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CONSERVATION OF NATURAL RESOURCES

JV'n Dr. Y Chandrakala

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PREFACE

Indeed it gives us great honor to put forth this book entitled "CONSERVATION OF NATURAL RESOURCES" and implementation of the knowledge in teaching learning process. The content of the book are very precise, will be helpful for student to understand about the basics of conservation of natural resources.

Dr. Y. Chandrakala

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Dr. Y. Chandrakala

Contents

CHAPTER 1

ECOLOGY

Ecology is a branch of biology that deals with the spatial and temporal patterns of the distribution and occurrence of organisms together with causes and consequences. Ecosystem processes such as primary production, soil formation, nutrient cycles and niche construction regulate the flow of energy and matter through an environment.

Ecosystems are dynamically interacting systems among the organisms, the communities they form and the non-living components of their environment. Life processes, interactions and adaptations.

Ecology has useful applications in conservation biology, wetland management, natural resource management (agroecology, agriculture and forestry, agroforestry, fisheries), urban planning (urban ecology), community health, economics, basic and applied science, and human social interaction (human ecology)

Organisms (including humans) and resources form ecosystems, which in turn maintain biophysical feedback mechanisms that moderate the processes that act on living (biotic) and non-living (abiotic) components of the planet.

Ecosystems support vital functions and produce natural capital such as biomass production (food, fuel, fiber and medicine), climate regulation, global biogeochemical cycles, water filtration, soil formation, erosion control, flood protection and many other natural features of scientific, historical, economic or intrinsic value.

The word "ecology" was coined in 1866 by the German scientist Ernst Haeckel. The ecology encompasses a wide variety of interacting levels of organization, ranging from the micro level (eg, cells) to the planetary scale (eg, the biosphere) of phenomena.

Ecosystems, for example, contain abiotic resources and interacting life forms (i.e., individual organisms that group in populations that cluster in different ecological communities).

Ecosystems are dynamic, they do not always follow a linear succession path, but they are always changing, sometimes quickly and sometimes so slowly that it can take thousands of years for ecological processes to trigger certain phases of succession. The degree of ecological dynamics can function as a closed system, such as aphids migrating on a single tree, while remaining open to greater influences such as atmosphere or climate.

Hence, ecologists organize ecosystems hierarchically by analyzing data collected from smaller entities, such as vegetation associations, climate, and soil types, and integrating that information to identify emerging patterns.

The ecology of global carbon balances exemplifies the relationship between biodiversity and biogeochemistry. It is estimated that Earth's oceans contain 40,000 gigatonnes (Gt) of carbon, vegetation and soil contain 2,070 Gt, and fossil fuel emissions are 6.3 Gt of carbon per year. Over the course of Earth's history, these global carbon budgets have been fundamentally restructured and largely regulated by Earth's ecology. For example, during the volcanic outgassing of the Early and Mid Eocene, the oxidation of methane stored in wetlands and ocean floor gases increased atmospheric concentrations of CO_2 (carbon dioxide) to similar levels of up to 3,500 ppm.

Twenty-five to thirty-two million years ago, the Oligocene saw another major restructuring of the global carbon cycle as grasses evolved a new mechanism of photosynthesis, C4 photosynthesis, and expanded their beaches. This new path evolved in response to the drop in atmospheric CO_2 concentrations below 550 ppm. The relative abundance and distribution of biological diversity changes the dynamics between organisms and their environment, so that ecosystems can be both a cause and an effect in relation to climate change. Human-induced changes in the planet's ecosystems (eg, disturbance, loss of biodiversity, agriculture) contribute to an increase in greenhouse gases in the atmosphere. The transformation of the global carbon cycle in the next century is expected to increase planetary temperatures, lead to more extreme fluctuations in weather patterns, change the distribution of species and accelerate the rate of extinction. The effects of global warming can already be seen when glaciers melt, when mountain ice caps melt and when sea levels rise. As a result, species distribution is changing along river banks and in continental areas, where migration patterns and nesting areas follow prevailing climate changes. Much of the permafrost is also melting to create a new mosaic of flooded areas with an increased rate of soil decay activity that increases methane (CH_4) emissions. There is concern about the increase of methane in the atmosphere in the context of the global carbon cycle, as methane is a greenhouse gas that is 23 times more efficient at absorbing long-wave radiation than CO_2 on a 100-year scale. Therefore, there is a link between global warming, degradation and respiration in soils and wetlands, leading to important climate feedback and globally altered biogeochemical cycles

