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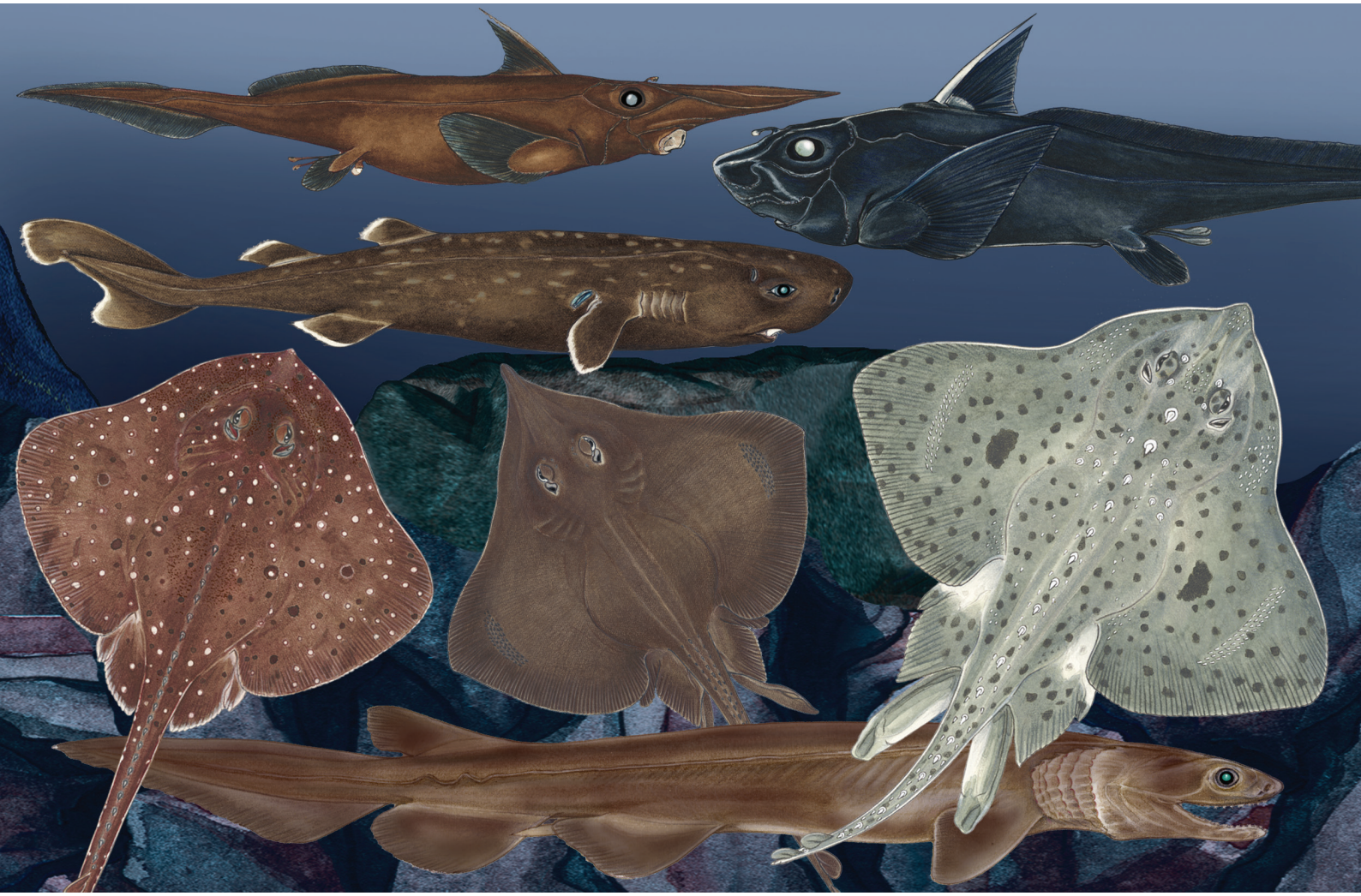
DEEP–SEA CARTILAGINOUS FISHES OF THE SOUTHEASTERN PACIFIC OCEAN



DEEP–SEA CARTILAGINOUS FISHES OF THE SOUTHEASTERN PACIFIC OCEAN

by

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Support to the implementation of the International Guidelines on the Management of Deep–Sea Fisheries in the High Seas (GCP/GLO/323/NOR)

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PREPARATION OF THIS DOCUMENT

This document was prepared under the “FAO Deep–sea Fisheries Programme”, thanks to generous funding from the Government of Norway (Support to the implementation of the International Guidelines on the Management of Deep–Sea Fisheries in the High Seas project) for the purpose of assisting states, institutions, the fishing industry and RFMO/As in the implementation of FAO International Guidelines for the Management of Deep–sea Fisheries in the High Seas. This catalogue was developed in close collaboration with the FishFinder Programme of the Marine and Inland Fisheries Branch, Fisheries Department, Food and Agriculture Organization of the United Nations (FAO).

Its production follows the recommendations made during a workshop on “Deep-sea Species Identification” held in Rome in 2009 organized in response to the need for a strategy for the development of appropriate deep-sea species identification tools for fishery purposes, in particular, to address the broadened requirements for reporting on not only target species, but also associated species following recent international developments with respect to fisheries management guidance and biodiversity conservation. The workshop recommended that a series of identification guides be developed for certain vulnerable groups of species affected by bottom gear, with an initial focus on three of the most impacted groups: cartilaginous fishes, corals and sponges. As a starting point, in consideration of the extensive information available on cartilaginous fishes from other FAO guides and publications, it was decided to develop identification guides for deep-sea members of this group at a regional level. The Indian Ocean was chosen as the first region and a two-volumes catalogue and an identification guide were developed, followed by a similar set of publications focusing on the southeastern Atlantic Ocean.

The present publication is dedicated to the identification of deep–sea cartilaginous fishes occurring in the southeastern Pacific Ocean (FAO Fishing Area 87) providing accounts for all orders, families, genera and species known to occur in the area. Moreover, fully illustrated keys to all taxa are included.

It is aimed at facilitating the species specific identification of the deep–sea cartilaginous fishes occurring in the southeastern Pacific Ocean by fishery observers, crew members, scientists, fishery officers and the interested public.

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ABSTRACT

This volume is a comprehensive, fully illustrated Catalogue of the Sharks, Batoid Fishes, and Chimaeras of the southeastern Pacific Ocean, encompassing FAO Fishing Area 87. The present volume includes 8 orders, 17 families, 39 genera, and 68 species of cartilaginous fishes occurring in the southeastern Pacific Ocean. It provides accounts for all orders, families, genera and species, and all keys to taxa are fully illustrated. Accounts of each species include: valid modern names and original citation of the species; synonyms; the English, French, and Spanish FAO names for the species (when available); a lateral view and often other useful illustrations; field marks; diagnostic features; distribution, including a GIS map; habitat; biology; size; interest to fisheries and human impact; local names (when available); a remarks section; and literature. The volume is fully indexed and also includes sections on terminology and measurements, an extensive glossary, and a dedicated bibliography.

ACKNOWLEDGEMENTS

A volume of this magnitude and scope could not be accomplished without the generous help of others and I wish to thank all of those who have been extremely helpful and generous with their time in responding to my numerous questions, providing data and information from their own research (some of it unpublished), and providing much needed literature. The generic and species accounts were improved immensely from the contribution of colleagues and friends. I wish to apologize beforehand if I have forgotten anybody, which will inevitably happen with a work of this magnitude, but I do thank you all for your help and assistance.

I would like to extend my thanks to the following individuals for general discussions and information on various aspects of this project: Francisco Concha (University of Connecticut and University of Valparaiso), Douglas Long (St. Mary's College), Amber Reichert, Justin Cordova, and Victoria Vásquez (Pacific Shark Research Center, Moss Landing Marine Laboratories), David Catania, William Eschmeyer, and Jon Fong (California Academy of Sciences, San Francisco), Gavin Naylor and Jenny Kemper (College of Charleston, Charleston, South Carolina, USA), Nicholas Straube (Bavarian State Collection of Zoology), John McEachran (Texas A & M University, College Station, Texas, USA), Jimmy Martinez (WWF, Ecuador), Mark Grace (NOAA Fisheries), Joost Pompert (Falkland Island Fisheries Department), Kelsey James (University of Rhode Island), and D. Ross Robertson (Smithsonian Tropical Research Institute). A special thanks to the library staff (Moss Landing Marine Laboratories, Moss Landing, California, USA) for tracking down those hard to find, usually obscure, references.

The Food and Agriculture Organization of the United Nations would like to thank Annalisa and Marina Durante, scientific illustrators, for producing the drawings of the following species: *Bathyraja meridionalis*, *Bathyraja longicauda*, *Bathyraja schroederi*, *Bathyraja macloviana*, *Bathyraja multispinis*, *Bathyraja peruana*, *Rajella nigerrima*, *Raiella sadowskii* and *Notoraja martinezi.* Thanks to Dr. Alejandro Sancho, scientific illustrator, for producing the drawings of *Hydrolagus macrophthalmus, H. mccoskeri*, and *H. melanophasma*. Finally, thanks to Dr. Domingo Lloris for providing the drawings of *Bathyraja magellanica*, *Psammobatis scobina* and *Zearaja chilensis*, and Dr. Carlos Bustamante for providing the drawing of *Amblyraja frerichsi*.

Table of Contents

1. INTRODUCTION

The present catalogue covers the deep–sea chondrichthyans of the southeastern Pacific Ocean, FAO Fishing Area 87. The catalogue includes species of major, moderate, minor, and minimal importance to fisheries as well as those of doubtful or potential use to fisheries. It also covers those little known species that may be of research, educational, and ecological importance. The catalogue is intended to be a comprehensive review of the cartilaginous fishes of the deep–sea southeastern Pacific Ocean in a form accessible to fisheries workers as well as researchers on shark systematics, biodiversity, distribution, and general biology. It also caters to other researchers that need comparative information on sharks, and their relatives, and to people who encounter sharks at sea, and the general public.

Biogeography of the Region. The southeastern Pacific region encompasses FAO Fishing Area 87, and is bounded by a line beginning on the South American mainland continental coast at the border between Panama and Colombia at 7°12'39"N latitude and 77°53'20" W longitude, and extending on a rhumb line in a southwesterly direction to 5°00'N latitude and 79°00'52"W longitude, and then running due west along the parallel 5°00'N to the meridian 120°00'W, then due south to 60°00'S latitude, and then running east along this parallel to a point at 67°16'W longitude, and then due north to 56°22'S latitude, and then east to 65°43'W longitude, and then due north to 55°22'S latitude, and then in a northwesterly direction along a rhumb line and across the Beagle Canal to the border between Chile and Argentina, and finally along the Pacific coast of South America to the point of departure (Figure 1 – Map of the southeastern Pacific Ocean FAO Area 87). FAO Area 87 includes the Humboldt (or Peru) Large Marine Ecosystem, defined by the Humboldt Current, also called the Peru Current, which extends from the southern tip of Chile to northern Peru. This is mostly a cold ocean current that flows north along the coast of Chile to northern Peru, where it meets the Pacific Central-American Large Marine Ecosystem, which is comprised of the Intertropical Convergence Zone. Warm tropical waters from the Intertropical Convergence Zone by contrast mostly influence the northern portion of FAO Area 87, including Colombia, Ecuador, and northern Peru. The southeastern Pacific region is one of the most productive marine ecosystems in the world, with the largest upwelling system. This area supports some of the largest pelagic fisheries catches for anchovies, sardines, and jack mackerel.

Classification and systematic arrangement used here. The higher classification of these fishes includes the class Chondrichthyes that is divided into two major groups, each with a long and separate, pre–Devonian history, the chimaeroids, Holocephali (with a single living order Chimaeriformes), and the sharks and batoids proper, with the surviving group Neoselachii divided into two cohorts, the Selachii (sharks) and the Batoidea (rays and skates) and includes all of the modern living species. The Selachii is further divided into two superorders, the Squalomorphii and Galeomorphii. The superorder Squalomorphii includes the orders Hexanchiformes, Echinorhiniformes, Squaliformes, Squatiniformes, and Pristiophoriformes, while the superorder Galeomorphii includes the Heterodontiformes, Orectolobiformes, Lamniformes, and Carcharhiniformes. The ordinal classification of the shark–like fishes largely follows the arrangement of Compagno (2001, 2005), Ebert (2013, 2014, 2015), Ebert, Fowler and Compagno (2013), and Ebert and Stehmann (2013) with some modifications in recognizing nine orders and 34 families. The cohort Batoidea recognizes four orders, Torpediniformes, Rhinopristiformes, Rajiformes, and Myliobatiformes, although the higher classification of batoid fishes and the assignment of various families to suborders or orders are not yet fully clarified. Nelson (2006) provided a table reflecting different concepts and comparing his own classification of the previous 3rd edition (Nelson, 1994) with those of Compagno (1999) with six orders and 21 families, McEachran and Aschliman (2004) with four orders and 14 families, and finally his own concept of the 4th edition (Nelson, 2006) with four orders and 17 families. More recently Aschliman, Claeson and McEachran (2012) recognized 13 batoid families, and considered the skates to be comprised of a single family with nearly 300 species, while Naylor *et al.* (2012a, b) found support for retaining the family Arhynchobatidae as separate from the family Rajidae. Therefore, given this uncertainty as to the higher classification of the batoids, particularly the skates, the classification of Nelson (2006) is followed with the exception of retaining the skate family Arhynchobatidae (Fowler, 1934), resurrected by Compagno (1999, 2005), and generally followed in most current literature (Ebert, 2014, 2015). The Holocephali (chimaeras) are composed of a single living order Chimaeriformes. The higher classification of chimaeras follows Didier (1995, 2004) and Didier, Kemper and Ebert (2012). The relationship of the sharks to the batoids is still unresolved, with recent classifications suggesting that the batoids are either sister to the modern sharks orders Pristiophoriformes and Squatiniformes, and share a common ancestry with the Squaliformes (e.g. the Hypnosqualean hypothesis), or follow traditional dichotomy of all modern sharks and batoids. The two hypotheses break down largely between traditional morphologists (Compagno, 1973, 1977, 1999 2001, 2005; Shirai, 1992a, 1996; de Carvalho, 1996) and newer molecular evidence (Douady *et al.*, 2003; Naylor *et al.*, 2005, 2012a, b; G. Naylor, pers. comm.).

The following classification to order is based on the above discussion on higher ordinal classifications (*starred orders are covered in this volume):

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 (frilled and cow sharks)*
      - Order Echinorhiniformes (bramble 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 Rhinopristiformes
Order Rajiformes (skates and guitarfishes)*
Order Myliobatiformes (stingrays)

Southeastern Pacific Ocean Biodiversity. The southeastern Pacific has a relatively low–diverse deep-sea chondrichthyan fauna with 8 orders, 17 families, 39 genera, and at least 68 species being represented (Table 1). However, these numbers are likely an under–estimate since there are several undescribed species and a few species complexes under investigation that should eventually resolve the systematics of those species. Also, the deep–sea is not well studied and it is likely that additional species may be found to occur in this region. The southeastern Pacific deep–sea shark fauna comprises 5 orders, 12 families, 26 genera, and at least 33 species (Table 1). The most species–rich group of deep–sea sharks are the Squaliformes with at least 20 species, representing about 61% of the deep–sea shark species in this region. Most are in the families Etmopteridae (n = 7) and the Somniosidae with 6 species. The Carcharhiniformes are represented by 5 species, all of which belong to the family Scyliorhinidae. All of the other shark orders only have three or fewer species representatives. The deep–sea batoid fauna is represented with 2 orders, 3 families, 9 genera, and at least 26 species (Table 1). The most specious group of deep–sea batoids are the skates (Rajiformes) that have two families (Arhynchobatidae and Rajidae), 8 genera and 25 species represented. The deep–sea chimaera fauna has representatives of two families (Chimaeridae and Rhinochimaeridae), and includes four genera, and at least 9 species.

SEP Ocean (FAO Area 87)	Sharks	Batoids	Chimaeras	Tot.
Orders	5	2	1	8
Families	12	3	2	17
Genera	26	9	4	39
Species	33	26	9	68

Table 1. – The families, genera, and species represented within the deep–sea southeastern Pacific Ocean (SEP).

1.1 Plan of the Catalogue.

The format for this catalogue follows that of the FAO Catalogue of Sharks of the World (Compagno, 2001), and other recent FAO Catalogues on the Sharks, Batoids, and Chimaeras of the North Atlantic (Ebert and Stehmann, 2013), Indian Ocean (Ebert, 2013, 2014), and southeastern Atlantic Ocean (Ebert, 2015), with orders as the highest taxonomic group dealt with here, followed by family, genus, and species accounts. Keys to the families and genera, where appropriate are also included. A difference in the present catalogue, from the other deep-sea catalogues (Ebert, 2013, 2014, 2015), is that all species accounts are dealt with in comprehensive detail. A list of all deep–sea species known to occur in the southeastern Pacific Ocean is presented for each family, with each genus presented in detail and a detailed species account of each shark, skate and chimaera.

The species specific information on the biology, conservation status, distribution, habitat, fisheries, and systematics of southeastern Pacific Ocean chondrichthyans was compiled from primary literature sources including, but not limited to, Compagno (2001), Ebert, Fowler and Compagno (2013), Kyne and Simpfendorfer (2010), and Ebert and Compagno (In press). Electronic sources were also of invaluable help and included, but were not limited to, the California Academy of Sciences Catalogue of Fishes (http://www.calacademy.org/research/ichthyology/catalog/fishcatsearch.html), IUCN Shark Specialist Group (http://www.iucnredlist.org), and Shark References (http://shark-references.com). A comprehensive bibliography of the literature, including primary, grey, and electronic sources is provided at the end of this volume.

Order accounts include the valid modern form of the order name with author and year; the original citation of the order name with its author, year, reference and pagination; the number of recognized families in the southeastern Pacific deep–sea; common order Synonyms mainly from the southeastern Pacific deep–sea region with the name, author, year, and pagination; the FAO order Vernacular Names in English, French and Spanish (when available); Field Marks and Diagnostic Features of members of the order; an account of the natural history of the order under separate sections covering Distribution, Habitat and Biology; a section on Interest to Fisheries and Human Impact, a synopsis of the human issues affecting shark families; Local Names (when available); a Remarks section mostly with comments on systematics; and a key to deep–sea southeastern Pacific families, when orders have more than one family.

Family accounts include the valid modern form of the family name with author and year; the original citation of the family name with its author, year, reference and pagination; the valid type genus with author and date; the number of recognized deep–sea southeastern Pacific Ocean genera in the family; family Synonyms with names mostly associated with the southeastern Pacific Ocean region and with the name, author, year, and pagination; the FAO family Vernacular Names in English, French and Spanish (when available); Field Marks and Diagnostic Features of members of the family; an account of the natural history of the family under separate sections covering Distribution, Habitat and Biology; a section on Interest to Fisheries and Human Impact, a synopsis of the human issues affecting shark families; Local Names (when available); a Remarks section mostly with comments on systematics; a Literature section covering references to the entire family; and a key to deep–sea southeastern Pacific genera, when families have more than one genus.

Generic accounts include the valid modern form of the genus name with author and year; the original citation of the genus (or subgenus), with its author, year, reference and pagination, and, if a subgenus, the original genus name with author and year that the subgenus was originally placed in; the type species and means of designating it (for example, by original designation, monotypy, absolute tautonymy, or subsequent designation); the number of recognized southeastern Pacific Ocean deep–sea species in the genus; the Synonyms of genera, with their rank (genus, subgenus, or other genus–group ranking), author,

year, pagination, and genus they were described in, if originally ranked as subgenera or equivalents; FAO Names if they exist; Field Marks if genera are large and distinctive; Diagnostic Features of the genus; Local Names (when available); a key to deep–sea southeastern Pacific species if the genus has more than one species (is not monotypic); and a Remarks section.

Species accounts include the valid modern names of the species, with author and date; the original citation of the species, with its author, year, reference pagination; the holotype, syntypes, lectotype or neotype of each species (paratypes are not listed in the present account), including the total length and sex of the specimen, its institutional deposition, and its catalogue number; the type locality including the location, coordinates and depth if available, where the holotype, syntypes, lectotype or neotype were caught; Synonyms of the species, including their names, authors and dates; a section listing other scientific names recently in use; the English, French, and Spanish FAO Names for the species (when available); a lateral view illustration, and often other useful illustrations (lateral view drawings are given of each shark species, usually ventral views of heads, and often teeth and denticles of the shark in question); Field Marks; Diagnostic Features (except in monotypic genera); Distribution, including a map; Habitat; Biology; Size; Interest to Fisheries and Human Impact; Local Names (when available); a Remarks section when necessary; and Literature.

Synonyms commonly seen in the southeastern Pacific Ocean deep–sea literature are listed, where appropriate, and include only true taxonomic synonyms of the valid family, genus and species given. For species, another category, Other Combinations, is provided for common misidentifications of a given species with another, valid species as well as commonly used combinations that place a valid species in different genera.

FAO Family and Species Names. English, French and Spanish names for each family and species, primarily for use within FAO, were selected by the following criteria: (a) each name applies to a single family or species worldwide; (b) the name conforms with FAO spelling nomenclature; (c) the name conforms to prior usage when possible. FAO names are not intended to replace local species names, but are necessary to overcome the confusion caused by the use of a single name for more than one species or several names for one species. The FAO names used here conform to prior FAO usage. The common French and Spanish names of species from the other FAO Catalogues, including the Sharks of World (Compagno, 1984a, b, 2001; Ebert and Compagno, In press, Ebert, In preparation), and regional FAO Catalogues on the Sharks, Rays, and Chimaeras of the Indian Ocean (Ebert, 2013, 2014), southeastern Atlantic (Ebert, 2015), North Atlantic (Ebert and Stehmann, 2013), eastern Central Atlantic (Compagno, 1981; Stehmann, 1990), Namibia (Bianchi *et al.*, 1999), western Central Atlantic (Compagno, 2002; Didier, 2002; McEachran and de Carvalho, 2002), and Mediterranean and Black Sea (Serena, 2005), were used when appropriate.

Keys, Field Marks, and Diagnostic Features. These sections include identification data in different forms. Keys to families, genera and species are standard dichotomous biological keys that are followed in steps of alternate choices to single out the taxa covered. It should be noted that the Keys include only those families, genera, and species that occur in FAO Area 87, or within the scope of the present Catalogue and do not include those groups not occurring with the area. Field Marks generally include a few obvious characters of use in field identification, extracted from Diagnostic Features at various levels, but included in a separate section. Field Marks are listed at the ordinal, familial and species levels, and occasionally the generic level in cases of large genera with many species. The arrangement of Field Mark characters is semihierarchical and pragmatic and may include characters from a higher level such as an order in lower level taxonomic accounts such as those of species. Field Marks include characters that are obvious in live or fresh–caught individuals but may be obscure in frozen or preserved material. Diagnostic Features are lists of characters at the ordinal, familial, generic, and species level, with the character choice generally limited to external characters, particularly at the species level, because of their primary purpose of identification rather than indication of relationships. The Diagnostic Features sections are hierarchical, with characters at the ordinal level generally not duplicated at the family, genus and species levels. Monotypic families with one genus (Pseudocarchariidae) or monotypic genera with one species (***Cetorhinus***) all have the Diagnostic Features section present only in the highest taxon covered.

Distribution. Geographic distributions for nearly all species are given by listing the countries off the coasts of or oceanographic features, e.g. seamounts and troughs, where the species occurs. In compiling distributional data and preparing maps it was noted that the distributions of many wide–ranging deep–sea species are very spottily known as present. In many cases gaps in distribution may not indicate absence of a given species but absence of knowledge. Continental slope chondrichthyan faunas are poorly known for much of the world, and a number of deep–sea species probably have wider ranges than are currently known. Much effort was made to screen out distribution errors, based on misidentifications of species, at a cost of presenting distributional lists and maps that are spotty, but possibly more accurate. One species (***Somniosus longus***), only known from a doubtful record from Area 87, is mentioned in the generic account, but not discussed further.

Habitat. Habitat covers information on physical conditions where various species are found. The known depth range of the species (in metres), position in the water column, type of substrate occupied, and preferences relative to coasts are noted when available. In most cases data on salinity, oxygen content, and specific temperature of the water in which they occur was not available or was not in an easily usable form and has not been regularly compiled here.

Biology. Includes data on reproduction, age and growth, diet, and behaviour and movement patterns. Compilation of these data suggests that very few deep–sea species are biologically well known, and several are known only from a very few specimens that have ever been observed.

Size. All size data are given as total lengths; this is the measurement most often used as an independent variable and standard measurement in the shark literature, although particularly in fisheries papers precaudal lengths, fork

lengths, and other measurements have been used from choice or necessity. Unfortunately chondrichthyan's researchers have not agreed on a standard method of measuring total length, so total lengths from different sources in the literature may not be strictly comparable. I prefer and advocate as a standard method a direct measurement, in which the shark is held belly down with its dorsal caudal–fin lobe depressed into line with its body axis and total length measured as a point to point distance (not over the curve of the body) from the snout tip to the tip of the dorsal caudal–fin lobe. This method lends itself readily to quick use of a fishboard with a perpendicular front bar or plate to index the fish's snout against, a one metre or two metre ruler or folding ruler slipped under the shark, batoid, or chimaera or even a steel or cloth tape, and avoids the trouble of computation and possible errors and loss of data.

Total length data presented includes maximum size, size at maturity (in some cases, a size range at maturity, when abundant data were available) and maximum size for both sexes, and size at birth or hatching. Sometimes size at sexual maturity for either or both sexes is not known, in which cases reported minimum and maximum sizes of adult individuals are given. In some cases maximum size exceeds that recorded for either sex, in which case the sex of the outsized individual or individuals representing the maximum size measurements was not indicated. In some poorly known species only immature individuals are known, in which case the hypothetical maximum adult size is almost certainly larger than the known immature maximum.

