POLITEKNIK MALAYSIA

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DO YOU REALLY KNOW ABOUT FISH?

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DO YOU REALLY KNOW ABOUT FISH?

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PREFACE

The highest gratitude is extended to the Almighty for our permission and opportunity to complete this e-Book: Do You Really Know About Fish.

This e-Book is published as reference material for students and lecturers, especially those involved in the field of aquaculture.

No words can be uttered to express our gratitude to all those involved in the making of this book especially the family, colleagues, and the secretariat who tirelessly give guidance and trust.

Hopefully, this e-Book will benefit the reader no matter where it is accessed.

THANK YOU

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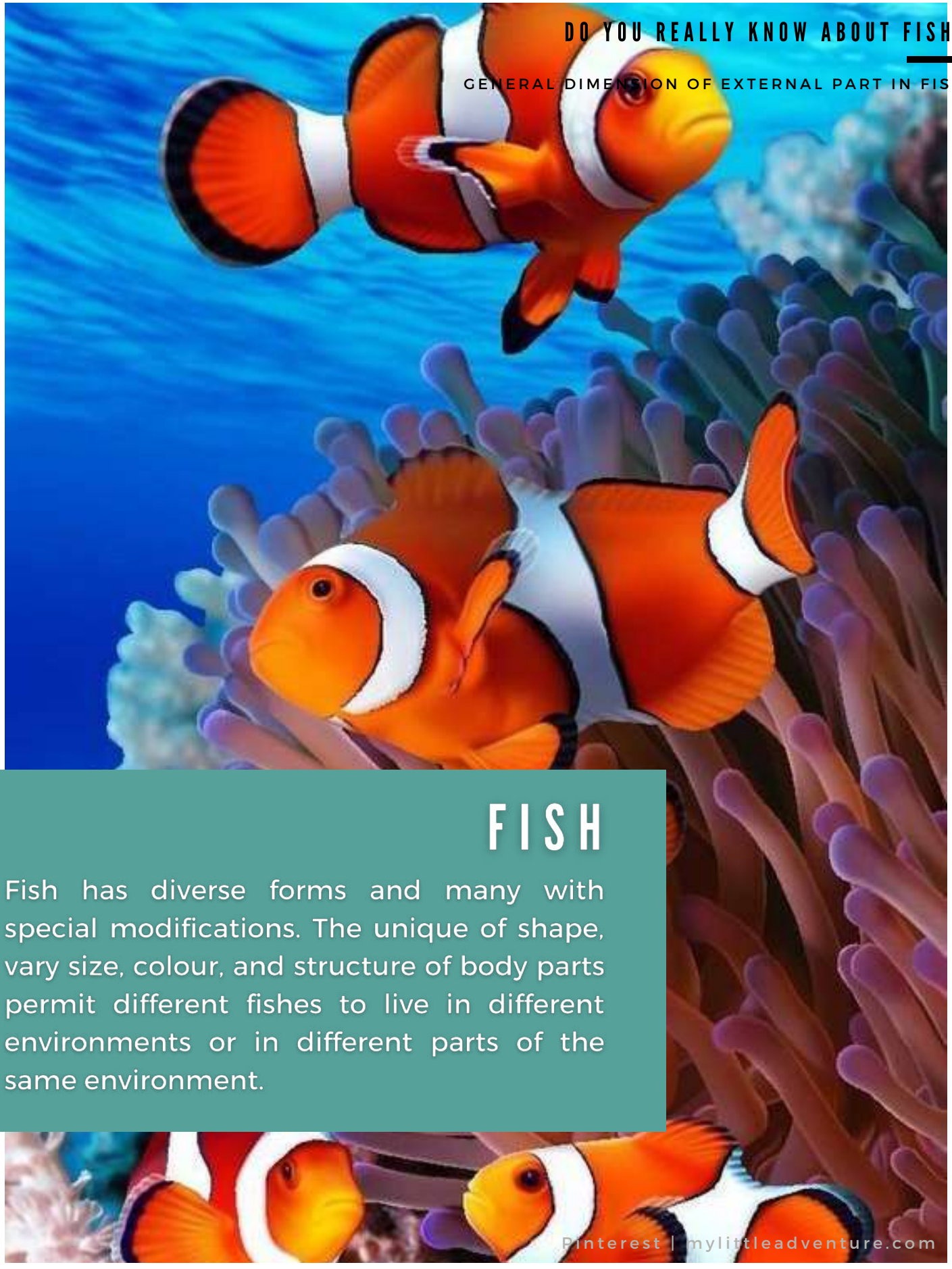


FISH

Fish has diverse forms and many with special modifications. The unique of shape, vary size, colour, and structure of body parts permit different fishes to live in different environments or in different parts of the same environment.

Pinterest | mylittleadventure.com

Pinterest | photo by m.imgur.com

GENERAL DIMENSION

EXTERNAL PART OF FISH

The external anatomy of a fish can reveal a great deal about where and how it lives. Anatomy is the study of an organism's structures. When describing the basic anatomy of an organism, it is useful and helpful to have some common terms with orientation cum dimension.

Pinterest | photo by gdaquarium.nl

General dimension is anatomical positions that are used to give an idea of where on the body a feature can be located. In simple way to comprehend this is just like using a map of determining north, south, east and west direction or orientation. Table below 1.1 defines common anatomy terms, Figure 1.1 shows the anatomical position of Tilapia fish, Oreochromis species while Figure 1.2 shows the orientation on three different animals.

Table 1.1 Common anatomy terms.

Anterior	front end / head end (used to say something is closer to the head)
Posterior	back end / tail end (used to say something is closer to the tail)
Dorsal	upper surface
Ventral	lower (belly) or bottom surface
Lateral	side of the body
Median	centre / middle of body

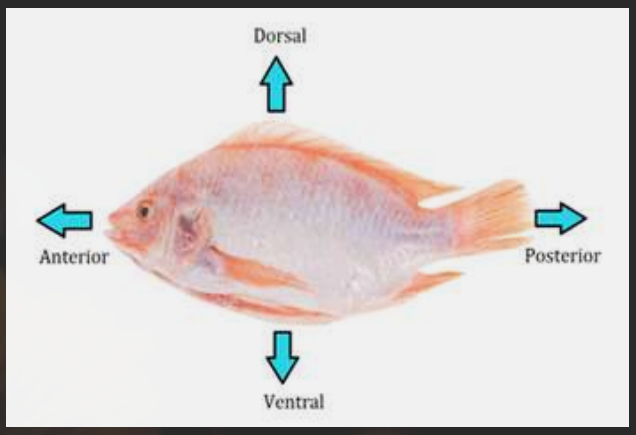


Figure 1.1 Anatomical position of Tilapia fish

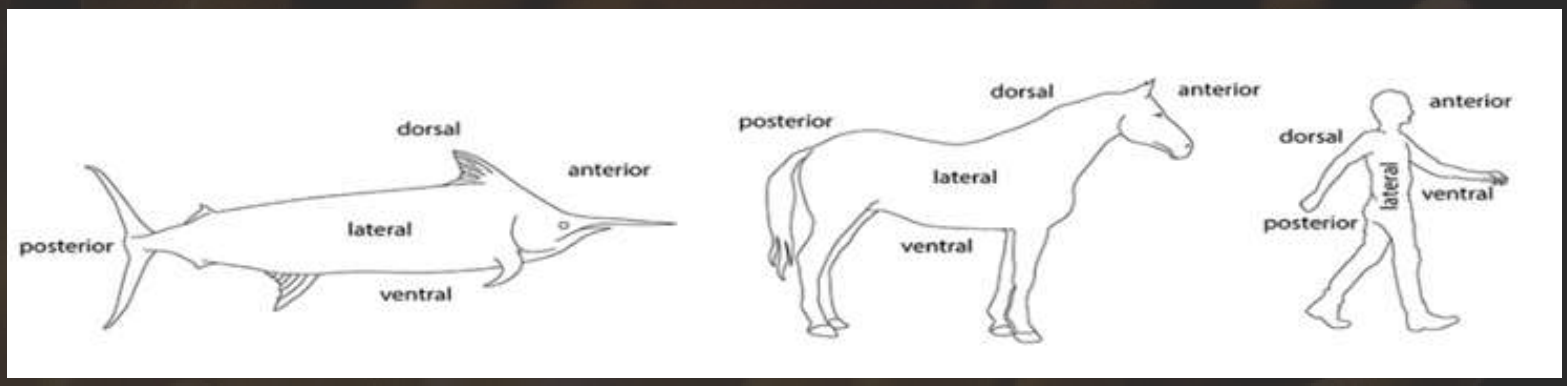


Figure 1.2 Common dimension terms applied to a billfish, a horse and a human.

Source: www.silverafood.com | 12 July 2021 | Byron Inouye, https://manoa.hawaii.edu | 12 July 2021 | Pinterest | photo by i pereira

Hammerhead Shark | Pinterest by mnn.com

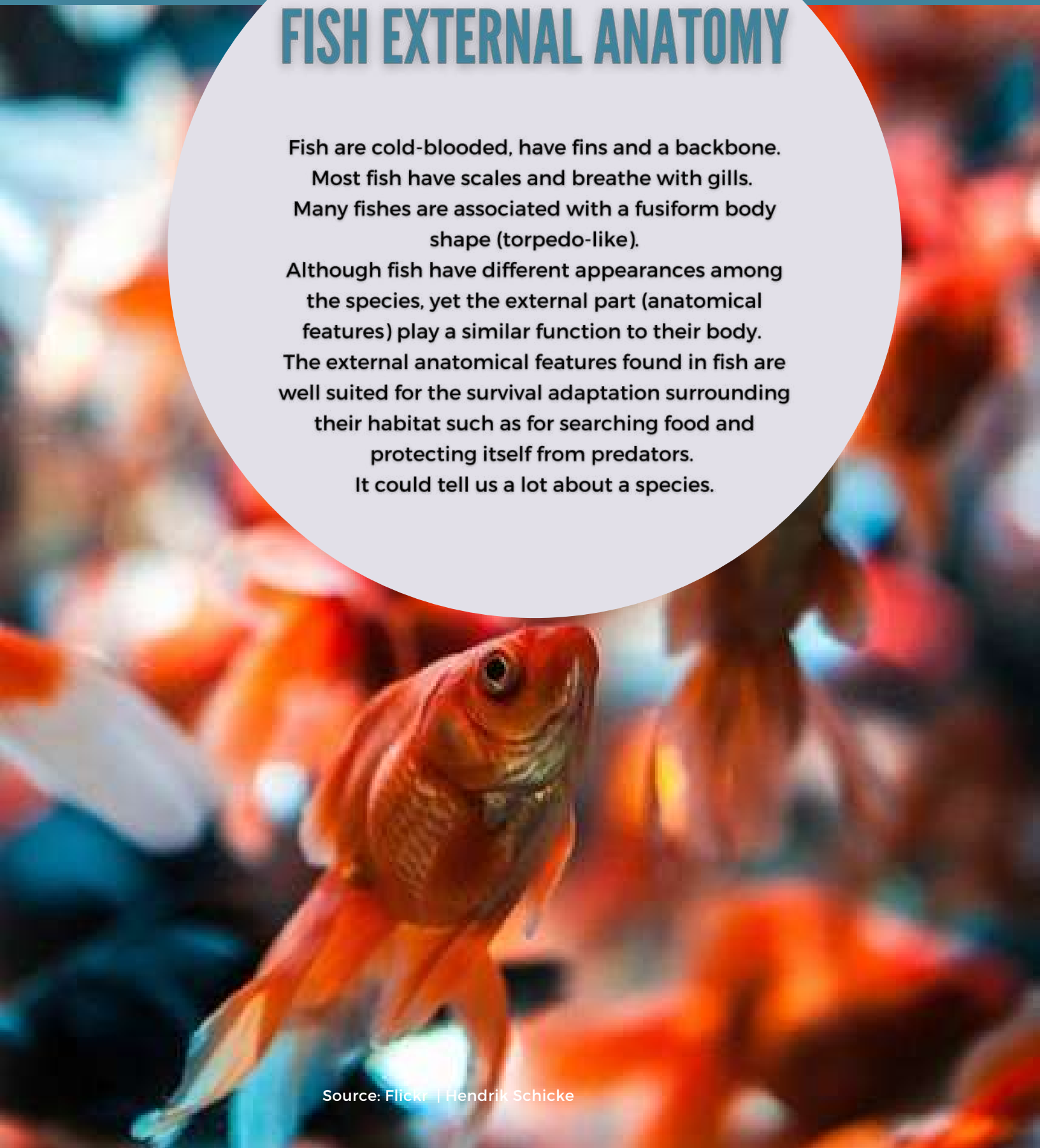
The Attractive View of Fish Species

each picture of view give different value of satisfaction and joy

Source: Pinterest by spotmydive.com | divephotoguide.com | wattpad.com | mnn.com

FISH EXTERNAL ANATOMY

Fish are cold-blooded, have fins and a backbone. Most fish have scales and breathe with gills. Many fishes are associated with a fusiform body shape (torpedo-like).
Although fish have different appearances among the species, yet the external part (anatomical features) play a similar function to their body. The external anatomical features found in fish are well suited for the survival adaptation surrounding their habitat such as for searching food and protecting itself from predators.
It could tell us a lot about a species.



Source: Flickr | Hendrik Schicke

The bass of Figure 2.2 below is an example of bony fish which has a fusiform body shape. Common external part of fish include: dorsal fin, anal fin, caudal fin, pectoral fins, pelvic fins, caudal peduncle, eyes, lateral line, nostril, mouth, scales, and opercle.

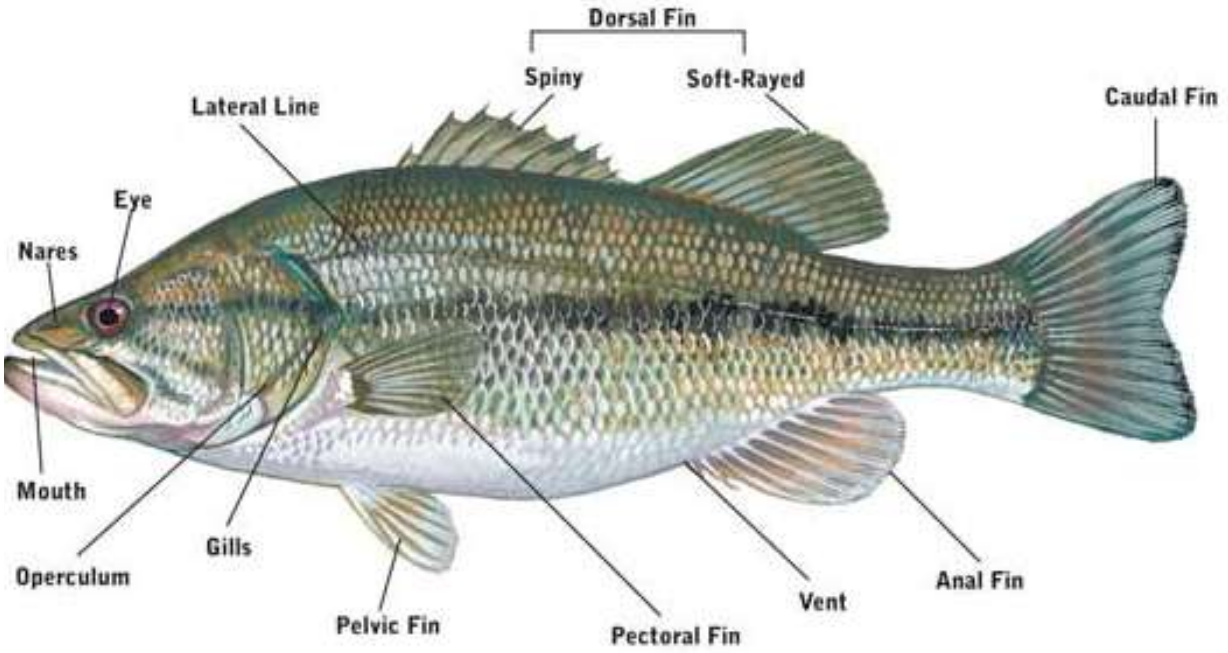
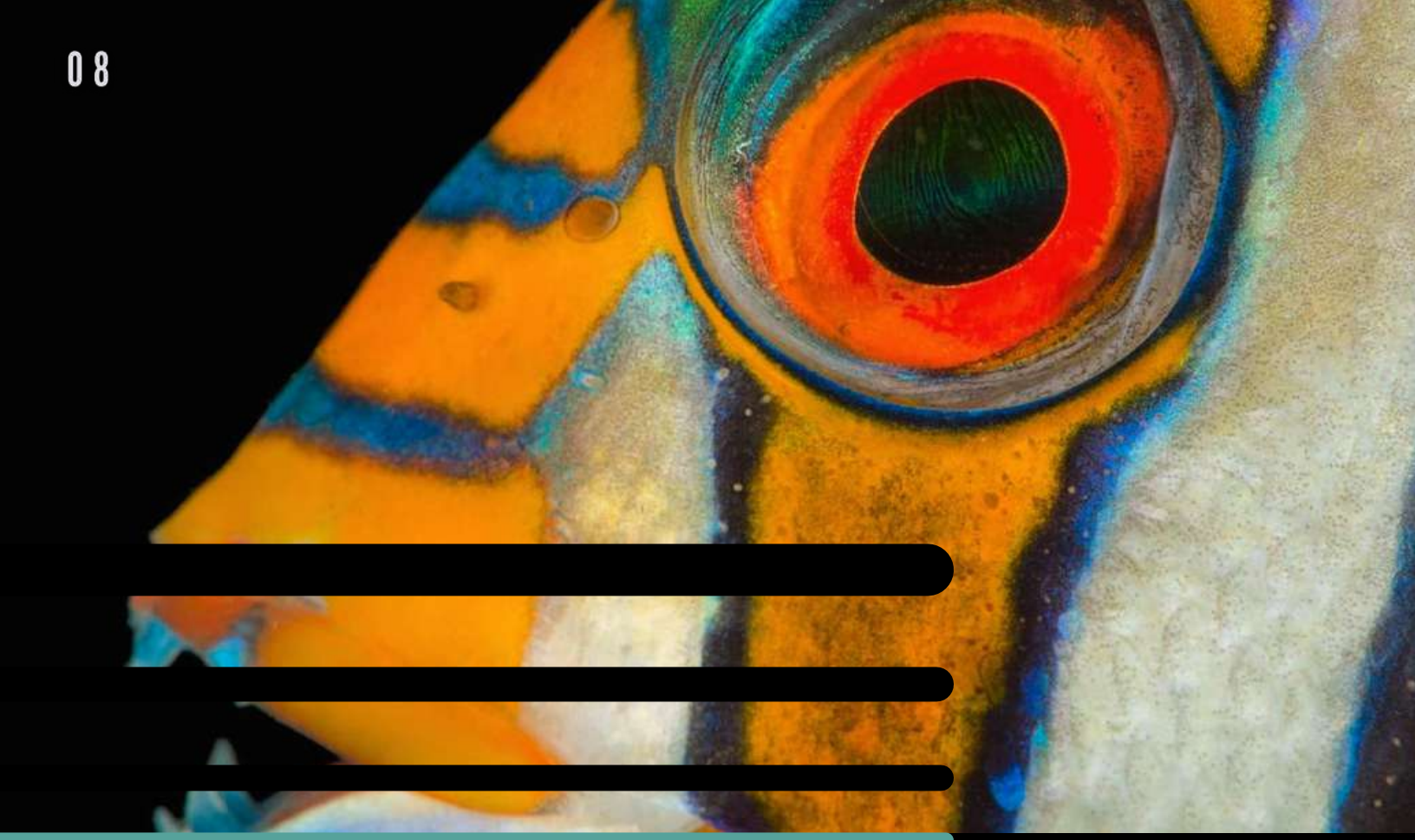


Figure 2.2 Bony fish anatomy

Source : SCDNR, https://www.dnr.sc.gov



Eye

Fish eyes vary in placement. According to the Florida Fish and Wildlife Conservation Commission, the fish eyes are rounder in fish than mammals because of the refractive index of water and focus is achieved by moving the lens in and out, not reshaping the lens as in mammals.

Based on New York State, Department of Environmental Conservation (2021) almost all fish have eyes that have an adjustable lens that moves back and forth to focus, sort of like a camera lens would function.

Fish usually have one eye on each side of the head to help them focus and zero in on prey. Eyes can warn when a predator is near, or can detect the slightest movement of small prey. Some fish can even see in color. Studies have found that Pacific salmon and rainbow trout have color vision that is similar to a human's.

Source: [illegible]

Pinterest | by Mojgan Mont

Mouth

Fish mouths have a variety of sizes, shapes, and orientations, hence it gives a good clue to what fish eat and their behaviour as well. The larger it is, the bigger the prey it can consume. Fish have a sense of taste and may sample items to taste them before swallowing if they are not obvious prey items (Florida Fish and Wildlife Conservation Commission, accessed on 18 July 2021).

Fish mouth |Earthlife.com (27 July 2021)

Snout

It is the elongated part at the mouth area of the fish that includes rostrum, beak or nose.

Rolfosteus, long-snouted fish |Source from dkfindout.com

Nostril

The nostril are located on the snout near to the fish mouth. The nostril of the bony fish are most dorsally while the shark and skates are ventrally. Paired nostrils or nares in fish are quite sensitive, it is function to detect odors in water. The species of eel and catfish have particularly well developed senses of smell. It is not for breathing purpose because it do not communicate to the fish mouth.

Fish nostril| Twitter photo from Nathalie Jurisch-Yaksi

www.anglingtimes.co.uk (Accessed on 1 August 2021)

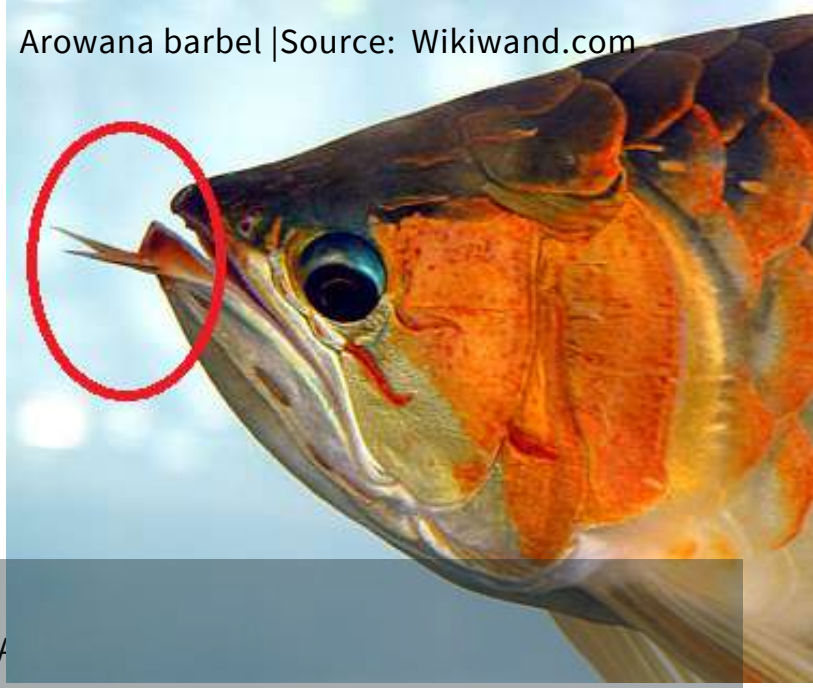
Gill Cover

The gills are the breathing organ that fish use to obtain oxygen from the water . Gill cover or operculum is a flexible bony plate that covers and protects the sensitive gills. Water enters through the mouth, passes over the gills and exits through the operculum.

badangling.com (Accessed on 1 August 2021)

Sea trout | Spey Fishery Board 2019

Catfish barbel |Source: Thesprucepet.com



Arowana barbel |Source: Wikiwand.com

Barbel

As stated from leisurepro.com, barbels are a whisker like organ found near the mouth of certain fish. These organs are sensory organs that help the fish locate food in murky waters, acting as taste buds or nostrils. Most fish possessing barbells are bottom dwelling fish such as catfish, carp, goatfish and some sharks, that primarily hunt, or scavenge for food in murkier waters, such as sea beds, or lakes. Barbels may be vary located on the head of a fish.