Ecology has complex origins, largely due to its interdisciplinary nature. ancient Greek philosophers such as Hippocrates and Aristotle were among the first to record observations about natural history. However, they viewed life as essentialism; conceiving species as statically immutable things, while varieties as aberrations of an idealized type. This contrasts with the modern understanding of ecological theory, where cultivars are seen as the true phenomena of interest and play a role in creating adaptations through natural selection.

By ecology we mean all science about the relationship of the organism to the environment, including in the broadest sense all "conditions of existence". Thus, the theory of evolution mechanically explains the domestic relationships of organisms as the necessary consequences of a cause and thus forms the monistic basis of ecology.

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The Alexander von Humboldt (1769-1859) was one of the first pioneers of ecological thinking and was one of the first to recognize ecological gradients, in which species were replaced or changed shape along ecological gradients, such as an increase in altitude. Humboldt was inspired by Isaac Newton in developing a form of "earth physics". In a Newtonian way, he introduced scientific accuracy for measurements in natural history and even proposed concepts that form the basis of a modern ecological law on the relationships between species. Natural historians such as Humboldt, James Hutton, and Jean-Baptiste

Lamarck (among others) laid the foundation for modern ecological science. The term "ecology" was coined by Ernst Haeckel in his book General Morphology of Organisms (1866). Haeckel was a zoologist, artist, writer and later professor of comparative anatomy.

CHAPTER 2

BIODIVERSITY

Biodiversity refers to the diversity of life and its processes. This includes the diversity of living organisms, the genetic differences between them, the communities and ecosystems in which they occur, and the ecological and evolutionary processes that keep them functional while constantly changing and adapting.

Biodiversity plays an important role in maintain of ecosystem and improve the quality of life for humans.

The natural capital that sustains the population is essential for sustaining ecosystem services and species migration (eg outflow of fish into rivers and control of avian insects) as one of the mechanisms causing this performance loss. Understanding biodiversity has practical applications for conservationists at the species and ecosystem level as they provide management advice to consultancies, governments and industry. For example Corals adapt and change their environment by forming calcium carbonate skeletons. This provides growth conditions for future generations and provides habitat for many other species.

“Habitats can be defined as regions of environmental space that consist of several dimensions and each represent a biotic or abiotic environmental variable. Changes in habitats provide important clues about competition in nature when a population changes compared to the habitats occupied by most other individuals of the species. Habitat changes also occur in the development cycle of amphibians and insects moving from aquatic to terrestrial habitats. Biotope and habitat are sometimes used interchangeably, but the former applies to the environment of a community while the latter applies to the environment of a species.

Termite mounds of different pole heights regulate gas exchange, temperature and other environmental parameters necessary to maintain the internal physiology of the entire colony.

The ecological niche is a central concept in the ecology of organisms and is divided into the basic niche and the realized niche. The basic niche is the environmental conditions under which a species can exist. The niche achieved is the ecological and ecological conditions under which a species persists.

Biogeographic patterns and distribution distributions are predicted by knowing the characteristics of a species and the requirements of the niche. A trait is a measurable trait, phenotype, or trait of an organism that can affect its survival. Genes play an important role in the interplay between development and environmental expression of traits. Resident species develop characteristics adapted to the selection pressures of their local environment. This usually gives them a competitive advantage and discourages similarly adapted species from having an overlapping geographic area.

When similarly adapted species overlap geographically, closer examination reveals subtle ecological differences in their habitat or nutritional needs. The habitat and the niche are called the ecotope. This is defined as the set of environmental and biological variables that affect an entire species.