Interest to Fisheries and Human Impact. This section includes fisheries information, including whether the species is taken in targeted or non–targeted (bycatch) fisheries and if taken as bycatch whether it is retained or discarded. Data on localities of fisheries, gear used, and uses of the particular species are noted when available. National fisheries data for deep–sea sharks is often sketchy and combined for a number of species. Thus, catch statistics are generally unavailable except for relatively few species of sharks but are noted when available, with particular emphasis on data from those species reported to FAO. Additional data are increasingly available from national and regional fisheries bodies and are presented when available. Other aspects of human interaction are presented if available or known, although the average person rarely encounters most of these deep–sea sharks. The current conservation Red List status of each species as evaluated by the IUCN Species Survival Commission's Shark Specialist Group (http://www.iucnredlist.org) is provided. At the end of the Bibliography section an electronic reference section has been added with a link to the Red List Assessment for each species included in the Catalogue.

Local Names. Many species have no vernacular names whatsoever or are lumped under catchall names, while some species such as the basking shark have dozens of names. Wherever possible common local names are presented, especially for important wide–ranging species. The broadening interest in sharks, batoids, and chimaeras, and urgent need to acquire species–specific data for their management and conservation should encourage fisheries biologists and other researchers to compile local names for their own countries or regions, and add to the sketchy knowledge of local names.

Remarks. Important information, especially on systematics and nomenclature, are given in the remarks section. Also, the relative number of families per order, genera per family, and species per genus worldwide is given when appropriate for comparison to the groups occurring within FAO Area 87.

Literature. References cited here include specific works with important information for each species and family as well as comprehensive accounts, but are not intended as a comprehensive bibliography.

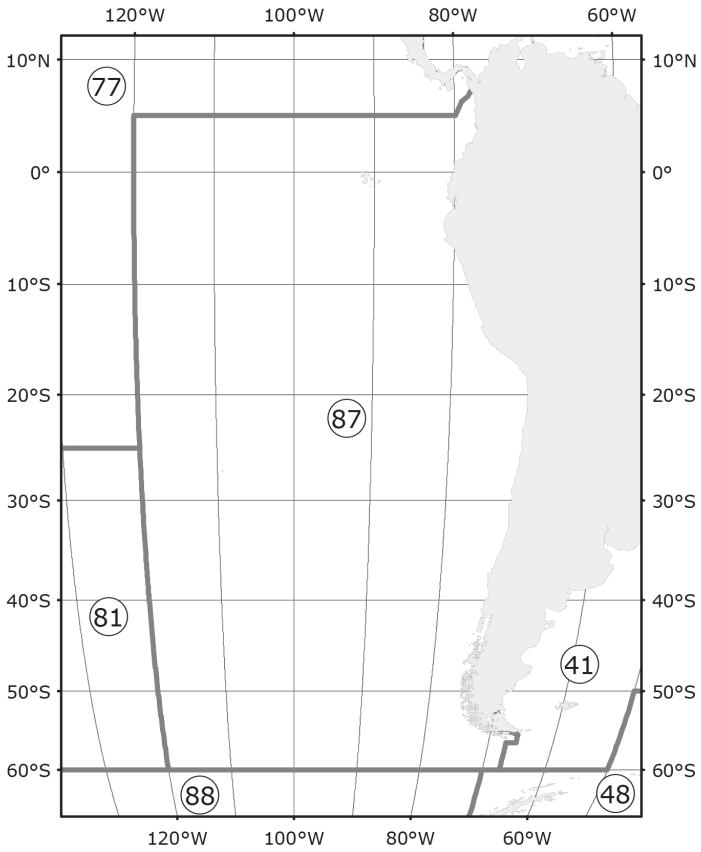


Fig. 1 Map of FAO Area 87 (Southeast Pacific Ocean). The southeastern portion of Area 77 (Eastern Central Pacific), eastern portion of Area 81 (southwest Pacific), northeastern portion of Area 88 (Antarctic Pacific), northwestern portion of Area 48 (Antarctic Atlantic), and southwestern portion of Area 41 (southwest Atlantic) are also shown.

1.2 Technical Terms and Measurements

1.2.1 Picture Guide to External Terminology of Sharks

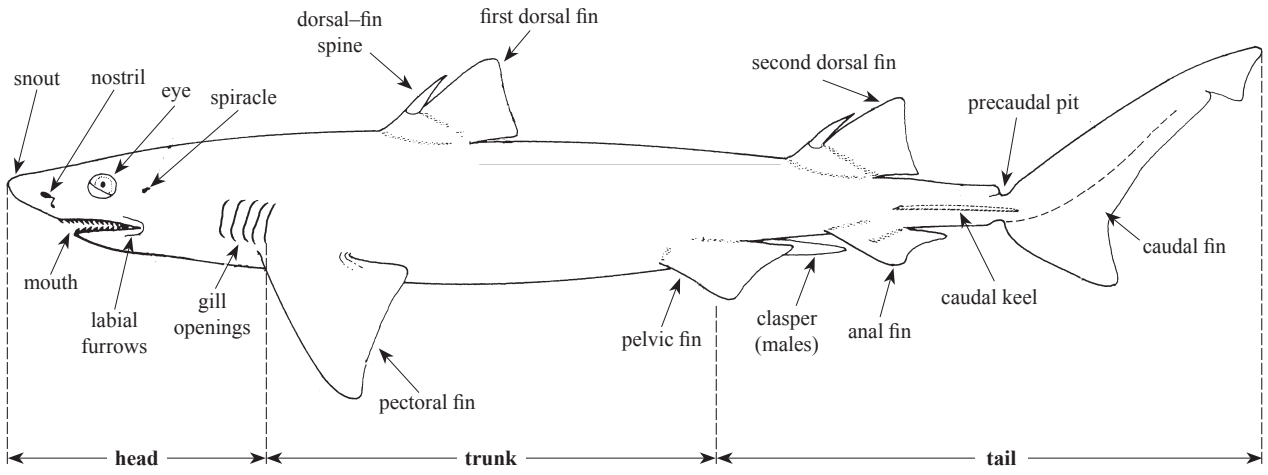


Fig. 2 Lateral view

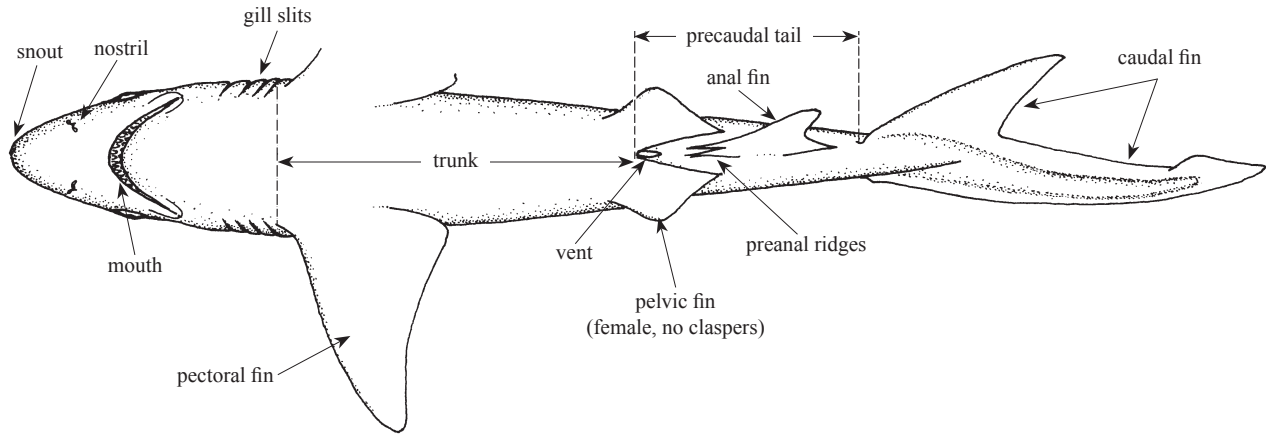


Fig. 3 Ventral view

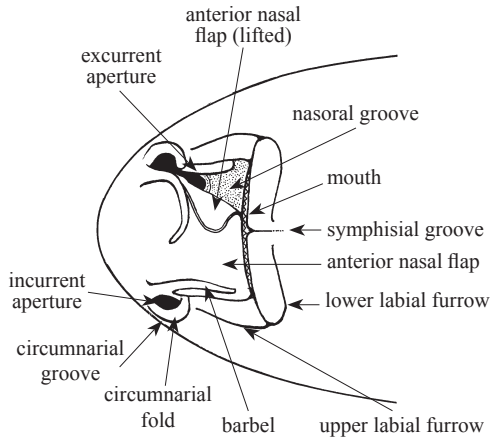


Fig. 4 Head of an orectoloboid shark (ventral view)

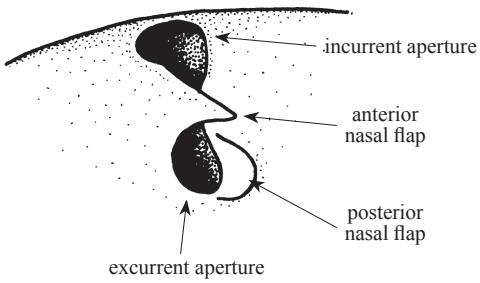


Fig. 5 Nostril

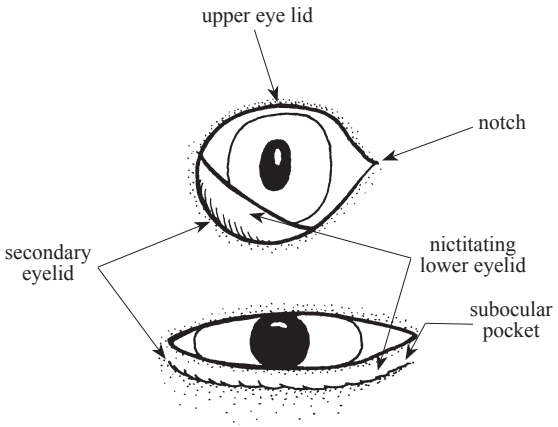


Fig. 6 Eyes

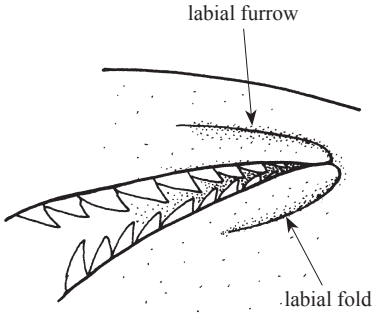


Fig. 7 Mouth corner

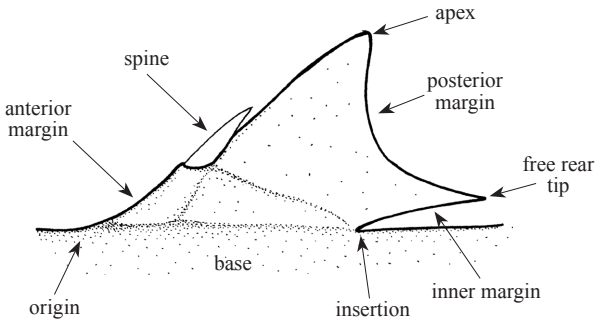


Fig. 8 Dorsal fin

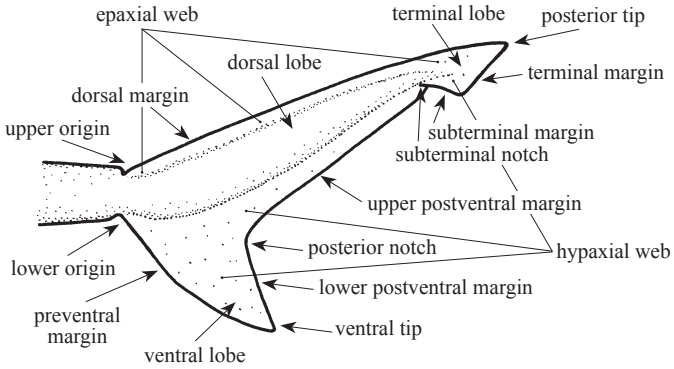


Fig. 9 Caudal fin

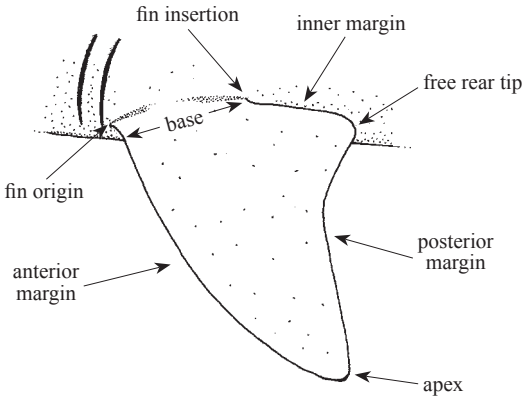


Fig. 10 Pectoral fin

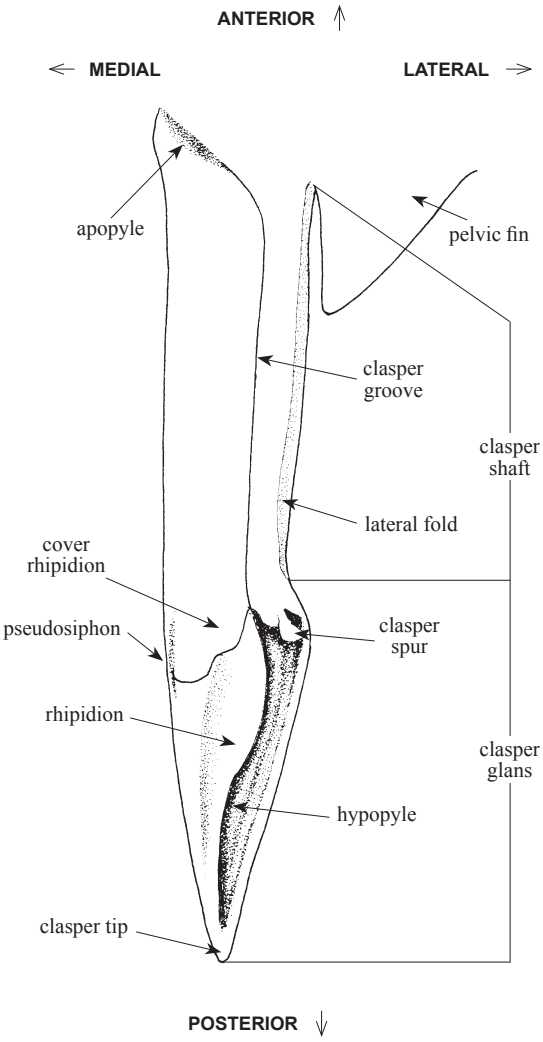
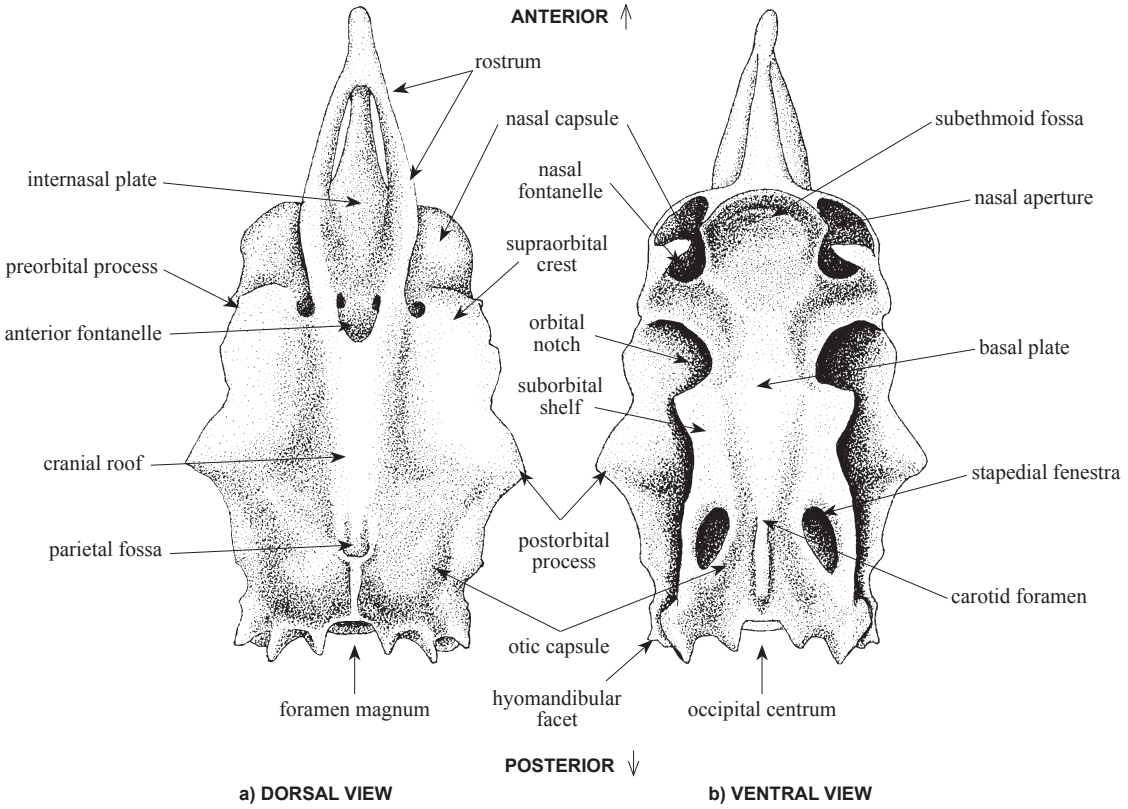


Fig. 11 Dorsal view of clasper (lamnid shark)

1.2.2 Picture Guide to Skeletal Terminology of Sharks



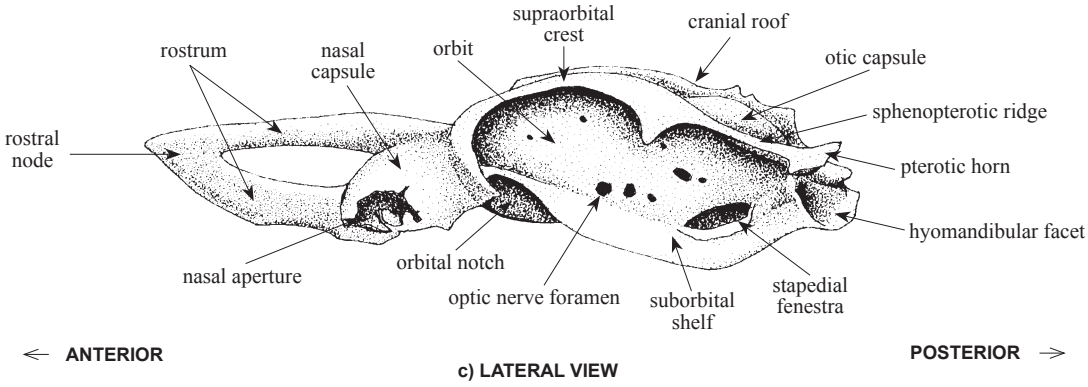


Fig. 12 Chondrocranium

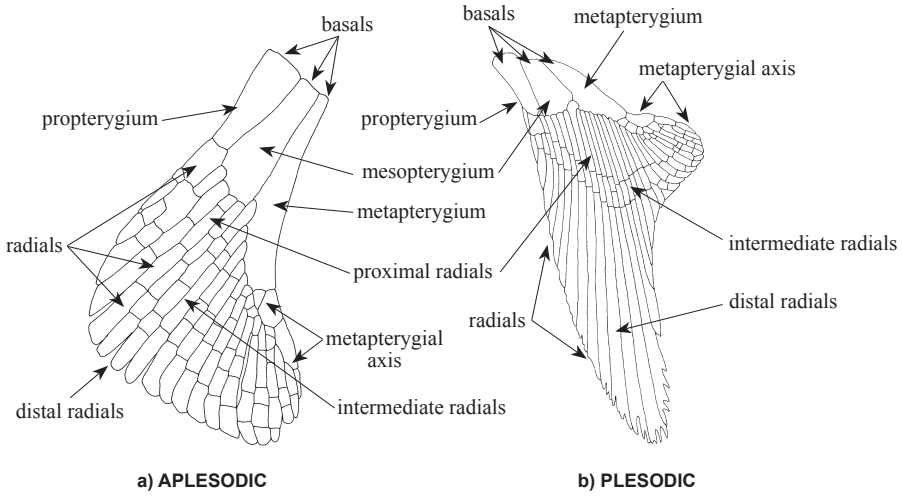


Fig. 13 Aplesodic and plesodic pectoral fins

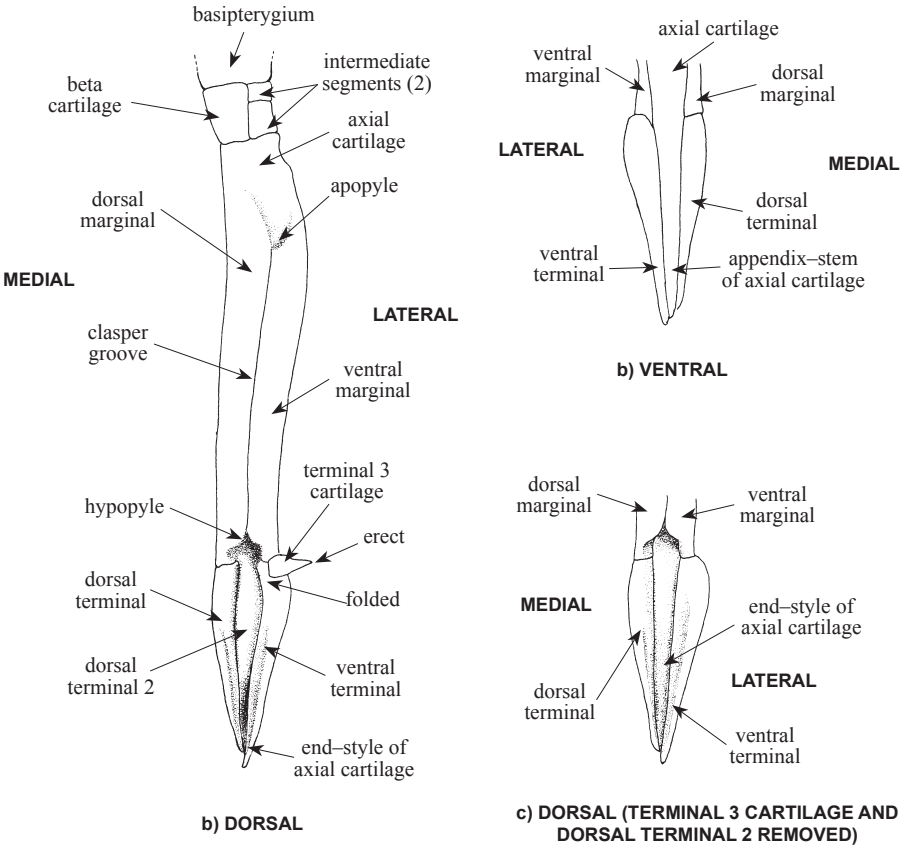


Fig. 14 Clasper skeleton of lamnid shark (right side)

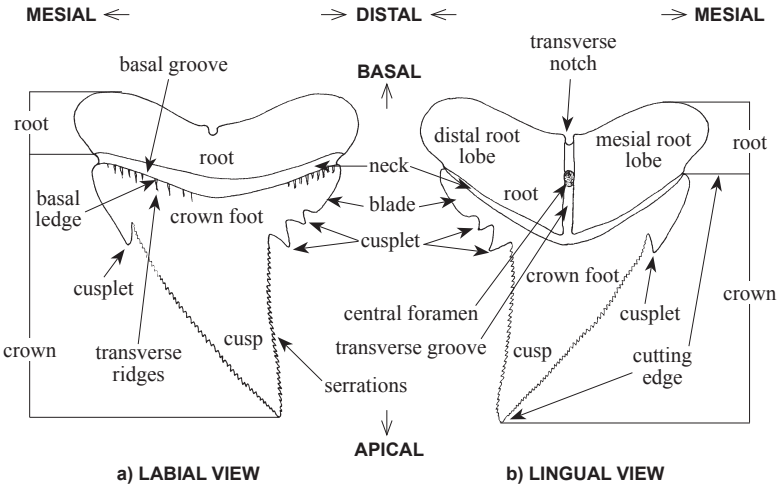


Fig. 15 Tooth terminology (left upper anterolateral tooth)

