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An introduction to the classification of elasmobranchs

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Introduction

The term Elasmobranchs or chondrichthyans refers to the group of marine organisms with a skeleton made of cartilage. They include sharks, skates, rays and chimaeras. These organisms are characterised by and differ from their sister group of bony fishes in the characteristics like cartilaginous skeleton, absence of swim bladders and presence of five to seven pairs of naked gill slits that are not covered by an operculum. The chondrichthyans which are placed in Class Elasmobranchii are grouped into two main subdivisions Holocephalii (Chimaeras or ratfishes and elephant fishes) with three families and approximately 37 species inhabiting deep cool waters; and the Elasmobranchii, which is a large, diverse group (sharks, skates and rays) with representatives in all types of environments, from fresh waters to the bottom of marine trenches and from polar regions to warm tropical waters with over 950 different species. Chimaeras are big-

eyed, stomachless, deep-sea creatures that possess an upper jaw which is fused to its cranium (unlike in sharks). The great majority of the commercially important species of chondrichthyans are elasmobranchs. The latter are named for their plated gills which communicate to the exterior by 5–7 openings. In total, there are about 869+ extant species of elasmobranchs, with about 400+ of those being sharks and the rest skates and rays. Taxonomy is also perhaps infamously known for its constant, yet essential, revisions of the relationships and identity of different organisms. Classification of elasmobranchs certainly does not evade this process, and species are sometimes lumped in with other species, or renamed, or assigned to different families and other taxonomic groupings. It is certain, however, that such revisions will clarify our view of the taxonomy and phylogeny (evolutionary relationships) of elasmobranchs, leading to a better understanding of how these creatures evolved.

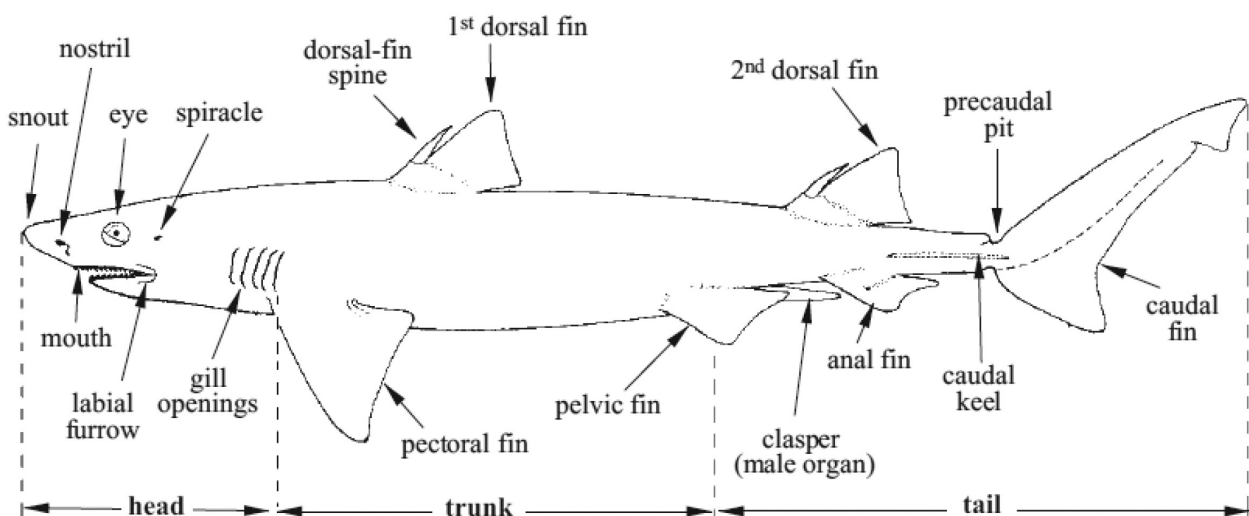


Fig. 1. Main parts of an Elasmobranch fish

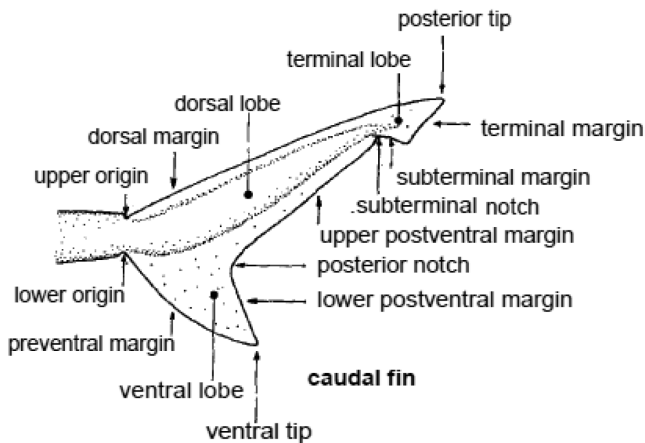


Fig. 2. Shark tail

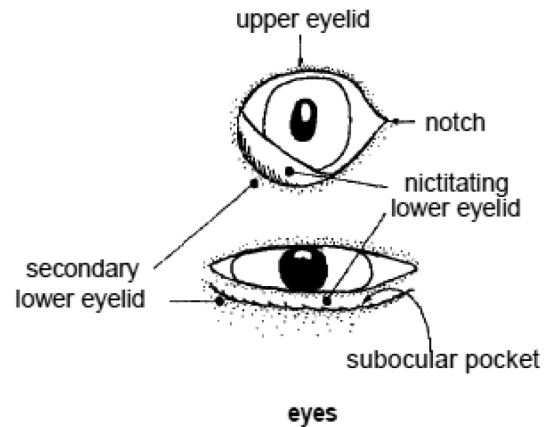


Fig. 3. Eye of sharkw (Source: FAO Species Catalogue No.8, vol. 1)

Class Chondrichthyes (cartilaginous fishes)

- Subclass Holocephali (chimaeras and fossil relatives)
- Order Chimaeriformes (chimaeras or silver sharks)
- Subclass Neoselachii (modern sharks and batoids)
- Cohort Selachii (modern sharks)

Superorder Squalomorphii (Squalomorph sharks)

- Order Hexanchiformes (cow and frilled sharks)
- Order Squaliformes (dogfish sharks)
- Order Squatiniformes (angel sharks)
- Order Pristiophoriformes (sawsharks)

Superorder Galeomorphii (Galeomorph sharks)

- Order Heterodontiformes (bullhead sharks)
- Order Lamniformes (mackerel sharks)
- Order Orectolobiformes (carpet sharks)
- Order Carcharhiniformes (ground sharks)
- Cohort Batoidea (batoids)
- Order Torpediniformes (electric rays)
- Order Pristiformes (sawfishes)
- Order Rajiformes (skates and guitarfishes)
- Order Myliobatiformes (stingrays)

Order Hexanchiformes (cow and frilled sharks)

- One dorsal fin, without spine, trunk cylindrical, head slightly depressed
- Anal fin present
- Six or seven gill slits present on sides of head, posteriormost in front of pectoral fin origins
- Eyes without nictitating fold
- Spiracle present but small, well behind eye
- Nostrils without barbels
- Nasoral grooves separate from mouth
- Mouth large, arched and elongated, extending well behind eyes

- Labial furrows when present reduced or absent on lower jaw
- Teeth without enlarged anterior or posterior teeth without a gap or small intermediate teeth between anterior and lateral teeth in the upper jaw
- 2 families
- Family Chlamydoselachidae (Genus Chlamydoselachus)
- Family Hexanchidae (Genera Hexanchus, Heptanchias)

Order Squaliformes - dogfish sharks

- Two dorsal fins, with or without spines
- Anal fin absent
- Five gill slits
- Spiracles present
- Nictitating lower eyelid absent
- Lateral-line canal closed
- 7 families - Echinorhinidae*, Oxynotidae, Squalidae, Etmopteridae, Centrophoridae, Somniosidae, Dalatiidae
- As per Nelson (2006), Family Echinorhinidae is placed in a separate order Echinirhiniformes

Order Squatiniformes – angel sharks.

- Marine, temperate to tropical, found along continental shelves and upper slopes
- Atlantic, and Pacific
- Body ray like
- Eyes dorsal
- Two spineless dorsal fins
- No anal fin
- Five gill openings
- Spiracle large
- Mouth almost terminal
- Nostrils terminal with barbels on anterior margin. Maximum length up to 2 m.
- Family Squatinidae– angel sharks.

Order Pristiophoriformes– saw sharks.

