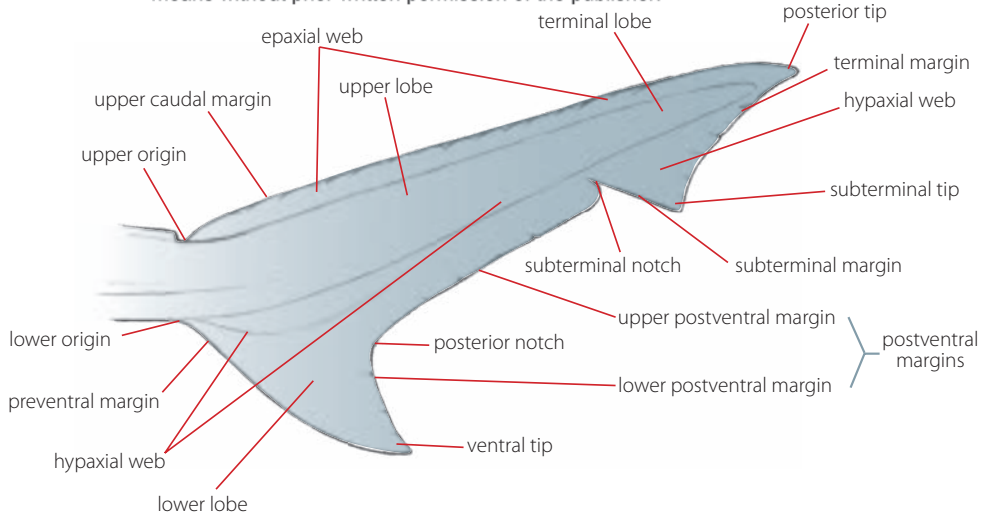


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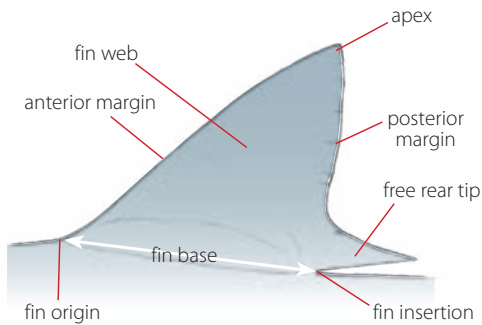
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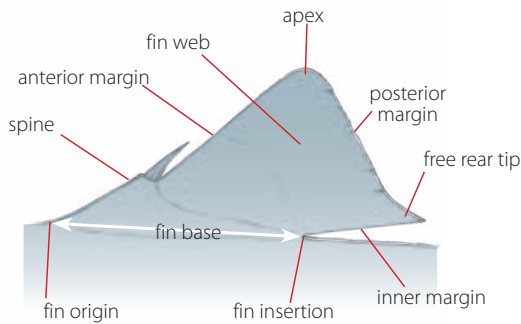
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Caudal fin topography

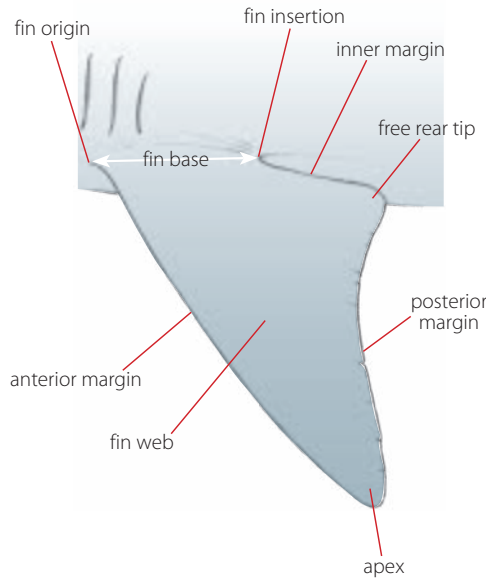


Spineless dorsal fin

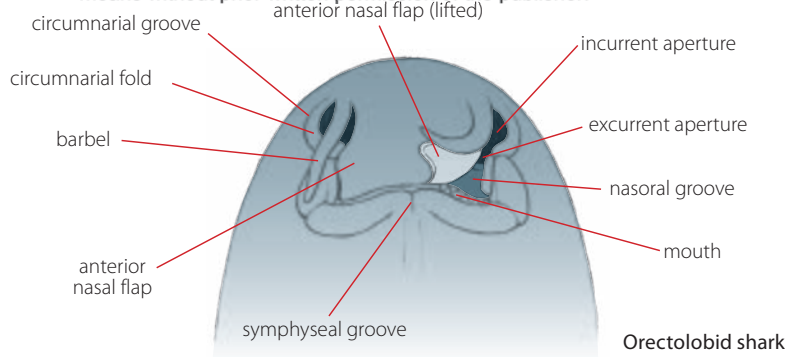


Spined dorsal fin

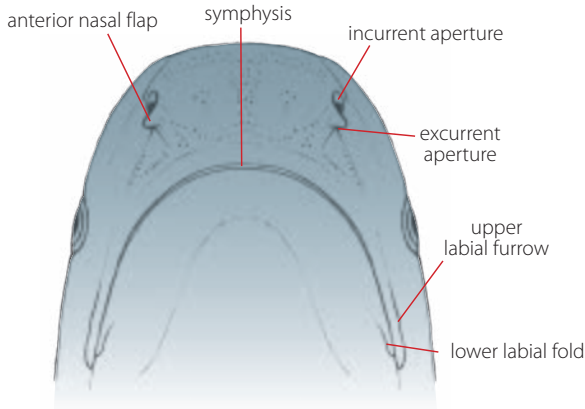
Dorsal fin topography



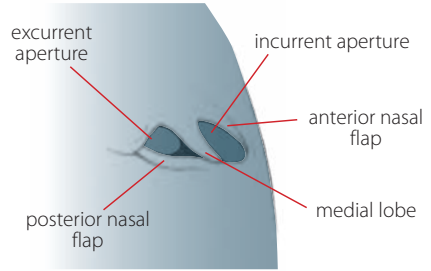
Pectoral fin topography



Orectolobid shark

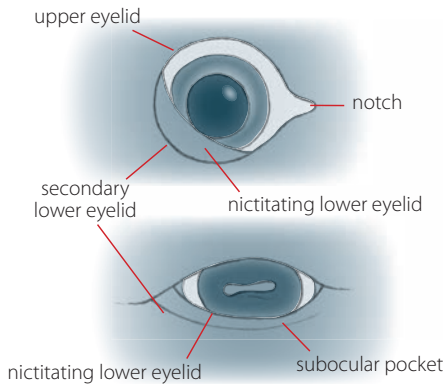


Requiem shark



Nostril of squalid shark

Head (ventral) topography

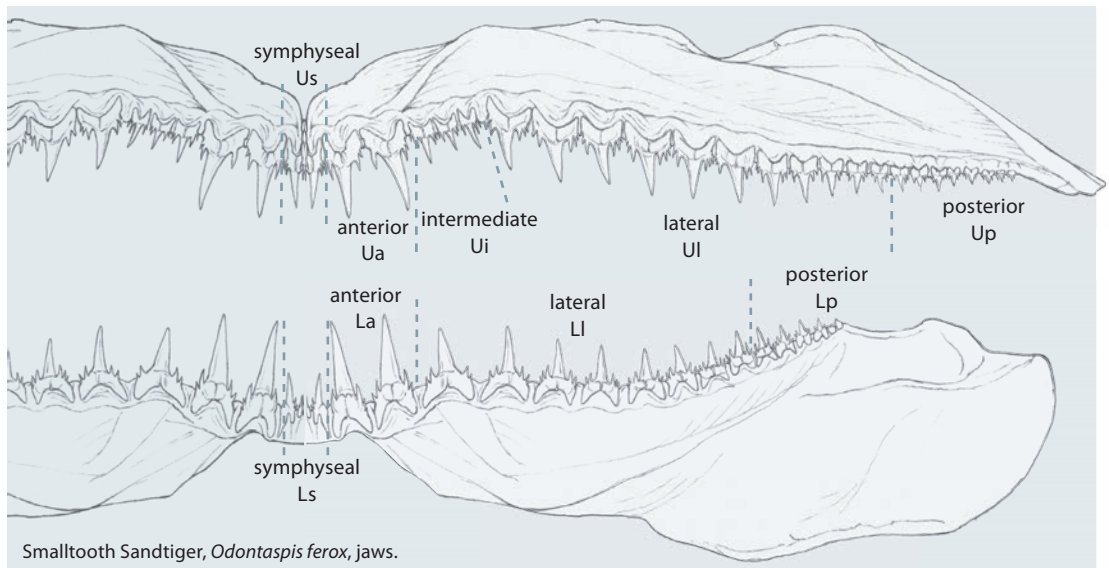


Eyes of (top) requiem sharks and (bottom) catsharks

Tooth types and tooth count

Since the earliest documented taxonomic studies of sharks, dental morphology has been used as a key factor in helping to distinguish between shark species. For the most part, shark teeth are developed in accordance with the predation type associated with that species and will vary accordingly. Additionally, in some cases teeth may alter with maturity to better suit their use, as prey and predation behavior changes. Perhaps the strongest variation in dentition may be seen within the same set of jaws of some species. Though not obvious in all species of sharks, this variation, known as heterodonty, often results in the development of broader, more distinctive teeth in the upper jaw and narrower, less robust teeth in the lower jaw. In nearly all species, heterodonty is strongly evident between one section and another within one quadrant of the upper or lower jaw. This results in the placement of the largest, most useful tooth forms in the anterior section of the jaw and smaller, lower-crowned teeth posteriorly. Each quadrant of a jaw can be broken down into sections of rows (or files) that include one or more of the following tooth types: symphyseal, anterior, intermediate, anterolateral (where there is no differentiation between anterior and lateral teeth), lateral, anteroposterior (teeth in the symphyseal region where there is no differentiation between anterior and posterior teeth), and posterior teeth.

Equally important in many cases, the tooth count (often referred to as dental meristics) may play an instrumental role in distinguishing species of sharks when tooth morphology alone cannot. Tooth counts are recorded as a total per quadrant of an upper and lower jaw, but may be even further specified by each section of a jaw according to tooth type and placement. Total counts, the most widely used method, may be broken down by upper left side total, centrally located teeth, and then right side total, followed by a similar count of the lower jaw. Each jaw half is divided at the center, called the symphysis, by small groups of teeth referred to as symphyseal teeth, or sometimes as even smaller teeth known as alternates and medials. As a simple rule of thumb, teeth at the center of a jaw that are one half the size or smaller of adjacent teeth are usually shown as a 'symphyseal count' in a meristic formula. For example, the jaw illustrated below would likely be counted as 24-2-24 /16-3-16 or as a total of 50 upper jaw, 35 lower jaw (as used in this book). It should be noted that, in some genera e.g. *Mustelus*, the tooth count may strongly vary within each species and therefore may not prove to be diagnostic. In any event, when a specimen is documented for scientific purposes and the jaws are unable to be kept, it is advisable to carefully record the tooth count.

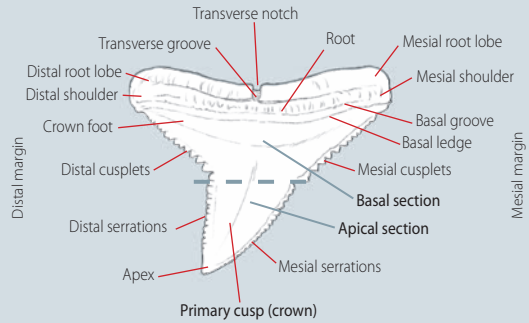


CARTILAGINOUS FISHES DENTITION GUIDE

The following six pages offer a quick overview of the tooth types of the main groups of cartilaginous fishes in the region, from the fused tooth plates of the chimaeras to the single blade-like teeth of many sharks.

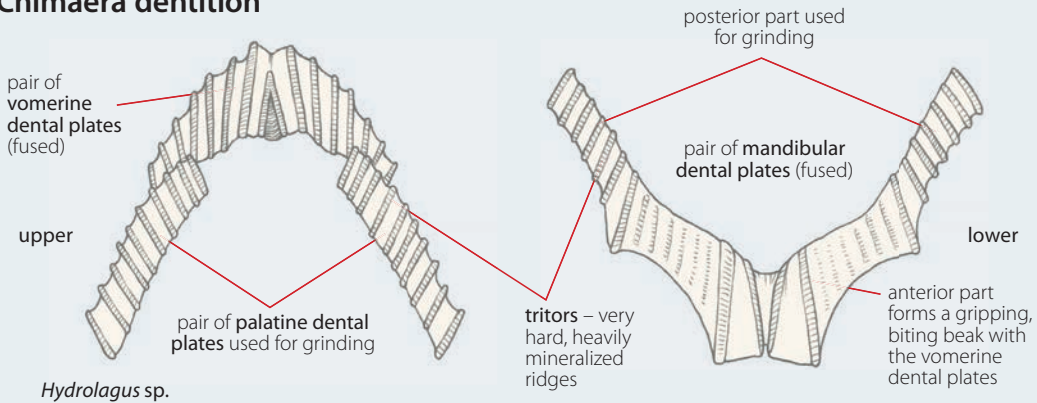
The batoid teeth are shown here in the jaw, as these (usually) minute teeth are not often found out of the jaw, unlike many of the shark teeth. Like sharks, they do shed their teeth, although some batoid species retain their teeth for quite a time (e.g. cownose rays). Again, like sharks, they possess teeth adapted to their prey, and some species have such minute teeth that they are not used for feeding (e.g. mobulid rays).

Shark teeth are shown to species level in the key guides found throughout the book.