Concept of an Ecosystem: Living organisms cannot live isolated from their non-living environment be-cause the latter provides materials and energy for the survival of the former i.e. there is interaction between a biotic community and its environment to produce a stable system; a natural self-sufficient unit which is known as an ecosystem.Ecosystem are the parts of nature where living orgaisms interact among themselves and with their physical environment. The term ‘ecosystem’ was coined by A.G. Tansley, an English botanist, in

1935. An ecosystem is the structural and functional unit of ecology (nature) encompassing complex interaction between its biotic (living) and abiotic (non-living) components.For example- a pond is a good example of ecosystem.

A pond, lake, desert, grassland, meadow, forest etc. are common examples of ecosystems.

Structure and Function of an Ecosystem:

Each ecosystem has two main components:

(1) Abiotic (2) Biotic

Biomes

Biomes are larger organizational units that categorize regions of the Earth's ecosystems based primarily on the structure and composition of vegetation. There are several methods of defining the continental boundaries of biomes dominated by different functional types of vegetative communities, the distribution of which is limited by climate, precipitation, weather and other environmental variables. The world's major land biomes include tropical rain forest, tropical dry forest, tropical savanna, desert, temperate grassland, temperate woodland and shrubland, temperate forest, northwestern coniferous forest, boreal forest, and tundra.

CHAPTER 3

BIOSPHERE

The greatest extent of the ecological organization is the biosphere: the sum of the planet's ecosystems. Ecological relationships regulate the flow of energy, nutrients and climate down to the planetary scale. For example, the dynamic history of the CO_2 and O_2 composition of the planet's atmosphere has been influenced by the biogenic flow of gases from respiration and photosynthesis, with values that fluctuate over time depending on ecology and the development of plants and animals.

Population ecology

Population ecology studies the dynamics of populations of species and how these populations interact with the environment. A population consists of individuals of the same species who live, interact and migrate in the same niche and habitat.

Metapopulations and migration

The concept of metapopulations was defined in 1969 as "a population of populations that are locally extinct and repopulating". Another statistical approach widely used in conservation research is metapopulation ecology.

Metapopulation models simplify the landscape in plots with different quality levels and metapopulations are linked by the migration behavior of organisms. Animal migration is different from other types of movement. Migration is also a phenomenon at the population level, such as in the migration routes that plants followed when they occupied the post-glacial environment in the north.

Community ecology

Interspecific interactions such as predators are a central aspect of community ecology. Community ecology studies shows how interactions between species and their environment affect the abundance, distribution and diversity of species within communities. Community Ecology is the study of the interactions between collections of species living in the same geographic area. Community ecologists study the determinants of patterns and processes for at least two interacting species.

Ecosystem Ecology

Ecosystems, vary with type and size. They are a category of the innumerable physical systems in the universe that extend from the entire universe to the atom.

Ecosystems can be habitats within biomes that form an integrated whole and dynamic system with both physical and biological complexes.

Ecosystem ecology is the science of determining the material flows (eg carbon, phosphorus) between different basins (eg biomass from trees, soil organic matter). Ecosystem ecologists are trying to find out the underlying causes of these flows.

Food webs

A food web is the archetype of the ecological web. Plants capture solar energy and use it to synthesize simple sugars during photosynthesis. As plants grow, they accumulate nutrients and are eaten by grazing herbivores. When consumed, energy is transferred through a chain of organisms.

The simplified linear food routes that go from a basic tropic species to a higher consumer is called the food chain. The largest interlocking model of food chains in an ecological community creates a complex food web. Food webs are a type of concept map or heuristic device used to illustrate and explore the paths of energy and material flows.

Food webs are often limited compared to the real world. Full empirical measurements are generally limited to a particular habitat, such as a cave or pond, and principles derived from studies of food web microcosms are extrapolated to larger systems.

Food relationships require extensive studies of the gut contents of organisms, which can be difficult to decipher, or stable isotopes can be used to track the flow of nutrients and energy through a food web. Despite these limitations, food webs remain a valuable tool for understanding community ecosystems.

Food webs represent the principles of the nature of trophic relationships: some species have many weak food connections (e.g. omnivores), while others are more specialized and have fewer food connections (e.g. primary predators).

Food webs are made up of subgroups in which members of a community are strongly connected and weak interactions occur between these subgroups. This increases the stability of the food web.

