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E-learning Material

Fins and Tails in Fishes :

Fins are usually the most distinctive anatomical features of a fish and highly specialized organs of locomotion, adapted for swimming in water. They are composed of bony spines or rays protruding from the body with skin covering them and joining them together, either in webbed fashion as seen in most bony fishes or similar to a flipper as seen in Sharks. Variation in their structures and arrangement they control movements and swimming. Fins located in different places on the fish, serve different purposes such as moving forward, turning, keeping an upright position or stopping. Basically fins are classified into two main types viz- The Median fins and Paired fins.





1.MEDIAN FINS :

The median fins are unpaired and associate with the axial skeleton of the fish.

Typically the median fins are found on dorsal, ventral and caudal position on the body of fish and named accordingly as dorsal, ventral and caudal or anal fins. During swimming the dorsal and ventral fins are used as stabilizers to prevent the body from rolling and caudal fins help drive the animal (fish) by back and forth sculling action.

2.PAIRED FINS :

The paired fins are unpaired and associate with appendicular skeleton of the fish. The paired fins are paired as pectoral and pelvic fins. They control the movement of fish during swimming.

In various fishes fins are used for various activities-

Flying fish (*Exocoetus, Crypsilurus*) used pectoral fins for gliding and Frog fish (*Antennarius multiocellatus*) use pectoral fins for crawling. In male Sharks and Mosquito fish (*Gambusia affinis*) use a modified fin to deliver sperm.

Thresher Sharks (*Alopias*) use their caudal fin to stun prey, Reef Stone Fish (*Synanceia verrucosa*) have spines in their dorsal fins they inject venom. Anglar Fish (*Lophious piscatorius*) use the first spine of their dorsal fin like a fishing rod to lure prey and trigger fish to avoid predators by squeezing into coral cervices and using spines in their fins to lock themselves in place.



MEDIAN FINS :

The median fins includes 1 or 2 dorsal fins along with mid dorsal line, a ventral, an anal fin behind anus or ventral (Cloaca) and a tail or caudal fin around the tip of tail. Dorsal fins may be in series or reduced or absent. Anal fins may be absent especially in bottom dweller. Basically median fins are of following types-

DORSAL FINS :

The dorsal fins are found on the mid-dorsal side of the body. It often comprises of two parts First dorsal fin and Second dorsal fin.



VENTRAL FINS :

Ventral fin is found close behind the ventral it is also known as anal fins. It is consists of usual myotomic and skeletal components.

The skeleton supporting fins are arises from two different sources viz- endoskeleton and dermal sources. The former Ist disposed in the form of fin rays called the radials or pterygiophores and latter as dermal fin rays or dermotricha. The radials are made up of cartilage or bone and form the supporting rods of fins

The dermal fin rays are considered, modified scales. They are usually forked at their tips to offer an extra support to the peripheral portion of the fins.

PAIRED FINS :

The paired fins includes a pair of pectoral fin and a pair of pelvic fin both of which are supported by their respective girdles. They are similar in form and segmentation but differ in their morphology.

(A) **PECTORAL FINS**:

The pectoral fins articulate with the pectoral girdle either by their basal or radials. The pectoral fins are usually located on the side of the body near the fish's head. These fins are used in most fishes for turning and sculling. Each fin is supported by a proximal row of variable number of basal and a distal row of radials. The basal generally include three (3) components an inner and posterior called Metapterygium, A middle one called Mesopterrygium and An outer Propterygium. Basal articulates directly with a scapular process a little beyond the glenoid region.

So that the pectoral fins scull back and forth in order to keep the fish in one position. As a fish breathes, water passes out the back of gills. This tends to act as a jet propulsion moving the fish forward. The sculling action of the pectoral fins helps to counteract this jet propelling action and will keep the fish in one place.

Pectoral girdles of fishes includes cartilage or cartilage replacement bone, as well as dermal bones derived from bony plates

In cartilagenous fishes, the girdle halves are fused producing the scapulocoracoid, that is joined to the other half of the pectoral girdle by the coracoid bar. In telelosts, the basic element is called the cleithrum, which supports the supracleithrum and, in turn, the posttemporal, through which the girdle is attached directly to the skull

For **Eg.** *Amia*, *Polypterus*, *Lepideosteus*, *Ceratodus* etc. In flying fish the pectoral fin are enlarged for soaring in the air.