- Marine (rarely in estuaries), temperate to tropical, continental and insular shelves and slopes

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- TL = TOTAL LENGTH
- FL = FORK LENGTH
- PCL = PRECAUDAL-FIN LENGTH
- PD2 = PRE-SECOND DORSAL-FIN LENGTH
- PD1 = PRE-FIRST DORSAL-FIN LENGTH
- HDL = HEAD LENGTH
- PG1 = PREBRANCHIAL LENGTH
- PSP = PRESPIRACULAR LENGTH
- POB = PREORBITAL LENGTH
- PP1 = PREPECTORAL-FIN LENGTH

- PP2 = PREPELVIC-FIN LENGTH
- SVL = SNOUT-VENT LENGTH
- PAL = PREANAL-FIN LENGTH
- IDS = INTERDORSAL SPACE
- DCS = DORSAL CAUDAL-FIN SPACE
- PPS = PECTORAL-FIN PELVIC-FIN SPACE
- PAS = PELVIC-FIN ANAL-FIN SPACE
- ACS = ANAL-FIN CAUDAL-FIN SPACE
- PCA = PELVIC-FIN CAUDAL-FIN SPACE
- VCL = VENT CAUDAL-FIN LENGTH

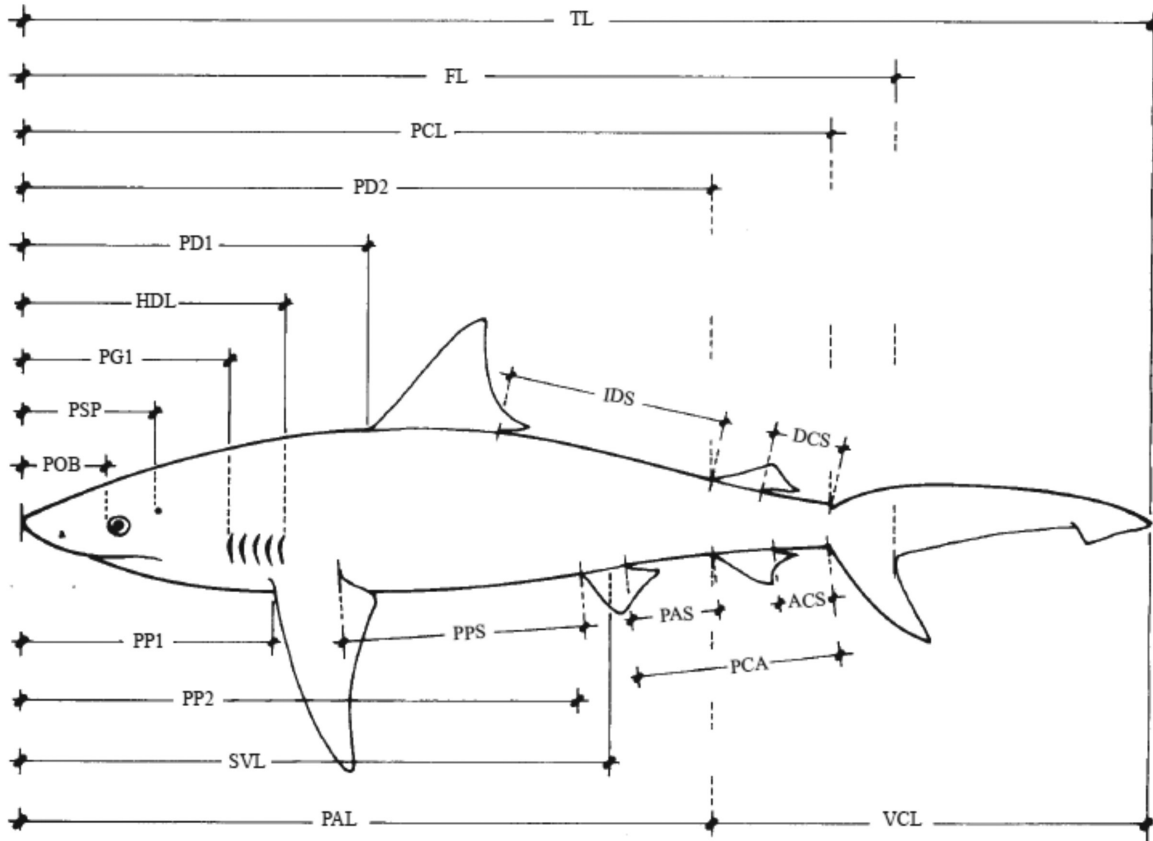


Fig. 17 Main longitudinal measures

- PRN = PRENARIAL LENGTH
- POR = PREORAL LENGTH
- EYL = EYE LENGTH
- EYH = EYE HEIGHT
- ING = INTERGILL LENGTH
- GS1 = FIRST GILL SLIT HEIGHT
- GS2 = SECOND GILL SLIT HEIGHT
- GS3 = THIRD GILL SLIT HEIGHT
- GS4 = FOURTH GILL SLIT HEIGHT
- GS5 = FIFTH GILL SLIT HEIGHT
- GS6 = SIXTH GILL SLIT HEIGHT
- GS7 = SEVENTH GILL SLIT HEIGHT
- P1A = PECTORAL-FIN ANTERIOR MARGIN
- P1R = PECTORAL-FIN RADIAL LENGTH
- P1B = PECTORAL-FIN BASE
- P1I = PECTORAL-FIN INNER MARGIN
- P1P = PECTORAL-FIN POSTERIOR MARGIN
- P1H = PECTORAL-FIN HEIGHT
- P1L = PECTORAL-FIN LENGTH
- SOD = SUBOCULAR POCKET DEPTH

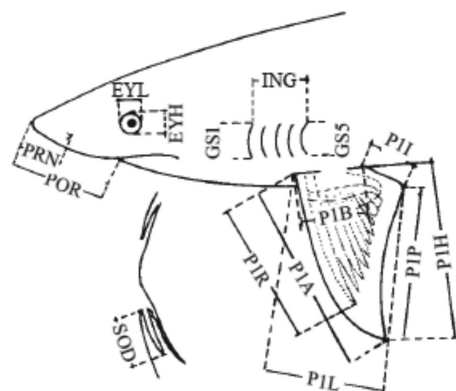


Fig. 18 Measurements of pectoral fin, gill slits, eye and snout

Fig. 4 Measurements used for sharks (Source: FAO Species Catalogue No.8, vol. 1)

- Western Atlantic in region of Bahamas, Florida, and Cuba, Southwestern Indian off South Africa, and Western Pacific from Southern Australia to Japan.
- Body shark like
- Snout produced in along flat blade with teeth on each side
- One pair of long barbels
- No dorsal fin spines
- Anal fin absent
- Spiracles large

Family Pristiophoridae - saw sharks.

Superorder Galeomorphii (Galeomorph sharks)

Order Heterodontiformes (bullhead sharks)

- Two dorsal fins, each with a spine
- Anal fin present
- Five gill slits
- Spiracle present but small
- Snout pig like
- Nictitating fold absent
- Oviparous
- One family - Heterodontidae
- 1genus Heterodontus, with eight species

Order Lamniformes – mackerel sharks

- Head conical, not expanded laterally
- Eyes usually on sides of head
- Nictitating eyelids, barbels absent
- Snout very short
- Spiracles usually present
- Five gill slits, last two above pectoral fin origin
- Two dorsal fins, without spines
- Anal fin present
- 7 families with 10 genera and 15 species
 - * Family Odontaspidae - Sand Tiger Sharks
 - * Family Pseudocarchariidae - Crocodile Sharks
 - * Family Alopiidae – Thresher Sharks
 - * Family Cetorhinidae– Basking Sharks
 - * Family Lamnidae - Mackerel Sharks
 - * Family Mitsukurinidae - Goblin Sharks
 - * Family Megachasmidae – Megamouth Sharks

Family Odontaspidae - sand tiger sharks

Eyes relatively small
 Gill openings all in front of pectoral fin, relatively large but not extending onto dorsal surface of head
 Caudal peduncle with an upper precaudal pit, without a lateral keel
 2 genera- Carcharias and Odontaspis, with three species Carcharias taurus-, Odontaspis ferox, Odontaspis noronhai

Family Mitsukurinidae - goblin sharks

Head nearly as long as trunk
 Snout with a greatly elongated with flattened blade like projections
 Jaws very protusible
 Gill openings short
 Peduncle pit absent
 Eye small
 Caudal fin long but ventral lobe not developed
 One genus, one species- Mitsukurina owstoni, Goblin shark

Family Pseudocarchariidae - crocodile sharks

Eyes exceptionally large
 Mouth large, parabolic, ventral on head, jaws protrusible
 Teeth large, anterior ones narrow, laterals compressed blade like
 Gill openings extending onto dorsal surface of head
 Pectoral fins small, pelvic large
 Caudal peduncle with upper and lower precaudal pits and with low lateral keel
 One genus with one species- Pseudocarcharias kamoharai, Crocodile shark