Trophy level

A trophic pyramid (a) and a food web (b) illustrate the ecological relationships between creatures typical of a boreal terrestrial ecosystem in the north. The trophic pyramid roughly represents the biomass (usually measured as total dry weight) at each level.

Biodiversity within ecosystems can be organized in trophic pyramids, where the vertical dimension represents nutritional relationships further from the base of the food chain to the main predators, and the horizontal dimension represents abundance or biomass at each level.

When the relative abundance or biomass of each species is sorted by their respective trophic levels, they naturally fall into a "pyramid of numbers." Species are generally classified into autotrophs (or primary producers), heterotrophs (or consumers), and detritivores (or decomposers).

Autotrophs are organisms that produce their own food through photosynthesis or chemosynthesis (production is greater than respiration). Heterotrophs are organisms that have to feed on others in order to nourish themselves and to have energy (respiration exceeds production). Heterotrophs can be further divided into several functional groups, including primary consumers (strict herbivores), secondary consumers (carnivorous predators that feed exclusively on herbivores), and tertiary consumers (predators that feed on a mix of herbivores and predators

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While the concept of keystone species is widely used as a protective tool, it has been criticized for being operationally ill-defined. It is difficult to determine experimentally which species can play a key role in each ecosystem. In addition, food web theory suggests that key species may not be abundant, so it is not clear how broadly the key species model can be applied.

COMPLEXITY

Complexity is understood as the great amount of computational effort required to assemble many interacting parts that go beyond the iterative memory capacity of the human mind. Global models of biodiversity are complex. This biocomplexity arises from the interaction between ecological processes that operate and influence models at different scales that deteriorate into each other, such as transition zones or ecotones covering landscapes.

Complexity arises from the interplay of the levels of biological organization as energy, and matter is integrated into larger units overlapping with smaller parts. "What sets were on a level become parts on a higher level." "The complexity in ecology consists of at least six different types: spatial, temporal, structural, procedural, behavioral and geometric."

Based on these principles, ecologists have identified emerging and self-organizing phenomena that operate at different scales of environmental influences, from molecular to planetary, and that require different explanations at each level of integration. Long-term ecological studies provide an important background for a better understanding of the complexity and resilience of ecosystems at longer temporal and broader spatial scales.

Ecology and evolutionary biology are sister disciplines of the life sciences. Natural selection, life history, development, adaptation, populations and heredity are examples of concepts that also fit into ecological and evolution theory. Thus, morphological, behavioral and genetic traits can be mapped on evolutionary trees to investigate the historical development of a species in terms of its functions and roles under different ecological conditions.

Behavioral Ecology

Social appearance and color variation in differently adapted chameleon species. All organisms can exhibit behavior. Even plants exhibit complex behaviors, including memory and communication. Behavioral ecology is the study of the behavior of an organism in its environment and its ecological and evolutionary effects.

Behaviors can be registered as traits and inherited in the same way as eye and hair color. Behaviors can develop through natural selection as adaptive traits that confer functional tools that increase reproductive capacity.

Parasitism: A spider-like harvester parasitized by mites. The reaper is consumed while the mites benefit from their host's travel and nutrition.

Molecular ecology

The important relationship between ecology and genetic inheritance dates back to modern molecular analysis techniques. Molecular ecology research has become more practical with the development of faster and more accessible genetic technologies such as the polymerase chain reaction (PCR). The emergence of molecular technologies and the influx of research questions into this new ecological field led to the publication of Molecular Ecology in 1992.

Molecular ecology, for example, has shown promiscuous sexual behavior and multiple male partners in tree martins previously considered socially monogamous. The combination of genetics, ecology and evolution has led to a new sub-discipline called phylogeography.

Human ecology

The story of life on Earth was a story of the interaction between living things and their environment. The physical form and habits of terrestrial vegetation and their animal life are largely determined by the environment. Given the length of Earth's time, the reverse effect, where life actually changes its environment, was relatively small. Only at the time of the present century has a species acquired significant power to change the nature of its world. Ecology is as much a biological science as it is a human science.

Human ecology is an interdisciplinary study of the ecology of our species. "Human ecology can be defined as: (1) from a bio-ecological point of view, as the study of humans as an ecological dominant factor in plant and animal communities and systems; (2) bio-ecological as just another animal affecting and affecting its physical environment; and (3) as humans are somewhat different from animal life in general, interact with physical environments, and are modified in distinctive and creative ways.

