M.Sc. II Sem. (Zoology)

Coelacanthiformes - General organization and affinities

- Crossopterygians or lobe-finned fish are now represented only by fossils.
- They were very dominant in Devonian times about 280 million years or more ago and became extinct by the end of Cretaceous.
- The Coelacanths, have been found in recent years since 1938 near Comoro Islands between Africa and Madagascar.
- The West Indian Ocean coelacanth (*Latimeria chalumnae*), the generic name was given in honour of Miss Courteny Latimer, curator of East London Museum (S. Africa), who recognized it as unusual. The specific name refers to the first site of capture, offshore the mouth of Chalumna river of South Africa.
- The Indonesian coelacanth (*Latimeria menadoensis*) is found in the waters of Sulawesi, Indonesia.
- The fin "spines" are also cartilaginous and hollow, hence the name coelacanth (coel, "hollow"; acanth, "spine")
- The coelacanth is an enormous, bottom-dwelling fish that is unlike other living fishes in a number of ways.
- Coelacanths can reach more than six feet long and weigh about 200 pounds, and they're covered in thick, scaly armor. It's estimated they can live up to 60 years or more.
- There are two living species of coelacanth, and both are rare.
- They are the sole remaining representatives of a once widespread family of lobe-finned fishes; more than 120 species are known from the fossil record.

Latimeria chalumnae

Unique Characteristics:

- The most striking feature of this "living fossil" is its paired lobe fins that extend away from its body like legs and move in an alternating pattern, like a trotting horse.
- Spines present at the back of fish have coelome, thus the name Coelacanth is given.
- Other unique characteristics include a hinged joint in the skull which allows the fish to widen its mouth for large prey; an oil-filled tube, called a notochord, which serves as a backbone; thick scales common only to extinct fish.
- Size ranges from 0.75 to slightly over 2 meters.
- Among them is the presence of a "rostral organ" in the snout that is part of the electrosensory system, and an intracranial joint or "hinge" in the skull that allows the anterior portion of the cranium to swing upwards, greatly enlarging the gape of the mouth.

➢ **External Structures of *Latimeria*:**

- The body is covered with cosmoid scales. The scales are round and overlap in such a fashion that the body becomes three scales thick.

- The paired fins act as active swimming organs and are also used for movement at the bottom of the sea. The paired fins are of pedunculate type.
- Each such fin has a short scale-covered lobe and the fin-rays are arranged on the tip in a fan-shaped fashion.
- There are two dorsal fins. The anterior dorsal fin is supported by a bony plate while the posterior one is almost like that of paired fins.
- The tail is diphycercal with a small median lobe. Like that of other teleosts, the fin-rays supporting the fins are highly mobile.
- *Latimeria* swims by rotating the pectoral fins and the paired fins are highly mobile.

➢ **Skeletal Structures of *Latimeria*:**

- The notochord persists as a massive un-constricted rod-like structure.
- The vertebral column is represented by a hollow un-ossified tube with the ossified neural and haemal spines.
- The fin spines are hollow, hence the name of the group, coelacanths or hollow spine.
- The skull has a well-developed joint between a condyle of the posterior end of basisphenoid and a cavity at the anterior end of the occipital region of the skull.
- The joint allows movement of the anterior portion of the skull and helps to catch the prey.

➢ **Digestive System of *Latimeria*:**

- The jaws and palate are provided with numerous minute teeth.
- The buccal cavity is spacious and leads into a powerful muscular oesophagus.
- The oesophagus leads into a large bag-like stomach.
- The intestine is spiral and continues as the rectum and cloacal pouch.
- The intestine contains a complicated spiral valve.
- A median nodular organ (homologous with the rectal gland of selachians) is present which pours its secretion into the cloaca.

- The cloacal pouch bears a urinogenital papilla.
- The liver is a bilobed structure with an enlarged gall-bladder.
- The pancreas is well-formed.

➢ **Swim-Bladder of *Latimeria*:**

- The swim-bladder is variable in size and shape in different individuals.
- It arises as a tube 3-8 cm in length from the ventral side of the oesophagus and continues backwards to occupy the dorsal side of the abdominal cavity.
- The cavity of the swim-bladder is greatly reduced and contains about 95% fatty tissue.
- The flesh of Latimeria is also excessively oily in nature.
- The swim-bladder is neither a hydrostatic nor a respiratory organ.

