Himalayan Temperate forests
(A)
32.) Which country has maximum growth rate?
A.) China B.) Kenya
C.) U.S.A. D.) Europe (B)

33.) Renewable source of energy in:
A.) Coal B.) Kerosene
C.) petroleum D.) Biomass (D)
34.) Property of soil based on the size of particle is termed:
A.) Field capacity B.) Texture
C.) Water holding capacity D.) Colour (B)
35.) Alluvial soil is mostly found in which region:
A.) Southern India B.) Eastern India

C.) Gangetic Jamuna Plains D.) Northern India (D)

36.) Overgrazing by animals result in:

A.) Positive Pollution B.) Negative pollution

C.)Sheet Erosion D.) Soil Erosion

(B)

37.) Removal of the soil by the action of wind and water is known as:

A.) Erosion B.)Fossilization

C.) Calcification D.) Salination

(A)

38.) In a polluted lake, the indez of pollution is:

A.) Frog B.) Daphnia

C.) Artemia D.0 None of these (B)

39.) If BOD of a river is found very high, it shows:

A.) Water is highly polluted B.) water is clean

C.) Water has minerals D.) All the above

(A)

40.) Minamata disease is caused due to pollution of water by:

A.) Lead B.) Zinc

C.) Mercury D.) None of the above (C)

41.) Loud noise causes:

A.) Irritation B.) High blood pressure

C.) Stomach ulcers D.) All the above (D)

42.) Noise Pollution is measured in:

A.) Hertz B.) Nanometers

C.) Decibels D.) None of the above (C)

43.) D.D.T. is:

A.) Antibiotic B.) Biodegradable pollutant

C.) Non- biodegradable pollutant D.) None of the above (C)

44.) Ozone layer is directly distributed by:

A.) Automobiles B.) Factories

C.) Supersonic jets D.) None of these (C)

45.) Which is the final victim of radioactive pollution ?

A.) Man B.) Algae

C.) Microorganism D.) lichens (A)

46.)Lead in the atmosphere can cause:

A.) Brain damage B.) Breathlessness

C.) Itching eyes D.) Respiratory elements

(A)

47.) Decreased BOD is an indication of:

A.) High CO_2 contents B.) High O_2 contents
C.) Higher microbial activity D.) Low microbial; activity (D)

48.) Deforestation causes:
A.) Soil Erosion B.) Food deficit
C.) Lowering of water table D.) All the above (D)

49.) Which of the following is endangered species of wildlife?
A.) Tiger B.) Lion
C.) Rhino D.) All the above (D)

50.) The number of organism in a population is increased by:
A.) mortality B.) Natility
C.) Emigration D.) Natility & immigration (D)

Key Terms

Ecology & Environment Science

Epillliminon: Thewarmer uppermost later of water lying above the thermocline in the lake.
Epiphyte: A plant that grows on a substrate other than the soil,such as the surface of another organism.
Erosion: The loss of soil because it is carried away by running water or wind.
Estuary: A bay or drowned valley where a river empties into the sea.
Famines: Acute food storage characterized by large scale loss of life.social disruption and economic chaos.
Fauna: All of the animals present in a given region.
Fen: An area of waterlogged soil that tends to be peaty; fed mainly by upwelling water;low productivity
Fermentation: Anaerobic breakdown of food molecules to release energy
Fusion: The combining of two atoms into a single atom as a result of collision.
Gasohol: A mixture of 90% gasoline and 10% ethanol use as vehicle fuel.
Gene bank: Institution where plant material is stored in a viable condition.
Gene pool:All of the genes present in a population of organism.
General fertility rate: Representation of population age structure and fecundity.
Humus: The more or less decomposed organic matter of the soil.
Intertidal: Between tidemarks
Ivory: White bone like substance forming the tusks of elephant
Lag phase: The initial stage of population growth during which growth occurs very slow.
Landfill: A method of disposing of solid wastes that involves burying the wastes in specially constructed sites.
Windmill:machine with a rotor that is moved slowly by the wind to produce mechanical power,used originally to mill grain and pump water
Zero population growth: If crude birth rate is equal to crude death rate for a long enough time,the result is zero population growth.

B.Sc. (Part-III) Examination, 2011

(Faculty of Science)

[Also common with subsidiary Paper of B.Sc. (Hons.)Part-III]

(Three Year Scheme of 10+2+3 Pattern)

Zoology (Second Paper)

Ecology and Environmental Biology

Time: 3 hours **Max. Marks : 33**

Part-I

Part I is compulsory to attempt. Answer the following questions in maximum 25 words. Each question carries 1 mark.

1. (i) What id deforestation?
   (i) What is ozone?
   (ii) Which chemical is mainly responsible for ozone depletion in Stratosphere?
   (iii) Which government agency is responsible for control of pollution at national level?
   (iv) Define biokinetic zone.
   (v) List the biotic components of ecosystem.
   (vi) Differentiate between producers, consumers and decomposers.
   (vii) Define non-point pollutants.
   (viii) What is sustainable development?

Part-II

Attempt FOUR questions in Part-II, selecting at least ONE question from each Section. Each question carries 6 marks.

Section-A

2. Write an essay on the role of humankind in modifying natural communities.
3. Give an account of lentic habitat with reference to lakes.
4. Write short notes on any two of the following:
   (a) Demography (b) Terrestrial ecosystem
   (c) Concept of limiting factors.

Section-B

5. Write an essay on noise pollution and its effects on animals.
6. Write brief account of any two of the following:
   (a) Ozone layer depletion (b) Niche
   (c) Types of radiation
7. Describe the principle zones of hydrosphere.