(B) PELVIC FINS :

The pelvic fins situated in front of anus but during course of evolution they tend to migrate anteriorly to contact the pectoral fins. This fin is paired a right one and left one. In some fishes the pelvic fins may be way up front and very close to the fish's throat while on the other fishes they may be further back and very close to the anal fin. The pelvic fins are used in stabilization and for stopping. They are also used in sculling. In some fishes as **Cling fishes**, the pelvic fin resembles a suction cup and help hold the fish **onto rocks**.

The pelvic fins of cartilaginous fishes, lie posterior to the pectoral fins. Basals comprises only two elements, the metapterigium and Protopterigium. Radials consists of one or more rows of small rod shaped structures from which dermal fin ray extend out to complete the structure of the fin.

For E.g. Chimaera, Cod, Gadidae etc

The pelvic fins of cartilaginous fishes lie posterior to the pectoral fins. Basals comprises only two elements, Metapterygium and Protopterygium. Radials consist of one or more rwos of small rod shaped structure from which the dermal fin rays extend out to complete the structure of the fin.

While the pelvic fin of bony fishes lies usually, far forward than where they should have been. In Trout they lie far back in front of anus and curiously in Cod, lie inserted in throat region quite anterior to the pectoral fins.



PELVIC GIRDLE OF FISHES :

The pelvic girdle of fishes is based on a single element, the puboischiac bar, that is embedded in the musculature of the trunk. The **pelvic girdle** of the elasmobranch **fishes** (e.g., sharks, skates, and rays) consists of either a curved cartilaginous structure called the puboischial bar or a pair of bars lying transversely in the ventral part of the body anterior to the cloaca; projecting dorsally on each side is a so-called iliac process.





CAUDAL FINS :

The Caudal fin is the fin (Latin Caudal- meaning –tail) located at the end of the caudal peduncle and is used for propulsion. It can be differentiated into a dorsal epichordal lobe and a ventral hypochordal lobe. Caudal fin propel the body forward and also neutrilizes drag against water.

Depending on the habits and habitats caudal fins are variously modified in fishes-

1. PECTOCERCAL TAIL :

This type of tail is most primitive type and found in Cyclostomes. In this type of fin has only one lobe inside which vertebral column extends up to the tip of tail. Dividing the latter into two equal parts. The lateral undulation of the whole body propels body forward. The fin maybe continuous with the dorsal fins.



2. PROTOHETEROCERCAL TAIL :

This type of tail is formed by the interruption of the continuous fold on dorsal and ventral side of the fish.

3. HETEROCERCAL TAIL :

This type of tail is found in Elasmobranches fishes in which fin has large dorsal lobe and a smaller ventral lobe. Ventral column extends into the upper lobe so that it can be moved sideways with force. This type of fin produces a lift force on the tail and keep the head down during swimming.



4. HOMOCERCAL TAIL :

A homocercal tail is a modified form of heterocercal tail. The fin is divided into two uniform sized lobe to increase its surface area, vertebral column extends up to the base of the fin and bends slightly upwards. The posterior end of the notochord becomes ossified into the Urostyle, that provides a rigid support to the dermotricha because the notochord is turned upwards.



E.g. Amia, Lepidosteus, Polypterus etc.

5. DIPHYCERCAL TAIL :

Diphycercal tail is that type of tail in which the vertebral column stops at the base of fin and fin itself has a single large uniform lobe that lashes side to sides.

E.g. Lung fishes and Latimeria, Chimaera, Protopterus etc.



6. ISOCERCAL TAIL :

In an isocercal tail the spine is drawn out into a long and straight rod like structure. The fin fold develops, both above and below the rod in the form of the marginal extensions of the tail and remains supported by the fin rays. The fin is similar to procercal type in structure but the vertebral column extends beyond the apex of the fin in a whip like shape. This type of tail suitable for swimming near bottom of the Sea.