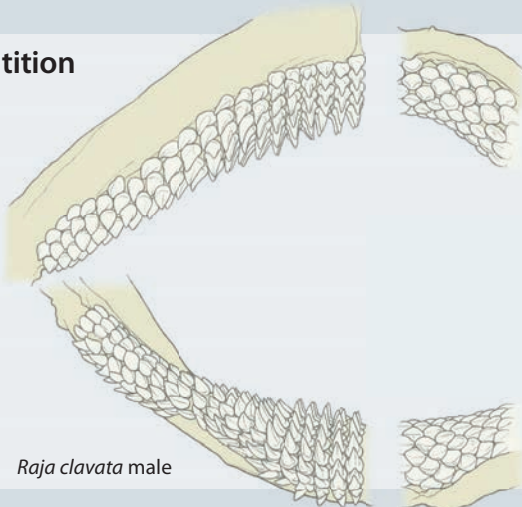


Labial view of a shark tooth

Chimaera dentition



Skate dentition



Skates have a similar dentition arrangement to the majority of batoids, with their numerous small teeth placed either in a pavement pattern or in parallel rows, or a combination of both. They are usually very similar in shape (low-crowned) and size; but sexual dimorphism may occur, for example *Raja clavata* (which occurs outside the region, in the Northeast Atlantic).

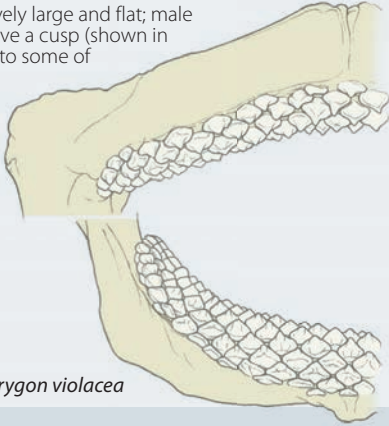
While female *R. clavata* have the low-crowned homodont dentition, males have differentiated tooth shapes (heterodont dentition), with tall, cusped teeth in the anterior jaw and low, button-like teeth in the posterior jaw.

Raja clavata male

Raja clavata female

Stingray dentition

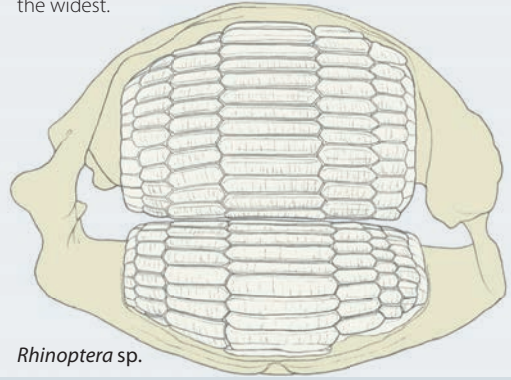
Teeth relatively large and flat; male stingrays have a cusp (shown in illustration) to some of their teeth.



Pteroplatytrygon violacea

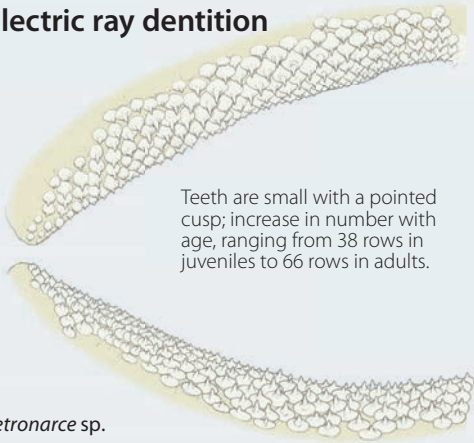
Cownose ray dentition

Pavement teeth, loosely interlocked, with the median row the widest.



Rhinoptera sp.

Electric ray dentition

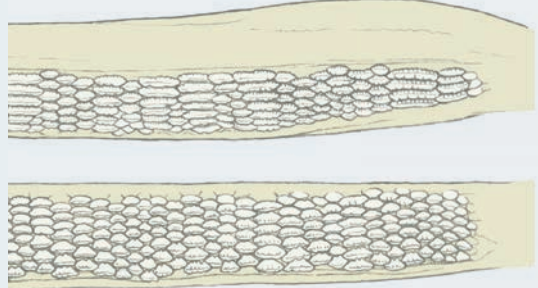


Teeth are small with a pointed cusp; increase in number with age, ranging from 38 rows in juveniles to 66 rows in adults.

Tetronarce sp.

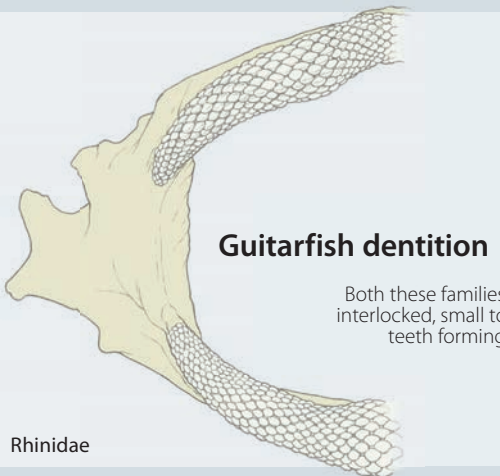
Mobulid ray dentition

Teeth are small, and in many species, may be non-functional for feeding due to a planktivorous diet.



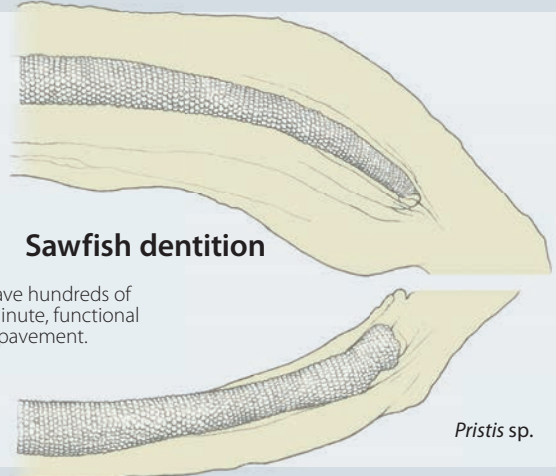
Mobula sp.

Guitarfish dentition



Rhinidae

Sawfish dentition

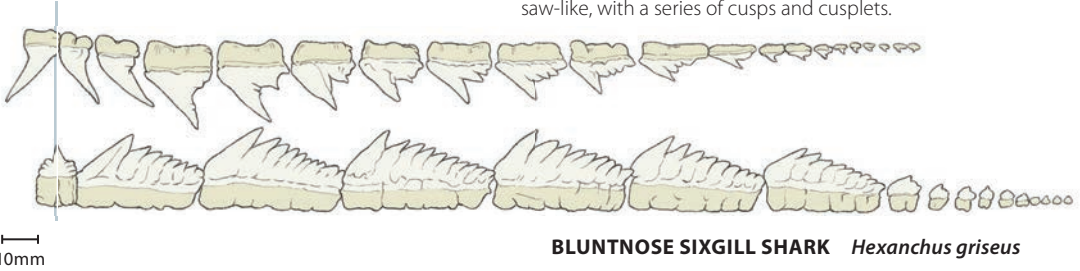


Pristis sp.

Both these families have hundreds of interlocked, small to minute, functional teeth forming a pavement.

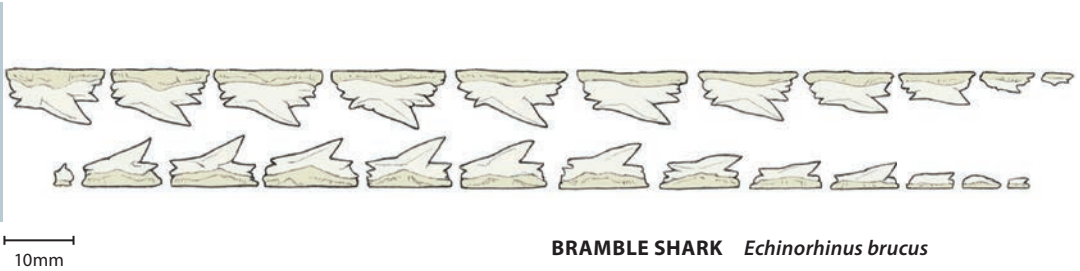
Cow shark dentition → p.217

Upper and lower teeth dissimilar; uppers smaller, narrower with a main cusp and often smaller cusplets; lowers large, broad, and saw-like, with a series of cusps and cusplets.



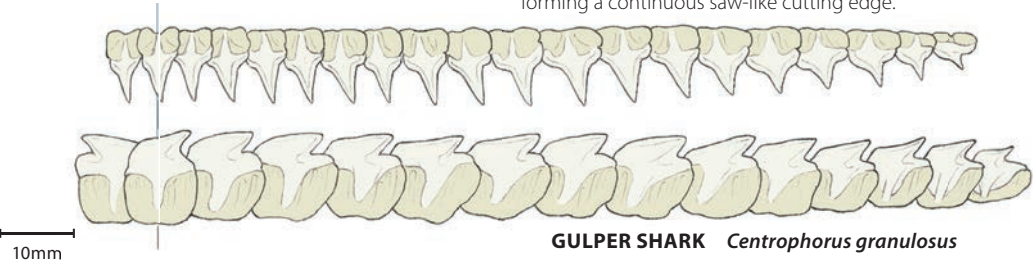
Bramble shark dentition → p.222

Upper and lower teeth similar; strongly compressed and blade-like, with a cusp and up to three side cusplets in adults.



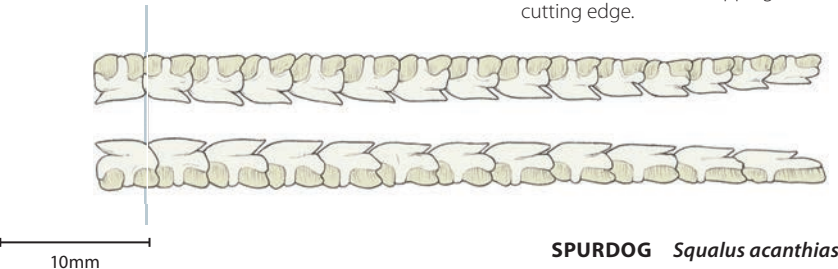
Gulper shark dentition → p.230

Upper and lower teeth dissimilar; uppers smaller than lowers, high cusped and blade-like; lowers broader and overlapping, forming a continuous saw-like cutting edge.



Dogfish shark dentition → p.230

Upper and lower teeth similar; compressed, low-crowned, broad-based and overlapping, forming a continuous saw-like cutting edge.



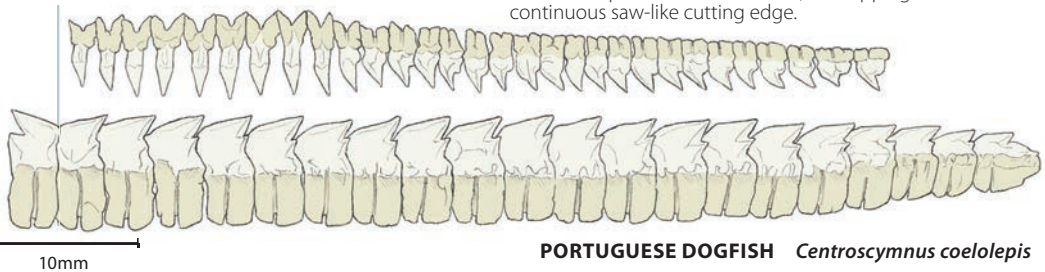
Lanternshark dentition → p.245



Upper and lower teeth usually dissimilar in Northwest Atlantic and Gulf of Mexico (exception *Centroscyllium* with similar lowers to uppers); uppers smaller, narrower with a main cusp and often smaller cusplets; lowers with hooked crowns overlapping, forming a continuous saw-like cutting edge.

BLURRED SMOOTH LANTERNSHARK *Etmopterus bigelowi*

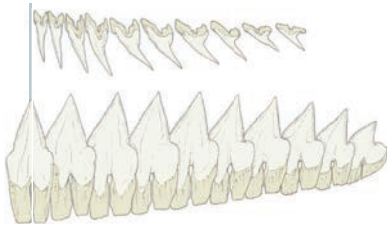
Sleeper shark dentition → p.261



Upper and lower teeth dissimilar; uppers smaller and lanceolate; lowers compressed and blade-like, overlapping to form a continuous saw-like cutting edge.

PORTUGUESE DOGFISH *Centroscymnus coelolepis*

Kitefin shark dentition → p.271



Upper and lower teeth dissimilar; uppers much smaller than lowers, lanceolate; lowers highly compressed, broad and blade-like, overlapping forming a continuous saw-like cutting edge.

KITEFIN SHARK *Dalatias licha*

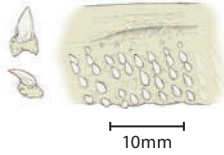
Angelshark dentition → p.279



Upper and lower teeth similar, moderately differentiated along the jaw; conically shaped, widening rapidly to a broad base.

SAND DEVIL *Squatina dumeril*

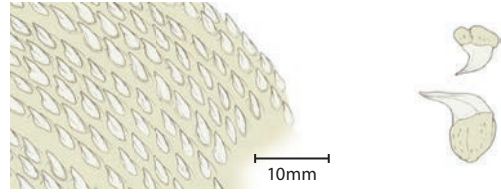
Planktivorous shark dentition → p.299
(mackerel shark order)



Upper and lower teeth similar in both species; minute, hook-shaped single cusp; *C. maximus* over 200 in both jaws, *R. typus* over 300.

BASKING SHARK *Cetorhinus maximus*

Planktivorous shark dentition → p.283
(carpetshark order)



WHALE SHARK *Rhincodon typus*

Carpent shark dentition → p.283

Upper and lower teeth similar; moderately compressed with alternating pattern, but not overlapping; central cusp is flanked by 2–6 lateral cusplets.



10mm

NURSE SHARK *Ginglymostoma cirratum*

Catshark dentition → p.319

Upper and lower teeth similar; small with acute narrow cusps, often lateral cusplets, not blade-like; posterior teeth can be comb-like.



10mm

Pseudotriakis microdon
teeth are similar to catshark teeth but far more numerous and appear comb-like in the jaw; see p.341.

