WLS-121 Wildlife Biology 3 (2+1)

Chapter	Topic
1.	Introduction to wildlife biology
2.	Distribution of important Indian mammals
3.	Basic requirements of wildlife – food, water, shelter, space, limiting factors
4.	Wildlife Ecology: Biotic factors, Biological basis of wildlife, Productivity
5.	Effect of light and temperature on animals
6.	Wildlife Habitat: Niche, Territory, Home Range, Edge, Cruising Radius, Carrying Capacity
7.	Animal behavior and adaptation
8.	Shift to Wildlife Management Habitat Improvement: Food, Water, Shelter improvement

Chapter:1

Introduction to Wildlife Biology

Wildlife is important natural resources that can be put to various uses by man. These include ethical, cultural, commercial, recreational and environmental uses. Wild animals are intimately connected with our society, tradition, cultural education, economy, recreation and ecology. They made our planet a place of joy, environment, peace and prosperity.

William Hornaday (1913) had coined the term wildlife in his book named "OUR VANISHING WILD LIFE"

Wildlife usually comprises undomesticated animal species, but it also consist of all organisms that grow or live wild in a region without being introduced by humans.

In broad sense wildlife includes whole fauna and flora found in natural habitat.
According to wildlife Protection Act 1972: wildlife includes any animal, bees, butterflies, crustacean, fish and moths; aquatic and land vegetation which form part of any habitat.

Animals include amphibians, birds, mammals and reptiles and their young ones.
Habitat include land, water or vegetation which is the natural home of any wild animal.
Wild animal means – any animal found wild in nature and includes any animal specified in Schedule I,II,III,IV or V .

On the other hand there are a number of negative aspects of wildlife. Both positive and negative values of wildlife.

Positive value:

Ethical value, cultural value, ecological value, scientific value, aesthetic and recreational value, commercial and economic value and game value.

Negative value:

Damage to agriculture, competition, human damage and land use pattern.

(Detailed lecture has been explained in class)

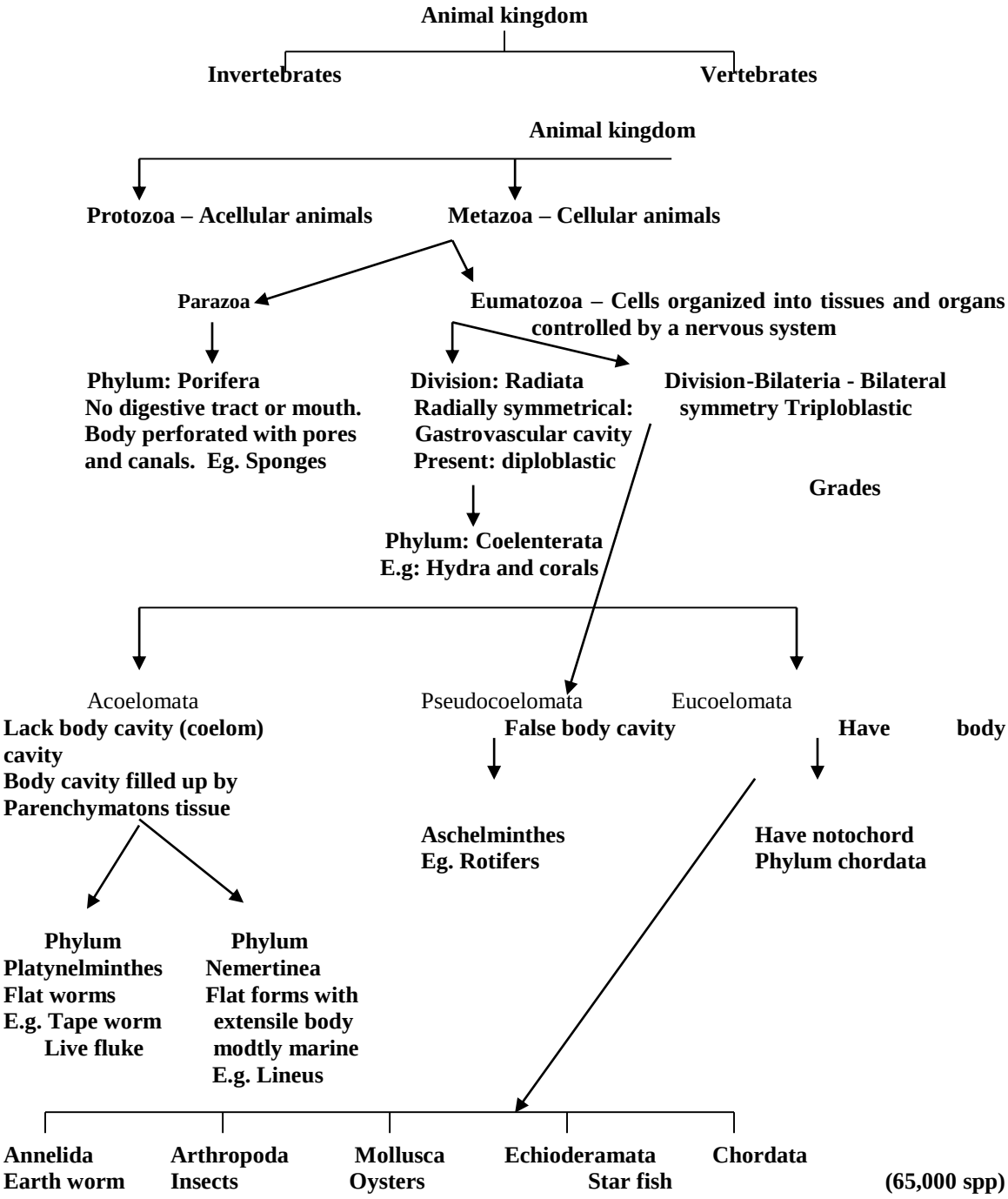
Chapter : 2
Distribution of Indian Mammals

Geological Time Scale with Notes on Events in the Evolution of Animals with changes in Environments

1	2	3	4	5	6
Era	Peirod	Epoch	Time of Beginning of period in million of years (approx.)	Geological and Climatic conditions	Animal Life and Dominance of particular group
	Quaternary	Recent	0.025	Forest and deserts; Warm climate; end of last glaciation	Age of modern man, development of human cultures Rise of world civilization
		Pleistocene	1	Periodic glaciation resulted in destruction, of many large mammals unusual solar activity	Age of primitive man; extinction
		Pliocene	**12**	**Polar and temperate climate, lce age, rise of mountains of America**	**Evolution of Man, Abundant mammals; Elephants; horses and camels like modern forms, Decline of some mammals**
		Miocene	**28**	**Some areas dry and arid; some areas cooler and water**	**Numerous mammals in their height of evolution; first man like apes, modern carnivores**
		Oligocene	**39**	**Pleasant and warmer climate low land;**	**Archaic mammals extinct. Modern mammals appeared**

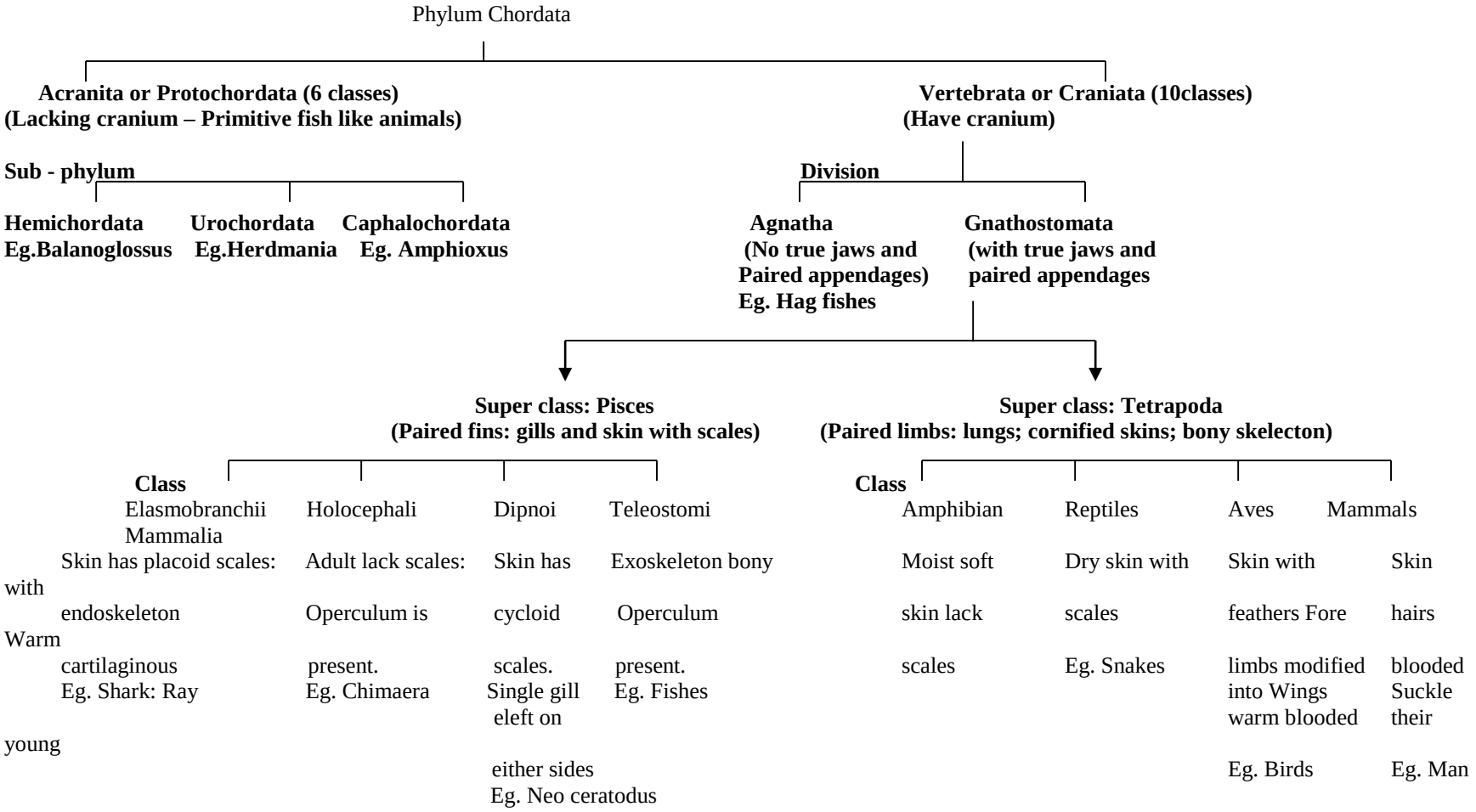
This system brings out the evolutionary relationship between animals and hence known as natural classification.