Family Megachasmidae – megamouth sharks

Head elongated, about length of trunk
 Mouth very large, terminal
 Snout short and broadly rounded
 Gill opening moderately long but not extending onto dorsal surface of head last two gill slits over pectoral fin base
 Teeth small, in numerous rows
 One genus with one species Megachasma pelagios- Megamouth shark

Family Alopiidae – thresher sharks

Upper lobe of caudal fin long and curving, about as long as rest of shark
 Last two gill openings above pectoral fin base
 Gill openings short
 Mouth small
 Pectoral fins long and narrow
 One genus, Alopias, with three species

Alopias superciliosus

Head nearly flat between eyes, with a deep horizontal groove on nape on each side above gills
 Eyes very large, with orbits expanded onto dorsal surface of head

Alopias pelagicus

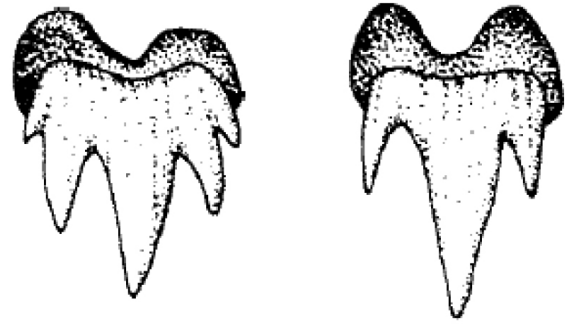
Head narrow, forehead nearly straight
 Eyes smaller, with orbits not expanded onto dorsal surface of head
 Pectoral fins nearly straight and broad-tipped

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Sides above pectoral bases dark

Alopias vulpinus

Head broad, snout shorter
 Eyes smaller, with orbits not expanded onto dorsal surface of head
 Forehead strongly arched
 Sides above pectoral-fin bases marked with a white patch



Family Cetorhinidae– basking sharks

Gill openings exceptionally large, extending almost to the top of the head;
 Teeth small and numerous
 Mouth large
 Eye small
 Gill rakers elongate
 One genus with one species *Cetorhinus maximus*, basking shark

- Spiracles present
- Teeth very small, numerous, with a single medial cusp and usually one or more cusplets on each side near the center of mouth
- Intestine with spiral valve
- Lateral keels or precaudal pits absent on caudal peduncle
- 16 genera- of which 7 genera are deep sea forms found in Indian Ocean
 Apristurus, Atelomycterus, Aulohalaelurus, Haploblepharus, Cephaloscyllium, Scyliorhinus, Poroderma, Holohalaelurus, Halaelurus, Scyliorhinus

Family Lamnidae - mackerel sharks

Large sharks with pointed snouts and spindle-shaped bodies
 Mouth large with blade like teeth, 40 rows in each jaw
 Gill slits long ending far lateral to mid dorsal surface
 Gill rakers absent
 Caudal fin nearly symmetrical and caudal peduncle with strong lateral keel and precaudal pits.
 Three genera, *Carcharodon*, *Isurus* and *Lamna*, with five species

Family Proscyllidae– finback cat sharks

- Nictitating eyelids rudimentary
- Spiracles large
- Posterior teeth comb like
- Labial furrows short or absent
- Three genera, *Ctenacis* (1), *Eridacnis*(3), and *Proscyllium* (1), with five species

Genus *Isurus*

- Cusplets absent on teeth
- Origin of first dorsal fin over or behind rear tips of pectoral fins
- Origin of second dorsal fin well in front of anal-fin origin
- Secondary keel absent on caudal fin
- 2 species - *Isurus oxyrinchus* and *Isurus paucus*

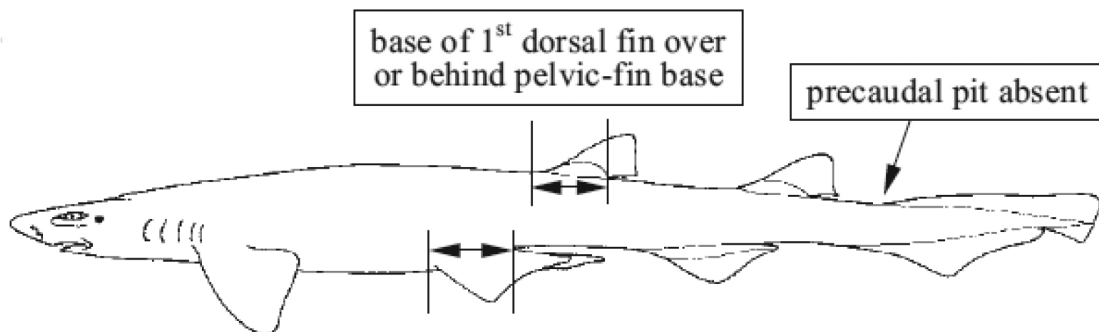
Family Pseudotriakidae– false cat sharks

- First dorsal fin low, elongate, and keel –like
- Nictating eyelids rudimentary
- Spiracles large
- Tooth rows exceptionally numerous
- Posterior teeth comblike
- Two monotypic genera, *Gollum* and *Pseudotriakis*

Family Scyliorhinidae - cat sharks

- Small sharks , body slender and elongated
- 5 gill slits, the last two posterior to pectoral fin origins
- First dorsal fin base opposite or behind pelvic fin base
- Nictitating eyelids rudimentary

Family Leptochariidae– barbeled hound sharks



- Labial furrows very long
- Anterior nasal flaps formed into slender barbels
- Nictitating eyelids internal
- Spiracles small
- Intestine with spiral valve
- One species, *Leptocharias smithii*, Barbeled hound shark

Family Triakidae– hound sharks

- Labial furrows moderately long
- Anterior nasal flaps usually not slender or barbel like
- Spiracles present
- Intestine with spiral valve
- Nine genera with at least 38 species

Family Hemigaleidae– weasel sharks

- Dorsal fin margin undulated
- Precaudal pit present
- Nictitating membrane internal
- Spiracles small
- Labial furrows moderately long
- Intestine with spiral valve
- Four genera, *Chaenogaleus* (1), *Hemigaleus* (1), *Hemipristis* (1), and *Paragaleus* (4), with seven species

Order Orectolobiformes - carpet sharks

- Two dorsal fins, without spines
- Anal fin present, broad, last two to four above or behind pectoral fin origin
- Five narrow gill slits
- Nictitating eyelids absent
- Barbels and nasoral grooves present
- Spiracles present
- Mouth short, ends in front of eyes
- 7 families, 14 genera and 32 species

Family Parascyllidae

Family Brachaeluridae

Family Orectolobidae

Family Hemiscylliidae

Family Stegostomatidae

Family Ginglymostomatidae

Family Rhincodontidae

Species reported from Indian waters

Stegostoma fasciatum (Hermann, 1783)

Nebrius ferrugineus (Lesson, 1830)

Rhincodon typus Smith, 1828

Suborder Parascyllioidei

Spiracles minute, without gill filaments; fifth gill opening large

Origin of anal fin well in front of origin of second dorsal fin.

Suborder Orectoloboidei

Spiracles moderate to large, with gill filaments; fifth gill opening moderate

in size

Origin of anal fin behind origin of second dorsal fin.

Family Parascyllidae – collared carpet sharks

- Marine, tropical to temperate, continental to slopes
- Spiracles minute
- Anal fin origin well in front of origin of second dorsal-fin
- Short caudal fin
- Caudal fin origin behind anal fin base at a distance greater than anal fin base
- Maximum length 3.3m, in *Cirrhoscyllium exolitum*, most under 9 m Two genera, *Cirrhoscyllium* and *Parascyllium*, with seven species.

1.Genus *Cirrhoscyllium*

Snout long, narrow pointed

A pair of barbels on throat

Head broad and flattened

Eyes oval

Spiracles large.

Origin of anal fin well behind second dorsal origin, separated from lower caudal origin by space less than its base length

Pectoral fins thin, large

Dark saddles present on body.

