

Types of scales

The term scale derives from the old French *escale*, meaning a shell pod or husk. Fish scales are formed of bone from the deeper, or dermal, skin layer. The morphology of a scale can be used to identify the species of fish it came from. Scales are the most widely used for determination of age and growth of fishes. Scales provide protection from the environment, from predators, parasites and other injuries, which can also provide effective camouflage through the use of reflection and colouration, as well as possible hydrodynamic advantages.

The scales of various kinds are the most complex derivatives of the fish integuments. They are derived from the mesenchymal cells of the dermis. Scales in modern forms are therefore thinner compared to their primitive forms. Scales differ among fish types. Scales of various kind fall into the following main types-

1. Cosmoid scales
2. Ganoid scales
3. Placoid scales
4. Cycloid scales
5. Ctenoid scales

Cosmoid scales

The cosmoid scales are regarded as direct descendents of bony plates of the primitive ostracoderms. These plates consisted of four layers. The cosmoid scales were built on a similar plan but differed only in that the dentine (here called cosmine) layer was present only in the exposed part of the scale. These scales were abundantly found in primitive members of Sarcopterygii, Crossopterygii and Dipnoi fishes or Lung fishes. The only living member with cosmoid scales is represented by the genus *Latimeria*. The scales are regarded as the precursor of the ganoid, placoid, cycloid and ctenoid scales.

Ganoid scales

These thick and somewhat rhomboidal scales fit closely together in diagonal rows to cover the entire body. These scales grow in size as the fish ages. Because of some differences in their structure they can be divided into two main types.

1. **Palaeoniscoid types-** This type differs from the cosmoid scales by the absence of a spongy bone layer and by the presence of laminations of enamel called ganoine in the outermost layer of the scales. The base of such is a lamellar bone pierced by vascular canals. Such scales were found on primitive and extinct Actinopterygians and on extant Chondrosteanes the *Polypterus*.

2. **Lepisosteoid type**- In these scales, both the spongy and the cosmine layers are entirely absent, so that the layer of ganoine lies directly upon the layer of isopedine. The bony base is a cellular and the canals though present are no longer vascular.

Placoid scales

Placoid scales (pointed, tooth-shaped) are the most primitive form of scales. The placoid scales or dermal denticles are characteristics of the cartilaginous fishes, sharks and rays (Example *Scoliodon*). Each scale has a disc-like basal plate embedded in the dermis and a spine projecting out through the dermis. In structures, a placoid scale resembles a tooth. The spine has an external covering of enamel-like, hard, transparent material called vitrodentine. This is followed by a layer of dentine enclosing a pulp cavity from which several branching dentinal tubules radiate in different directions. The centre of the basal plate is perforated by an aperture to provide entrance to the blood vessels and nerves from the dermis. The scales are closely set but do not overlap each other. These scales do not grow in size as the fish size increases. Instead, more scales are added.

Cycloid scales

The cycloid scales are known as the bony ridge scales. Cycloid scales are large, thin, and round or oval in shape, and they exhibit growth rings. It is present in majority of the teleostean fishes and is thin, flexible, transparent structures due to the absence of the first and the middle layers of other types. The cycloid scales are similar to ctenoid scales in all respect except they are circular in outline, have concentric lines of growth and are loosely seated in dermal pockets of animals. These scales grow in size as the fish ages.

The cycloid scales are thin and roughly rounded in the shape, being thicker in the centre and thinning out towards the margin. They are found in a large number of teleostean fishes having soft rayed fins as *Labeo rohita* (Rohu), *Labeo calbasu* (Karoohi), *Catla catla* (Catla/Bhakur), *Cirrhinus mrigala* (Mrigal or Nain), *Cyprinus carpio* (Common carp or China Rohu), *Oreochromis niloticus* (Nile Tilapia) etc. They form a protective covering over the skin and project diagonally in an imbricating pattern. The part of the scale which is exposed to view in situ condition (posterior area) generally shows less distinct ridges or circuli and chromatophores are also sometimes attached to it. The anterior area lies embedded in the skin.

Ctenoid scales

Ctenoid scales are the most advanced of all the scale forms. These are derived from cycloid scales and are confined to spiny-rayed teleosts. The ctenoid scales are also circular and can be distinguished from the cycloid scale by having a more or less serrated free edge. Moreover, several spines are present on the surface of the posterior area of the scales. The ctenoid scales are found in a large number of fishes with spiny rayed fins. All intermediate types between the cycloid and ctenoid scales are found on different parts of the body. These scales grow in size as the fish ages.

The cycloid and ctenoid scales develop in the form of a dermal papilla formed by the multiplication of cells. The epidermis does not take part in the formation of these scales, which appear at an average body length between 12.50 mm. The scales are generally formed first at the dorsal peduncle and then spread to the rest part of the body. The papilla first secretes the central part of the scale or focus or nucleus and then the ridges are deposited on the growing scale.

While different kinds of fish have developed different types of scales, each type allows the fish to function well in its environment. The more primitive scales allow for more protection than the advanced scale forms. Advanced fish use the increased speed allowed by their thinner scales to avoid harm, possibly avoiding capture by the tougher but slower primitive fish.

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