Classification



Phylum chordata

It has approximately 65,000 known living animals – many extinct forms also


Phylum Chordata
Acranita or Protochordata (6 classes)
(Lacking cranium – Primitive fish like animals)
Vertebrata or Craniata (10classes)
(Have cranium)
Sub - phylum
Hemichordata
Eg.Balanoglossus
Urochordata
Eg.Herdmania
Caphalochordata
Eg. Amphioxus
Division
Agnatha
(No true jaws and
Paired appendages)
Eg. Hag fishes
Gnathostomata
(with true jaws and
paired appendages
Super class: Pisces
(Paired fins: gills and skin with scales)
Super class: Tetrapoda
(Paired limbs: lungs; cornified skins; bony skelecton)
Class
Elasmobranchii
Mammalia
Holocephali
Dipnoi
Teleostomi
Class
Amphibian
Reptiles
Aves
Mammals
Skin has placoid scales:
endoskeleton
cartilaginous
Eg. Shark: Ray
Adult lack scales:
Operculum is
present.
Eg. Chimaera
Skin has
cycloid
scales.
Single gill
eleft on
either sides
Eg. Neo ceratodus
Exoskeleton bony
Operculum
present.
Eg. Fishes
Moist soft
skin lack
scales
Eg. Snakes
Dry skin with
scales
Skin with
feathers Fore
limbs modified
into Wings
warm blooded
Eg. Birds
Skin
hairs
Warm
blooded
Suckle
their
young
Eg. Man

Class: Mammalia

Evaluation:

A slow and gradual change in the genetic compositions of population leads to process / stages / types of evolution.

1. Micro 2. Macro and 3. Mega.

Population genetic:

The study of mechanisms of evolution.

Micro - evolution:

- Relatively continues, and gradual small changes in the interbreeding population – result of the interaction of some elemental form of evolution (material, recombinant, natural).
- It brings sub-specific differentiation within the species – but new species or higher categories of animals can not be present.
- Produce very small evolution differences.
- It is a sequential evolution (sewage, 1965) i.e. The defended the basic pattern of evolution into. I. Sequential and Divergent evolution
- The existing gene pool modification.
- Can't produce new population, temporary changes.
- Changes in gene combinations are non - adoptions

Induction of variation can be introduced in the genotype of the individuals by the process of interbreeding. Where recombination of genes take place.

2. Macro – evolution:

- Also known as adaptive radiation
- Different habit, habitat and environmental changes to a successful group to animals divide into small groups by adaptive radiation.
- Divergent evolution (Sewage, 1969)
- Few populations originate from the old ones.
- Production of new adaptive types takes place through a process of population fragmentation and genetic divergence.
- Large changes take place in the body form and there is marked increase in the size of the individual.
- Organisms become well adapted to changed environments.
- "Quantum evolution" - sudden change

- Evolution of new species

  Eg. Evolution of horse.

  Genus Eohippus (upto 11ht) – Horses (*Equus equus*)

  Changes teak place: 1) Structure of limbs

  2) Length of the neck

  3) Structure of teeth

- The produced organism should cope with the changed environment.

III Mega Evolution:

- Evolution of new types of animal from the predecessors (ie) gives size to higher taxonomic categories (under classes etc)

New system of animal organization during adaptive radiation)

↓

Fishes (Pisces)

Amphibians (Amphibia)

Reptiles (Reptilia)

↓

Birds and mammals

↓

(Avian) (Mammalia)

Post adaptations:

Development of more specialized adaptation.

Evolution of mammals

- Traced from a series of fossil synapsid reptiles of the group therapsida
- During this process of evolution, the structure of many posts of the body changed in Mammalian directed.

Important modification:

1. False palate.
2. Differentiation of teeth into incisors, canines, pre molar and molar.
3. Modification of limbs so as to bending roof of the mouth in mammals, formed by flat extension of the maxillae meeting in the middle and separating the bucked from the rural existing.

Quadrate:

A cartilage bone at the kind end of the upper jaw in most vertebrates – much reduced and becomes to incurs the ear.

- Mammal: mammary glands.
- Body is covered with hairs which are epidermal in origin.
- Warm-blooded animals
- Glands (sebaceoue, sweat, sent, mile glands)
- Mammary glands are present in all the mammals for feeding the young ones.
- Two occipital condyles in the skull.
- Two pairs of pentadactyle limbs (A limb having five digits).
- Toes are produced with having claws, nails, hoofs of fleshy pads.
- The external ear of pinna is present (most cases).
- Three ear ossicles , Malleus, incus and stapes – present in the middle ear.
- Teeth : heterodont – (most mammals - two types of teeth
  Thecodont - having teeth in sockets
  Diphyodont - having two sets of teeth
- Viviparous animals.
- A larynx with vocal cord is present (the voice box).
- Internal fertilization placenta is formed between the uterus and the developing embryo.
- 12 pairs of cranial nerves.
- Males (penis)

Distribution

- Life occurs in all habitats (high mountains to deep-sea areas .
- All the animals are not present in all habitat
- Confined to certain particular areas over the globe.
- Range – The area of distribution of a species.

Two aspects

- Distribution of animals in space.
- Distribution of animals in time.

1. Distribution of animals in space:

- Distributed over the surface of the earth (land and water)

  ie. Horizontal distribution of animals in different
- Continents and Islands.
- Zoogeography - They study of geographical distribution of animals. (Zoogeographical reasons)
- Vertical distribution (Bathymetric)
- Both in land and water (it includes)

  1) Holobiotic (marine) – fishes
  2) Linnobiotic (fresh water) – Rhinoceros
  3) Geobiotic (Terrestrial) – Dear, elephant etc.

2. Distribution of animals in time (geological distribution)

- Covers the evolutionary history of the animals a distribution of animals in the past, based on fossil records.

Pattern of animal distribution

1. Continuous distribution:
   - Cosmopolitan having wide range of distribution
   - Found all over the world.

   Eg. Bats, rats, cuckors etc.

   Eurytopic : Uniform distribution
   (generalised adaptation) - snakes

   Stenotopic: Confined to particular areas
   (specialised adaptation) – hill tops tahr

2. Discontinuous distribution
   - not confined in the distribution of the individuals of the same species or related species over the globe.
   - Found to inhabit same
3. Bipolar distribution
   - location to polar regions (North and South poles)

Factors – affecting normal distribution of animals

1. Physical barriers

a) Geographical : Himalayan range in India.
b) Large bodes of waters and land masses , salinity of water
c) Vegetation barriers, large distances.

2. Biological barriers:
   a. Food and enemies, sedentary habit and territorial weakness.
   b. Height
   c. Depth of sea
3. Climatic barriers:

   Temperature, moisture and light.

Vertical distribution : conditions – Needed

1. Air or water medium
   - Need a specific conditioned for breathers air alone, or water alone. But, *Rana tigrina* (both air and water breathers)
   - Temperature of water controls phytoplanktons and zooplanktons densities.

2. Presence or absence of light:
   - Presence or absence of light affect the animal population through the food supply.
   - Rest rhythm to the altered times of light and darkness.
   - Fauna of a particular zone depends on the nature of the food available.

3. Presence or absence of substratum

   a. Ecological factor – in sea Fauna and flora influenced by the nature of bottom eg hardness, pebbles, gravel, sand or soft bud etc.

   b. Secondary factor

      Eg. Fresh or salty water
      - water pressure - presence by depth affected
      - sensitive eyes or receptors
      - exhibit bioluminescence in the dark surrounding.
      - Evolved during mesozoic and cenozoic eras

DISTRIBUTION OF WILDLIFE SPECIFICALLY MAMMALS IN INDIA

Zoo-geography: Ecological and historical aspects

Historical – cum – geographical factors

Philip Sclater (1858) and Alfred Russel Wallace (1876)

Region	Area
Nearctic	North America and Greenland
Palaearctic	Eurasia, canary Islands, Korean, Japan, Northern Africa
Ethiopian	Africa, South of the Sahara
Oriental	India and Indochina
Australian	Australia, New guinea, and Islands
Neotropical	South and Central America

REGIONS AND THEIR RELATED FAUNA OF INDIA

The faunal distribution of India is divided into three major Ecological sub divisions. (comes under oriental)

I. The Himalayan mountain systems:

Some of the animals the bears, wild pigs, tigers, snow leopards are found on both sills of the Himalaya in the Palearctic and oriental regions.

1. Himalayan foot hills (Kashmir to Assam)

2. Higher altitudes in the western Himalayas from Kashmir to Ladakh.

3. Eastern Himalayan sub region.

II. The peninsular – Indian sub region

- Having woodland savannah - Ethiopian region & North Africa.
- Animals are lion, cheetah, leopard, Hyena, Jackal and Antelopes

III. The tropical Evergreen forests (or) Indo – Malayan

Sub region:

- Natural Rain – forest vegetation. (Pliocene)
- It has both Indian and Malayan, Indo-chinese fauna.
- Has a wealth of species of flora and fauna (i.e) Western Ghats)
- Animals such as Red panda, Gibbon, tree shrew, tapir, Giant squirrel, flying lemur.

I. The Himalayan mountain system

- Altitude however influence the distribution of flora as well as fauna
- Every 1000 act size in altitude is equivalent to a 10^{o} increase in latitude.
- 3500 mt elevation
- Western Himalayas – region – low rainfall – more snow, temperate conditions
- Eastern Himalaya region more rainfall, snow fall is confound to very high altitudes and at lower altitudes conditions reasonable the tropical rain forest.