Pimelodus pictus |Source: Aquafood.co.uk

Caudal fin | Flickr Photo by Paul Vecsei

Grass carp anal fin | Flickr Photo by Ryan Hagerty

Pectoral fin of Sea robin | Pinterest photo by Garth McGlasson

GENERAL DIMENSION OF EXTERNAL PART IN FISH

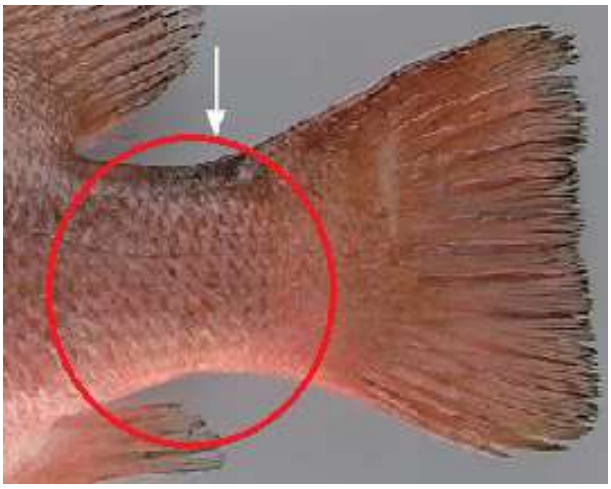
Fin

Fins are flap-like structures that are involved in fish movement to maintain its position, move, steer and brake. It consists of hard ray, soft ray and spine.

Fins that are supported by spines are rigid and quite sharp. It plays a protective part, and is found in many freshwater fish species. They are neither single fins such as the dorsal fins, caudal fin and anal fin, nor paired fins, which include the pectoral and pelvic fins.

Dorsal fins. : a median fin along the back; there may be two or more dorsal fins, in which case the most anterior one is designated the first.
Pectoral fins. paired fins on the sides behind the gill cover. It has adapted to something more like arms.
Pelvic fins. One or more fins located on the bottom of the fish when seen in profile.
Anal fin. the median, unpaired, ventrally located fin that lies behind the anus, usually on the posterior half of the fish.
Caudal fin, often called the tail fin, provides the main power for forward movement in fish.
(Tesfamichael, A. et.al., 2019)
More interesting details about fins will be discussed in the next chapter.

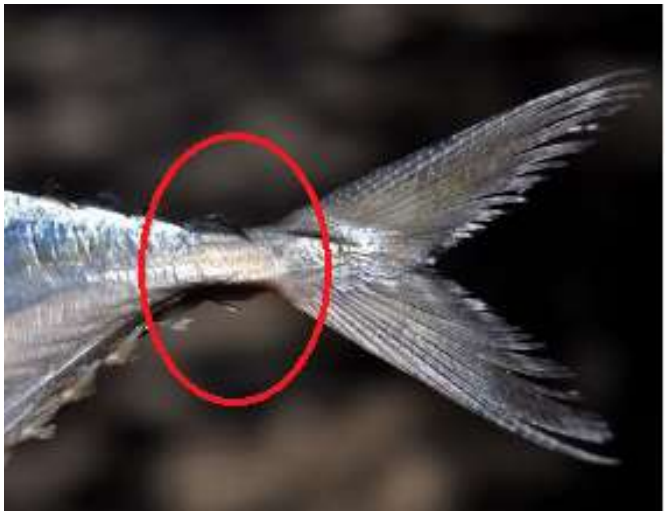
Caudal peduncle



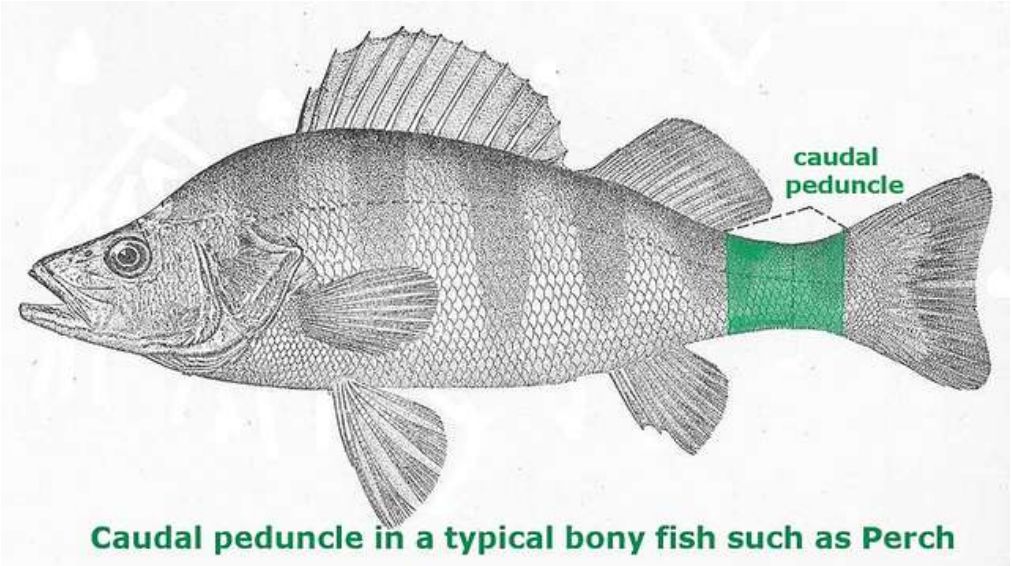
Caudal peduncle of Lutjanus malabaricus (Kim et al.,2012)

Caudal peduncle, in fish, the posterior part of the body between the rear parts of the dorsal and anal fins, and the caudal fin (Tesfamichael, A. et.al., 2019).

The caudal peduncle is the tapered region behind the dorsal and anal fins where the caudal fin attaches to the body. The depth of the caudal peduncle, which is measured at its narrowest point, gives some indication of the power of a fish and the speed at which it can swim. For example, ambush predators, like barracudas or gars, have a caudal peduncle that is not much narrower than their torpedo-shaped bodies. They can lie-in-wait and then give a few powerful thrusts of their tail to surprise a prey fish. Other very fast swimming, powerful fish, like tunas and mackerels, have a very narrow caudal peduncle. They can even have keels, like those on a boat, to help support and stabilize the caudal fin and make swimming far and fast more efficient. (Abby, 2014)



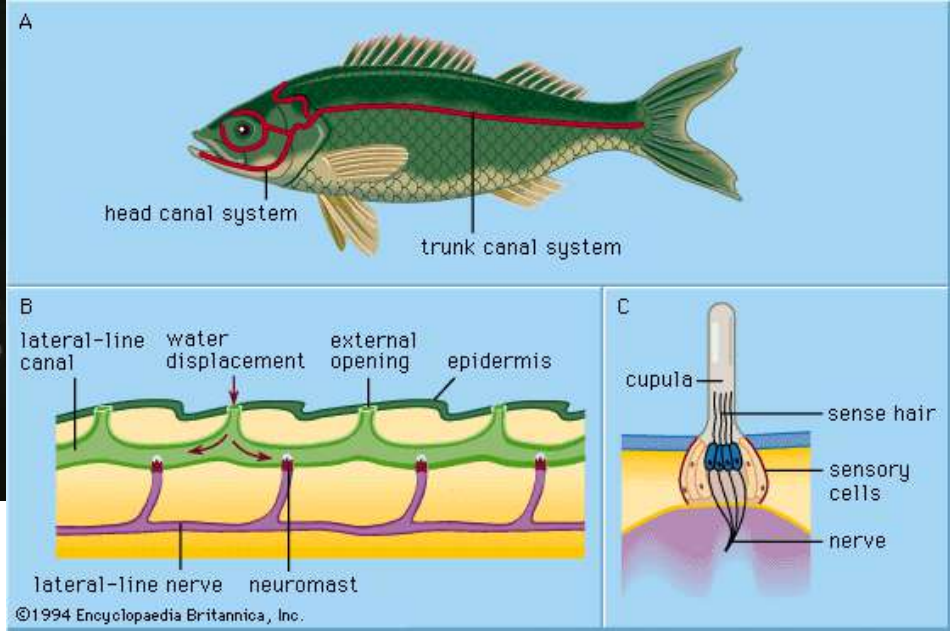
Narrow caudal peduncle of fast swimmers fish (Abby,2014)



Wikimedia.commons (Accessed on 26 July 2021)

Earthlife.net (Accessed on 27 July 2021)

Lateral line

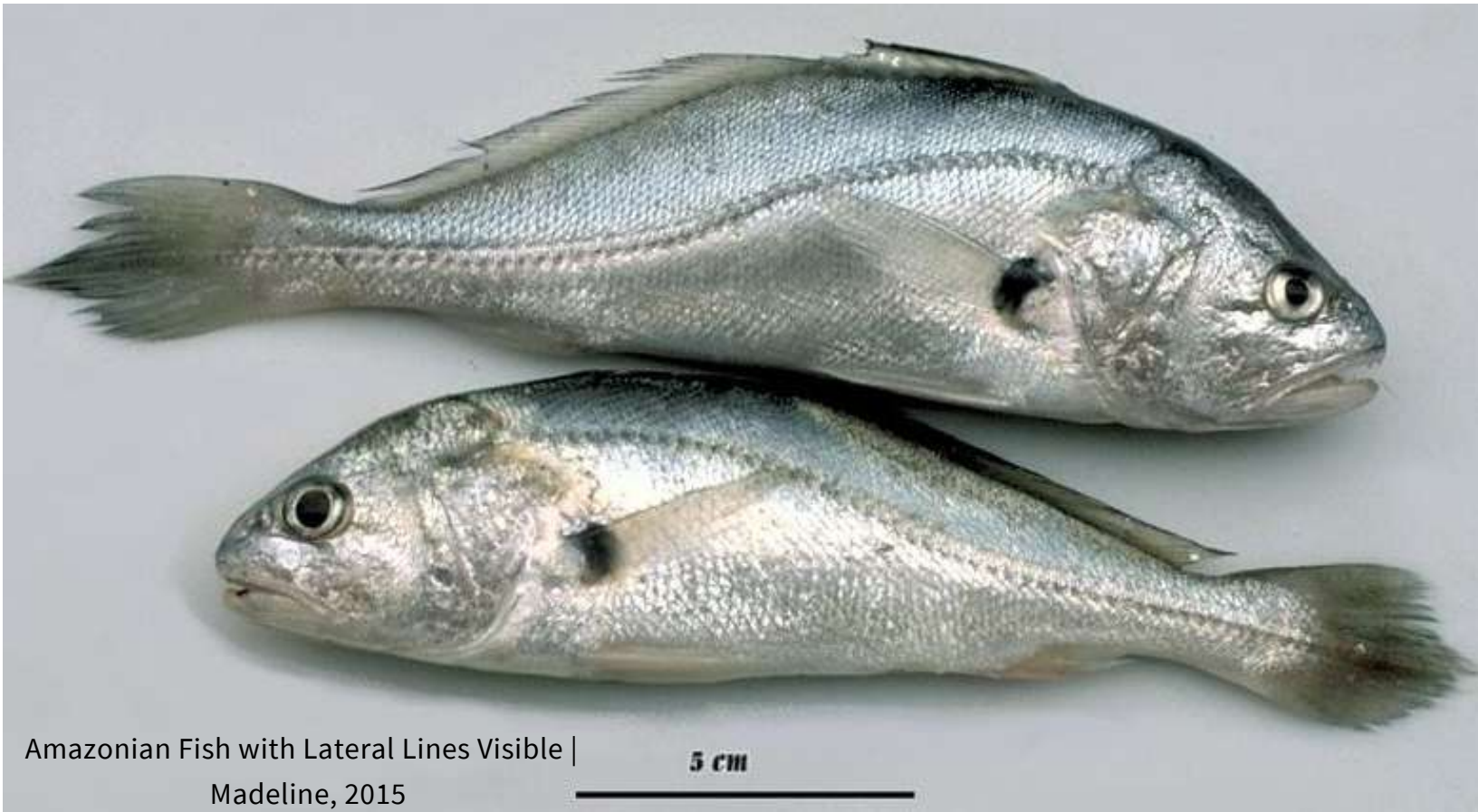


Lateral line system

Source: Sanibelseaschool.org (Accessed on 26 July 2021)

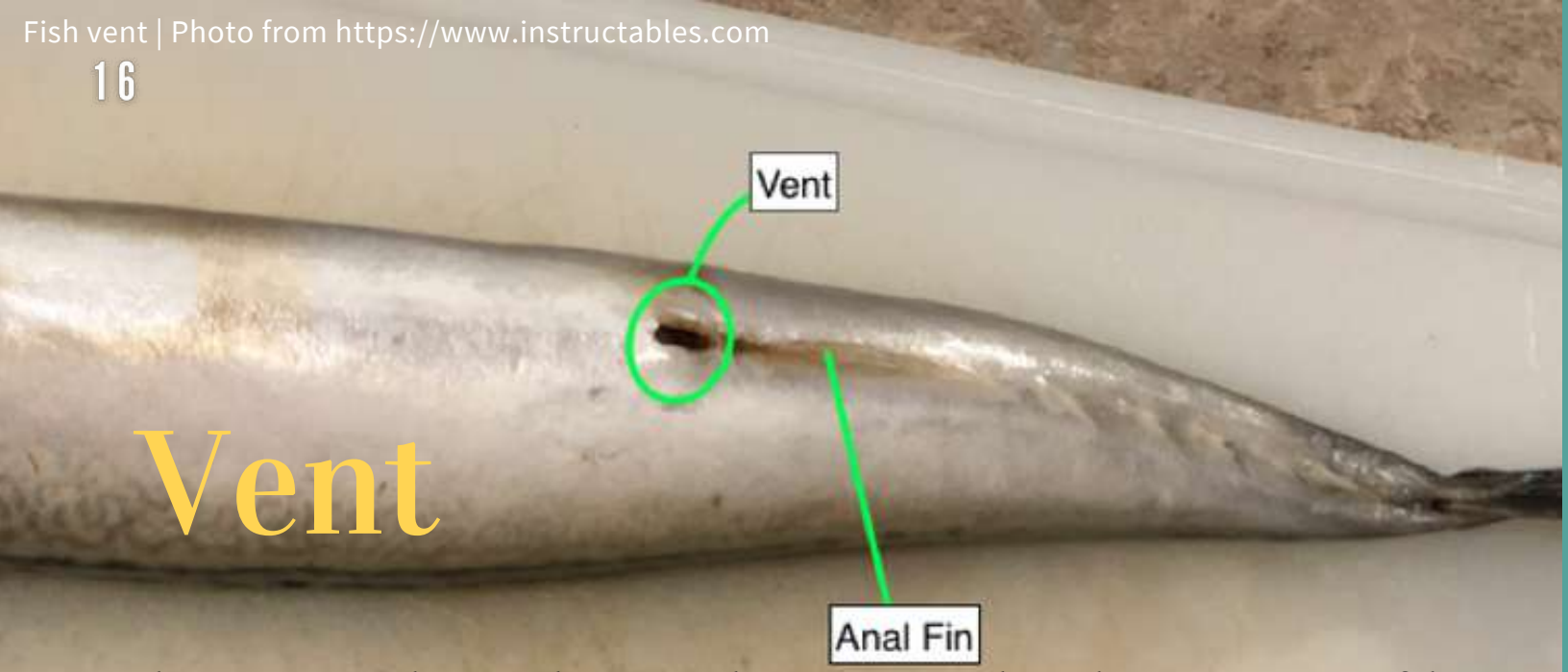
It is a series of sensory cells usually situated at the side along the length of the fish body. It is the organ of mechanosensory which consist of neuromast, a sensory cell with a hair-like. However, the nerves help the fish detect low frequency vibration or motion in the water and other environmental conditions.

In most species, it consists of a line of receptors running along each side of the fish. It can be continuous or broken. In some fish families like cichlids it is broken, the two parts of lateral line are separated and may not be in a single line (Sandeep Raghuvanshi, 2015).



Amazonian Fish with Lateral Lines Visible | Madeline, 2015

Fish vent | Photo from https://www.instructables.com



Vent

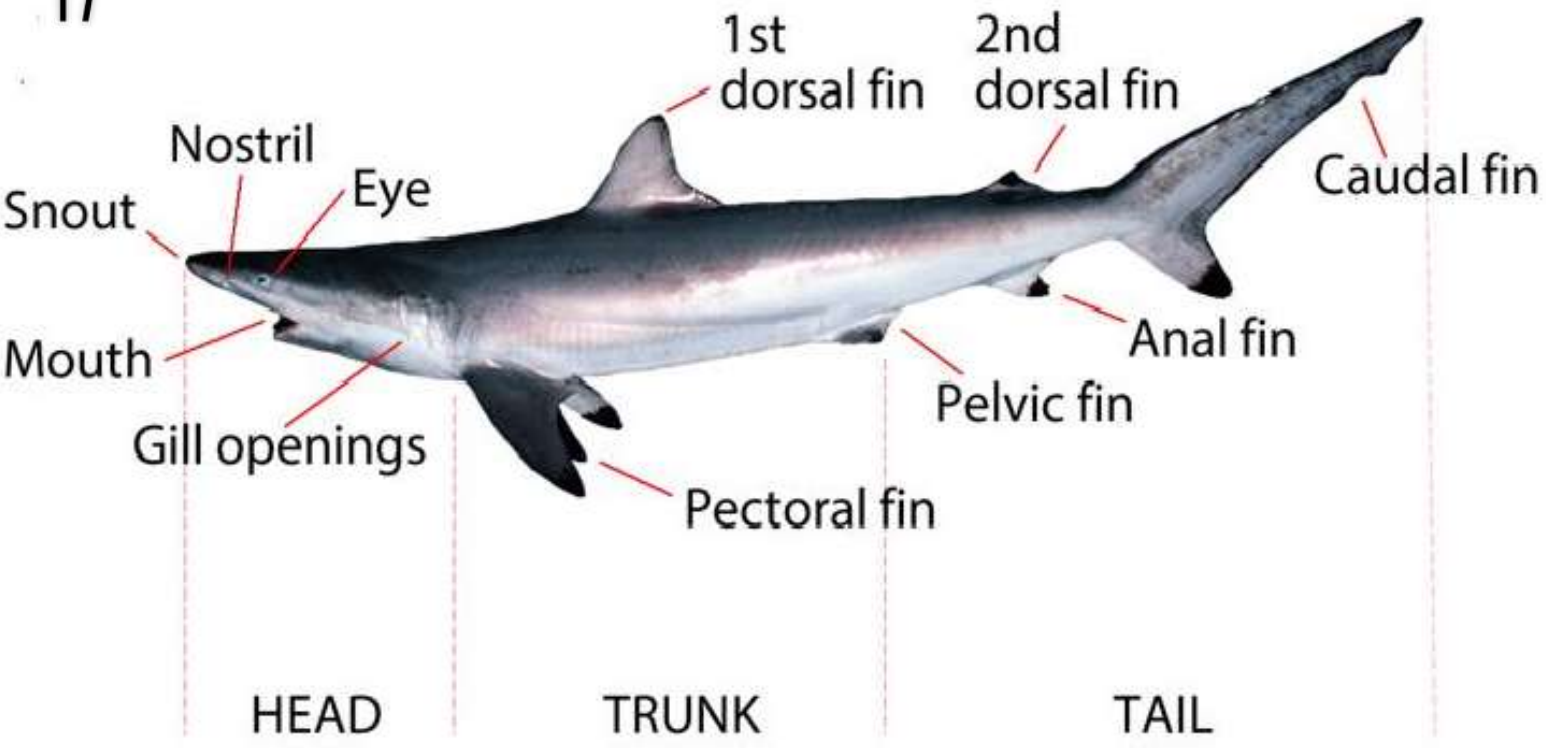
The vent or anus is the external opening to digestive urinary and reproductive tracts. In most fish, it is located immediately in front of the anal fin (Florida Fish and Wildlife Conservation Commission, accessed on 18 July 2021).

Fish scale | Pinterest photo from pixgallery.com

Scale

Most species of bony fishes are covered with a layer of bony plates structure called scales. There are five types of bony fish scales: placoid, cosmoid, ganoid, cycloid, and ctenoid. Most of bony fishes have ctenoid and cycloid scales. Some bony fishes may have scales only on portions of their body, and some species have no scales such as catfish species.

Scales roles as assist the fish in swimming and reduced water friction and resistance. Apart of that, it is a protective layer that can support the body structure and give colour to the fish.



Shark anatomy

Source : Vims.edu (Accessed on 27 July 2021)

Gill slit

Gill slits. According to wikipedia , Gill slits are individual openings to gills, for example multiple gill arches, which lack a single outer cover. Such gills are characteristic of cartilaginous fish such as sharks and rays, as well as deep-branching vertebrates such as lampreys. In contrast, bony fishes have a single outer bony gill covering called an operculum.

Shark | Pinterest Photo Courtesy: IUCN / Jeremy Stafford-Deits

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ADIPOSE FIN

The adipose fin is a soft, fleshy fin found on the back behind the dorsal fin and just forward of the caudal fin. It is absent in many fish families, but is found in Salmonidae, characins and catfishes.

The function of adipose fin is not clearly understood, however it has a network of nerves, so might be used as a sense organ (Sandeep Raghuvanshi, 2015).