Section-C

8. What is the difference between National Park and Sanctuary? Describe the National Parks of Rajasthan.
9. Discuss the impact of urbanization in detail.

10. Discuss the problems of the space. What are the solutions to these problems?

B.Sc. (Part-III) Examination, 2010

(Faculty of Science)

[Also common with subsidiary Paper of B.Sc. (Hons.)Part-III]

(Three Year Scheme of 10+2+3 Pattern)

Zoology (Second Paper)
Ecology and Environmental Biology

Time: 3 hours **Max. Marks : 33**

Part-I

Part I is compulsory to attempt. Answer the following questions in maximum 25 words. Each question carries 1 mark.

1. (a) What is synecology ?

   (b) Define leibig's jaw of minimum.

   (c) What is biotic potential?

   (d) What is meant by food web?

   (e) What is nekton?

   (f) What is Red Data Book?

   (g) What is meant by bio-magnification?

   (h) What is thermo cline?

   (i) Define Exo-biology.

Part-II

Attempt FOUR questions in Part-II, selecting at least ONE question from each Section. Each question carries 6 marks.

SECTION-A

2. What do you mean by biogeochemical cycles ? Describe nitrogen cycle in detail.
3. What is ecological succession ? Describe various stages of xerosere.
4. Write notes on the following :
   (i) Age Pyramid
   (ii) Lotic Environment

SECTION-B

5. Describe the sources and effects of water pollution.
6. Write an essay on management and conservation of non-renewable resources.
7. Write notes on the following :
   (i) Global Warning
   (ii) Biodegradation

SECTION-C

8. Why is conservation of wild life necessary? Explain.
9. Write an essay on the causes and impacts of urbanization.
10. Write notes on the following:
    (i) Space ecosystem
    (ii) Endangered wild animals of Rajasthan.

B.Sc. (Part-III) Examination, 2009

(Faculty of Science)

[Also common with subsidiary Paper of B.Sc. (Hons.)Part-III]

(Three Year Scheme of 10+2+3 Pattern)

Zoology (Second Paper)
Ecology and Environmental Biology

Time: 3 hours **Max. Marks : 33**

Part-I

Time: 1 hour **Max. Marks : 13**

Part I is compulsory to attempt. Answer the all 26 questions. Each question carries half mark.

I. Multiple Choice type Questions. (Q. Nos. 1 to 6)

1. Salinity percent of sea water is –

(a) 0.35 (b) 3.5

(c) 0.035 (d) 1.5.

2. Concept of Ecological Pyramid was proposed by –

(a) A.G. Tansley (b) Charles Elton

(c) F.F. Blackman (d) F. Clement.

3. Which of the following is not relate with greenhouse effect?

(a) Methane (b) Nitrous oxide

(c) Helium (d) Carbon dioxide.

4. Which of the following is a biopesticide ?

(a) Decis (b) Fenvalerate

(c) N.P.V. (d) Carbrayl.

5. Insecticidal property of DDT was discovered by –
   (a) Zeidler (b) E.P. Odum
   (c) Ernst Haeckel (d) Paul Muller.

6. Which of the following is a renewable resource?
   (a) Kerosene (b) CNG
   (c) Biomass (d) LPG

II. Fill in the blanks (Q. Nos. 7 to 10)

7. Sound is measured in ………………….. units.

8. An example of cold desert is ……………. Desert.

9. Phosphorus cycle is a …………….type of biogeochemical cycle.

10. The bacteria which converts ammonium compounds into nitrite is …………………..

III. Reply in one word. (Q. Nos. 11 to 15)

11. The place of meeting of river with the sea –

12. A phenomenon is which the organism consume their own fellow –

13. Name of city where Zoological Survey of India is situated -

14. Association between flagellate Trichonympha and termite –

15. Organisms which can remain active within narrow range of temperature difference only-

IV. Write True (T) and False (F) in the following statements (Q. Nos. 16 to 20).

16. All radiations are not harmful.
(True/False)

17. Effect of fall-out is long term, but in a small area.
(True/False)

18. River Mississippi is an appropriate example of lentic habitat.
(True/False)

19. Salinity of sea water is continuously increasing.
(True/False)

20. Fertile soil is an important biotic factor of the environment.
(True/False)

V. Write full forms of the following :- (Q. Nos. 21 to 26)

21. IUCN
22. BNHS
23. AIDS
24. Define xenobiotics.
25. What are Nektons?
26. Give definition of Antibiosis.

Part-II

Time: 2 hour **Max. Marks : 20**

Attempt FOUR questions in Part-II, selecting at least ONE question from each Section. Each question carries 5 marks.

SECTION-A

1. What is meant by biogeochemical cycles? Describe Nitrogen cycle in detail.

2. Define habitat. Explain the characteristics of terrestrial habitat with special reference to desert. Also discuss adaptations found in hot desert inhabitants.

3. Differentiate the following –
   (i) Immigration and Migration
   (ii) Parasite and Parasitoid
   (iii) Biotic Potential and Environmental Resistance
   (iv) Ecotones and Edge effect
   (ix) Primary and Secondary succession.

SECTION-B

4. Describe various intraspecific relations found among organisms.

5. Write an essay on "Conservation of Natural Resources".

6. Give an account of an two of the following:
   (i) Bioaccumulation and Biomagnifications
   (ii) Concept of environment
   (iii) Greenhouse effect.

SECTION-C

7. Enumerate various endangered and threatened species of Rajasthan. Describe various efforts of Government and Non-government Organizations for the management of wild life.

8. What is meant by space ecology? Give an account of space ecosystem, its related problems and their solutions.

9. Briefly describe any two of the following:-
   (i) Population Explosion
   (ii) Problems of Urbanization
   (iii) State Bird of Rajasthan.

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