I. 1. The Himalaya foothills

- Richest area for the tropical big mammals of Northern India.
- Animals Elephant, sambar, swamp deer, cheetal, Hog deer, Earking deer. Wild boar, Tiger.
- Co-predators : Panther, wild dog.
- Camp followers : Haryana, Jackal
- South the block, sloth bears are found rodents porcupine.
- The great one horned Rhinoceros. But now it is conformed to a few pockets in Assam and Nepal tarai.
- Another which shares the hebitat with Rhinoceros is Gaur wild buffalo.
- The bow – antlered deer (kaibul lanjo sanctuary in Manipur) (Threatened deer in the world).
- In tarai – The major cause in due to Agriculture. Hydro electric generation – project to wild animals.
- II Project Areas (Corbett park) & manes sanctuary.
- This is the most vulnerable ones for is wildlife
- The Gangatic gharial only found in the region (or) Tributaries of river Ganga.
- Manes sanctuary (1950s). Gee establish a new sp of monkey namely Golden lungur which is heaved after him as Presbytis gee.

I. 2. The high altitude region of western Himalayas

Wild ass, wild goats, sheep. The largest Bird (yak). They are black with long black horus and a little white on the muzzle.

- The blue sheep (or) Bharal sikkum to Nepal.
- Shapu (or) urial smallest in the wild sheep
- Antelopes chiru Tibetan gazelle
- All these animals are adapted to cold & harsh conditions. Their coat is thick winter, thinner summer, and is rock climbers.
- The Hangul (or) Kashmir stag (European red deer)
- The show (or) the Sikkim stag is another deer.
- The musk deer (musk pods) collected from make and used for perfumes.
- Predator's wild, fore, smaller cats, bears, scavengers and griffon vultures, ravens.
-

I. 3) The Eastern Himalayan sub-zone :

- The animal life in the temperate region in different from the western Himalaya and is characterised by the presence of Indo-*Chinese fauna*.
- Real panda, hog badgers, ferret badgers, porcupines, goat, Goral (sudler goat), Takins (largest goat).

II 1) Peninsular India and the drainage Basin of the Ganga:

- Fauna ungulates, herbivorous, Elephants, Muntjac, sambar, deer, wild boar, Gaur. Mouse deer, cheetel, meadows of Kanha or of Corbett National park. The deer is both a grazier and a browser and has a high breeding potential. Hoq deer, swamp deer (or) Barasinga.
- Predators - Tiger, leopard, wild dog, low whole. Cheetah and lion.
- The lion once had a wide sarge distribution in western and central India across into Persia, the Middle East. But now confined to a small pocket of forest in the Gir National park of Gujarat.
- Carnivores - Striped hyena, Jackal.

II 2) The Indian Desert:

Fauna Rodents (largest group) desert gerbils.

- The largest mammal of the Indian desert is the Asiatic wild ass, which lives in the south-west of the thar desert on the little Rana of kutch.
- Bird Great Indian Bustard

III The tropical Rain forest regions

Fauna

- Elephants, Gaur, Barking deer, (most of all tree dwellers) Non human primates. North east region of Assam gibbon (only Ape). Golden langur, leaf monkey, pig tailed macaque loon tailed macaque Nilgiri larger, slender loris, Bats (flying mammals). Nilgiri mongoose - necked mongoose, Malabar spiny mouse (flying squirrels).

This zone is the richest gene pool resources of flora and fauna in the country.

For more information visit:

http://www.rhinoresourcecenter.com/pdf_files/138/1386208439.pdf

Chapter-3

Basic requirements of wildlife - food, water, shelter, space, limiting factors

Wildlife habitat are areas distributed horizontally and vertically across the landscape that fulfill the needs of a specific wildlife species for the basic requirements of food, water, reproduction (nesting), and protection against predators and competitors (cover/shelter). Habitat provides the space requirements that allow wildlife to occupy, move around, and to generally survive and cope with climatic extremes.

The concept of wildlife habitat varies according to the needs of each species to successfully nest, roost, forage, and reproduce. Given the wide diversity of wildlife within and across continents of the world, the needs of a particular wildlife species will vary greatly; however, all terrestrial species require food, cover, water, and space.

It is generally accepted that increases in the diversity of vegetation across a landscape will lead to increases in the value of the landscape as habitat for a variety of species. One important aspect in understanding whether sufficient wildlife habitat is available involves understanding the needs and requirements of a species throughout its life cycle. In many cases, healthy and bountiful wildlife populations are dependent on a mosaic of different habitats across a landscape. To complicate matters a bit, habitat requirements may vary by season of year, as some species (particularly birds) may migrate thousands of miles between breeding and wintering grounds.

Food:

The availability of food is a basic habitat requirement to which we can all relate, the availability of the food plays a critical role in allowing a species, including humans, to live, grow, reproduce, and survive. The consumption of food allows wildlife species to generate energy, which is critical since they need energy to reproduce and to escape predators. Food is also important for predators, since they need energy to hunt prey in the first place. Not having enough food weakens a species' ability to move and to avoid being consumed by predators. A lack of food can also weaken a wildlife species' ability to ward off disease, which can then make it vulnerable to a variety of other threats.

Not all food sources are of the same quality. All wildlife species, as well as humans, have their preferred suite of foods. For instance, white-tailed deer in the southern United States prefer to consume acorns, which are produced by various species of oaks (*Quercus* spp.). Apples are another favorite food source of the white-tailed deer, which is a concern of landowners who grow apple trees near wooded areas. White-tailed deer will also consume a wide variety of leaves from bushes and trees, as well as forbs and grasses if a sufficient supply of acorns is not available. However, white-tailed deer tend to avoid eating vegetation with leathery or prickly foliage. Other wildlife species, such as the gray wolf, prefer to consume ungulates such as deer, elk, caribou, or moose, but they will also consume smaller animals, such as hares, badgers, squirrels, and mice, as well as lizards, snakes, and frogs, when larger prey is in short supply.

Even though wildlife species express preferences for food, they will typically consume whatever is available in order to generate the energy needed to reproduce and to survive. Like humans, they would prefer to simply consume certain types of food, but generally cannot because a limitless supply of the preferred food is usually unavailable. In many cases, this does not have an adverse impact on wildlife species health. Unfortunately, if a particular habitat only provides low-quality food sources, then the health and vigor of a particular wildlife species could be adversely affected. Low-quality food supplies could lead to weak individuals and potentially affect or inhibit reproduction processes.

Cover/ shelter:

Another key requirement of wildlife habitat is the cover that exists within a landscape. Cover is used by different species of wildlife for many purposes such as nesting, breeding, roosting, rearing young, and escaping predators. Predators use cover as a venue for creeping up on and stalking potential prey. Cover may also be used as thermal protection during extremely hot or cold periods. Cover requirements of different wildlife species can vary greatly. For instance, white-tailed deer in the commonly bed down (sleep) in dense coniferous or deciduous forests or in places that contain a dense collection of understory vegetation. It is not uncommon to find deer in coniferous stands of trees in the winter, because these types of forests exclude more snow than do pure deciduous stands of trees. Deer, however, will venture out into open areas such as clearcuts, fields, or suburban backyards to forage on the various grasses, forbs, shrubs, or herbaceous plants located there. Frightened, deer will flee to a wooded area and quickly stop running because they feel more secure within the cover of the surrounding vegetation.

Water:

A third requirement of wildlife habitat involves the availability of water. As with humans, all wildlife species require some level of water consumption in order to survive and reproduce. In addition, bodies of water can be the specific places where birds, mammals, or other species, Otter (*Lontra canadensis*), can locate the food that they prefer to consume. Perhaps these are the only areas where the sources of food that they consume exist. Water is also critical for regulating body temperature, metabolism, and digestion, and for facilitating the removal of metabolic wastes . Some wildlife species, such as roadrunners or horny toads have adapted to arid areas with low amounts of annual rainfall, while other species require sufficient water (e.g., red salamanders (*Pseudotriton ruber*) of the United States) and require landscapes that contain depressional wetlands, ponds, and other hydrologic features.

Limiting Factor

A limiting factor is a resource or environmental condition which limits the growth, distribution or abundance of an organism or population within an ecosystem.

These can be either physical or biological factors which can be identified through a response of increased or decreased growth, abundance, or distribution of a population, when the factor is changed and when the other factors necessary to life are not.

Limiting factors are theorized under Liebig's Law of the Minimum, which states that "growth is not controlled by the total amount of resources available, but by the scarcest resource".

A limiting factor restricts organisms from occupying their fundamental niche and results instead in the fulfillment of their actual or realized niche.

Types of Limiting Factor

1. Density Dependent Factors

Density dependent factors are those factors whose effect on a population is determined by the total size of the population. Predation and disease, as well as resource availability, are all examples of density dependent factors. As an example, disease is likely to spread quicker through a larger, denser population, impacting the number of individuals within the population more than it would in a smaller, more widely dispersed population.

2. Density Independent Factors

A density independent limiting factor is one which limits the size of a population, but whose effect is not dependent on the size of the population (the number of individuals). Examples of density independent factors include environmentally stressful events such as earthquakes, tsunamis, and volcanic eruptions, as well as sudden climate changes such as drought or flood, and destructive occurrences, such as the input of extreme environmental pollutants. Density independent factors will usually kill all members of a population, regardless of the population size.

3. Physical and Biological Limiting Factors

Limiting factors can also be split into further categories. Physical factors or abiotic factors include temperature, water availability, oxygen, salinity, light, food and nutrients; biological factors or biotic factors, involve interactions between organisms such as predation, competition, parasitism and herbivory.

Examples of Limiting Factors

Resources

Resources such as food, water, light, space, shelter and access to mates are all limiting factors. If an organism, group or population does not have enough resources to sustain it, individuals will die through starvation, desiccation and stress, or they will fail to produce offspring.

In the case of photosynthesizing organisms such as plants, light is a vitally important limiting factor, essential for their growth. This is most prominent in understory plants of a forest, where photon energy from light is made less available, as it is unable to penetrate through higher canopy levels. However, many different plants are adapted to withstand different levels of light, allowing them to survive with less light energy input.

