Dipnoi: Distribution, Morphology and Affinities | Bony Fishes

Introduction:

Structure of Dipnoi:

Dipnoi (Gr. di-two, pnoe-breathing) is a small order of fresh water bony fishes. They respire by gills and lungs. Dipnoi evolved during Devonian period. They are characterized by short jaws, crushing plate from teeth, internal nares, reduced exo- and endo- skeleton, and diphycercal tail. The air bladder i.e., so called 'lungs' are one or two. They are functional with related changes in the circulatory system and in the heart.

Distribution of Dipnoi:

Fossil evidence support to the view that once dipnoans enjoyed cosmopolitan (worldwide) distribution. Two fossil forms are Dipterus from Devonian period and Ceratodus from triassic period. But the modern lung fishes show discont inuous distribution.

The three surviving genera of lung fishes are Neoceratodus (=Epiceratodus) Protopterus and Lepidosiren. All they are inhabitants of river. But Protopterus lives in large lakes too. They all breath air. Neoceratodus is found only in the Burnett and Mary rivers of Queens-land in Australia, so commonly called as 'Burnett Salmon' or Australian lungfish.

Neoceratodus is the only living genus of the family Ceratodont idae, the other being extinct Ceratodus. Protopterus lives in large lakes and rivers of tropical Africa. It is commonly called as Nile lungfish' or African lung fish. Lepidosiren is found in river Amazon and Paraguay basin in South America. It is commonly called as 'Amazon lungfish' or South American lungfish.

Morphology of Dipnoi:

1. Neoceratodus forsteri:

The body of Dipnoi is elongated and compressed measuring about 90 to 150 cms. The body surface including the head and paired fins is covered with thin, bony, overlapping cycloid scales which are not regarded as denticles.

Paired fins are lobe like paddles, enabling the fish to crawl over the bottom. But these are weak to support the fish outside water. The fish has a diphycercal tail with symmetrical tail fin. Tail fin rays are un-jointed and fibrous. External nostrils lie enclosed within the upper lip. Internal nostrils (choanae) are present.

Branchial arches are four in number and bi-segmented, Hyobranchial cleft is open and associated with pseudo-branches. The first four branchial arches carry holobranches. Gills are covered with bony opercula. It respire exclusively by gills, and uses it's single lung (Monopneumona) only under stress. A lateral line is present. Lower jaw is with a small toothless dentary on each side. Dental plates are oval crescentic or triangular terminating in a smooth or feebly denticulated biting margins.

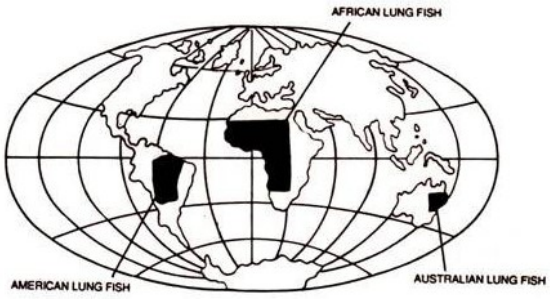

Fig. 16.1 Discont inuous distribution of Lung fishes (Dipnoi).

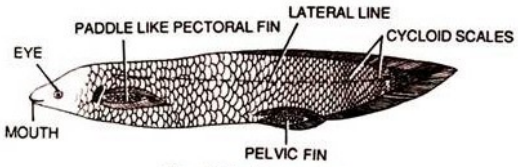

Fig. 16.2 Neoceratodus

Neoceratodus is inactive and sluggish in habit, usually lying motionless on the bottom. It is carnivorous and feeds on fresh water crustaceans, worms and molluscs.

2. Protopterus has four species. The body is elongaed, cylinderical and more or less eel-like and grows to a length of about 200 cms. Body is covered over by over-lapping cycloid scales. The dorsal anal and tail fins are continuous and are supported by partially calcified fibre-like rays called camptotricha.

The pectoral and pelvic fins are represented as limbs. They are long, thin and filamentous and help in walking along the bottom. The caudal fin and its supporting fleshy lobe taper to a posterior point i.e. it is isocercal or protocercal. The mouth is small.

Inside the mouth margin internal nostrils are present. The fleshy lips extend back on the sides of the head. The eyes are small. Six branchial arches and five gill slits are covered by operculum. The opercular opening is limited to a slit just in front of the pectoral fin.

Gills are weakly developed and will die if prevented from reaching surface of water to use their paired lungs (Dipneumona). The lateral line system is well developed and is indicated on the head grooves or lines of openings. The cloacal opening lies ventrally at the root of the tail and close to it are two abdominal pores.

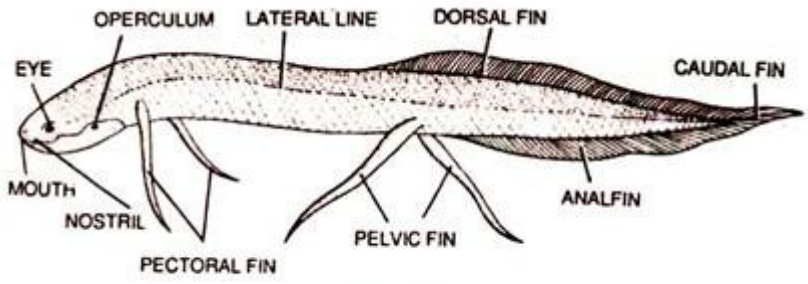

Fig. 16.3 **Protopterus**

Protopterus is a carnivorus and voracious feeder. It feeds on worms, crustaceans, insects, frogs and many other small animals. During un-favourable seasons it undergoes summer sleep or aestivation and burrow

into the soil to a depth of about 60 cms for atleast 6 months in waterproofed “cocoon” made of clay and mucus.