2.Genus *Parascyllium*

Snout short, thick, and broadly rounded

Pectoral fins thick, muscular, and rather small

No barbels on throat

Eyes more elongated and slit-like

Body with spots, in some with collar

Family Brachaeluridae - blind sharks

- Marine, tropical to temperate continental shelf, primarily coastal
- Spiracles large
- Nasal barbels very long
- Eyes dorsolateral
- Vertebrae 117-142.
- Maximum length about 1.2m, reported in *Brachaelurus waddi*.
- Two monotypic extant genera, *Brachaelurus* and *Heteroscyllium*

Family Rhincodontidae (Rhiniodontidae) - whale shark

- Broad, flat head, truncated snout
- Mouth large, terminal
- Caudal peduncle with strong lateral keels.
- Caudal fin with a strong ventral lobe, but without a strong terminal lobe and subterminal notch
- Teeth reduced, numerous internal gill slits inside mouth cavity with filter screens.
- Gill openings very large, fifth gill slit well separated from

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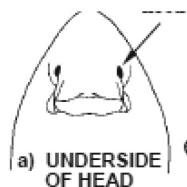
- Gill rakers elongate
- One species *Rhincodon typus*, whale shark

Family Orectolobidae – wobbegongs

- Marine, tropical to warm temperate, continental shelf
- Head and body depressed; flattened, variegated
- Mouth nearly terminal; skin flaps present
- Nostrils with very long pointed or branched barbels
- Spiracles large, gill slits small
- Enlarged fang like teeth at symphysis of upper and lower jaws
- Maximum length about 3.2m, reported in *Orectolobus maculatus*
- Three genera, *Eucrossorhynchus*, *Orectolobus* and *Sutorectus*, with six species

Family Hemiscylliidae - bamboo sharks

- Marine, tropical and subtropical, continental shelves
- Small, slender sharks, nasal barbels short; spiracles large
- Dorsal fins two, spineless
- Anal fin low and rounded, origin well behind origin of second dorsal fin
- Caudal peduncle without lateral keels or precaudal pits
- Vertebrae 151-192
- Maximum length about 1.0m, recorded in *Chiloscyllium punctatum* and 70 cm in *Hemiscyllium ocellatum*.
- Two genera, *Chiloscyllium* and *Hemiscyllium* with 12 species.

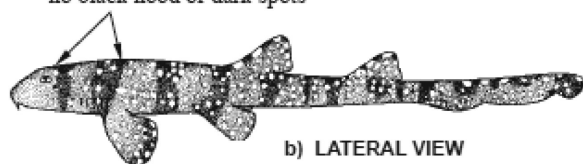


1. Genus *Chiloscyllium*

- Nostrils subterminal on snout
- Preoral snout long
- Mouth closer to eyes than snout tip
- Eyes and supraorbital ridges hardly elevated
- 7 species recognised –

- Chiloscyllium indicum*
- Chiloscyllium plagiosum*
- Chiloscyllium arabicum* -Arabian carpet shark
- Chiloscyllium punctatum*
- Chiloscyllium burmensis*

no black hood or dark spots



- Chiloscyllium griseum* - Grey bamboo shark
- Chiloscyllium hasselti*

2. Genus *Hemiscyllium*

- Nostrils terminal on snout
- Preoral snout short
- Mouth closer to snout tip than eyes
- Eyes and supraorbital ridges prominently elevated
- Large dark spot or spots on sides of body above pectoral fins, or a black hood on head
- 5 species recognised –

- Hemiscyllium strahani*
- Hemiscyllium trispiculare*
- Hemiscyllium freycineti*
- Hemiscyllium ocellatum*
- Hemiscyllium hallstromi*



Family Stegostomatidae - zebra sharks

- Species moderate in size
- Eyes placed lateral on head without movable upper eyelids
- Spiracles large
- Nostrils with short pointed barbels
- Caudal fin unusually long, almost as long as rest of shark
- Caudal peduncle without lateral keels or precaudal pits
- Maximum length possibly 3.5m, usually under 2.5m
- One genus, one species, *Stegostoma fasciatum* (Hermann, 1783).

Family Ginglymostomatidae – nurse sharks

- Spiracles small, behind the eyes
- Eyes placed lateral on head in *Nebrius*
- Nostrils with short to moderately long barbels, no lobe and groove around outer edges of nostrils
- Circumnarial grooves absent, nasoral grooves present
- Fourth and fifth gill slits almost overlapping
- Maximum length about 3m, recorded in *Ginglymostoma cirratum* and *Nebrius ferrugineus*
- 3 monotypic genera, *Ginglymostoma*, *Nebrius* and *Pseudoginglymostoma*

1. Genus *Ginglymostoma*

- Nasal barbels elongate reaching mouth
- Lower lip trilobate
- Second dorsal and anal fins much smaller than first dorsal fin
- Eyes and gill openings dorsolateral on head
- Teeth neither compressed nor imbricate
- Pectoral fins broad and not falcate
- One species - *Ginglymostoma cirratum*

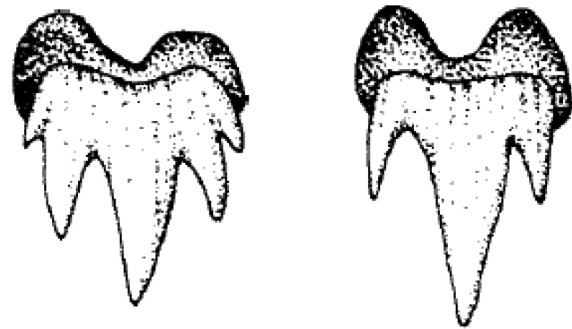
2. Genus *Nebrius*

- Eyes and gill openings lateral on head
- Teeth compressed on sides of jaws
- Pectoral, dorsal and anal fins angular apically
- Pectoral fins narrow and falcate

One species - *Nebrius ferrugineus* - Tawny nurse shark

3. Genus *Pseudoginglymostoma*

- Nasal barbels greatly reduced, not reaching mouth
- Lower lip not trilobate
- Caudal fin short
- One species - *Pseudoginglymostoma brevicaudatum*



Order Carcharhiniformes - ground sharks

This order includes many of the most ecologically and commercially important species.

Prominent characters are -

- Nictitating eyelids present
- Two dorsal fins without spines
- Anal fin present
- Five gill slits, with the last one to three over the pectoral fin
- Gill rakers absent
- Mouth extending behind eyes
- Includes 8 families, 49 genera, and at least 224 species

- Family Scyliorhinidae
- Family Proscylliidae
- Family Pseudotriakidae
- Family Leptochariidae
- Family Triakidae
- Family Hemigaleidae
- Family Carcharhinidae
- Family Sphyrnidae

16 genera- of which 7 genera are deep sea forms found in Indian Ocean

- Apristurus*, *Atelomycterus*, *Aulohalaelurus*, *Haploblepharus*, *Cephaloscyllium*, *Scyliorhinus*, *Poroderma*, *Holohalaelurus*, *Halaelurus*, *Scyliorhinus*

Family Carcharhinidae – requiem sharks

- Dorsal fin margin undulated, origin ahead of pelvic base.
- Precaudal pit present
- Spiracles usually absent
- Nictitating eyelids internal
- Intestine with scroll valve
- 32 species from Western Indian Ocean

Family Scyliorhinidae - cat sharks

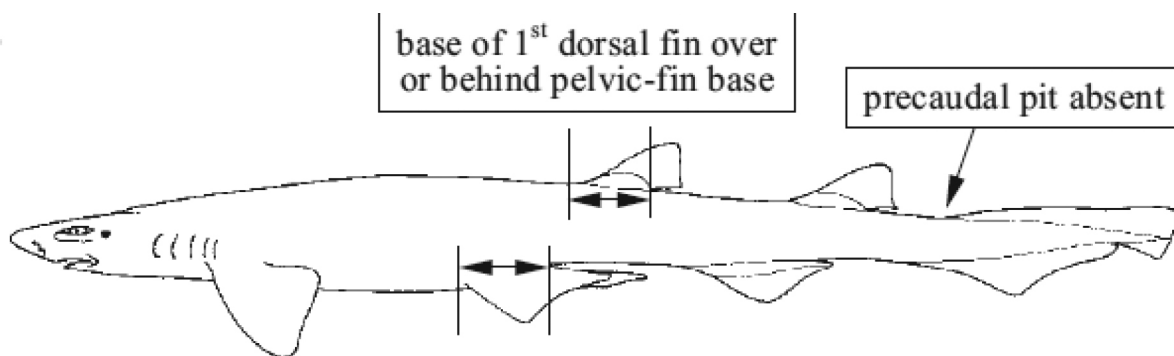
- Small sharks , body slender and elongated
- 5 gill slits, the last two posterior to pectoral fin origins
- First dorsal fin base opposite or behind pelvic fin base
- Nictitating eyelids rudimentary
- Spiracles present
- Teeth very small, numerous, with a single medial cusp and usually one or more cusplets on each side near the center of mouth
- Intestine with spiral valve
- Lateral keels or precaudal pits absent on caudal peduncle

1.Genus *Carcharhinus*

- Small to large sharks with round eyes, internal nictitating eyelids, usually no spiracles.
- Teeth usually blade like with one cusp.
- Development usually viviparous with young born fully developed. Includes several dangerous species.
- Carcharhinus hemiodon* (Valenciennes, in Müller & Henle, 1839) – Pondicherry shark -protected under WPA (1972).

