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**B.Sc. Zoology Part II**

**DIPNOI**

**INTRODUCTION**

- ✓ The dipnoans, belonging to the order **Dipnoi** of the subclass **Sarcopterygii** of Osteichthyes, are generally called “**lung fishes**”.
- ✓ The name Dipnoi (Gr; *di*= two + *pnoe*= breathing) means “**double breather**”, as they respire through gills as well as lungs.

**DISTRIBUTION**

- ✓ Fossil dipnoans appeared in mid-Devonian probably as an offshoot of the crossopterygian stem.
- ✓ They flourished moderately in Permian and Triassic and later became rare.
- ✓ The earlier recorded fossil lungfish is **Dipterous** of mid-Devonian.
- ✓ From this genus, dipnoan evolution led directly to the Triassic form *Ceratodus*, having a wide distribution over earth.
- ✓ Dipnoans have remained conservative and changed very little since that time.

There are only 3 living genera of lung fishes, one in each of the 3 continents of the Southern Hemisphere:-

**1. *Neoceratodus* (= *Epiceratodus*):-**

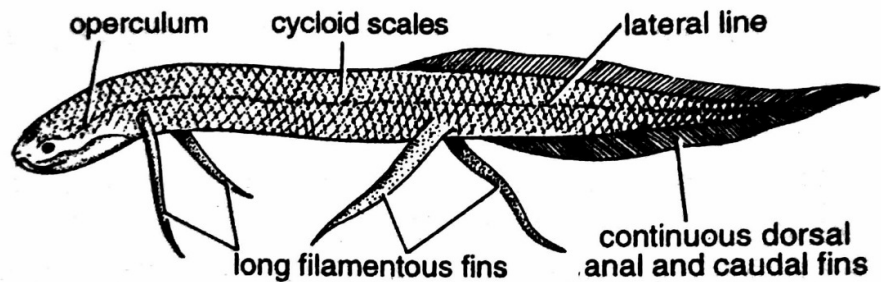
- ✓ Single species *N. forsteri* found in Burnett and Marry Rivers in Queensland (Australia).
- ✓ A direct descendant of ancient lungfish.
- ✓ Attains a length of 1.5 meters and a weight of 45 kg.



**AUSTRALIAN LUNGFISH**  
*Neoceratodus forsteri*

## 2. *Protopterus*:-

- ✓ Four or so species in certain lakes and rivers of tropical Africa (rivers Senegal, white Nile and Zambesi and Lake Tanganyika).
- ✓ Grow up to 1 or 2 meters and weigh about 40 kg.



**AFRICAN LUNGFISH**  
*Protopterus*

## 3. *Lepidosiren*:-

- ✓ Single species *L. paradoxa* in river Amazon and its tributaries of tropical South America.



**AMERICAN LUNGFISH**  
*Lepidosiren paradoxa*

## HABITS AND HABITAT

- ✓ Lungfishes are large, bizarre fishes, inhabiting semi-permanent freshwater and swamps in Africa, South America and Australia.
- ✓ They probably survive because they live in habitats where no actinopterygians can successfully compete.
- ✓ All can survive extremely stagnant waters, periodically coming to the surface and gulping air into their lungs.
- ✓ *Neoceratodus* respire exclusively via gills and use its single lung only under stress.
- ✓ *Lepidosiren* and *Protopterus* have weakly developed gills and will draw if prevented from reaching the surface to use their paired lungs.
- ✓ All are sluggish bottom dwellers and predaceous carnivores feeding on worms, molluscs, crustaceans, frogs, small fishes and even members of their own species.

- ✓ Besides swimming in water by undulating body movements, they also crawl on the bottom using their paired fins like legs.
- ✓ *Lepidosiren* and African *Protopterus* species survive drought by aestivating in a mucous cocoon buried in the bottom mud of their dried-up habitats.
- ✓ During aestivation the air bladder is constantly used as a lung.
- ✓ When mud softens again during rains, they resume their normal life like fish.
- ✓ Male *Protopterus* vigorously guards eggs laid by female in an oval muddy pit or nest, after fertilizing them.
- ✓ Parental care is even more pronounced in male *Lepidosiren* whose pelvic fins develop vascular tufts during breeding season.
- ✓ The male periodically leaves the nest to engulf atmospheric air and Oxygen diffuses from freshly aerated blood of pelvic fins to the vicinity of eggs or young for respiration and growth.

## PECULIARITIES

### EXTERNAL FEATURES

- ✓ Lungfishes are slender fish-like or eel-like creatures, 1 to 2 meters in length.
- ✓ Paired pectoral and pelvic fins, often designated as limbs, are narrow lobe-like or filamentous, with a central axis of flesh and bone.
- ✓ Dorsal anal and caudal fins are fused into a continuous, symmetrical, diphyccercal tail, supported by partly calcified fin rays.
- ✓ Snout is depressed bearing external nostrils enclosed within upper lip.
- ✓ Mouth is subterminal or ventral.
- ✓ Gills are covered on either side by an operculum leaving a single slit-like gill slit.
- ✓ Spiracles are absent.
- ✓ Anus, urinary and genital apertures and one or two abdominal pores lie within a small mid-ventral cloaca.
- ✓ Eyes are small.
- ✓ Lateral line system is well developed, especially on head.
- ✓ Skin is covered by an exoskeleton of thin, bony, overlapping cycloid scales.

