In *Balanoglossus minutus;* which is living in tubes, the living light is mainly used for attracting the prey.

2. Escape from Predators

The deep sea shrimps *Acanthophyra* and *Systellaspis* and the cephalopod *Heteroteuthis* discharge luminous secretions when irritated. This will confuse the predators, so that the animals can easily escape into the deep waters.

The detachable luminous scale like plates of the polynoid worms *Acholoe astericola* serve to distract a predator organism while the animal moves away.

3. Role in Sexual Behaviour

Bioluminescence helps in serving as signals for bringing together the two sexes in mating. The living light plays a part in the ***timing of reproduction*** and in synchronising the activities of the two sexes. In the polychaete fire worms *Odonto syllis* of Bermuda, swarming is timed by lunar and diurnal rhythms. The large females start swimming in the surface waters in the evening. They become luminescent and swim in small circles, discharging eggs and luminous secretions. In response, to this the males from deeper waters dart to discharge their gametes.

Intraspecific recognition signals are observed in the mating of the American firefly *Photinus pyralis*. The females of this species, do not fly about and so crawl in the evening to the grass and wait for a signal. The males flash their lanterns and fly about 50 cm above ground level. A female can recognize this light very easily and flashes back after an interval of 2 seconds. By repeated signals the male approaches the female and mating occurs.

Unit IV

25. Adaptations

Adaptation is defined as *'the adjustments made by individuals in response to specific environmental conditions'.*

Living organisms are equipped in a variety of ways to cope with their environment. For example, aquatic animals are equipped with paddle-like structures for swimming. Burrowing animals are provided with digging organs. Desert plants have special devices for getting and storing water.

Adaptations make the organism fit to its environment. The organisms which can adjust themselves to the environment are said to be well ***adapted*** and they are successful in their survival. The organisms which have no ability to adjust themselves to the environment are said to be ***ill-adapted*** and they are not successful and hence become extinct.

Animals possess the following adaptations :

1. *Aquatic adaptation.*
2. *Cursorial adaptation.*
3. *Desert adaptation.*
4. *Cave adaptation.*
5. *Fossorial (burrowing) adaptation.*
6. *Arboreal adaptation.*
7. *Flight (volant) adaptation.*

1. Aquatic Adaptations

The fitness of animals to live in water is called ***aquatic adaptation.*** Aquatic adaptations are of two types. They are ***primary*** aquatic adaptation and ***secondary*** aquatic adaptation.

1. Primary Aquatic Adaptations

The aquatic animals developed from aquatic ancestors are called ***primary aquatic animals***. Eg. *Fishes*. The adaptations developed by primary aquatic animals are called ***primary aquatic adaptations***. They are as follows :

1. Stream-lined Body : Fishes are provided with a stream-lined (boat-shaped) body. It offers little resistance in swimming.

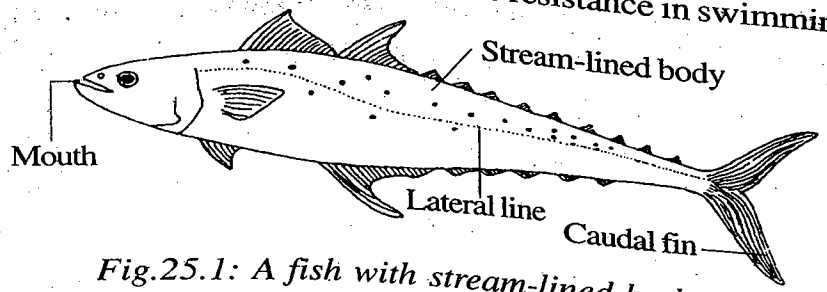


Fig.25.1: A fish with stream-lined body.

2. Fins : Fins are the outgrowths of the body. They are pectoral fins, pelvic fins, dorsal fins, anal fins and caudal fins. They help in locomotion in water. The pectoral, pelvic and dorsal fins act as ***balancers***. Caudal fins help to change directions.

3. Undulations : In some animals, the body musculature is well developed. It helps the lateral undulations of the body. The lateral undulations bring about the locomotion of the animal.

4. Gills : Gills are specialized structures exchanging gases between water and blood.

5. Lateral Line Sense Organs : Lateral line sense organs are canals filled with mucous and water and they extend the

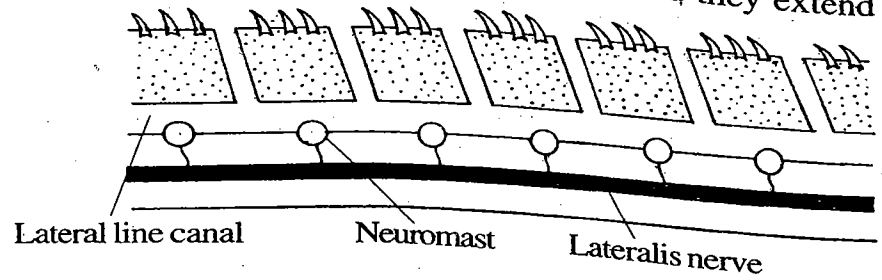


Fig.25.2 : L.S. of Lateral line sense organ.

entire length of the body. They contain neuromast organs. They help to detect temperature, pressure and water-current.

6. Air Bladder : The air bladder is situated between the alimentary canal and vertebral column. It has a ***hydrostatic*** function. Fishes are able to maintain themselves at particular depths by regulating the gas-content of the air bladder.

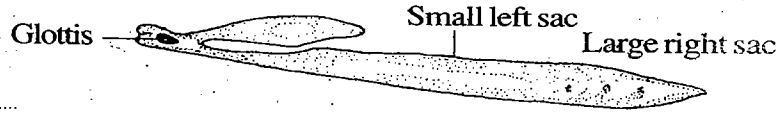


Fig.25.3: Air bladder of Polypterus.

7. Eyes : The eyes are adapted to vision in dim light prevailing in water. The nictitating membrane is transparent and it protects the eye from water.

8. Mucous Glands : Mucous glands are present in the skin. They secrete mucous which prevents diffusion of water through skin.

9. Scales : Scales protect the body against the action of water.

10. Osmoregulation : Aquatic animals have developed different methods to solve the osmotic problems.

The freshwater is hypotonic to the body-fluids of freshwater fishes. Hence ***endosmosis*** occurs. The excess of water is removed by the kidney. A certain amount of salt is also lost through urine. This loss of salt is made good by the ***chloride cells*** present in gills. They absorb salts from freshwater and add them to the body fluid.

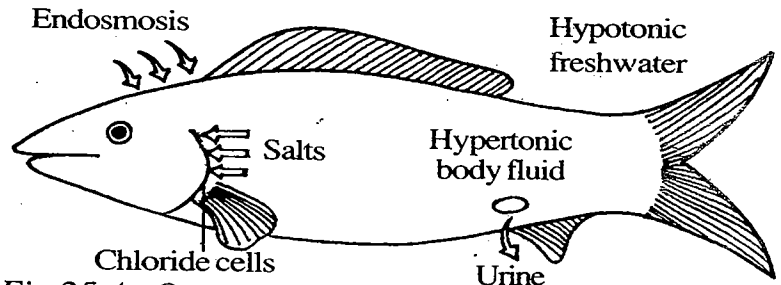


Fig.25.4: Osmoregulation in freshwater fish.

In marine teleost fishes, ***exosmosis*** occurs because seawater is hypertonic and the body fluid is hypotonic. This loss of water is made good by drinking seawater. As seawater contains a large amount of salt, the salt content of the body fluid increases. The excess of salt is removed by ***chloride secretory cells*** present in the gills.