2.Genus: *Rhizoprionodon*

- Labial furrow long, conspicuous
- Teeth oblique and narrow-cusped *Rhizoprionodon acutus* –Milk shark
- Distinct line of pores at corners of mouth
- Teeth narrow, sharply angled and finely serrated
- 2nd dorsal fin origin behind anal fin origin



3. Genus Galeocerdo

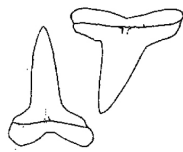
Short blunt snout
 Large mouth
 Pointed tail, curved serrated teeth,
 Raised keels on either side of caudal peduncle
 Dusky bars on body
 One species – *Galeocerdo cuvier*

4. Genus Triaenodon:

Snout very short, broadly rounded
 Teeth narrow, smooth-edged cusps with strong cusplets
 on each side, no serrations
 First dorsal and caudal fin tips broad white
 Second dorsal fin half the height of first dorsal.

5. Genus Negaprion:

Snout short
 Teeth with narrow unserrated cusps



6. Genus Lamiopsis:

Snout long
 Preoral length about equal to mouth width.
 Upper teeth with broad, triangular, serrated cusps, lowers
 with narrow, smooth cusps

7. Genus Loxodon:

Labial furrows reduced confined to mouth corners
 Notch present posteriorly on eye

8. Genus Scoliodon

Second dorsal fin smaller than first dorsal
 Head greatly depressed trowel-shaped.
 Pectoral fins triangular in shape

Free rear tip of first dorsal on a vertical over midbases of
 pelvic fins.
 Postventral margin of caudal fin only slightly concave.

9. Genus Prionace

10. Genus Nasolamia

Snout very narrow
 Nostrils large close-set
 Internarial space 1.3 times nostril width or less

11. Genus Glyphis

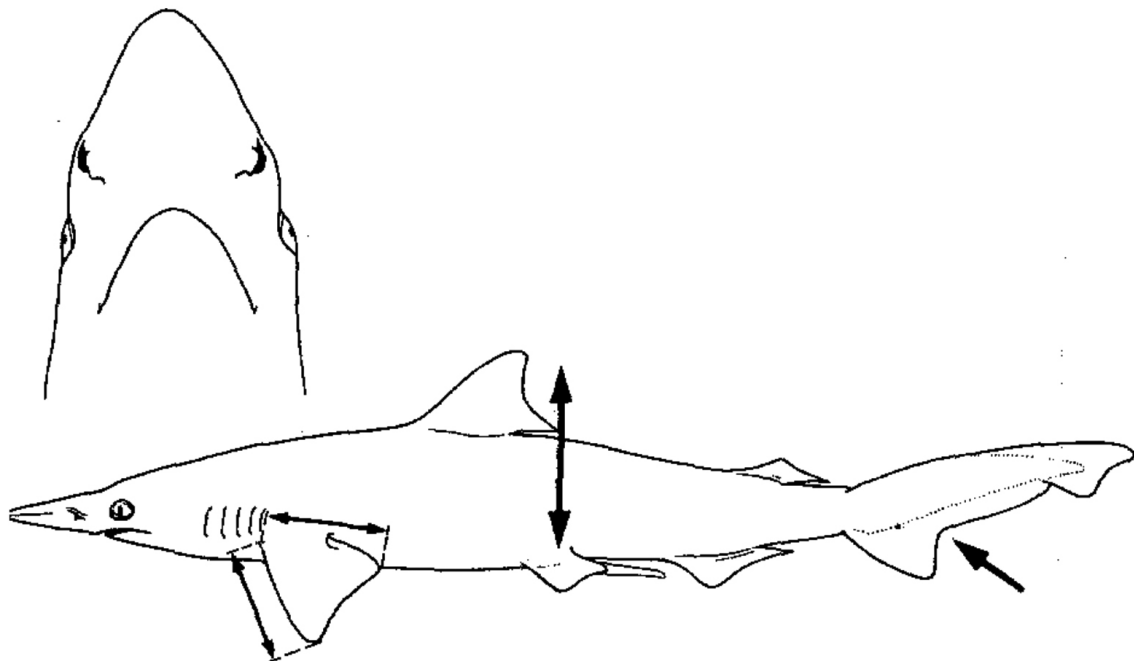
Cusps of lower teeth protruding when mouth is closed
 Second dorsal fin 1/2 the height of first dorsal.
 Precaudal pits longitudinal
 Snout broader, smaller nostrils more widely spaced,
 internarial space 3 times the nostril width
Glyphis gangeticus – protected under Indian Wildlife
 Protection Act (1972)

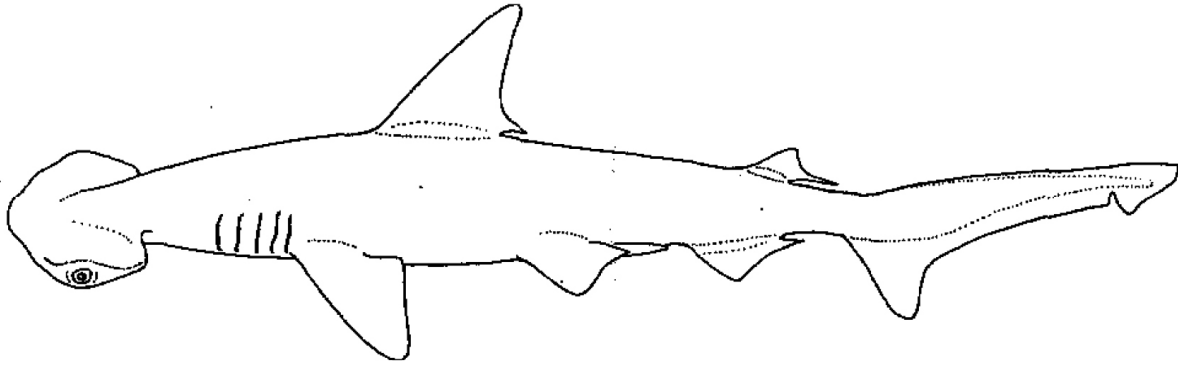
12. Genus Isogomphodon

Second dorsal fin smaller than first
 Snout triangular dagger-shaped in dorsoventral view,
 while narrow and spearlike laterally
 Tooth rows 49 - 56

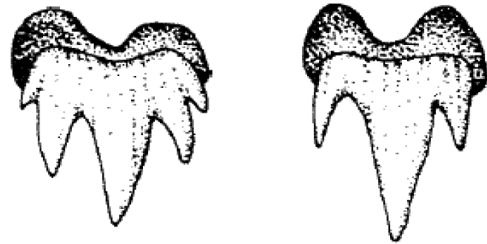
Family Sphyrnidae – hammerhead sharks

Head with lateral, bladelike expansions
 Eyes at its outer edges
 Two dorsal fins, first dorsal fin high and pointed, base
 shorter than caudal fin, anterior to origins of pelvic fins
 Second dorsal and anal fins much smaller than the first
 dorsal fin
 Three species reported from Indian waters





Sphyrna mokarran (Rüppell, 1837)
Sphyrna lewini (Griffith and Smith, 1834).
Sphyrna zygaena (Linnaeus, 1



examples of teeth
 (with a central cusp and one or more pairs of lateral cusplets)

Family Proscyllidae – finback cat sharks

Nictitating eyelids rudimentary
 Spiracles large
 Posterior teeth comb like
 Labial furrows short or absent
 Posterior teeth on dental bands comb like
 Labial furrows very short or absent, when present confined to mouth corners
 Three genera, *Ctenacis* (1), *Eridacnis*(3), and *Proscyllium* (1), with five species

Spiracles small
 Intestine with spiral valve
 One species, *Leptocharias smithii*, Barbeled hound shark

1. Genus Ctenacis

2. Genus Eridacnis

Eridacnis radcliffei Smith, 1913- Pygmy ribbontail catshark
 One of the smallest living sharks
 Anal fin and two equal-sized, spineless dorsal fins
 Nictitating eyelids, mouth triangular,
 Labial furrows rudimentary or absent, posterior teeth comblike

3.Genus Proscyllium

Family Pseudotriakidae – false cat sharks

Head without laterally expanded blades
 Eyes elongated and slitlike, nictating eyelids rudimentary
 Spiracles large
 Tooth rows exceptionally numerous
 Posterior teeth comb like
 First dorsal fin low, elongate, and keel –like
 Two monotypic genera, *Gollum* and *Pseudotriakis*