CHAIN CATSHARK *Scyliorhinus retifer*

Houndshark dentition → p.346

Upper and lower teeth similar; small, placed into an interlocking pavement pattern; sometimes with cusps and cusplets.



10mm



GULF OF MEXICO SMOOTHHOUND *Mustelus sinuatus*

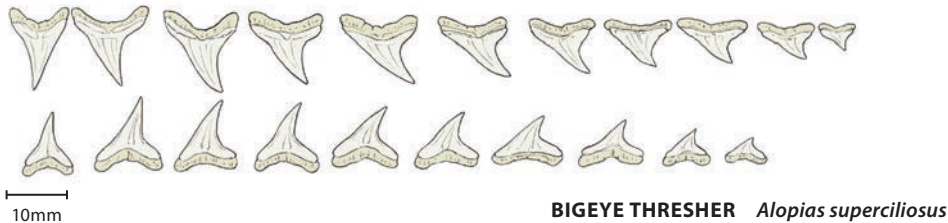
Goblin and sandtiger shark dentition → p.291

Upper and lower teeth similar; teeth large, awl-shaped, with or without lateral cusplets present; large anterior teeth followed by smaller intermediate teeth.



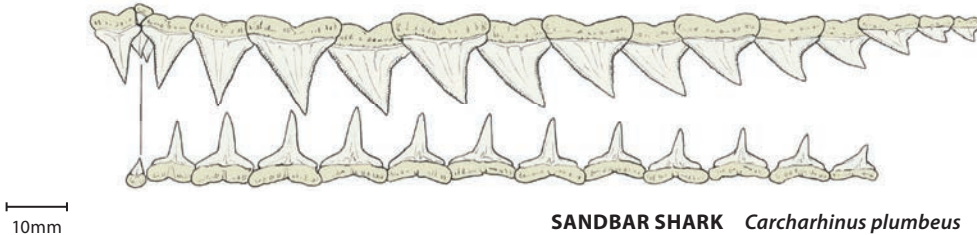
Thresher and mackerel shark dentition → p.296 and p.303

Upper and lower teeth similar; teeth relatively large to very large, broadly triangular, and serrated to long and slender; with smooth-edged cusps.



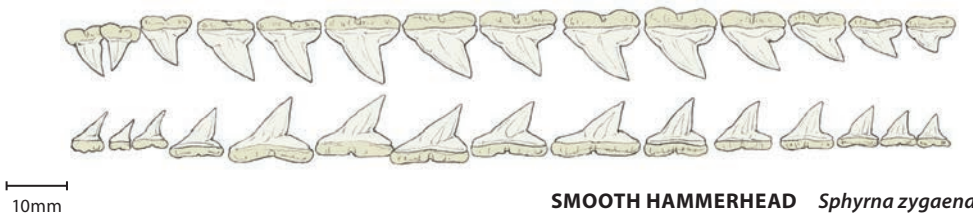
Requiem shark dentition → p.352

Upper and lower teeth dissimilar; uppers usually with erect to slightly oblique cusps, usually serrated; lowers usually with oblique to erect, narrow, serrated cusp (*Galeocerdo cuvier* exception with blade-like cusp).

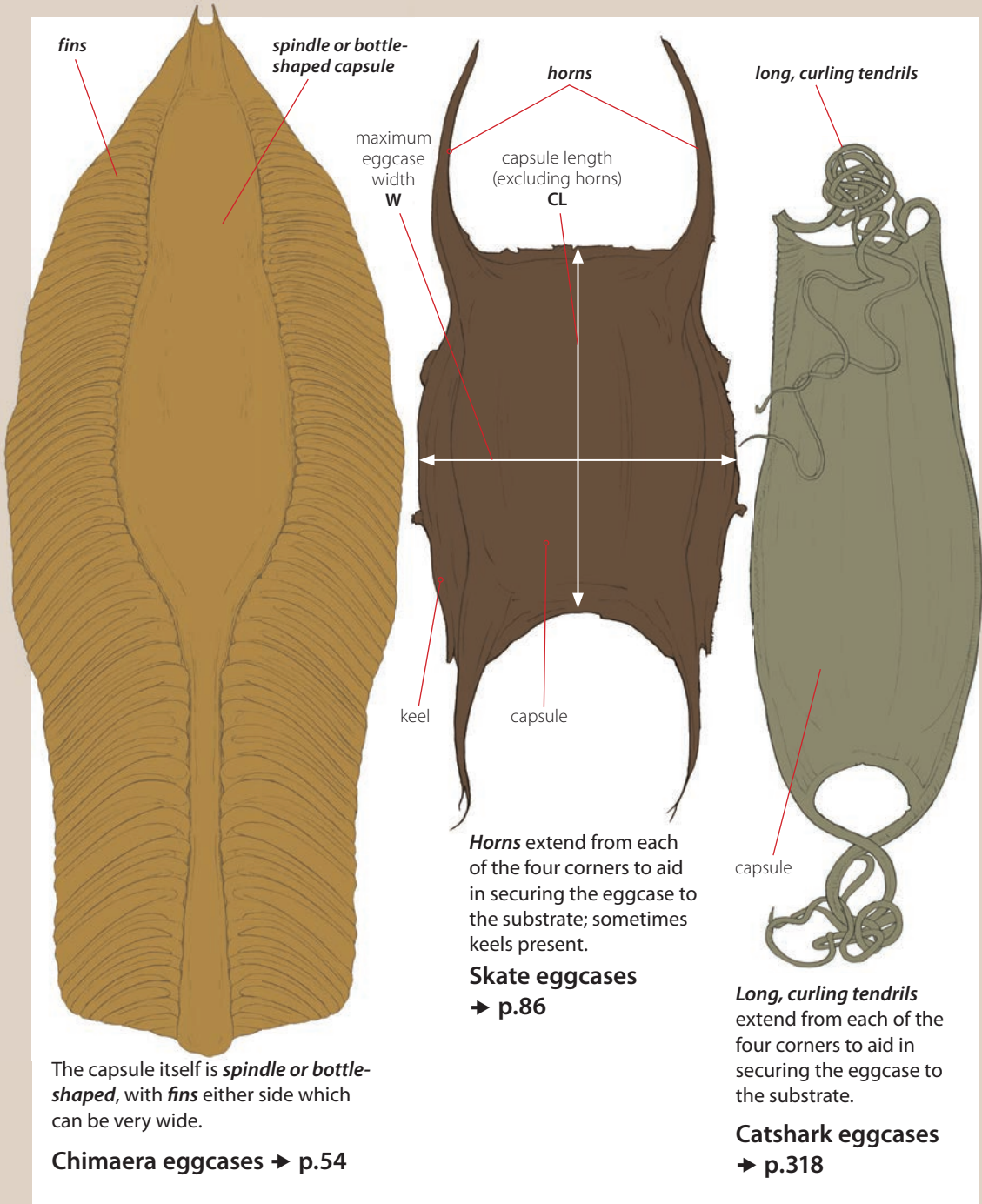


Hammerhead shark dentition → p.389

Upper and lower teeth relatively similar; teeth moderately large, more or less blade-like, with moderately broad cusps and no lateral cusplets; teeth weakly differentiated across the jaws.

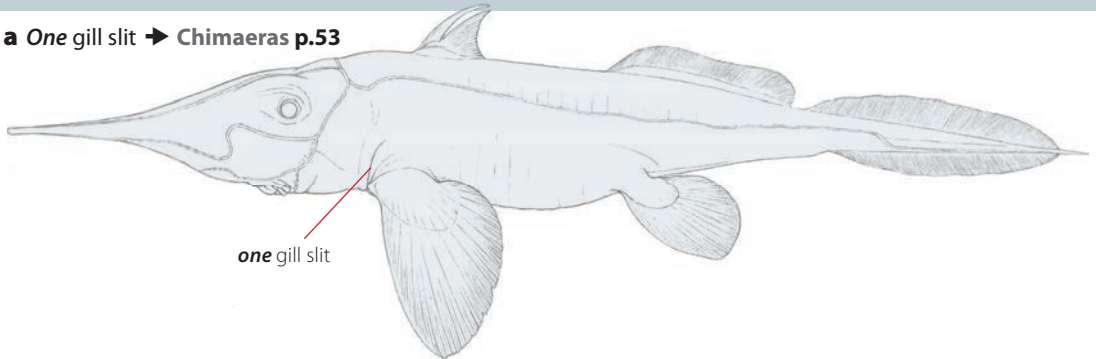


CARTILAGINOUS FISHES EGGCASE GUIDE

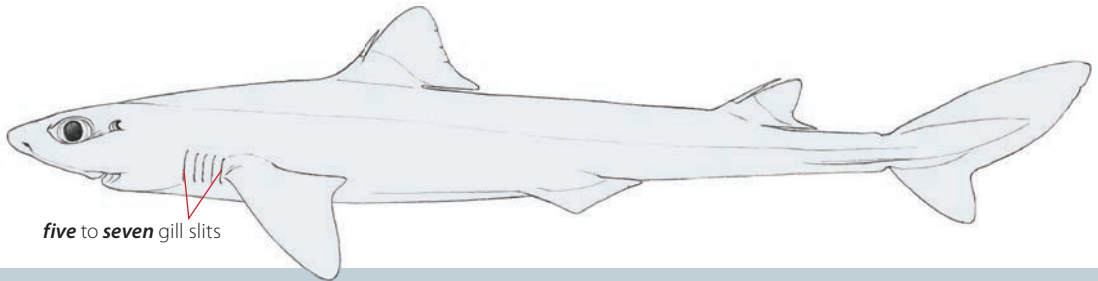


CARTILAGINOUS FISHES KEY GUIDE

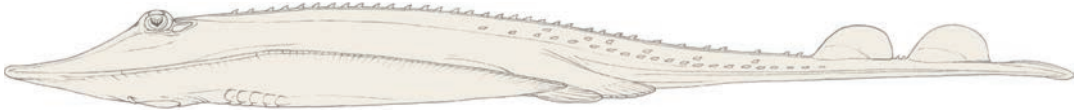
1a One gill slit → Chimaeras p.53



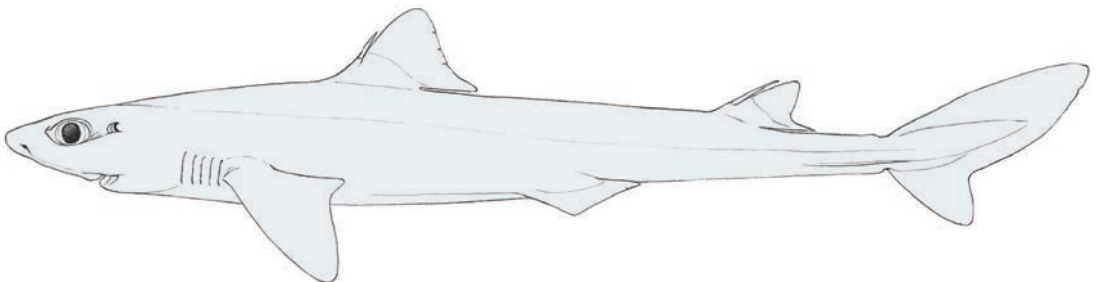
1b Five to seven gill slits → Sharks and rays → ②