Ecosystems produce, regulate, maintain and provide services vital to human health (cognitive and physiological) and the economy. Ecosystem management is not just a matter of science or a simple extension of traditional resource management. It offers a fundamental overhaul of how humans can work with nature.

Ecology is a science used in the restoration and restoration of sites disrupted by human intervention, natural resource management, and environmental impact assessment. Edward O. Wilson predicted in 1992 that the 21st century will be "the era of ecological restoration." Ecological science has exploded into industrial investment in the restoration of ecosystems and their processes in abandoned sites after disruption. Natural resource managers, for example in forestry, employ ecologists to develop, adapt and apply ecosystem-based methods at the planning, use and restoration phases of land use. Ecological science is used in sustainable harvesting methods, disease and fire management, fish stock management, land use integration in protected areas and communities, and conservation in complex geopolitical landscapes.

CHAPTER 4

RELATIONSHIP WITH THE ENVIRONMENT

The ecosystem environment includes both physical parameters and biotic attributes. It is dynamically linked and contains resources for businesses at all times throughout their lifecycle. Like ecology, the term environment has several conceptual meanings and overlaps with the term nature. The environment "includes the physical world, the social world of human relationships, and the built world of human creation." The physical environment is beyond the studied level of biological organization, including abiotic factors such as temperature, radiation, light, chemistry, climate and geology. The biotic environment includes genes, cells, organisms, members of the same species and other species that share the habitat.

The distinction between external and internal environments is an abstraction that analyzes life and environment into units or facts that are inextricably linked in reality. There is a cause and effect intertwining between the environment and life. The laws of thermodynamics apply to ecology, for example because of their physical state. With an understanding of the metabolic and thermodynamic principles, a complete representation of the flows of energy and matter through an ecosystem.

The ecological and ecological relationships are investigated on the basis of conceptually manageable and isolated material parts. The change of an ecological or environmental factor can simultaneously influence the dynamic state of an entire ecosystem.

DISRUPTION AND RESILIENCE

Ecosystems are regularly confronted with fluctuations and natural disturbances of the environment over time and geographic space. A disturbance is a process of removing biomass from a community, eg B. Fire, flood, drought or robbery.

Disturbances occur in very different areas in terms of size, distance and time period and are both the cause and the product of natural fluctuations in mortality rates, species groups and biomass densities within an ecological community.

These disruptions create places of innovation where new directions emerge from the patchwork of natural experiments and possibilities. Ecological resilience is a fundamental theory of ecosystem management. Biodiversity strengthens the resilience of ecosystems, which act as a kind of regenerative insurance.

Metabolism is the rate at which energy and material resources are absorbed into the environment, converted into an organism, and used for maintenance, growth, and reproduction and is a fundamental physiological feature.

The Earth was formed about 4.5 billion years ago. As it frozen and a crust and oceans formed, the atmosphere turned from hydrogen to one composed mainly of methane and ammonia.

Over the next billions of years, the metabolic activity of life turned the atmosphere into a mixture of carbon dioxide, nitrogen and water vapor.

These gases changed the way sunlight hit the Earth's surface, and the greenhouse effects trapped heat. The mixture of reducing and oxidizing gases contained unused free energy sources that paved the way for the development of primitive ecosystems, and in turn the atmosphere evolved as well. The leaf is the main site of photosynthesis in most plants.

The development of the first organisms, probably anaerobic methanogenic microbes, began the process with the conversion of atmospheric hydrogen into methane

($4H_2 + CO_2 \rightarrow CH_4 + 2H_2O$)

Anoxygenic photosynthesis decreased hydrogen concentrations and increased atmospheric methane, converting hydrogen sulfide into water or other sulfur compounds

(e.g., $2H_2S + CO_2 + hv \rightarrow CH_2O + H_2O + 2S$).

Early forms of fermentation also increased atmospheric methane levels. The transition to an oxygen-dominant atmosphere (the Great Oxidation) did not begin until about 2.4 to 2.3 billion years ago, but photosynthetic processes started 0.3 to 1 billion years ago.