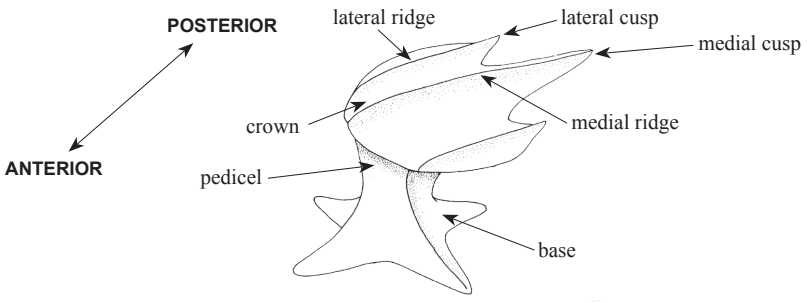


Fig. 16 Oblique anterolateral view of lateral trunk dermal denticle

1.2.3 Measurements Used for Sharks

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

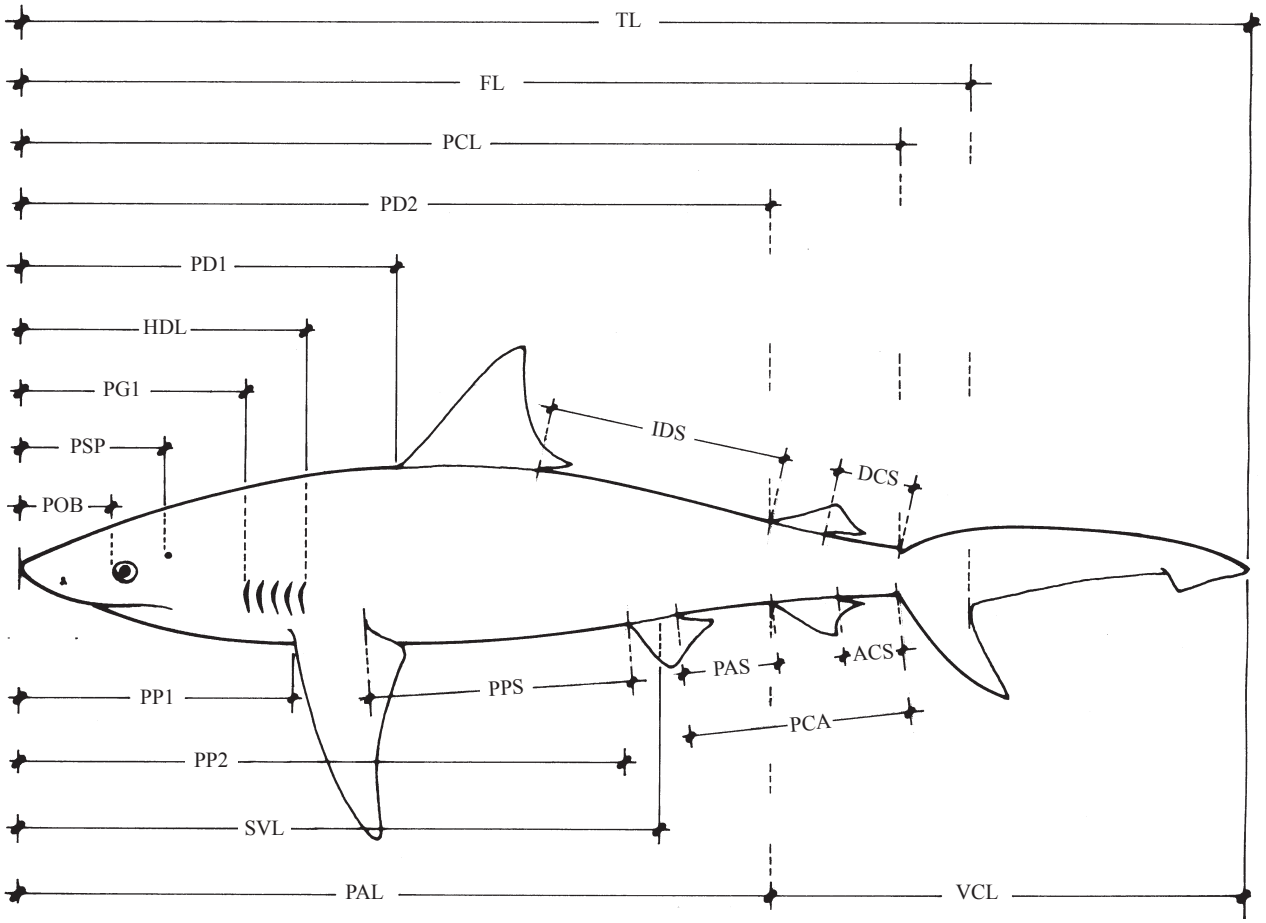


Fig. 17 Main longitudinal measures

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

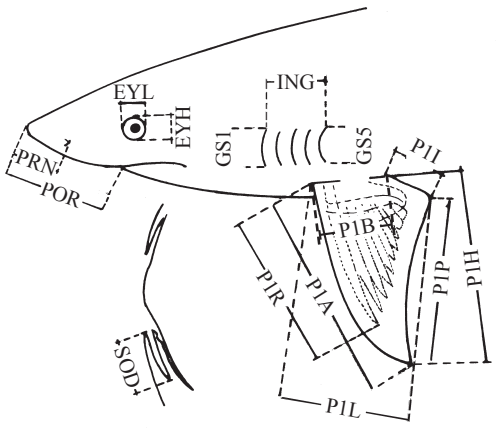


Fig. 18 Measurements of pectoral fin, gill slits, eye and snout

CDM = DORSAL CAUDAL–FIN MARGIN
CPV = PREVENTRAL CAUDAL–FIN MARGIN
CPU = UPPER POSTVENTRAL CAUDAL–FIN MARGIN
CPL = LOWER POSTVENTRAL CAUDAL–FIN MARGIN
CFW = CAUDAL–FIN FORK WIDTH
CFL = CAUDAL–FIN FORK LENGTH
CST = SUBTERMINAL CAUDAL–FIN MARGIN
CSW = SUBTERMINAL CAUDAL–FIN WIDTH
CTR = TERMINAL CAUDAL–FIN MARGIN
CTL = TERMINAL CAUDAL–FIN LOBE

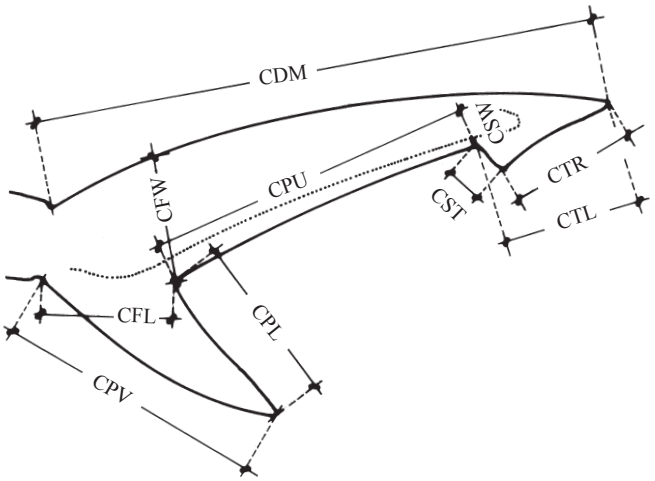


Fig. 19 Measurements of caudal fin

D1L = FIRST DORSAL–FIN LENGTH
D1A = FIRST DORSAL–FIN ANTERIOR MARGIN
D1B = FIRST DORSAL–FIN BASE
D1H = FIRST DORSAL–FIN HEIGHT
D1I = FIRST DORSAL–FIN INNER MARGIN
D1P = FIRST DORSAL–FIN POSTERIOR MARGIN

D2L = SECOND DORSAL–FIN LENGTH
D2A = SECOND DORSAL–FIN ANTERIOR MARGIN
D2B = SECOND DORSAL–FIN BASE
D2H = SECOND DORSAL–FIN HEIGHT
D2I = SECOND DORSAL–FIN INNER MARGIN
D2P = SECOND DORSAL–FIN POSTERIOR MARGIN

P2L = PELVIC–FIN LENGTH
P2A = PELVIC–FIN ANTERIOR MARGIN
P2B = PELVIC–FIN BASE
P2H = PELVIC–FIN HEIGHT
P2I = PELVIC–FIN INNER MARGIN [LENGTH]
P2P = PELVIC–FIN POSTERIOR MARGIN [LENGTH]

ANL = ANAL–FIN LENGTH
ANA = ANAL–FIN ANTERIOR MARGIN
ANB = ANAL–FIN BASE
ANH = ANAL–FIN HEIGHT
ANI = ANAL–FIN INNER MARGIN
ANP = ANAL–FIN POSTERIOR MARGIN

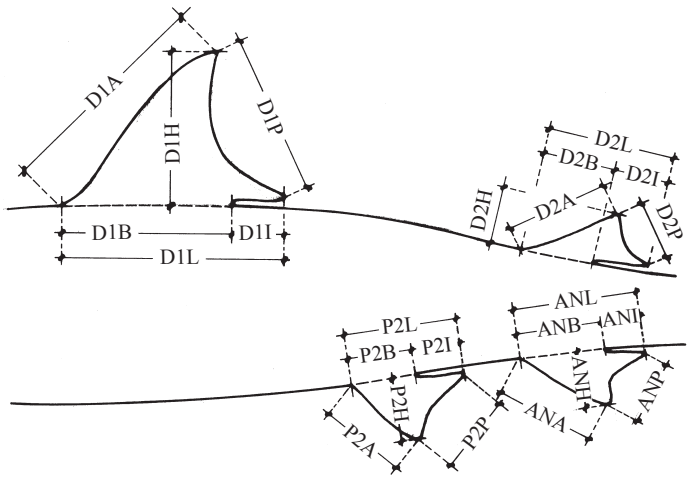


Fig. 20 Measurements of dorsal, pelvic and anal fins

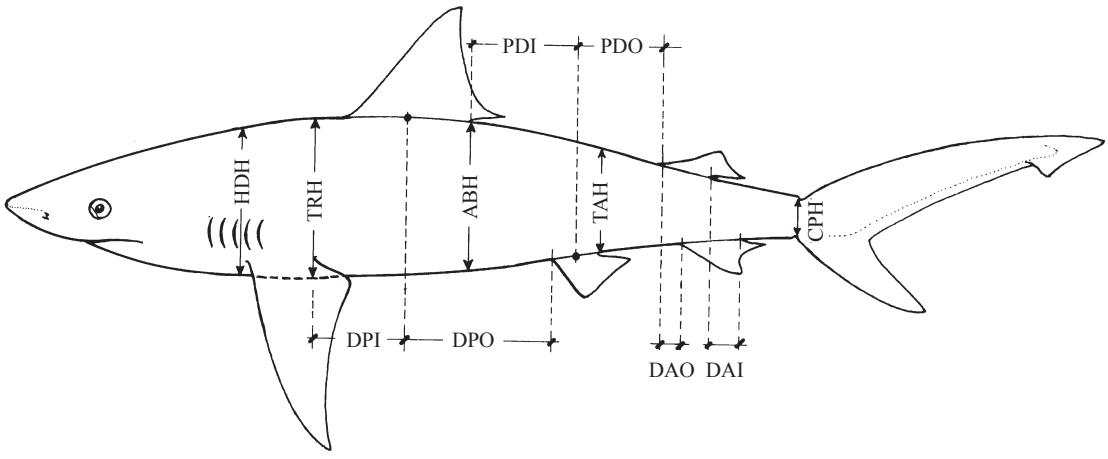
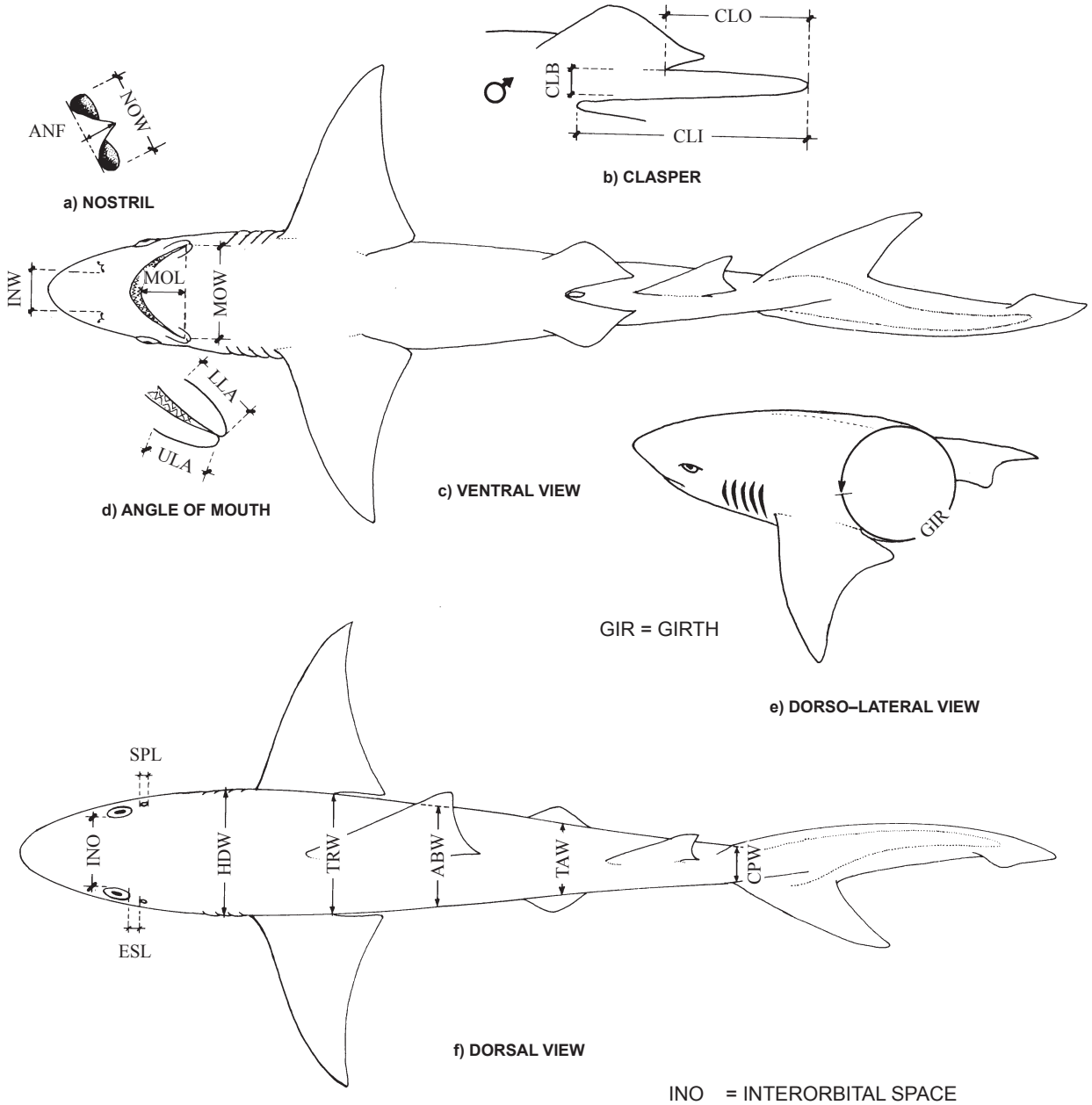


Fig. 21 Other common measurements (lateral view)

HDH = HEAD HEIGHT
TRH = TRUNK HEIGHT
ABH = ABDOMEN HEIGHT
TAH = TAIL HEIGHT
CPH = CAUDAL–FIN PEDUNCLE HEIGHT
DAI = SECOND DORSAL–FIN INSERTION ANAL–FIN INSERTION
DAO = SECOND DORSAL–FIN ORIGIN ANAL–FIN ORIGIN
DPI = FIRST DORSAL–FIN MIDPOINT PECTORAL–FIN INSERTION
DPO = FIRST DORSAL–FIN MIDPOINT PELVIC–FIN ORIGIN
PDI = PELVIC–FIN MIDPOINT FIRST DORSAL–FIN INSERTION
PDO = PELVIC–FIN MIDPOINT SECOND DORSAL–FIN ORIGIN

MOL = MOUTH LENGTH
MOW = MOUTH WIDTH
ULA = UPPER LABIAL–FURROW LENGTH
LLA = LOWER LABIAL–FURROW LENGTH
NOW = NOSTRIL WIDTH
INW = INTERNARIAL SPACE
ANF = ANTERIOR NASAL–FLAP LENGTH

CLO = CLASPER OUTER LENGTH
CLI = CLASPER INNER LENGTH
CLB = CLASPER BASE WIDTH



INO = INTERORBITAL SPACE
SPL = SPIRACLE LENGTH
ESL = EYE SPIRACLE SPACE
HDW = HEAD WIDTH
TRW = TRUNK WIDTH
ABW = ABDOMEN WIDTH
TAW = TAIL WIDTH
CPW = CAUDAL–FIN PEDUNCLE WIDTH

Fig. 22 Other common measurements (ventral and dorsal view)

1.2.4 Picture Guide to External Terminology and Measurements used for Batoids

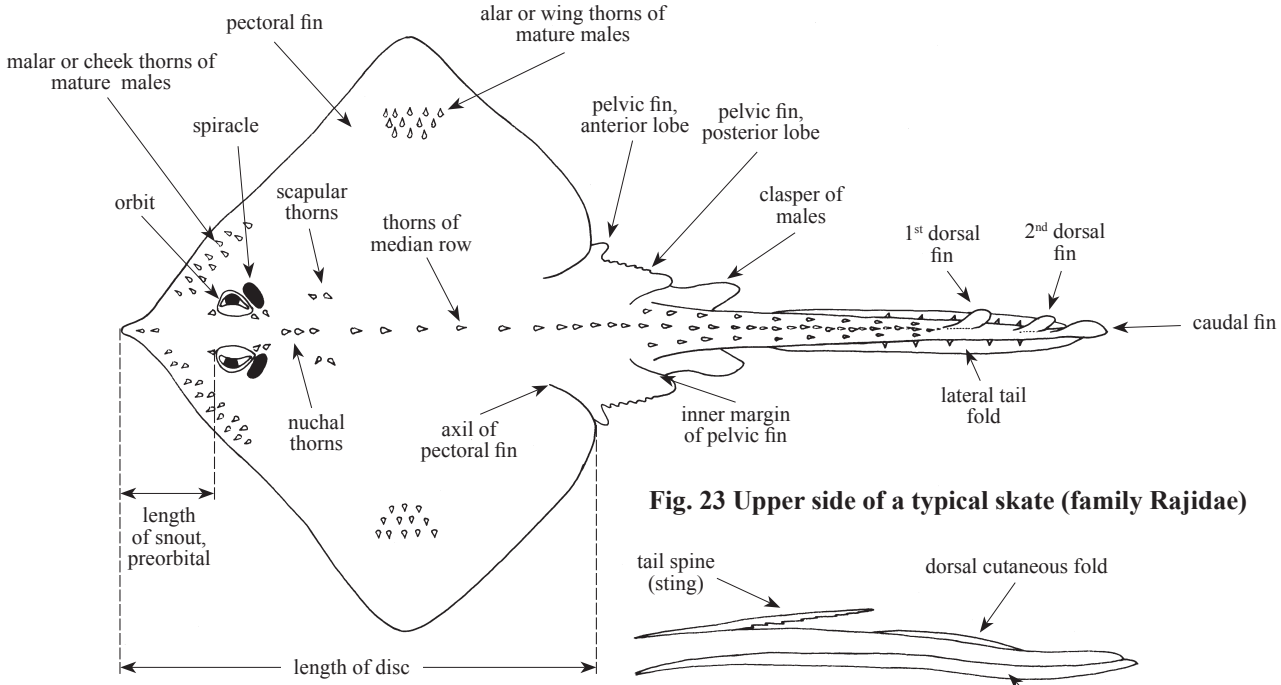


Fig. 23 Upper side of a typical skate (family Rajidae)

Fig. 24 Base of tail in stingrays (family Dasyatidae)

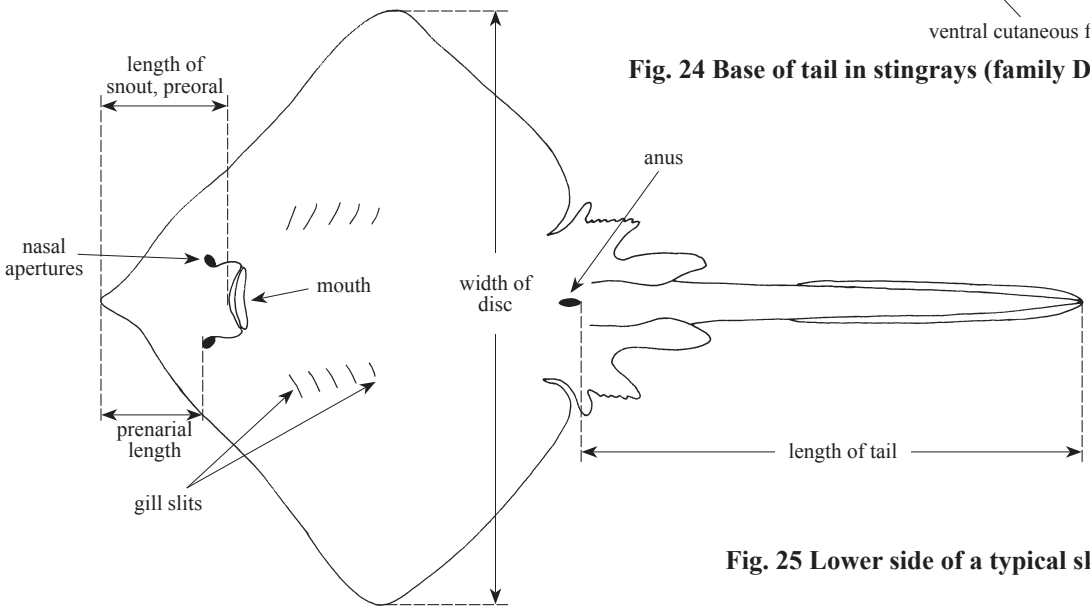


Fig. 25 Lower side of a typical skate

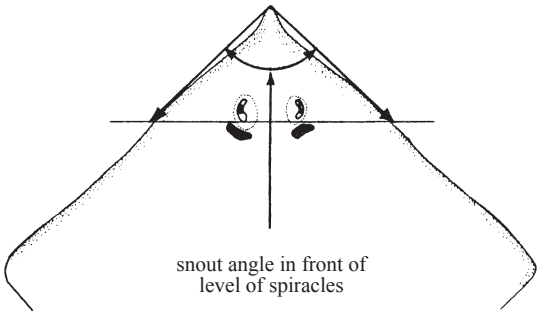


Fig. 26 Anterior part of disc of a skate

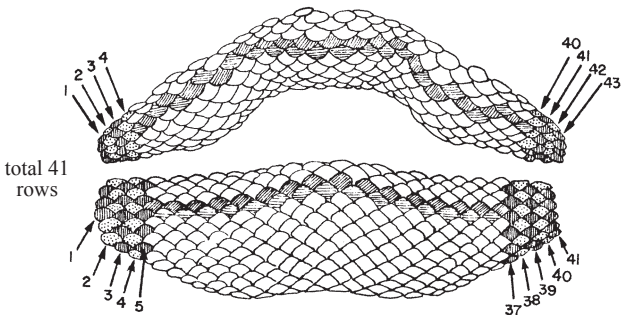


Fig. 27 Teeth of a stingray (arrows indicate method of counting pavement pattern in batoids)

1.2.5 Picture Guide to External Terminology and Measurements used for Chimaeras

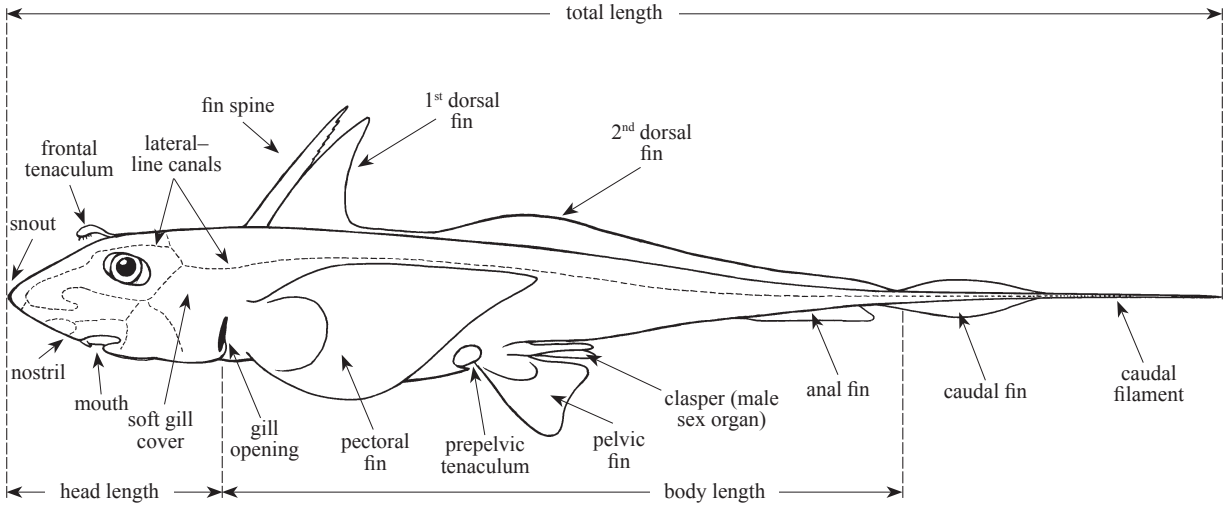


Fig. 28 Lateral view of a typical Chimaera

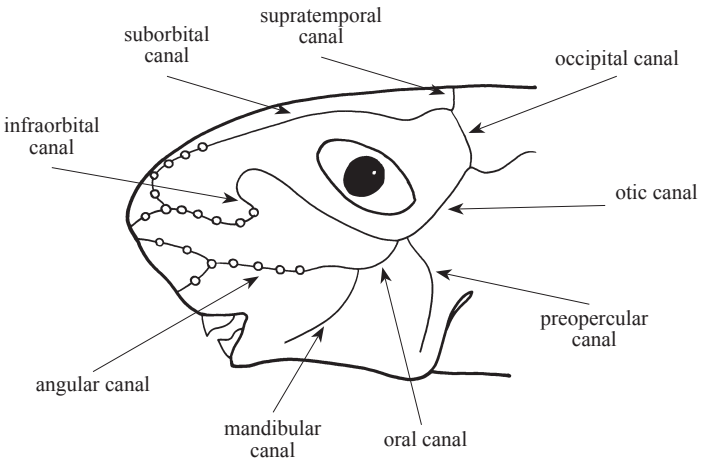


Fig. 29 Lateral line canals of the head of a typical Chimaera

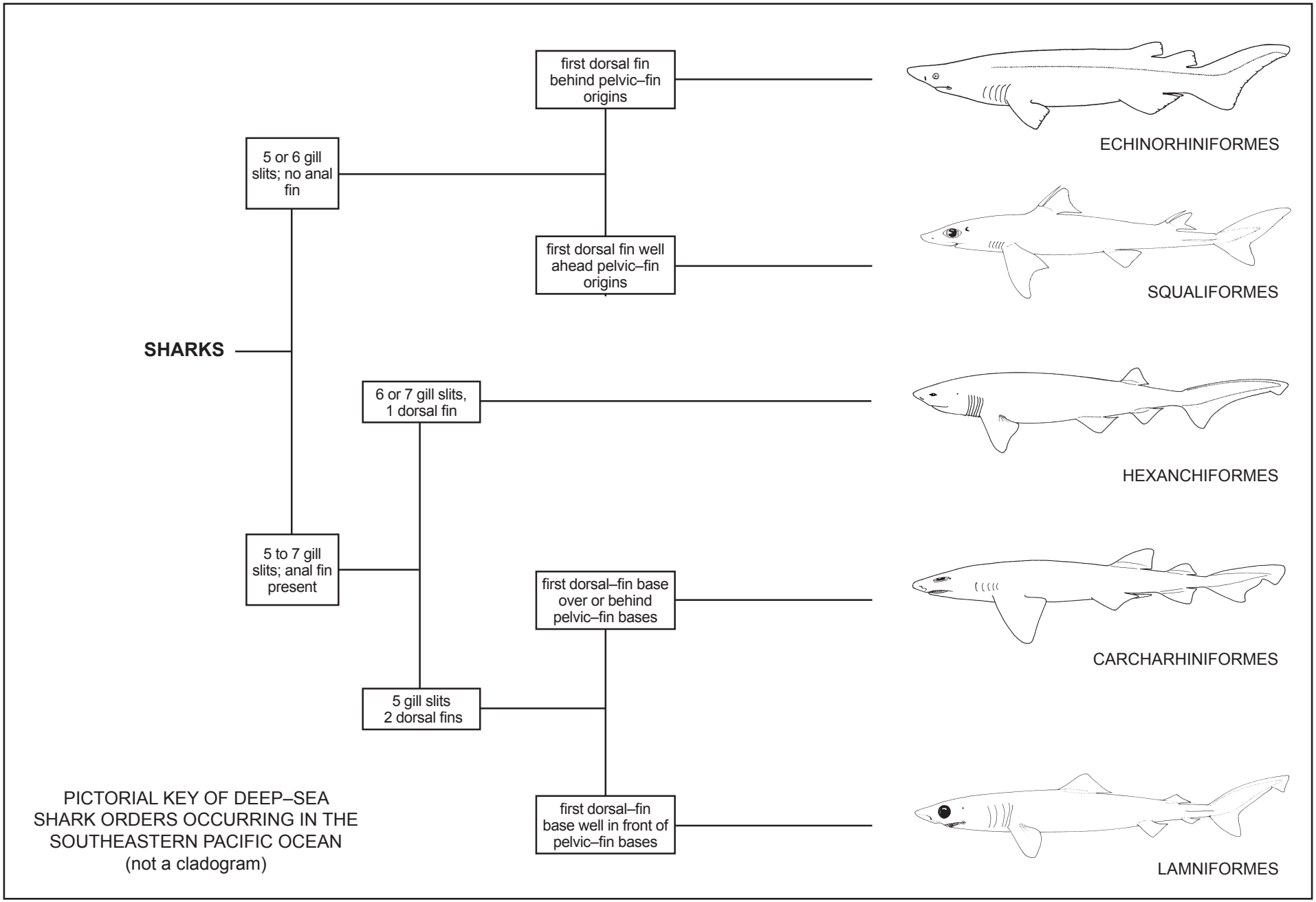


Fig. 30 Higher classification of Sharks (Orders)