As well as light, growth of plants is limited by the availability of the nutrients nitrogen (N), phosphorus (P), potassium (K) and sulfur (S). Each plant needs a specifically balanced ratio of these nutrients in order to survive. If one of the nutrients is not present in sufficient amounts, this is considered the limiting factor to growth.

The limiting resource within an ecosystem determines the carrying capacity (indicated in ecology by the letter, "K"), which is the maximum number of individuals in a population that a habitat can support without environmental degradation.

In an ecosystem with unlimited resources, no predators and no disease, populations may experience exponential growth. The carrying capacity therefore acts as a moderator of population size; once limiting resources start to become depleted by increasing numbers of individuals, intraspecific competition occurs and the growth rate of the population begins to slow as individuals die or fail to reproduce. Eventually the growth rate levels off at a plateau – this plateau is the carrying capacity. Once the carrying capacity of an environment has been reached, individuals may begin to search for resources elsewhere, migrating away from the original population and creating new populations. If the populations become separated indefinitely, this can lead to speciation.

Environmental Conditions

Limiting factors are also present as environmental conditions. Two of the most prominent examples are temperature and precipitation; these are widely affected by the climate, and seasonal changes within the climate. The effect that each factor has on a particular organism is determined by each individual species' life history traits.

Maintaining a correct body temperature is vitally important for almost all organisms in order to perform metabolic functions effectively. With many organisms, this means they can only inhabit certain depths, as in marine organisms, certain elevations, as in mountain dwelling animals and plants, and certain latitudes of the earth, i.e. the tropics or the Northern hemisphere.

Although sunlight tends to be a factor which controls the temperature of a habitat, and thus affects photosynthesis in terms of photon energy, correct temperature is also important for catalyzing enzymes in photosynthetic reactions. Above the optimum temperature, enzymes are catalyzed at an increased rate, which can lead to denaturing of the enzymes. This is called a light independent reaction. Increased temperature also leads to desiccation of

leaves, as it causes increased evapotranspiration and removes too much water from the plant. Conversely, if temperatures fall too low, frost may form on leaves, which damages the cell walls and cell contents.

The amount of precipitation in an environment is also important for plants. The absorption of water as a resource is vital for plant growth and other functions, so lack of rainfall can lead to wilting, scorching and damaged cells. Precipitation is also important because many plants are evolved to withstand different amounts of atmospheric humidity. As the thin, tough leaves of cacti make them specifically adapted to surviving in hot and arid conditions, too much rainfall can affect their ability to reproduce, which in turn restricts the population growth. Too much rainfall may also flood the soil, reducing the amount of oxygen available to the roots, causing root loss or leaving the plants susceptible to fungal damage.

Biotic factors

As well as resource and climatic factors affecting population growth, biotic factors such as predation, herbivory, parasitism, and interspecific and intraspecific competition, are also limiting factors; these tend to be density dependent factors.

Parasitism, like disease, is generally more destructive to large, dense populations because the parasite is able to effectively parasitize more individuals if they are in close contact. Within tropical ecosystems, the Cordyceps fungus is a prominent parasite, and has many strains specialized on different species. Because it is such a successful parasite, it keeps many populations down, working as a limiting factor, and it is thought to be one of the main reasons that most species in tropical rainforests are rare. The availability of host species, which the Cordyceps fungus can parasitize, is a limiting factor for the fungus.

The population density of predators and prey are limiting factors for each of these parties. If a population, for example deer, reaches high numbers because there has been an increase in a resource that is their limiting factor – such as increased tree growth after a warm summer – their predators, for example, wolves, will experience an increase in their food source. The wolf population, with a surplus of deer to eat, may then be able to reproduce more freely, increasing their own population. As the population of wolves increases, they will require the high number of deer, which was available as their limiting factor when the population grew. As the wolves heavily predate the deer populations, the resources will eventually become scarce, and the wolf population will no longer be sustainable. As wolves die, pressure on the deer population is reduced and the numbers will be able to increase again; thus the cycle continues.

Human Limiting Factors

The increase in human population is responsible for placing many limiting factors on species that did not historically exist. Density dependent limiting factors such as decreased availability of space due to deforestation is a global issue, causing decline and extinctions

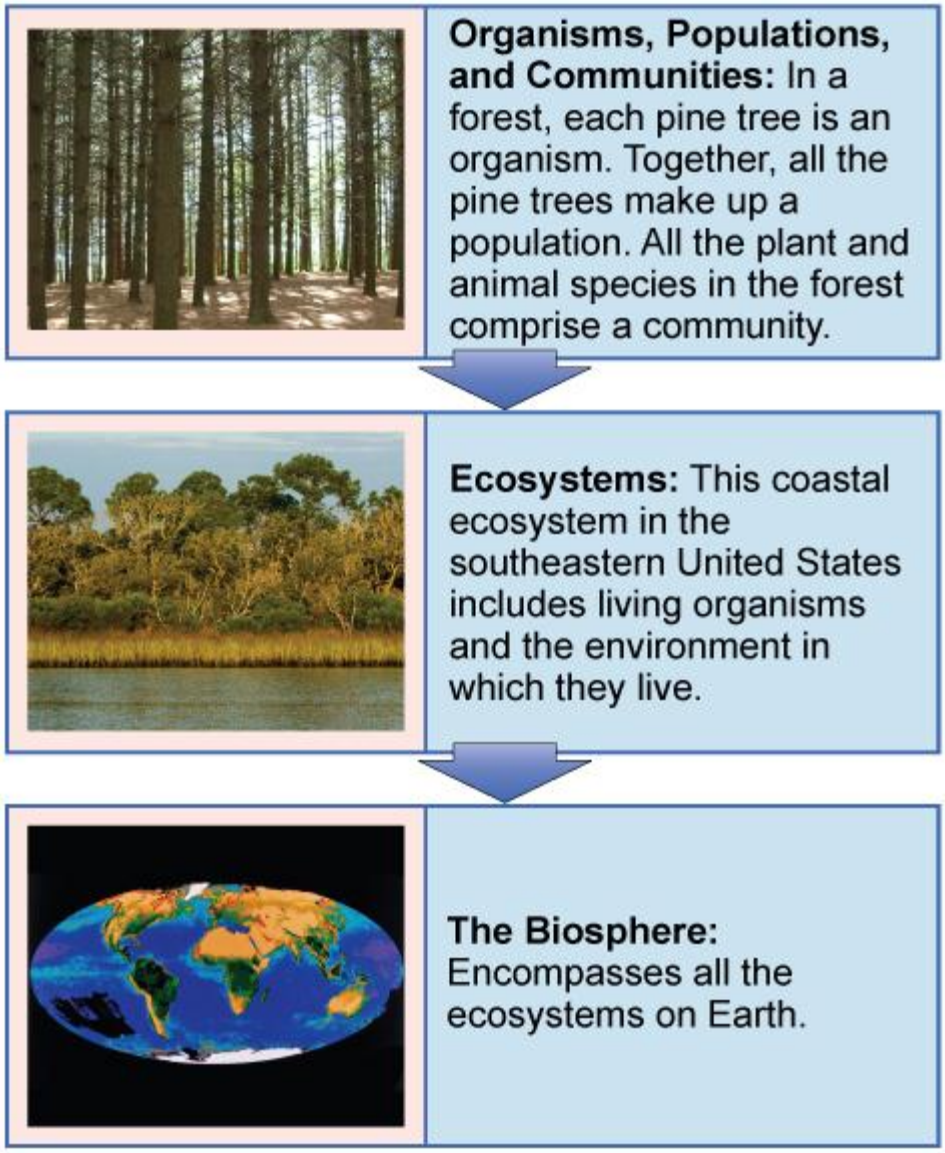
in many populations. Resources are also increasingly scarce due to hunting and leaching of nutrients from soil, which causes intraspecific and interspecific competition within and between populations. Removal of predators has also disturbed the balance of natural biotic, cycle of predators and prey; in some cases, prey animals have been able to thrive in the absence of predators, exceeding the carrying capacity of ecosystems and causing environmental damage. Predators have also been introduced as invasive species into ecosystems, putting pressure on prey populations and thus on the prey's natural predators.

Chapter-4
Wildlife Ecology: Biotic factors, Biological basis of wildlife, Productivity

Ecology how organisms interact with one another and with their environment
(environment = biotic (other organisms) and abiotic (physical factors))

Levels of ecology

Ecologists often work at five broad levels, sometimes discretely and sometimes with overlap: **organism, population, community, ecosystem, and biosphere.**



Organisms make up a population. Multiple populations of different species make up a community. Communities in a particular area make up an ecosystem. All of the ecosystems on Earth make up the biosphere.

From smallest to largest:

- **Organism:** Organismal ecologists study adaptations, beneficial features arising by natural selection, that allow organisms to live in specific habitats. These adaptations can be morphological, physiological, or behavioral.
- **Population:** A population is a group of organisms of the same species that live in the same area at the same time. Population ecologists study the size, density, and structure of populations and how they change over time.
- **Community:** A biological community consists of all the populations of different species that live in a given area. Community ecologists focus on interactions between populations and how these interactions shape the community.
- **Ecosystem:** An ecosystem consists of all the biotic and abiotic factors that influence that community. Ecosystem ecologists often focus on flow of energy and recycling of nutrients.
- **Biosphere:** The biosphere is planet Earth, viewed as an ecological system. Ecologists working at the biosphere level may study global patterns—for example, climate or species distribution—interactions among ecosystems, and phenomena that affect the entire globe, such as climate change.