➢ **Respiratory System of *Latimeria*:**

- Respiration takes place by gills.
- There is a deep spiracular pouch in Latimeria which lacks mandibular pseudo branch and external opening.
- The gills are composed of a small hyoidean hemi branch on the posterior surface of the hyoid arch and four holobranchs.
- The fifth branchial arch is greatly reduced and lacks gill.

➢ **Circulatory System of *Latimeria*:**

- The heart is a very simple structure.
- It is composed of sinus venosus and auricle located behind the ventricle and conus arteriosus which bears four rows of endocardial thickenings on its inner wall.
- These thickenings represent the pseudo valves or reduced valves. Presence of such valves speaks about the primitive condition.
- The red blood cells are large in size resembling that of dipnoans and amphibians.
- **Nervous System of *Latimeria*:**

- The brain is small and occupies less than one-hundredth part of the cranial cavity.
- The rest of the space is filled up with fatty substance.
- There is a large corpus striatum in the forebrain and the roof is very thin.
- **Sense Organs of *Latimeria*:**
- Besides the eyes, internal ears and lateral line sense organs, there are two peculiar sense organs in the rostral region.
- They are designated as rostral sense organs.
- Each is composed of a large sac-like median organ of unknown function and communicates with the exterior by three rostral tubes on each side of the snout.
- The rostral sense organ is not connected with the olfactory organ and is filled up with a gelatinous substance.
- It bears similarity with the ampullae of Lorenzini.
- The rostral sense organ is innervated by the superficial ophthalmic nerve.
- The other sensory organ is olfactory in function.
- It is a paired structure and communicates with the exterior by nasal tubes.

➢ **Urinogenital System of *Latimeria*:**

- The kidneys are fused to form a median structure and remain attached to the ventral wall of the abdominal cavity.
- The ventral position of kidney is a peculiar occurrence and not found in other vertebrates.
- There are two ureters, each of which dilates into an expanded bladder.
- The ureters open into the urinogenital papilla.
- The gonads are usually paired and the gonoducts open between the bases of the pelvic fins.

➢ **Development :**

- Coelacanths are ovoviviparous, with females bearing their offspring internally for 13 months to three years.
- Embryo development is supported by yolk provisioned by the female.
- Eggs have been measured to be 1 to 9 cm in diameter and weight 100 to 350 g.
- Near term juveniles can reach 35 cm in length and weigh up to 500 g.
- Few juvenile specimens have ever been caught following birth, and none have been witnessed in the presence of adults.

➢ **Reproduction :**

- The mode of reproduction is ovoviviparity.
- This involves internal fertilization of eggs, followed by a gestation period thought to be about a year in duration during which time the embryos feed off the yolk sac of the egg, culminating in the live births of fully formed young.
- Only two females carrying young, or "pups", have been captured.
- One female contained five full-term pups, each approximately 14" long, and the other had twenty six pups of approximately the same size.

Affinities of Coelacantheformes

- The paired fins resemble superficially with those of actinopterygians.
- The endoskeleton of the fin is of the archipterygial type, consisting of a single basal plate attached to the girdle.
- The skull resembles with that of the osteolepides in processing a movable hinge between the parietals and post-parietals.
- There are some similarities in the anatomy and physiology of *Latimeria* and the chondrichthyes, specially in the mechanism of osmoregulation.
- Like the elasmobranchs, *Latimeria* also maintain a high concentration of urea in the blood, and thus isosmotic with the sea water.
- The structure of the pituitary gland also resemble with that of the Chondrichthyes.

- There are few basic similarities between coelacanths and bony fishes, as in the skeleton, presence of bony scales, swim bladder etc.

Affinities with Rhipidistians:

Coelacanths resembles the rhipidistians in the following features which suggest close relationship between the two groups:

- Presence of intracranial hinge although the mechanism of hinge differs in two groups.
- Poorly ossified vertebral column.
- Cosmoid type of scales.
- Structure of pectoral and pelvic girdles.

Affinites with Ambhibians:

They are of special interest because of their resemblance to amphibians:

- The skeletal elements of paired fins lobes resembled the proximal skeletal elements of tetrapod limbs.
- The bones of the paired fins articulate with the pelvic and pectoral girdles, much like those of tetrapods.
- Skull was similar to that of earliest amphibians.
- Freshwater forms migrated from one body of water to another because they could use their air bladders like lungs.
- Many had internal nares piercing the roof of mouth cavity, although not meant for breathing.