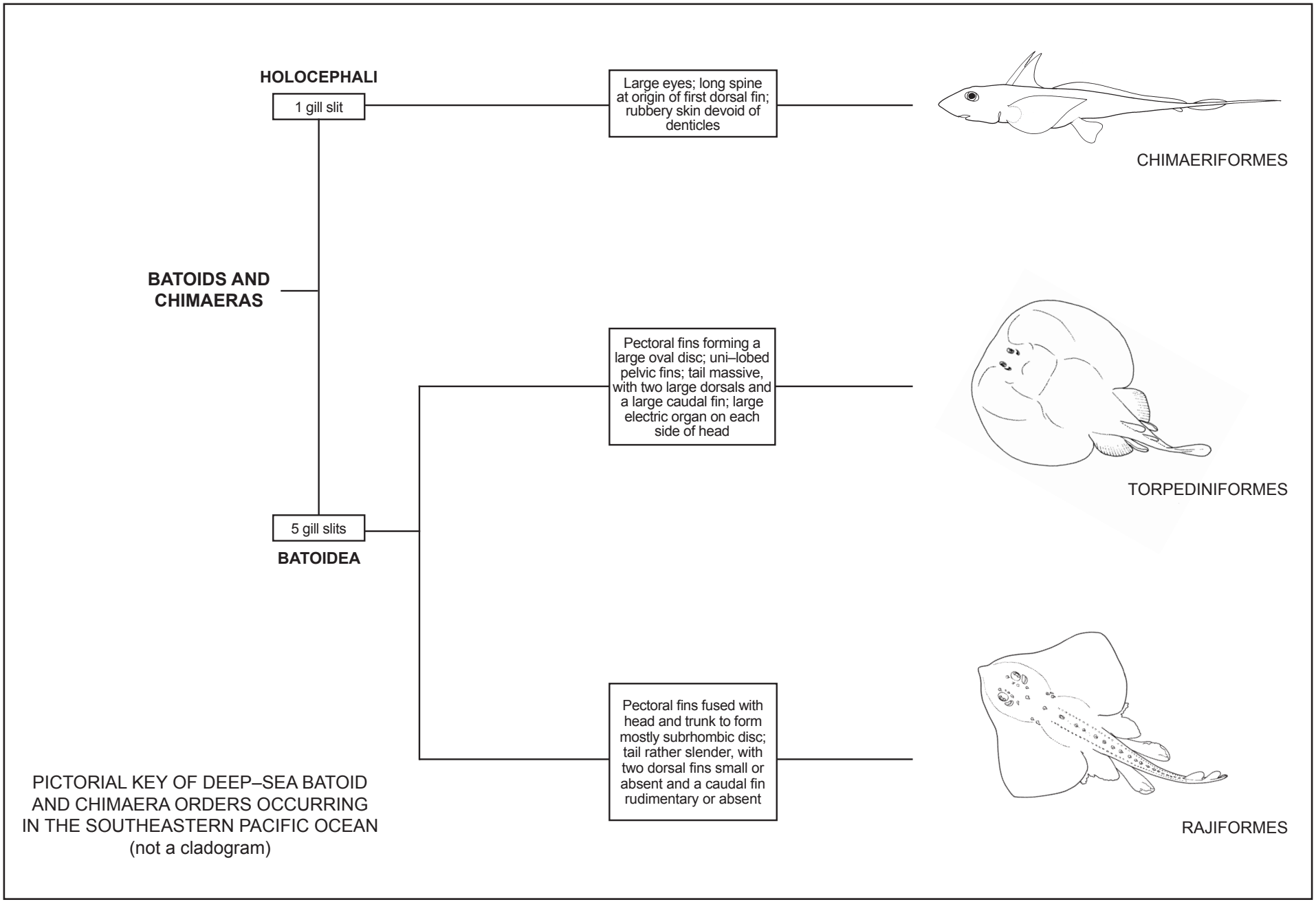


Fig. 31 Higher classification of Batoids and Chimaeras (Orders)

1.2.6 Glossary of Technical Terms

The following glossary of terms used for the anatomy and biology of shark–like fishes is modified from terms in Compagno (1984a, 1988, 1999b) and a short glossary in Compagno, Ebert and Smale (1989). The main glossary duplicates that in volume 2 of the revised shark catalogue (Compagno, 2001), except that additional terms for habitat and distribution used in the text are reinstated in the glossary. Terms for photophore patterns (including photomarks) that pertain only to the Family Etmopteridae and primarily to the genus ***Etmopterus*** are discussed under that family.

Abdominal ridges or **keels:** In some sharks, paired longitudinal dermal ridges that extend from the bases of the pectoral fins to the pelvic–fin bases.

Abyss: The deep sea bottom, ocean basins or abyssal plain descending from 4500 m to about 6000 m.

Accessory dorsal marginal: In the clasper skeleton, a flat cartilage on the posterior end of the dorsal marginal cartilage that supports the cover rhipidion.

Acute: Pointed or sharp at tip.

Adductor mandibulae muscles: Paired head muscles originating on the lateral faces of the quadrate process of the palatoquadrates and inserting on the lateral surface of the Meckel's cartilages; the primary jaw–closing muscles of sharks.

Adelphophagy: Foetus–eating, a mode of live–bearing reproduction employing uterine cannibalism; early foetuses deplete their yolk sacs early and subsist by first eating their smaller siblings and then eating nutritive eggs produced by the mother. At present only known for certain in the sand tiger shark (***Carcharias taurus***), but suspected in a few other lamnoids.

Alar thorns: Enlarged hooked shaped spines on the outer pectoral fins of adult male skates.

Alternate teeth: Small oral teeth with asymmetrical crowns that form two interdigitated rows on the symphysis, with the cusps of each row hooked mesially towards the opposite row. Additional paired rows of alternates may be present distal to the symphysial rows.

Amphitemperate: Referring to a species that occurs in temperate water in the Northern and Southern Hemispheres, but is absent from the tropics.

Anal fin: A single fin on the ventral surface of the tail between the pelvic fins and caudal fin of some sharks, absent in batoids, dogfish, sawsharks, angel sharks, and some chimaeras.

Annular rings or **annuli:** In a vertebral centrum in cross section, rings of calcified cartilage separated by uncalcified cartilage that occupy the intermedialia only, or concentric rings that cross both the intermedialia and basalia.

Anterior: Forward, in the longitudinal direction of the snout tip. Also, **cranial**.

Anterior fontanelle: On the elasmobranch neurocranium, an aperture on the anterodorsomedial surface, usually at the rear of the ethmoid region and forming a passage into the internal cranial cavity. It is closed by a tough membrane, varies tremendously in shape, and may be pinched off by the medially expanded orbits in a few sharks.

Anterior margin: In precaudal fins, the margin from the fin origin to its apex.

Anterior nasal flap: A flap on the front edges of the nostrils, that serves to partially divide the nostril into incurrent and excurrent apertures or openings.

Anterior teeth: Enlarged, tall, narrow–rooted oral teeth near the symphysis, often with lingually curved cusps.

Anterodorsal palpebral depressor muscle: In the orectoloboid family Parascylliidae, paired head muscles that originate at the insertions of the preorbitalis muscles on the anterolateroventral face of the Meckel's cartilage, and insert on the skin of the upper eyelid anterior to the eye. These are possibly for depressing the upper eyelids and closing the eyes, and are not found in any other sharks.

Antorbital cartilages: On the neurocranium of sawsharks and batoids, separate cartilages attached to the sides of the nasal capsules that support the sides or front of the head.

Apex: In precaudal fins, the distal tip, which can be acutely pointed to broadly rounded.

Apical: In oral teeth, towards the tip of the crown or cusp. Can also be used as indicating direction towards the apex or tip of a fin, fin–spine, etc.

Aplacental viviparity: Live–bearing in which the young do not have a yolk–sac placenta. Found in all groups of live–bearing sharks.

Aplesodic fin: A pectoral, pelvic, dorsal, or anal fin in which the fin radial cartilages do not extend into the distal fin web and between the supporting ceratotrichia of the fin web. Modern sharks always have aplesodic caudal fins, in which the haemal arches of the caudal vertebrae do not support the ventral caudal lobe.

Apopyle: The anterior opening of the clasper, on the anteromesial surface of the clasper and close to the vent. The apopyle receives sperm from the cloaca and fluid from the siphons, which enter the clasper groove and are discharged through the hypopyle. Apopyle is also used for clasper skeletons for the anterior opening of the tubular shafts formed by enlarged marginal and axial cartilages.

Axial cartilage: In the clasper skeleton, the elongated ventral rod or plate–shaped cartilage that forms the main support of the clasper. Also termed **appendix–stem**.

Barbels: Long conical paired dermal lobes on the snouts of sharks, that may serve to locate prey. Sawsharks have barbels on the underside of the snout in front of the nostrils as in sturgeon, but most barbeled sharks have them associated with the nostrils, either as an extension of the

anterior nasal flaps or as separate structures medial to the nasal apertures.

Basal: In oral teeth, a proximal direction towards the crown foot and roots.

Basal cartilages or **basals:** In precaudal fins the large cartilages of the fin bases, immediately distal to the pectoral and pelvic fin girdles or the vertebral column (dorsal and anal fins), on which the radials articulate distally. The paired pectoral fins of living sharks primitively have a tribasal pectoral fin, with a **propterygium**, **mesopterygium**, and **metapterygium** as basals, although these may be fused; in batoids, additional **neopterygial basals** may be added between the **mesopterygium** and **metapterygium** and the **propterygium** is variably expanded anterior with a **propterygial basal** and axis. The pelvic fins have a **basipterygium** that supports the pelvic radials and, in males, the claspers. The caudal fin has no basals, but these are functionally replaced by expanded neural and haemal arches of the vertebral column.

Basal communicating canals: See **subnasal fenestrae**.

Basal groove: In oral teeth, a deep groove proximal to the basal ledge on the labial surface of the crown neck and apical root margin.

Basal ledge: In oral teeth, a shelf–like projection on the labial surface of the crown foot.

Basal plate: The floor of the cranial cavity of the neurocranium, a ventral, medial plate extending from the ethmoid region between the orbits and otic capsules and below the cranial cavity to the occipital condyles, occipital centrum and foramen magnum.

Basals or **basalia:** In a vertebral centrum, the diagonal spaces below the attachment surfaces of the basidorsal cartilages, above the basiventral cartilages, and between the two halves of the double cone. Basalia may be filled with uncalcified cartilage, may have diagonal calcifications penetrating the uncalcified cartilage, or may have calcified annuli or solid calcified cartilage that are continuous with calcification of the intermedialia. See **diagonal calcifications** and **intermedialia**.

Base: In precaudal fins, the proximal part of the fin between the origin and insertion, extending distally, and supported by the cartilaginous fin skeleton. In the caudal fin, that thickened longitudinal part of the fin enclosing the vertebral column and between the epaxial and hypaxial lobes or webs of the fin. In oral teeth, the proximal root and crown foot, in apposition to the distal cusp. In denticles, the proximal anchoring structures, often with four or more lobes, holding the denticles in the skin.

Basidorsal cartilages: A pair of wedge–shaped arched, thin cartilages articulating with the dorsolateral surfaces of a vertebral centrum and forming a continuous neural arch with the interdorsal cartilages to protect the spinal cord.

Basipterygium: The large elongate longitudinal cartilage at the fin base of the pelvic fin, attached to the posterolateral ends of the pelvic girdle or puboischiadic bar. The basipterygium has pelvic radials attached along its distal edge and has the clasper skeleton attached posteriorly in males.

Basiventral cartilages: A pair of rounded or wedge–shaped cartilages on the ventrolateral surfaces of a vertebral centrum that form the bases for attachment of ribs in monospondylous precaudal vertebrae. In diplospondylous precaudal and caudal vertebrae the basiventrals form haemal arches along with the interventral cartilages for protecting the caudal artery and vein.

Bathypelagic zone: That part of the oceans beyond the continental and insular shelves, from about 1000 m to 3000 to 6000 m and above the middle and lower continental rises and the abyssal plain, the sunless zone. Some oceanic sharks may transit the epipelagic, mesopelagic and bathypelagic zones to the bottom while migrating vertically.

Batoid: A ray or flat or winged shark, a neoselachian of the cohort Batoidea, a sawfish, sharkray, wedgefish, guitarfish, thornray, panray, electric ray, skate, stingray, butterfly ray, eagle ray, cownose ray, devil ray or ***Manta***. Rays are closely allied to the sawsharks (Pristiophoriformes) and angel sharks (Squatiniformes), but differ from them in having the pectoral fins fused to the sides of the head over the gill openings, which are ventral rather than laterally or ventrolaterally placed.

Benthic or **Demersal:** referring to organisms that are bottom–dwelling.

Beta cartilage: In the clasper skeleton, a single, dorsolateral flattened, wedge–shaped or cylindrical cartilage connecting the pelvic basipterygium and axial cartilage and reinforcing the intermediate segments, possibly derived from a pelvic radial.

Blade: In oral teeth, an arcuate, convex–edged section of the cutting edge of the crown foot, without cusplets.

Body: Can refer to an entire shark, sometimes restricted to the trunk and precaudal tail.

Body ridges: Elongated longitudinal dermal ridges on the sides of the trunk and precaudal tail in certain carpet sharks (Orectolobiformes), in the whale, zebra and some bamboo sharks.

Branchial arches: The paired visceral arches behind the hyoid arch and just in front of the **scapulocoracoid** that support the gills. In elasmobranchs the five to seven branchial arches primitively consist of a pair of dorsomedial and wedge–shaped cartilages, the **pharyngobranchials**, closely situated against the roof of the pharynx, a pair of dorsolateral and more cylindrical **epibranchials** that are connected dorsomedially to the **pharyngobranchials**, a pair of ventrolateral cylindrical **ceratobranchials** that are connected ventrolaterally to the epibranchials, a pair of ventromedial hypobranchials that are connected ventrolaterally to the ceratobranchials, and unpaired ventromedial **basibranchials** that are connected ventrolaterally to the hypobranchials. The hypobranchials and basibranchials along with the expanded ventral ends of the ceratobranchials form the **basibranchial skeleton** of the floor of the branchial pharynx. The branchial skeleton

is variably modified in elasmobranchs, with basibranchials and sometimes hypobranchials often lost, the last two pharyngobranchials and the last epibranchial often fused together, and the last basibranchial often expanded into a long, broad **copula** with which the anterior hypobranchials and posterior ceratobranchials articulate.

Calcified cartilage: Shark skeletons are formed of hyaline cartilage or gristle, but this is often reinforced with layers of calcified cartilage, cartilage impregnated with a mineral, hydroxyapatite, similar to that of bone but organized differently, in a hard, tile–like pavement of tiny **tesserae**, or more compactly as in the calcified structures of vertebral centra.

Calcified double cones: In vertebrae, the primary calcifications of the notochordal sheath, in lateral view resembling two hollow, horizontal cones with their apices merged, or an hourglass.

Cannibal viviparity: See **uterine cannibalism**.

Carcharhinoid: A ground shark, a member of the order Carcharhiniformes, and including the catsharks, false catsharks, finbacked catsharks, barbeled houndsharks, houndsharks, weasel sharks, requiem sharks and hammerheads.

Carina: On the crowns of oral teeth, a low blunt mesodistal ridge replacing the cusp and cutting edge, in sharks that eat hard–shelled invertebrate prey.

Carotid foramen: A single foramen or one of a pair of foramina that penetrate the basal plate usually near its midlength and allow passage of the internal carotid arteries into the cranial cavity. In some advanced elasmobranchs the carotid foramina shift through the stapedial foramina and onto the medial wall of the orbit.

Cartilaginous fishes: Members of the class Chondrichthyes.

Caudal crest: A prominent saw–like row of enlarged pointed denticles along the dorsal caudal margin and sometimes along the ventral caudal margin of the caudal fin. Found in certain sharks including hexanchoids and some carcharhinoids.

Caudal filament: The long, thin, whip–like structure that extends behind the end of the caudal fin in chimaeras.

Caudal fin: The fin on the end of the tail in shark–like fishes, lost in some batoids.

Caudal keels: A dermal keel on each side of the caudal peduncle that may extend onto the base of the caudal fin, and may, in a few sharks, extend forward as a body keel to the side of the trunk.

Caudal peduncle: That part of the precaudal tail extending from the insertions of the dorsal and anal fins to the front of the caudal fin.

Central foramen: In oral teeth, a nutrient foramen on the midline of the lingual surface of the root, in the transverse groove.

Centrum (plural, Centra): A spool–shaped, partially or usually fully calcified structure that forms as a segmental constriction in the notochordal sheath of neoselachians, and which as an articulated string forms the principal structural units of the vertebral column. Centra are primarily formed by the calcified double cones in the notochordal sheath, which may be their only calcification, but additional secondary calcification may occur in the centrum between the outer surfaces of the calcified double cones, including calcified intermedialia, radii, annuli, and diagonal calcifications.

Ceratotrichia: Slender soft or stiff filaments of an elastic protein, superficially resembling keratin or horn, from the Greek *keratos*, horn, and *trichos*, hair. Ceratotrichia run in parallel and radial to the fin base and support the fin webs. The prime ingredient of shark–fin soup.

Chimaera: A member of the order Chimaeriformes, subclass Holocephali, see also **Chimaeroid**, **Holocephali**.

Chimaeroid: A chimaera, ratfish, silver shark, ghost shark, spookfish or elephant fish, a member of the order Chimaeriformes.

Chondrichthyan: Referring to the class Chondrichthyes.

Chondrichthyes: The class Chondrichthyes, from Greek *chondros*, cartilage, and *ichthos*, fish, a major taxonomic group of aquatic, gill–breathing, jawed, finned vertebrates with primarily cartilaginous skeletons, 1 to 7 external gill openings, oral teeth in transverse rows on their jaws, and mostly small, tooth–like scales or dermal denticles. Chondrichthyes include the living elasmobranchs and holocephalans and their numerous fossil relatives, and also can be termed shark–like fishes or simply sharks.

Chondrocranium: See **neurocranium**.

Circumglobal: Occurring around the world.

Circumnarial fold: A raised semicircular, lateral flap of skin around the incurrent aperture of a nostril, in heterodontoids, orectoloboids, and a few batoids, defined by a circumnarial groove.

Circumnarial groove: A shallow groove defining the lateral bases of the circumnarial folds.

Circumtropical: Occurring around the tropical regions of the world.

Clasper claws: In parascylliid orectoloboids, a longitudinal row of large anterolaterally directed claw–like denticles on the dorsolateral surface of the clasper glans, supported by the terminal ventral.

Clasper dactyl: In parascylliid orectoloboids, a large finger–like process on the medial face of the clasper, supported by the dorsal terminal and having a **mesospur**, an analogue to the lateral spur or spine of the terminal 3 cartilage of other orectoloboids and other sharks.

Clasper gaff or **hook:** In the external clasper glans, a posterior hook–like structure, like a clasper spur but formed from the dorsal terminal cartilage, found in squaloids of the family Squalidae.

Clasper glans: The distal and dorsal part of the external clasper from the hypopyle to its tip, and including various movable terminal structures; also, the same area of the clasper skeleton.

Clasper groove: The longitudinal groove through the clasper, surrounded by the axial and marginal cartilages, and connecting the apopyle and hypopyle.

Clasper hooks: In the clasper glans of some carcharhinoid sharks, small claw–like dermal denticles arranged in a row along the ventral surface of the free edge of the exorhipidion.

Clasper sacs: Dermal sacs with longitudinally ribbed walls on the ventral and medial surfaces of the claspers of hexanchoids.

Clasper shaft: That part of the clasper skeleton from its origin on the pelvic fin basipterygium to the hypopyle; also, that part of the external clasper from its base to the hypopyle.

Clasper spine: In the external clasper, a projection of the terminal 3 cartilage on the lateral surface of the clasper glans, which forms a short to long, acutely pointed, spine that is covered with shiny hard tissue, possibly enameloid, dentine or both. In some squaloids other terminal cartilages may have spines.

Clasper spur: In the external clasper, a projection of the terminal 3 cartilage on the lateral surface of the clasper glans, which may be pointed but is not covered with shiny hard tissue.

Clasper tip: The posterior end of a clasper.

Claspers: The paired copulatory organs present on the pelvic fins of male cartilaginous fishes, for internal fertilization of eggs, also termed **mixopterygia**.

Classification: The ordering of organisms into groups on the basis of their relationships, which may be by similarity or common ancestry.

Cloaca: The common chamber at the rear of the body cavity of elasmobranchs through which body wastes and reproductive products including sperm, eggs, and young pass, to be expelled to the outside through a common opening or **vent**.

Common name: The informal or regional vernacular name of an organism; these names may change from region to region.

Concave: Curving inwards as opposed to convex (curving outwards).

Confluent: Joined together, without a space.

Continental shelf: The portion of the seabed surrounding the continents and islands from the shore–line to approximately 200 m depth.

Continental slope: The portion of the seabed that slopes steeply from the edge of the outer continental shelf down to the ocean floor; below approximately 200 m depth.

Convex: Arching or curving outwards as opposed to concave (see above).

Cover rhipidion: On the external clasper glans, an elongated, longitudinal blade or flap on its dorsomedial external edge, often supported by an accessory dorsal marginal cartilage.

Cranial cavity: The central cavity of the neurocranium, containing the brain, pituitary gland, and roots of the cranial nerves. It extends posteriorly between the orbits and otic capsules to the foramen magnum.

Cranial roof: The anterior roof of the cranial cavity of the neurocranium, a dorsomedial, arched or flattened plate extending from the anterior fontanelle and between the orbits to the parietal fossa of the otic capsule. Sometimes perforated by a frontal or parietal foramen or fenestra, which may be continuous with the anterior fontanelle and can occupy most of the cranial roof.

Craniomandibular muscles: Paired head muscles in heterodontoid sharks that originate from long tendons on the medial walls of the orbits that extend below and transverse to the levator palatoquadrati and spiracular constrictor muscles and behind the spiracles to insert on the posterodorsolateral face of the Meckel's cartilages. They are found in no other sharks and may serve to retract or elevate the jaws.

Crown: The distal part of the oral tooth, almost entirely covered with shiny enameloid except for the neck. In denticles, a flat dorsal plate–like or thorn–like structure, elevated above the denticle base on a stalk or pedicle or confluent with the base.

Crown foot: The expanded, proximal, basal part of the crown, often bearing cusplets or blades.