### INTERNAL FEATURES

- ✓ Endoskeleton is mostly cartilaginous.
- ✓ Notochord is persistent with cartilaginous vertebral arches but lacking vertebral centra.
- ✓ Anterior vertebrae are fused with skull.
- ✓ Primary cranium persists with little ossification and with or without fontanelles.
- ✓ Premaxillae and maxillae absent and teeth modified as crushing plates.
- ✓ There are 4 to 6 cartilaginous branchial arches.
- ✓ Jaw suspension is autostylic.
- ✓ Pectoral girdle is a stout cartilage with a pair of investing bones on either side.

- ✓ Pelvic girdle is well developed and cartilaginous.
- ✓ Intestine has a spiral valve.
- ✓ Glottis may be protected by an epiglottis.
- ✓ Internal nares may open into mouth cavity much like those of Amphibia.
- ✓ Air bladder (swim bladder) forms a single or double lung with internal alveoli as in higher vertebrates.
- ✓ Gills may be well developed or reduced.
- ✓ Auricle and ventricle of heart and sinus venosus are imperfectly divided.
- ✓ The large atrioventricular opening is filled by a fibrous plug, there being no true valves.
- ✓ Ventral aorta is very small.
- ✓ Conus arteriosus is partly fully partitioned.
- ✓ A spiral valve is present.
- ✓ A pulmonary artery is given off on either side from efferent branchial system.
- ✓ A pulmonary vein opens into left side of auricle.
- ✓ There are two precavals (ductus cuvieri) and a large posterior venacava (posterior cardinal vein) as in tetrapods.
- ✓ Mid-brain is almost undivided into optic lobes.
- ✓ Pallium of cerebral hemispheres has a layer of nerve cells.
- ✓ Paired oviducts open anteriorly into coelom in female.
- ✓ Vasa efferentia carry sperms through excretory part of kidney in male.
- ✓ Fertilization is external.
- ✓ Development includes metamorphosis.
- ✓ Larvae may develop suckers and external gills.

## CLASSIFICATION

- ✓ Order **Dipnoi** is divided into two suborders:-

### SUBORDER I: MONOPNEUMONA

- ✓ Lung single.
- ✓ Lateral jointed rays of archipterygium (paired fins well developed).  
**Example:-** Living Australian *Neoceratodus forsteri* and extinct Triassic *Ceratodus*.

### SUBORDER II: DIPNEUMONA

- ✓ Lung double.
- ✓ Lateral rays of archipterygium (paired fins) vestigial or absent.  
**Example:-** African *Protopterus* and American *Lepidosiren paradoxa*.

## AFFINITIES OF DIPNOI

- ✓ With special features of their own, the Dipnoi combine characteristics in which they resemble different group of fishes as well as Amphibia.

## I. AFFINITIES WITH FISHES (GENERAL)

- ✓ Lungfishes are true fishes beyond doubt as they resemble them in general in the following features;-
  1. Body spindle-shaped and stream lined.
  2. Locomotory appendages fins.
  3. Diphyccercal caudal fin.
  4. Largely ossified, slender dermal fin rays.
  5. Body covered by overlapping cycloid scales.
  6. Notochord persistent.
  7. Vertebrae without centra.
  8. Skull with little ossification and with several investing bones.
  9. Branchial arches 4 to 6 pairs present.
  10. Aquatic respiration by gills.
  11. Lateral line sensory system.

## II. AFFINITIES WITH AMPHIBIA

- ✓ Dipnoans resemble amphibians in several features, such as:-
  1. Semiaquatic or marshy habitat.
  2. Internal nostrils piercing roof of mouth cavity.
  3. Multicellular skin glands.
  4. Dermal scales present in **Gymnophiona**.
  5. Lungs capable of pulmonary respiration.
  6. Spiracles lacking.
  7. Vomerine teeth present.
  8. Auricle and sinus venosus partially divided into right and left halves.
  9. Conus arteriosus spirally twisted and longitudinally partitioned.
  10. Ventral aorta short.
  11. Presence of anterior abdominal vein, posterior venacava, pulmonary artery and vein.
  12. Pericardium is thin-walled.
  13. Jaw suspension **autostylic**.
  14. Brain similar in structure of cerebrum and cerebellum.
  15. Sperms carried through excretory part of mesonephric kidney.

## CONCLUSION

This close similarity led early workers to conclude that lungfishes gave rise to amphibians, a view no longer held now-a-days. According to **Dollo**, these similarities probably were due to convergent evolution on account of similar habits and habitat.

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