Family Leptochariidae – barbeled hound sharks

Eyes horizontally oval
 Labial furrows very long
 Anterior nasal flaps formed into slender barbels
 Nictitating eyelids internal

Family Hemigaleidae – weasel sharks

Dorsal fin margin undulated
 Precaudal pit present
 Nictitating membrane internal
 Spiracles small
 Labial furrows moderately long
 Intestine with spiral valve
 Four genera, *Chaenogaleus* (1), *Hemigaleus* (1), *Hemipristis* (1) and *Paragaleus* (4), with seven species

Family Triakidae – hound sharks

One of the most species-rich orders of sharks
 First dorsal fin originates in front of pelvic fins
 Labial furrows moderately long
 Anterior nasal flaps usually not slender or barbel like
 Spiracles present
 Intestine with spiral valve
 Anal fin smaller than second dorsal and with concave rear margin
 Precaudal pits absent
 Top edge of caudal fin not undulated
 9 genera with at least 38 species

1.Genus Mustelus

- Slender houndsharks with long, parabolic subangular snouts,
- Eyes dorsolateral, strong subocular ridges,

An introduction to the classification of elasmobranchs

- Mouths angular, teeth formed into a pavement, with cusps and cusplets variably developed
- Medial teeth not differentiated from anterolaterals
- Second dorsal fin nearly as large as first

1. *Mustelus mosis* Hemprich & Ehrenberg, 1899 - Arabian smooth-hound

Head snout short, broad internarial space,
 Large eyes, narrow interorbital space,
 Upper labial furrows about equal to lowers,
 Low-crowned teeth with weak cusps,
 Dorsal fins unfringed, a semifalcate ventral caudal lobe,
 59 to 81 precaudal centra,
 Heavily hypercalcified head and other cartilages.
 This is the only species of *Mustelus* in most areas where it occurs.

2. *M. mustelus*

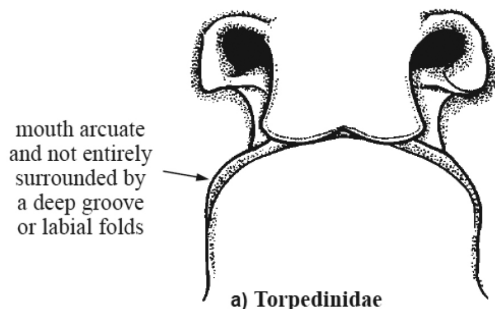
3. *M. mangloreanses*

Order Torpediniformes -electric rays

- Powerful electric organs, derived from branchial muscles in head region
- Skin soft and loose
- Eye small to obsolete
- Caudal fin well developed
- Dorsal fin 0-2
- Body disc thick and flabby, oval to roundish, snout short, truncate or rounded, skin soft and loose, without armature of dermal denticles or their modifications
- Tail section thick, caudal fin well developed
- Electric production is largely for feeding and defence.
- 2 families
 Family Torpedinidae– Torpedo Electric Rays
 Family Narcinidae – Numbfishes

Family Torpedinidae– torpedo electric rays

- Disc truncate or emarginated anteriorly
- Jaws extremely slender
- No labial cartilages
- Rostrum reduced
- Mouth arcuate and not entirely surrounded by a deep groove or labial folds
- Shape of disc truncate or emarginate anteriorly



- Two genera with 22 species

Subfamily Torpedinae (Torpedo electric rays)

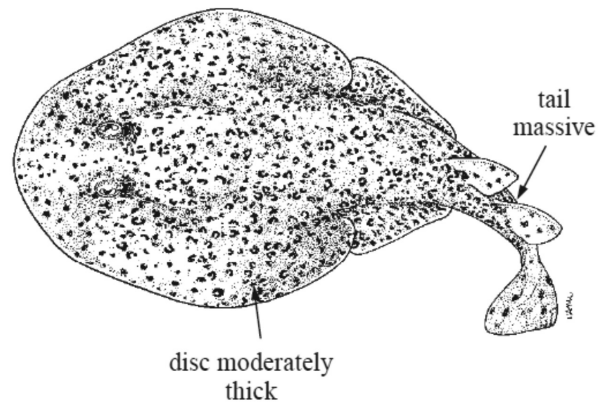
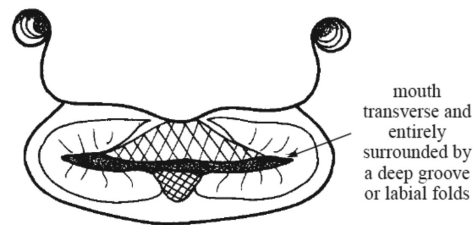
- Tail and dorsal and caudal fins well developed
- This taxon is ranked as a separate family by some workers
- Genus Torpedo

Sub family Hypninae (coffin rays)

- Tail and dorsal and caudal fins very small.
- Continental shelf and uppermost slope, off Australia

Family Narcinidae – numbfishes

- Disc rounded anteriorly;
- Jaws stout, strong labial cartilages
- Rostrum present
- Mouth transverse and entirely surrounded by a deep groove or labial folds



- Shape of disc rounded anteriorly
- 9 genera with around 37 species

The family has 10 recognized genera, with about 43 nominal species, of which four genera and five species are considered to be deep-sea inhabitants; three genera and five species occur in the Indian Ocean deep-sea.

Deep sea species occurring in the Indian Ocean

Benthobatis moresbyi Alcock, 1898 -Moresby's blind electric ray

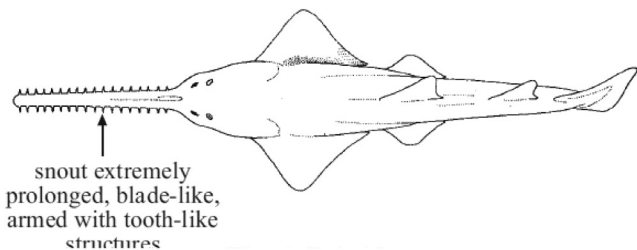
Sub family Narcininae (Numbfishes)

- Deep groove around mouth and lips, jaws long and strongly protractile

- Rostrum broad
- Usually two dorsal fins
- Four genera, *Benthobatis* (4), *Discopteg* (1), and *Narcine* (17), with 26 species and many undescribed species

Sub family Narkinae (Sleeper rays)

- Shallow grooves around mouth, jaws short and weakly protractile
- Rostrum narrow; usually a single dorsal fin
- Five genera, *Crassinarke* (1), *Heteronarce* (4), *Narke* (3), *Temera* (1) and *Typhlonarke* (2) with 11 species



Order Pristiformes– saw fishes

Family pristidae – sawfishes

- Snout produced in a long flat blade with teeth on each side
- Barbels absent
- Body somewhat shark like, although the head is depressed
- Two distinct dorsal fins and a caudal fin
- Two genera, *Anoxypristis* and *Pristis*, with about seven

species

1.Genus Pristis

Pristis zijsron

- Long, saw-toothed snout
- Gill slits located entirely on white ventral surface
- 1st dorsal fin origin is behind the pelvic fin origin
- 24-28 teeth on each side of saw that are more closely spaced nearer the saw-tip than near the mouth

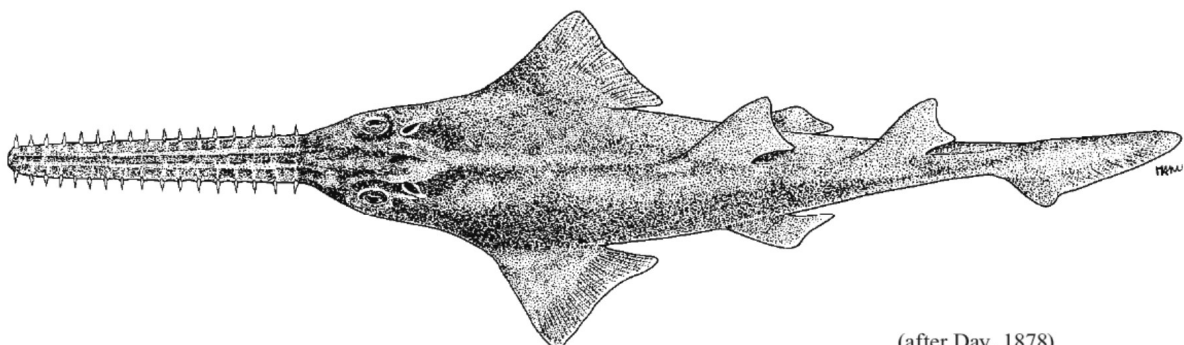
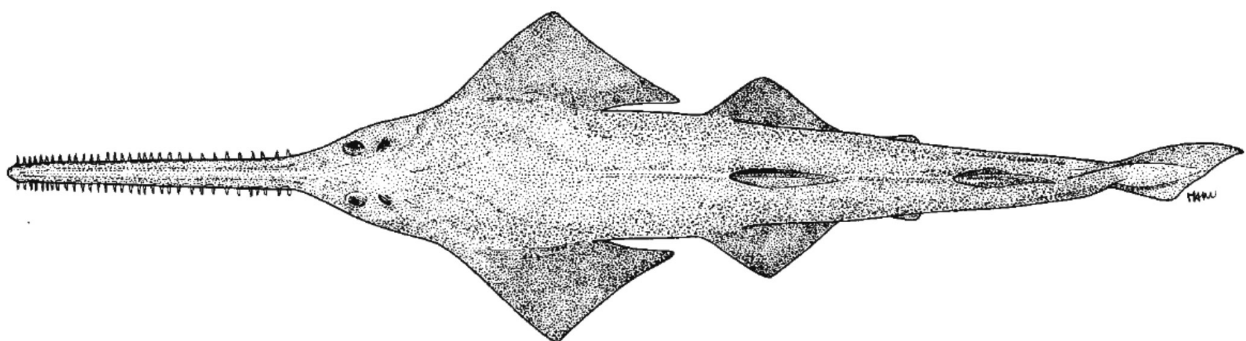
Pristis microdon Latham, 1851