Cusp: A usually pointed large distal projection of the crown. A **primary cusp** is situated on the midline of the crown foot. **Multicuspid** refers to oral teeth or denticles with more than one cusp. In lateral trunk denticles, the posterior ends of the crown may have **medial** and **lateral cusps**, sharp or blunt projections associated with the medial and lateral ridges.

Cusplet: As with a cusp, but a small projection in association with a cusp, and usually mesial and distal but not medial on the crown foot.

Cutting edge: In oral teeth, the compressed sharp longitudinal ridge on the mesodistal edges of the crown.

Deciduous: Usually referring to denticles that are easily rubbed off, especially common in Chimaeras.

Demersal: Living on the bottom.

Dentine: The primary material of shark oral teeth, a hard tissue with numerous vascular and nonvascular canals.

Dermal denticle or **placoid scale:** A small tooth–like scale found in cartilaginous fishes, covered with enameloid, with a core and base of dentine and usually small and often close–set to one another and covering the body. A few nonbatoid sharks, many batoids, and chimaeroids generally

have them enlarged and sparse or reduced in numbers.

Dermal lobes: In wobbegongs, family Orectolobidae, narrow or broad–based, simple or branched projections of skin along the horizontal head rim and on the chin.

Diagonal calcifications: In a vertebral centrum in cross–section, plate–like (**diagonal calcified lamellae**) or knob–like (**diagonal calcified lobes**) structures of calcified cartilage that partially fills the uncalcified basalia. These have a radial orientation from the centre of the centrum.

Diphycercal: A caudal fin with the vertebral axis running horizontally into the fin base, which is not elevated.

Diplospondylous vertebrae: Vertebrae of the tail with two centra and two basidorsal and basiventral elements per segment, and mostly with a haemal arch formed by the basiventral and interventral elements. These include diplospondylous precaudal vertebrae between the monospondylous vertebrae and the base of the caudal fin, and diplospondylous caudal vertebrae in the caudal fin.

Disc: The fused unit of the head, snout, and pectoral fins and body on batoids; also referred to as the Pectoral disc.

Distal: In any direction, at the far end of a structure. In oral teeth, used in a special sense for structures on the teeth towards the posterolateral mouth corners or rictuses. See **apical** and **basal**.

Dorsal: Upwards, in the vertical direction of the back. See **ventral**.

Dorsal fin: A fin located on the trunk or precaudal tail or both, and between the head and caudal fin. Most sharks have two dorsal fins, some batoids one or none.

Dorsal–fin spine: A small to large enameloid–covered, dentine–cored spine located on the anterior margins of one or both of the dorsal fins, found on bullhead sharks (Heterodontiformes), many dogfish sharks, fossil (but not living) batoids, chimaeroids, but lost entirely or buried in the fin bases of other shark–like fishes.

Dorsal lobe: In the caudal fin, the entire fin including its base, epaxial and hypaxial webs but excepting the ventral lobe.

Dorsal margin: In the caudal fin, the margin from the upper origin to its posterior tip. Usually continuous, but in angel sharks (Squatiniformes) with their hypocercal, superficially inverted caudal fins, it is subdivided. See **squatinoid caudal fin**.

Dorsal marginal: In the clasper skeleton, a flat semicylindrical cartilage that is partially fused to the medial edge of the axial cartilage, and forms the medial wall of the clasper groove.

Dorsal terminal: On the skeleton of the clasper glans, an often triangular, elongated, curved, plate–like cartilage that articulates or is attached to the medial or dorsomedial edge of the end–style and anteriorly to the dorsal marginal.

Dorsal terminal 2: A flat elongated cartilage with its mesial edge attached to the floor of the glans, and supporting the rhipidion.

Ectethmoid chambers: On the neurocranium, cavities in the nasal capsule that drain the nasal sinuses through the orbitonasal canals into the orbital sinuses.

Ectethmoid processes: On the neurocranium of hexanchoid and some squaloid sharks, posteroventrolateral angular or lobular projections of the nasal capsules and the preorbital walls.

Egg case: A stiff–walled elongate–oval, rounded rectangular, conical, or dart–shaped capsule that surrounds the eggs of oviparous sharks, and is deposited by the female shark on the substrate. It is analogous to the shell of a bird's egg and is made of protein, which is a type of collagen that superficially resembles horn or keratin. Egg cases often have pairs of tendrils or horn–like structures on their ends, or flat flanges on their sides or spiral flanges around their lengths, which anchor the cases to the bottom. As the egg travels from the ovaries into the oviducts and through the nidamental glands, the egg case is secreted around it and the egg is fertilized. Live–bearing sharks may retain egg cases, and these vary from being rigid and similar to those of oviparous sharks to soft, bag–like, degenerate and membranous. Soft egg cases may disintegrate during the birth cycle.

Elasmobranch: Referring to the subclass Elasmobranchii.

Elasmobranchii: The subclass Elasmobranchii, (from Greek *elasmos*, plate, and *branchos*, gills, in allusion to their plate–like gill septa), the shark–like fishes other than the Holocephali or chimaeras, and including the living nonbatoid sharks, batoids, and a host of fossil species. They differ from holocephalans in having 5 to 7 pairs of gill openings open to the exterior and not covered by a soft gill cover, oral teeth separate and not formed as tooth plates, a fixed first dorsal fin with or without a fin spine, and a short spined or spineless second dorsal.

Embryo: An earlier development stage of the young of a live–bearing shark, ranging from nearly microscopic to moderate–sized but not like a miniature adult. See **foetus**.

Enameloid: The shiny hard external coating of the crowns of shark oral teeth, superficially similar to enamel in land vertebrates.

End–style: In the clasper skeleton, the posterior end of the axial cartilage, between the dorsal and ventral terminal cartilages.

Endemic: A species or higher taxonomic group of organisms that is only found in a given area. It can include national endemics found in a river system or along part or all of the coast of a given country, but also regional endemics, found off or in adjacent countries with similar habitat, but not elsewhere.

Epaxial lobe or **web:** In the caudal fin, that part of the caudal fin between the base and dorsal margin, supported by ceratotrichia.

Epaxial web: The entire fin web above the vertebral column and caudal base.

Epipelagic zone: That part of the oceans beyond the continental and insular shelves, in oceanic waters, from the surface to the limits of where most sunlight penetrates, about 200 meters. Also known as the sunlit sea or `blue water'. Most epipelagic sharks are found in the epipelagic zone, but may penetrate the mesopelagic zone.

Epiphysial foramen or **notch:** On the neurocranium, a foramen or notch in the cranial roof at the dorsomedial edge of the anterior fontanelle, that houses the pineal body.

Ethmoid region: That anteriormost sector of the neurocranium including the nasal capsules, internasal plate between them, and the rostrum.

Ethmonuchal muscles: In the orectoloboid family Parascylliidae, paired head muscles that originate on the dorsal myomeres of the nape, and insert via long tendons on the nasal capsules. These are possibly for elevating the snout. Not found in any other sharks, though analogous muscles exist in batoids.

Euselachian: Referring to the Euselachii.

Euselachii: The cohort Euselachii (Greek *Eu*, true, good or original, and *selachos*, shark or cartilaginous fish), the spined or 'phalacanthous' sharks, including the modern sharks or Neoselachii, and fossil shark groups including the hybodonts, the ctenacanths, and the xenacanths, all primitively with anal fins and having two dorsal fins with fin spines.

Excurrent apertures: The posterior and ventrally facing openings of the nostrils, which direct water out of the nasal cavities and which are often partially covered by the anterior nasal flaps. These are usually medial on the nostrils and posteromedial to the incurrent apertures, but may be posterior to the incurrent apertures only.

Exorhipidion: In claspers, a longitudinally elongated, external blade or flap with its base attached to the dorsolateral edge of the clasper glans, and with its free edge directed medially. It is supported by the **ventral terminal 2 cartilage**.

Eye notch: A sharp anterior or posterior indentation in the eyelid, where present cleanly dividing the upper and lower eyelids.

Eye spots: Large eye–like pigment spots on the dorsal surface of some batoids; they are usually located on the dorsal surface of the pectoral fins.

Filament or Filamentous: A thread–like structure usually associated with the tail.

Filter screens: In the whale shark (Rhincodontidae) and devil rays (Mobulidae), transverse bars with lateral dermal lobes on the internal gill openings that form devices for screening out plankton.

Fin skeletons: In unpaired precaudal fins, the basal plates and radials; in the caudal fin, the vertebral column including expanded neural and haemal arches; and in the paired fins, the fin girdles, basals, and radials.

Fin web: The usually thin, compressed part of the fin, distal to the base, that is supported by ceratotrichia alone (in aplesodic fins) or by ceratotrichia surrounding expanded fin radials or by radials only (plesodic fin).

First dorsal constrictor muscles: Paired head muscles that are confluent and functionally part of the levator palatoquadrati muscles in most nonbatoid sharks, except in orectoloboids where they are discrete muscles with separate origins and insertions similar to but more lateral than the levators.

First dorsal fin: The anteriormost dorsal fin of two, ranging in position from over the pectoral fin bases to far posterior on the precaudal tail.

Foetus: A later development stage of the unborn young of a live–bearing shark, that essentially resembles a small adult. **Term foetuses** are ready to be born, and generally have oral teeth and denticles erupting, have a colour pattern (often more striking than adults), and, in ovoviviparous sharks, have their yolk sacs reabsorbed.

Foramen magnum: On the neurocranium, the 'great hole' or posteromedial aperture through the occiput into the cranial cavity, above the occipital centrum and medial and usually dorsal to the occipital condyles. The spinal cord passes from the brain through the foramen magnum into the neural canal of the vertebral column.

Free rear tips: The pectoral, pelvic, dorsal, and anal fins all have a movable rear corner or flap, the free rear tip, that is separated from the trunk or tail by a notch and an inner margin. In some sharks the rear tips of some fins are very elongated.

Frontal and **parietal fenestrae:** On the neurocranium, medial apertures in the cranial roof between the anterior fontanelle and the parietal fossa, the frontal fenestra being closer to the anterior fontanelle and the parietal fenestra to the parietal fossa. Sometimes the two merge and become a **frontoparietal fenestra**, while in many batoids and in some orectoloboid sharks there is a merging of the anterior fontanelle with the frontoparietal fenestra so that it extends nearly to the parietal fossa. All of these fenestrae are closed by tough membranes.

Functional series: A series of oral teeth that are in functional position on the jaw.

Galeomorph: Referring to the Galeomorphii.

Galeomorphii: The neoselachian superorder Galeomorphii, including the heterodontoid, lamnoid, orectoloboid, and carcharhinoid sharks.

Gill openings or **slits:** In elasmobranchs, the paired rows of five to seven transverse openings on the sides or underside of the head for the discharge of water through the gills. Chimaeras have their four gill openings hidden by a soft gill cover and discharge water through a single external gill opening.

Gill–raker denticles: In the basking shark (Cetorhinidae),

elongated denticles with hair–like cusps arranged in rows on the internal gill openings, which filter out planktonic organisms.

Gill–raker papillae: Sparse to dense dermal papillae on the gill arches of some sharks that serve as filters to collect small food organisms.

Girdle: A bar of cartilage buried in the body wall that supports the basals of the paired fins: the pectoral girdle (scapulocoracoid) and pelvic girdle (puboischiadic bar).

Hadal: The benthic zone of the deep trenches, 6000 to about 11000 m, from which no cartilaginous fishes have been observed or recorded to date.

Hadopelagic zone: The pelagic zone inside the deep trenches, 6000 to about 11000 m, from which no chondrichthyans have been observed or recorded.

Haemal arch: The arch ventral to the notochord or vertebral centra on tail vertebrae that is formed by the basiventrals and interventrals and which houses the caudal artery and caudal vein in a **haemal canal**.

Haemal spines: On the haemal arches of the diplospondylous precaudal and caudal vertebrae, elongated ventral surfaces forming vertical plates, particularly well–developed on the caudal fin.

Head: That part of a cartilaginous fish from its snout tip to the last or (in chimaeras) only gill slits.

Heterocercal: A caudal fin with the vertebral axis slanted dorsally into the fin base, which is also dorsally elevated.

Heterodontoid: A bullhead shark, horn shark, or Port Jackson shark, a member of the order Heterodontiformes, family Heterodontidae.

Heterodonty: In oral teeth, structural differences between teeth in various positions on the jaws, between teeth in the same position during different life stages, or between teeth in the same positions in the two sexes.

Hexanchoid: A cowshark or frilled shark, members of the order Hexanchiformes, and including the sixgill sharks, sevengill sharks, and frilled sharks.

Holocephalan: Referring to the Holocephali.

Holocephali: The subclass Holocephali (from Greek *holos*, entire, and *kephalos*, head), the living chimaeras and their numerous fossil relatives, a major subdivision of the class Chondrichthyes. The name is in reference to the fusion of the upper jaws or palatoquadrates to the skull in all living species and in many but not all fossils. The living holocephalans include three families in the order Chimaeriformes. The living species differ from elasmobranchs in having four pairs of gill openings covered by a soft gill cover and with a single pair of external gill openings, oral teeth fused and reduced to three pairs of ever–growing tooth plates, an erectile first dorsal fin with a spine and a long, low spineless second dorsal.

Holotype: Either the only specimen used and mentioned in an original description of a species, with or without a designation of such, or one of two or more specimens used and mentioned in an original description of a species and designated as such. This becomes the 'name–bearer' of the species, and is used to validate the species or scientific name by anchoring it to a single specimen.

Homodonty: In oral teeth, structural similarity between teeth in various positions on the jaws, between teeth in the same position during different life stages, or between teeth in the same positions in the two sexes.

Hyoid arch: The visceral arch that supports the tongue and, in elasmobranchs, the rear of the upper jaws. The hyoid arch is between the mandibular arch and the first branchial arch, and has the spiracular pocket between it and the mandibular arch. The hyoid arch in elasmobranchs includes a medial **basihyoid** in the floor of the mouth and inside the tongue, a pair of elongated **ceratohyals** articulating with the basihyoid and the hyomandibulae, and a pair of **hyomandibulae** articulating with the ceratohyals and the hyomandibular facets of the neurocranium. Chimaeroids have a nonsuspensory hyoid arch similar to the gill arches, with a pair of **epihyals** and **pharyngohyals** equivalent to the hyomandibulae. Batoids have the ceratohyals reduced and separated from the hyomandibulars or absent, and functionally replaced by paired dorsal and ventral **pseudohyoids**.

Hyomandibular facet: On the neurocranium of elasmobranchs, a joint surface, socket or cotyle that is usually on the ventrolateral surfaces of each otic capsule but may be extended posteriorly or arched dorsally. The heads of the hyomandibulae articulate with these facets. Chimaeras lack hyomandibular facets and differentiated hyomandibulae.

Hyomandibular nerve foramina: Foramina for the roots of the hyomandibular nerves, behind the orbital fissures. These foramina are confluent with the orbital fissure in many sharks.

Hypaxial web: The entire fin web below the vertebral column (vertebral axis) and the caudal base.

Hypercalcified structures: Parts of the skeleton that have developed extremely dense calcified cartilage, primarily during growth and maturation, which sometimes swell to knobs that distort and engulf existing cartilaginous structures. The rostrum of the salmon shark (***Lamna ditropis***) is a particularly impressive hypercalcified structure.

Hypocercal: A caudal fin with the vertebral axis slanted ventrally into the fin base, which is also ventrally depressed. Found only in angel sharks (Squatiniformes) among living sharks.

Hypopyle: On the external clasper and clasper skeleton, the posterior opening of the clasper groove onto the clasper glans.

Incurrent apertures: The anterior and ventrally facing openings of the nostrils, which direct water into the nasal cavities. These are usually lateral on the nostrils and anterolateral to the excurrent apertures, but may be anterior to the excurrent apertures only.

Independent dentition: Teeth along a mesodistal series in which the roots do not overlap and are separated by a space. See **overlapping dentition**.

Inner margin: In precaudal fins including the pectoral, pelvic, dorsal and anal fins, the margin from the fin insertion to the rear tip.

Insertion: The posterior or rear end of the fin base in precaudal fins. The caudal fin lacks insertions except with many batoids and some chimaeroids that have a caudal filament that extends posterior to the fin. See **origin**.

Interdorsal cartilages: A pair of wedge–shaped arched thin cartilages fitting between the basidorsal cartilages of each vertebra to complete the neural arch.

Interdorsal ridge: A ridge of skin on the midback of sharks, in a line between the first and second dorsal fins; particularly important in identifying grey sharks (genus ***Carcharhinus***, family Carcharhinidae).

Intermedialia: In a vertebral centrum, dorsal, ventral and lateral spaces between the attachment surfaces of the basidorsal and basiventral cartilages and between the two halves of the double cone. These can be filled with uncalcified cartilage, with solid or hollow wedges of calcified cartilage, or with plate–like, branched calcified radii within uncalcified cartilage. See **basalia**.

Intermediate segments: In the clasper skeleton, one or more short cylindrical cartilages connecting the pelvic basipterygium to the axial cartilage of the clasper. Also termed **stem–joints**.

Intermediate teeth: Small oral teeth between the laterals and anteriors of the upper jaw, found in most lamnoids.

Internasal plate or **septum:** On the neurocranium, a plate or partition between the two nasal capsules. It ranges from a vertical plate to a broad horizontal plate.

Interventral cartilages: A pair of rounded or wedge–shaped cartilages fitting between the basiventral cartilages of each vertebra, that in diplospondylous precaudal and caudal vertebrae form the haemal arches with the basiventral cartilages.

Intestinal valve: A dermal flap inside the intestine, protruding into its cavity or lumen, and of various forms in different cartilaginous fishes. Often formed like a corkscrew or augur. See **spiral**, **ring** and **scroll valves**.

Jaws: See **mandibular arch**.

Labial cartilages: Paired cartilages that are internal and support the labial folds at the lateral angles of the mouth. Living neoselachians typically have two pairs of upper labial cartilages, the **anterodorsal** and **posterodorsal** labial cartilages, and one pair of **ventral labial cartilages**, but these are variably reduced and sometimes absent in many sharks. Chimaeras have more elaborate labial cartilages than living elasmobranchs.

Labial flange: On tooth crowns of many squaloids and some orectoloboids, a narrow, vertically elongated labial basal ledge.

Labial folds: Lobes of skin at the lateral angles of the mouth, usually with labial cartilages inside them, separated from the sides of the jaws by pockets of skin (labial grooves or furrows).

Labial furrows or **labial grooves:** Grooves around the mouth angles on the outer surface of the jaws of many cartilaginous fishes, isolating the labial folds. Primitively there is a distinct **upper labial furrow** above the mouth corner and a **lower labial furrow** below it.

Labial: In oral teeth, the outer face of the tooth that is directed outside the mouth and towards the lips. See **lingual**.

Lamnoid: A mackerel shark, a member of the order Lamniformes, and including the sand tiger sharks, goblin sharks, crocodile sharks, megamouth shark, thresher sharks, basking shark, and the makos, porbeagle, salmon shark and white shark.

Lateral clasper fold: In mackerel sharks (family Lamnidae), a unique longitudinal flap of skin along the lateral edge of the external clasper shaft.

Lateral commissures: On the neurocranium, tube–like or ring–like enclosed passages for the lateral head veins, which drain the orbital sinuses, through the postorbital walls of the orbits and below the sphenopterotic ridges and above the hyomandibular facets in neoselachians. The lateral commissures are reduced or absent in many living neoselachians.

Lateral or **laterad:** Outwards, in the transverse direction towards the periphery of the body. See **medial**.

Lateral orolabial grooves: Shallow longitudinal grooves on the lower jaw that connect the edge of the lip on each side with the medial ends of the lower labial furrows. Found in more advanced orectoloboids.

Lateral teeth: Large broad–rooted, compressed, high crowned oral teeth on the sides of the jaws between the anteriors and posteriors.

Lateral trunk denticle: A dermal denticle from the dorsolateral surface of the back below the first dorsal fin base.

Lectotype: One of two or more specimens that were syntypes in an original description, designated as a lectotype by a subsequent writer. It then becomes equivalent to a holotype, and anchors the name of the species to a specimen unless invalidated by a ruling of the International Commission on Zoological Nomenclature or a previous designation of a lectotype.

Levator palatoquadrati muscles: Paired head muscles that primitively originate on the underside of the postorbital processes and sphenopterotic ridges, extend vertically, and insert on the posteromedial surfaces of the quadrate processes of the palatoquadrates. In advanced carcharhinoids the origins of the levator palatoquadrati muscles are expanded far forwards and diagonally into the orbits. Primitively these muscles lift or retract the jaws upwards, but in advanced carcharhinoids may help rotate the jaws forwards and downwards in opposition to the

levator hyomandibularis muscles, which retract the jaws.

Lingual: In oral teeth, the inner face of the tooth that is directed inside the mouth and towards the tongue. See **labial**.

Littoral zone: That part of the oceans over the continental and insular shelves, from the intertidal to 200 m.

Live–bearing: A mode of reproduction in which female sharks give birth to young sharks, which are miniatures of the adults. See **viviparity**.

Longitudinal ridges: In lateral trunk denticles, parallel ridges that extend anteroposteriorly on the distal surface of the crown. These may be in the form of a single **medial ridge** (sometimes paired), and paired **lateral ridges**, and may terminate in medial and lateral cusps.

Lower eyelid: The ventral half of the eyelid, separated by a deep pocket (conjunctival fornix) from the eyeball. In some derived batoids the pocket also fuses with the eyeball.

Lower origin: In the caudal fin, the anteroventral beginning of the hypaxial or lower web of the caudal fin, at the posterior end of the anal–caudal or pelvic–caudal space (see measurement illustrations).

Lower postventral margin: In the caudal fin, the lower part of the postventral margin of the hypaxial web, from the ventral tip to the posterior notch.

Malar: Rows of thorn patches found only on adult males (in some skate species) along anterior margin of disc in front of the eyes.

Mandibular arch: The paired primary jaw cartilages of sharks, including the dorsal palatoquadrates and the ventral Meckel's cartilages.

Mandibulocutaneous muscles: Paired head muscles in squaloid and hexanchoid sharks, that originate on the inside of the skin of the head behind the eyes and near the spiracles, and insert on the dorsoposterolateral face of the quadrate processes of the palatoquadrates.

Meckel's cartilages: The paired lower jaw cartilages, articulating mesially with each other at the midline or symphysis of the lower jaw, and articulating laterally with the distal ends of the palatoquadrates. The Meckel's cartilages are fused together at the symphysis in some shark–like fishes or are articulated to a symphysial cartilage in others.

Medial teeth: Small oral teeth, generally symmetrical and with narrow roots, in one row at the symphysis and often in additional paired rows on either side of the symphysial one.

Medial: Inwards, in the transverse direction towards the middle of the body. See **lateral**.

Mesial: In oral teeth, mesial structures are towards the midlines of the jaws, the symphyses. See **distal**.

Mesopelagic zone: That part of the oceans beyond the continental and insular shelves, in oceanic waters, from about 200 to 1000 m, the twilight zone where little light penetrates.

Mesopterygium: In the pectoral fin skeleton of living neoselachians, the middle basal cartilage, between the propterygium and metapterygium. The mesopterygium is sometimes fused to the propterygium or metapterygium, or to both.

Mesorhipidion: A knife–like or blade–like structure on the lateral clasper glans of some carcharhinoid sharks, formed from the terminal 3 cartilage, and over and partially lateral to the ventral terminal and mesial to the pseudopera.

Metapterygial axis: In the pectoral fin skeleton of living neoselachians, the posterior extension of the mesopterygium as a flattened, elongated segmented series of cartilages that supports the distal bases and free rear tips of the pectoral fins; the axis has radials along its distal edge continuous with the radials on the metapterygial basal.

Metapterygial basal: In the pectoral fin skeleton of living neoselachians, the anteriormost, expanded cartilage of the metapterygium.

Metapterygial proximal segment: In the hexanchoid pectoral fin skeleton, a short jointed segment on the proximal end of the metapterygial basal, not found in other sharks.

Metapterygium: In the pectoral fin skeleton of living neoselachians, the rearmost basal cartilage, adjacent to the posterior edge of the mesopterygium and with several radials attached to its distal edge. It includes the **metapterygial basal** and the **metapterygial axis**.

Molariform: In oral teeth, referring to a tooth with a broad flat crown with low cusps or none, for crushing hard–shelled invertebrate prey.

Monospondylous precaudal vertebrae: Vertebrae with one centrum and one pair of basidorsals, basiventrals, and ribs per body segment (myotome), and generally extending from the occiput to the end of the body cavity and to over the pelvic girdle. However there is much variation in the position of the monospondylous–diplospondylous transition, which can range well in front or behind the pelvic girdle.

Monospondylous–diplospondylous transition: The position on the vertebral column where monospondylous centra end and diplospondylous centra begin. In lateral view the transition often appears as an abrupt decrease in length of the diplospondylous centrum compared to the last monospondylous centrum, but this can be obscure in various sharks with very numerous, very short centra. Often a centrum of intermediate length appears between a long monospondylous centrum and a short diplospondylous centrum. In a few sharks there is a **stutter zone** of alternating long and short centra that marks the transition. Also, the basidorsals and basiventrals have foramina for the spinal nerves on every other vertebra, rather than on each vertebra as in monospondylous vertebrae. The transition from long to short centra is generally coordinated with the transition of vertebrae with free ribs and no haemal arches to those without ribs and with haemal arches. However, in some sharks the two transitions can be anterior or posterior to each other.

Multiple oviparity: A mode of egg–laying or oviparity in which female sharks retain several pairs of cased eggs in the oviducts, in which embryos grow to advanced

developmental stages. When deposited on the bottom (in captivity) the eggs may take less than a month to hatch. Found only in the scyliorhinid genus ***Halaelurus***, with some uncertainty as to whether the eggs are normally retained in the oviducts until hatching. Eggs laid by these sharks may be abnormal, unusual, or an alternate to ovoviviparity. The whale shark (***Rhincodon typus***) may have multiple retention of egg cases; near–term foetuses have been found in their uteri and egg–cases with developing foetuses have been collected on the bottom.