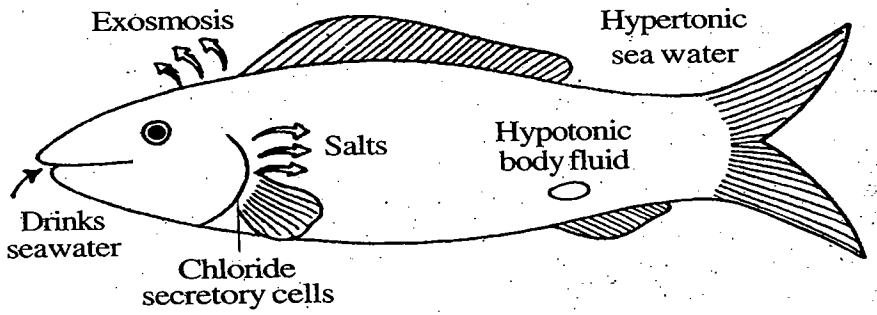
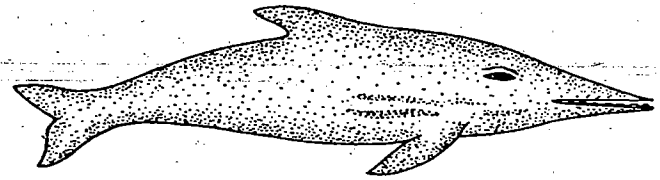


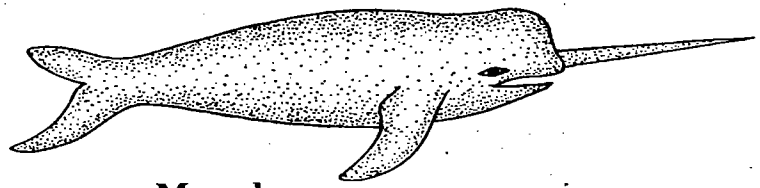
Fig.25.5 : Osmoregulation in marine fish.

2. Secondary Aquatic Adaptations

The aquatic animals developed from terrestrial ancestors are called ***secondary aquatic animals***. Eg. *Ichthyosaurs* (extinct reptiles), *turtles*, *dolphins*, *porpoises*, *sea lions*, etc.

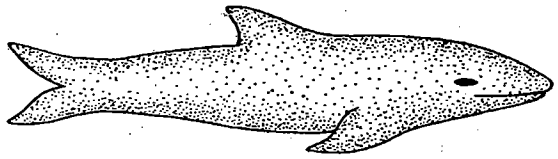


Dolphin

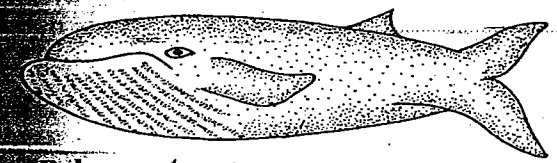


Monodon

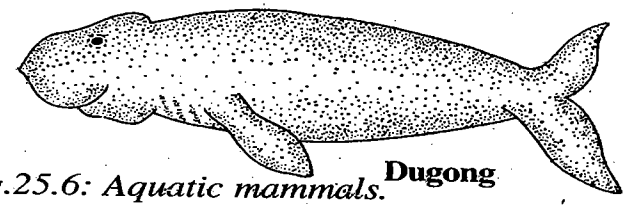
Fig.25.6: Aquatic mammals.



Phocaena(Porpoise)



Balaenoptera
(Blue whale)



Dugong

Fig.25.6: Aquatic mammals.

The adaptations developed by secondary aquatic animals are called secondary aquatic adaptations. They are as follows :

1. Stream-lined Body : Most of the aquatic animals have a stream-lined body. It offers little resistance in water.

2. Fins : Dorsal and caudal fins are present. They are the folds of skin and help in locomotion. The tail fins propel the body forwards.

3. Flippers : The fore limbs are modified into ***flippers***. They are paddle-like and help in swimming.

4. Webbed Foot : In turtles and ducks, the foot is webbed and it helps in swimming.

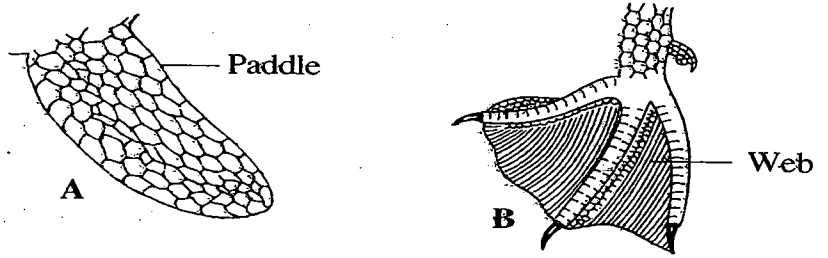


Fig.25.7: A. Paddle- like foot of a turtle; B. Webbed foot of a duck.

5. Absence of Neck : In whales and dolphins, the neck is absent. The absence of neck reduces the resistance from water.

6. Skin : In secondary aquatic animals, scales and hairs are absent.

7. Blubber : In whales, dolphins and porpoises, a fatty layer is deposited below the skin. It is called ***blubber***. It prevents the loss of heat and reduces specific gravity.

8. Absence of Ear Pinna : In whales, dolphins and sea-lions ear pinna is absent. It reduces resistance in water.

9. Eyes : Eyes are like those of fish and are protected by the secretion of ***Hardenian gland***.

10. Dentition : Dentition is ***homodont***. In baleen whales, ***baleen plates*** are present. They help in ***filter feeding*** in water. As these animals depend on micro-organisms, the power of mastication is lost.

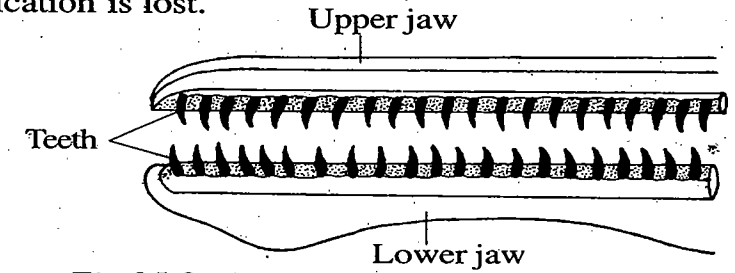


Fig.25.8: Homodont dentition in dolphin.

11. Precociousness : Young ones are precocious and they show greater activity immediately after their birth.

12. Lungs : The secondary aquatic forms breath through lungs. In whales and dolphins, the nostrils can be closed by muscular flaps. The lungs are highly elastic and extensible. Hence they can store large volumes of air. This helps the animals to remain under water for a considerable period of time.

13. Oxygen-carrying Capacity : The oxygen-carrying capacity of the haemoglobin of aquatic mammals is very high.

14. Skeleton : The bones are light and spongy. Chest is cylindrical. Movement in various joints of the limb bones is lacking.

15. Vision : The nictitating membrane is absent from the eyes. The lacrymal glands secrete a fatty substance which protects the cornea and conjunctiva against the action of seawater.

16. Storage of Oxygen : Fishes can use oxygen dissolved in the water. But aquatic mammals cannot use the oxygen dissolved in water. They have to depend on the oxygen of atmospheric air. This air is denied for them when they remain under water. Hence they have the facilities to store oxygen in the various parts of the body. They store oxygen in the lungs, muscles, blood and body tissues.