Radiation: heat, temperature and light

The biology of life operates in a certain temperature range. Heat is a form of energy that regulates temperature. Heat affects growth rates, activity, behavior and primary production. The temperature largely depends on the incidence of solar radiation.

The leaf is the main site of photosynthesis in most plants.

Throughout history, Earth's atmosphere and biogeochemical cycles have been in dynamic equilibrium with planetary ecosystems. History is marked by periods of significant change, followed by millions of years of stability.

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The biology of life operates in a certain temperature range. Heat is a form of energy that regulates temperature. Heat affects growth rates, activity, behavior and primary production. The temperature largely depends on the incidence of solar radiation. The spatial temperature fluctuations in latitude and longitude have a strong effect on the climate and thus on the distribution of biological diversity and primary production in different ecosystems or biomes on the planet. Heat and temperature are largely related to metabolic activity.

Physical environments - The water

Wetlands such as shallow water, high plant productivity and anaerobic substrates provide a suitable environment for important physical, biological and chemical processes. As a result of these processes, wetlands play an important role in the global nutrient and element cycles.

The diffusion of carbon dioxide and oxygen is about 10,000 times slower in water than in air. When soils are submerged, they quickly lose oxygen, become hypoxic (an environment with an O2 concentration of less than 2 mg / liter), and eventually completely anoxic, where anaerobic bacteria thrive between the roots.

Water also affects the intensity and spectral composition of light, as it is reflected from the water's surface and submerged particles. Aquatic plants exhibit a multitude of morphological and physiological adaptations that allow them to survive, compete and diversify in these environments. For example, their roots and stems contain large air spaces (aerenchyma) that control the efficient transport of gases (e.g. CO_2 and O_2) used in respiration and photosynthesis. Saltwater plants (halophytes) have additional special adaptations, such as developing special organs to remove salt and osmoregulate their internal salt concentrations ($NaCl$) to live in estuaries, brackish or ocean environments. Soil anaerobic microorganisms in water bodies use nitrate, manganese ions, iron ions, sulfate, carbon dioxide and some organic compounds. Other microorganisms are facultative anaerobes and use oxygen to breathe when the soil gets drier.

The activity of soil microorganisms and water chemistry reduce the redox potential of water. Carbon dioxide, for example, is reduced by methanogenic bacteria to methane (CH_4). The physiology of fish has also been specially adapted to compensate for environmental salinity through osmoregulation. Their gills form electrochemical gradients involved in the excretion of salt in salt water and its uptake in fresh water.

Gravity

The shape and energy of the Earth are strongly influenced by gravity. On a large scale, the distribution of gravities on Earth is uneven and affects the shape and movement of tectonic plates, as well as geomorphic processes such as mountain formation and erosion. These forces determine many geophysical properties and distributions of ecological biomes on Earth. At the level of the organism, gravitational forces provide direction signals for the growth of plants and fungi (gravitropism), orientation signals for the migration of animals and influence the biomechanics and size of animals. Ecological features such as the distribution of biomass in trees during growth are subject to mechanical failure as gravity affects the position and structure of branches and leaves.

The cardiovascular system of animals is functionally adapted to overcome compressive and gravity forces, which depend on the properties of the organisms (eg size, size, shape), their behavior (eg B. diving, running, flies) and their occupation changes habitat (e.g. water, hot deserts, cold tundras).

Climatic and osmotic pressure is a physiological burden on organisms, especially those that fly and breathe at great heights or dive into the depths of the ocean. These constraints affect the vertical boundaries of biosphere ecosystems because organisms are physiologically sensitive and adapt to differences in atmospheric and osmotic pressures of water. For example, the oxygen content decreases with decreasing pressure and is a limiting factor for life at higher altitudes. The transport of water through plants is another important ecophysiological process affected by osmotic pressure gradients. The pressure of the water in the depths of the oceans forces organisms to adapt to these conditions. For example, diving animals such as whales, dolphins and seals have been specially adapted to accommodate changes in sound due to differences in water pressure. The differences between hagfish species are another example of adapting to deep-sea pressure by modifying specialized proteins.