Nasal aperture: On the neurocranium, an aperture in the anteroventral surface or floor of each nasal capsule, through which the nostril directs water into and out of the nasal organ.

Nasal capsules: On the neurocranium, a pair of spherical, oval or trumpet–shaped, thin–walled structures behind the rostrum (when present) and in front of the orbits, cranial roof and basal plate. They serve as containers for the nasal organs or organs of smell, and have passages into the cranial cavity to connect the nasal organs with the brain.

Nasal curtain: Anterior nasal flaps that are expanded medially and posteriorly and have fused with each other. Nasal curtains are found in some carcharhinoid sharks and in many batoids.

Nasal flap: One of a set of dermal flaps associated with the nostrils, and serving to direct water into and out of them, including the anterior, posterior, and mesonarial flaps.

Nasal fontanelle: On the neurocranium, an aperture in the posteroventral surface or floor of each nasal capsule, behind the nasal apertures and closed by a dermal membrane.

Nasoral grooves: Many bottom–dwelling, relatively inactive sharks have nasoral grooves, shallow or deep grooves on the ventral surface of the snout between the excurrent apertures and the mouth. The nasoral grooves are covered by expanded anterior nasal flaps that reach the mouth, and form water channels that allow the respiratory current to pull water by partial pressure into and out of the nostrils and into the mouth. This allows the shark to actively irrigate its nasal cavities while sitting still or when slowly moving. Nasoral grooves occur in heterodontoids, orectoloboids, chimaeroids, some carcharhinoids, and most batoids. Also termed **oronasal grooves**.

Neck: A narrow band of finely porous dull tissue (possibly orthodentine) encircling the proximal end of the crown of a tooth, and apparently covered with dental membrane.

Neoselachian: Referring to the Neoselachii.

Neoselachii: From Greek *neos*, new, and *selachos*, shark. The modern sharks, the subcohort Neoselachii, consisting of the living elasmobranchs and their immediate fossil relatives. See **Euselachii**.

Neotype: A specimen, not part of the original type series for a species, which is designated by a subsequent author, particularly if the holotype or other types have been destroyed, were never designated in the original description, or are presently useless.

Neural arch: In shark vertebrae, a dorsal arch formed by basidorsal and interdorsal cartilages above the centrum and forming a neural canal containing the spinal cord.

Neural spines: On the neural arches of shark vertebrae, elevated dorsal plate–like surfaces, particularly well–developed in many squalomorph sharks.

Neurocranium: In sharks, a box–shaped complex cartilaginous structure at the anterior end of the vertebral column, containing the brain, housing and supporting the nasal organs, eyes, ears, and other sense organs, and supporting the visceral arches or splanchnocranium. Also termed **chondrocranium**, **chondroneurocranium**, or **endocranium**.

Nictitating lower eyelid: In the ground sharks (order Carcharhiniformes), a movable lower eyelid that has special posterior eyelid muscles that lift it and, in some species, completely close the eye opening (or palpebral aperture). Often incorrectly termed **nictitating membrane**, a different, nonhomologous structure in terrestrial vertebrates.

Nictitating upper eyelid: In parascylliid orectoloboids, the upper eyelid has anterior eyelid muscles that pull it down and close the eye opening, analogous to the nictitating lower eyelids of carcharhinoids.

Nomenclature: In biology, the application of distinctive names to groups of organisms.

Nostrils: The external openings of the cavities of the nasal organs, or organs of smell.

Notochord: In embryonic sharks (and other chordates) the notochord is a fluid–filled tube below the spinal cord that has a connective–tissue notochordal sheath surrounding it. The notochord forms the primitive developmental base of the chondrichthyan vertebral column. Chimaeroids retain the notochord and its sheath without constriction (although some have ring–like centra in the sheath), but in neoselachians it is constricted by the development of double–cone calcifications of the centra within the sheath into biconical chambers between each centrum. The addition of centra to the notochordal sheath strengthens the vertebral column. Some deepwater squaloid, hexanchoid, and lamnoid sharks have the sheath constriction and calcified double cones variably reduced, sometimes to connective tissue septa only. Some of these taxa with a 'notochordal' vertebral column have been considered primitive but are apparently derived from ancestors with well–calcified, constricted vertebral centra.

Nuchal thorns: One or more thorns on the nape of skates, located just behind the spiracles; some juvenile skates may have an enlarged nuchal thorn to aid in escaping the egg case, but this thorn disappears soon after birth while in some species this thorn may remain throughout the skate's life.

Occipital centrum: On the occiput of the neurocranium, the posterior half of a calcified double cone of the vertebral column, imbedded in the basal plate and articulating with the anteriormost centrum of the vertebral column. Also termed occipital hemicentrum.

Occiput: The posteriormost sector of the neurocranium, behind and partially between the otic capsules, with its dorsal surface from the parietal fossa rearwards to the foramen magnum, and its posterior surface including the occipital condyles, the occipital centrum, the paired vagus nerve foramina, the paired glossopharyngial nerve foramina, and the rear surface of the hyomandibular facets.

Oceanic: Referring to organisms inhabiting those parts of the oceans beyond the continental and insular shelves, over the continental slopes, ocean floor, sea mounts and abyssal trenches. The open ocean.

Ocelli or **eyespots:** Large eye–like pigment spots located on the dorsal surface of the pectoral fins or bodies of some sharks including rays, angel sharks, and some bamboo sharks, possibly serving to frighten potential enemies.

Oophagy: From Greek *oön*, egg, and *phagos*, to eat. Egg–eating, a mode of live–bearing reproduction employing uterine cannibalism; early foetuses deplete their yolk sacs early and subsist by eating nutritive eggs produced by the mother. Known in several lamnoid sharks, the carcharhinoid family Pseudotriakidae, and in the orectoloboid family Ginglymostomatidae (***Nebrius ferrugineus***).

Optic nerve foramen: A large foramen usually in the middle of the orbital wall, passing the optic nerve from the brain to the eye.

Optic pedicel: On the neurocranium, a slender cartilage that projects from the medial orbital wall and articulates with the eyeball; it serves as a pivot point for the eyeball and a spacer between the eyeball and the orbital wall.

Orbital fissures: The main foramina or fenestrae that pass the trigeminal and facial nerves from the brain to the orbits, located on the posteroventral ends of the medial walls of the orbits.

Orbital notches: On the neurocranium, the paired anterior notches in the suborbital shelves that articulate with the orbital processes of the palatoquadrates. In many squalomorph sharks these are enlarged, deepened, socket–like, and posteriorly situated in the orbits, with telescoping of the suborbital shelves, and are lost in batoids.

Orbital thorns: Thorns around the eyes of some skate species.

Orbits: Large, paired cavities on the sides of the neurocranium, behind the nasal capsules, mostly in front of the otic capsules, and separated medially by the cranial cavity. They are bounded anteriorly by the preorbital walls and processes, dorsally by the supraorbital crests, ventrally by the suborbital shelves (reduced or lost in various squalomorph sharks), and posteriorly by the postorbital processes and walls. The orbits contain the eyeballs and their muscles, venous sinuses, several arteries that connect to the cranial cavity, and most of the cranial nerves.

Orectoloboid: A carpet shark, a member of the order Orectolobiformes, including barbelthroat carpet sharks, blind sharks, wobbegong sharks, bamboo sharks, epaulette sharks, nurse sharks, zebra sharks, and whale sharks.

Origin: The anterior or front end of the fin base in all fins. The caudal fin has **upper** and **lower** origins but no insertion. See **insertion**.

Orthodentine: A primary hard tissue comprising the crown of oral teeth in sharks, with numerous fine mostly parallel nonvascular tubules.

Orthodont: An oral tooth with its crown filled with orthodentine, and with a prominent central pulp cavity.

Osteodentine: A primary hard tissue comprising the roots and sometimes the inside of the crown in the oral tooth, with bone–like large reticulating, thick–walled tubules.

Osteodont: An oral tooth with its crown filled with osteodentine, continuous with the root, and without a pulp cavity.

Otic capsules: On the neurocranium, a pair of complex thick–walled capsules containing the inner ears, and located between the orbits and the occiput, and partially separated medially by the cranial cavity.

Overlapping dentition: Teeth along a mesodistal series in which the roots overlap and are not separated by a space. Two types of overlap patterns occur, **alternate overlap**, in which teeth in a series alternate from more labial to more lingual, and **imbricate overlap**, in which the distal end of each tooth lingually or labially overlaps the mesial end of the succeeding tooth, repeating to the distal ends of the dental band. **Alternate–imbricate dentitions** combine both alternate and imbricate overlap. See **independent dentition**.

Oviparity: A mode of reproduction in which female sharks deposit eggs enclosed in oblong or conical egg–cases on the bottom, which hatch in less than a month to more than a year, producing young sharks which are miniatures of the adults.

Ovoviviparity: Generally equivalent to **yolk–sac viviparity**, live–bearing in which the young are nourished primarily by the yolk in the yolk sac, which is gradually depleted and the yolk sac reabsorbed until the young are ready to be born. Sometimes used to cover all forms of **aplacental viviparity**, including **cannibal viviparity**.

Paired fins: The pectoral and pelvic fins.

Palatoquadrates: The paired upper jaw cartilages, articulating mesially with each other at the midline or symphysis of the upper jaw, and articulating laterally with the distal ends of the Meckel's cartilages. The palatoquadrates are fused to the neurocranium in all living holocephalans. The palatoquadrates of neoselachians are divided into cylindrical anteromedial sectors or **palatine processes**, which articulate or are otherwise attached to each other at the symphysis; variably modified conical to flattened articular structures or **orbital processes** on the middle of the palatoquadrates for attachment to the neurocranium at the orbital notches; and often elevated posterodistal **quadrate processes** that articulate with the distal ends of the Meckel's cartilages and are loosely or firmly attached to the distal ends of the hyomandibulae. In a few living neoselachians, and many fossil elasmobranchs,

the quadrate processes have **postorbital articulations** with the rear surfaces of the postorbital processes of the neurocranium.

Palpebral aperture: The eye opening, defined by the upper and lower eyelids.

Papillae: Elongated finger–like processes of skin, located around the spiracles of torpedo rays, and in the mouths and on the gill arches of other sharks.

Papillose gill rakers: See **gill raker papillae**.

Paralectotype: One of two or more specimens that were syntypes in an original description, but which became a paralectotype or paralectotypes when a subsequent author designated one of the syntypes as a lectotype. Paralectotypes are equivalent to paratypes.

Paratype: Each specimen of a type series other than the holotype. Specimens other than the holotype automatically become paratypes unless the author designates them as referred specimens that are not part of the type series.

Parietal fossa: On the neurocranium, a shallow or deep depression between the otic capsules and at the rear of the cranial roof, that houses foramina for paired ducts leading to the inner ears and for the spaces around them.

Pectoral fins: A symmetrical pair of fins on each side of the trunk just behind the head and in front of the abdomen. These are present in all cartilaginous fishes and correspond to the forelimbs of a land vertebrate (a tetrapod or four–footed vertebrate).

Pectoral or **shoulder girdle:** See **scapulocoracoid**.

Pedicel: In lateral trunk denticles, a narrow stalk separating the crown from the base.

Pelagic: Referring to organisms that are free–swimming, not bottom–dwelling.

Pelvic fin: Asymmetrical pair of fins on the sides of the body between the abdomen and precaudal tail which correspond to the hindlimbs of land vertebrate (a tetrapod or four–footed vertebrate). Also, **ventral fins**.

Pelvic girdle: See **puboischiadic bar**.

Photophores: Conspicuously pigmented small spots on the bodies of most lantern sharks (family Etmopteridae) and some kitefin sharks (family Dalatiidae). These are tiny round organs that are covered with a conspicuous dark pigment (melanin) and produce light by a low–temperature chemical reaction.

Placenta: See **yolk–sac placenta**.

Placental viviparity: Live–bearing in which the young develop a yolk–sac placenta, which is apparently confined to the carcharhinoid sharks.

Placoid scale: See **dermal denticle**.

Plesodic fin: A pectoral, pelvic, dorsal, or anal fin in which the radial cartilages of the fin skeleton extend far into the distal fin web, often near its edges, and between the supporting ceratotrichia of the fin web. Some fossil sharks also have plesodic caudal fins, in which the expanded haemal arches of the caudal vertebrae extend far into the fin web. In more advanced batoids the radials of the plesodic paired fins become highly branched and segmented, very narrow and slender, and essentially replace the ceratotrichia as supports for the fin webs.

Pores, pigmented: In a few sharks and skates, the pores for the lateral line and ampullae of Lorenzini are conspicuously black–pigmented, and look like little black specks.

Posterior: Rearwards, in the longitudinal direction of the caudal–fin tip or tail filament. Also **caudal**.

Posterior margin: In precaudal fins, the margin from the fin apex to either the free rear tip (in sharks with distinct inner margins) or the fin insertion (for those without inner margins).

Posterior nasal flaps: Low flaps or ridges arising on the posterior edges of the excurrent apertures of the nostrils.

Posterior notch: In the caudal fin, the notch in the postventral margin dividing it into upper and lower parts.

Posterior teeth: Small or sometimes enlarged irregular oral teeth near and at the distal ends of the dental bands, with low crowns and sometimes missing cusps.

Posterior tip: The posteriormost corner or end of the terminal lobe of the caudal fin.

Postocular eyelid muscles: A complex of paired head muscles unique to carcharhinoid sharks that originate around the spiracles and insert on the posterior ends of the upper eyelids and nictitating lower eyelids. Primitively they depress the upper eyelid and elevate the nictitating lower eyelid to close the eye, but in more derived carcharhinoids the eye is closed only by elevation of the nictitating lower eyelid.

Postorbital processes: On the neurocranium, posterolateral projections of the supraorbital crests, below which the postorbital walls originate.

Postorbital walls: On the neurocranium, the posterior boundaries of the orbits, variously reduced vertical plates of cartilage that close the orbits between the postorbital processes and the suborbital shelves, more or less reduced in living neoselachians.

Postventral margin: In the caudal fin, the margin from the ventral tip to the subterminal notch of the caudal fin. See **lower** and **upper** postventral margins.

Preanal ridges: A pair of low, short to long, narrow ridges on the midline of the caudal peduncle extending anteriorly from the anal fin base.

Precaudal fins: All fins in front of the caudal fin.

Precaudal pit: A depression at the upper and sometimes lower origin of the caudal fin where it joins the caudal peduncle.

Precaudal tail: That part of the tail from its base at the vent to the origins of the caudal fin.

Precaudal vertebrae: Vertebrae from the occiput to the dorsal origin of the caudal fin.

Predorsal ridge: A low narrow ridge of skin on the midline of the back anterior to the first dorsal fin base.

Preorbital canals: On the neurocranium, anterior passages for the superficial opthalmic nerves out of the orbits and onto the nasal capsules and rostrum, situated at the anteromesial edges of the supraorbital crests at the rear bases of the preorbital processes; sometimes greatly expanded posteriorly.

Preorbital processes: On the neurocranium, anterolateral projections of the supraorbital crests, below which the preorbital walls originate.

Preorbital walls: On the neurocranium, the anterior boundaries of the orbits, curved vertical plates of cartilage that vary from complete to absent in neoselachians.

Preorbitalis muscles: Paired head muscles that primitively originate on the rear of the nasal capsules or on the preorbital walls, run diagonally rearwards, and insert on the adductor mandibulae at the mouth angles. Orectoloboids and heterodontoids have the preorbitalis vertical, with cross–biased fibres in the latter, and the insertions are along the ventral edge of Meckel's cartilage. In derived orectoloboids the origins of the preorbitalis are expanded onto the cranial roof and the muscles greatly expanded. Primitively the preorbitalis may primarily serve to protrude the jaws, but they may primarily serve to increase the power of the bite in orectoloboids and heterodontoids. Also termed **levator labii superioris muscles**.

Preventral margin: In the caudal fin, the margin from the lower origin to the ventral tip of the caudal fin.

Pristiophoroid: A saw shark, order Pristiophoriformes, family Pristiophoridae.

Propterygium: In the pectoral fin skeleton of living neoselachians, the anteriormost basal cartilage, adjacent to the anterior edge of the mesopterygium and with one or more radials attached to its distal end. In batoids with expanded anterior pectoral fin lobes it becomes expanded and segmented into a **propterygial basal** and **propterygial axis**, similar to the metapterygial basal and axis.

Proximal: In any direction, at the near end of a structure.

Pseudopera: On the external clasper glans, a dorsally opening blind pocket along the lateral edge of the clasper, and about opposite the anterior edge of the glans.

Pseudosiphon: On the external clasper glans, a dorsally opening blind pocket along the medial edge of the clasper, and about opposite the cover rhipidion.

Pterotic horn or **process:** On the neurocranium, elongated posterior projections of the sphenopterotic ridges of the otic capsules.

Puboischiadic bar: A transverse flattened or cylindrical plate in the posterior body wall opposite the anterior ends of the pelvic fins, in front of the vent and at the posterior end of the body cavity, that supports a few anterior pelvic radials and a basal cartilage, the basipterygium. The **pelvic girdle**.

Radial cartilages or **radials:** The small, segmented, more distal cartilages of the precaudal fins, attached proximally to the distal edges of the basal cartilages. In the pectoral fin skeleton of living neoselachians, the radials mostly have three segments but range from no segments to 30 or more. The radial segments adjacent to the pectoral basals are the **proximal radials**, the radial segments furthest from the basals are the **distal radials**, and any segments between them are **intermediate radials**.

Radii: In a vertebral centrum in cross–section, branching plates of calcified cartilage in the intermedialia. These have a radial orientation from the centre of the centrum.

Ray: See **batoid**.

Replacement series: A series of oral teeth that are lingual to the functional series, and not in a functional position on the jaw.

Rhipidion: In nonbatoid sharks, a longitudinal, elongated flap attached to the floor of the glans along its base and with its free edge directed laterally. In skates (Rajoidei) rhipidion is used for a soft mass of erectile tissue in the glans, not necessarily homologous to the rhipidion of nonbatoid sharks.

Rhomboidal: In the form of a rhombus or diamond.

Ribs: On the shark vertebral column, short to elongated paired and typically pointed cartilages attached to the basiventral cartilages and extending into the horizontal septum of the segmented trunk musculature or myomeres. Chondrichthyan ribs are therefore dorsal ribs rather than ventral ribs as in bony fishes (which support the body cavity).

Ring valve: A type of spiral intestinal valve in which the valve turns are very numerous and short and resemble a stack of washers.

Rise: The transitional and less steep bottom zone from the lower slope to the abyss or ocean floor, between 2250 m and 4500 m. The rise can be divided into upper (2250 to 3000 m), middle (3000 to 3750 m) and lower (3750 to 4500 m) rises. Few sharks are known from the rise, and those mostly from the upper rise. See **Abyss**, **Hadal**, **Shelf** and **Slope**.

Root lobe: Sharks often have the roots of their oral teeth divided into separate lobes at their midlengths, which are termed **mesial** and **distal root lobes**.

Root: The proximal part of the oral tooth, made of porous osteodentine and anchoring the tooth in the dental membrane of the jaw.

Rostral keel: In the neurocranium of squaloids, a large vertical plate on the underside of the rostrum and internasal septum, sometimes reduced, and with the cavities of the subnasal fenestrae on either side of the keel.

Rostral node: On the neurocranium, the anterior end of the rostrum of cartilaginous fishes, and the plate formed by the fused anterior ends of the tripodal rostra in many galeomorph sharks.

Rostral thorns: Thorns on the rostrum of some skate species.

Rostromandibular muscle: In the orectoloboid family Parascylliidae, paired head muscles that originate on the sides of the adductor mandibulae muscles and insert via long tendons on the medial rostral cartilage. These are possibly for depressing the snout. Not found in any other sharks, though analogous muscles exist in batoids.

Rostronuchal muscles: In the orectoloboid family Parascylliidae, paired head muscles that originate on the dorsal myomeres of the nape, and insert via long tendons on the medial rostral cartilage. These are possibly for elevating the snout. Not found in any other sharks, though analogous muscles exist in batoids.

Rostrum: On the neurocranium, the cartilaginous anteriormost structure which supports the prenasal snout including lateral line canals and masses of ampullae, and is located in front of the nasal capsules and anterior fontanelle. The rostrum is very variable, and in squalomorph sharks is primitively trough or basin–shaped, while it may be primitively rod–shaped or tripodal in galeomorph sharks. It is absent in a few nonbatoid sharks and in many batoids. See **rostrum**, **tripodal**.

Rostrum, tripodal: The rostrum of the neurocranium in lamnoids and carcharhinoids is primitively tripodal, with a pair of dorsolateral **lateral rostral cartilages** that arise from the posterolaterodorsal surfaces of the nasal capsules or from the preorbital wall, and a **medial rostral cartilage** that arises from the anteromedial surface of the internasal septum. The medial and lateral rostral cartilages extend anteriorly and articulate or fuse at the rostral node. Living orectoloboids have only the medial rostral cartilage although a tripodal rostrum may be present in some fossil orectoloboids, while heterodontoid sharks lack a rostrum as adults but apparently lose it as embryos.

Row: In oral teeth, a single replicating line of teeth, approximately transverse to the longitudinal jaw axis, which includes functional teeth and their replacements, derived from one tooth–producing area on the jaw.

Saw or **saw–snout:** The elongated snout in sawfish and sawsharks, with side and (in sawsharks) ventral teeth formed from enlarged denticles, used to kill, ensnare or dig for prey. Also termed rostral saw.

Scapular thorns: Thorns on the shoulder girdle of some skate species.

Scapulocoracoid: The primitively U–shaped cartilage in the body wall just behind the gills and at the anterior end of the pectoral bases, that supports the pectoral fins and articulates with the pectoral basals. The scapulocoracoid consists of a ventral **coracoid bar** connecting its paired **lateral faces** with articular condyles or ridges for the pectoral basals, and a pair of dorsal **scapular processes** dorsal to the lateral faces. The scapular processes sometimes have separate **suprascapulae** above them, but they are sometimes fused with the scapular processes. The coracoid bar has a medial joint or even a separate medial cartilage (sternal cartilage) in a few living sharks, as with many fossil cartilaginous fishes. The **pectoral** or **shoulder girdle**.

Scroll valve: A type of spiral intestinal valve in requiem and hammerhead sharks in which the valve has uncoiled and resembles a rolled–up bib or scroll.

Second dorsal fin: The posteriormost dorsal fin of two in cartilaginous fishes, ranging in position from over the pelvic–fin bases to far posterior on the precaudal tail.

Secondary caudal keels: Low horizontal dermal keels on the ventral base of the caudal fin in mackerel sharks (Lamnidae) and sometimes somniosids.

Secondary lower eyelid: The eyelid below or lateral to the nictitating lower eyelid, separated from it by a subocular groove or pocket, and, in many carcharhinoids with internal nictitating lower eyelids, functionally replacing them as lower eyelids. Some orectoloboids have shallow subocular grooves separating their non–nictitating lower eyelids from weakly developed secondary lower eyelids. They may, however, be able to close their eye openings by retracting the eyeballs.

Semiplesodic fin: In some sharks, a pectoral or dorsal fin with the fin radial cartilages extending partway into the fin web but not to its distal edges, essentially intermediate between plesodic and aplesodic fins.

Series: In oral teeth, a line of teeth along the jaws which is parallel to the jaw axis and includes teeth from all rows present.

Serrations: In oral teeth, minute teeth formed by the cutting edge of the crown that enhance the slicing abilities of the teeth.

Sexual dimorphism: Differences in physical shape or form usually found in skates.

Shark: Generally used for cylindrical or flattened cartilaginous fishes with 5 to 7 external gill openings on the sides of their heads, pectoral fins that are not attached to the head above the gill openings, and a large, stout tail with a large caudal fin; that is, all living elasmobranchs except the rays or batoids. Living sharks in this sense are all members of the Neoselachii, the modern sharks and rays. Shark is also used loosely for fossil chondrichthyans that are not neoselachians but have a shark–like form, and even for 'spiny sharks' (acanthodians) and for certain teleosts. Rays are essentially flattened sharks with the pectoral fins attached to their heads and are cladistically nested within the squalomorph sharks, while living chimaeras are the immediate sister group of living neoselachians and are called ghost sharks or silver sharks. Hence shark is used here in an alternate and broader sense to include the rays and chimaeras.

Shelf, continental and insular: The sloping plateau–like area along the continents and islands between the shoreline and approximately 200 m depth. It is roughly divided into inshore (intertidal to 100 m), and offshore (100 to 200 m) zones. The shelves have the greatest diversity of cartilaginous fishes. See **Abyss**, **Rise** and **Slope**.

Shoulder: In oral teeth, an arcuate or straight, convex–edged section of the crown foot, without cusplets and similar to a blade but without a cutting edge.

Single oviparity: A mode of egg–laying or oviparity in which female sharks produce encased eggs in pairs, which are not retained in the oviducts and are deposited on the bottom. Embryos in the egg–cases are at an early developmental stage, and take a few months to over a year to hatch. Found in almost all oviparous cartilaginous fishes.

Siphons: A pair of dermal sacs in the ventral abdominal wall of male sharks, connecting posteriorly with the apopyles of the claspers, and extending anteriorly a variable distance from about opposite the pelvic–fin origins to opposite the pectoral–fin bases.

Skull or **cranium:** The skull or head skeleton of sharks includes the **neurocranium** and the **splanchnocranium** or visceral arches. The visceral arches articulate with and are associated with the neurocranium, but, except for the upper jaws of many holocephalans, are not fused to it. Also termed **syncranium**.