Table 25:1: The amount of oxygen stored in the different regions of a whale.

Lungs	-	91% (Human lungs carry 34%)
Muscles	-	41%
Blood	-	41%
Tissues	-	9%

17. Blow Hole : The two nostrils open to the outside by a single opening called ***blow hole***. It can be closed by a flap of skin to prevent the entry of water.

18. Filter Feeding : The aquatic mammal, baleen whale, feeds on marine plankton. Hence it is called ***planktonophagous***

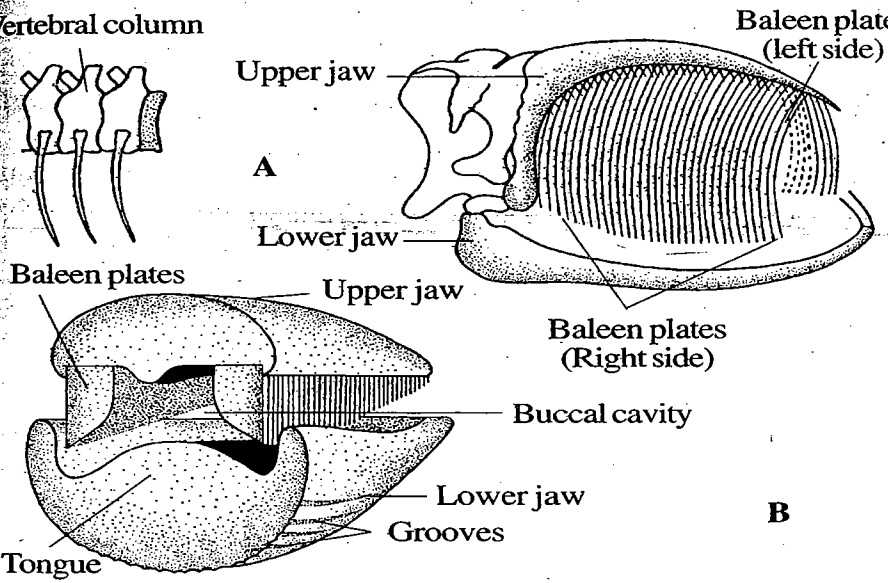


Fig.25.9 : The jaws of blue whales to show the baleen plates. A. Lateral view, B. Cross section.

3. Desert Adaptations

A desert is a waterless, treeless, large waste-land often covered with sand. It is characterized by low or no rainfall, scarcity of water, extremes of temperature and dust-storms. The important deserts in the world are ***Thar*** (India), ***Gobi*** (China), ***Sahara*** and ***Kalahari*** (Africa).

Deserts are broadly classified into two groups, namely ***hot-deserts*** and ***cold deserts***. In hot deserts, the temperature is very high. Eg. *Sahara, Gobi, Thar,* etc. In cold deserts, the temperature is very low. They are situated at high altitudes. Eg. *Tadakh, Tibet, Alps, Scandinavian mountains,* etc.

1. Desert Fauna

Uromastix, Moloch horridus, Heloderma, Mabuia, rattle snakes, *Phrynosoma, Phrynocephalus,* birds like quails, Indian bustard, grey partridge and mammals like bats, hedgehog, hare, ant-eater, porcupine, mouse, wild boar, sambhar deer, spotted deer, wolf, red foxes, jungle cats, *Panther,* etc. are some of the desert animals.

2. Desert Adaptations

Desert animals develop adaptations for four purposes. They are :

1. *Water conservation*
2. *Water getting*
3. *Tolerance of heat* and
4. *Protection.*

1. Water Conservation

Desert is characterized by dry atmosphere. Hence desert animals tend to lose water from their body through evaporation, So the desert animals have plenty of adaptations for conserving water.

1. Impervious Skin : In desert animals, evaporation through body-surface is prevented by the development of impervious skin. The skin may be covered by scales, spines, scutes, shields, etc. Eg. *Moloch horridus.*

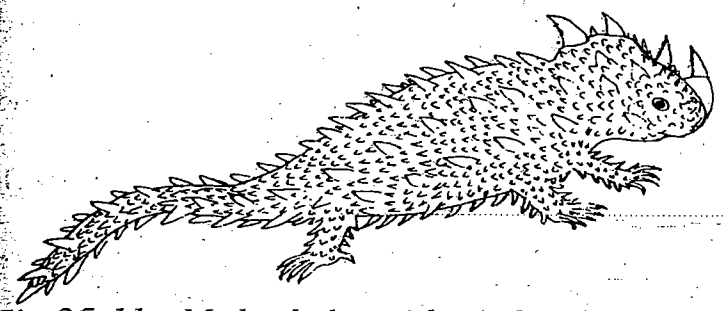


Fig.25.11: Moloch horridus, the desert lizard has impervious skin protected by scales and spines.

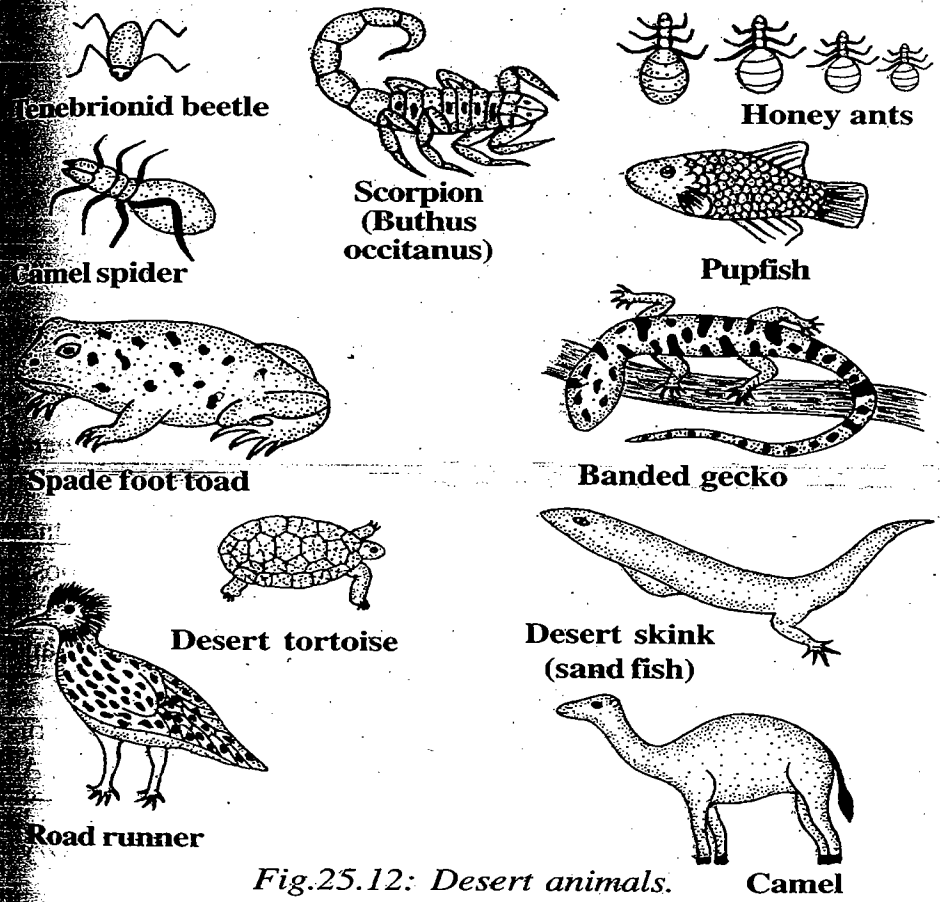


Fig.25.12: Desert animals.