- Rostral saw with 14 to 23 pairs of teeth
- Rostrum with sides markedly divergent posteriorly
- Rostrum broad and stout
- Rostral teeth moderately flattened, Elongated interspace between posterior most 2 rostral teeth
- 1 to 2 times space between first 2 rostral teeth
- First dorsal fin with origin well anterior to pelvic-fin origins
- No secondary caudal keel below the main one on the caudal-fin
- Caudal fin without a subterminal notch but with a short ventral lobe

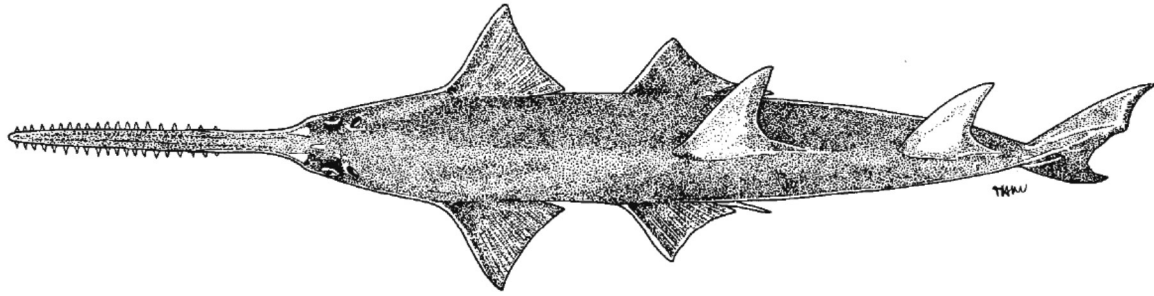
2.Genus Anoxypristis

Anoxypristis cuspidata (Latham, 1794)

- Rostral saw with 16 to 29 pairs of teeth
- Posteriormost teeth on rostral saw well anterior to base



(after Dav. 1878)



of saw
 Rostral teeth greatly flattened, blade-like, and triangular
 Broad incurrent grooves on underside of snout
 Nostrils long, narrow and diagonal
 A secondary caudal keel below the first one on the caudal-fin base.
 Caudal fin with a shallow subterminal notch and a long, prominent ventral lobe.

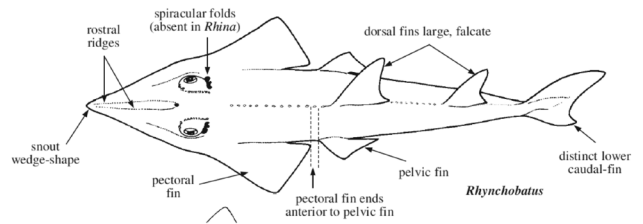
Caudal fin large, bilobed
 Origin of first dorsal over or in front of pelvics
 Head and anterior part of head broadly rounded, with deep indentation separating it from pectoral fin origin
 Rhina ancylostoma

Order Rajiformes – skates

Caudal fin moderately well developed, reduced , or absent;
 Tail extremely slender
 Dorsal fins 0-2
 Most with prickles or thorns on skin, often with a row along midline of back
 Claspers long , slender , and depressed distally
 Four families, 32 genera, and 285 species
 Family Rhinidae - Bowmouth Guitarfishes
 Family Rhynchobatidae - Wedge Fishes
 Family Rhinobatidae - Guitarfishes
 Family Rajidae - Skates

Family Rhynchobatidae - wedge fishes

Body moderate between sharklike and skatelike
 Caudal fin large, bilobed
 Origin of first dorsal over or in front of pelvics
 Snout and anterior part of head broadly angular and wedge shaped, with shallow indentation separating it



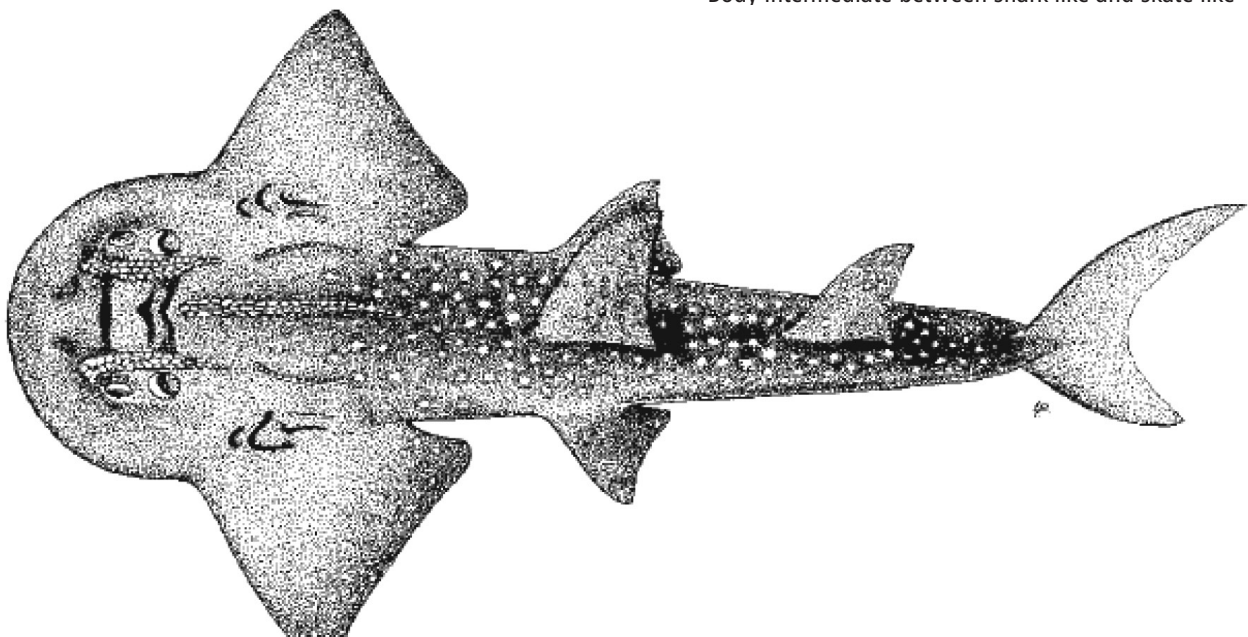
from pectoral fin origin
 One genus Rhynchobatus, with four species

Family Rhinidae - bowmouth guitarfishes

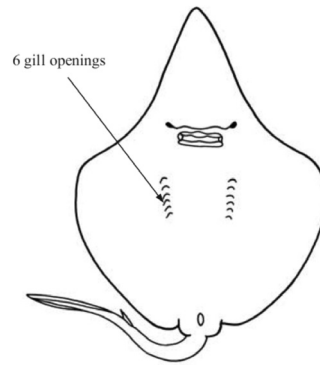
Body intermediate between sharklike and skate like

Family Rhinobatidae - guitarfishes

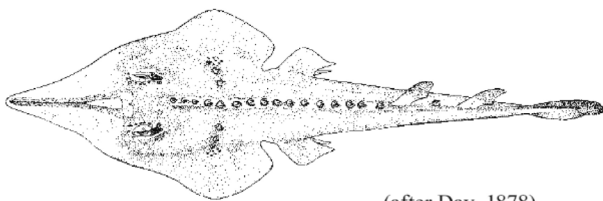
Body intermediate between shark like and skate like