Ecology of individual organisms

1. physiological ecology
2. temperature and water balance
3. light and biological cycles
4. physiological ecology and conservation

Ecology of Populations

- Population Ecology = the study of how populations interact with their environment
- Population = group of individuals of the same species occupying a common geographical area
- Habitat - where a species normally lives

Characteristics of populations - Each population has certain characteristics:

1. Population size = number of individuals making up its gene pool
2. Population density = number of individuals per unit of area or volume, e.g. persons/square mile
3. Population distribution = the general pattern in which the population members are dispersed through its habitat, may be: Clumped (most common), Uniformly dispersed (rare), or Randomly dispersed

4. Age structure defines the relative proportions of individuals of each age: Pre-reproductive, Reproductive, and Post-reproductive
5. Population size and growth Population size is dependent on births, immigration, deaths, and emigration
6. Zero population growth designates a near balance of births and deaths
7. Exponential growth: If birth and death rates of a population remain constant they can be combine into one variable r = net reproduction per individual per unit time (rate of increase)
8. Population growth may be represented mathematically as: G = rN Where G = population growth per unit time, r = rate of increase and N= the number of individuals. When plotted against time a graph in the shape of a J will be obtained denoting exponential growth, i.e. one variable increases much faster than the other
9. As long as per capita birth rates remain even slightly above per capita death rates, a population will grow exponentially - with ever-increasing rates and shorted "doubling times"
10. It took 2 million years for the world's human population to reach 1 billion, yet it took only 12 years to reach the fifth billion
11. If a population lives under ideal conditions it may display its biotic potential - the maximum rate of increase under ideal conditions. Few populations live under ideal conditions because a number of factor limit their growth
12. Limiting factor - any resource that is in short supply, e.g. food, minerals, light, living space, refuge from predators, etc.
13. Carrying capacity = maximum number of individuals of a species or population a given environment can sustain. Each habitat or area can only support so many individuals
14. Because of limiting factors populations rarely exhibit J shaped growth curves

Logistic growth

15. Early on populations will exhibit very rapid growth but as they near the carrying capacity they will level off is called logistic growth and it produces an S shaped curve
16. Logistic growth is density dependent, i.e. the growth is affected by the density of individuals.
17. For example - 26 reindeer were introduced onto an island off the coast of Alaska in 1910. Within 30 years the herd increased to 2,000. However, overgrazing reduced the food supply and the population crashed to 8 animals by 1950
18. High density and overcrowding put individuals at greater risk of being killed, e.g. predators, parasites and pathogens have greater numbers of prey and hosts in a smaller area to interact
19. Bubonic plague swept through Europe in the 14th century, killing at least 25 million. The disease spread rapidly in overcrowded cities where sanitary conditions were poor and rats were abundant

20. Population size and growth may also be controlled by density-independent factors, e.g. adverse weather, floods, droughts, cold temperatures

Life history patterns

• Not all individuals in a population are the same age.
• Different populations may have very different age structures and these will determine their growth patterns
• Age structure refers to the proportions of pre-reproductive, reproductive and post-reproductive age individuals in a population. The age structure of a population will determine its future
• Each species has a characteristic life span and the probability of dying increases with age

• Population ecologists, as well as insurance companies track cohorts and construct life tables for
populations
• Cohort = a group of individuals born at the same time, e.g. baby boomers are a large group of
individuals born just after World War II
• A life table is an age-specific death schedule. Such a schedule is often converted to a more palatable survivorship schedule. For each age interval there is an predicted life expectancy or survivorship
• Ecologists divide populations into age classes and assign birth rates and mortality risks to each class. Absolute population numbers mean very little unless their age structure is known
• For example, population A might have many more members than population However, all the members of A might be post-reproductive, whereas population B might consist of mostly pre-reproductive and reproductive age individuals. Population A might be in danger of extinction.

Life history strategies

• **r-selected organisms** - put most of their energy into rapid growth and reproduction. This is common of organisms that occupy unpredictable environments, e.g. weeds are usually annuals with rapid growth
and early reproduction. They produce large number of seeds containing few stored nutrients
• K-selected organisms - put most of their energy into growth. They are common in stable environments
near carrying capacity, e.g. long lived trees such as redwoods take many years of growth to reach
reproductive age.

Ecology of Communities

Community = two or more populations of different species occupying the same geographical area

• Community Ecology = the study of how different species interact within communities
• Habitat = the physical place where an organism lives, e.g. a pine forest or fresh water lake
• Some organisms, particularly migratory birds require more than one habitat
• Niche = the functional role of an organism in a community, its job or position
• Each species has a potential niche - what they could do with no competitors or resource limitations but due to competition and/or resource limitations, most organisms occupy a realized niche, the part of the fundamental niche that a species actually occupies in nature

Species interactions

• **Neutral** - two species that don't interact at all
• **Commensalism** - beneficial to one species but neutral to another, e.g. birds that nest in trees, epiphytes (plants that grow on other plants) such as tropical orchids
• **Mutualism** - an interaction that is beneficial to both species, e.g. plants and their pollinators, plants and animals that disperse their seeds, certain fungi and plant roots
• **Parasitism** - an interaction that benefits one species and is detrimental to another. Note that the host is generally not killed.
• **Predation** - an interaction beneficial to one species and detrimental to another. In this case the prey is killed. Predators are those that kill and eat other animals. Although many organisms eat plants they usually don't kill them because they are a constant supply of food. Prey are killed and eaten.

Competitive interactions

• Competition has negative effect on both organisms competing for a resource
• Because resources are limited in nature there will always be competition for them
• Competition is the driving force of evolution, those that win leave more offspring

• **Types of competition:**

Intraspecific - competition among individuals of the same species, e.g. humans compete against
other humans

Interspecific - competition between different species, e.g. humans compete against a wide variety of species seeking to utilize our food resources

The theory of competitive exclusion maintains that species who utilize the same resources cannot
coexist indefinitely - the "one niche, one species" concept

resource partitioning - the resources are divided, permitting species with similar requirements to use the same resources in different areas, ways and/or times.

Community stability

• Communities are assemblages of many different species occupying the same geographical area

• Communities are not static, they gradually change over time because the environment changes and species themselves tend to also change their habitats

Ecology of Ecosystems

Ecosystem = a community of organisms interacting within a particular physical environment

or an ecosystem is a community plus its abiotic factors, e.g. soil, rain, temperatures, etc. Virtually all energy on earth comes from the sun, via photoautotrophs (primarily plants), and it is ultimately distributed throughout ecosystems.

• Primary producers are the autotrophs

• All other organisms are consumers Consumers which eat plants are called herbivores

• Consumers which eat animals are called carnivores Organisms such as humans, which eat both plants and animals, are called omnivores

• Decomposers, which includes fungi and bacteria, obtain their energy by breaking down the remains or products of organisms

• Detritivores are decomposers which eat detritus - organic wastes and dead organisms

Structure of ecosystems

• Energy flows through ecosystems via food webs, intricate pathways of energy flow and material cycling

• Ecosystems are arranged by trophic (feeding) levels between various producers, the autotrophs, and consumers, the heterotrophs:

• First trophic level - contains the autotrophs which build energy containing molecules

• They also absorb nitrogen, phosphorous, sulfur and other molecules necessary for life

• They provide both an energy-fixation base as well as the nutrient-concentration base for ecosystems

• Two types of autotrophs: Photoautotrophs - plants and some Protista

• Chemoautotrophs - bacteria

• Second trophic level - contains the primary consumers which eat the primary producers including herbivores, decomposers and detritivores, e.g. insects, grasshoppers, deer and wildebeest

• Third trophic level - contains the secondary consumers, primary carnivores which eat the herbivores, e.g. mice, spiders and many birds

• Fourth trophic level - contains the tertiary consumers, secondary carnivores who eat the primary carnivores, e.g. weasel, owl, sharks and wolves.

• Linear food chains are probably rare in nature because the same food source may be part of several interwoven food chains and many organisms have several food sources

• Decomposers play a key role in ecosystems but are often not represented on food chains

Food Chains

• Producer
• 1st order Consumer or Herbivore
• 2nd order Consumer or 1st order Carnivore
• 3rd order Consumer or 2nd order Carnivore
• 4th order Consumer or 3rd order Carnivore
• Decomposers – consume dead and decaying matter as bacteria

Food Web – many food chains in relation to each other

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Energy flow though ecosystems

• Gross primary productivity = the rate at which the primary producers capture and store energy per unit time since the primary producers expend energy during respiration the net primary productivity is considerably lower than the gross productivity
• Productivity is usually measured as biomass (dry weight of organic matter) per unit area per a specified time interval, e.g. kg/m2/yr
• The trophic structure of an ecosystem is often represented by an ecological pyramid, with the primary producers at the base and the other levels above
• Most of the food eaten by organisms is converted to biomass, or used to maintain metabolic functions, or lost as heat, only about 10% of the energy makes it to the next level
• This massive energy loss between trophic levels explains why food chains can't contain more than a few levels It takes billions of primary producers (plants) to support millions of

primary consumers, which support a few secondary consumers. This is why there are so few large carnivores on earth
• An energy pyramid is a more useful way to depict an ecosystem's trophic structure
• Each block of the pyramid is proportional to the amount of energy it contains
• Pyramids may also represent biomass or numbers of individuals
• The energy pyramid concept helps explain the phenomenon of biological magnification - the tendency for toxic substances to increase in concentration at progressively higher levels of the food chain

Energy vs. Nutrients
• Nutrients are cyclic – biogeochemical cycles
• Energy flow is one way

Biomass and Energy Pyramids
Ecological succession = a directional, cumulative change in the species that occupy a given area,
through time
• Primary succession - starts from barren ground, e.g. new islands or de-glaciated areas
• Secondary succession - starts from disturbed areas, e.g. abandoned farm land or storm ravaged land
• Succession starts with a pioneer community, the first organisms to occupy an area
• Several transitional communities may come and go
• A climax community, a stable, self-perpetuating array of species in equilibrium with one another and their habitat, will form.
Biodiversity - Biodiversity, the number of different species within an area, is greatest in tropical areas near the equator and it decreases towards the poles
• Tropical areas have more sunlight and of greater intensity, more rainfall and longer growing seasons for plants
• This environment is quite stable and contains many vertical "layers" which provide more microhabitats
• These areas can support more species, e.g. the number of bird species is directly correlated with latitude

Weather and climate
• Biome = a large region of land characterized by the climax vegetation of the ecosystems within its boundaries
• The distribution and key features of biomes are the outcome of temperatures, soils and moisture levels (which vary with latitude and altitude), and evolutionary history
• Weather = the condition of the atmosphere at any given time
• Climate = the accumulation of weather events over a long period of time (temperatures, humidity, wind, cloud cover, rainfall)
• Climate is dependent upon several factors:
Solar radiation

The earth's daily rotation
The earth's rotation around the sun
The distributions of continents and oceans

Biotic Factors:

Biotic factors are the living parts of an ecosystem. Because of the way ecosystems work – as complex systems of competition and cooperation, where the action of every life form can effect all the others – any living thing within an ecosystem can be considered a biotic factor.