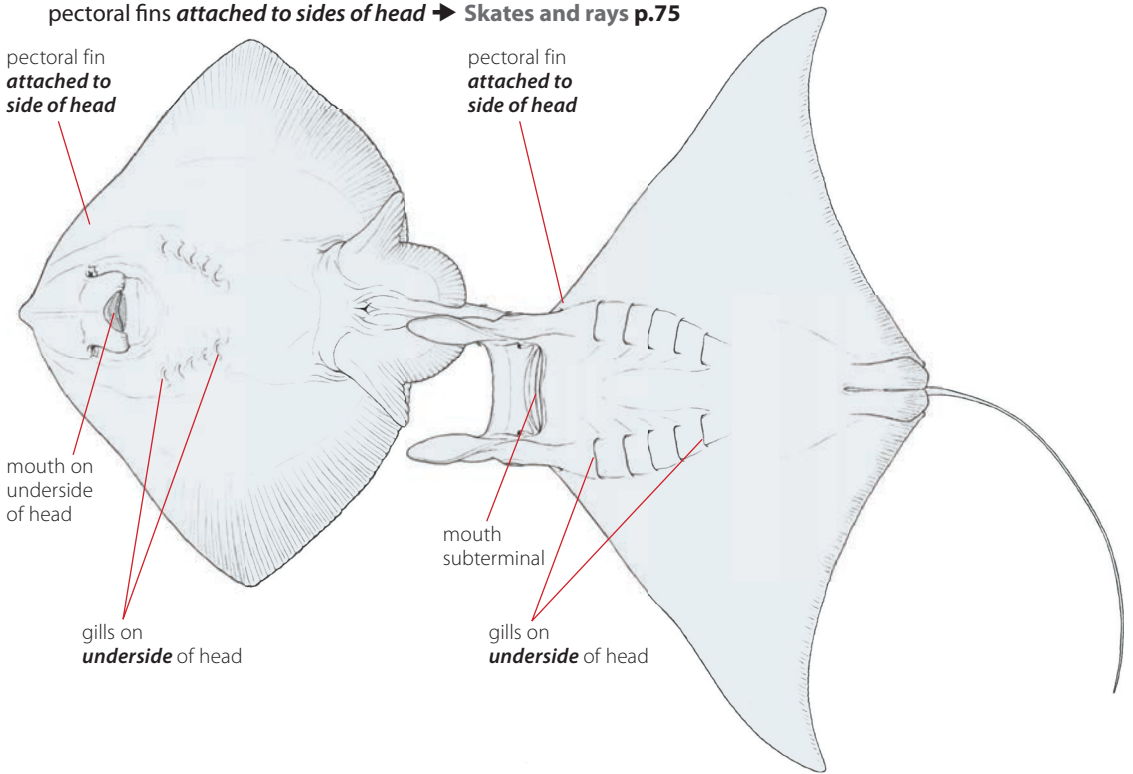
2a Body flat, ray-like → ③



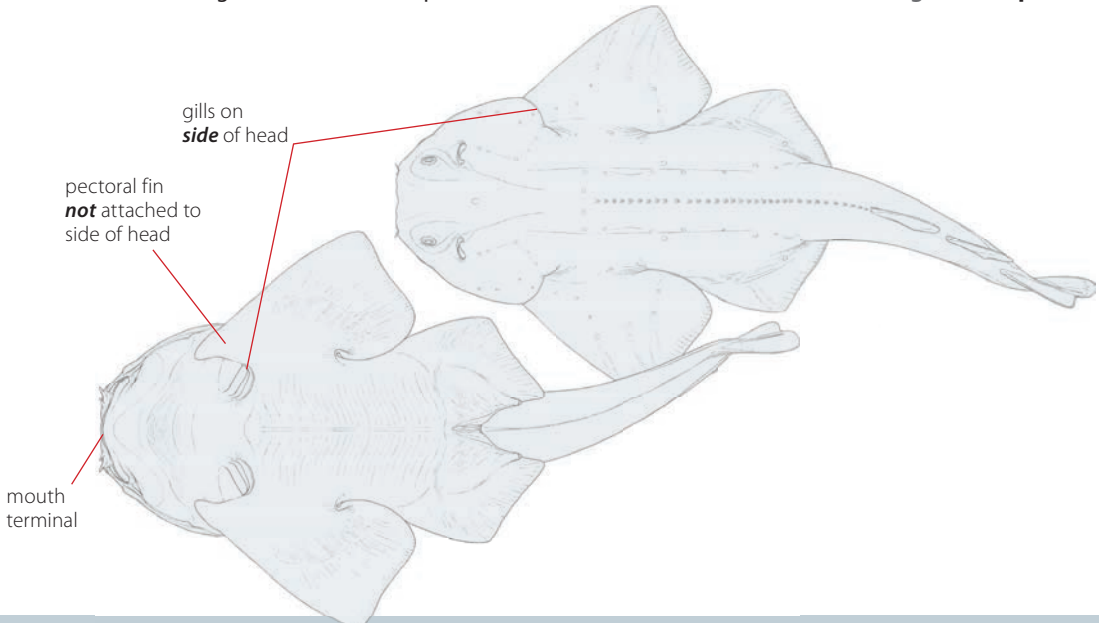
2b Body not ray-like → Sharks p.211



3a Mouth usually on underside of head (exception are the mobulid rays); gills on **underside** of head; pectoral fins **attached to sides of head** → **Skates and rays p.75**



3b Mouth **terminal**; gills **lateral** on head; pectoral fins **not attached** to sides of head → **Angelsharks p.279**



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CHIMAERAS



CHIMAERAS CHIMAERIFORMES

Chimaeras in the region

The waters of the Northwest Atlantic and Gulf of Mexico are home to a moderately diverse assemblage of chimaeriform fishes, with 17% of all known species (9 of 53) occurring here. Two families, the short-nosed (Chimaeridae) and long-nosed (Rhinochimaeridae) chimaeras, are represented with six and three species respectively. Most short-nosed chimaeras found in the region occur only in the Atlantic Ocean, with the exception of the Atlantic Chimaera *Hydrolagus affinis* whose distribution extends into the southwest corner of the Indian Ocean off South Africa. In contrast, the long-nosed chimaeras are predominantly wide-ranging, with two species found globally. The third, the Atlantic Long-nosed Chimaera *Rhinochimaera atlantica*, although mostly restricted to the Atlantic Ocean, has a distribution also extending into the southwest corner of the Indian Ocean.

In Northwest Atlantic waters, the short-nosed chimaeras are the more diverse group with six species present. Two species occur in the Gulf of Mexico, both of which are also found in the Northwest Atlantic – the Gulf Chimaera *Hydrolagus alberti* and Large-eyed Chimaera *Hydrolagus mirabilis*. Yet, while the Gulf Chimaera just barely ranges into the Northwest Atlantic, it being a more common species in the Caribbean, the Large-eyed Chimaera *Hydrolagus mirabilis* has one of the widest distributions of any short-nosed chimaera, found from the Gulf of Mexico to Canada, across to Northeast Atlantic waters including the Mediterranean, and southwards along the African coast to Namibia. In contrast, the distributions of the Bahamas Ghostshark *Chimaera bahamaensis* and the Cuban Chimaera *Chimaera cubana* appear more restricted. The former is known from only four specimens: two from the Bahamas and two specimens recorded off the east coast of Florida (although it is likely more widespread); while the latter appears endemic to the Northwest Atlantic and the Caribbean.

As a group, the long-nosed chimaeras have a much wider geographic distribution. Two of the three species present in the region, the Small-spined Chimaera *Harriotta haeckeli* and Narrow-nosed Chimaera *Harriotta raleighana*, are found in all major ocean basins. The third, the Atlantic Long-nosed Chimaera *Rhinochimaera atlantica*, although primarily occurring in the Atlantic Ocean, has a distribution extending into the Southwest Indian Ocean off South Africa (other records of this species from the Western Indian Ocean are based on the Paddle-nose Chimaera *Rhinochimaera africana*). The Atlantic Long-nosed Chimaera and the Narrow-nosed Chimaera are both known to occur in the Gulf of Mexico.

Description

Respective snout shape and length – short and blunt versus long and narrow – can easily separate the two chimaera families found in the region. Within each family, however, species-specific identification can be somewhat difficult unless one knows what to look for when separating out individual species.

The family Chimaeridae comprises two recognized genera. Although morphologically and genetically similar, they can be separated on the basis of whether an anal fin is present (*Chimaera*) or absent (*Hydrolagus*). Once this has been determined, other characteristics to look for include: the shape of the second dorsal fin margin (whether it is wavy or relatively straight); body size, if the individual has been determined to be an adult (is it a small-bodied or large-bodied species); eye diameter; and height of the first dorsal fin spine relative to the height of the first dorsal fin (is it greater or less than the fin height at its apex). This family can be roughly categorized as those with a large body and massive head, and small-bodied species with a relatively small head and conical snout. Noting any patterning can be helpful, as is general overall body coloration. However, care should be taken as coloration within chimaera species can vary widely and even overlap with that of other species. Specific details for separating species can be found in the Species Key Guide on p.56.

Similarly, the family Rhinochimaeridae – with three recognized genera – can also be separated by the presence (*Neoharriotta*) or absence (*Harriotta* and *Rhinochimaera*) of an anal fin. Presently, just two *Harriotta* and one *Rhinochimaera* species are known to occur in the region. These three species can be separated by the lateral profile of their head and snout. The head and long snout of *Rhinochimaera* (knife-nosed chimaeras) are relatively straight in profile and have tubercles along the margin of the upper caudal lobe. This differs from *Harriotta* (narrow-nosed chimaeras), which have a concave head and snout profile and lack tubercles along the margin of the upper caudal lobe. Details for separating species can be found in the Species Key Guide on p.65. The Caribbean Sickle-finned Chimaera *Neoharriotta carri*, as the name implies, is known from the Caribbean and it would not be surprising for a vagrant individual to eventually be found in the area; it can, however, be easily separated from the other three species by the presence of an anal fin.

Habitat and ecology

The Chimaeriformes are found in all oceans except for Antarctic waters. As a group, they remain very poorly known as most species inhabit the deep sea along outer continental shelves, slopes, seamounts, and ridges, from depths of about 200m to over 3,100m. Most are rarely encountered but, based on limited information and depending on species, they may occur over soft sandy or mud bottoms, as well as rocky reefs with high vertical relief. Use of remotely operated vehicles (ROVs) has shown some species to be very particular in their habitat preference, favoring soft bottoms or rocky reefs.

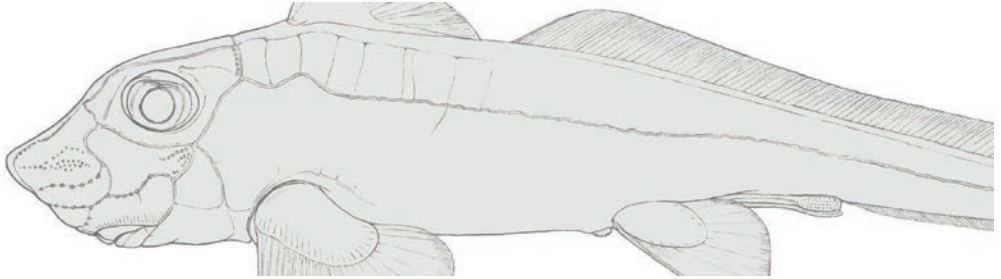
All known chimaera species are oviparous (egg-layers) in their mode of reproduction. Aside from this, almost nothing else is known about their reproductive cycles,

fecundity, or age and growth. Those species for which feeding data are available mostly appear to consume benthic invertebrates including worms, crustaceans, bivalves, gastropods, cephalopods, brittle stars, and small fishes.

Further compounding the lack of life history data is that many species are infrequently encountered and often misidentified. None of the short-nosed chimaeras has been well studied, with the eggcases unknown for all species except for the Large-eyed Rabbitfish. The long-nosed chimaeras are almost entirely unknown. Even though some species are occasionally caught in large numbers, information on their life history and diet remains sparse.

CHIMAERA FAMILIES KEY GUIDE

1a Snout *short* and *blunt* → Chimaeridae p.56



1b Snout *long* and *tapered* → Rhinochimaeridae p.65

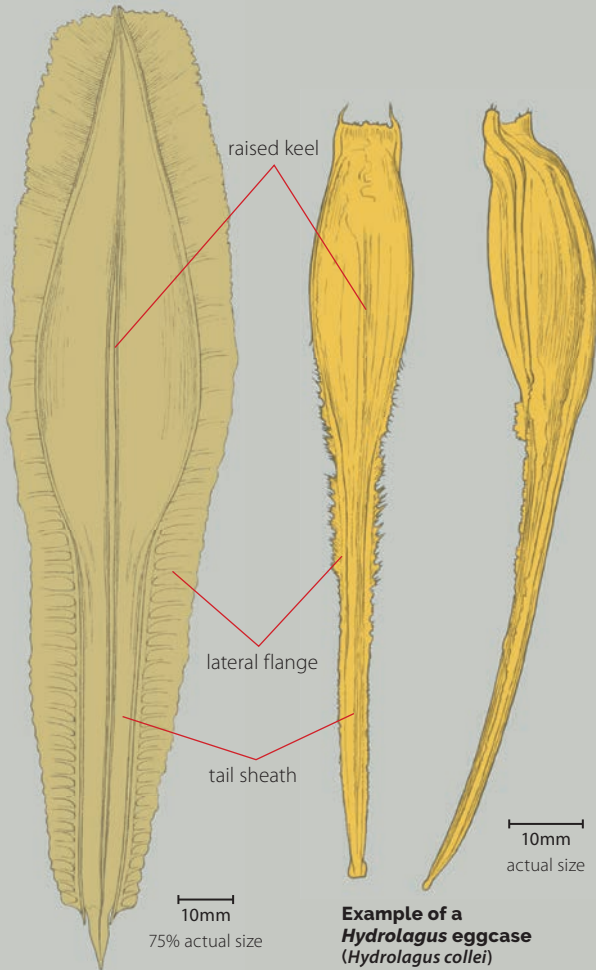


Chimaera species eggcase guide

The eggcases of chimaeras can be separated by family, but at the genus and species level it is difficult since species often overlap in their distribution. Unless the eggcases are removed from a female, or she is observed depositing eggcases, it is very difficult to relate eggcases to individual species.

Chimaeridae

Teardrop-shaped with small lateral flanges and a dorsal surface that has a raised keel along the midline. The anterior end of the spindle is bulbous and tapers posteriorly to an elongate tail sheath. Along each side of the tail sheath is a series of small pores that open during the later stages of the embryo's development.



Example of a Chimaera eggcase
(Chimaera monstrosa)

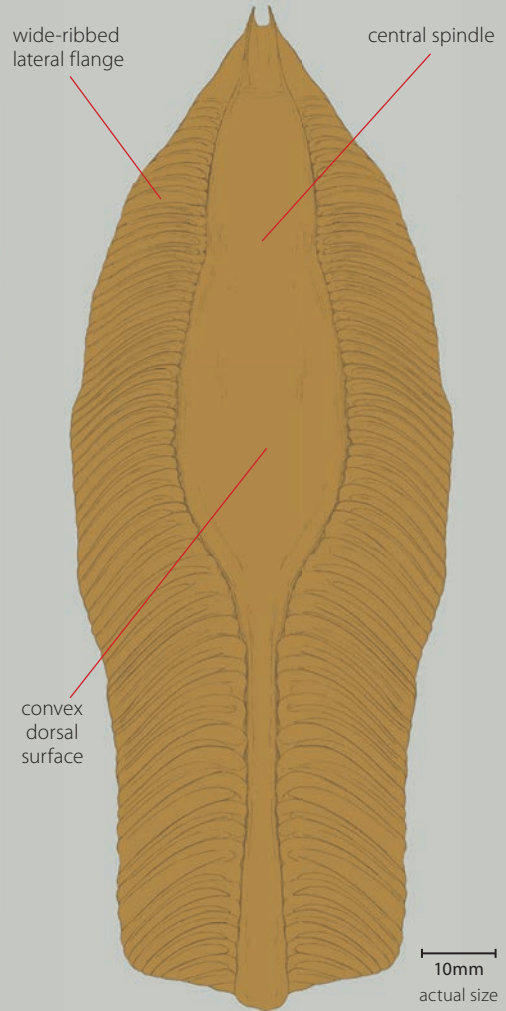
pp.58–59

Example of a Hydrolagus eggcase
(Hydrolagus collei)

pp.60–63

Rhinochimaeridae

Wide-ribbed lateral flanges with a teardrop-shaped central spindle. The dorsal surface is convex and the ventral surface is concave. Like the Chimaeridae eggcases, there are a series of small pores along the posterior edges of the central spindle.