Tail stout, not definitely marked off from body
 Two distinct dorsal fins and a caudal fin, the latter not bilobed
 Origin of first dorsal behind pelvics
 Denticles over body from a row on midline of back
 Tail without spine
 Snout wedge-shaped and variously prolonged but not as a blade and without lateral teeth
 Four genera, *Aptychotrema* (3), *Rhinobatos*, *Trygonorrhina* (1), and *Zapteryx* (3), with 42 species



Rhinobatos granulatus Cuvier, 1829



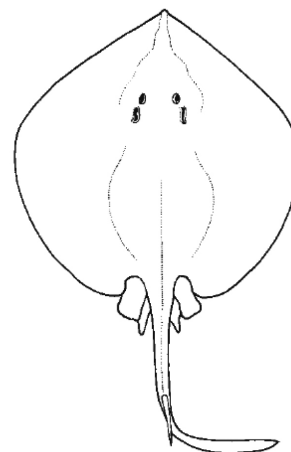
(after Day, 1878)

Brain very small, posteriorly placed in large cranial cavity
 Tail with one or two serrate spines
Hexatrygon bickelli Heemstra and Smith, 1980

Super family Urolophoidea

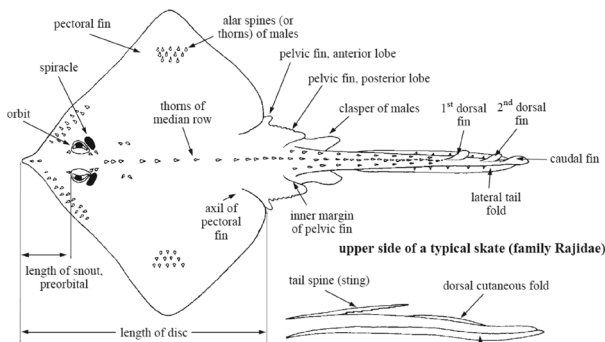
Family Plesiobatidae – deep water stingrays

Nasal curtain incompletely initiated, not reaching the mouth
 Maximum length 2.7m



Plesiobatis daviesi (Wallace, 1967)

FAMILY RAJIDAE -



SKATES

Caudal fin moderately well developed, reduced, or absent
 Tail extremely slender
 Weak electric organs derived from caudal muscles
 Dorsal fins 0-2, most with prickles on skin, often with a row along midline of back
 Tail variable in shape and length with or without armature of prickles, thorns, and spines
 Disc not fleshy toward margins
 Body mostly firm

Family Urolophidae - round stingrays

Disc less than 1.3 times as broad as long
 Caudal fin small but well developed
 Dorsal fin present in some species
 Tail moderately long with a barbed spine

Superfamily UROTRYGONOIDAE

Family Urotrygonidae - american round stingrays

Disc not more than 1.3 times as broad as long
 Tail slender and about as long as disc length, without dorsal fin with poisonous spines, Caudal fin well developed, supported by cartilaginous radials
 Tail broad and thick at base and not whip-like distally
 Two genera, *Urobatis* (6), and *Urotrygon* (10), with 16 species

Order Myliobatiformes– stingrays

Suborder – Myliobatoidei

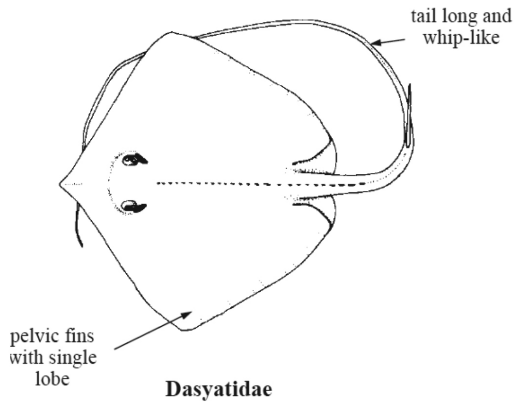
Family Hexatrygonidae– sixgill stingrays

Six gill openings and six gill arches
 Snout elongate, thin, translucent
 No supraorbital crests on cranium
 Spiracles large, well behind eyes, with external flap like valve

Super family Dasyatoidea

Family Dasyatidae (Trygonidae) - whiptail stingrays

Eyes and spiracles on top of head;
 Head part of disc, anterior margins of pectoral fins continuous along sides of head
 No separate cephalic fins or rostral lobes
 Disc about 1.3 times as broad as long
 Caudal fin absent, tail long very slender to whiplike,
 Poisonous spines on tail



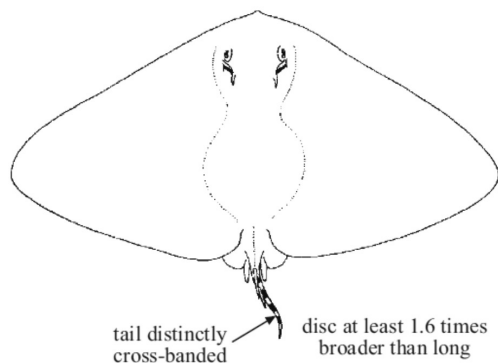
Caudal fin absent
 Tail much longer than disc width;
 Transverse parts of nasal curtains with fringed margins
 Floor of mouth with several fleshy papillae

Family Potamotrygonidae -river stingrays

Long, median, anteriorly directed process from the pelvic girdle
 Angular cartilages present, within hyomandibular-Meckelian ligament
 Adaption to freshwater as evidenced by rectal gland

Family Gymnuridae - butterfly rays

Eyes and spiracles on top of head; head part of disc, anterior margins of pectoral fins continuous along sides of head;
 No separate cephalic fins or rostral lobes
 Disc extremely broad
 Dorsal fin and tail spines present or absent



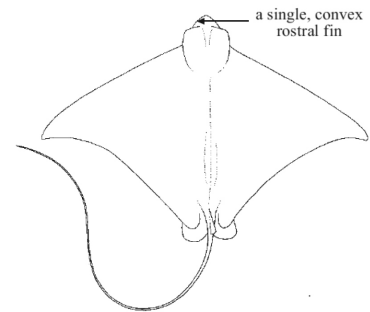
Disc more than 1.5 times as broad as long
 Tail distinctly shorter than disc width
 Transverse parts of nasal curtains smooth-edged
 Papillae absent on floor of mouth
 Tail short
 No caudal fin
 2 genera, Aetoplatea (2) and Gymnura (least 9), with at least 11 species

Family Myliobatidae – eagle rays

Distinct but small dorsal fin present
 Most species with one or more long poisonous spines on tail
 No caudal fin
 Head elevated above disc
 Eyes and spiracles lateral on head
 Gill openings about length of eye to much longer
 Tail much longer than disc
 Small dorsal fin
 Pectoral fin absent or reduced
 Anterior parts of pectoral fins forming 1 fleshy lobe extending below front of head, or this lobe with a more or less deep median notch, thus forming 2 basally connected lobes
 Teeth large, flat, and in a few series only

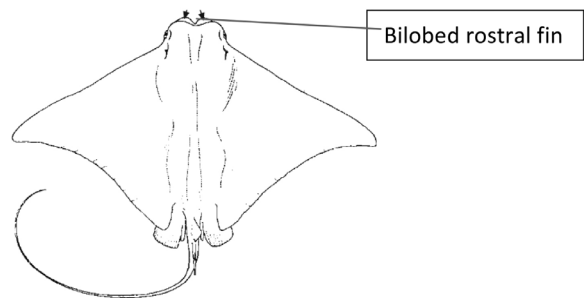
Subfamily Myliobatinae (Eagle rays)-

Anterior face of cranium nearly straight



Subrostral fin not incised
 Four genera, Aetobatus (3), Aetomylaeus (4), Myliobatis and Pteromylaeus (2)

Subfamily RHINOPTERINAE (COWNOSE RAYS)



Anterior face of cranium concave, subrostral fin incised (bilobed)

One genus, *Rhinoptera*

Rhinoptera javanica

Subfamily MOBULINAE (DEVIL RAYS)

Members of this family are the only living vertebrates with three pairs of functional limbs

The cephalic pair assist in feeding and are the anterior sub division of the pectorals

Two genera, *Manta* and *Mobula*

Family Mobulidae

Anterior subdivisions of pectoral fins forming 2 thin and widely separated cephalic fins

teeth minute and in bands of many series in 1 or both jaws

Mobula japonica, *M. kuhlii*, *M. tarpacana*

Manta birostris, *Manta alfredi*

Further reading

1. Fishes of the World by Joseph S. Nelson
2. FAO Species Catalogue, Vol. 4, Part 1 Sharks Of The World, FAO Fisheries Synopsis No. 125, Volume 4, Part 1