3. Lepidosiren paradoxa:

Body is elongated, cylinderical and more or less eel-like. It grows to the length of about 125 cms. The skin covering the body contains very small cycloid scales. Gill slits are 5 pairs covered with operculum. Gills are weakly developed, respiration is supplemented with two lungs (Dipneumona). Paired fins are thin and filamentous. Dorsal and caudal fins are united.

Pelvic fin have vascular filamentous in male during breeding season. Eyes are moderate and well developed like Neoceratodus. External (cutaneous) gills are absent in adult but present in larva. Like Protopterus, they survive drought by secreting mucous cocoons in mud. During aestivation the air bladder is used as lungs.

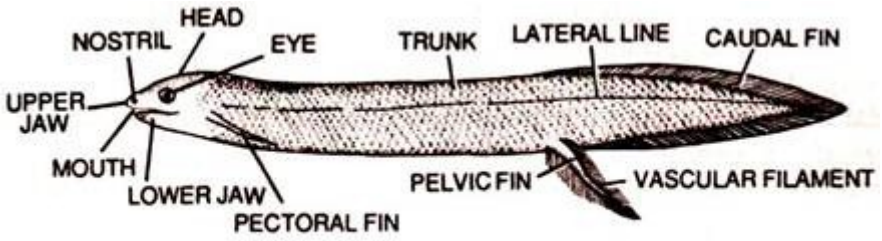

Fig. 16.4 Lepidosiren

Lepidosiren is not exclusively carnivorous, food mainly comprises fresh snails and mass of algae.

Affinities of Dipnoi:

Dipnoi form an interesting group of fishes. Presence of the lungs lead to the view that they are the ancestors of amphibia. Other-words, they were considered as the connecting link between Pisces and Amphibia. This view is no more supported. Present view is to treat them as a specialized or degenerate descendants of the more primitive lobe-finned fishes to which they closely resemble.

The affinities of Dipnoi can be studied under following heads:

(a) Affinities with fishes in general:

1. Spindle-shaped, eel-like body.
2. Body covered with scales (Cycloid).
3. Presence of paired fins.
4. Diphycercal caudal fins.
5. Persistent notochord.
6. Skull with little ossification.
7. Paired gill-slits.
8. Branchial respiration.
9. Lateral line sense organs.

(b) Affinities with Elasmobranchii:

1. Endoskeleton mostly cartilaginous.
2. Intestine with spiral valves.
3. Conus arteriosus with valves.
4. Presence of sinus venosus.
5. Each gill with two efferent arteries.
6. Absence of nephrostome in uriniferous tubules.
7. Small diencephalon with vascular roots.
8. Similar female reproductive organs.

(c) Affinities with Holocephali:

1. Excurrent nostrils opening into mouth cavity.
2. Autostylic jaw suspensorium.
3. Gills covered with operculum.
4. No distinct stomach.
5. Intestine with a spiral valve.
6. Teeth fused to form dental plates.
7. Identical cranial muscles.
8. Identical kidneys, gonads and gonoducts.
9. Two efferent arteries in each gill.

(d) Affinities with Actinopterygii:

1. Blunt snout with ventral nostril.
2. Presence of cycloid scales.
3. Strong palate and splenial teeth.
4. Presence of operculum covering gills.
5. Presence of swim bladder.
6. Paired inferior jugular veins.

(e) Affinities with Crossopterygii:

1. Diphycercal caudal fin.
2. Powerful leg-like lobate fins.
3. Identical skull bones.
4. Vertebral column upto the tip of caudal fin.
5. Air bladder for pulmonary respiration.
6. Internal nostrils.
7. Presence of contractile conus arteriosus.
8. Larva with cutaneous gill.

2. Affinities and Disimilarities with Amphibins:

(a) Affinities:

1. Semiaquatic habitat.
2. Internal nostrils
3. Vomerine teeth.
4. Autostylic jaw suspensorium.
5. Multicellular cutaneous glands.
6. Cutaneous gill in larva.
7. Pulmonary respiration.
8. Dermal scales as in Apoda.
9. Auricle and sinus venosus partially divided.
10. Ventral aorta short or absent
11. Presence of anterior abdominal vein, posterior vena cava, pulmonary artery and veins.
12. Thin walled pericardium.
13. Long and narrow cerebral hemispheres.
14. Similar structure of egg and development

5. Conclusion:

The above affinities indicate that dipnoans are not most advanced pisces from which amphibians could evolve. They are degenerate descendants of Crossopterygii. According to Jarvik (1968) dipnoans are more specialized than crossopterygian. According to latest view, both dipnoans and amphibians have originated from some crossopterygian like ancestor.

There must have been a common ancestor for Dipnoi, Crossopterygii and Labyrinthodont amphibia. So most probably, dipnoans are not the “fathers of the amphibia”, but “uncles of the amphibian”. However, Jarvik (1980) considers that the Dipnoi may be related to elasmorbranchs than any other animals.