2. Nocturnal Habit : To prevent evaporation, certain desert animals are active during night only.

3. Shady Places : Diurnal animals rest in shady places to prevent the loss of water.

4. Burrowing Habit : Evaporation is prevented by living inside burrows during hot days.

5. Aestivation : Certain desert animals like pocket mice, Kangaroo rat, etc. aestivate to prevent dessiccation.

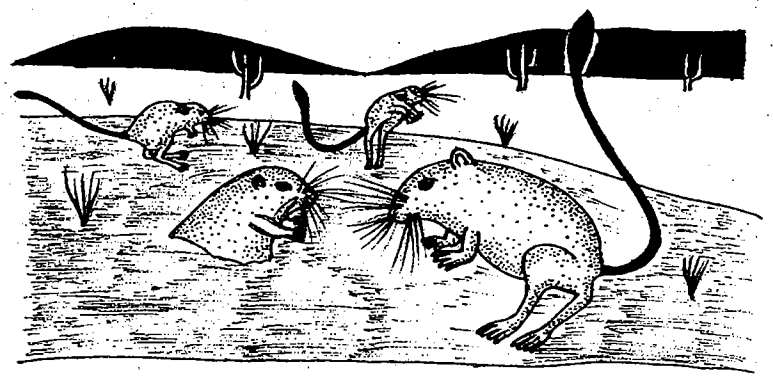


Fig.25.13 : Kangaroo rats. They have good adaptations for desert life. They can live inside burrows to prevent evaporation. They have no sweat glands. They depend on metabolic water. They do not drink water.

6. Excretion : Desert insects, reptiles and birds produce ***uric acid*** as their nitrogenous waste product, since the disposal of ***uric acid*** does not require water. Again water from faeces and urine is reabsorbed in these animals. Hence the faeces and urine are in the form of paste.

7. Absence of Sweat Glands : The desert rodents and ruminants have no sweat glands. Hence sweat is not produced. As a result, water is conserved.

8. Reduced Metabolic Rate : The African antelope *Oryx* reduces its metabolic rate and conserves water.

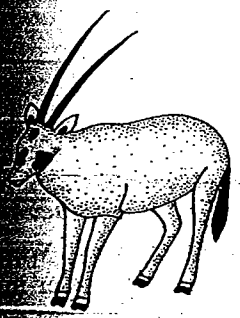


Fig.25.14: Oryx, the African antelope is a successful desert mammal. It has no sweat glands. Low metabolic rate. It can store heat in its body during day (hyperthermia).

2. Water Getting

Water scarcity is prevalent in deserts. Hence desert animals face problems of getting water. Water problem in deserts is solved in the following ways:

1. Water Holes : Desert animals get water from water holes.

2. Migration : Desert animals migrate short or long distances to get water.

3. Water From Food : Certain desert animals depend on the small amount of water present in the food taken in. The water present in succulent plants forms the source of water for rabbits and turtles.

4. Water From Seeds : The rodent *Jerboas* can live without water except that obtained from dry seeds.

5. Water From Blood : Carnivorous animals get water from the blood of their prey.

6. Metabolic Water : Animals like ants and kangaroo rats depend on the small amount of water arising as a by-product in metabolism.

$$C_6H_{12}O_6 + O_2 \longrightarrow H_2O + CO_2 + \text{Energy}$$

7. Hygroscopic Skin : The skin of spiny lizard *Moloch horridus* is hygroscopic. It absorbs water from the atmosphere like a blotting paper.

8. Intestinal Storage : The lizard *Uromastix* stores water in the intestine.

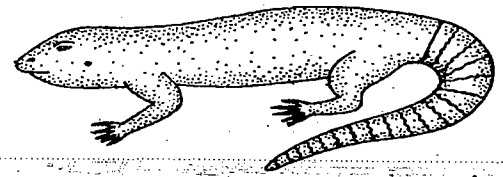


Fig.25.15: Uromastix. It can store water in the intestine.

9. Water Cells : Camel can take in large quantities of water when available. For example, it drinks 40 litres of water in 10 minutes. The water is stored in the ***'water cells'*** present in the rumen of stomach.

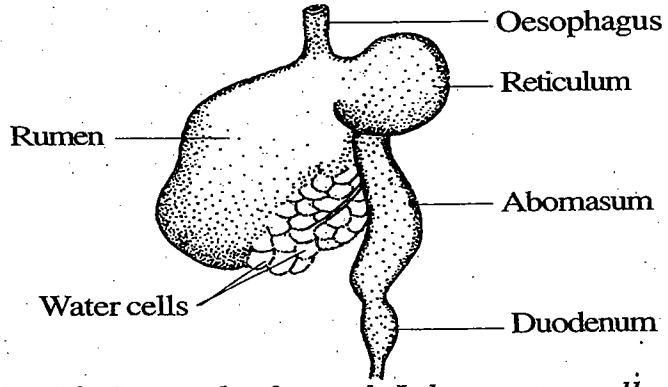


Fig.25.16: Stomach of camel. It has water cells in the rumen and reticulum to store water.

10. No Drinks : Desert birds like black-throated sparrow, zebra finch, antelope grey-backed finch, lark, etc. can survive indefinitely without drinking water. Similarly kangaroo rat can seal its burrow by day and thus keeps its chamber moist and can live throughout the year without drinking water.

3. Tolerance of Heat

Heat is very high in deserts. To escape from heat, desert animals possess the following adaptations :

1. Heat Resistance : Camel is resistant to heat. The body temperature of camel is labile. During day it can allow its body temperature to rise to 40.6° C without sweating. Similarly, at night it allows its body temperature to drop to 33.8° C. Hence camel is resistant to heat.

Similarly, the African antelope *Oryx* can store heat in its body during day. It causes a substantial rise in body temperature (hyperthermia).

2. Aestivation : Certain desert animals like pocket mice, kangaroo rat, etc. aestivate to tide over extreme heat.

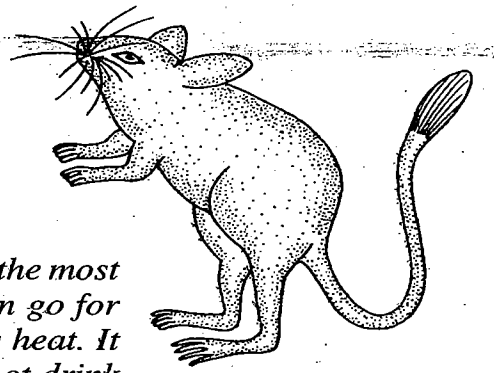


Fig.25.17: Kangaroo rat, the most successful desert rodent. It can go for aestivation to tide over excess heat. It has no sweat glands, It does not drink water. It can reduce its metabolic rate.

3. Tolerance of Dehydration : Most mammals die, when they lose as much as 20% of the water from their bodies. But camel can lose over 40% without serious danger.

4. Absence of Fatty Insulation : Camel accumulates its fat in the hump rather than over the body. This speeds up the flow of heat away from the body.

4. Protection

Desert animals protect themselves in the following ways :

1. Nocturnal habit protects them from the scorching sun.
2. They live in burrows.
3. They have adaptations for swift running.
4. They are provided with long legs to keep their body above the burning sand.
5. Their nostrils, eyes and ears are protected from dust-storms. In camel, the nostril can be closed like eyes.

In *Mabuiya,* the lower eyelid is much enlarged and transparent; it can be used to close the eye without affecting vision.