Trout adipose fin | Flickr Photo by jksnijders

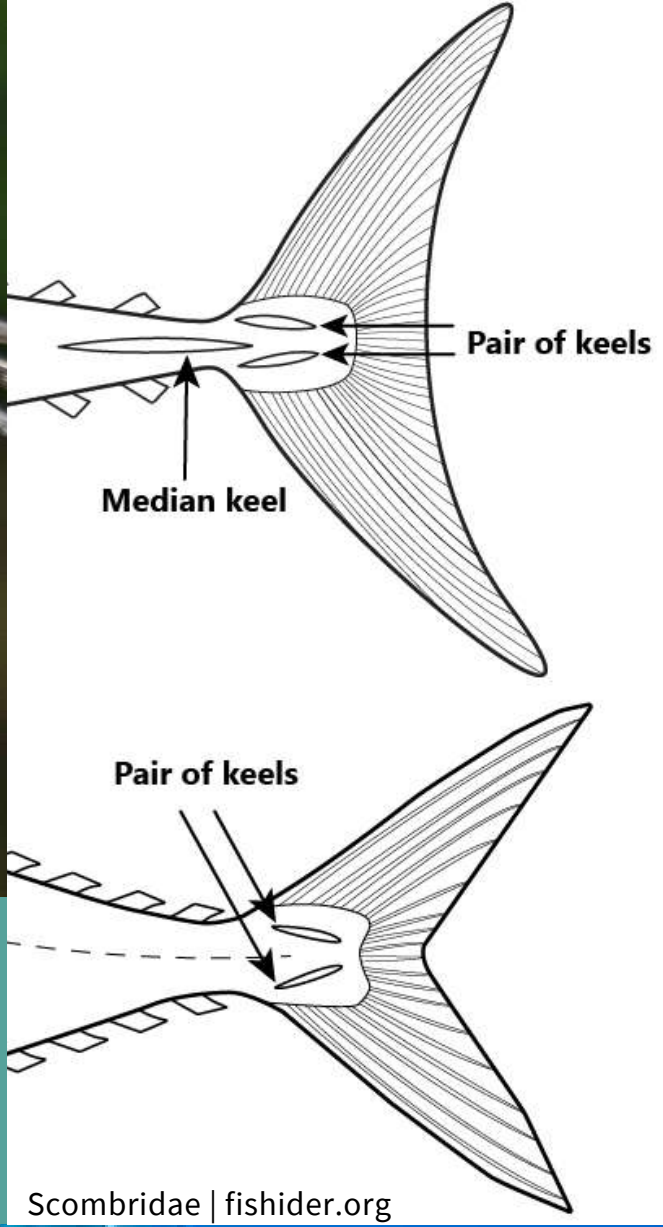
The soft and fleshy adipose fin | Pinterest Photo by hootsuite.com

Leopard Corydoras (Corydoras Trilineatus) | www.aquadiction.world

Tail of a Scombrid fish | wiktionary.org

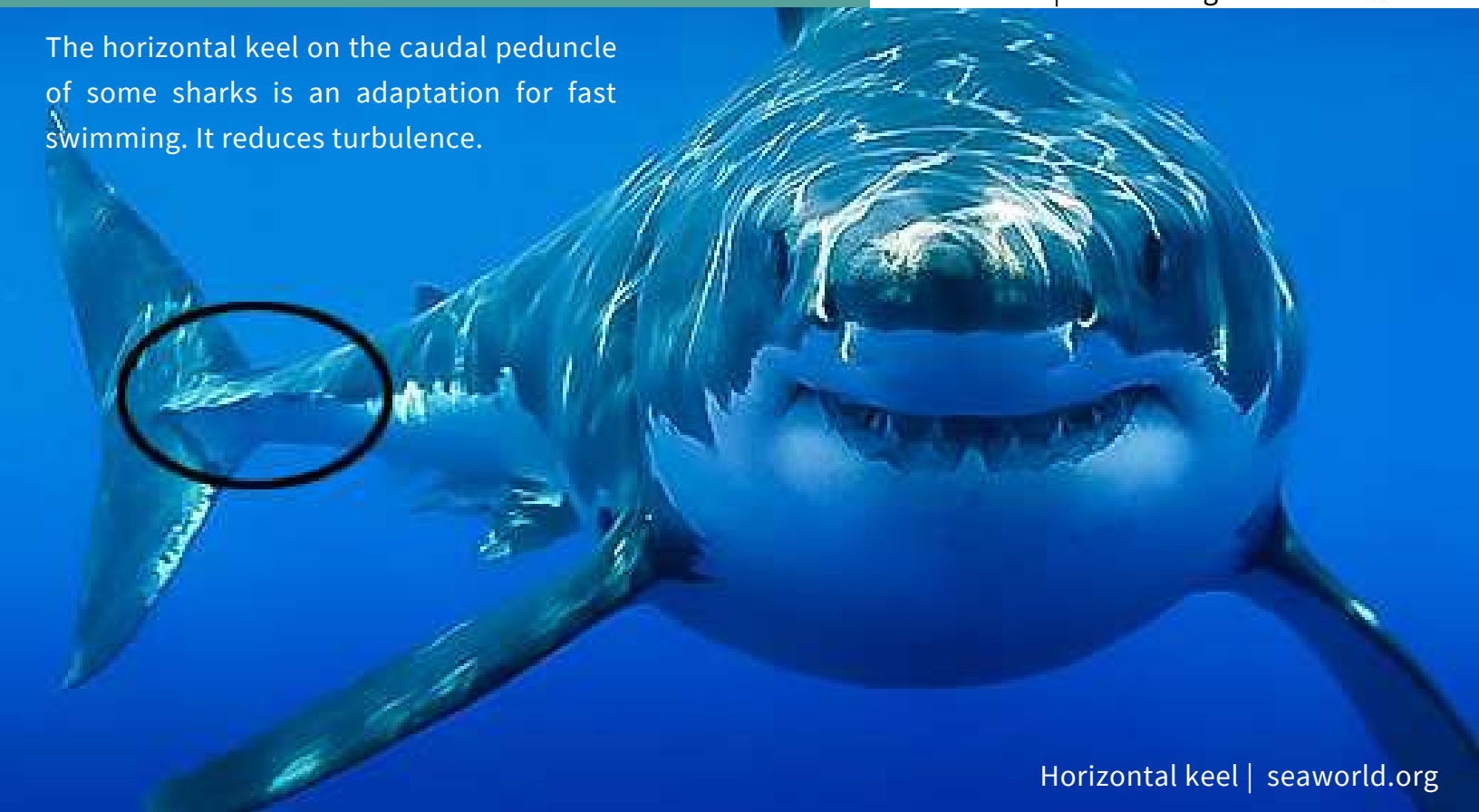
KEEL

A lateral ridge found just anterior to each side of the tail fin on the caudal peduncle of some types of fast-swimming fish. The keels improve the stability of the fish's attitude at speed in the water, and strengthen the support of the caudal fin (Wicktionary,2021).

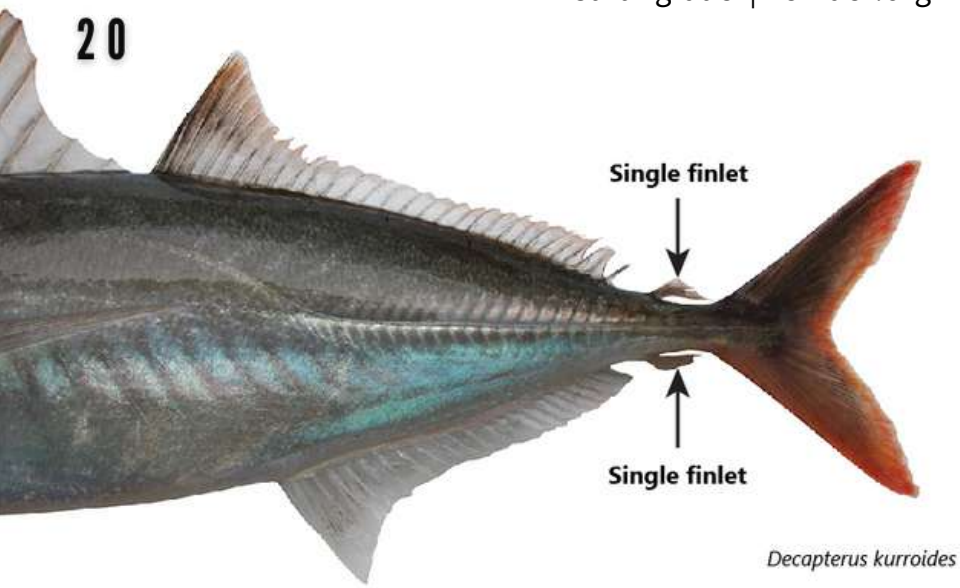


Scombridae | fishider.org

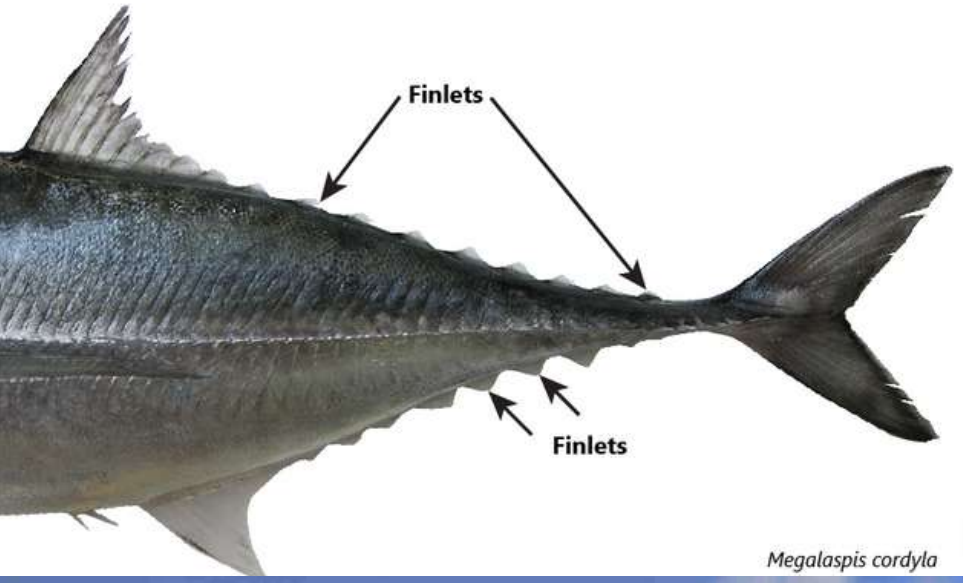
The horizontal keel on the caudal peduncle of some sharks is an adaptation for fast swimming. It reduces turbulence.



Horizontal keel | seaworld.org



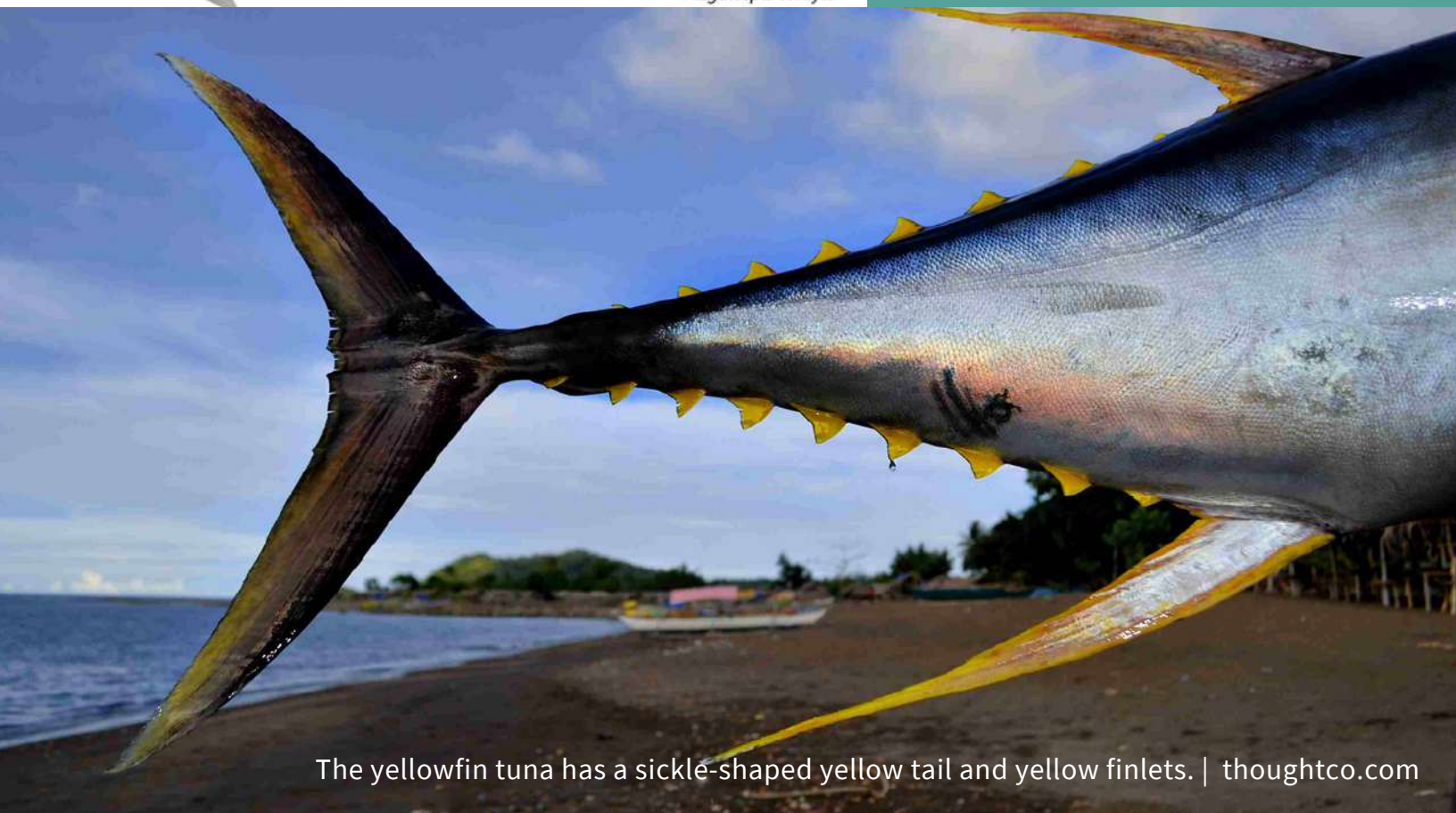
Decapterus kurroides



Megalaspis cordyla

FINLET

Small non-retractable fins, generally on the caudal peduncle between the last dorsal or anal fin and the caudal fin of some fishes. In some groups, such as tuna, finlets are rayless (FAO,2019). These finlets are found on fast swimming fish like tuna, and is said to aid in the speed of the fish, by cutting through the water.



The yellowfin tuna has a sickle-shaped yellow tail and yellow finlets. | thoughtco.com

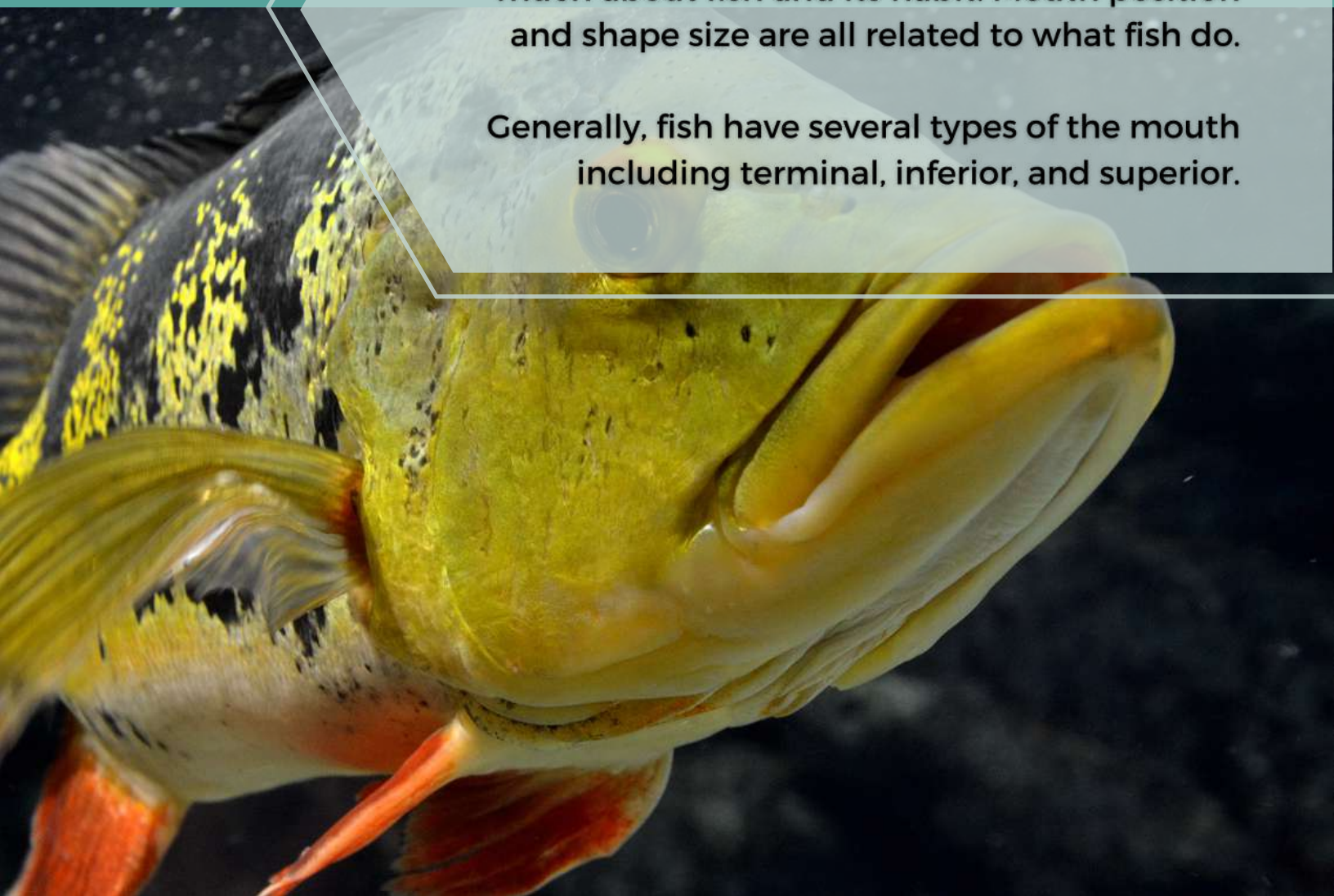
FISH MOUTH TYPES

Have you ever wondered what the types of mouth that fish have?

The mouth is one of the most important parts of the body for survival where food intake occurs.

Studying fish mouths is crucial in revealing much about fish and its habit. Mouth position and shape size are all related to what fish do.

Generally, fish have several types of the mouth including terminal, inferior, and superior.



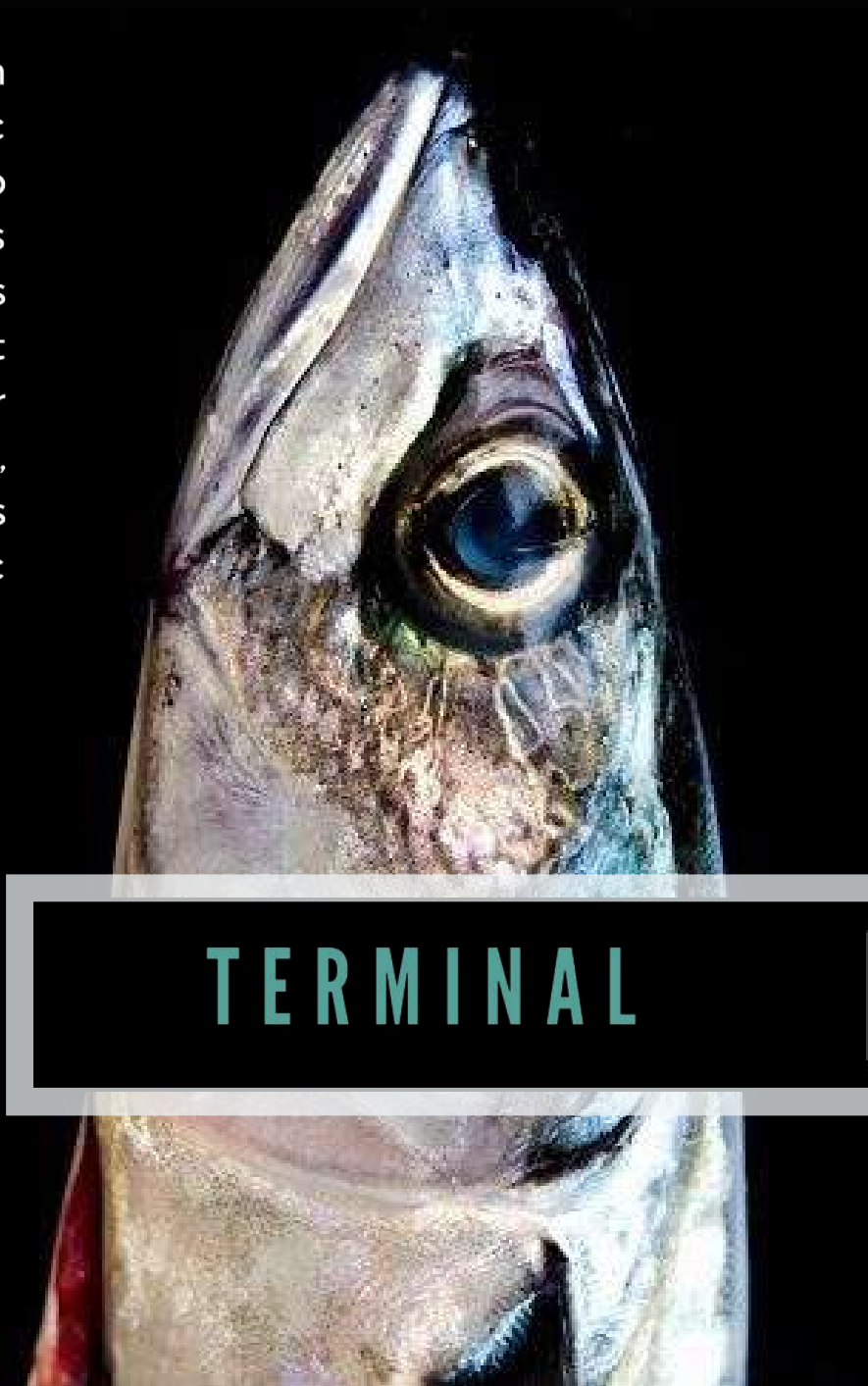
DO YOU REALLY KNOW ABOUT FISH?

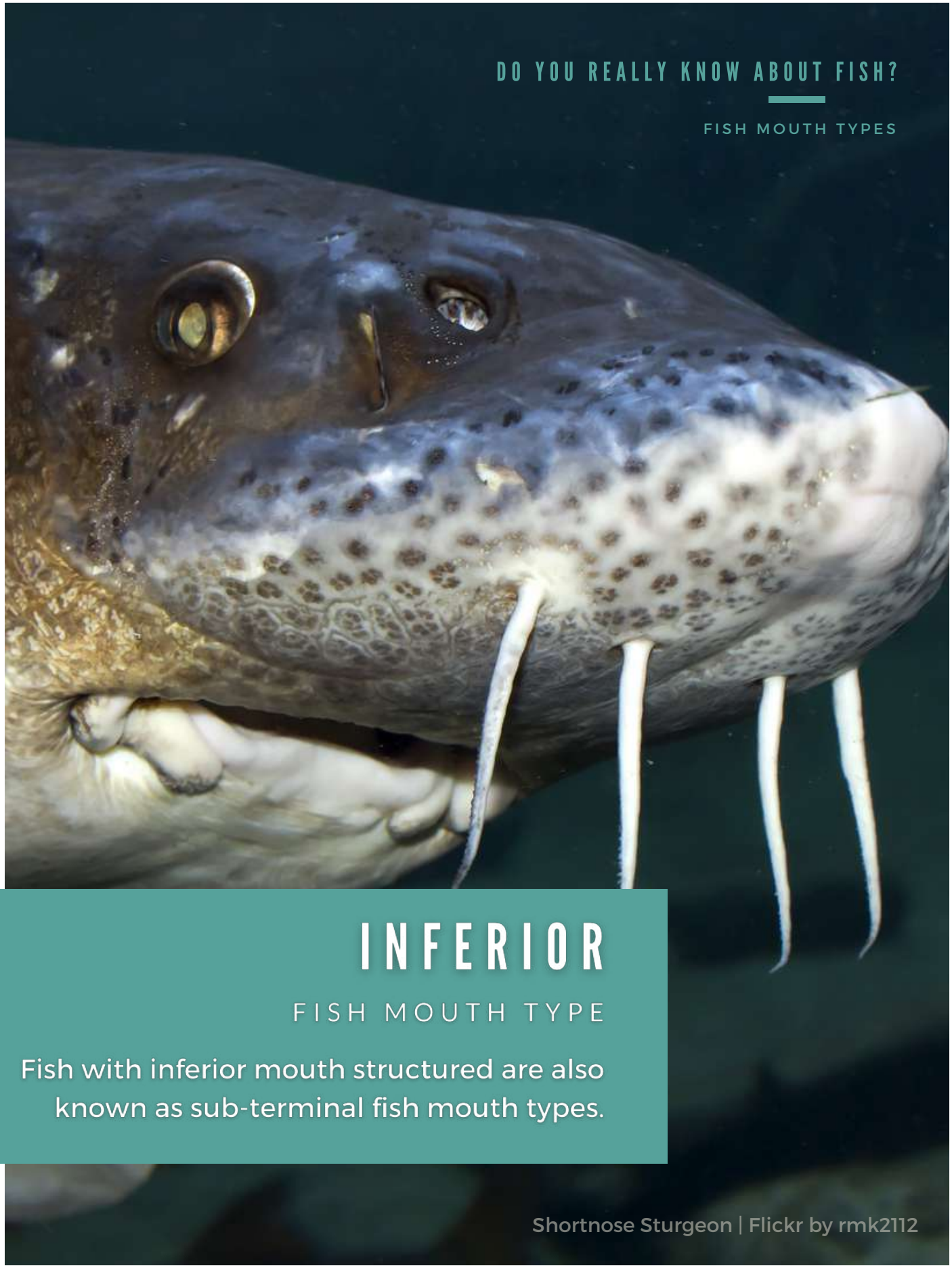
FISH MOUTH TYPES

Most fish are categorized as terminal mouth type, where the mouth is located at the end of snout with both jaws the same length.

The terminal mouth fish species are generally pelagic water feeders. They are also known as omnivorous fishes when eating anything that is available [4]. Their diet primarily consists of other fish along with some squids, the occasional crustacean as well as algae and aquatic plants.

Tunas, mackerels, tetras, and barbs are examples of fish species with terminal mouth types.





INFERIOR

FISH MOUTH TYPE

Fish with inferior mouth structured are also known as sub-terminal fish mouth types.