Biotic factors such as soil bacteria, plant life, top predators, and polluters can all profoundly shape which organisms can live in an ecosystems and what survival strategies they use.

Biotic factors, together with non-living abiotic factors such as temperature, sunlight, geography, and chemistry, determine what ecosystems look like and what ecological niches are available.

Types of Biotic Factors:

Biotic factors are grouped by scientists into three major groups, which define their role in the flow of energy which all living things in the ecosystem need to survive. These groups are producers or autotrophs, consumers or heterotrophs, and decomposers or detritivores.Producers

I. **Producers** – also known as autotrophs, from the Greek words "auto" for "self" and "troph" for "food" – are organisms that make their own food using inorganic materials and energy sources.

Producers are extremely important: without them, no life could exist at all!

The very first life forms on Earth had to learn to make fuel and building materials to make more cells out of non-living materials. That's because when the first life forms appeared, there were no other life forms to feed on! So the first life forms had to be producers. Producers remain vital today as the life forms that can harness inorganic energy to be used as fuel for life.

There are two major classes of producers:

1. **Photoautotrophs** are by far the most common type of producer on Earth today. These producers harness energy from sunlight to power their life functions. Green plants, green algae, and some bacteria are photoautotrophs.

Most photoautotrophs use a pigment, such as chlorophyll, to catch photons from the Sun and harvest their energy. They then package that energy into a form that all life forms can use, and use it to create proteins, sugars, lipids, and more essential materials for life.

In most ecosystems, plants – which are producers that are multicellular, highly complex, and very efficient at turning sunlight into fuel for living organisms – form the bottom of the energy pyramid. All other organisms depend on the energy plants harvest from the Sun to survive.

2. **Chemoautotrophs** are fairly rare in most ecosystems. They obtain energy from chemicals such as hydrogen, iron, and sulfur, which are not common in most environments. Nonetheless, they can still play an important role in ecosystems because of their unusual biochemistry.

Some methanogens – microorganisms that make methane – are chemoautotrophs. Methane, a greenhouse gas which is much more powerful than carbon dioxide, may play a major role in regulating the planet's temperature. Other chemoautotrophs can produce similarly powerful chemicals with their unique metabolisms.

It is actually not known whether the first forms of life on Earth were photoautotrophs or chemoautotrophs. Photoautotrophs are more common today, but that may simply be because sunlight is more plentiful than the chemicals chemoautotrophs use as their energy source.

II. Consumers

Consumers, also called "heterotrophs," are organisms that eat other living organisms in order to obtain energy. Their name comes from the Greek "hetero" for "other" and "troph" for "food."

Herbivores who eat plants, carnivores who eat animals, and omnivores who eat both plants and animals, are all heterotrophs.

Heterotrophy probably evolved when some organisms discovered that they could eat autotrophs as a source of energy, instead of creating their own energy and organic materials.

Some autotrophs subsequently evolved symbiotic relationships with consumers, such as angiosperms – plants which produce nectars and fruits to attract animals, who ultimately help them to reproduce.

Most levels of most ecosystems' energy pyramids consist of consumers – herbivores, minor predators, and top predators who eat other organisms.

III. Decomposers

Decomposers, or detritovores, are organisms that use organic compounds from producers and consumers as their source of energy. They are important to ecosystems because they break down materials from other living things into simpler forms, which can then be used again by other organisms.

Decomposers include soil bacteria, fungi, worms, flies, and other organisms that break down dead materials or waste products from other life forms. They are distinct from consumers, because consumers usually consume other organisms while they are still alive. Decomposers, on the other hand, metabolize waste products that might not be of interest to consumers, such as rotting fruit and dead animals. In the process they break down these dead things into simpler chemicals that can be used by heterotrophs to thrive and produce more energy for the ecosystem as a whole.

This is the principle behind the practice of composting – where waste scraps of plants and animal products are put into a pile, where decomposers such as bacteria, worms, and flies are allowed to thrive. These decomposers turn the waste products into rich fertilizer for the

composter's garden, which then grows bigger and healthier thanks to the decomposers breaking down the waste products in the compost.
Decomposers are the link between the bottom of an ecosystem's energy pyramid and the other levels. Decomposers can take energy and raw materials from dead plants, herbivores, lesser carnivores, and even top carnivores, and break it down into a form that can be used by the ecosystem's producers to make it easier for them to harness sunlight. In this way, the ecosystem's energy cycle is preserved.

Common mistakes and misconceptions

- **Dead organisms are *not* abiotic.** Some people think that if an organism is no longer alive, it cannot be considered biotic. However, if something used to be alive, or was part of a living organism (such as a bone, or hair), it is still considered biotic.
- **Populations and communities are not the same.** Although some people use those terms interchangeably at times, in biology, these terms have specific meanings. Populations consist of only one species in an area, while communities encompass multiple species.
- **Some people think that the loss of a few species is not a big deal.** However, this could not be further from the truth! Biodiversity is crucial to the success of our planet because each species, no matter how big or how small, has an important role to play.

In addition, a richer biodiversity allows organisms and ecosystems to adapt to environmental change, and also offers many contributions to medicine and agriculture as well.

Chapter-5

Effect of light and temperature on animals

Importance of light on wildlife:

Main source of natural light is sunlight or isolation. Other sources area moon light and light from stars and light from luminescent organisms.

Effects of light on wildlife

a. Metabolism
b. Reproduction
c. Growth
d. Locomotion
e. Photosynthesis

Effect on plants

a. Long day plants, short day plants and day neutral plants
b. Effects on animals:
c. Migration
d. Diapause
e. Food storing behaviors
f. Increased gonadac activity
g. Lunar periodicity
h. Bioluminescence

Effect of Water

Around 73% of our earth surface is constituted by water and it is readily available medium for life.

Unique properties of water:

It act as universal solvent

Many gases minerals dissolved are essential for life process

Oxygen exchange requires the medium of water.

Aquatic environment

Aquatic environment can be divided in to marine, estuarine and fresh water habitats. Various animals are adopted in different ways to thrive in environment.

Effect of temperature on wild life

One of the important environmental factors- directs impacts and growth of wildlife. It controls

- Distribution of behavioral characters
- Reproduction and rate of embryo development
- Metabolic process
- Migration

Minimum temperature:

Freezing of tissues then it will reflects in metabolic activity and withdrawal of water from cells

Maximum temperature:

Having their own morphological and physiological modification eg is camel

Optimum temperature:

Vital process goes on at an optimum level

For most of plants and animals is 15 to 25 degrees Celsius

Chapter -6
Wildlife Habitat: Niche, Territory, Home Range, Edge, Cruising Radius, Carrying Capacity

Habitat:
Habitat is the place where an organism or community lives; it is a spatial entity on the surface of the earth. Habitat can be visualized as macrohabitat or microhabitat. Macrohabitat is a broader concept, over which a wildlife manager can have no control, viz., land use patterns, composition of air, velocity of wind and the like. On the other hand, microhabitat pertains to the various on site factors like trees, landscape, thickets and similar features which affect wildlife populations.

The niche
Niche can be defined as the functional status of an organism in an ecosystem or the role played by a species in its natural habitat. This functional status or role is possible because of various structural adaptations, specific behaviour and physiological response. Niche is a role rather than a place and as such it can be understood from the interaction between the species and the environment.

Pinch period
It is the period during which the limiting factors are most active. A limiting factor is that factor which restrict the growth of an animal population, when all other factors are favourable. The non-availability of food, water, mates or any welfare factor in a habitat may become limiting for a population. Excess of any one factor, may also at times, limit the population growth. The usual pinch period in a tropical wildlife habitat is the dry or lean summer season, during which food and water are scarce in the habitat.

Qualifiers: Any event or activity which affects the quality of a habitat, by modifying it, is known as a qualifier. Qualifiers may be biotic, phonological or climatic in nature. Phenological qualifiers include appearance of new leaves, leaf fall, flowering and fruiting. A habitat may gain importance due to such events which may attract wild animals to the spot.

Ecological equivalents: Similar niches may exist in different regions or communities. These niches may be occupied by organisms which show similar, but not identical, habits, adjustments or adaptations. Such animals are known as ecological equivalents. Ecologically equivalent species may not show taxonomic relationship. Thus the mountain lion of North America and the African lion can be considered as equivalents.

Territory, home-range and cruising radius: The environment of an animal comprises of biotic and abiotic components; the biotic components are vegetal and faunal, with which an animal interacts. This interaction leads to various kinds of animal distribution in space,

which are not uniform, but appear in clusters; in managerial parlance, a wildlife often speaks of densities or animals per unit area for devising future strategies. The behaviour of many animal species in space has been interpreted in several ways.

Cruising radius

This term has been loosely used in wildlife management. Some workers consider the extent of an animals movement as the outer boundary of a circle; half of this is treated as diameter to express the cruising radius. Many a times, this concept does not hold good because of the elongate ranges of certain animals. Working out the cruising radius involves drawing the home range, by fitting a circle within the known points of animal occupancy. However, this is considerably affected by the home ranges of other animals. On the whole, cruising radius, even though an approximation, is helpful for managerial prescriptions pertaining to spatial utilization of a habitat.

Edges

An edge is the place of contact between plant communities or successional stages or vegetative conditions. It can also be a cultivated field, coming in contract with a forest. The area which is influenced by the transition between the communities or stages is called as an ecotone. Ecotones and edges are comparatively richer in wild animals than the adjoining areas, and hence they are of much importance in wildlife management.