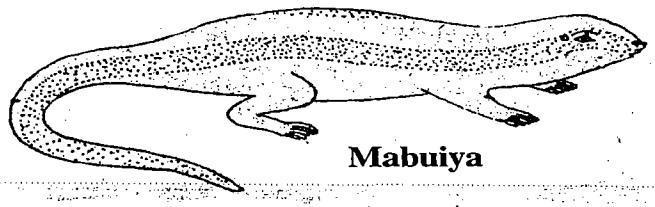


Fig.25.18 : Mabuiya. It can close its eye with the help of the transparent lower eyelid. This protects the eye from the drifting sand.

6. They are provided with spines for protection.

7. The presence of poison is another desert adaptation. Eg. *Rattle snake, Heloderma punctatum* (lizard), etc.

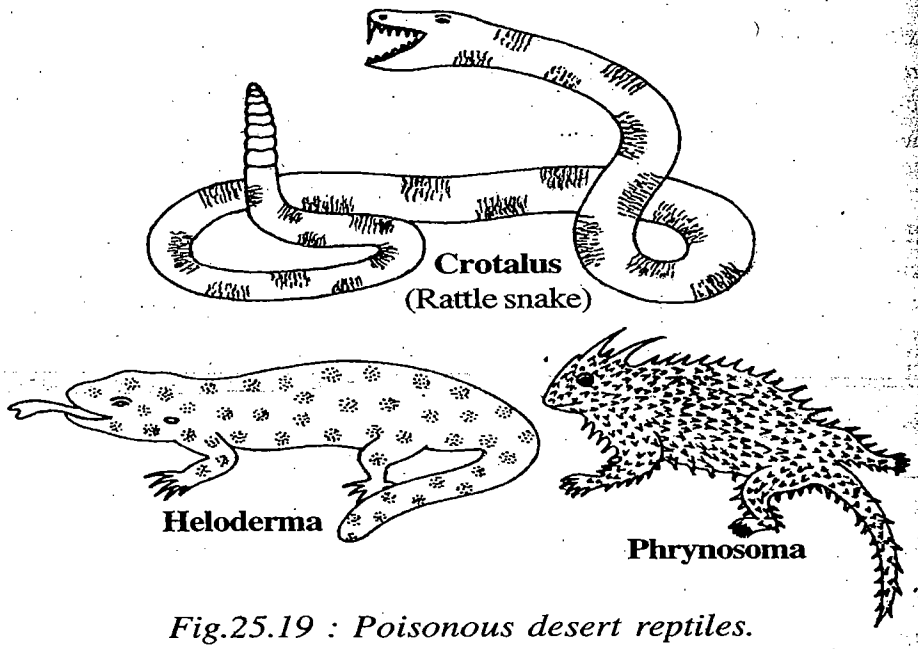


Fig.25.19 : Poisonous desert reptiles.

4. Cave Adaptations

Caves are natural hollows on the earth. They may be present on the surface of the earth or in the sides of hills, mountains and rocks or underground or underbodies of water.

1. Origin of Caves

Caves are formed in the following ways :

1. Flowing Rivers : Most of the caves are abandoned channels through which underground rivers must have flowed in the past.

2. Dissolution of Limestone : Limestone is readily soluble in water. When limestone is present somewhere on the earth, it gradually dissolves and the surface water gradually sinks to form crevices. These crevices deepen to form caves.

3. Wind Erosion : Caves in sand is formed by erosion caused by winds.

4. Sea Erosion : Caves in the sea are formed by the dashing of waves.

2. Zonation of Caves

Based on the penetration of light, a cave is divided into three zones, namely the ***dysphotic*** (twilight) region, the ***middle*** region and the ***inner*** region.

1. Dysphotic or Twilight Region : This is the mouth region of the cave. It extends upto the region where light can penetrate.

2. Middle Region : In this region, the penetration of light is lesser.

3. Inner Region : This region has no light at all. Total darkness prevails here.

3. Characteristics of Cave

Caves are characterized by the following features :

1. Darkness : Light is absent from caves; hence total darkness prevails in caves.

2. Uniform Temperature : The temperature in caves remains uniform throughout the year.

3. High Humidity : The humidity in caves is high.

4. Absence of Air Currents : The air in caves remains stagnant.

4. Cave Flora

The cave flora includes only the non-green plants like fungus, mold, mushrooms, etc.

20. Wild Life Conservation

Wild life refers to the *uncultivated species of plants and animals living in their natural habitat.* Wild life management refers to the protection, preservation, perpetuation and judicious control of populations of rare species of plants and animals in their natural habitat.

Aims of Wild Life Conservation

Wild life conservation has the following aims:

1. To protect and preserve the rare species of plants and animals from ***extinction***.
2. To preserve the ***breeding*** stock.
3. To prevent ***deforestation***.
4. To maintain the balance of nature.
5. To study the ecological relations of the plants and animals in natural habitat.

Necessity for Conservation

The conservation of wild life provides the following advantages and benefits :

1. Balance of Nature

Conservation of life maintains a balance of nature. Examples: a. When all the herbivorous animals in a forest are killed, the tiger and lions enter human settlements and attack human beings and domesticated species. b. The killing of snakes for their skin allows the rat population to increase enormously.

2. Genetic Resource

The wild flora and fauna are a rich resource of genes which can be used in breeding new forms of plants and animals with desirable characters like disease resistance, high productivity, higher ecological amplitude, etc. This calls for the preservation of wild life as an important genetic resource.

3. Economic Value

Wild life is a wealth of the country and it is a good source of income. Wild life yields timber, firewood, hides, ivory, horns, fur, etc. Live and dead animals can be stored in Zoos and Museums for exhibition.

4. Recreation

Wild life forms a source of enjoyment and recreation to human beings.

5. Education

Visits to sanctuaries give education to the students of schools and colleges.

Causes for Wild Life Depletion

The decline and depletion of wild life is caused by the following factors:

1. Deforestation
2. Hunting
3. Poaching
4. Conversion of wild life habitats into house sites, into transport routes, agricultural land, industrial sites, etc. for our increasing population.
5. Establishment of hydroelectric projects. Eg. *The Silent Valley in Kerala.*
6. Pollution
7. Poor breeding potential in wild animals.
8. The breeding of wild animals near human dwellings. For example, marine turtles breed on the sea shore and their eggs are stolen by human beings.
9. Natural calamities such as flood, droughts, fires, epidemics, etc.