Shortnose Sturgeon | Flickr by rmk2112

INFERIOR mouth

structure is located at the ventral part of the head where the lower jaw is shorter than the upper jaw.

Inferior fish mouths normally bottom feeders. They eat foods on the bottom of the body or on the seafloor. Their diets most of the time are benthic organisms such as crustaceans or shellfish [3].

Stingray | Flickr by Jesse Estes

Hammer Head Shark | Flickr by Tony Lindberg

FISH MOUTH TYPES

SUPERIOR

Superior mouth structure is facing upwards or slightly upturned. The lower jaw is longer than the upper jaw and functions much like a scoop. Normally, the superior fish mouth species eat food at or near the surface.

Arowana | Pinterest by Rose Iewis

Tarpon | Flickr by Arie Eliens

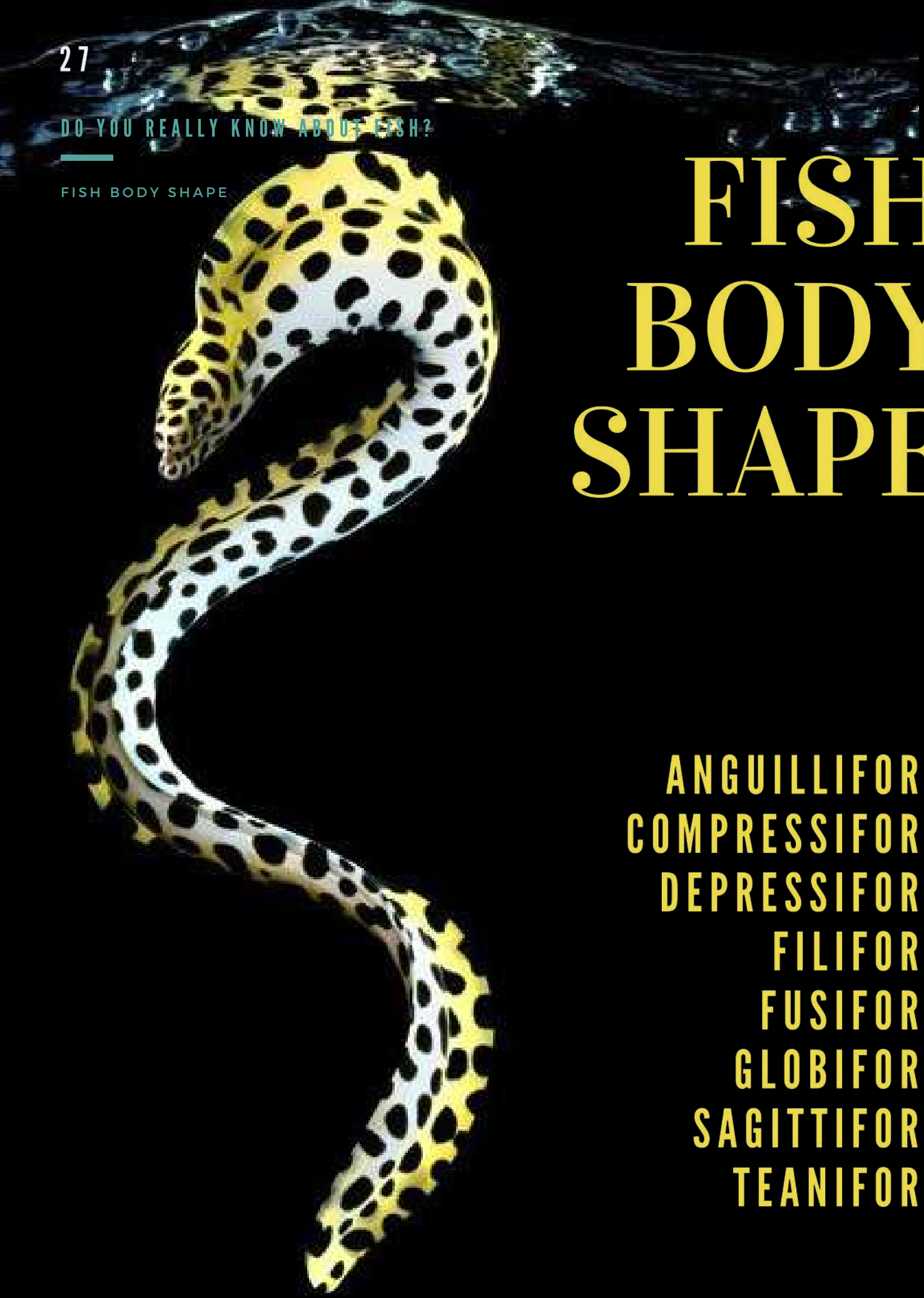
SUPERIOR

Usually, surface oriented fish lie-in-wait for prey to appear above them, then strike suddenly from below [1]. Their diet normally includes insects but some may feed other fish or other prey items that reside on or near the surface. Tarpons, Betta fishes, and Arowanas are examples of superior fish mouth types.

Betta Fish | Flickr by da nokkaew

Marble Hatched | Flickr by threefingeredlord

FISH BODY SHAPE

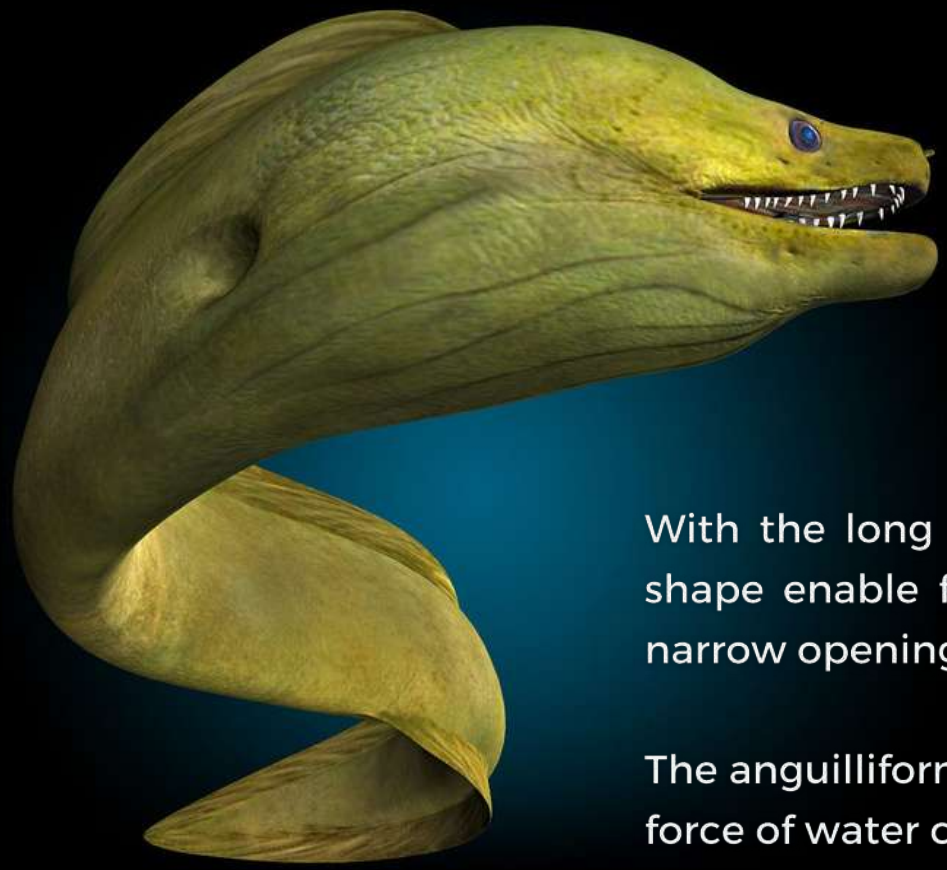


FISH BODY SHAPE

ANGUILLIFORM
COMPRESSIFORM
DEPRESSIFORM
FILIFORM
FUSIFORM
GLOBIFORM
SAGITTIFORM
TEANIFORM

ANGUILLIFORM

Anguilliform fish is snake or eel-like form with blunt or rounded head, small or absent of pectoral fins. Their dorsal and anal fins may be elongated throughout the body.



With the long and skinny body shape enable fish to move into narrow openings.

The anguilliform shape resist the force of water current.
The example of anguilliform fish are eels and lampreys.

Green Moray Eel | Pinterest by James Dies

COMPRESSIFORM

Compressiform body shape is fish laterally compressed and known with deep bodied.

Discus Fish | Pinterest by Neluka Malla

Longfin Batfish | Pinterest by Ona Lisa

Dorsal and anal fins are relatively long, while pectoral fins high on the body and pelvic fins moved forward. In some species possess ventral keel.

This body shape enable fishes to burst of speed quickly and quick turns. The fishes are also able to move along crevices.

Discus, angle fishes, and tilapias are examples of fishes with compressiform body shape.

DEPRESSIFORM

Depressiform body shape is fish horizontally compressed.

The dorsoventrally body shapes and swim bladder absent or greatly reduced, enable fish to stay at the bottom.

Rays and flounder fishes are examples of fishes with depressiform body shape.

Gulf Flounder | Pinterest by ginger boyd

FILIFORM

Filiform body shape that is skinny and elongated with thread like shape.

These fishes normally slow swimmers, slither through the water like a snake, live in soft mud, sand or under rocks.

Pipefishes and sand lances are examples of fishes with filiform body shape.

Pipe Fish | Pinterest by Suzy Cameron

FUSIFORM

Fusiform is more or less torpedo-like shape body with a slightly rounded head and long, wide in the middle, and tapers at both ends.

CHARACTERISTICS

Generally, fusiform-shaped fishes are known as the fastest swimmer in the water column by streamlining the body, they can reduce drag and modify the water flow over the body and appendages [2].

Most of the bone fishes are fusiform in shape. For examples wahoo, tunas, barracudas, mackerels, and many open-ocean sharks such as blues, orcas, and oceanic whitetips.

Bluefin Tuna | Pinterest by Kemil Tara

GLOBIFORM

Globiform fish are round like a globe in shape and typically slow swimmers in the ocean.

Generally, they have short fins, and large round eyes [6]. in the face of being a slow swimmer species, the globiform fish have a specialized adaptation that allows them to take in water and increase their body size up to 4 times to scare the predators.

Pufferfish fall into globiform body shapes.

Puffer Fish | Pinterest by Yvonne Thompson

SAGITTIFORM

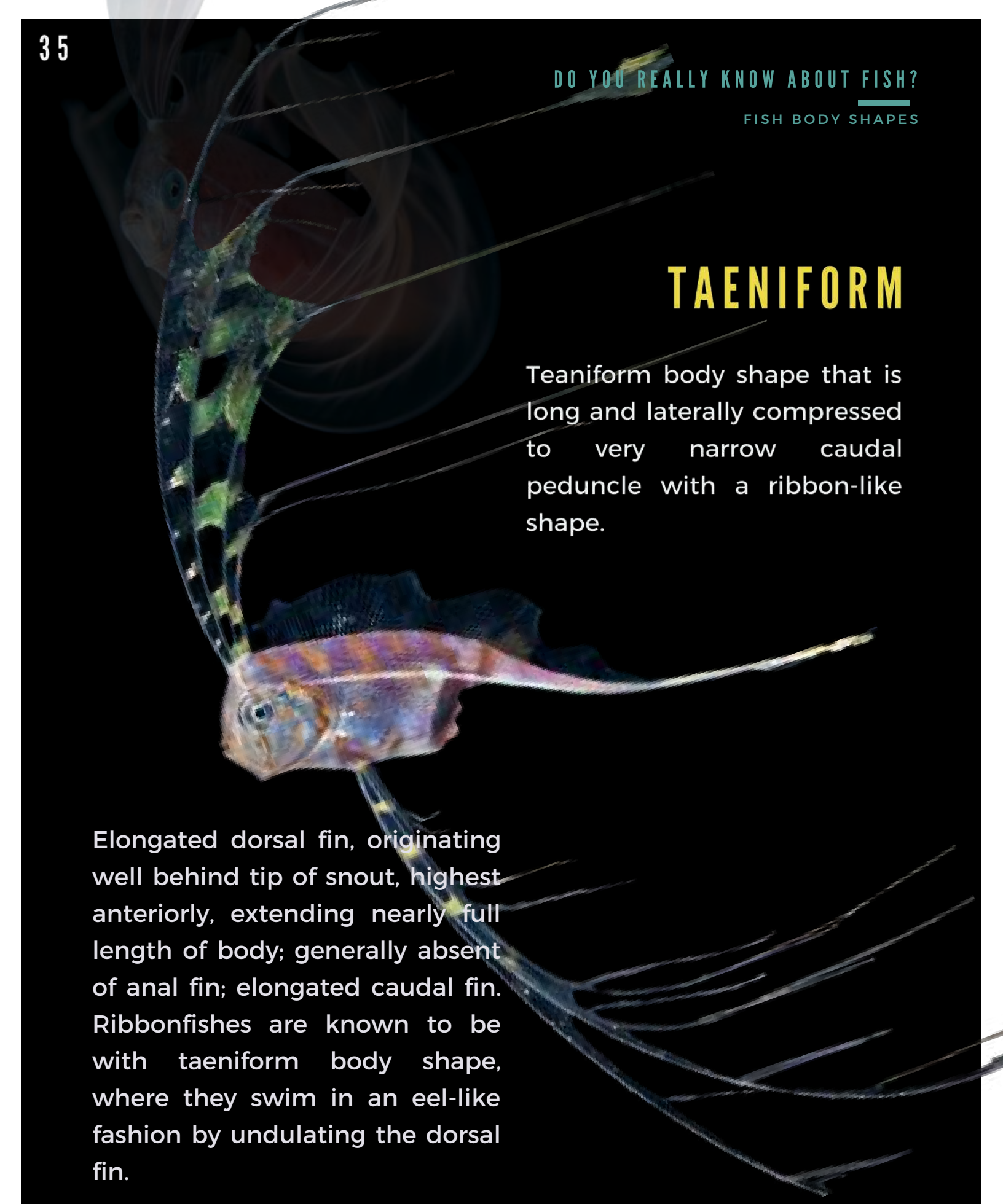
Sagittiform is an elongated tubular body layout that is arrow-like in shape. Fishes with this body shape commonly known as a predator which depend on an ability to strike prey quickly from a hiding place.

There are several species that fall into the sagittiform body shape including pikes, gars, needlefish, barracuda, killifish and topminnows[7].

Cuban Gar | Pinterest by kiryuuu

TAENIFORM

Teaniform body shape that is long and laterally compressed to very narrow caudal peduncle with a ribbon-like shape.



Elongated dorsal fin, originating well behind tip of snout, highest anteriorly, extending nearly full length of body; generally absent of anal fin; elongated caudal fin. Ribbonfishes are known to be with taeniform body shape, where they swim in an eel-like fashion by undulating the dorsal fin.

Wahoo Fish | Pinterest by Sean Farrel

FIN OF FISHES

SOURCE: earthlife.net

Fins are among the most recognizable features of a fish.

There are two types of fins, which is median and paired. Median fins are single in number which runs down the mid-line of the body.

Median fins are dorsal, caudal and anal fins while paired fins are pectoral and pelvic which are arranged in pairs homologous to human arms and legs.

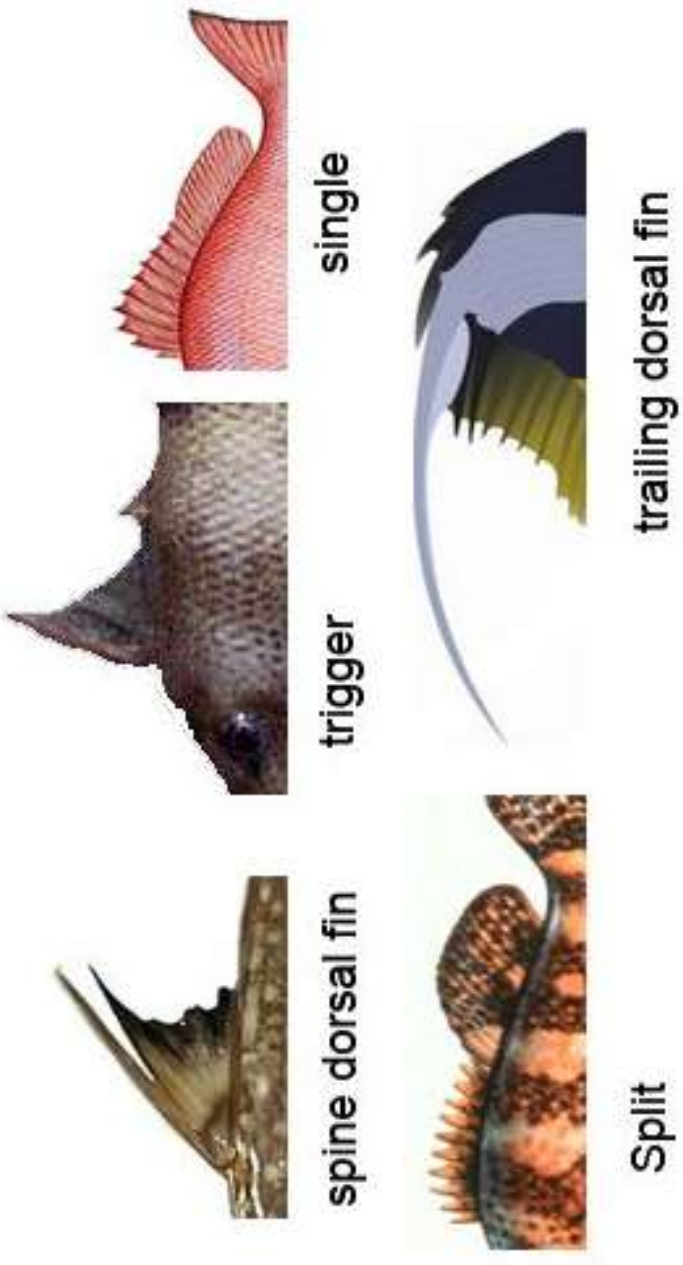
DORSAL FIN

This type of fin is located on the top or back of the fish which help the fish in quick turns or stops. It also helps the fish against rolling.

In fish, there are three distinct dorsal fins such as proximal, central or middle, and distal dorsal fins. Some fish have two dorsal fins where the central and distal fins are combined together.
heading

TYPES OF DORSAL FINS:

SINGLE
POINTED
SPLIT
SPINE TRIANGULAR
TRIGGER
TRAILING



SOURCE: leisurepro.com

Different types of dorsal fin related to swimming behaviour and habitat of the fish

Some fish was undergo modification in their dorsal fin due to evolutiion and adaptatiion to new environment

SOUARCE: deepblue.com

The dorsal fin of Remora gets modified to form the sucker.

Remora attaches itself to the shark at its belly for its transportation and food. This remora can travel to different areas without spending energy and the leftover food of the shark was eaten by this fish. This type of relationship seen in Shark and Remora is known as Commensalism. Sharks also protect Remora from predators.

Commensalism is the relationship in which one organism is benefited and another is neither benefited or harmed

Angelfish
Use dorsal fin as a lure which helps to attract the prey

Sailfish
Large retractable dorsal fin is to assist in balance during fast swimming

SOURCE: triz-journal.com

SOURCE: Oceana.org

HIGHLY MODIFIED DOFRSAL FIN

DEEP SEA ANGLERFISH, ALSO KNOWN AS THE HUMPBACK ANGLERFISH

Life in the deep sea is difficult, so many fishes there have special adaptations to improve their ability to feed and to mate

These strange looking fish have a stout body, a large head, and an enormous mouth.

But their most distinctive feature is a whiplike rod that protrudes out of the top of their head, which ends in a blob called a lure. The angling structure evolved from the spines of the fish's dorsal fin.

The deep sea anglerfish’s lure is filled with bacteria that make their own light. Using a muscular skin flap, a deep sea anglerfish can either hide or reveal its lighted lure. By pulsing the light and moving the lure back and forth, they successfully attract pelagic crustaceans, fishes, and other prey.

The lure is also used to attract a mate. The only individuals that fit the above description are females. Females are the large, ambush predators; females have the lighted lures. Males are very small (one inch/three centimeters) and are not predatory

SOURCE: Wikipedia

PELVIC FIN

PELVIC FIN

The pelvic fins are paired fins found on the ventral (bottom) side of fish. In teleost (bony) fishes, pelvic fins placement gives some indication of evolution. For more basal groups, the pelvic fins are located at mid-body in the abdominal region.

Pelvic fins, although little studied, are of great interest as they are one of the most morphologically plastic structures within the fishes. The function of the pelvic fins is as variable as their morphology between fish. They are used in swimming as an aerofoil, brake, propulsor, and rudder, for ground walking, and for hovering. At the same time, pelvic fins can be spined and used for protection, contain gases, and be used for floatation, sensory perception, camouflage, a holdfast organ, and for reproduction.

Although early studies that amputated pelvic fins and recorded no change in swimming ability concluded that pelvic fins had limited or no locomotory function, recent work has suggested otherwise. Slow-speed swimming experiments have shown that trout actively oscillate their fins in a contralateral pattern. This oscillation alters the flow conditions along the ventral aspect of the fish, possibly acting to stabilize the fish and influence the hydrodynamic function of downstream fins. Pelvic fins are also active during yawing maneuvers in trout species.

SOURCE: Encyclopedia.com

CLINGFISH

Pelvic modification

Clingfish are most commonly found in the inter-tidal zone of oceans worldwide. They are rarely seen swimming in the open water, but rather it moves in short dashes and often remains cryptically attached to sessile invertebrates and vegetation.