Wind and turbulence

The architecture of the inflorescence of grasses is exposed to the physical pressure of the wind and is formed by the forces of natural selection that facilitate wind pollination (anemophilia). Turbulent forces in air and water influence the environment as well as the distribution, shape and dynamics of the ecosystem. Ecosystems around the world are affected by the circulation patterns of the global trade winds. Wind energy and the turbulent forces it generates can affect the thermal, nutrient-rich and biochemical profiles of ecosystems. For example, the wind crossing the surface of a lake creates turbulence, mixes the water column, and affects the environmental profile to create thermally stratified zones that affect the structure of fish, algae, and other parts of the aquatic ecosystem.

Wind speed and turbulence also influence evaporation rates and the energy balance of plants and animals. Wind speed, temperature and moisture content can vary as the wind moves through different soil properties and altitudes.

Fire

Forest fires are changing the land, leaving an environmental mosaic that diversifies the landscape into different successive stages and habitats of different quality (left). Some species have been adapted to forest fires, e.g. B. Pine trees that only open their cones after a fire (right). Plants convert carbon dioxide into biomass and release oxygen into the atmosphere. About 350 million years ago (the end of the Devonian era), photosynthesis brought the oxygen concentration in the air above 17%, enabling combustion. A fire releases CO2 and converts fuel into ash and tar. Fire is an important environmental parameter that raises many problems related to its control and suppression. While the problem of fires in relation to ecology and plants has long been recognized, Charles Cooper drew attention to the problem of forest fires in relation to the ecology of suppression and forest fire management in the 1960s.

Native Americans of the North were among the first to influence the fire regime by controlling its spread near their homes or setting fires to stimulate the production of herbaceous foods and baskets. Fire creates heterogeneous ecosystems in age and canopy structure, and changes in soil nutrient input and released canopy structure open new ecological niches for seedlings. Most ecosystems are adapted to natural fire cycles. For example, factories are equipped with various modifications to fight forest fires. Some species (Pinus halepensis, for example) cannot germinate until their seeds have survived a fire or been exposed to certain compounds in the smoke. The environmentally induced germination of seeds is known as serotinia.

Soil is the top living layer of mineral and organic waste that covers the planet's surface. It is the main organizational center for most ecosystem functions and is vital to agricultural science and ecology. The decomposition of dead organic matter (eg leaves on forest soils) results in soils containing minerals and nutrients that stimulate crop production.

The collection of soil ecosystems on the planet is called the pedosphere, in which a large biomass of terrestrial biodiversity is organized in trophic levels. For example, invertebrates that feed and chop larger leaves make smaller pieces for small organisms in the food chain. Together these organisms are the detritivores that regulate soil formation.

Tree roots, fungi, bacteria, worms, ants, beetles, centipedes, spiders, mammals, birds, reptiles, amphibians, and other lesser-known creatures all work to create the food web of life in soil ecosystems. Soils are composite phenotypes in which inorganic substances are incorporated into the physiology of an entire community.

As organisms feed and migrate through the soil, they physically move materials, an ecological process known as bioturbation. This aerates the soil and stimulates heterotrophic growth and production. Soil microorganisms are affected by the trophic dynamics of the ecosystem and are reintroduced into it.

Six main elements (hydrogen, carbon, nitrogen, oxygen, sulfur and phosphorus; H, C, N, O, S and P) make up all biological macromolecules and drive the geochemical processes of the earth. From the smallest scale of biology, the combined effect of billions on billions of ecological processes amplifies and regulates Earth's biogeochemical cycles. Understanding the mediated relationships and cycles between these elements and their ecological pathways has a significant impact on understanding global biogeochemistry.

CHAPTER 5

NATURAL RESOURCES

The earth's natural resources include air, minerals, plants, soil, water, and wildlife. Conservation is the care and protection of these resources so that they can last for future generations. While extinction is a natural process, the rate at which it is happening today is not. Natural resources are resources that exist without human action. This includes all treasured traits such as commercial and industrial use, aesthetic value, scientific interest, and cultural value. On earth, it includes sunlight, atmosphere, water, earth (including all minerals), and all vegetation and wildlife. Natural resources can be part of our natural heritage or be protected in nature reserves.