Endangered Species

During the last 2000 years about 106 species of animals and 139 species of birds have become extinct. Now it is estimated that about 600 species of birds and animals are going to become extinct, if proper protective measures are not taken. These species are called ***endangered*** species. Most of the endangered species are mammals. Some of them are as follows:

Mammals

Loris tardigradus	-	Slender loris
Nycticebus coucang	-	Slow loris
Macaca silenus	-	Lion tailed monkey
Presbytis johni	-	Nilgiri langur
Manis	-	Scaly ant-eater
Canis lupus	-	Wolf
C. cureus	-	Jackal
Vulpes vulpes	-	Red fox
Ursus arctos	-	Brown bear
U. torqualus	-	Black bear
Melursus	-	Sloth bear
Viverra megaspilla	-	Malabar civet
Panthera leo	-	Lion
P. tigris	-	Tiger

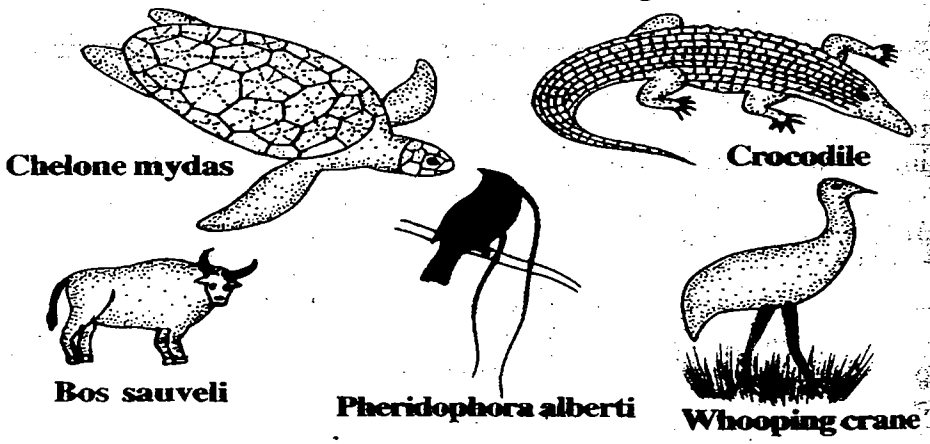


Fig.20.1 : Some endangered animals.

Panthera pardus	-	Leopard
Acinonyx tigris	-	Cheetah
Rhinoceros unicornis	-	Rhino
Asinus hemionus	-	Wild ass
Cervus elephus	-	Kashmir stag
C. duvauceli	-	Swamp deer
Moschus sifanicus	-	Musk deer
Antelope cervicapra	-	Black buck
Gazella dorcas	-	Indian gazella
Bos gaurus	-	Indian bison
Bubalus bubalis	-	Wild buffalo
Petinomys fuscocapillus	-	Flying squirrel
Lozodonta africana	-	African elephant
Elephas maximus	-	Indian elephant
Petaurista petaurista	-	Giant flying squirrel
Platinista gangetica	-	Ganga dolphin

Birds

Cairina scutalata	-	White winged ducks
Cygnus columbianus	-	Whistling swan
C. olor	-	Mute swan
Cygnus cygnus	-	Whooper swan
Avicada leuphotes	-	Indian falcon
Heliacetus leucogaster	-	Sea eagle
Galloperdix spadicea	-	Red spurfowl
Ophrysia superciliosa	-	Mountain quail
Otis tetrax	-	Little bustard
Ardeots nigriceps	-	Great bustard
Ptilolaemus	-	Hornbill
Pavo cristatus	-	Peacock

Reptiles

Dermochelys	-	Leather back turtle
Chelone mydas	-	Green turtle
Butagur baska	-	Box tortoise
Crocodilus porosus	-	Estuarine turtle
C. palustris	-	Marsh crocodile
Python molurus	-	Python
P. reticulata	-	Python

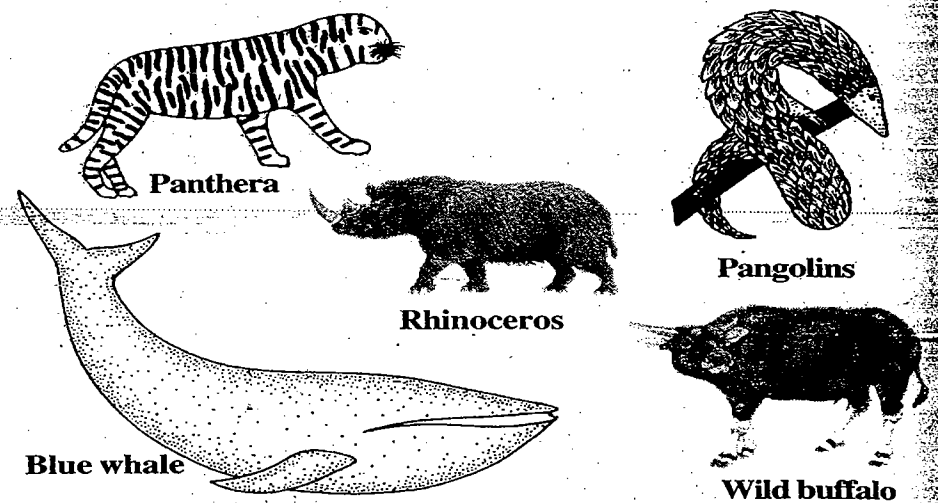


Fig.20.2 : Some endangered animals

Amphibia

Tylototriton verrucosus	-	Himalayan newt
Nectophryne tuberculosa	-	Viviparous toad

Methods of Conservation

1. Knowledge of Wild Life

For proper management of wild life a thorough knowledge of the ecology of wild animals is essential.

2. Appointment of Officials

The management of wild life is made effective by appointing suitable officials. These officials should have inherent love for wild life and they should be given required training.

3. Protective Laws

Restrictive laws should be framed at the Government level to prevent the exploitation of endangered species.

India was the first country to enact a Wild Life Protection Act. The following acts have been framed so far:

1. The Wild Birds and Animals Protection Act of 1887.

2. Forest Act XVI, 1927 : It was enacted for the protection of games.

3. Indian Board for Wild Life, 1952.

4. The Wild Life Protection Act of 1972 : This act prohibits the hunting of females. Chief Wild Life Wardens and authorized officers are appointed to watch. 1. the possession, trapping and the shooting of wild animals alive or dead; 2. the serving of their meat in eating houses; 3. their transportation and export.

5. Restriction of Hunting : When hunting licence is given clear instruction should be given to hunters not to hunt the endangered species.

6. Poaching : Poaching is the illegal exploitation of wild species. The offenders should be severely punished.

7. Habitat Improvement : Habitats of wild life should be improved by constructing ***water holes*** and ***salt-licks*** and by raising plantations of better and nourishing todder grasses and trees.

8. Restoration of Habitats : Disturbances caused to wild life must be removed. Forest that has been denuded earlier can be restored by reforestation. Polluted rivers can be made clean by treating the effluents.

9. Clonal Bank : The cells of rare species of plants are collected, preserved and stored safely. In case, these plants become extinct the preserved cells can be cultured and grown into plants. This is called ***clonal bank*** system.

10. Provision for Shelter and Cover : The survival of wild animals can be encouraged by providing natural shelter and cover. This can be achieved by rearing herbs and shrubs.

11. Artificial Stocking : Certain species can be introduced into a new area by importing them from another area.

12. Game Farming : The endangered species can be reared in protected areas and then they can be released in their natural habitat. Eg. *The marine turtles lay their eggs on the sea shore.* The eggs can be collected and hatched in the laboratories and the young ones are released into the sea.

13. Epidemic Control : Veterinary experts should be appointed to take care of wild life.

14. Census: Effective census operations should be adopted to measure the population sizes of various wild animals.

15. Educating the Public : Common men should be properly educated about the advantages and disadvantages of wild life.

16. Establishment of Sanctuaries and National Parks: Wild animals can be well protected by establishing sanctuaries and national parks. These sanctuaries and parks provide protection and optimum living conditions to wild animals.

Organizations Involved in Wild Life Conservation

A number of bodies and organizations are put in wild life management. They are the following:

1. International Union for Conservation of Nature and Natural Resources (IUCN)

It is established in 1948. It is an independent international agency. It convenes a General Assembly every third year. The main objective of IUCN is to promote and support action that will ensure the perpetuation of wild nature and natural resources in as many parts of the World as possible. It provides awareness, assistance and research facilities.