Atlantic Long-nosed Chimaera
Rhinochimaera atlantica

p.68

Short-nosed chimaeras Chimaeridae

The short-nosed chimaeras are poorly documented in Northwest Atlantic and Gulf of Mexico waters. Three of the six known species were originally described from the region – the Bahamas Ghost Shark *Chimaera bahamaensis*, Cuban Chimaera *Chimaera cubana*, and Gulf Chimaera *Hydrolagus alberti*. The Cuban naturalist Felipe Poey (1799–1891) documented the first short-nosed chimaera species from North American waters in 1866 based on a specimen from Matanza, Cuba, but incorrectly identified it as the European Rabbitfish *Chimaera monstrosa*. It was later described as a new species – the Cuban Chimaera – by the Cuban ichthyologist Luis Howell-Rivero (1899–1986) in 1936. The Gulf Chimaera was named in 1951 by American ichthyologists Henry Bigelow (1879–1967) and William Schroder (1895–1977) based on specimens from Pensacola, Florida, while the Bahamas Ghost Shark was only discovered and named in 2010. The first records of the Atlantic Chimaera *Hydrolagus affinis* from North American waters incorrectly described it as a new species, first as *Chimaera plumbea* in 1878 and then as *Chimaera abbreviata* in 1883; both attributed to the American ichthyologist Theodore Gill (1837–1914). Both descriptions were later found to be synonymous

with *Hydrolagus affinis*, which was formally named in 1868 by the Portuguese naturalist Felix Antonio de Brito Capello (1828–1879), based on a specimen taken in deep water off Portugal. These early North American records of the Atlantic Chimaera came from a deep water long-line halibut fishery that began operating off Nova Scotia and in the Gulf of Maine around 1875. The species was apparently very common. More recently, the Large-eyed Rabbitfish *Hydrolagus mirabilis* and Pale Chimaera *Hydrolagus pallidus* have only been documented in the region since the late 1990s and are rarely encountered except during exploratory deepsea surveys or as commercial fisheries expand into deeper waters.

The IUCN Red List conservation status for all short-nosed chimaeras in the Northwest Atlantic and Gulf of Mexico is Least Concern due to their deepsea habitat, relatively wide geographic distribution and low fishing pressure throughout much of their range. Short-nosed chimaeras are infrequently caught in the region, with the exception of the Gulf Chimaera, which surveys in the northern Gulf of Mexico indicate is the most abundant deepsea chondrichthyan caught in bottom trawls. All other short-nosed chimaeras are primarily encountered during research surveys.



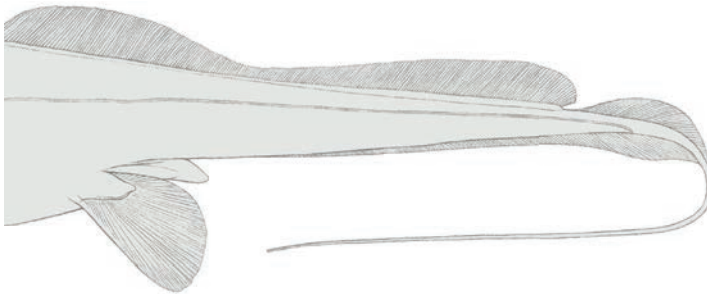
Bahamas Ghost Shark, *Chimaera bahamaensis*, observed during the NOAA 2019 Southeastern U.S. Deep-sea Exploration.

Short-nosed chimaera species key guide

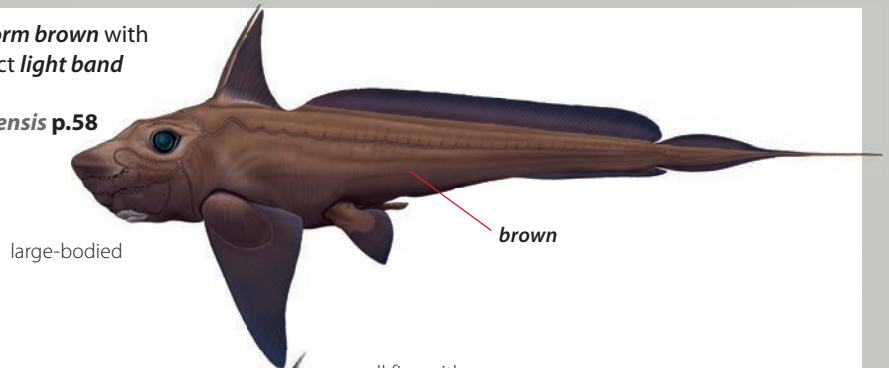
1a Anal fin *present* → *Chimaera* → ②



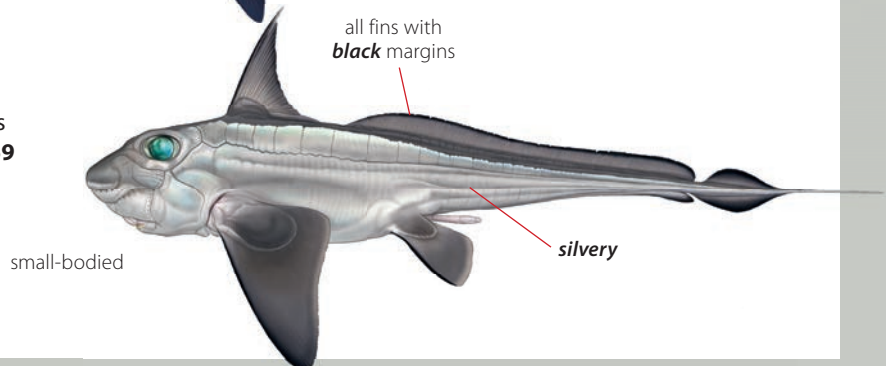
1b Anal fin *absent* → *Hydrolagus* → ③



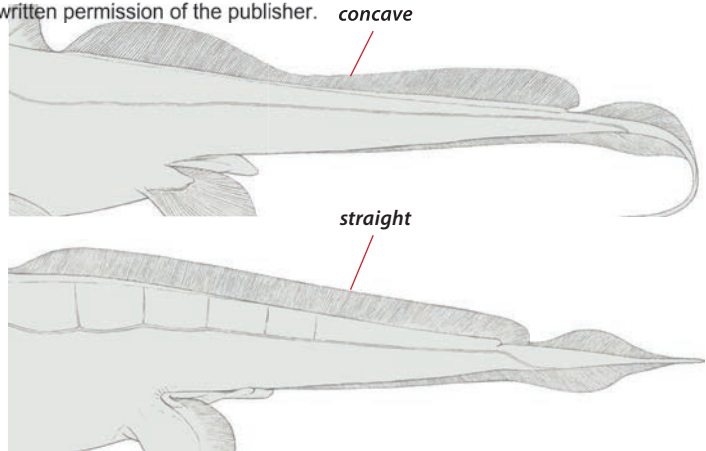
2a Large body; body *uniform brown* with *darker fins* and a distinct *light band across upper snout*
→ *Chimaera bahamaensis* p.58



2b Small body; body *silvery*,
all fins with *black margins*
→ *Chimaera cubana* p.59

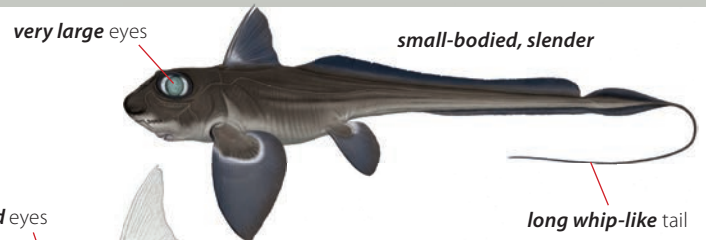


- 3a** Second dorsal fin margin **deeply concave** →
Hydrolagus mirabilis p.62

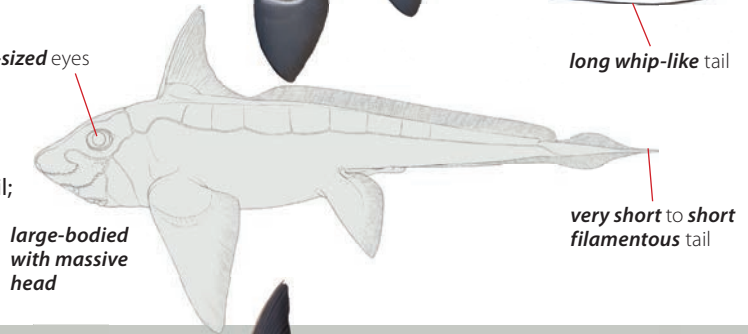


- 3b** Second dorsal fin margin **relatively straight** → ④

- 4a** *Small-bodied, slender* chimaera; eyes **very large**, about 30–35% head length; **long** whip-like tail; adult BDL 45cm or less → *Hydrolagus alberti* p.61

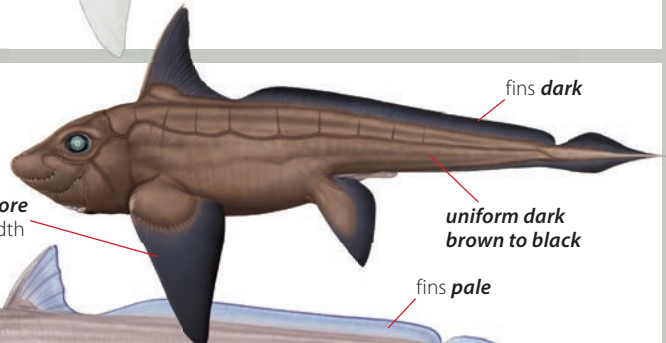


- 4b** *Large-bodied, massive head*; eyes about 20% head length; **very short to short** filamentous tail; adult BDL over 65cm → ⑤



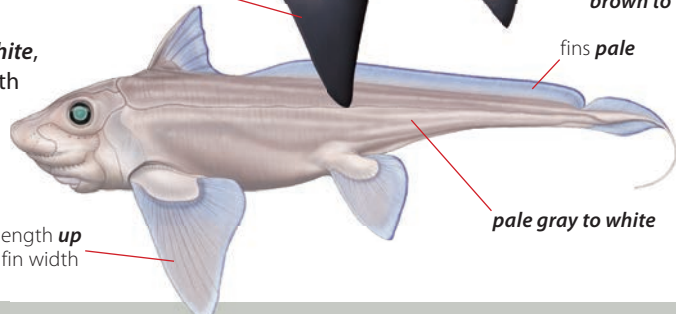
- 5a** Body uniform **dark brown to black**, all fins **dark**; pectoral fin length **more than 1.5 times** fin width → *Hydrolagus affinis* p.60

pectoral fin length **more than 1.5 times** fin width



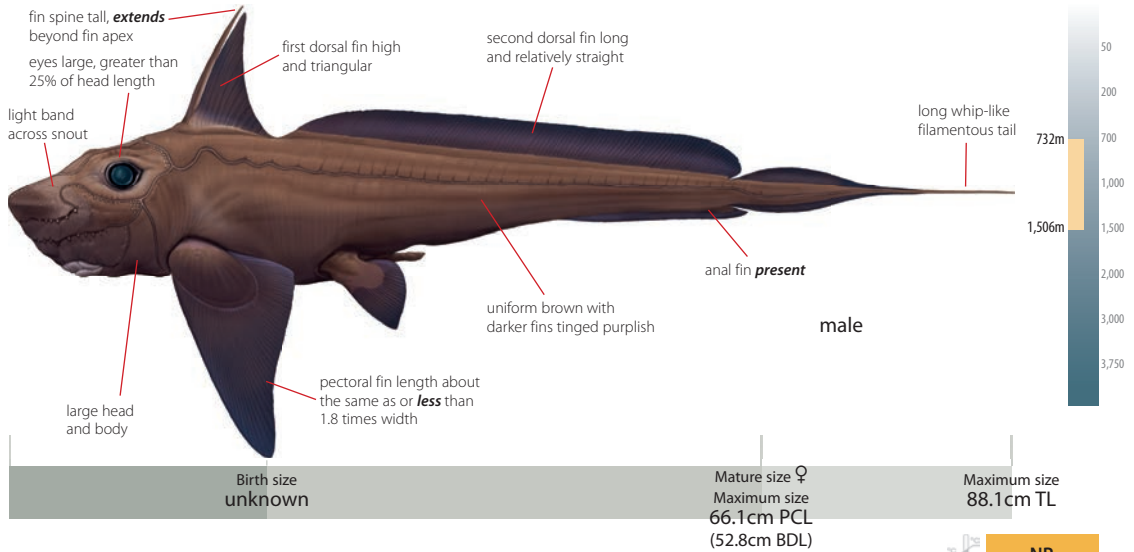
- 5b** Body uniform **pale gray to white**, all fins **pale**; pectoral fin length **up to 1.5 times** fin width → *Hydrolagus pallidus* p.63

pectoral fin length **up to 1.5 times** fin width



BAHAMAS GHOST SHARK *Chimaera bahamaensis*

CWM



NR

NR

NR ♀ NR

NR ♀ NR

LC

Description Medium-sized chimaera; large head; stout trunk to about pelvic fin origins where it quickly tapers posteriorly to whip-like filamentous tail. Eyes large, greater than 25% of head length. First dorsal fin high and triangular; fin spine tall, extending above dorsal fin apex. Second dorsal fin margin relatively straight along entire length, not undulating. Pectoral fins large and broad, length about same or less than 1.8 times width. **Color** Uniform brown with darker fins and a distinct light band across the upper snout. After preservation body uniform caramel brown with no mottling or spotting present; fins slightly darker caramel and dorsal fin spine beige.

Habitat Benthic, found along continental and insular slopes from 732–1,506m.