Slope, continental and insular: The precipitous bottom zone from the edge of the outer shelf down to the submarine rise, between 200 m to 2250 m. The slope can be divided into upper (200 to 750 m), middle (750 to 1500 m) and lower (1500 to 2250 m) slopes, of which the upper and middle slope has the highest diversity of deepwater benthic sharks. See **Abyss**, **Rise** and **Shelf**.

Snout: That part of a cartilaginous fish in front of its eyes and mouth, and including the nostrils.

Sphenopterotic ridge: On the neurocranium, a horizontal ridge along the dorsolateral edge of each otic capsule that either ends at the occiput or terminates in an expanded pterotic process.

Spiracle: A small to large opening between the eye and first gill opening of most sharks and rays, representing the modified gill opening between the jaws and hyoid (tongue) arch. This is secondarily lost in chimaeras and some sharks.

Spiral or **conicospiral valve:** An intestinal valve shaped like a corkscrew or augur, with the valve angled anteriorly and medially in the intestine.

Splanchnocranium: That part of the shark skull including the visceral arches. These include the jaws or mandibular arch, the tongue or hyoid arch, and the five to seven gill or branchial arches. Also, **viscerocranium**.

Squalene: Along–chain oily hydrocarbon present in the liver oil of deepwater cartilaginous fishes. It is highly valued for industrial and medicinal use.

Squalomorph: Referring to the Squalomorphii.

Squalomorphii: The neoselachian superorder Squalomorphii, including the hexanchoid, squaloid, squatinoid,and pristiophoroid sharks.

Squatinoid: An angel shark, order Squatiniformes, family Squatinidae.

Squatinoid caudal fin: Angel sharks (Squatiniformes) are unique among living sharks in having hypocercal caudal fins that resemble inverted caudal fins of ordinary sharks. The dorsal margin is subdivided into a **predorsal** margin from the upper origin to its **dorsal tip** (analogous to the preventral margin and ventral tips in ordinary sharks), a **postdorsal** margin (like the postventral margin) from the dorsal tip to its supraterminal notch (similar to the subterminal notch), and a short **supraterminal margin** and large **ventral terminal margin** (similar to the subterminal and terminal margins) between the supraterminal notch and the ventral tip of the caudal. The ventral margin has a preventral margin forming a ventral lobe with the ventral tip and the ventral terminal margin.

Stapedial foramen or **fenestra:** On the neurocranium, a foramen through the posteroventromedial surface of each suborbital shelf into the orbit, for the stapedial or orbital arteries. It may be greatly expanded into a stapedial fenestra in sharks with greatly coiled stapedial arteries or lost in sharks with the suborbital shelves greatly reduced or absent.

Stapediocarotid foramen: On the neurocranium of certain sharks, fusion of the stapedial and carotid foramina on either side produces a single pair of stapediocarotid foramina.

Subcaudal keel: In a few dogfish sharks (family Centrophoridae), a single longitudinal dermal keel on the underside of the caudal peduncle.

Subethmoid fossa: On the neurocranium, a deep cavity on the ventral surfaces of the nasal capsules and the internasal plate, into which fit the palatine processes of the upper jaws.

Subnasal fenestrae: On the neurocranium of squaloids, a pair of apertures in the internasal plate between the nasal capsules that connect the cerebral cavity with two ventral fluid–filled cavities between the nasal capsules and the rostral keel. The fenestrae themselves are covered by tough membranes as with the anterior fontanelle. Subnasal fenestrae are present in most squaloids but reduced in a few derived species, and are not found in other sharks. Their function is obscure but may be sensory. Also termed **basal communicating canals**.

Suborbital shelf: On the neurocranium, a horizontal plate arising on the ventral junction of the orbital wall and basal plate on each side which extends from the nasal capsule to the otic capsule; it forms the floor of the orbit. A well–developed suborbital shelf is apparently primitive for shark–like fishes but is variably telescoped, reduced or lost in many squalomorph sharks and a few galeomorphs.

Subterminal margin: In the caudal fin, the margin from the subterminal notch to the ventral beginning of the terminal margin.

Subterminal mouth or **ventral mouth:** Mouth located on the underside of the head, behind the snout. Also termed an **inferior mouth**, in reference to its ventral position but not its function. A **superior mouth** (not found in living cartilaginous fishes) is on the dorsal surface of the head.

Subterminal notch: On the caudal fin of most non–batoid sharks and at least one batoid, the notch in the lower distal end of the caudal fin, between the postventral and subterminal margins, and defining the anterior end of the terminal lobe.

Superficial ophthalmic nerve foramina: Foramina for the roots of the superficial ophthalmic nerves in the medial wall of the orbits, separate from the orbital fissure. These foramina are confluent with the orbital fissure in many sharks.

Supraorbital crest: On the neurocranium, an arched horizontal plate of cartilage forming the dorsal edge of the orbit on each side; it arises from the medial orbital wall and the cranial roof and extends horizontally from the preorbital process to the postorbital process. It is apparently primitive for shark–like fishes but is variably reduced or absent in some living elasmobranchs.

Supraorbital or **brow ridge:** A dermal ridge above each eye, particularly well–developed in heterodontoids and some orectoloboids.

Symphyseal or **symphysial groove:** A longitudinal groove on the ventral surface of the lower jaw of some orectoloboid sharks, extending posteriorly from the lower symphysis.

Symphysial teeth: Larger oral teeth in one row on either side of the symphysis, distal to medials or alternates where present. Symphysials are broader than medials and usually have asymmetrical roots.

Symphysis: The midline of the upper and lower jaws, where the paired jaw cartilages articulate with each other.

Syntype: Two or more specimens used and mentioned in an original description of a species, where there was no designation of a holotype or a holotype and paratype(s) by the describer of the species.

Systematics: Scientific study of the kinds and diversity of organisms, including relationships between them.

Tail: That part of a cartilaginous fish from the cloacal opening or vent (anus in chimaeroids, which lack a cloaca) to the tip of the caudal fin or caudal filament, and including the anal fin, usually the second dorsal fin when present, and caudal fin.

Taxon, plural taxa: A taxonomic group at any level in a classification. Thus the taxon Chondrichthyes is a class with two taxa as subclasses, Elasmobranchii and Holocephali, and the taxon ***Galeorhinus***, a genus, has one taxon as a species, ***G. galeus***.

Taxonomy: Often used as a synonym of systematics or classification, but narrowed by some researchers to the theoretical study of the principles of classification.

Temperate: Two circumglobal bands of moderate ocean temperatures usually ranging between 10° and 22 °C at the surface, but highly variable due to currents and upwelling: including the north temperate zone between the Tropic of Cancer, 23°27'N latitude, to the Arctic Circle, 66°30'N; and the south temperate zone between the Tropic of Capricorn, 23°27'S latitude, to the Antarctic Circle, 66°30'N.

Tenaculum: A unique reproductive organ found on adult male chimaera. The frontal tenaculum is located on the forehead and is curved with hook–like denticles and a knob at the end. The pelvic tenaculum is located just in front of the pelvic fins. All these structures are used during courtship and copulation in chimaeras.

Term foetus: See **foetus**.

Terminal 3 cartilage: A wedge–shaped or elongated cartilage articulating with the posterior edge of the ventral marginal cartilage and over the ventral terminal cartilages. It supports a variety of structures, including clasper spines and spurs, the shields of many skates (Rajoidei), and the mesorhipidion of some carcharhinoid sharks.

Terminal lobe: In the caudal fin of most non–batoid sharks and at least one batoid, the free rear wedge–shaped lobe at the tip of the caudal fin, extending from the subterminal notch to the posterior tip.

Terminal margin: In the caudal fin, the margin from the ventral end of the subterminal margin to the posterior tip.

Terminal mouth: Mouth located at the very front of the animal. Most cartilaginous fishes have subterminal mouths, but some species (viper sharks, wobbegongs, angel sharks, frilled sharks, whale sharks, megamouth sharks, and ***Manta***) have it terminal or nearly so.

Thorn: In many batoids, most angel sharks and the bramble shark (***Echinorhinus brucus***), enlarged, flat conical denticles with a sharp, erect crown and a flattened base (which may grow as the shark grows).

Tongue arch: See **hyoid arch**.

Transverse groove: In oral teeth, a deep groove transverse on the lingual root surface, transecting it into mesial and distal root lobes.

Transverse notch: In oral teeth, a distinct notch in the proximal labial edge of the root at about its midlength.

Transverse ridges: Small narrow ridges on the labial and lingual surfaces of the crown, apicobasally oriented and sometimes extending to the cusp edges.

Tribasal pectoral fin: A pectoral fin skeleton with three basal cartilages, the propterygium, mesopterygium, and metapterygium, primitively found in most euselachians including living neoselachians.

Trilobate lower lip: In advanced orectoloboids, shallow orolabial grooves divide the lower lips into a medial section and a pair of lateral sections.

Tropeic folds: Longitudinal paired ridges on the ventral midline of the abdomen in frilled sharks (Chlamydoselachidae).

Tropical: Circumglobal band of warm coastal and oceanic water, usually above 22°C at the surface (but varying because of currents and upwelling), between the latitudes of 23°27'North (Tropic of Cancer) and 23°27' South (Tropic of Capricorn) and including the Equator.

Truncate: Blunt, abbreviated.

Trunk: That part of a cartilaginous fish between its head

and tail, from the last gill openings to the vent, including the abdomen, back, pectoral and pelvic fins, and often the first dorsal fin.

Umbilical cord: A modified yolk stalk in placental viviparous sharks, carrying nutrients from the placenta to the foetus.

Unpaired fins: The dorsal, anal, and caudal fins.

Upper eyelid: The dorsal half of the eyelid, separated by a deep pocket (conjunctival fornix) from the eyeball. The upper eyelid fuses with the eyeball and the pocket is lost in all batoids.

Upper origin: In the caudal fin, the anterodorsal beginning of the epaxial or upper web of the caudal fin, at the posterior end of the dorso–caudal space (see measurement illustrations).

Upper postventral margin: In the caudal fin, the upper part of the postventral margin of the hypaxial web, from the posterior notch to the subterminal notch.

Uterine cannibalism or **cannibal viviparity:** A mode of reproduction in which foetuses deplete their yolk–sacs early and subsist by eating nutritive eggs produced by the mother (see **oophagy**) or first eat smaller siblings and then nutritive eggs (see **adelphophagy**).

Vent: The opening of the cloaca on the ventral surface of the body between the inner margins and at the level of the pelvic–fin insertions.

Ventral: Downward, in the vertical direction of the abdomen. See **dorsal**.

Ventral fin: See **pelvic fin**.

Ventral lobe: In the caudal fin, the expanded distal end of the preventral and lower postventral margins, defined by the posterior notch of the caudal fin.

Ventral margin: In the caudal fin, the entire ventral margin from lower origin to posterior tip, either a continuous margin or variably subdivided into preventral, postventral, subterminal and terminal margins.

Ventral marginal: In the clasper skeleton, a flat semicylindrical cartilage that is partially fused to the lateral edge of the axial cartilage, and forms the lateral wall of the clasper groove.

Ventral terminal: On the skeleton of the clasper glans, an often triangular, elongated, curved, plate–like cartilage that articulates or is attached to the lateral or ventrolateral edge of the end–style and to the posterior end of the ventral marginal cartilage.

Ventral tip: In the caudal fin, the ventral apex of the caudal fin where the preventral and postventral margins merge.

Vertebra, plural **vertebrae:** A single unit of the vertebral column, including a vertebral centrum and associated cartilages that form neural arches and ribs or haemal arches.

Vertebral axis: That part of the vertebral column inside the base of the caudal fin.

Vertebral column: The entire set or string of vertebrae or 'backbone' of a shark, from the rear of the chondrocranium to the end of the caudal base. Living elasmobranchs range from having as few as 35 vertebrae (some squaloids of the family Somniosidae) to as many as 477 vertebrae (thresher sharks).

Visceral arches: See **splanchnocranium**.

Viviparity: Used in two ways in recent literature, as being equivalent to **placental viviparity** only, that is for carcharhinoid sharks with a yolk–sac placenta; or for all forms of live–bearing or **aplacental viviparity**.

Web, fin: See **fin web**.

Yolk sac or **yolk sack:** Almost all sharks start embryonic development somewhat like a chicken, as a large spherical yolky egg inside an elongated shell, the egg case. A small disk of dividing cells represents the pre–embryo or blastula atop the huge yolk mass. The blastula expands around the sides and ventral surface of the yolk mass, and differentiates into an increasingly shark–like embryo, the yolk sac or bag–like structure containing the yolk, and a narrow tubular yolk stalk, between the abdomen of the embryo and the yolk sac.

Yolk stalk: The connecting passage between embryo or foetus and yolk sac, which allows yolk to pass from the sac into the embryonic gut.

Yolk–sac placenta: An organ in the uterus of some ground sharks (order Carcharhiniformes), formed from the embryonic yolk sac of the embryo and maternal uterine lining, through which maternal nutriment is passed to the embryo. It is analogous to the placenta of live–bearing mammals. There are several forms of yolk–sac placentas in carcharhinoid sharks, including entire, discoidal, globular, and columnar placentas (see Compagno, 1988).

Yolk–sac viviparity: Live–bearing in which the young are nourished primarily by the yolk in the yolk sacs, which is gradually depleted and the yolk sacs reabsorbed until the young are ready to be born.

2. SYSTEMATIC CATALOGUE – Subclass NEOSELACHII – Cohort SELACHII

2.1 Order HEXANCHIFORMES – Frilled and cow sharks

Order: Hexanchiformes Garman, 1913, *Mem. Mus. Comp. Zool. Harvard* 36: 10, 11 (emendation of order Plagiostoma, suborder Antacea, "group" Hexanchoidei Garman, 1913).

Number of Recognized Deep–sea Southeastern Pacific Ocean Families: 2.

Synonyms: Part 1 Squali, Abtheilung 3: Müller and Henle, 1839: 80. Ordo Plagiostomi, Subordo Squalini, Sectio Proktopterides, Tribus Mononotopterini: Bleeker, 1859: xii. Order Squali, suborder Squali: Gill, 1862: 394, 396. Order Squali, suborder Galei: Gill, 1872: 23. Order Plagiostomi diplospondyli, suborder (equivalent rank) Palaeonotidani: Hasse, 1879: 35, tab. 2. Order Selachophichthyoidi: Garman, 1884b: 116; Garman, 1884c: 484; Jordan, 1923: 97; Whitley, 1940: 68. Order Pternodonta: Gill, 1884: 524. Order Opistarthri: Garman, 1884c: 484; Gill, 1893: 129. Group Cladodonti Garman, 1885a: 30. Group Notidani Garman, 1885a: 30. Order Selachii, suborder Asterospondyli: Woodward, 1889: 157. Order Diplospondyli: Jordan and Evermann, 1896: 15, 16; Fowler, 1941: 4; Smith, 1949: 37, 38. Order Euselachii, suborder Pleurotremata, Division Notidanoidei: Regan, 1906a: 722. Order Selachii, Group 1, suborder Notidani Goodrich, 1909: 139. Order Pleurotremata, suborder Notidanoidei: Engelhardt, 1913: 97. Order Notidani, suborder Opistharthri: Jordan, 1923: 97. Order Plagiostomi, suborder Notidaniformes: Lozano y Rey, 1928: 280. Order Hexanchea, suborder Hexanchida, superfamily Hexanchoidea: White, 1936: 4; White, 1937: 36, tab. 1; Whitley, 1940: 68. Order Euselachii, suborder Notidaniformes: Bertin, 1939: 8. Order Hexanchiformes: Berg, 1940 (1947): 136; Berg and Svetovidov, 1955: 63; Arambourg and Bertin, 1958: 2025; Patterson, 1967: 670; Lindberg, 1971: 8, 256; Rass and Lindberg, 1971: 303; Applegate, 1974: 743; Nelson, 1976: 32; Chu and Meng, 1979: 114, tab. 2; Compagno, 1973: 26; Nelson, 1984: 49; Compagno, 1984a: 13; Pfeil, 1983: 24; Gubanov, Kondyurin and Myagkov, 1986: 3, 44; Cappetta, 1987: 26, 44; Eschmeyer, 1990: 435; Shirai, 1992: 122; Nelson, 1994: 53; de Carvalho, 1996: 55; Shirai, 1996: 33; Eschmeyer, 2012. Order Selachii, Suborder Notidanoidea: Romer, 1945: 576; Bigelow and Schroeder, 1948: 77. Order Selachii, suborder Chlamydoselachoidea: Bigelow and Schroeder, 1948: 77, 93. Order Hexanchoidei: Schultz and Stern, 1948: 224. Order Hexanchiformes, suborder Chlamydoselachoidei: Berg and Svetovidov, 1955: 63; Patterson, 1967: 670; Compagno, 1973: 26; Cappetta, 1987: 26, 44; de Carvalho, 1996: 55. Order Hexanchiformes, suborder Hexanchoidei: Berg and Svetovidov, 1955: 64; Patterson, 1967: 670; Compagno, 1973: 26; Cappetta, 1987: 26, 44; de Carvalho, 1996: 55. Order Lamnida, suborder Hexanchida: Matsubara, 1955: 1–789. Order Lamnida, suborder Chlamydoselachina: Matsubara, 1955: 1–789. Order Pleurotrema, suborder Notidanoidea: Norman, 1966: 6. Order Selachii, suborder Hexanchoidea: Romer, 1966: 350. Order Chlamydoselachida, suborder Chlamydoselachina: Fowler, 1967a: 91. Order Hexanchida, suborder Hexanchina: Fowler, 1967a: 83. Order Chlamydoselachida: Glikman, 1967: 213; Fowler, 1967a: 91. Order Hexanchida: Glikman, 1967: 214; Fowler, 1967a: 82. Order Hexanchida, suborder Hexanchoidei: Glikman, 1967: 214. Order Selachii: Blot, 1969: 702–776. Order Pleurotremata, suborder Hexanchiformes: Budker and Whitehead, 1971: 5, tab. 2. Order Chlamydoselachiformes: Fowler, 1947: 8; Rass and Lindberg, 1971: 303; Applegate, 1974: 743; Pfeil, 1983: 24; Shirai, 1992: 122; Shirai, 1996: 33. Order Hexanchiformes, suborder Chlamydoselachoidea: Chu and Meng, 1979: 114, tab. 2. Order Hexanchiformes, suborder Hexanchoidea: Chu and Meng, 1979: 114, tab. 2. Order Galeomorpha, suborder Hexanchoidea: Carroll, 1988: 599.

FAO Name: En – Frilled and cow sharks.

Field Marks: Sharks with six or seven pairs of gill openings, one spineless dorsal fin, and an anal fin.

Diagnostic Features: Head conical to slightly depressed, not expanded laterally. Snout very short to moderately long, truncated to conical, not greatly elongated or flattened, and without lateral teeth or rostral barbels. Eyes on sides of head, without nictitating lower eyelids, secondary lower eyelids, or subocular pouches; upper eyelids not fused to eyeball. Nostrils of the ordinary shark type, transverse on snout, without barbels, nasoral grooves or circumnarial grooves, separate from mouth, anterior nasal flaps short and not reaching mouth. Six or seven paired gill openings are present on sides of head, with the last gill opening in front of pectoral–fin origins. Spiracles present, very small, and well behind and above level of eyes. Mouth large, arched and elongated, extending well behind eyes. Labial furrows reduced but present on both jaws. Teeth weakly to strongly differentiated along the jaws, without enlarged anterior teeth or enlarged molariform posterior teeth and without a gap or small intermediate teeth between anterior and lateral teeth in the upper jaw. Tooth row counts 19 to 46 upper jaw, 19 to 38 lower jaw. Trunk cylindrical or somewhat compressed, but not flattened and ray–like. Caudal peduncle without lateral dermal ridges or keels. Dermal denticles covering entire body, with no enlarged thorns or spines. Pectoral fins small to moderately large, not expanded and ray–like, without triangular anterior lobes that cover the gill slits. Pelvic fins small to moderately large, with vent continuous with their inner margins. Claspers without siphons in the abdomen but with large clasper sacs. A single spineless dorsal fin present, with origin over or behind pelvic–fin insertions. Anal fin is present. Caudal fin with a long dorsal lobe and the ventral lobe short to absent. Vertebral counts: total vertebral counts 118 to 171, precaudal vertebral counts 54 to 102, monospondylous vertebral counts 18 to 75, diplospondylous vertebral counts 13 to 38, and caudal vertebral counts 50 to 82. Intestinal valve of spiral or ring type, with 14 to 49 turns. Moderate sized to very large sharks with adults 85 to 500 cm or more in length. **Colour:** variable depending on species from a silvery grey to reddish brown, olive grey, dark brown or black above, most species light below, but some (***Chlamydoselachus***) uniformly coloured; most species without prominent spotting (except ***Notorynchus***) or saddle markings; juvenile colour patterns of some species are quite striking with darker or lighter fin edges.

Distribution: Wide–ranging in all seas, but are only found inshore in temperate seas and in deep water in the tropics.

Habitat: These sharks occur in a wide range of marine habitats from shallow bays and estuaries (in some parts of the world), on the continental shelves down to the continental and insular slopes and on seamounts and submarine ridges, from close inshore to at least 2500 m; some deepwater species common down to 1100 m. These sharks do not penetrate into fresh water rivers and lakes but can be found in estuaries that fluctuate seasonally in salinity.

Biology: Reproductive mode is yolk–sac viviparity with litters ranging from 2 to at least 108. These are rare to common sharks where they occur that feed on a wide variety of cephalopods, crustaceans, bony fishes, other sharks, and batoid fishes, and with the largest members of this group, ***Hexanchus griseus*** and ***Notorynchus cepedianus*** also consuming marine mammals.

Interest to Fisheries and Human Impact: These sharks are relatively unimportant commercially, but are targeted by some shark fisheries and are regular bycatch components of other fisheries. They are incidentally caught in trawls, gillnets, and on long–line gear. Larger species may snap during capture, but are apparently docile when approached underwater. Ecotourism diving operations have sprung up in some areas, such as False Bay, South Africa, where the larger species are known to seasonally congregate.

The conservation status of the group varies by region from Data Deficient to Near Threatened depending on the species.

Local names: No information.

Remarks: The interrelationships of frilled and cow sharks were reassessed by Ebert and Compagno (In press) and built upon newer findings on hexanchoid morphology by Maisey and Wolfram (1984), Ebert (1990), Shirai (1992a, b, 1996), and de Carvalho (1996). These works, along with more recent molecular evidence (Naylor *et al*., 2005, 2012a, b), tend to support the chlamydoselachids and hexanchids as a monophyletic squalomorph group, united by several derived features of their skeletal and external morphology including details of their chondrocrania, branchial skeleton, pectoral and pelvic fin skeletons, clasper morphology, and external morphology. It also suggests that both chlamydoselachids and hexanchids are highly derived and ecomorphologically divergent, and that some of the 'primitive' features that they supposedly share with various palaeoselachian and protoselachian sharks may be convergent.

The present classification of the Hexanchiformes continues to rank the living taxa in a common order with two families, the Chlamydoselachidae and Hexanchidae, comprised of four genera and six species; both families, three genera and three deep–sea species occur in the southeastern Pacific Ocean. The relatively shallow occurring ***Notorynchus cepedianus***, although very common along the western coast of South America is not discussed further here.

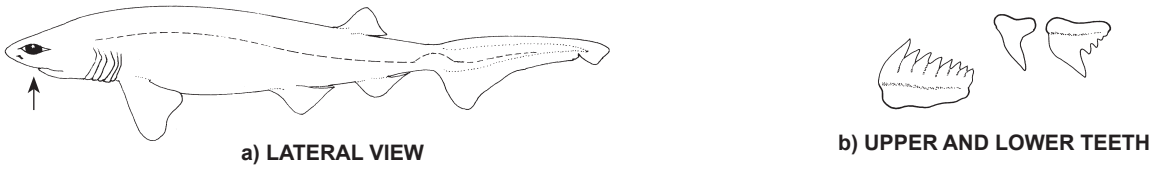
Key to Deep–sea Southeastern Pacific Ocean Families:

1a. Body elongated and eel–like. Head snakelike, with short snout and terminal mouth (Fig. 32a). Teeth tricuspidate in both jaws (Fig. 32b) . . . . . **family Chlamydoselachidae**

a) LATERAL VIEW b) UPPER AND LOWER TOOTH

Fig. 32 Chlamydoselachidae

1b. Body moderately stout and not eel–like. Head not snakelike, with moderate snout and subterminal mouth (Fig. 33a). Teeth cuspidate in upper jaw and compressed and comb–like in lower jaw (Fig. 33b) . . . . . **family Hexanchidae**



a) LATERAL VIEW b) UPPER AND LOWER TEETH

Fig. 33 Hexanchidae

2.1.1 Family CHLAMYDOSELACHIDAE

Family: Chlamydoselachidae Garman, 1884a, *Bull. Essex Inst*., 16: 52 (p. 8 in separate).

Type genus: ***Chlamydoselachus*** Garman, 1884a.

Number of Recognized Deep–sea Southeastern Pacific Ocean Genera: 1.

Synonyms: Family Chlamidoselachidae Cervigón, 1960: 40. Erroneous spelling of Chlamydoselachidae Garman, 1884a.

FAO Names: En – Frilled sharks; **Fr** – Requins à collerette; **Sp** – Tiburones anguila.

Field Marks: See genus ***Chlamydoselachus***.