2. World Wild Life Fund (WWF)

It was established in 1961 in Switzerland. It has the membership of 23 countries including ***India.***

In 1986, World Wild life Fund was renamed as ***World Wide Fund for Nature.***

3. WWF-India

WWF-India was founded in 1969. Its headquarter is in ***Bombay.*** Its main aims are conservation, education and research. Some of the important projects undertaken and supported for WWF-India are

1. Andaman Pig Study
2. Crane Conservation Project
3. Crocodile Breeding Project

4. Ecological Survey of Western Ghats
5. Sloth Bear Project
6. Status Survey of Sea Turtle.

4. Wild Life Preservation Society of India

It is a voluntary organization founded by wild life lovers in ***Dehradun*** in 1958. It is a member of IUCN. It has the following aims:

1. It promotes interest in wild life.
2. It imports knowledge in the protection of wild life.
3. It co-operates with the Government in the protection of wild life.
4. It assists in enforcing wild life protection acts.
5. It promotes wild life tourism.
6. It advises and helps the Government and wild life administrators in the formation, maintenance and protection of National Parks and Sanctuaries.

5. Bombay Natural History Society

It is a non-Government body founded in 1883. It is dedicated to the cause of nature conservation. It has been actively engaged in collecting information and specimens of fauna and flora throughout India, Burma and Sri Lanka. Its publication is serving the cause of nature conservation through publication of articles and new report on fauna and flora.

6. Indian Board for Wild Life

IBWL is constituted in 1952. It has a Bird Wing and a Zoo Wing to deal with the study and preservation of birds and animals and the development of Zoological gardens and Parks in the country. The main functions of IBWL are :

1. It helps to set up National Parks, Sanctuaries and Zoological Gardens for preserving wild life in their natural habitat.
2. It devices ways and means for the protection of wild life through co-ordinated legislature and practical measures, with particular reference to declaration of certain species of animals as protected animals and prevention of indiscriminate killing.

3. It promotes public interest in wild life and the need for its preservation in harmony with natural and human environments.

4. It prevents cruetly to beasts and birds caught alive.

5. It advises the Government on policy in respect of living animals, trophies, skins, furs, feathers, ivory and other wild life products.

7. State Boards for Wild Life (SBWL)

It is constituted at all States in India. It does the same functions as the IBWL but at the State level. It enforces legislation effectively against poaching and illegal killing of game birds and other animals. It celebrates ***Wild Life Week*** in the first week of October every year with the aim to educate people on wild life.

8. National Wild life Action Plan

The NWAP was constituted in 1983. Under this plan the protected area is proposed to be increased to cover 4% of the geographical area as against 3% at present.

9. Red Data Books

It is introduced in the 7th plan. RDB will give a complete list of all endangered animals and plants in the country. About 253 species of animals and about 2000 species of plants are reported to be endangered.

Sanctuaries and National Parks

Sanctuaries are *forest areas where the killing and capturing of animals are prohibited* except under orders of the authorities concerned. National Parks are set up for preserving the flora, fauna, landscapes and the historic objects of an area. Some well known wild life Sanctuaries and National Parks are given below:

1. Vadanthangal Bird Sanctuary

It covers an area of 0.30 sq.km over a lake, about 85 km South of Chennai. It is a bird sanctuary. Many migratory birds regularly visit this area during October and March. When summer starts, the lake becomes empty because the birds migrate

to their homelands. ***Ibis, spoon bills, open-billed stork, egrets, cormorant, darter, grey heron, pelican*** and ***dab-chich*** are some of the birds that visit this sanctuary.

2. Mudumalai Sanctuary

This sanctuary is situated in ***Nilgiri*** district. It was established in 1940. It covers an area of 321sq.kms. It is characterized by dense forests and diversity of fauna. The common wild animals of this sanctuary are as follows: ***Wild elephants, bison, sambhar, chital, barking deer, mouse deer, tiger, panther, bonnet monkey, giant squirrel, flying squirrel, wild dog, jackal, wild cat, porcupine, pangolin, flying lizard, python, rat snake***, etc.

3. Mundanthurai Sanctuary

It is situated in ***Tirunelveli*** district at Papanasam hills. Thamaraparani river passes through this sanctuary. It was established in 1962. It encloses an area of about 520 sq.km. It is formed of thick forests. The wild animals here include ***tiger, panther, sambhar*** and ***chital.***

4. Anamalai Sanctuary

This sanctuary is located in ***Coimbatore*** district. It was established in 1972. It covers an area of 968 sq.km. The wild animals of this sanctuary include ***elephants, bison, sambhar, spotted deer*** (chital), ***barking deer, Nilgiri tahr, lion-tailed monkey, tiger, panther, sloth bear, langur, porcupine, pangolin,*** etc.

5. Point Calimere

This sanctuary is situated in ***Tanjore*** district. It covers an area of 17 sq.km. The backwater of this sanctuary is inhabited by flocks of ***flamingo*** and ***pelicans*** in winter. The nearby Vedaranyam forests are inhabited by large number of ***black bucks, chital, wild boars,*** etc.

6. Muntradaippu Sanctuary

This sanctuary is situated at the National Highway between ***Nagercoil*** and ***Tirunelveli***. This sanctuary is inhabited by many migratory birds.

7. Periyar Sanctuary

This sanctuary is situated in ***Kerala*** state. It covers an area of 777sq.km. It was established in 1940 around an artificial lake. The fauna here includes ***elephants, bison*** (gaur), ***sambhar, chital, barking deer, leopards, sloth bear, wild dogs, wild boars, Nilgiri langur, grey hornbills, egrets***, etc.

8. Bandipur Wild Life Sanctuary

This sanctuary is situated in ***Mysore.*** It was established in 1941. It covers an area of 147 sq.km. It has thick forests and the fauna includes ***gaurs, elephants, leopards, sloth bear, wild dog, chital, panther, barking deer, porcupine, langur***, etc.

9. Guindy Deer Park

It is situated near ***Chennai.*** The animals here include ***chitals*** and ***black bucks.***

10. Bharatpur Bird Sanctuary

It is situated at ***Bharatpur*** in ***Rajasthan***. It covers an area of 29 sq.km. The fauna here includes ***cormorants, spoon-bills, white ibis, darters, egrets, painted storks, open-billed storks, great black-necked storks, ducks, geese, siberian cranes, spotted black buck, sambhar, wildboar, python,*** etc.

21. Fisheries Management

The term ***'fisheries'*** refers to *the capture of aquatic animals for the use of human beings.* Fisheries management includes all the skillful steps taken by man for the complete exploitation of aquatic resources. Fishery is the aquatic counterpart of agriculture. Both fisheries and agriculture are expected to step up the production of food. While agriculture is progressing towards ***green revolution,*** fishery is progressing towards ***blue revolution.***

Divisions of Indian Fishery

The Indian fishery can be divided into two groups, namely ***marine fisheries*** and ***inland fisheries***.

1. Marine Fisheries

'Marine fisheries' refers to *the capture of fishes and other aquatic organisms from the sea.* Marine fishery is further divided into two, namely a. ***Coastal fishery*** and b. ***Off-shore or deep sea fishery***.

1. Coastal Fishery : The capture of fishes in the coastal waters along the West coast and East coast comes under coastal fishery.

2. Off-shore or Deep sea Fishery : The exploitation of fish fauna of the ocean beyond the area of continental shelf comes under this fishery. Deep sea fishery requires harbour facilities, mechanished boats, storage facilities, marketing facilities, etc.