E.g Homocephali, Anguilliformes, Notopteridae, Belennidae, Gymnarchidae, Macrusidae families member fishes.



7. GEPHYROCERCAL TAIL :

This type of tail is similar to isocercal tail but the fin are reduced to vestiges. The caudal lobe is truncated and bypurals in spines column are not found.

E.g. Fleasfer and Orthagoriscus etc.



8. HYPOCERCAL TAIL :

It is derived from heterocercal tail by blending of the hinder end of the notochord downwards. The dorsal lobe becomes larger tha the ventral lobe which is much reduced while swimming the head is naturally lifted up and the tail pulled down by hypocercal tail fin, facilitating the fish to swim upward in water and then jump out of the water to glide in air to considerable distance to escape predators.

E.g Flying fish, Latimeria etc.



ORIGIN OF PAIRED FINS :

The paired appendages of vertebrates are homologous to the paired fins of fishes there are some hypothesis are known to explain the origin of paired fins in fishes which are as follows-

1.GILL ARCH HYPOTHESIS :

The **Gagenbaur** suggested that paired fins are modified gill structures. The gill arch represents the girdle, branchial rays the fin rays and gill septa represents the fin fold. The gill arch of a gill supports the gill septum and bears the branchial rays. The posterior position of pelvic fins is explained by assuming a backward migration of the gill arch on the body but this theory was not accepted due to some demerits such as-

- **1.** The gill are internal in position while the fins are external.
- **2.** The pectoral girdle is connected to the head by the dermal elements and not by chondral elements as in fins.
- 3. The posterior position of pelvic fin is the greatest difficulty.
- **4.** The vestigial muscle buds in front of pelvic fin would also not support the backward migration in ancient Ganthostomes.
- **5.** This theory however remains silent to explain a common origin of essentially comparable median and paired fins resembles in structure and development.

2. FIN- FOLD HYPOTHESIS :

The fin-fold hypothesis proposed by **Batfour, Thacher and Mivart**. This theory supports by continuous fold of Amphioxus. The fin-fold of this animal along the dorsal, caudal and then upto the atriopore on the ventral side. At this point the fold diverge into a paired metapleural folds and extends anteriorly upto a short distance behind the mouth. It is proposed that both the median and paired fins are derived by interruption of this fold at many places. This theory was accepted by following facts-

1. It suggest a common origin for median and paired fins.

- 2. The presence of a row of spines between the pectoral and pelvic fins of Climatus he suggested their origin from continuous fold.
- **3.** The theory agrees with the embryological derivation of fin arising by the concentration of a series of Myotomic buds.





Fig. 42.18. Origin of appendages. A - Continuous fin-folds; B - Formation of permanent fine from continuous folds.



FIN FOLD THEORY OF THE ORIGIN OF PAIRED FINS

In the FIN FOLD THEORY, it is hypothesized that primitive fishes (probably gnathostomes) may have had a continuous, laterally directed stabilizing structure one each side of the body.

It is further hypothesized that the pectoral (fore) and pelvic (hind) fins were pieced out of these elongate, transsegmental structures.

3.FIN SPINE HYPOTHESIS :

According to this theory the idea of origin of paired fins goes back to Ostracoderms which are regarded as the ancesters of cyclostomes. It is assumed that in old fishes skin raised and extended between the spines, these spines latter elaborated into the endoskeleton framework to convert the fins into the locomotor devices.

In many acanthodians the pectoral and pelvic fins were members of a series of spiny appendages that extended the length of the trunk and were provided with fleshy webs. Loss of all appendages in the series but their persistence in the pectoral and pelvic region might well account for the origin of paired region fins from some Ostracoderms like ancestors.

References :

- 1. Anatomy and Physiology of Fishes by Dr Santosh Kumar and Dr Manju Tembhre
- A Text Book of Fish Biology and Fisheries by Dr S. S. Khanna and Prof. H. R. Singh
- 3. A Text Book of Fish Biology and Indian Fisheries By Dr Rahul P. Parihar.
- 4. Fish and Fisheries of India by V.G. Jhingran
- 5. Images from <u>www.Google.co.in</u>

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