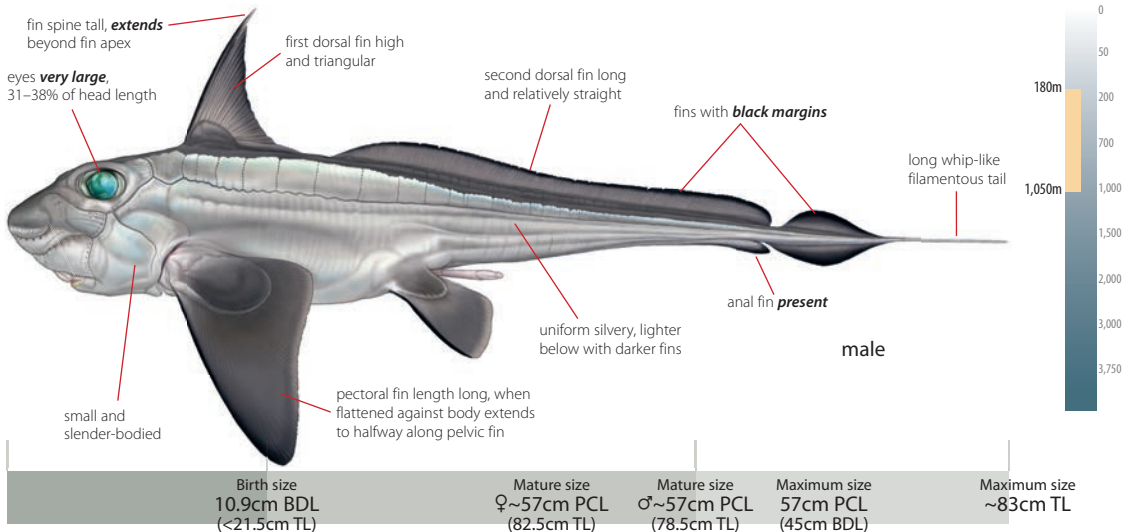
Biology Oviparous, nothing else known of its life history. Diet unknown, likely includes benthic invertebrates. **Eggcases** Unknown.


IUCN Red List Status Least Concern Due to its deepsea habitat and lack of commercial fisheries operating in the region. Known from only four specimens, including an adult female and an adult male.





CUBAN CHIMAERA *Chimaera cubana*


CMU 





 65°F?



 NR

 NR ♀ NR

 NR ♀ NR



LC

Description Small, slender-bodied chimaera; relatively large head with body tapering to slender whip-like filamentous tail. Snout bluntly rounded. Eyes very large, 31–38% of head length. First dorsal fin high and triangular; fin spine height extending above dorsal fin apex. Second dorsal fin margin relatively straight along entire length, not indented. Pectoral fins large, triangular in shape; length when depressed against body extends halfway along length of pelvic fins. **Color** Uniform silvery, lighter below. All fins with black margins.

Habitat Benthic, found along continental and insular slopes from 180–1,050m; appears to occur shallower than other local chimaera species (*Hydrolagus alberti* and *H. mirabilis*). Little is known of its specific habitat preference, but appears to occur over both rocky and mixed rock and sand aggregate seabeds; a water temperature of 65°F at a depth of 280m was recorded during capture of one individual.

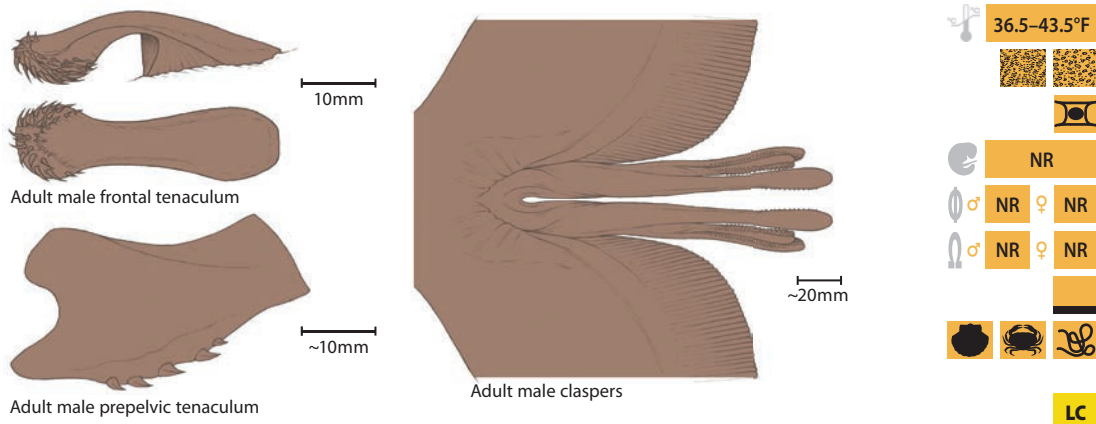
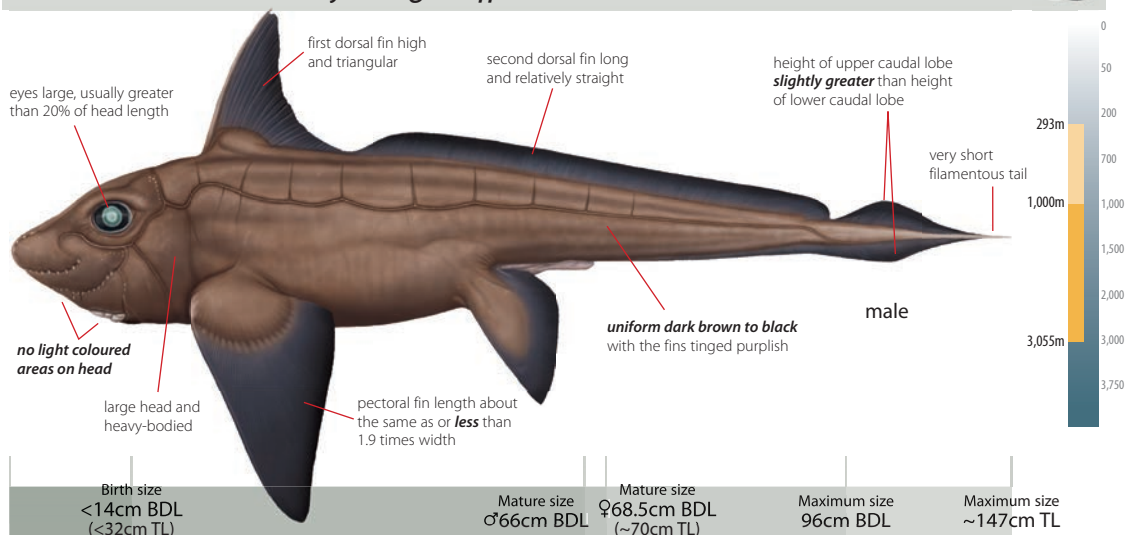
Biology Oviparous, but nothing known about its life history. Diet is mostly benthic invertebrates, including barnacles, amphipods, copepods, marine snails, bivalves, crustaceans, and small bony fishes. **Eggcases** Unknown.

IUCN Red List Status Least Concern Widespread but patchy throughout its range, this species is taken as bycatch on occasion. However, fisheries in the region generally do not extend to the this species' depth range, giving it considerable refuge in deep water beyond most fishing activity.



ATLANTIC CHIMAERA *Hydrolagus affinis*

CYA 



Also called Small-eyed Rabbitfish. **Description** Very large chimaera; large head with noticeably stout body tapering to a short filamentous tail which, when intact, is less than BDL. Eyes large, usually greater than 20% of head length. First dorsal fin high and triangular. Height of second dorsal fin margin relatively even along entire length. Pectoral fin length about same as or less than 1.9 times width. **Color** Variable, ranging from a uniform dark brown to black with the fins tinged purplish. Some individuals may be lightly mottled, but mostly no blotches, stripes or other distinct mottling patterns.

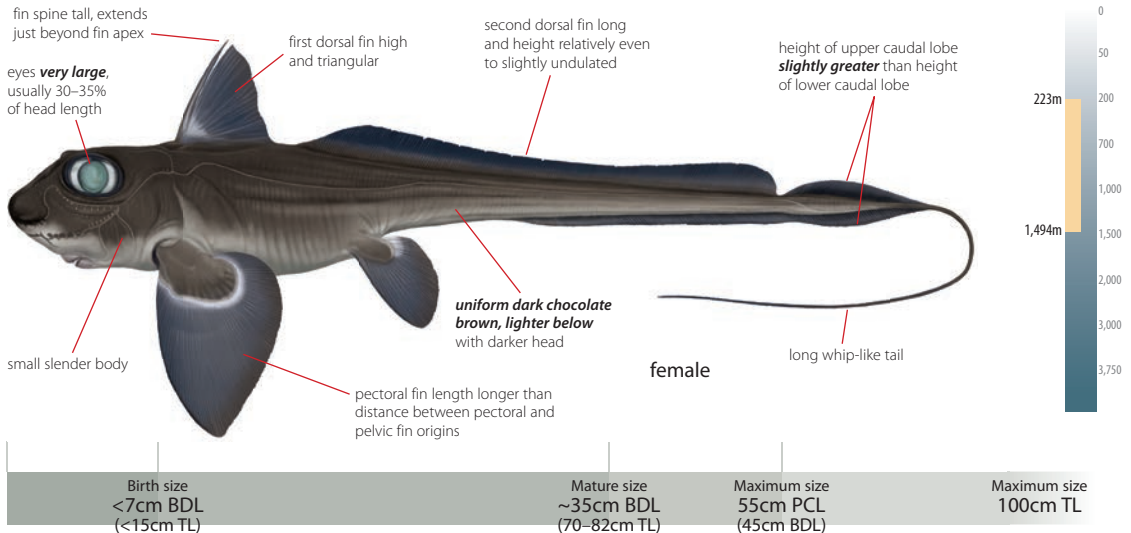
Habitat Benthic, found along continental slopes and seamounts from 293–3,055m, but most common below 1,000m. Little is known of its specific habitat preference, but appears to occur over mud or soft substrate seabeds and in water temperatures of 36.5–43.5°F.

Biology Oviparous, nothing else known of its life history. Diet is mostly invertebrates, including mussels. **Eggcases** Unknown.

IUCN Red List Status Least Concern Due to its deepsea habitat, wide geographic range and absence of deepsea fisheries where it occurs.



GULF CHIMAERA *Hydrolagus alberti*



NR

NR

♂ 7–16 ♀ 9–19

♂ 10–20 ♀ 12–23

LC

Description Small, slender-bodied chimaera; tapering gradually from behind head to slender whip-like filamentous tail. Eyes large, about 30–35% head length. First dorsal fin high and triangular; fin spine reaches just beyond fin apex in adults. Second dorsal fin margin relatively straight to slightly undulated, but not distinctly concave. Pectoral fin length longer than distance between pectoral and pelvic fin origins; fins more rounded in juveniles, becoming distinctly triangular in adults. Tail about 75% of BDL. **Color** Uniform dark chocolate brown, lighter ventrally. Darker brown on head and fins.

Habitat The most common chimaera in the Gulf of Mexico, occurring from 223–1,494m at an average depth around 500m. Prefers soft sand and mud bottoms.

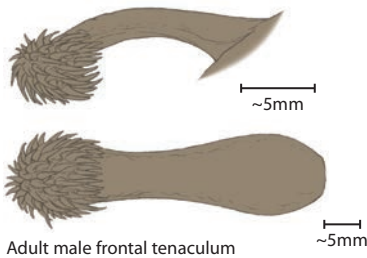
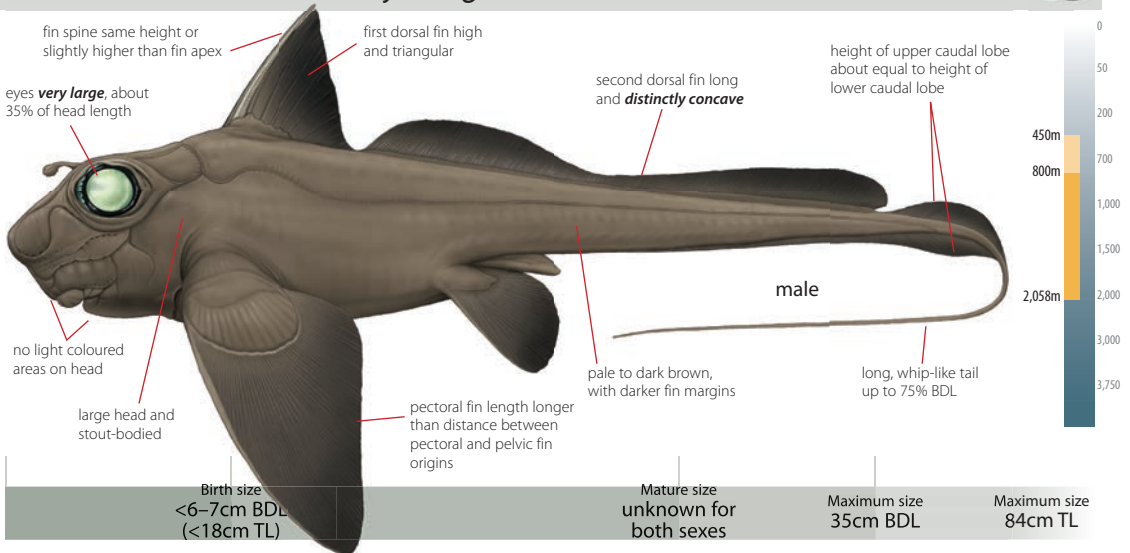
Biology Oviparous, no known seasonal reproductive cycle. Age at maturity estimated at 7–16 years for males and 9–19 years for females, with a maximum age of 10–20 years for males and 12–23 years for females. Diet consists of benthic invertebrates and small bony fishes. **Eggcases** Unknown.


IUCN Red List Status Least Concern The Gulf Chimaera’s deepsea habitat and range provides refuge from most fishing activity.