Clingfish are characterized by a large suction disc formed by the union of the pelvic fins and adjacent folds of flesh. This disc allows cling-fish to attach themselves to the bottom and, in this way, they are able to withstand strong currents

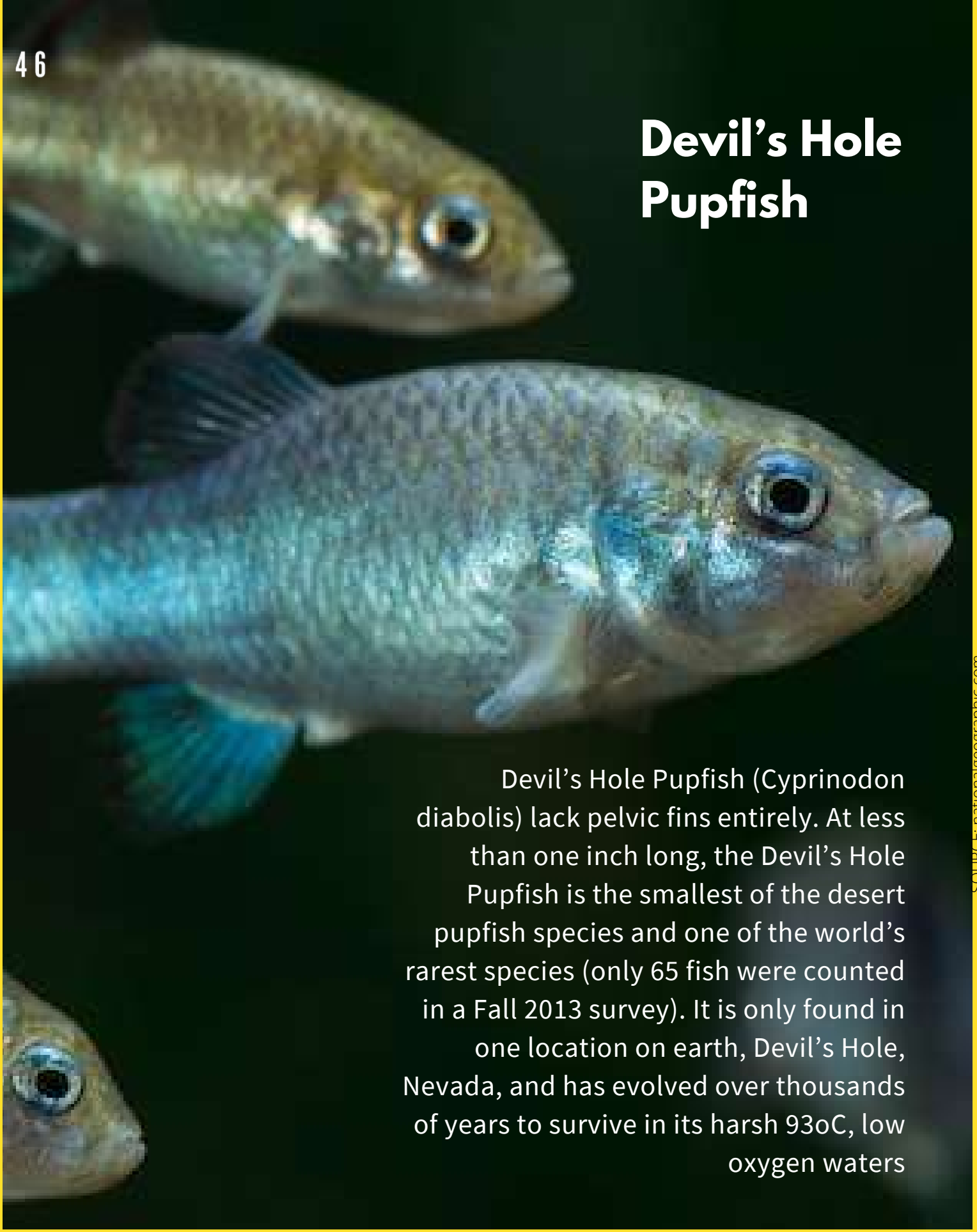
PELVIC MODIFICATION

GUPPIES

SOURCE: Free3d.com

Guppies (Poecilia reticulate) exhibit sexually dimorphic pelvic fins, where the males and females do not have the same fins. The pelvic fin's first and second rays are significantly shorter on the male Guppy than the Female guppy. Research suggests that this specialization may assist with reproduction

Devil's Hole Pupfish



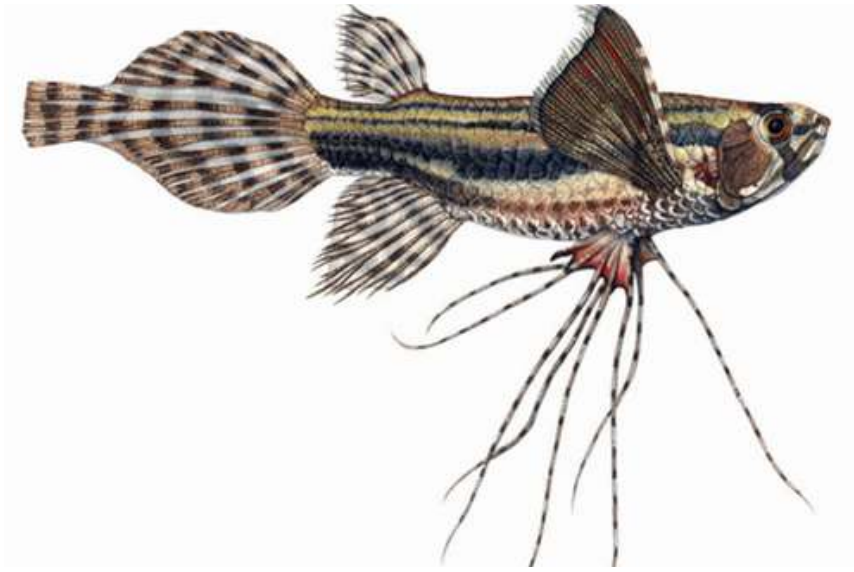
Devil's Hole Pupfish (Cyprinodon diabolis) lack pelvic fins entirely. At less than one inch long, the Devil's Hole Pupfish is the smallest of the desert pupfish species and one of the world's rarest species (only 65 fish were counted in a Fall 2013 survey). It is only found in one location on earth, Devil's Hole, Nevada, and has evolved over thousands of years to survive in its harsh 93oC, low oxygen waters

SOURCE: nationalgeographic.com

PELVIC MODIFICATION

Like pectoral fins, pelvic fins are often tucked against the body during moderate- and high-speed steady swimming to reduce drag, possibly leading to their earlier reputation of having little to no locomotory function. In some highly derived species, pelvic fins have developed other sensory organ to ensure survival.

Freshwater butterflyfish (Pantodon buchholzi) use their pelvic fins for gliding.



Sea Robin fish use their pelvic fin for walking along the substrate

SOURCE: fishionary.fisheries.org

CAUDAL FIN

One of the most prominent characteristics of early vertebrates is the elongate caudal fin bearing fin rays. The caudal fin represents a fundamental design feature of vertebrates that predates the origin of jaws and is found in both agnathans and gnathostomes. The caudal fin also represents the most posterior region of the vertebrate axis and is the location where fluid, accelerated by movement of the body anteriorly, is shed into the surrounding medium

Unlike many marine mammals with tails that use an up-and-down motion, fish generally use a side-to-side thrust of their caudal fin for propulsion. The shape of the caudal fin can be indicative of the style of motion for a fish. For example, very fast swimming fish like tunas have lunate caudal fins for more efficient swimming while lie-in-wait predators like grouper have a strong, wide base of the tail, the caudal peduncle, for faster acceleration.

Varieties of Caudal Fins

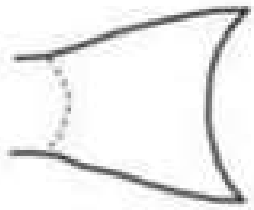
The diversity of caudal structure in fishes has been grouped into broad categories based primarily on the shape and relative sizes of the upper and lower tail lobes and the position of the vertebral column within the tail.

The basic classification of fin shape dates from Louis Agassiz in 1833 who proposed the terms "heterocercal" (for externally asymmetrical tails with larger dorsal lobes containing the terminal extension of the vertebral column or notochord) and "homocercal" (for tails which are externally symmetrical and have equal-sized upper and lower lobes)

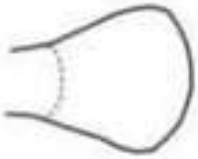
The heterocercal tail is sometimes called the shark-tail type of caudal fin.Elasmobranch (cartilaginous fish) and some primitive type of bony fishes contain this type of fin. This fin has two unequal lobes where the upper smaller lobe is known as epichordal lobe and a much larger lower lobe is known as hypochordal lobe. In this case, the hind end of the vertebral column becomes bent upwards and continues almost up to the tip of the fin.

Most of the higher teleosts have homocercal caudal fin. It has superficially symmetrical and two equal sized lobes such as upper epichordal and the lower hypochordal lobe. Internally, this tail is asymmetrical and the hinder end part of the vertebral column is greatly shortened and turned upward. In this case, the vertebral column does not touch the posterior limit of the fin.

TYPES OF CAUDAL FIN



Emerginate



Rounded

EMERGINATE

This broom-like caudal fin is used for quick acceleration and offers high maneuverability.
e.g. Trout, Carp, Perch

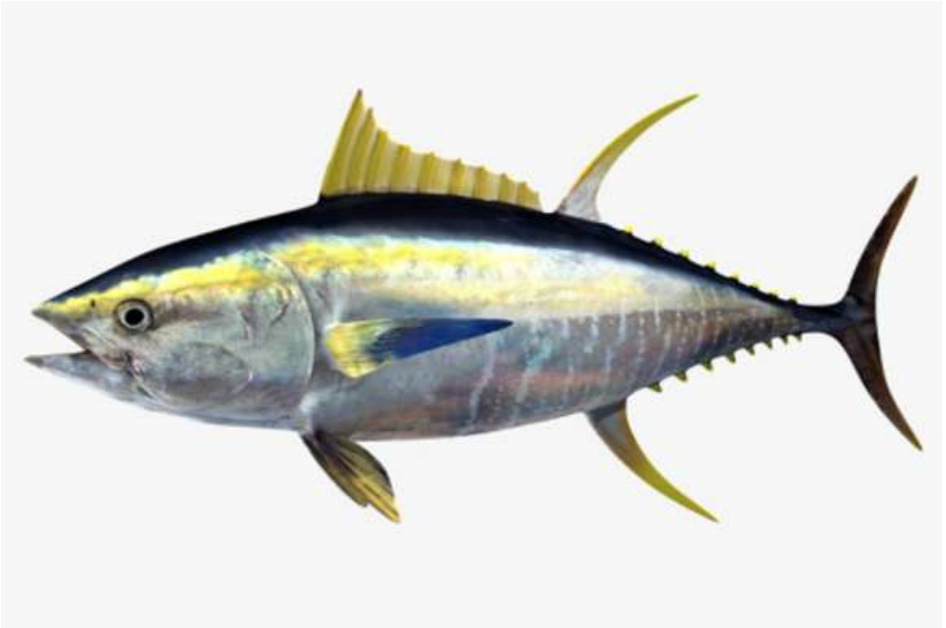
ROUNDED

It is used for slow swimming, accelerating, and maneuvering.
e.g. Turbot and Lemon-Sole

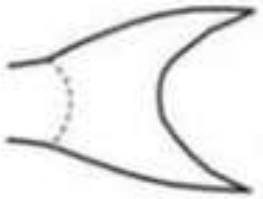
LUNATE, FORKED

Types of caudal fin

LUNATE

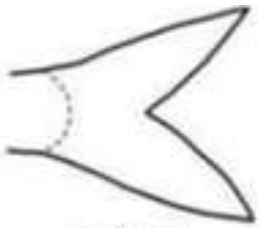


FiBUILT FOR SPEED! These thin, crescent-shaped caudal fins allow for great speed over long distances and are most often seen on fishes that live in open water. The thin fin allows less drag at the posterior end of the fish, which allows for fast-paced, long-distance swimming. Most fish that possess a lunate caudal fin are highly migratory species. These lunate caudal fins do not allow for high maneuverability, and thus, these fishes are almost exclusively piscivorous (fish eating)
e.g. Tuna



Lunate

FORKED

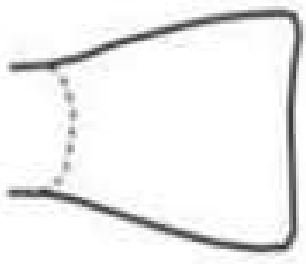


Forked

Fish that possess a forked caudal fin often use ambush-like prey capture techniques similar to fish that have a truncate caudal fin, but also swim great distances at high speeds similar to those fish possessing a lunate caudal fin
e.g. Herring, Mackerel

Types of caudal fin

TRUNCATE



Truncate

Found primarily in ambush predators that don't chase down prey. Truncate caudal fins can be found in many benthic (bottom-dwelling) fishes. Primary prey items include crustaceans, prey fishes that also have truncate caudal fins, other benthic fishes, and carrion.
e.g. Grouper

POINTED

Pointed

Usedor swimming between rocks and crevices
e.g. Eel

MODIFICATIONS OF CAUDAL FIN

MANY FISHES HAVE SPECIALIZED MODIFIED TYPES OF CAUDAL FINS

Diphycercal

The clavus is the hardened bridge between anal and dorsal fins, Highly advance, found in molids (molas/ocean sunfish) with no caudal bones

PSEUDOCAUDAL CAUDAL FIN

In the modern lungfishes (Dipnoi), the pseudocaudal caudal fins are found. In this case, fins are developed from the backward growth of dorsal and ventral elements

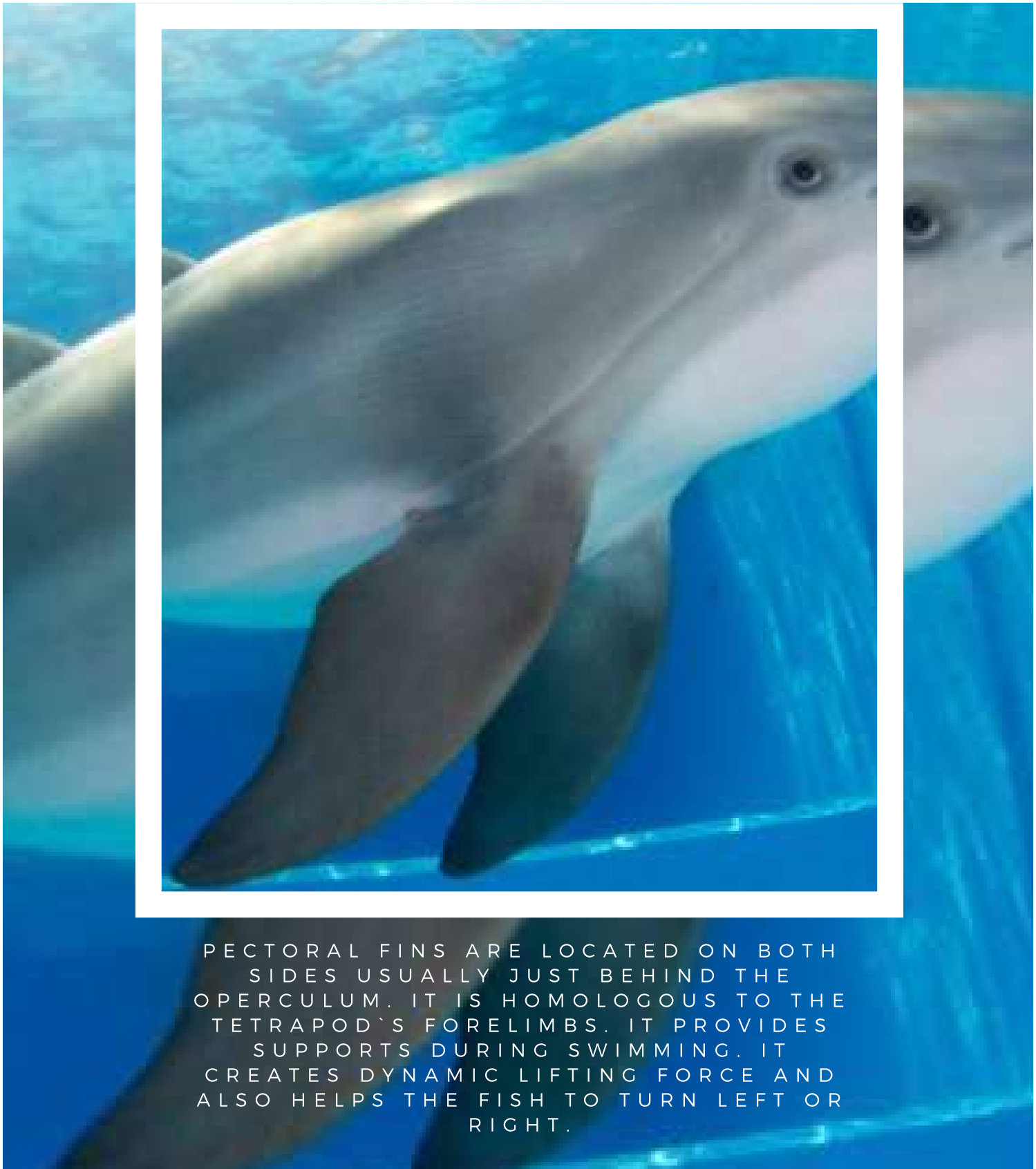
INTERNALLY SYMMETRICAL CAUDAL FIN

This is a reduced type of caudal fin where some fin elements are fused together. They are found in cods (Order: Gadiformes).

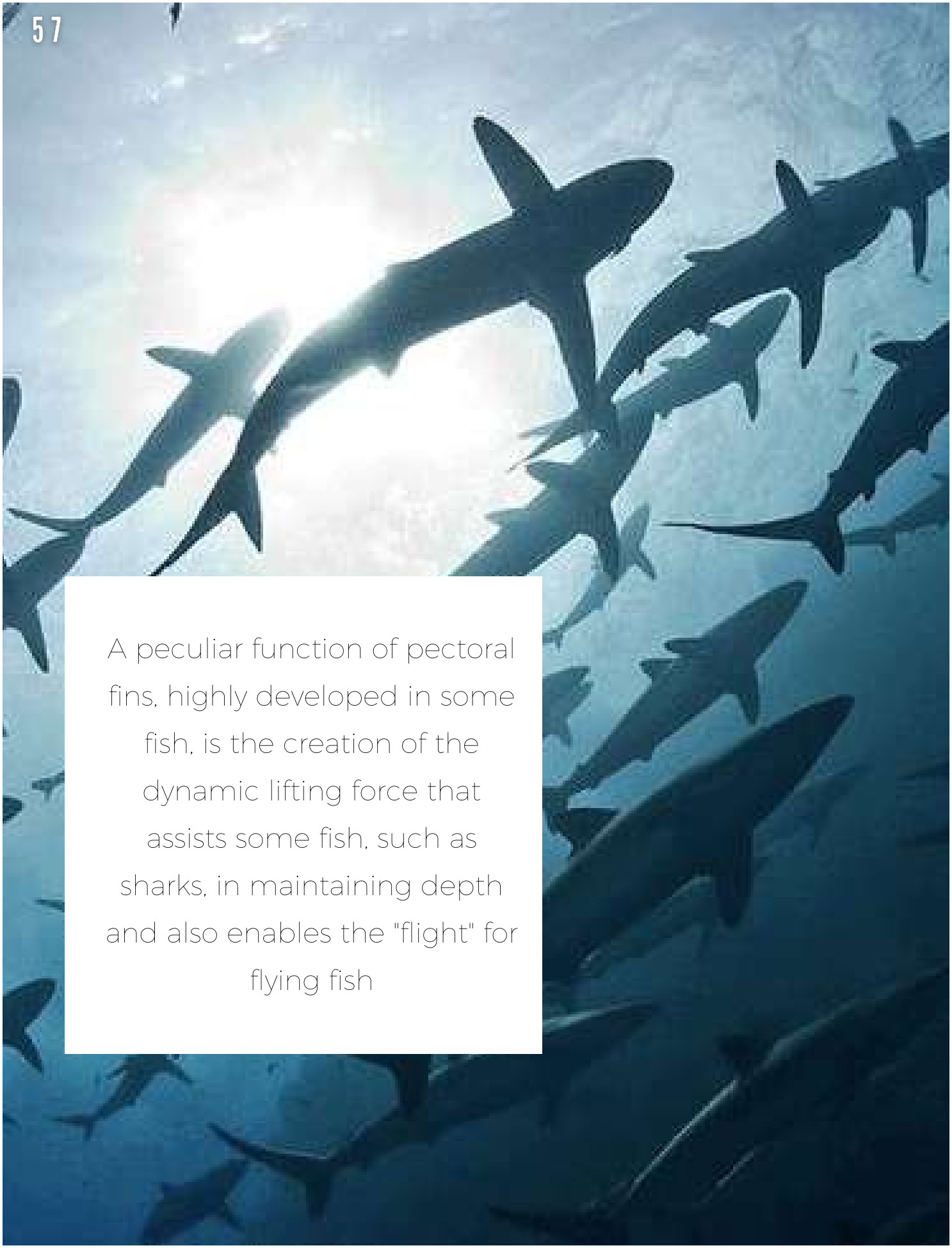
Gephyrocercal Caudal Fin

It is a very specialized type of caudal fin which is also known as bridge caudal fin. Generally, they look like the isocercal fin but the fins are reduced to vestiges. In this case, the caudal lobe is truncated where hypurals of the spinal column are lacking. These types of fins are found in the pearlfishes (Carpus), Flerasfer and Orthagoriscus (mola fish).

PECTORAL FIN



PECTORAL FINS ARE LOCATED ON BOTH SIDES USUALLY JUST BEHIND THE OPERCULUM. IT IS HOMOLOGOUS TO THE TETRAPOD`S FORELIMBS. IT PROVIDES SUPPORTS DURING SWIMMING. IT CREATES DYNAMIC LIFTING FORCE AND ALSO HELPS THE FISH TO TURN LEFT OR RIGHT.

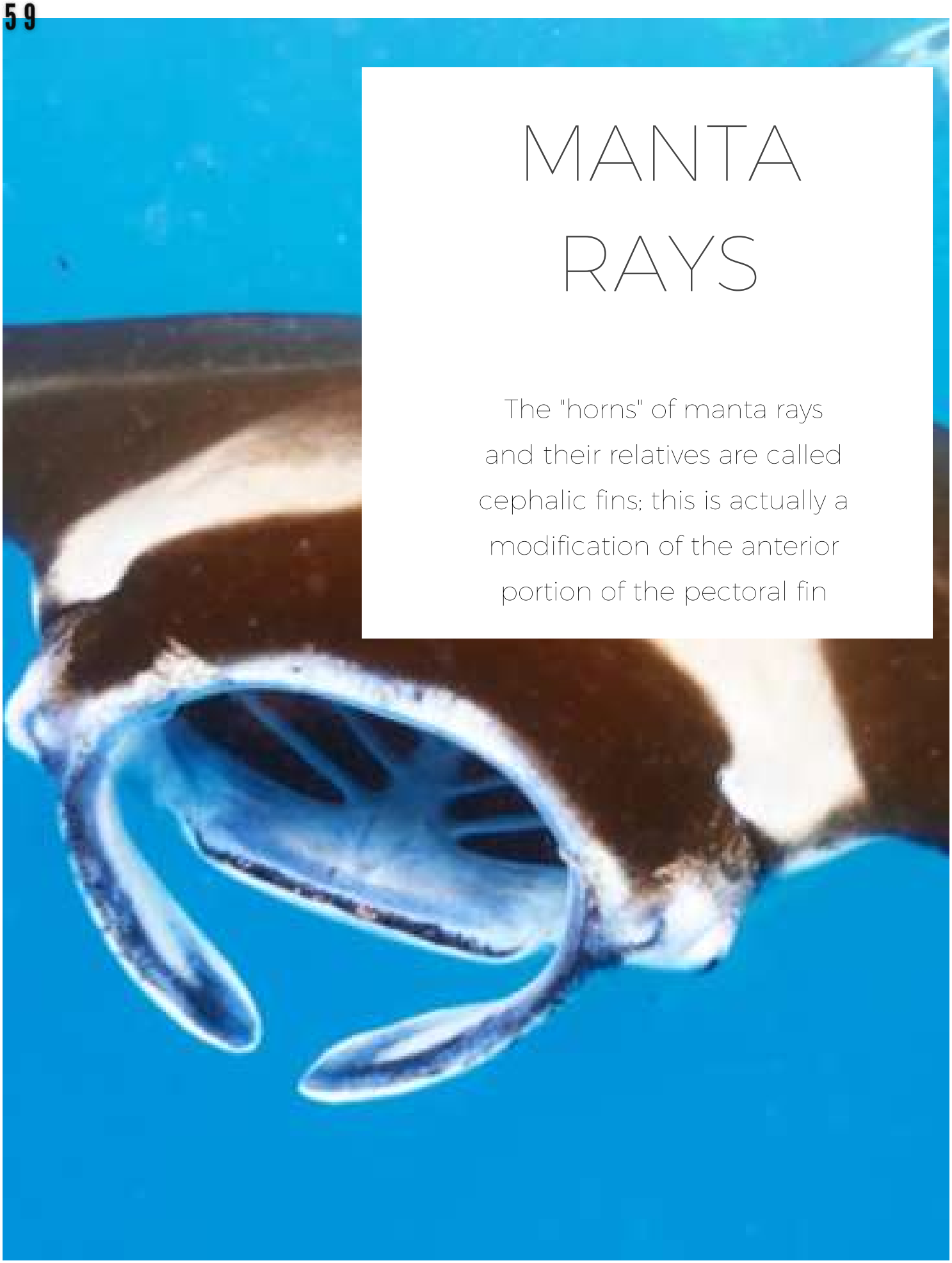


A peculiar function of pectoral fins, highly developed in some fish, is the creation of the dynamic lifting force that assists some fish, such as sharks, in maintaining depth and also enables the "flight" for flying fish

MODIFICATION OF PECTORAL FIN

In many fish, the pectoral fins aid in walking, especially in the lobe-like fins of some anglerfish and in the mudskipper.

Certain rays of the pectoral fins may be adapted into finger-like projections, such as in sea robins and flying gurnards.