Edge as a measure of diversity

Ecologically, diversity is related to stability. The induced and inherent edges reflect the total diversity in an area. Patton, in 1975, indicated that the amount of an edge can be expressed as an index for a given area. Information about the number of plants and animal species, their frequency of occurrence is required for standard diversity indexes. For practical purposes, edge can be used as an indicator or index of diversity. In forest land management, a diversity index can be used to indicate the habitat diversity, for evaluating management alternatives with respect to the immediate and long term effects on diversity, and to know the effect of the shape of timber harvest areas on diversity.

Snags

Snag means a standing dead tree, which is devoid of leaves and branches. Snags can be classified as hard or soft; hard snags are usually marketable and they are free from decay, whereas soft snags show stages of deterioration. Snags are extremely important in wildlife management, since they are used by many wild animals in their day-to-day activity. Many species of fungi, mosses and lichens use decayed wood as a substratum for growth; invertebrates usually use the spaces, which are present in between the bark and timber, as a habitat.

Point habitats and coverts

Certain entities, created for management, such as water holes, salt licks, machans, observation blinds, camping grounds and patches of vegetation planted for wildlife can be seen as points on a map; these are called as coverts and they constitute a special one

dimensional habitats or points. When two or more vegetation types come together or when a corner less than 120^{o} occurs, coverts are formed, coverts are considered as special places for wildlife and their value varies with season.

Juxtaposition

Juxtaposition is the measure of the proximity of different habitat units. It indicates the proximity or adjacency of the habitat requirements, year round, to a site which is being analyzed for a particular species. Such closeness may be often desirable for animals, because this minimizes loss of energy. Dissimilar habitat units, if properly juxtaposed, increase the animal richness; thus in a habitat, if food is present in close proximity to cover, or if nesting cover is present close to feeding areas, more number of wild animals are attracted.

Interspersion

It is a measure of system relations. Essentially, it means the intermixing of units pertaining to different habitat types. A good distribution of habitat types means that the given area is good in interspersion; clumping in any one area, of the various habitat types, indicates a bad interspersion. Various diversity indices exist, which can be used for estimating interspersion.

Biotic succession

This is also called as plant succession or ecological succession. It refers to a predictable change in the species composition of a plant community over a period of time. The various stages in this process are called as seral stages. Primary succession is the succession which takes place on an exposed site for the first time. The succession which takes place after disturbances, such as fires or storms, is known as the secondary succession; this is more common in a habitat. Secondary succession is rather quick when compared to the primary one, because the soil conditions and the seed availability are more favourable. During the process of succession, the plant species which are present in the early succesional stage are small, non-woody species, which have the capacity to come up in the open area, under direct sunlight, thus *Saccharum munja* and *Tamarix dioca* are present on exposed riverain belts, during the initial stages of riverain succession in the gangetic plains, which result in sal forests.

Carrying capacity

This is an extremely important concept in wildlife management; essentially it means the number of conspecific animals which a given area can support. Many people have defined this concept and the definitions may vary; ecologists, who study population dynamics, generally use the term ‘K’ for denoting the maximum limit or the upper limit, beyond which a particular population cannot increase in a given habitat. Many wildlifers depend upon certain practical criteria which are easily measurable in the field. One such easy criterion

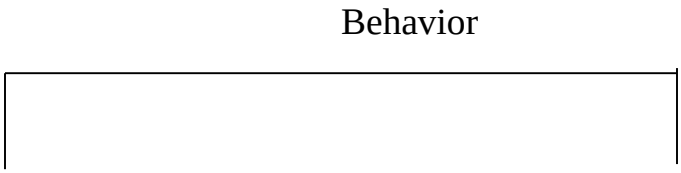
is the general health of animals. Usually populations which are below the level of carrying capacity, have access to greater amounts of food and other welfare factors, and consequently, their health is better; they do not exhibit signs of starvation or disease. Some people prefer to call carrying capacity as the average number of animals which can be supported in an area over a period of years.

Chapter-7
Animal behavior and adaptation

Behavior

- What an organisms goes in and environment
- For external factors

Classifications



(External stems is responsible for the animals to elite the response)

1. Reflexes:

- Simplest – Fixed responses to stimulus
- Eg. Construction of the pupil of eye to intense light
- Repeals depend upon the reflex are.
- Operate as long as the stimulus are present.
- Reflex behavior affects only a small perform of the body of the organisms.

A. Physic reflexes – (small movements)

- small know jerk – So quick adjustments for the animal.

B. Tonier reflexes : (long lasting adjustment)

Like maintaining the body posture

2. Orientation behavior

- Change of an organisms position in relation to an external stimulus
- If subject to a potentidly unsuitable and harmful situation. Eg: fish

A) Kineses

- An animal respond to a change or alteration in the stimulus intensity by changing its land of activity.
- It the stimulus intensity is altered, two different effects each be observed

(i) Orthokinesis : Actual tale of movement gets altered.
(ii) Klinokinesis : an alteration in the frequency of turning carriedout by the organism during its random movements.

B. Taxes
- Movement which is oriented in relation to the direction of a particular stimulus

Types : (Based on the seasoning system of the organisms)
Taxis : Whole organized is involved
Reflex : actions pertains to only a part of the organisms
i) Positive : If the orientation is in the direction of this stimulus.
ii) Negative : If the movement mores away from the stimulus source

3. Instinct : (Many mysterious actions of animals)
- complex patterns of behavior which are in born in animals.
- Species specific, innate and adaptive
- Insectss are of tremendous value to animals for their adaptations in nature, for a successful life.
- Elaborate actions may be involves.
- Eg. Nest building activity in birds.
  - Weaver bird– so typical of its species.
  - Spider spinning a web

- Specious specific behavior is inherited and internal conditions of an animal.
- Higher vertebrates courtship and mating behavior do not * unless the sex hormones start appearing in the blood stream of the animal – hunting of birds.

Releasers : Signals which trigger the instinctive acts.
- Ethnologists believe the presence of and in-born rural centre (or) the innate releasing mechanizing (IRM) – which specific way to the releases, so that the environmental signals are decoded in the narrows system of the animal concerned.

Biological rhythms
- All living organisms have the capacity to measure the passage of time.
- The metabolism and behavior and controlled rhythminlly in * as well as multicellular

Animals – Various environmental * and their receptor, physiological effects – periodic * exist in an environment due to the * positioning of the moon, sun and the earth.

Circadian rhythms:
- Variation in the intensity of a physiological process on a pattern of behavior with a periodicity of about 24 hours – behavioral activities – in a day.
- Diurnal and noctumal organism possess the rhythms eg. Flying squirrel may remain in its nest during the daylight but active in the night. – If this animal is kept under

constant darkness, then the daily rhythm continues – but the insert of activity gets shift and slightly every day.

- Endogenous rhythm – adaptation to a environment
- It reflects the ability of animals to perform certain tasks during the day and night

Communication

Any activity that allow the behaviour of other organisms (Wallace, 1929)

- Signaler as well as the recipients – benefited

eg. Sambar, rutting call – saw from production.

Communication structure (Jolly, 1972)

1. Signal : Constitute the form of the act. Walking on four legs, screaming, running.
2. Motivation : Mental state of the animal
3. Meaning : Determined by the action of the animal which receives the message.
4. Function : Adaptiveness (or) the evolutionary advantage of the signal.

Methods of communication

1. Visual communication
   - Birds, lover life forms (reptiles and fishes diurnal ones)
   - Visual signals can be stated or stopped at will. eg. A bird may suddenly spot a predator and may freeze.
   - Pheasants permanent future
   - Others it is a temporary ones.
   - Large mammals / animals resort to certain threatening postures. Eg. Elephants
   - Disadvantage : If the sensor is not detected by the other animals.
   - Based on the distance
   - The head region appears to be particularly important in visual communication (eg. Alarmed antelopes – gazing in a group.
   - Wild boars and wolves, which live in groups, facial expressions are extremely important.
2. Acoustical communication
   - Sound communication – Arthopodes and vertebrates
   - Fish – frictional devices / Air bladder
   - Land dwelling vertebrates : vibrating special membrane

Non-vocal sound : wild have may thump the ground / bird may be drumming its wings.

- frogs / toads – mating and in territoriality
- reptiles : parly developed sound system
- Snakes : substratum vibratom

- Tortoises : bound sounds.
- Birds and mammals – Complication sound production
- Mammals : earns -
  eg: Alarm call, vary in their dimensions
  Mobbing call like frequency, volume
  Breeding call and timing

Digging and burrowing animals : soil
Type of vegetation and natural features

- Birds animal sound – to precent the nests from safe from predators.
- Distance plays role – disseminating

3. Chemical communication

- Small and taste – pheromones – (chemical sections)
- Insects, fishes, amphibians, reptiles etc.
- Mammals : have tremendoco reproductive value.
- Long time persistent
- Effectiveness of a chemical in communication is dependent on the animal movement in the vicinity.

Uses:

i) Procuring food very effective – not a possible to modify
ii) Finding mate them at short notices be sound signals.
iii) Making territories Making an escape

Eg: Tigers: aminer fixed in lipids – relemns during breeding season – not by water - for reproduction.

Adaptiveness of communication

1) Recognition
- species – making mistakes -

2) Reproduction

Interspecific interactions – common in wildlife prefers the same sex

- To keep the territory in the unite and safe– by forewarning.
- Opposite sex – plumage color, pastimes, – courtship behavior.

Parental care

- Definite post natural care – for raising
- Young seagulls direct their beaks towards a particular spot on the mother's beak for getting food.

Inter – specific communication

- Mammals – birds

- Learned behavior patterns, in-born patterns,
- Define signals

Adaptation

Adaptation has three related meanings. Firstly, it is the dynamic evolutionary process that fits organisms to their environment, enhancing their evolutionary fitness. Secondly, it is a state reached by the population during that process. Thirdly, it is a phenotypic trait or adaptive trait, with a functional role in each individual organism, that is maintained and has evolved through natural selection.

Co-adaptation

Pollinating insects are co-adapted with flowering plants.

In coevolution, where the existence of one species is tightly bound up with the life of another species, new or 'improved' adaptations which occur in one species are often followed by the appearance and spread of corresponding features in the other species. These co-adaptational relationships are intrinsically dynamic, and may continue on a trajectory for millions of years, as has occurred in the relationship between flowering plants and pollinating insects.[54][55]

Mimicry: Copying some other organism.