LARGE-EYED RABBITFISH *Hydrolagus mirabilis*


CYH 





 39.4–45.3°F



 NR

 ♂ NR ♀ NR

 ♂ NR ♀ NR



Description Small, stout-bodied chimaera; tapering from behind the pelvic fins to a very long, slender whip-like filamentous tail. Eyes very large, about 35% of head length. First dorsal fin high and triangular; fin spine same height or slightly higher than fin apex. Second dorsal fin margin distinctly concave with anterior and posterior portions appearing nearly discontinuous. Pectoral fin length longer than distance to pelvic fin origins. Tail about 75% of BDL. **Color** Uniform pale to dark brown with darker fin margins. Second dorsal fin lighter colored at base than along distal edge.

Habitat Benthic, along upper continental slopes from 450–2,058m, mostly below 800m. Inhabits rocky rubble or soft muddy seabeds with bottom temperatures ranging from 39.4–45.3°F. Juveniles are more common in deeper water (usually around 1,000m) and subadults more common in shallower water; adult males and females segregate by depth with the latter occupying a depth range similar to juveniles.

Biology Oviparous, nothing else known of its life history. Diet includes benthic invertebrates such as brittlestars, jellyfishes, tunicates, and small bony fishes. **Eggcases** About 13cm long. Rounded anteriorly, tapering posteriorly to an elongated filament.

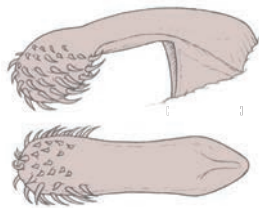
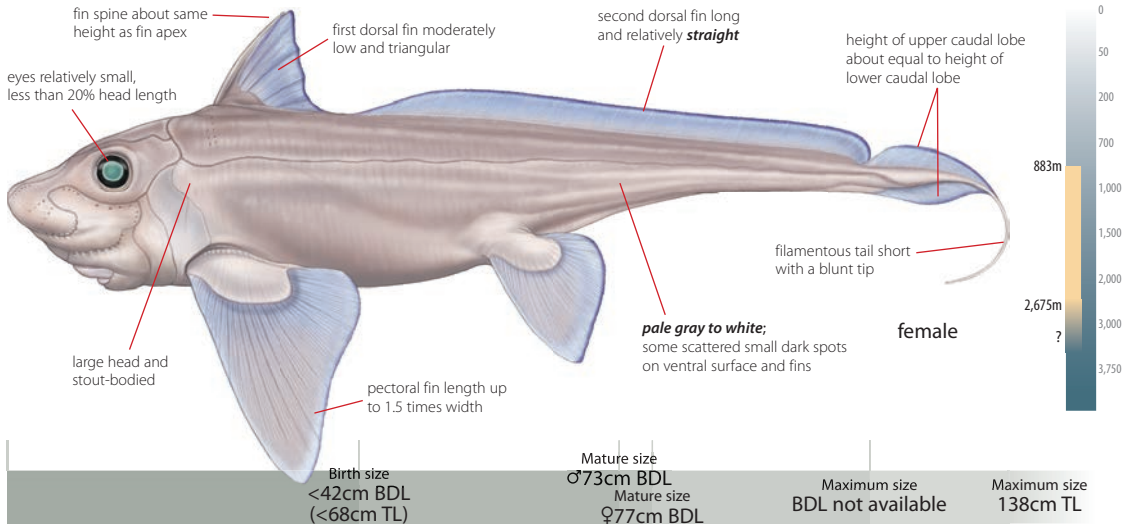
IUCN Red List Status **Least Concern** Due to its deepsea habitat, wide geographic range and lack of deepsea fisheries throughout most of its range.



LC

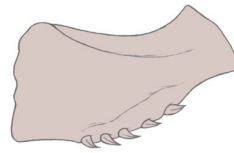
PALE CHIMAERA *Hydrolagus pallidus*

CYZ 




Adult male frontal tenaculum


10mm





Adult male prepelvic tenaculum



~10mm



 36.3–44.6°F




 NR

 NR

 NR

 NR  NR

 NR  NR

LC

Description Very large, stout-bodied chimaera; tapering from large head to short filamentous tail. Eyes relatively small. First dorsal fin moderately high and triangular; fin spine about same height as fin apex. Second dorsal fin continuous to upper caudal lobe; height relatively even or slightly sloping along its length, but not undulated. Pectoral fin length up to 1.5 times width. Tail with a blunt tip. **Color** Uniformly pale gray to white, except for some scattered small dark spots on ventral surface and fins. This species is very similar in shape to *Hydrolagus affinis* (p.60), however genetic studies seem to confirm it is a distinct species.

Habitat Benthic, along deepsea slopes, troughs and seamounts from 883–2,675m, possibly deeper. This species has been captured in bottom waters ranging in temperature from 36.3–44.6°F.

Biology Oviparous, nothing else known of its life history. Diet includes benthic invertebrates. **Eggcases** Unknown.

IUCN Red List Status **Least Concern** Although taken occasionally as bycatch, its deepsea habitat and wide geographic range is outside most fishing activity.



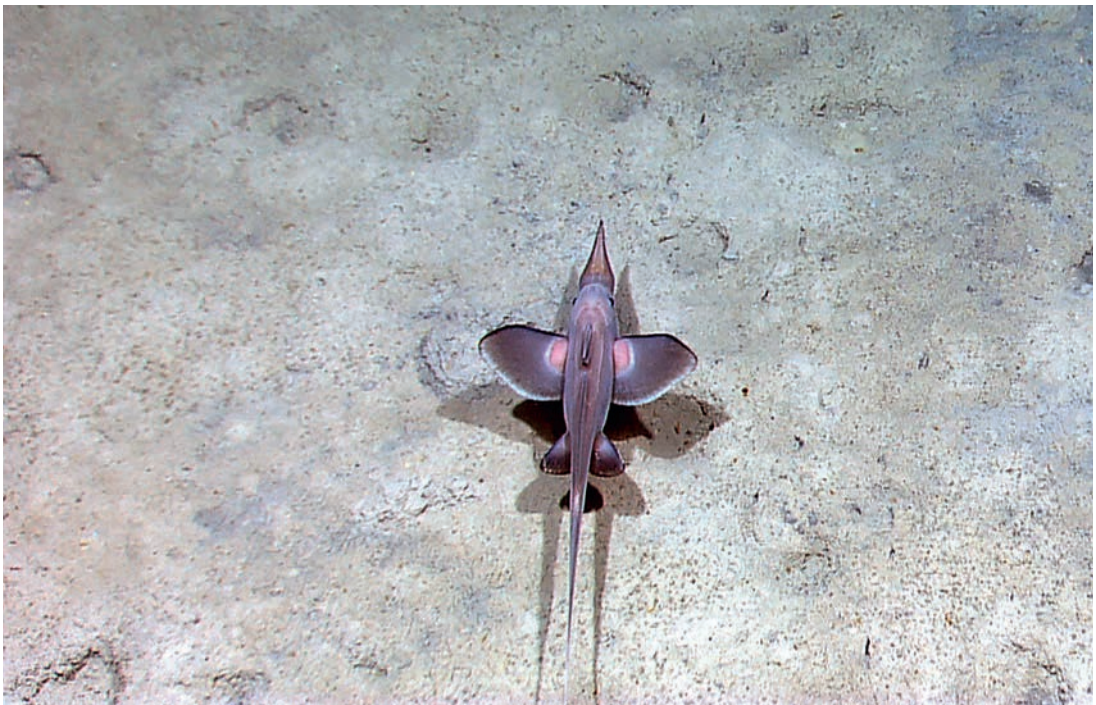
Long-nosed chimaeras *Rhinochimaeridae*

The long-nosed chimaeras (*Rhinochimaeridae*) are a small family with only eight species described worldwide. Three are known to occur in Northwest Atlantic waters, where they are mostly wide-ranging, deepsea species found to depths of over 3,100m. The Narrow-nosed Chimaera *Harriotta raleighana* and Small-spined Chimaera *Harriotta haeckeli* were described from the Northwest Atlantic in 1895 and 1972 respectively. The third, the Atlantic Long-nosed Chimaera *Rhinochimaera atlantica*, was described in 1909 following its discovery on the continental slope southwest of Ireland. Interestingly, the Small-spined Chimaera, described 77 years after the Narrow-nosed Chimaera, was misidentified as the latter species for many years prior to being recognized as a distinct species.

There is presently some confusion over the precise scientific name of the Narrow-nosed Chimaera since the

original description and type series included four specimens (referred to as syntypes) and no designated holotype. The species was originally described by the American ichthyologists George B. Goode (1851–1896) and Tarleton H. Bean (1846–1916) in 1895. Following their description, two other American ichthyologists, David Starr Jordan (1851–1931) and Barton W. Evermann (1853–1932), established a lectotype from the syntype series. However, the lectotype they designated may actually have been based on a specimen of the Small-spined Chimaera described in 1972.

Because long-nosed chimaeras are geographically wide-ranging, often found in exceptionally deep water and only sporadically encountered, they are of little or no significance in commercial fisheries. All three species occurring in the region are assessed as Least Concern on the IUCN Red List.

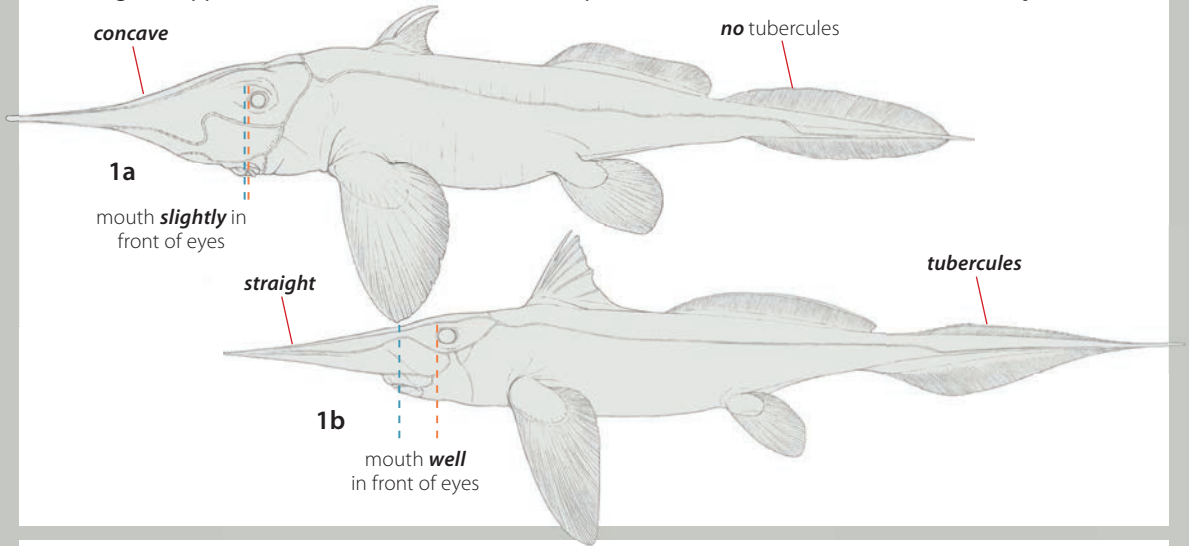


Narrow-nosed Chimaera, *Harriotta raleighana*, observed during the NOAA 2012 Okeanos Explorer Program, Gulf of Mexico Expedition.

Long-nosed chimaera species key guide

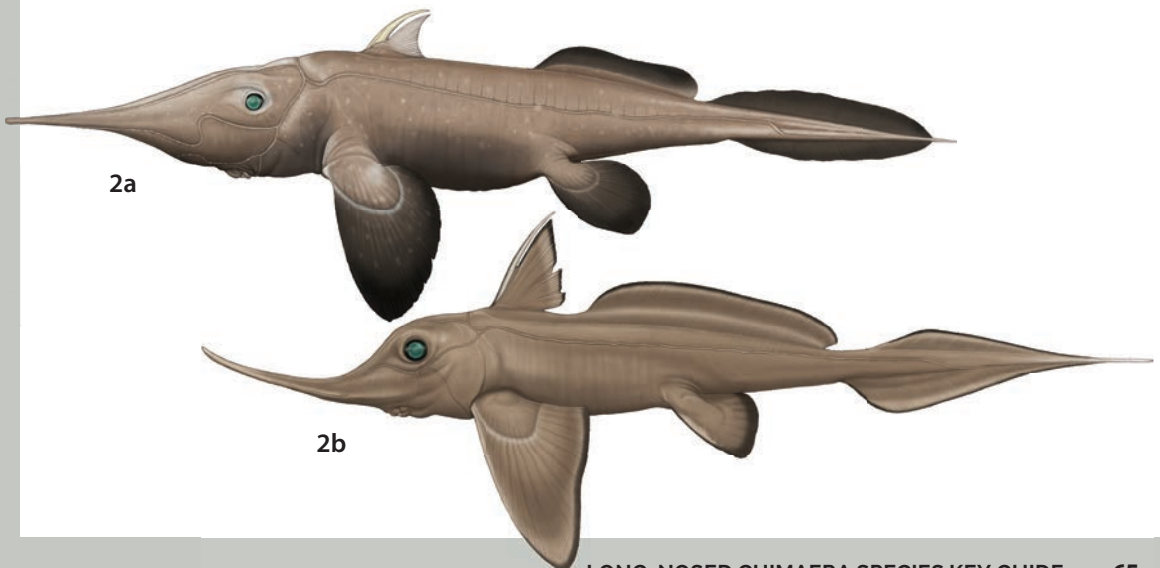
1a Lateral head profile *concave*; mouth *slightly anterior* to eyes; margin of upper caudal lobe *without* tubercles; tooth plates *ridged* → **2**

1b Lateral head profile *straight*; mouth *well in front* of eyes; margin of upper caudal lobe *with* tubercles; tooth plates *smooth* → **Rhinochimaera atlantica** p.68