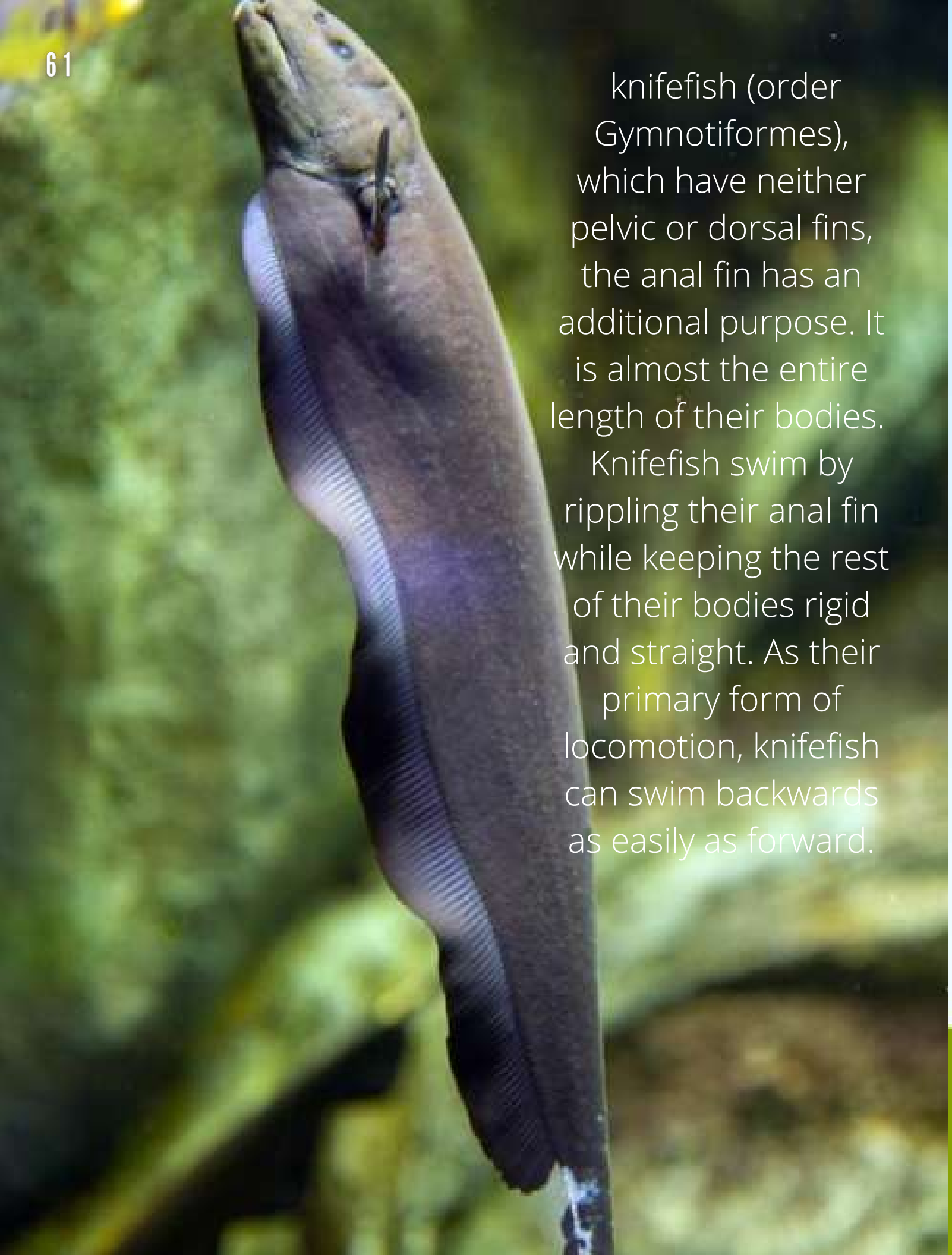
MANTA RAYS

The "horns" of manta rays and their relatives are called cephalic fins; this is actually a modification of the anterior portion of the pectoral fin

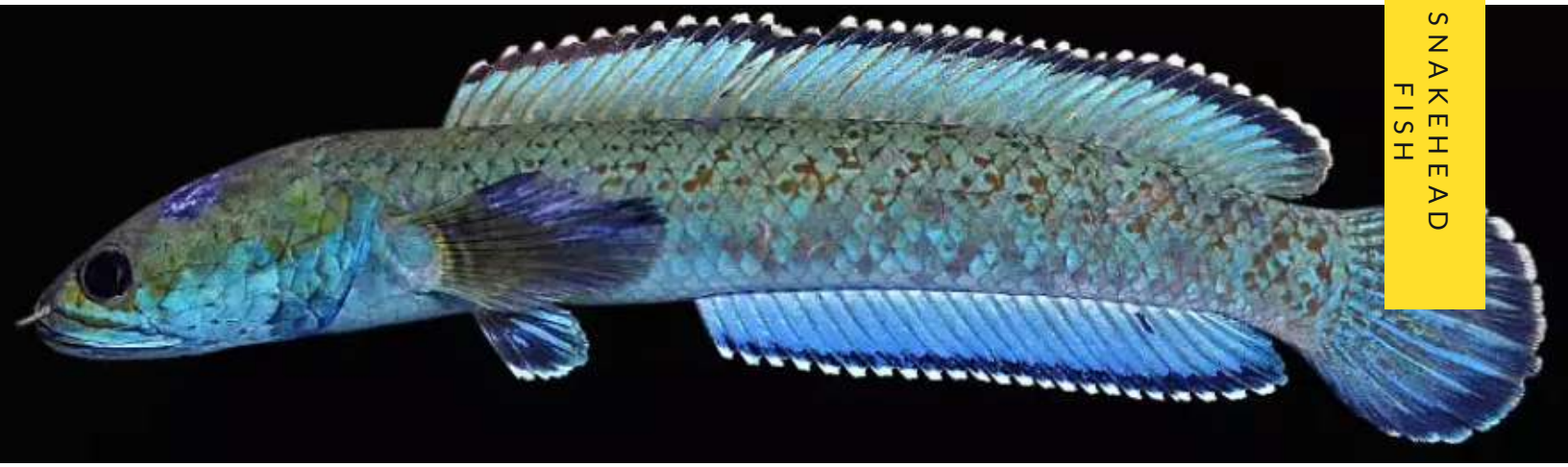
ANAL FIN

NO. 9 • $4.99

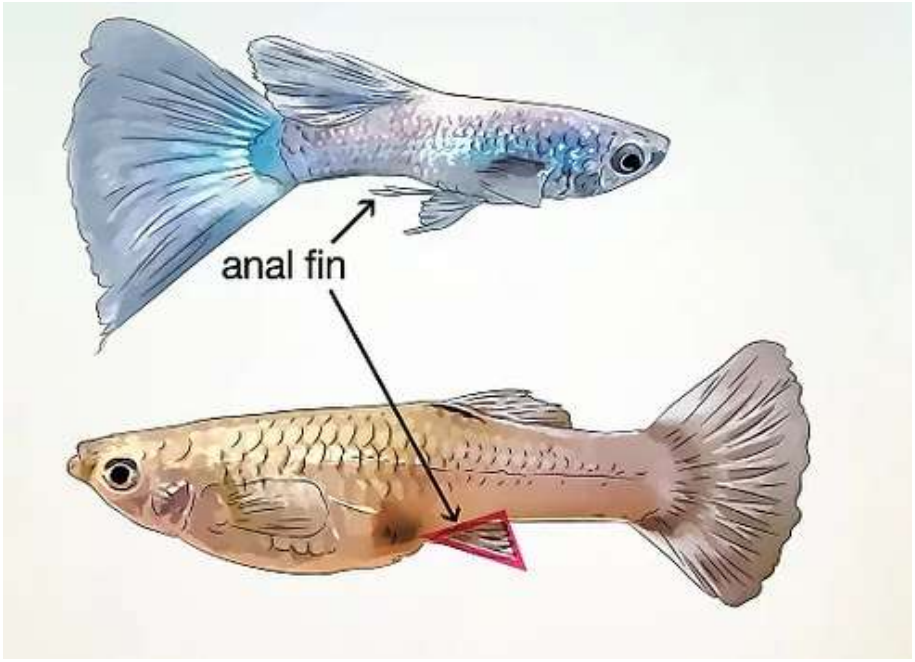
THE ANAL FIN IS ALSO KNOWN AS CLOACAL FIN WHICH IS LOCATED ON THE VENTRAL SIDE JUST BEHIND THE ANUS.
IT SUPPORTS THE DORSAL FIN AND STABILIZES THE FISH DURING SWIMMING AND CONTRINOLS THE ROLLING MOTION.



knifefish (order Gymnotiformes), which have neither pelvic or dorsal fins, the anal fin has an additional purpose. It is almost the entire length of their bodies. Knifefish swim by rippling their anal fin while keeping the rest of their bodies rigid and straight. As their primary form of locomotion, knifefish can swim backwards as easily as forward.



Snakeheads (family Channidae) have an elongated anal fin. They can survive on land for up to four days (as long as they are still wet) and can "walk" up to a quarter mile on wet land to find other habitable water bodies.



Coercive mating is often seen in species with internal fertilization; iconic examples are fish of the family Poeciliidae. Males in this family have modified anal fins (gonopodia) that they use to inseminate females, who have a small degree of control over matings

FINLETS

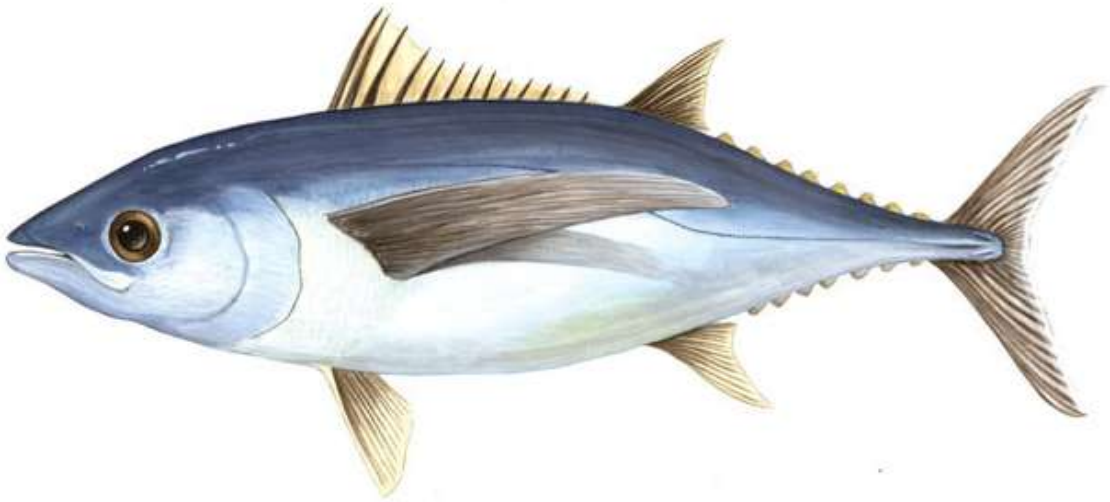
Finlets are highly specialized fins located on the dorsal and ventral sides of the body between the dorsal fin and/or the anal fin and the caudal fin.

It appear as series of small non-retractable fins common to scombrid fishes (mackerels, bonitos and tunas), which are known for their high swimming speed.

Although individual finlets are small, the summed area of the finlets of a mackerel can reach 15% of its caudal fin area. In addition, finlets are located immediately upstream of the caudal fin (the main propulsor of the fish), which suggests that they may play an important role in the swimming dynamics of scombrid fishes.

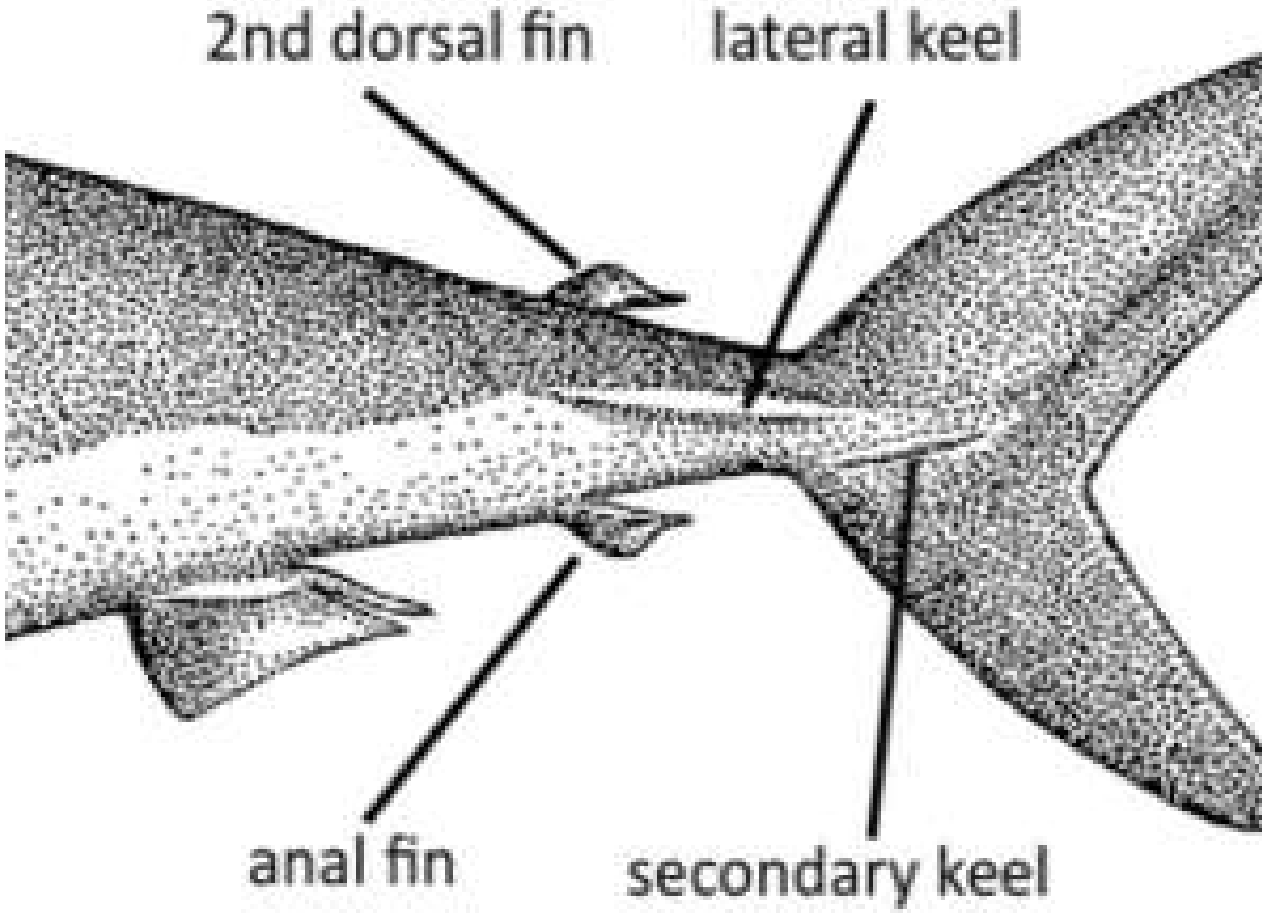
In Bichirs, the finlets are only on the dorsal side with unique series which vary in number from seven to 18, instead of a single dorsal fin.

Each of the dorsal finlets has bifid (double-edged) tips, and are the only fins with spines; the rest of the fins are composed of soft rays



In Scombrids, finlets are small, rayless, non-retractable fins located on both the dorsal and ventral margins of the body.

Finlets in Scombrids have been evaluated for their contribution to locomotion because these fish are such high-performance swimmers. Finlets may contribute to dampening of cross-flow turbulence around the caudal peduncle



KEELS

A lateral ridge found just anterior to each side of the tail fin on the caudal peduncle of some types of fast-swimming fish.

The keels improve the stability of the fish's attitude at speed in the water, and strengthen the support of the caudal fin.

Tunas are known for their extraordinary swimming performance, which is accomplished through various specializations. The caudal keels, are a remarkable specialization in tunas and have convergently arisen in other fast-swimming marine animals.

DID YOU KNOW?

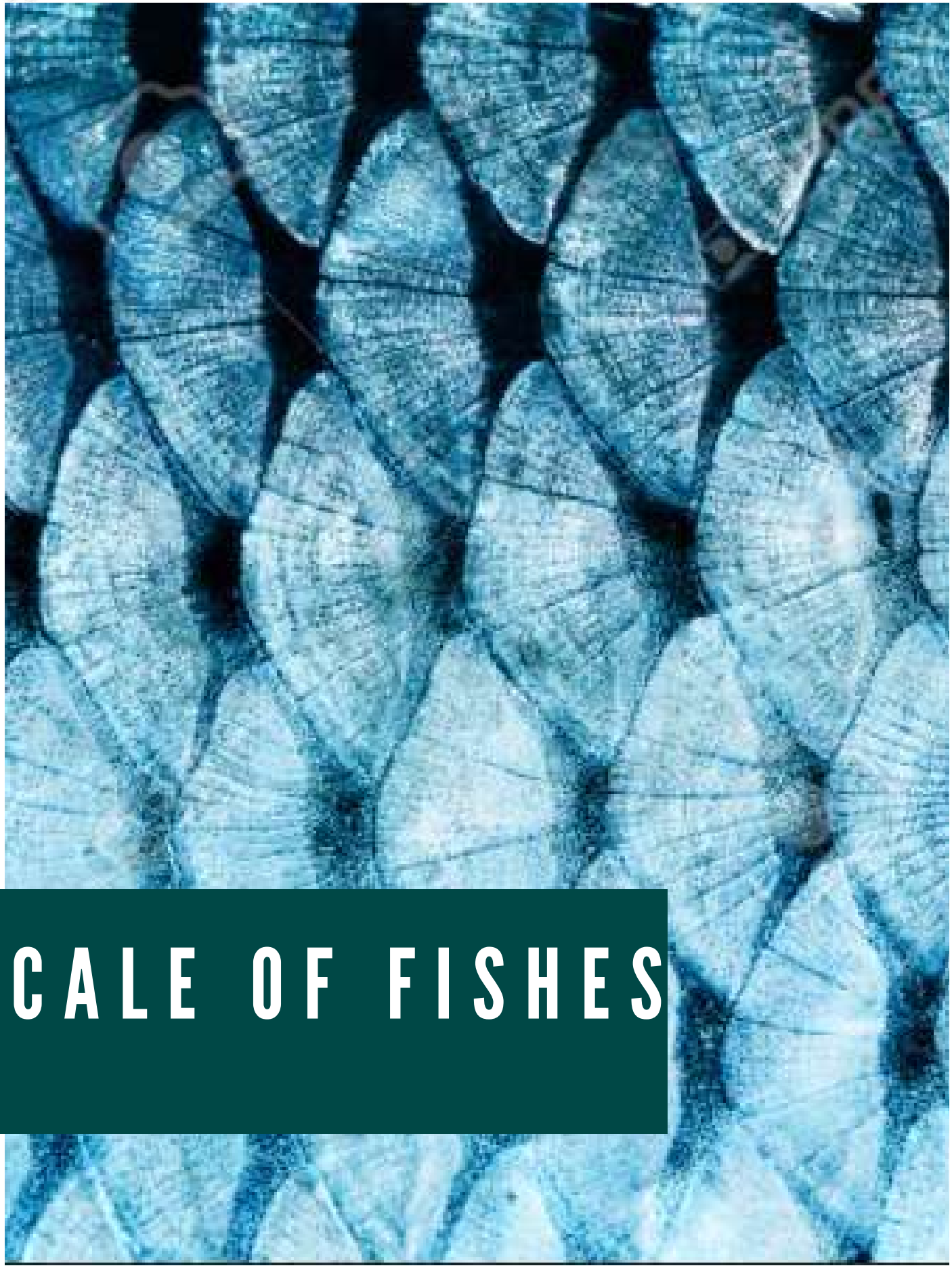
THE COALACANTAH

Coelacanths are the only living representatives of an ancient order of fishes, until recently thought to have become extinct 70 million years ago, at about the same time as the dinosaurs

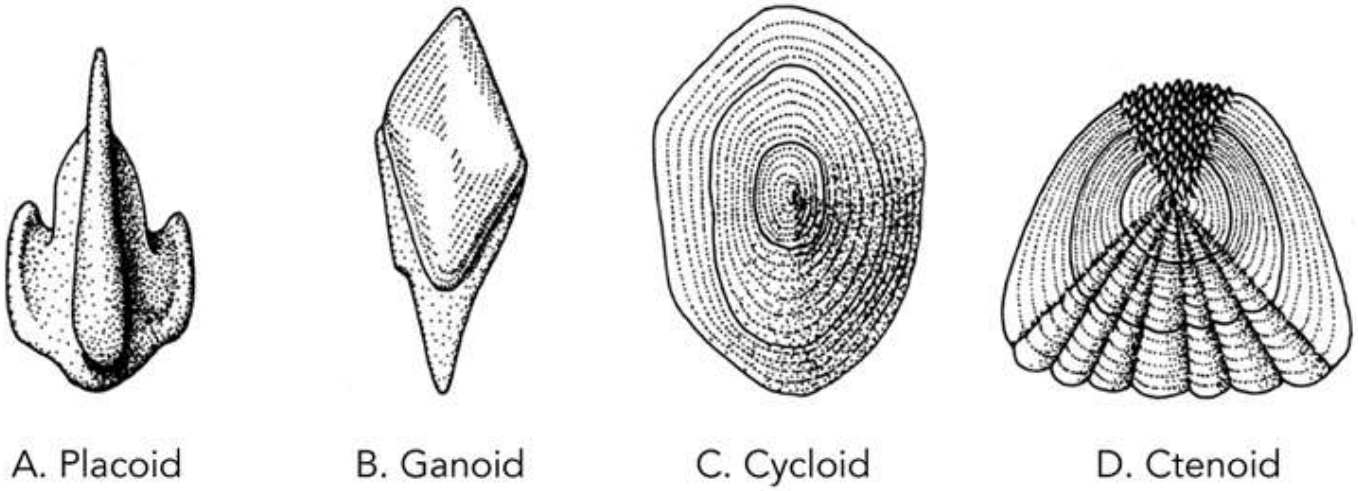
In 1938, however, scientists were astonished when living coelacanths were discovered.
However, unlike other bony fishes, the pectoral and pelvic fins of the coelacanth are muscular, and even leg-like in appearance.

The evolutionary ancestor of amphibians, and thus of all land-dwelling animals, had fins similar to those of the coelacanth

The fins are able to move over 180°, allowing the fish to swim forwards, backwards, and even upside down.



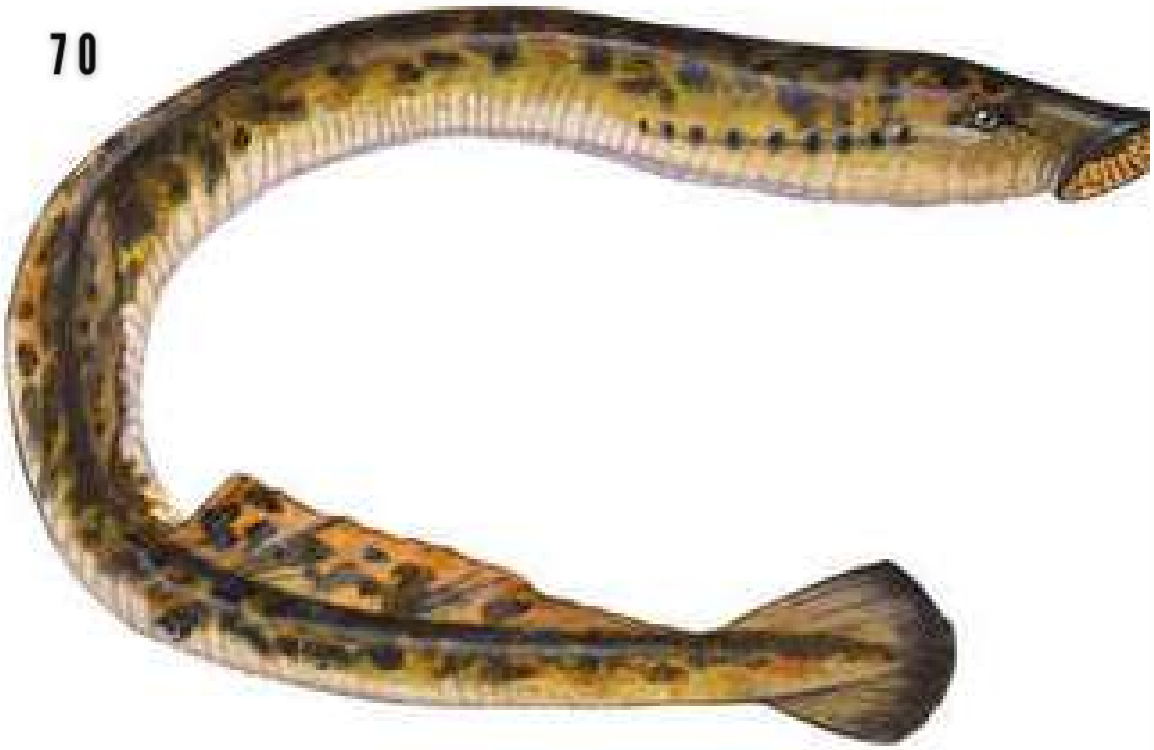
SCALE OF FISHES



Scales are small plate-shaped dermal or epidermal structures that are found in the outer skeletons of fish, reptiles, or some mammals.