Natural resources can be classified in different ways. Natural resources are materials and components (something that can be used) that occur in the environment. Every man-made product is made up of natural resources (at its fundamental level). A natural resource can exist as a separate entity such as fresh water, air, and a living organism such as fish, or it can exist in another form that must be processed to preserve the resource as such, such as rare metal ores, earth elements, petroleum and the most forms of energy. Here are different methods for categorizing natural resources. This includes the original source, the level of development and its renewability.

Based on their origin, natural resources can be divided into two types:

• Biotic - Biotic resources are extracted from the biosphere (living and organic matter) such as forests and animals and from materials that can be extracted from them. Fossil fuels like coal and petroleum also fall into this category because they are formed from decomposed organic matter.

• Abiotic - Abiotic resources come from non-living, non-organic materials. Examples of abiotic resources are earth, fresh water, air, rare earth elements, and heavy metals such as ores like gold, iron, copper, silver, etc.

Stage of development, natural resources can be described as follows:

• Potential Resources - Potential resources are those that could be used in the future - for example, petroleum in sedimentary rocks, which will remain a potential resource until they are drilled and used.

• Actual Resources - Resources that have been researched, quantified and qualified and that are currently being used in development, e.g. B. wood processing, and which generally depend on the technology

• Reserve Resources - That portion of an actual resource that can be profitably developed in the future.

• Resources in stock - those that have been studied but cannot be used due to a lack of technology - for example hydrogen

Based on the recovery rate, natural resources can be classified as follows:

• Renewable raw materials - Renewable raw materials can be refilled in a natural way. Some of these resources such as sunlight, air, wind, water, etc. are permanently available and their quantities are not significantly affected by human consumption. Although many renewable resources do not have such a rapid rate of recovery, these resources tend to be depleted from overuse. Resources from a human consumption perspective are classified as renewable as long as the replenishment / restoration rate exceeds the consumption rate. They can easily be replenished from non-renewable resources.

• Non-renewable resources - Non-renewable resources are formed slowly or not naturally in the environment. Minerals are the most common resource in this category. From a human point of view, resources are not renewable if their rate of consumption exceeds the rate of reconstitution / restoration. A good example of this is fossil fuels, which fall into this category as their rate of formation is extremely slow (possibly millions of years) which means they are considered non-renewable. Some resources are naturally depleted in quantity without human intervention. The most notable are radioactive elements such as uranium, which naturally breaks down into heavy metals. Of these, metallic minerals can be reused through recycling , but coal and petroleum cannot be recycled. Once fully used, they take millions of years to recover.

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Resource extraction includes all activities that extract resources from nature. This can range from traditional uses of pre-industrial societies to global industry. The raw materials industry forms the basis of the primary sector of the economy alongside agriculture. The extraction creates raw material, which is then processed to create value. Examples of extractive industries are hunting, fishing, mining, oil and gas drilling, and forestry. Natural resources can significantly increase a country's prosperity.

The extractive industry is a rapidly growing activity in many less developed countries, but the wealth generated does not always lead to sustainable and inclusive growth. People often accuse extractive industries of trading only to maximize short-term value, which means that less developed countries are vulnerable to powerful companies.

The depletion of natural resources is linked to social inequalities. Since most of the biodiversity is found in developing countries, depletion of this resource could lead to the loss of ecosystem services for these countries. Some consider this exhaustion to be a major cause of social unrest and conflict in developing countries.

Habitat conservation is a land management practice aimed at maintaining, protecting and restoring habitats for wild plants and animals, particularly conservation-dependent species, and preventing their extinction, fragmentation or reduction in their range.

Natural resource management is a discipline in the management of natural resources such as land, water, soil, plants and animals - with a special focus on how management affects the quality of life of generations in the present and future. Sustainable development is monitored based on the judicial use of resources to supply current and future generations. The disciplines of fishing, forestry, and wildlife are examples of important sub-disciplines in natural resource management.

Conservation is the care and protection of these resources so that they can last for future generations. This includes the preservation of biodiversity, genes and ecosystems as well as the functions of the environment, such as B. the nutrient cycle.

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