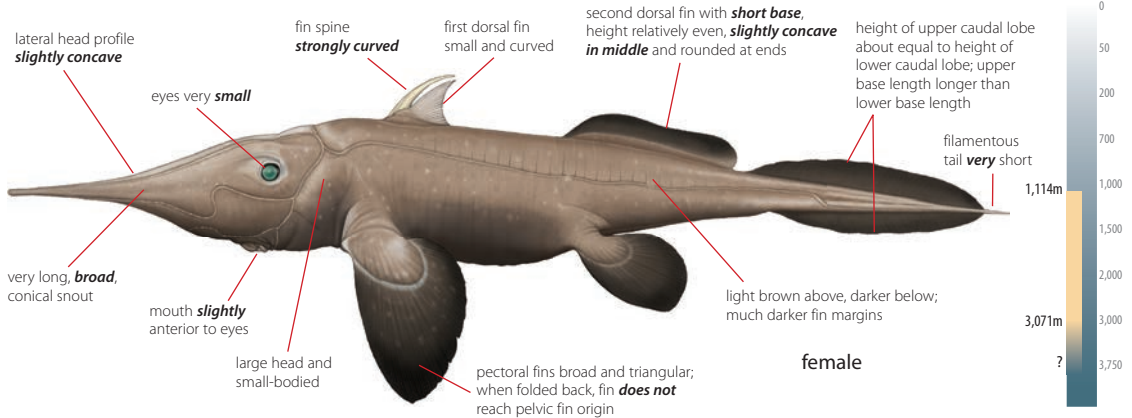
2a Dorsal spine *strongly curved, does not* extend beyond first dorsal fin apex; eyes relatively *small; light brown* above, *darker below* → **Harriotta haeckeli** p.60

2b Dorsal spine slightly curved, extends *beyond* first dorsal fin apex; eyes relatively *large; uniform dark brown* → **Harriotta raleighana** p.61

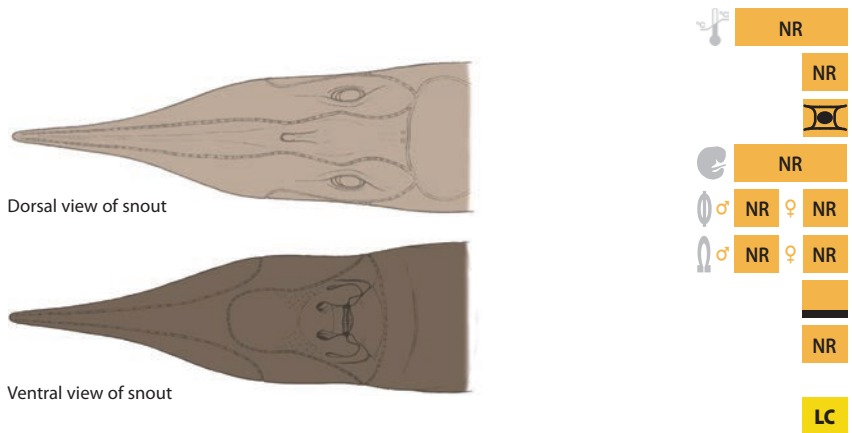


SMALL-SPINED CHIMAERA *Harriotta haeckeli*

HCH 



Birth size Unknown	Mature size ♂~45cm TL (20cm BDL)	Mature size ♀~60cm TL (25cm BDL)	Maximum size 74cm TL (without tail filament)
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Description Small-bodied chimaera; body tapering from large head to very short, filamentous tail. Snout very long, broad and conical with wide base. Eyes very small. First dorsal fin small and curved; fin spine noticeably curved and short. Second dorsal fin relatively short and slightly concave. Dorsal fin heights about the same. Pectoral fins broad and triangular; length shorter than distance to pelvic fin origin. **Color** Uniform light brown above, becoming darker below, with fin margins much darker even blackish. Fin spine pale.

Habitat Rare, very deep water species found from 1,114m to at least 3,071m, possibly deeper. In some areas, it seems to replace *Harriotta raleighana* (opposite) at depths below 1,500m.

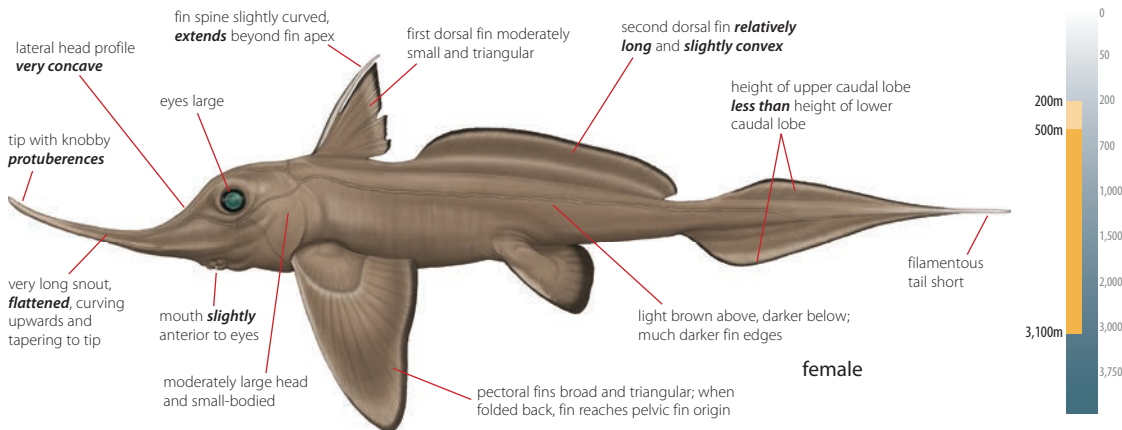
Biology Oviparous, nothing else known of its life history. **Eggcases** Unknown.

IUCN Red List Status Least Concern This species' deepsea habitat mostly precludes it from fisheries bycatch.

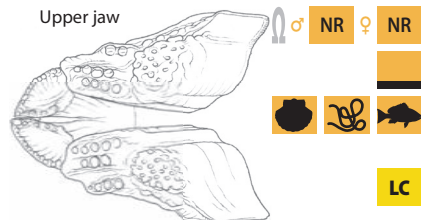
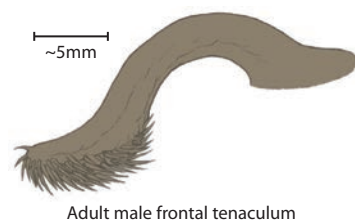


NARROW-NOSED CHIMAERA *Harriotta raleighana*

HCR 



Birth size 10–13cm PCL	Mature size ♂25–30cm BDL	Mature size ♀30cm BDL	Maximum size 70cm PCL	Maximum size ~120cm TL
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Description Small-bodied chimaera; moderately large head tapering to short, filamentous tail. Snout very long, slightly flattened, tapering to a point with knobby protuberances at the tip, sometimes curving upwards; adult males have a proportionally longer snout than adult females. Eyes large. First dorsal fin moderately small and triangular; fin spine slightly curved, extends beyond fin apex. Second dorsal fin relatively long and slightly convex. Pectoral fins broad and triangular, length greater than distance to pelvic fin origin. **Color** Uniform light to dark brown with fin margins much darker.

Habitat Benthic, found over continental slopes from 200–3,100m, although mostly deeper than 500m; there is an unconfirmed Indian Ocean record from only 100m. There appears to be an ontogenetic migration between 300–1,000m, with smaller individuals found from 300–1,000m and larger individuals mostly occurring deeper than 1,000m. This species has been observed at depth by ROVs over soft mud and gravelly to cobbled seabeds. Bottom temperatures where this species has been observed range from 37.4–43°F.

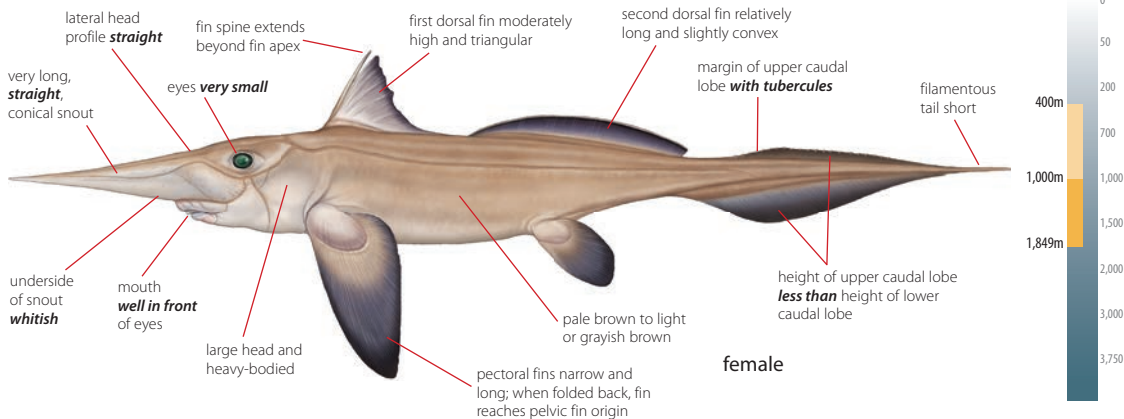
Biology Oviparous, females are able to store sperm enabling them to give birth throughout the year. Very little else is known of its life history. Diet includes polychaetes, molluscs, other small benthic invertebrates, and bony fishes. **Eggcases** Small, ~16mm long. Strongly convex, thin lateral flanges with narrow transverse ridges numbering over 50 rows on each side. Capsule dark colored, but lighter on flanges.

IUCN Red List Status Least Concern Although taken as bycatch on occasion, this species' deepsea habitat and wide distribution limits fishing pressure.

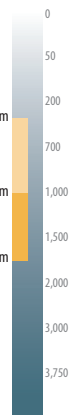


ATLANTIC LONG-NOSED CHIMAERA *Rhinochimaera atlantica*

RCT



female



Birth size ~15cm TL	Mature size ♂81.3cm PCL (107cm TL)	Mature size ♀127.4cm TL (99cm BDL)	Maximum size 90cm PCL (~147cm TL)
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33.8–44.8°F



NR

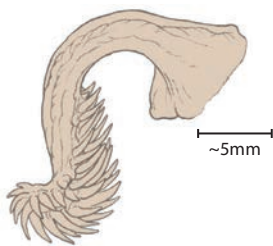
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NR

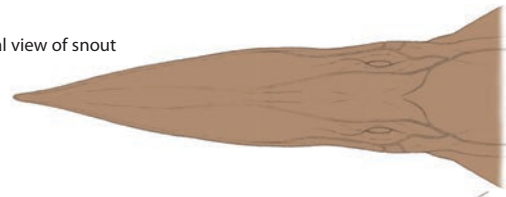
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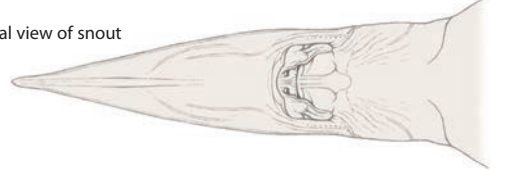


Adult male frontal tenaculum

Dorsal view of snout



Ventral view of snout



Description Large, heavy-bodied chimaera; large head tapering to short filamentous tail. Snout very long and straight, tapering from fleshy subtriangular base to a narrow, bluntly pointed tip without knobs; length about 50–87% body length, longer in juveniles than in adults. Eyes very small. First dorsal fin moderately high and triangular; fin spine extends beyond fin apex. Second dorsal fin margin relatively long and slightly convex. Pectoral fins narrow and long; length greater than distance to pelvic fin origin. **Color** Pale to light brown or grayish brown with darker fins. Ventral surface of snout whitish. Very similar in appearance to *Rhinochimaera pacifica*, however genetic information confirms they are distinct species.

Habitat Benthic, mostly occurs over soft substrates, from 400–1,849m, typically over 1,000m. This species has been caught in waters with bottom temperatures ranging from 33.8–44.8°F. A relatively common deepsea species where it occurs.

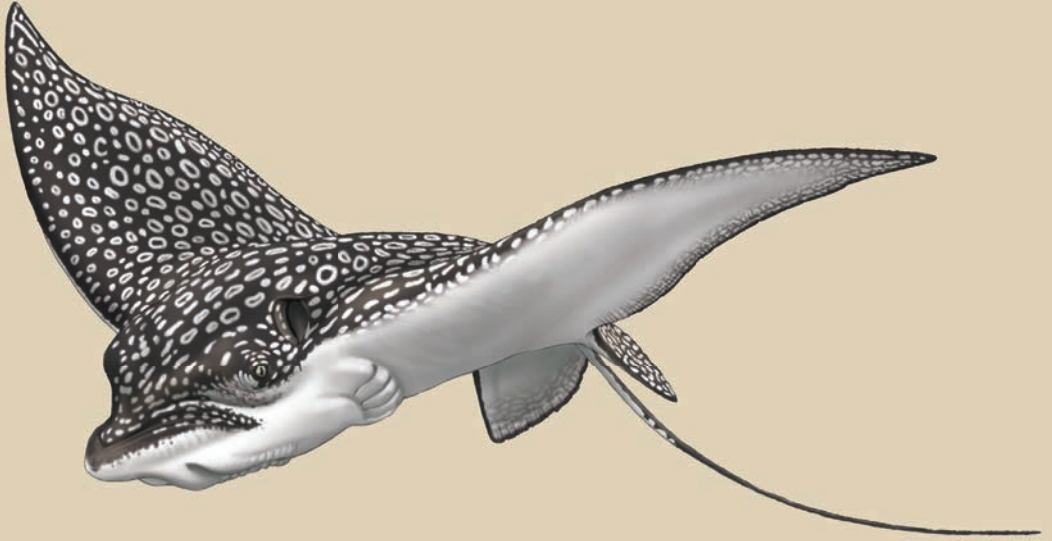
Biology Oviparous, nothing else known about its life history. This species appears to aggregate in large numbers, usually grouping by size, sex, and maturity. **Eggcases** Spindle-shaped with an anterior constriction, a long posterior tube and very wide lateral flanges with numerous transverse ribs.

IUCN Red List Status Least Concern Although taken as bycatch in some areas, this species' wide distribution and deepsea habitat limits fishing pressure.



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SKATES AND RAYS



(continued...)

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