1. Batesian mimicry. This is the mimicry by a palatable species of an unpalatable or noxious species (the model), gaining a selective advantage as predators avoid the model and therefore also the mimic. Mimicry is thus an anti-predator adaptation. A common example seen in temperate gardens is the hoverfly, many of which—though bearing no sting—mimic the warning coloration of hymenoptera (wasps and bees). Such mimicry does not need to be perfect to improve the survival of the palatable species.
2. Mullerian mimicry is a natural phenomenon in which two or more well-defended species, often foul-tasting and that share common predators, have come to mimic each other's honest warning signals, to their mutual benefit. This works because predators can learn to avoid all of them with fewer experiences with members of any one of the relevant species.

Chapter-8

Shift to Wildlife Management & Habitat Improvement: Food, Water, Shelter improvement

Wildlife Management:

It was first established by Aldo Leopold

1. Wildlife management deals with protecting endangered and threatened Species, subspecies and their habitat.

2. It taken into consideration the Ecological Principles such as carrying capacity of the habitat, Preservation and Control of habitat, Reforestation, Predator control, Re-introduction of Extinct species, Capture and Re-allocation of abundant species, Management of desirable and undesirable species.

Purpose of Wildlife Management:-

1. Protection of natural habitat through controlled limited exploitation of resources.

2. Maintenance of viable no of sp. in protected areas ie N.P. or sanctuary.

3. Establishment of biosphere reserve for plants and animals.

4. Protection through legislation.

Principles of Wildlife Management:-

1. Wildlife management is based on Ecological Principle. This is the relation of an organism to its environment including other living organism that inhabits the same soil, water, vegetation & atmosphere.

2. Habitat is the key to wildlife survival.

3. Carrying capacity is the number of animals the habitat can support throughout the year without damage to the animals and habitat.

4. It wildlife number exceed the carrying capacity then the excess animals will die.

Wildlife Management:- Practices and tools :-

1. Manipulative Management :-

Regulating number of animals directly by altering/ changing food supply, habitat, density of predators etc.

2. Custodial Management :-

It is a protective management and minimizes the external influences on the population and its habitat. It is done by setting protected area i.e., N.P. or sanctuary where the habitat is protected and the threatened species are conserved by law.

1. Habitat Management:-

It is a primary tool to manage, protect and enhance wildlife population.

Habitat:-

The environment/natural home where a wild animal live is called its habitat its must provide

1. Cover (shelter)

2. Food and water

3. Space

a) Cover/Shelter Management :-

It refers to the part of habitat / environment that provides protection and enhance the survival / Reproduction of the animal.

(a) Protective cover:-

Provide shelter from adverse, weather condition.

Provide protection from predators

(i) Hedge Grows - refers planting low, woody vegetation along river and pond.

(ii) Brush Piles - Small trees, woods, shrubs etc.

(iii) Natural/Artificial Roost - By planting of trees.

(b) **Nesting cover -** It is done by placing artificial nest inside forest suitable to animal requirement.

(i) Ground Nesting Cover **-** It gives permanent, undisturbed cover. It is achieved by regulating planting, grazing.

(ii) Nesting Trees **-** Trees of 5-10 yrs are retained for nesting of bids and animals. Trees with existing nest are conserved and monitored.

(iii) Nest Boxes **-** Artificial nest boxes should be placed (light & durable) according to the animal's requirement, wood duck nest box & Squirrel nest box.

b) Space & Home Range Requirement :-

Wild animals require certain area where they move around, to escape from predators, obtain food and water for their survival this area is often called as home range.
Eg: 1. How large the animal is (require more space)

2. Animal food preferences (carnivores genially require more space)

Space requirement is based on carrying capacity of that area. If carrying capacity of an area increases than it will support more wildlife.

c) Food & Water Management :-

A) Food Management**:**
Planting of fruits and fodder trees is needed to meet the food requirement of birds and grazing animals. Fodder yield from the forest is regulated by planting & sowing of trees, controlled fire, grazing control.

B) Water Management:-

Water management is must inside the forest that can be achieved through various ways like.

1. Water holes
2. Rivers & Stream
3. Springs
4. Reservoirs and ponds
5. Dug outs

2. Predator Management and Control:-

Predation population maintains the prey (herbivores) populations. This intern regulates the vegetation in the particular forest.
Hence if the population of prey are or predator is not in proportion then if will adversely import the ecosystem.

3. Fire Protection :-

- Fire is a natural component of ecosystem. it can damage vegetation may lead to soil erosion and lose of fertility.
- It also leads to carbon emission.

- If properly used, fire is a valuable tool for farmers and herders.

- In forestry it is used for preparation of sites for plantation and regeneration.

- Effective fire control is a matter of education and agricultural policy.

4. Cutting and Grazing :-

Cutting and grazing can be used to prevent a decline in rangeland quality and maintain or improve wildlife habitat.
- Grazing plan that matches animal numbers to predicted forage yield should be carried out before animal turn out. Rest periods/ grazing period for each paddock needs to be based on previous history and future goals.
-

Provision of salt licks:
- Animals can't survive without consuming salt.

- They need salt for different body functions like producing saliva to kick start digestion.

- Vegetation is rich in potassium as compared to sodium.

- They need salt licks to raise sodium intake and balance potassium and sodium ratio.

- Lactating females require whose salt for the antlers growth in young ones.

- Salt is an essential part of nutrition with using impart on health, reproduction, coat condition etc.

The following elements are needed for good health of wildlife.

Ions	**Nacl,**	**Mg,**	**Cu,**	**Zinc,**	**Iodine,**	**Selenium**	**Iron**
Functions	Functioning of nervous system	Healthy Nerve cell, Strong bones Good muscle	Strong bones	Healing process & disease resistance skin & bone development	Metabolism, thyroid gland	Fertility	Red Blood cell, oxygen transfer

How to use salt licks:

1. Hang the salt licks near a water source on a well travelled trail/path.

2. Do not places lick directly on ground but placed it on log (approximately 3 feet above the ground)

3. The base of the lick should have a diameter of about 1/2 feet (6 inches)

4. Fix the salt lick with a nail to the tree, so that the diluted salt can run down the tree trunk and can be utilized by small animals.

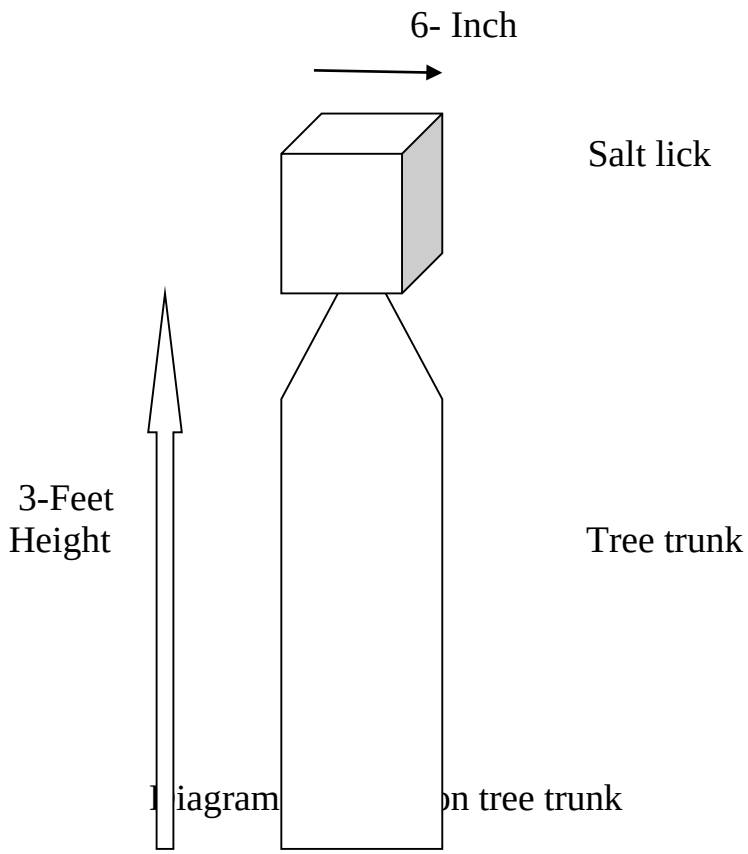


Diagram on tree trunk

Provision of Food:

- Wildlife must have food to surve.
- Animals having proper food and nutrition throughout their life grow larger in size and remain healthy.

- Healthy animals in turn have higher reproduction rate and are more resistant to diseases.

- Rate and are more resistant to diseases.

- Healthy animals can escape predators in better way.

- Food (Nutrition) affects birth and death rates.

- Availability of food varies from season to season and location to location.

- Food availability to predators means prey availability. Predator generally do not experience problem related with diet quality because animal (matter) is nutritionally complete and easy to digest.

- Even though carnivore animals expend most of this energy in searching, chasing, capturing and killing their food. So they need more energy, which they get from the animal matter.
- Herbivores/ Plant eaters may become nutritionally stressed by lack/ shortage of food (quantity) or due to the lack of highly nutritious food (quality). Herbivores do not feed randomly in the environment but they show specific feeding patterns. These patterns are called food preferences. Wild animals die from starvation because they do not get enough food to survive (quantity) carnivores die because they cannot catch enough to eat. Animal die from malnutrition because they cannot find food that meets their nutritional need (quality)

- It the field looks green and covered with lush plants, this does not mean deer and other herbivores have adequate food.
- Young growing animals require more, protein than adult. While milk supplies the protein needed by newly born mammals.
- Young carnivores often supplement the demand of protein with meat. While young herbivores need milk.
- Food management can be done by planting, plants full of nutrition and according to the need and preferences of the wild animals. This can improve the heath, quality and abundance of wildlife population.

Food are classified as

1. Preferred: - Abundant in animal's diet compared to its abundance in field.

2. Staple: - Earlier our regular basis and meet the nutritional need of the animal.

3. Emergency: - Eaten to fulfill short term nutritional needs.

4. Stuffers: - They are eaten because there is nothing else to eat.