1. *Migration*
2. *Land bridges*
3. *Natural rafts and driftwoods.*
4. *Wind*
5. *Storms*
6. *Transportation by animals capable of flight.*
7. *Human agency, etc.*

28. Zoogeography

- ***Zoogeography*** is a *science dealing with the distribution of animals on the Earth.*
- The distribution of animals on the Earth is studied in many ways.
- The study of the distribution of animals of the past is called ***geological distribution.***
- The study of the distribution of animals on different habitats is called ***ecological distribution.*** Eg. *Marine habitat, forest, pond,* etc.
- The study of the distribution of animals in different continents is called ***geographical distribution.***
- Again, there are four patterns of distribution, namely
  1. *Continuous distribution*
  2. *Discontinuous distribution*
  3. *Parallel distribution*
  4. *Endemism (Isolated distribution).*
- The distribution of animals throughout the Earth is called ***continuous distribution.*** It is also called ***cosmopolitan distribution.*** Eg. *Paramecium, crow,* etc.
- The distribution of animals in widely separated areas is called ***discontinuous distribution*** of animals. Eg. *Lung fishes, Flightless birds, Peripatus, Apodan amphibians,* etc.

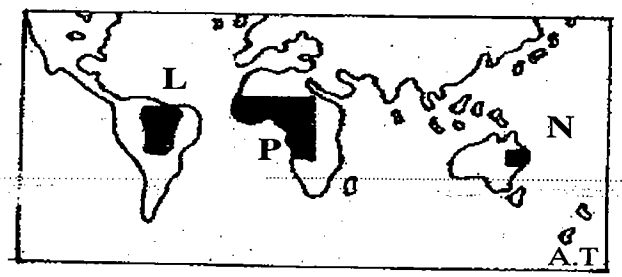


Fig.28.1: Discontinuous distribution.

- The development of similar way of life, similar adaptations by different groups of animals living in different geographical areas are called ***parallel distribution.*** Eg. *Marsupial* and *placental mammals.*
- The distribution of animals in a restricted area on the Earth is ***endemism*** or ***isolated distribution.*** The species exhibiting restricted distribution is called ***endemic species.***
- ***Wallace*** (1876) divided the Earth into 6 regions ***(realms)*** called ***zoogeographical regions.*** They are

1. Oriental region	*4. Ethiopian region*
2. Australian region	*5. Nearctic region*
3. Neotropical region	*6. Palaearctic region*

- The zoogeographical division is mainly based on the distribution of ***land vertebrates*** and ***freshwater fishes.***
- The ***Palaearctic*** and ***Nearctic*** regions are very similar in their vertebrates, climate, vegetation, etc. Hence these two regions are together called ***Holarctic.***
- The Neotropical region is also called ***Neogea.***
- Similarly, the Australian region is called ***Notogea.***
- The Palaearctic, Nearctic, Ethiopian and Oriental regions are together called ***Metagea.***

1. Oriental Region

- Oriental region is a ***zoogeographical realm.***
- It is one of the 6 geographical regions of the Earth.
- The Oriental region along with Palaearctic, Nearctic and Ethiopian region is called ***Metagea.***

- The Oriental region includes-

India	*Java*
Indo-china	*Sumatra*
South China	*Siam*
Burma	*Borneo*
Srilanka	*Formosa*
Malaya	*Phillippines*

- On the Northern side, it is bounded by ***Himalayas.***
- On other sides it is bounded by seas such as ***Indian ocean*** and ***Pacific oceans.***
- It is separated from Australia by an imaginary line called ***Wallace line.*** Another line called ***Weber's line*** runs to the East of Wallace line.
- The Oriental region has four sub-regions. They are
  1. Indian sub-region
  2. Sri Lankan sub-region
  3. Indo-Chinese sub-region
  4. Indo-Malayan sub-region
- The climate is ***tropical*** in the South and *temperate* in the North.
- It contains ***forests*** and ***deserts.***
- The fauna of Oriental region closely resemble the Ethiopian region.

Hence these two regions are together called ***Palaeotropical region.***

- The fauna includes-

Carps	Dogs	Rhinoceros
Frogs	Cats	Deers
Lizards	Pigs	Bears
Snakes	Lions	Bats, etc.
Turtles	Monkeys	
Crocodiles	Apes	
Parrots	Elephants	
Pigeons		
Peacock		

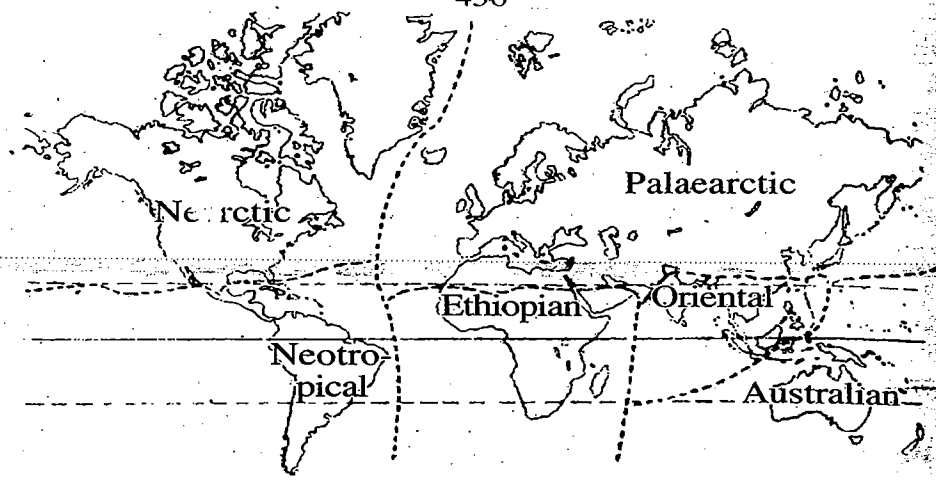


Fig.28.2: Zoogeographical region.

2. Australian Region

- Australian region is a ***zoogeographical realm.***
- It is one of the 6 geographical regions of the Earth.
- This region is also called ***Notogea.***
- It includes

Australia *New Guinea*
New Zealand *Tasmania,* etc.

- Australian region has ***no land connection*** with other regions.
- Australian region is separated from Oriental region by an imaginary line called ***Wallace line.***
- The climate is partly ***temperate*** and partly ***tropical.***
- The Australian region is characterized by the ***absence of Eutherian mammals*** and the presence of ***Prototheria*** and ***Metatheria.***
- The fauna includes

Neoceratodus (Lung fish)
Frogs

Crocodiles	Egg laying mammals
Varanus	Kangaroo

Python, Rats, Pigeons, Dogs } Introduced from other regions.
Parrots

3. Neotropical Region

- Neotropical region is a ***zoogeographical realm.***
- It is one of the 6 geographical regions.
- It is also called ***Neogea.***
- It includes

South America
Central America
West Indies
Southern Mexico.

- It has land connection only in the North; on all other sides, it is surrounded by the sea.
- It has ***tropical climate***
- Deserts are absent
- It has thick ***forests.***
- The fauna includes-

Protopterus (Lung fish)

Cat fish	Pigeon
Electric eels	Parrots
Frogs	Deers
Coral snakes	Camels
Boas	Rabbits
Crocodiles	Monkeys
Tortoises	Ant-eaters
Ratite birds	Pigs

4. Ethiopian Region

- Ethiopian region is a ***zoogeographical realm.***
- It is one of the 6 geographical regions.
- The Ethiopian region, along with Palaearctic, Nearctic and Oriental regions is called ***Metagea.***