The skeletons of many vertebrates are covered by two types of scales, namely epidermal and dermal. Epidermal scales originate from the malpighian layer of the epidermis. Such scales are found in terrestrial vertebrates such as reptiles, birds and mammals.

Afterwards, dermal scales emerge from the mesenchyme of fish. Such scales are made up of small, thin, thorny and crushed or bony plates that stick closely to each other. The outer skeleton of a fish is called scales.



MOST FISH BEAR SCALES. AGNATHA AND CATFISH HAVE NO SCALES

•Some fish, especially paddle fish (Polyodon), mirror carp (Cyprinus carpio) have partial scales.

Other fish such as trout and freshwater eel have very small scales. Scales cover most of the body and protect the skin from injury

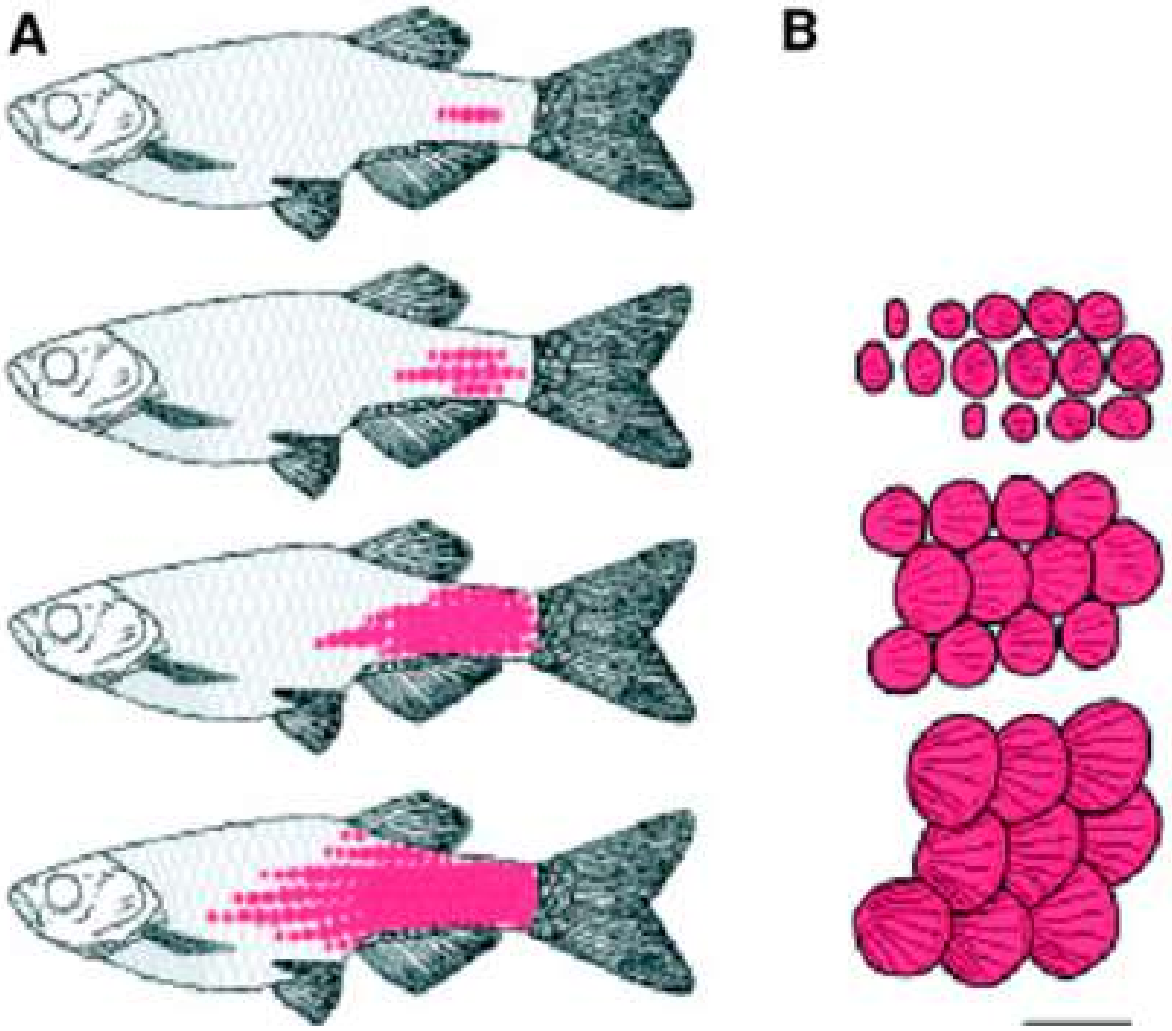
Scales prevent the fish from becoming dehydrated by maintaining the proper balance of water inside the fish. Technically, a fish would be able to live it's whole life without scales, as long as it avoids all the threat

The scales contain a variety of pigments that give the fish a variety of colors

FISH LATERAL LINE

The scales form a lateral line in the body of the fish along the side of the body and play an important role in detecting vibrations in the water as it acts as a sensory receptor.

THE LATERAL-LINE SYSTEM IS A SENSORY SYSTEM FOUND IN FISHES AND AQUATIC AMPHIBIANS. WITH THE LATERAL-LINE SYSTEM, FISHES MEASURE THE RELATIVE MOVEMENTS BETWEEN THEIR BODY AND THE SURROUNDING WATER AT EACH OF UP TO SEVERAL THOUSAND SENSORY ORGANS, THE NEUROMASTS

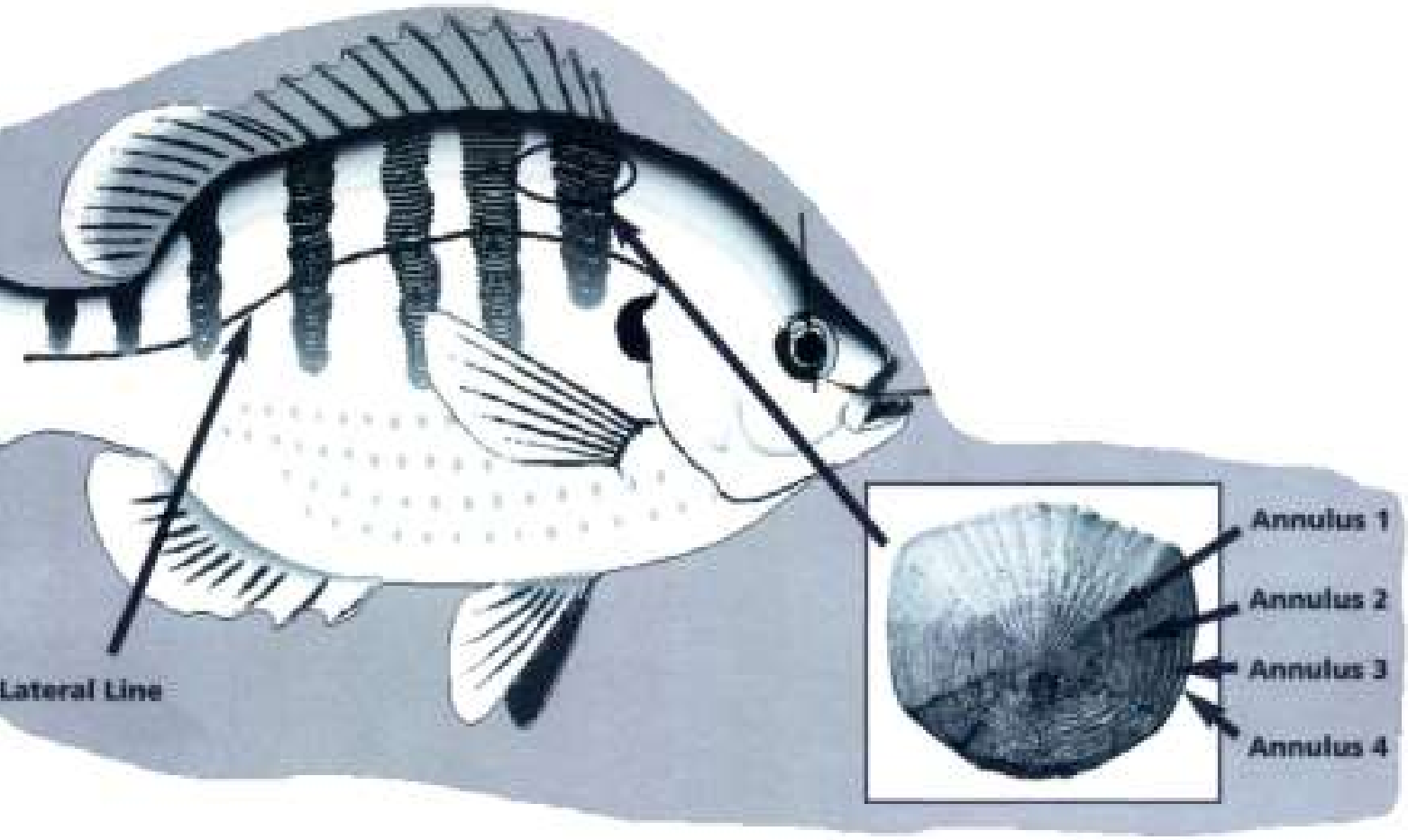


SCALE DEVELOPMENT

When the fish hatches from the egg, its body is covered by small scales. As the fish grows so does the scales

However, the number of scales remains the same throughout life but the lost scales can be restored at some point

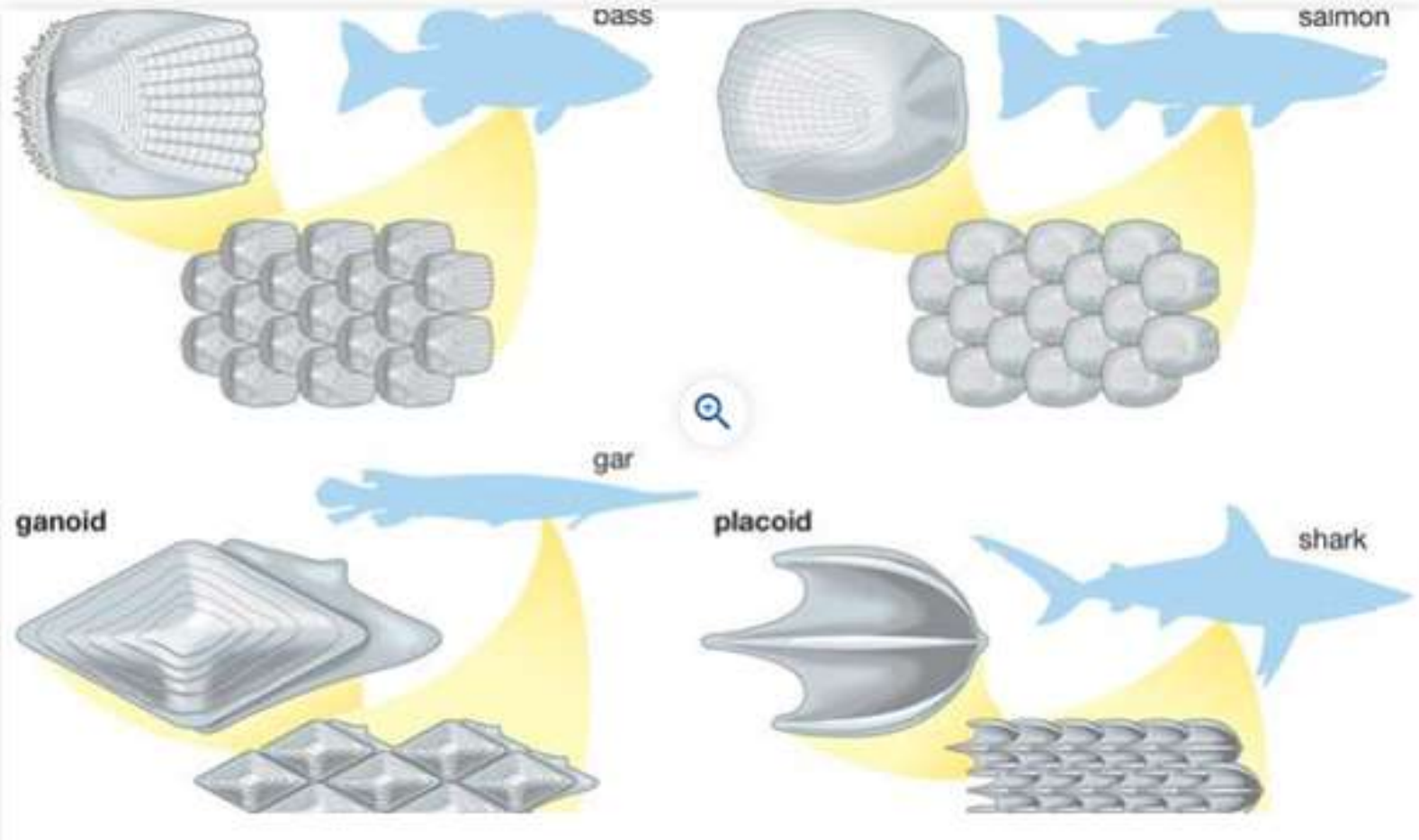
SCALE DEVELOPMENT



•A small circular growth ring is formed in the scales and this ring is called circuli or circulus (in singular). Circulus formed in summer are quite wide whereas circulus formed in winter are intertwined. In that densely enclosed region a black circle is formed which is known as the annulus.

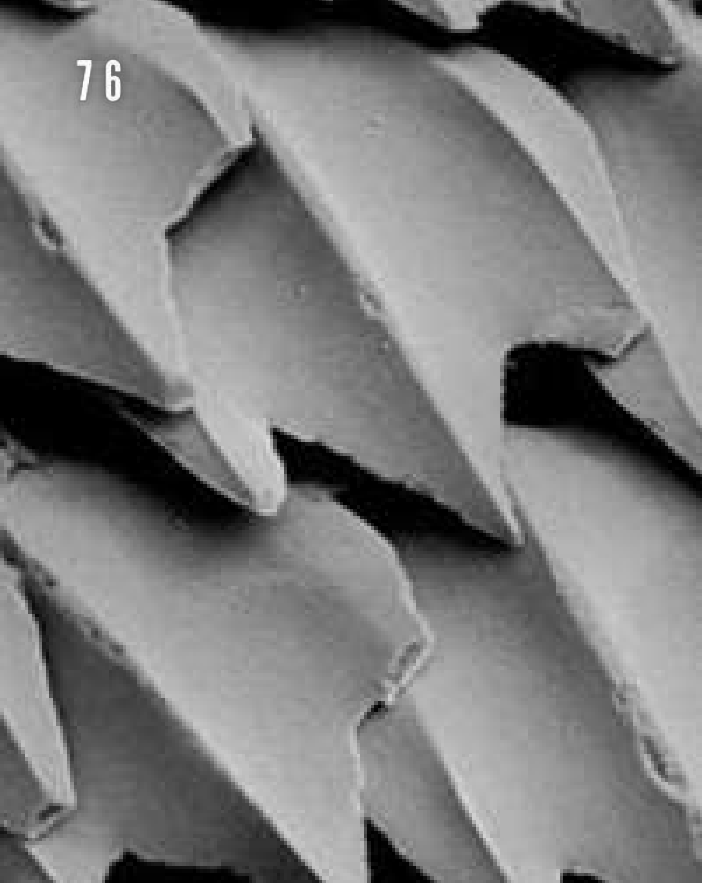
The age of the fish is determined by counting the number of annulus in scales

TYPES OF SCALES



Fish scales can also be divided into two based on their structure, namely:

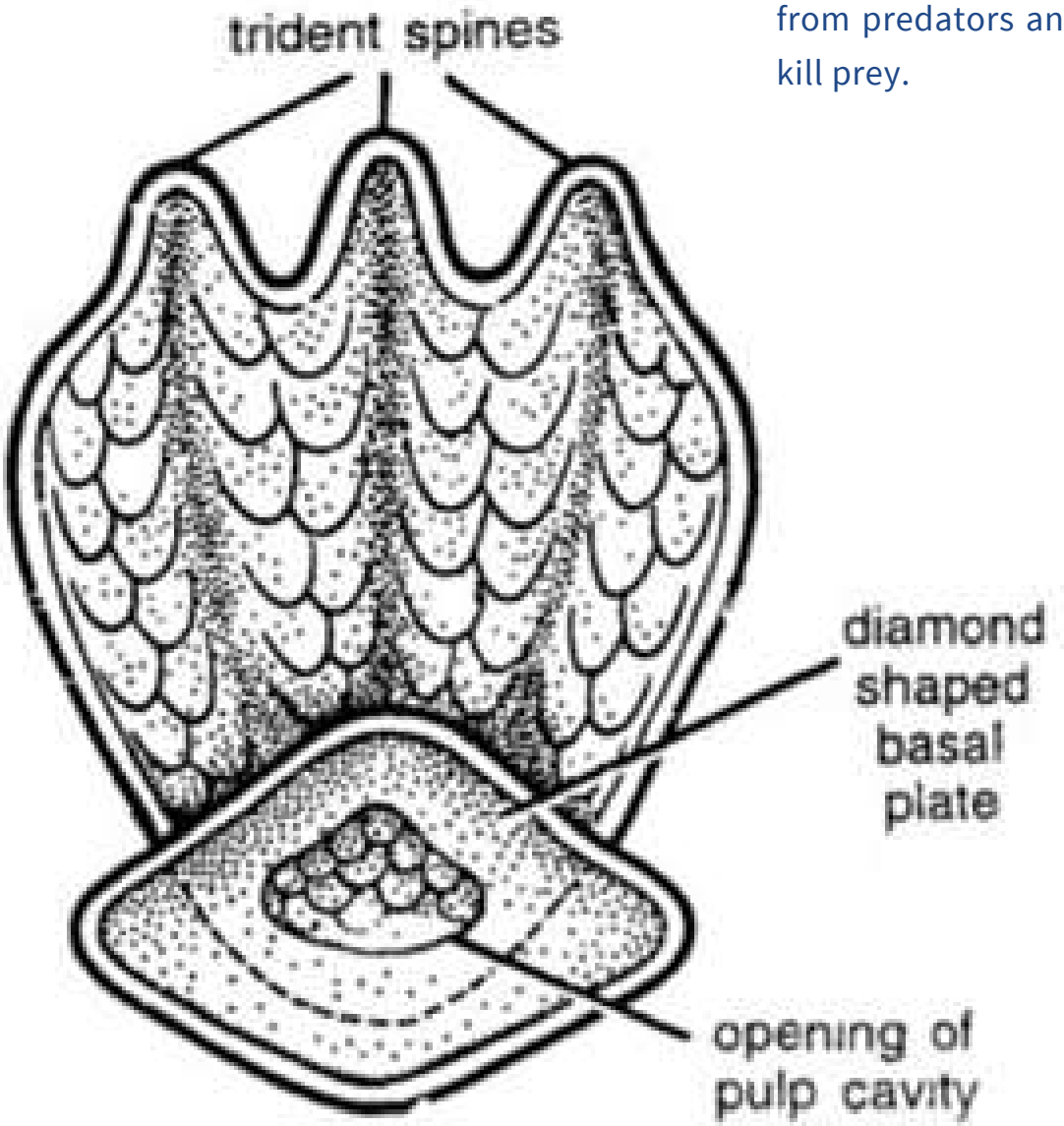
- Placoid
- Non-placoid

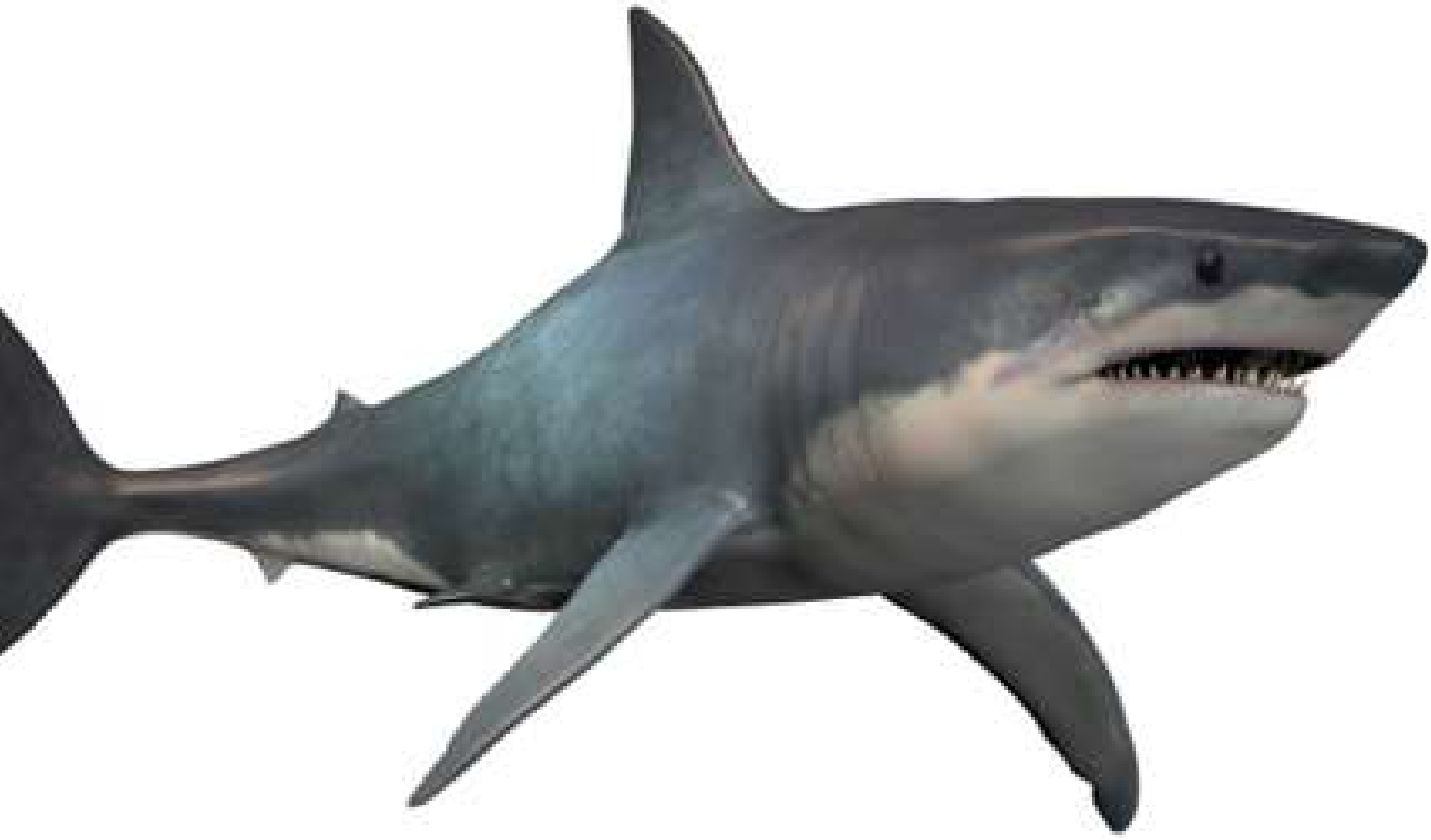


PLACOID SCALES

Placoid scales (or denticles) are spiny, toothlike projections seen only in cartilaginous fishes.

Placoid scales are rough to the touch and the structure they form is nearly impossible to penetrate. These scales function to protect a fish from predators and can even be used to injure or kill prey.





PLACOID SCALE

Such scales are found only in cartilaginous fish (Chondrichthyes) but are absent in the subclass Holocephali. The most common reference of this scale is to shark The scales cover the skin like sand grains. Placoid scales are arranged in different rows individually to form the outer skeleton.

At the bottom of each scales is a base plate and a pointed thorn arising from the base. This thorn is curved backwards. As a result, the scales protect the skin from abrasive injuries. Each base plate is made up of calcium-rich tissues.

These scales have the same structure as their teeth, and are also referred to as dermal denticles (dermal=skin, denticle=teeth).

These denticles are slanted toward the tail of the shark and help direct the flow of water around the shark's body, reducing friction so it can swim with less effort.

Unlike the scales of bony fishes, placoid scales do not increase in size as the fish grows, instead new scales are added between older scales

non-placoid scales

COSMOID

GANOID

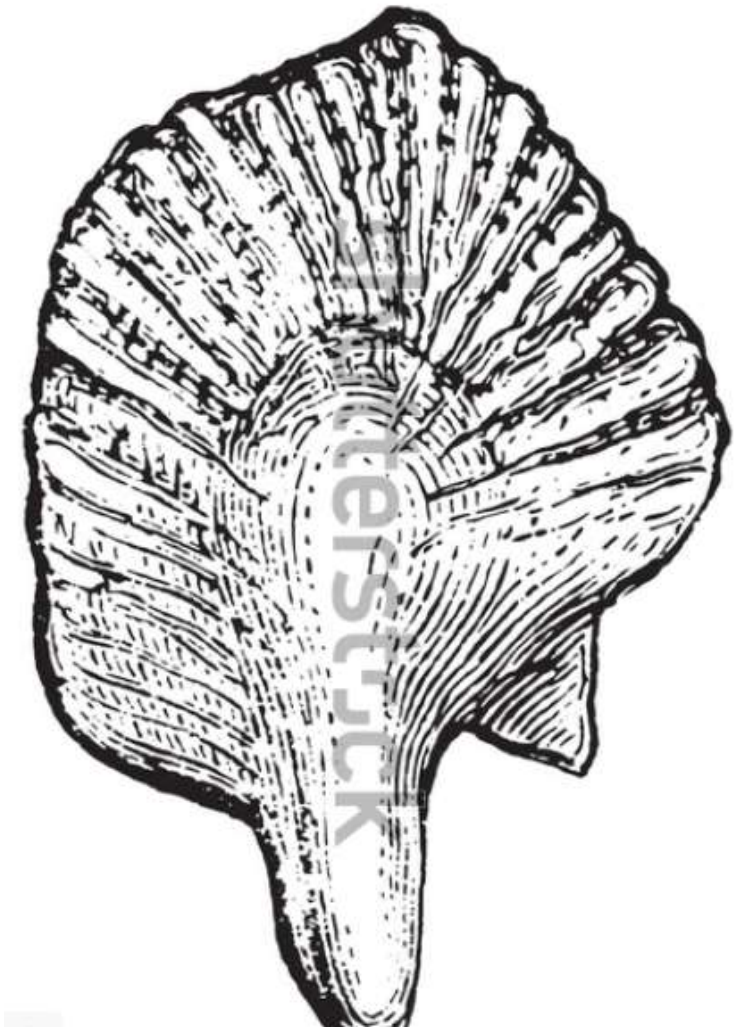
BONY RIDGE

Cycloid

Ctenoid

COSMOID SCALE

Cosmoid scales are similar to placoid scales and probably evolved from the fusion of placoid scales. They consist of two basal layers of bone, a layer of dentine-like cosmine, and an outer layer of vitrodentine



cosmoid scale

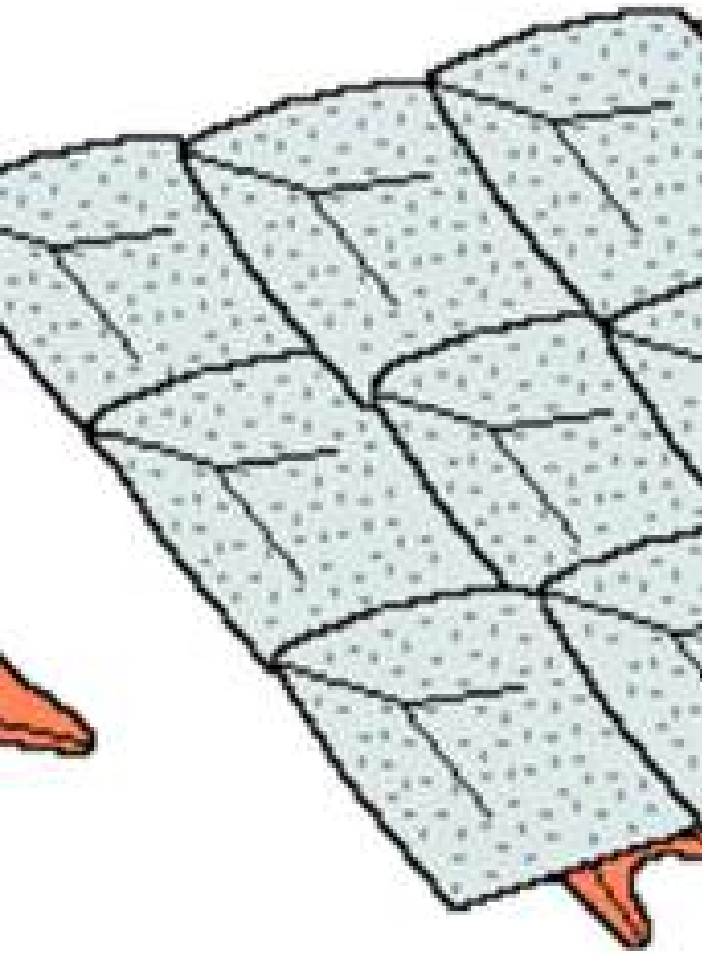
As the fish grows each scale becomes larger as new bone is added to the basal layers.

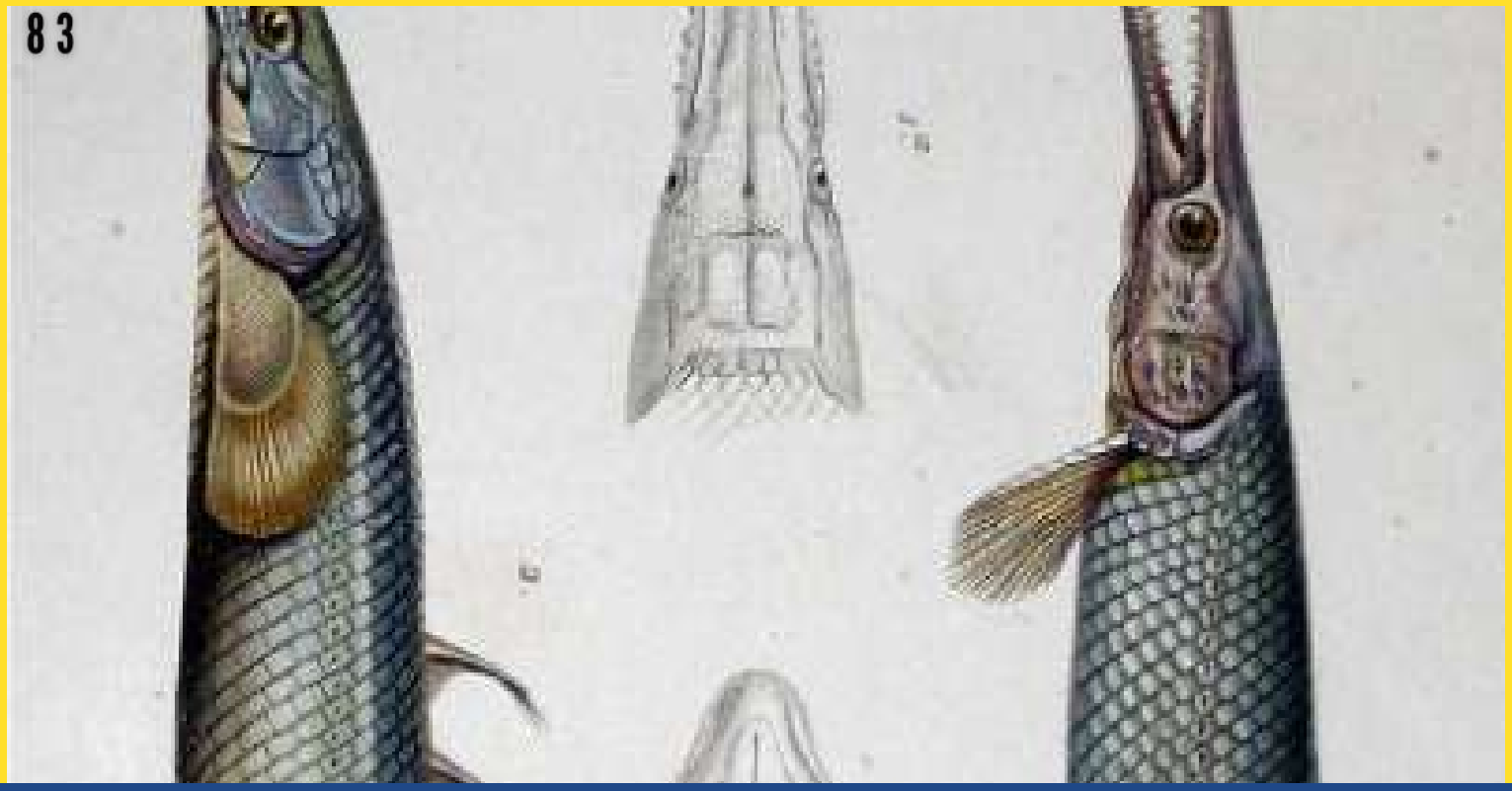
This scale found only in fossil lung-fish (Dipnoi), and in Crossopterygii, including the living coelacanth

GANOID SCALE

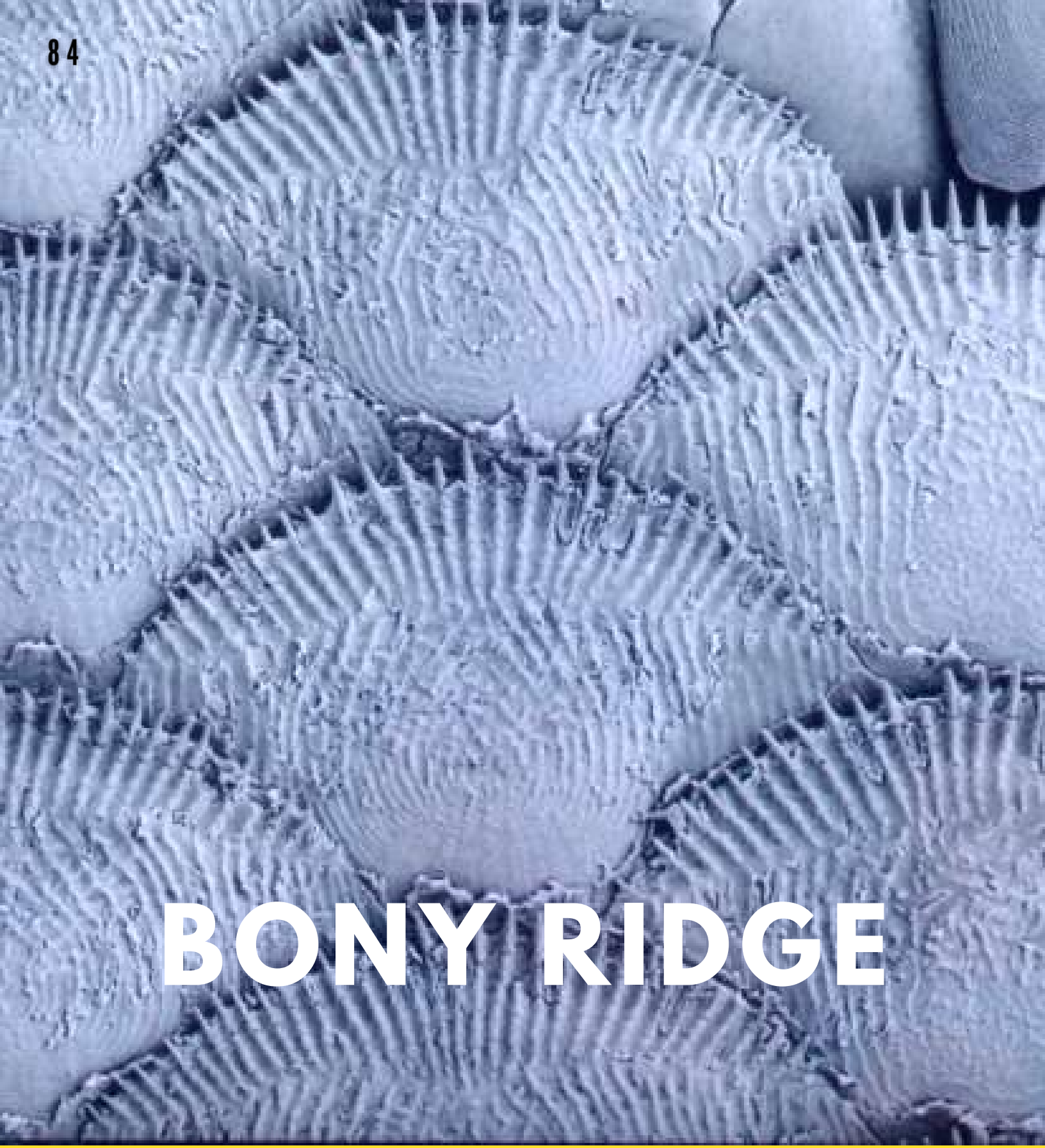
Ganoid scales consist of thick, usually diamond-shaped plates. The roof also has tile-like scales attached side by side to form a bony covering. In some cases, the scales overlap.

Sometimes considered a modification of the placoid type, are chiefly bony but are covered with an enamel-like substance called ganoin





Diamond-shaped ganoid scales, present in gars and bichirs and considered primitive for bony fishes, are composed of layers of silvery enamel (ganoin) on the upper surface and bone on the lower.



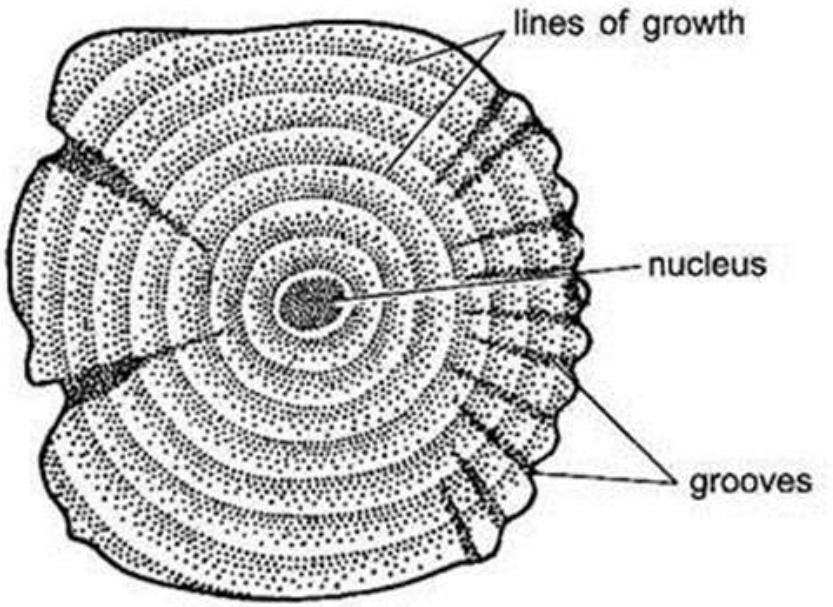
BONY RIDGE

CYCLOID & CTENOID

This scales are thin, piercing. It does not have enameloid and dentinal layer. This type of scales is found in most living bony fish(Osteichthyes).

They are overlapping which allow for greater flexibility in movement than other types of scales such as ganoid scales

CYCLOID SCALE



This scales consist of round plates. The center of this scales is called nuclues. Many concentric circular growth lines can be seen from the nucleus. The upper part of these growth lines is made up of thin bony and the lower part is made up of fibrous connective tissue.

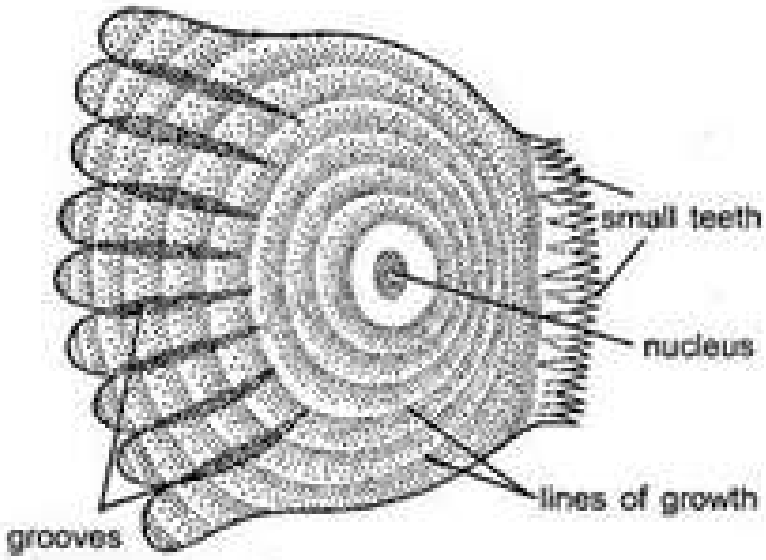
The surface layer of the scale is comprised of calcium-based salts and the inner layer is predominately collagen.

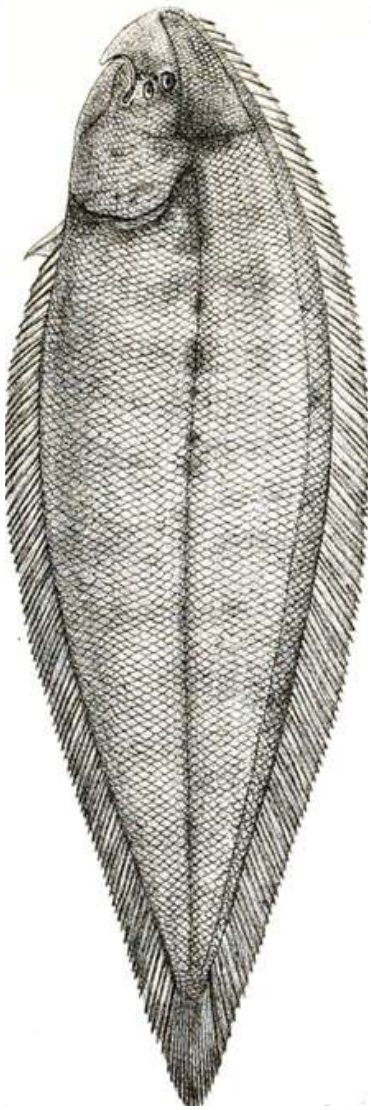
As a fish grows, its scales grow, adding concentric layers, similar to tree rings. For certain species, these rings can be counted to estimate the age of a fish

The anterior part of each scale is usually overlapped by the posterior portion of the scale in front. This arrangement of imbricate (overlapping) scales gives the fish greater flexibility than in those species with cosmoid and ganoid scales

Such scales are found in lungfish, some Holosteans and non-teleostean such as carp (Cypriniformes), hilsa (Clupeiformes) and cod (Gadiformes).

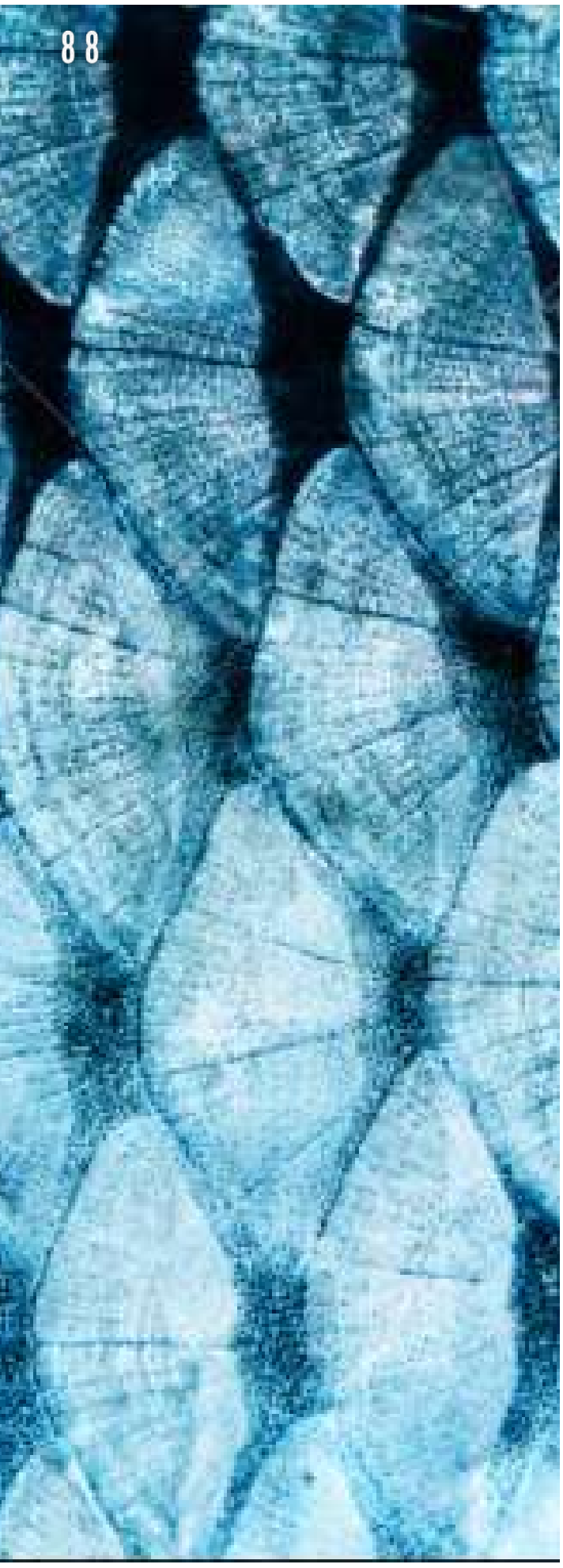
CTENOID SCALE





Ctenoid scales are similar to cycloid, except that they have spines or comblike teeth along their free edges.

Such scales can be seen in modern advanced teleostean fish such as perch (Perciformes), sunfish, etc



DO ALL FISH HAVE SCALES?

Not all fish have scales, some species such the Sun-fish (Mola mola) and the Siluroidei (Naked Catfish) have none at all.

Other species, like the Common Eel appear to have no scales, but they really have microscopic scales deeply embedded in their dermis.

Even in those fish that have scales, they do not always cover the whole body.

The size and distribution of scales over a fish's body often, but not always, reflect the way it lives.
Thus fish that swim quickly, or that live in fast flowing waters (Trout, Tuna etc), tend to have small scales.

While fish that swim slowly in slow moving waters, tend to have larger scales, i.e. Carp.

FISH SCALE EVOLUTION

Fish scales of modern fish are embedded in (and grow out of) the dermis and are covered entirely by the epidermis. They grow as the fish grow – thus, in many cases, they reflect a history of the fish's life

In other fish, some (as in the Flounder, Platichthys flesus) or all (as in the Diamond Flounder, P. stellatus) are modified into bony tubercles. Many other fish also have tubercles, such as Turbot and Black Sea Turbot (Scophthalmus spp.).

In other species of fish, some of the scales have become modified into shields to protect the lateral line or into spines. In Surgeon-fish and their allies (Teuthidae) these spines can be razor sharp. The moveable spines of Porcupine-fishes (Diodontidae) and Puffers (Tetraodontidae) are also modified scales.

SCALE EVOLUTION

IN SOME S. AMERICAN CATFISHES, THE SCALES HAVE BECOME MODIFIED INTO BONY PLATES TO MAKE ARMOUR.
THIS IS ALSO THE CASE IN SEA HORSES AND PIPE FISH.
IN THESE CASES THE ADDED PROTECTION IS PAID FOR BY REDUCED FLEXIBILITY AND SPEED.

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