Diagnostic Features: Elongated eel–shaped sharks with the head flattened and subtrapezoidal in dorsoventral outline. A pair of longitudinal keels or tropeic folds is present on the ventral surface of the abdomen. A prominent horizontal subocular groove above the upper lip extends below the nostrils and eyes to the cheek. Snout extremely short, its tip nearly transverse and truncated. Eyes are well behind symphyses of mouth. Interbranchial septa greatly enlarged and frilly, ventral edges of those of first gill openings attached across the throat as a gular flap; gill raker papillae absent from gill arches. Nostrils are about opposite of jaw symphyses. Lateral trunk denticles with spike–like crowns; enlarged and monocuspidate denticles along the mouth edges. Mouth terminal, teeth and mouth edges exposed when mouth is closed. Upper lip not expanded below the level of tooth bases to form a prominent flange and groove; lower lip not expanded anteriorly and laterally to the teeth series; no deep groove between lower lip and teeth. Tongue prominent and with a deep sublingual groove separating it from the dental membrane. Labial cartilages complete (two pairs of uppers and one pair of lowers). Teeth are alike in both jaws, with three cusps and two cusplets on crown, and with flat, low lingually bilobate roots; no small granular posterior teeth. Total tooth counts 19 to 30 upper jaw, 21 to 29 lower jaw. Pectoral fins rounded and smaller than pelvic fins. Pelvic fins with broadly rounded anterior margins and apices, inner margin not forming an expanded clasper sheath in males. Dorsal fin very low, rounded, and elongated, insertion just behind upper caudal–fin origin. Anal fin is broad–based and rounded, larger than dorsal fin; anal–fin insertion ending at the lower caudal–fin origin. Caudal peduncle is very short and compressed. Caudal fin with a vestigial subterminal notch; ventral caudal–fin lobe is essentially absent. Vertebral counts: total vertebral counts 147 to 171, precaudal vertebral counts 93 to 102, monospondylous vertebral counts 18 to 75, diplospondylous precaudal vertebral counts 21 to 76, and caudal vertebral counts 52 to 78. Intestinal spiral valve turn counts 26 to 49. These are moderately large sharks, with adults up to 196 cm total length. **Colour:** a uniform dark chocolate brown, brownish grey or brownish black without any dark or light banding or mottled colour patterns.

Distribution: The family Chlamydoselachidae has a patchy, but almost circumglobal range with most records of this family from the western Pacific, southern Africa, and the eastern North Atlantic including the Mid–Atlantic Ridge.

Habitat: Frilled sharks are benthic, epibenthic, and occasionally epipelagic, and are often in association with continents, islands, submarine canyons, peaks and ridges. They appear to be most common in boreal, temperate and subtropical seas.

Biology: Reproductive mode is viviparous with a yolk sac, and litters of up to 12. The reproductive cycle may be either two years or possibly up to three and a half years. Nothing is known about the age and growth of these sharks. The diet consists mainly of cephalopods, teleosts, and elasmobranchs, especially members of the families Squalidae and Scyliorhinidae.

Interest to Fisheries and Human Impact: There are no targeted fisheries for these sharks since they are relatively uncommon in most areas where they occur and their flesh is of little value. They are likely caught on occasion as bycatch, but are most likely discarded.

The conservation status of ***Chlamydoselachus anguineus*** is Near Threatened globally due to concerns over expansion of deep–sea fisheries, especially in the western North Pacific, while ***C. africana*** has been assessed as Data Deficient. These sharks are in general poorly known due to a lack of life history data and information on population trends.

Local names: No information.

Remarks: A single genus, ***Chlamydoselachus***.

Literature: Garman (1884a, b, c, d); Ebert (1990, 2013, 2015); Ebert and Compagno (2009); Ebert, Fowler and Compagno (2013); Ebert and Stehmann (2013).

List of Deep–sea Species Occurring in the Area:

Chlamydoselachus anguineus Garman, 1884

Chlamydoselachus Garman, 1884

Genus: ***Chlamydoselachus*** Garman, 1884a, *Bull. Essex Inst*., 16: 47, 52 (pp. 8, 13 in separate).

Type species: ***Chlamydoselachus anguineus*** Garman, 1884a, by monotypy.

Number of Recognized Deep–sea Southeastern Pacific Ocean Species: 1.

Synonyms: Genus ***Chlamydoselache*** Günther, 1887: 2. Emendation of ***Chlamydoselachus*** Garman, 1884a, and hence taking the same type species, ***Chlamydoselachus anguineus*** Garman, 1884a. Genus ***Chlamydoselachoides*** Fowler, 1947: 8. Type species: ***Chlamydoselachus lawleyi*** Davis, 1887 by original designation; Pliocene of Tuscany, Italy. Synonymized with ***Chlamydoselachus*** by Pfeil (1983) and Cappetta (1987), which is followed here. Genus ***Chlamidoselachus*** Cervigón, 1960: 36, 39–42. Consistent erroneous spelling of ***Chlamydoselachus*** Garman, 1884a (cited six times as such).

Field Marks: Eel–like sharks with 6 gill slits, terminal mouth with tricuspid teeth in both jaws, and one dorsal fin.

Diagnostic Features: See family.

Local names: No information.

Remarks: Living frilled sharks had long been considered a single wide–ranging species, ***Chlamydoselachus anguineus*** Garman, 1884, but Ebert (1990) compared frilled sharks from a wide geographic range and suggested that the morphological variability of this species may represent an additional species within the genus. Further comparisons and examination of frilled sharks taken from off Angola and Namibia with Pacific specimens from Australia, California (USA), Japan, New Zealand, and Taiwan (Province of China), and from the North Atlantic revealed differences in morphometrics, size at maturity, chondrocranial morphology, vertebral counts, vertebral morphology and calcification patterns, pectoral–fin skeletal morphology and radial counts, and intestinal valve counts that led Ebert and Compagno (2009) to separate the African frilled shark (***C. africana***) into a distinctly different species.

Southeastern Pacific Ocean records of frilled sharks (***Chlamydoselachus* spp.**) are patchy, and as such specimens should be carefully examined to determine the specific species involved. The frilled shark (***C. anguineus***) is known from the eastern Pacific from a single record off southern California, and a single record from off northern Chile, but there are various anecdotal accounts of frilled sharks being caught off southern California and in the Gulf of California.

Chlamydoselachus anguineus Garman, 1884

Chlamydoselachus anguineus Garman, 1884a, *Bull. Essex Inst*., 16: 47 (p. 3 in separate), fig. Holotype, Museum of Comparative Zoology, Harvard University, MCZ–800–S, female, probably adult, ca. 151 cm (59.5") TL with caudal tip missing, from "Japanese seas" (probably southeastern Honshu), now in pieces (Ebert, 1990; Hartel and Dingerkus, *in* Garman, 1997, The Plagiostoma: xxxvii).

Synonyms: ***Chlamydoselache anguinea*** Günther, 1887: 2 (emended spelling).

FAO Names: En – Frilled shark; **Fr** – Requin lézard; **Sp** – Tiburón anguila.

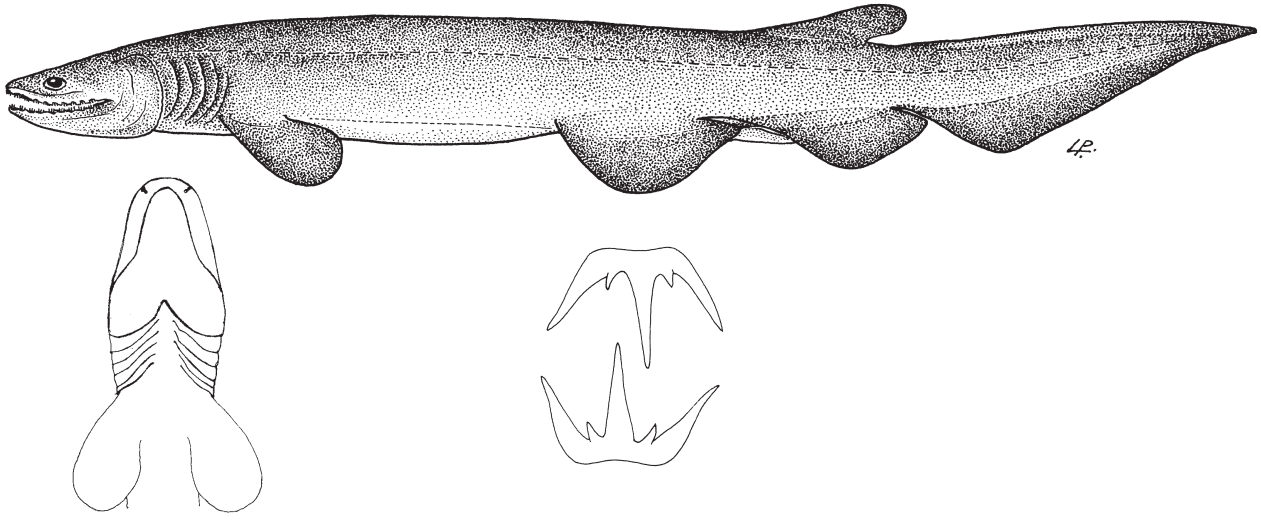


Fig. 34 ***Chlamydoselachus anguineus***

Field Marks: Eel–like shark with 6 gill slits, snakelike terminal mouth with tricuspid teeth in both jaws, and one dorsal fin. Colour uniform brown with dark brown fins and prominent lighter lateral line.

Diagnostic Features: Body long, slender, eel–like, compressed behind the pelvic fins. Pectoral–pelvic space elongated 26.4 to 31.0% total length. Head broad, flattened, wider than high, slightly convex; head length 13.1 to 16.2% total length. Preoral snout length 0.1 times mouth width. Snout tip broadly rounded. Nostrils lateral, width 6.3 to 7.9 in internarial width. Eyes large, rounded, length approximately 10.1 times in head length. Spiracle present or absent. Height of gill openings descending in length; first gill opening extends across throat. Mouth broadly rounded, large, distensible. Teeth are similar in both upper and lower jaws, each tooth with three long, slender, smooth–edged cusps, and a small pointed cusplet between each cusp; upper medial teeth paired, form similar to anterolateral teeth, but noticeably reduced; lower jaw with a single medial tooth row undifferentiated from anterolaterals; teeth on upper and lower jaws are curved inwards and set on a broad base that projects behind and interlocks with the tooth base posterior to it; tooth count is 19 to 28 upper jaw, 21 to 29 lower jaw. Lateral trunk denticles lanceolate, single cusped, with flattened bases; crown slightly projected above the body with four longitudinal ridges extending from the base to the cusp; denticle crowns widely spaced. Pectoral fins are broad, rounded and low on body; pectoral–fin length 7.6 to 8.6% total length; pectoral fins smaller than pelvic fins; pectoral–fin origin is posterior to sixth gill opening. Pelvic fins large and broadly rounded; anterior and posterior margins convex. Anal fin very large, broadly rounded, its height is 1.5 to 2.0 times dorsal–fin height, base length 1.2 to 1.6 in dorsal–fin base; anterior and posterior fin margins are rounded and convex; an acute angle forms at the tip of the posterior and inner margins. Dorsal fin is set far back, about 54.3 to 65.0% total length from snout tip; anterior margin is rounded and convex with posterior margin. Caudal fin elongated, subtriangular, and without a subterminal lobe; length of dorsal margin 2.5 times in precaudal length. Vertebral counts: total vertebral counts 160 to 171, precaudal vertebral counts 93 to 102, monospondylous vertebral counts 72 to 75, diplospondylous vertebral counts 21 to 27. Spiral valve turns 35 to 49. A large species, adults up to 196 cm total length. **Colour:** dark chocolate brown, brownish grey or brownish black.

Distribution: Southeastern Pacific: a single record from Chile (37°03'S, 73°31'W). In the eastern central Pacific, a single confirmed record and various anecdotal accounts from off southern California. Elsewhere, wide ranging but patchily distributed.

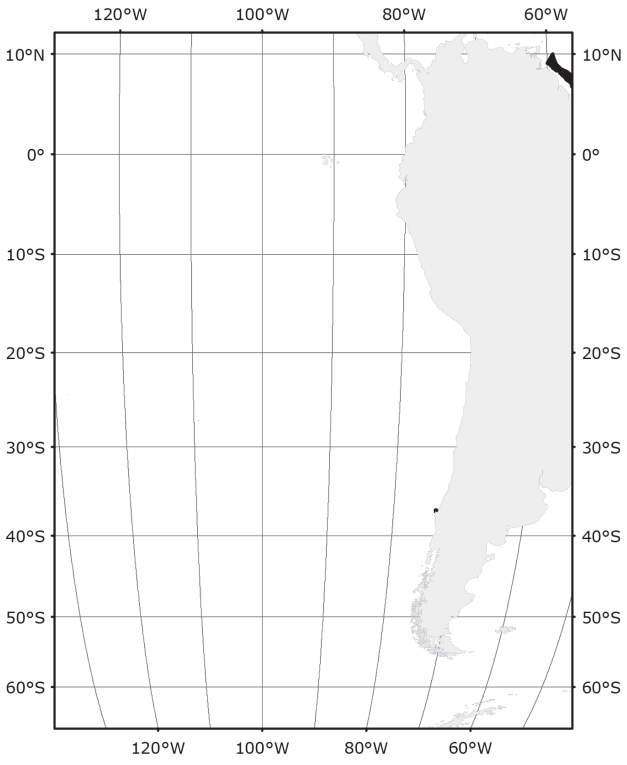


Fig. 35 ***Chlamydoselachus anguineus***

Known distribution

Habitat: This species is extremely rare in the eastern Pacific, and nothing is known about its habitat. Elsewhere, this is a rare to locally common benthic, epibenthic, and occasionally pelagic species on offshore continental and insular shelves, upper slopes, seamounts, and along mid–ocean ridges at depths between 20 and 1500 m. Usually caught near the bottom, individuals are known to migrate into the water column, venturing at least 1500 m, or more, off the bottom and into the midwater. In Suruga Bay, Honshu, Japan, these sharks are regularly caught in pelagic trawls and in bottom gillnets at 51 to 300 m. A remote operated vehicle videotaped a frilled shark swimming a couple meters off the bottom off North Carolina, U.S.A.

Biology: Yolk–sac viviparous, with the number of young ranging from 2 to 15 per litter, six being the average. Very little is known about its reproductive cycle or life history. Kukuev and Pavlov (2008), based on the catch of 34 frilled sharks in a single bottom trawl tow, suggested that seamounts along the Mid–Atlantic Ridge were areas where mating activity occurred. In Japanese waters this species appears to reproduce year–round with mating thought to occur from March to June. The gestation period is probably very long, on the order of one to two years, by extrapolating the observed growth rate of early embryos artificially kept alive for up to 3 months. Tanaka *et al.* (1990) suggested that the total gestation period maybe up to 3.5 years. Uterine eggs are enormous, about 11 to 12 cm in diameter, and greatly distend the abdomens of gravid females.

The needle–sharp, slender–cusped teeth of this shark suggest feeding on deepwater cephalopods and bottom fishes. The only diet study with a reasonable sample size (n = 139) of frilled sharks was in Japanese waters where squids were found to be the dominant prey item, occurring in about 61% of the stomachs examined compared to 11% with fish remains (Kubota, Shiobara and Kubodera, 1991). Examination of frilled shark diet from the North Atlantic and elsewhere reveals them to have consumed mostly smaller sharks, mainly squaloids and scyliorhinids (Ebert, 1990, 2003; D.A. Ebert, pers. obs.).

The long mouth of the frilled shark can accommodate relatively large prey, and their snakelike head and firm, muscular bodies suggest that they may be able to slowly approach faster swimming epipelagic prey and make a sudden snakelike lunge to snag a potential prey item with their relatively strong, tooth–studded jaws. The mouth of a frilled shark bears a functional resemblance to a squid jig, with many needle–sharp, inward and diagonally–directed curved points on its teeth which is enhanced by the outward rotation of the tooth rows when the jaws are protruded. Even a glancing strike by a shark on a cephalopod or other soft–bodied prey could readily snag it.

Live frilled sharks have been photographed swimming in captivity with mouth agape and with lighter coloured tooth bands highlighted against the darker coloured mouth. Whether this serves to lure prey items such as squids and fishes to within striking distance is speculative at present. Also, a frilled shark caught on video by a remotely operated vehicle (ROV) showed it to take flight quite rapidly as the ROV approached. There are no known predators of these sharks, but one can assume that larger sharks may on occasion consume them.

Size: Maximum total length 196 cm; males adult at approximately 118 cm to 163 cm; females maturing at 130 to 150 cm and reaching 196 cm. Size at birth about 39 to 60 cm. The single known southeastern Pacific specimen from off Chile was a female measuring 141 cm total length.

Interest to Fisheries and Human Impact: This species may be taken as bycatch on occasion, but it is of no importance in southeastern Pacific Ocean fisheries. Elsewhere, this species if taken as bycatch and not discarded is utilized for meat or fishmeal. It has occasionally been kept in aquaria in Japan. A harmless species, the needle–sharp teeth can hook and cut the hands of the unwary scientist examining its mouth.

The conservation status of this species is Near Threatened due to concerns over expansion of deepwater fisheries that may increase bycatch levels.

Local names: No information.

Literature: Garman (1884a, b, c, d, 1885, 1913); Gudger and Smith (1933); Armada (1977); Ebert (1990, 2003, 2013); Tanaka *et al.* (1990); Kubota, Shiobara and Kubodera (1991); Sedberry, Meister and Loefer (2007); Kukuev and Pavlov (2008); Ebert and Compagno (2009); Last and Stevens (2009); Barnett *et al.* (2012); Ebert, Fowler, and Compagno (2013); Ebert and Stehmann (2013); Bustamante, Vargas-Caro, and Bennett (2014); D.A. Ebert (unpubl. data).

2.1.2 Family HEXANCHIDAE

Family: Tribe Hexanchina Gray, 1851 (family Squalidae), *List Fish British Mus., Pt. 1, Chondropterygii, British Mus. (Nat. Hist.)*: 67, London.

Type genus: ***Hexanchus*** Rafinesque, 1810.

Number of Recognized Deep–sea Southeastern Pacific Ocean Genera: 2.

Synonyms: Subfamily Notidanini Bonaparte, 1838 (family Squalidae): 130. Type subgenus: ***Notidanus*** Cuvier, 1816, a junior synonym of ***Hexanchus*** Rafinesque, 1810. Family Notidanidae Owen, 1846: 51. Type subgenus: ***Notidanus*** Cuvier, 1816, a junior synonym of ***Hexanchus*** Rafinesque, 1810. Family Notidanoidae Gill, 1862: 404. Type subgenus: ***Notidanus*** Cuvier, 1816, a junior synonym of ***Hexanchus*** Rafinesque, 1810. Family Hexanchidae Gill, 1884: 618. Also subfamily Hexanchinae (family Hexanchidae) Fowler, 1947: 8. Type genus: ***Hexanchus*** Rafinesque, 1810. Family Heptranchidae Garman, 1913: 2. Type genus: ***Heptranchias*** Rafinesque, 1810. Family Hexeptranchidae Garman, 1913: 2, 14. Inadmissible since based on a combination of two type genera, ***Hexanchus*** Rafinesque, 1810 and ***Heptranchias*** Rafinesque, 1810. Family Heptranchidae Barnard, 1925: 20. Type genus: ***Heptranchias*** Rafinesque, 1810. Family Heptranchiidae McCulloch, 1929: 3. Subfamily Heptranchiinae (family Hexanchidae) Fowler, 1947: 8. Type genus: ***Heptranchias*** Rafinesque, 1810. Family Notorynchidae Shirai, 1992: 122. Type genus: ***Notorynchus*** Ayres, 1855.

FAO Names: En – Cow sharks; **Fr** – Requins grises; **Sp** – Cañabotas.

Field Marks: Moderately slender to stocky sharks with a subterminal mouth, large compressed comb–like teeth in the lower jaw, smaller cuspidate teeth in upper jaw, 6 or 7 pairs of gill openings, one spineless dorsal fin, and an anal fin.

Diagnostic Features: Moderately elongated to stout sharks with the head flattened and conical in dorsoventral outline. No subocular groove on head. Snout moderately long; snout tip pointed to broadly rounded. Eyes about opposite to symphyses of mouth. Interbranchial septa moderately enlarged, without a gular flap connecting the first gill openings; gill raker papillae present on gill arches. Nostrils positioned well anterior to jaw symphyses. Mouth subterminal. Teeth and mouth edges concealed when mouth is closed. Upper lip expanded below the level of tooth bases to form a prominent flange and groove that extends posteriorly to the mouth angle and labial furrows; lower lip expanded anterior and lateral to the teeth series and separated from them by a deep groove. Labial cartilages are incomplete with one pair on the upper jaw only. Teeth dissimilar

in upper and lower jaws, with lower anterolateral teeth much larger, compressed, comb–shaped, and with more cusplets than uppers; small granular posterior teeth present. Tooth counts 23 to 46 upper jaw, 15 to 38 lower jaw. No longitudinal keels on the abdomen. Caudal peduncle is moderately long and cylindrical. Enlarged and cuspidate denticles weakly developed or absent from the mouth edges. Pectoral fins angular, larger than pelvic fins. Pelvic fins with nearly straight anterior margins and narrowly rounded apices, inner margins expanded into broad clasper sheaths in males. Dorsal fin relatively high, angular, and short, insertion well anterior to upper caudal–fin origin by dorsal–fin base length or more. Anal fin is narrow–based and angular, insertion ending well anterior to the lower caudal–fin origin. Caudal fin with a well–developed subterminal notch and a ventral caudal–fin lobe weak to moderately developed. Vertebral counts: total vertebral counts 118 to 159, precaudal vertebral counts 72 to 94, monospondylous vertebral counts 41 to 58, diplospondylous vertebral counts 13 to 38, caudal vertebral counts 50 to 82. Spiral valve turns 14 to 39. These sharks range in size from small to very large, with various species between 140 to 500 cm and more in maximum total length. **Colour:** uniform olive to dark grey, black or brown above, lighter to white below; some species with scattered small spots on the dorsal surface, others without any spotting.

Distribution: Worldwide in boreal and cold temperate to tropical seas.

Habitat: Most cow shark species are deepwater inhabitants of the outer continental shelves, upper continental slopes, insular shelves and slopes, and submarine canyons down to at least 2500 m depth, near the bottom or well above it. Some species also occur in shallow bays, close inshore, and near the surface.

Biology: Reproduction is yolk–sac viviparity with some species having relatively large litters of 13 to at least 108. The reproductive cycle, although poorly known, is annual or biannual for those species where some information is available. These are sluggish to active, strong swimming sharks usually occurring near the bottom. They feed on a wide variety of relatively large marine organisms, including crustaceans and cephalopods, bony fishes, other sharks, rays, marine mammals including seals and dolphins, and carrion (including mammalian meat).

Interest to Fisheries and Human Impact: Cow sharks are relatively unimportant commercially but are regular components of shark fisheries and bycatch of other fisheries in temperate and tropical waters, and are usually taken by line gear, bottom and pelagic trawls, and gill nets. These sharks are excellent for human food and are utilized fresh and dried–salted; they are also processed for fishmeal, oil, and leather. Some species are subject to sports fisheries in inshore temperate waters.

Cow sharks may snap when captured and can inflict lacerations if carelessly handled; the two larger species (***Hexanchus griseus*** and ***Notorynchus cepedianus***) have been confirmed as biting divers in the sea. Diving with ***N. cepedianus*** and ***H. griseus*** in the sea has become a popular ecotourism attraction in some areas, especially in False Bay, Southern Africa. Although the paucity of confirmed attacks by cow sharks biting people suggests that they are often docile and inquisitive in their reactions to humans, large cow sharks should be treated with respect as with other big macropredatory sharks.

The conservation status of this family is poorly known. The smaller deep–sea species are little–known but potentially vulnerable to demersal trawl and longline fisheries. The larger species have been the subject of localized fisheries from various geographic regions throughout the world. All of these targeted fisheries quickly ended when these species were subsequently overfished.

Local names: Tiburones de 6 y 7 agallas (Peru).

Remarks: Three living genera are currently recognized, ***Heptranchias***, ***Hexanchus***, and ***Notorynchus***, of which two (***Heptranchias*** and ***Hexanchus***) occur in the deep–sea. The monotypic genus ***Notorynchus*** is mostly a coastal species, often occurring in bays and estuaries, and along the open coast usually at less than 200 m depth. This species will not be discussed here further.

Literature: Garman (1913); Bigelow and Schroeder (1948); Springer and Waller (1969); Garrick and Paul (1971); Compagno (1984a); Ebert (1990, 2013, 2015); Shirai (1992a,b, 1996); de Carvalho (1996); Barnett *et al.* (2012); Ebert and Stehmann (2013); Ebert, Fowler and Compagno (2013).

List of Deep–sea Species Occurring in the Area:

Heptranchias perlo (Bonnaterre, 1788)
Hexanchus griseus (Bonnaterre, 1788)

Key to Deep–sea Southeastern Pacific Ocean Genera:

1a. Six pairs of gill openings (Fig. 36) . . . . . ***Hexanchus***

1b. Seven pairs of gill openings (Fig. 37) . . . . . ***Heptranchias***

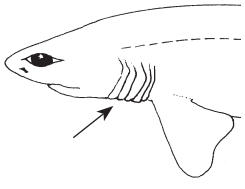


Fig. 36 ***Hexanchus***

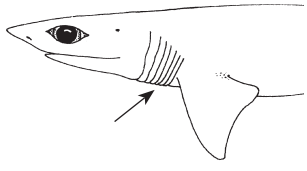


Fig. 37 ***Heptranchias***

Heptranchias Rafinesque, 1810

Genus: ***Heptranchias*** Rafinesque, 1810, *Caratt. gen. sp. animal. piant. Sicilia,* pt. 1: 13.

Type species: "***Squalus cinereus*** Lacépède" by original designation, equals ***S. cinereus*** Gmelin, *in* Linnaeus and Gmelin, 1789 and a junior synonym of ***Squalus perlo*** Bonnaterre, 1788.

Number of Recognized Deep–sea Southeastern Pacific Ocean Species: 1.

Synonyms: Genus ***Heptanchus*** Müller and Henle, 1837a: 115; Müller and Henle, 1837b: 398; Müller and Henle, 1838a: 88; Müller and Henle, 1838b: 64 (two species, but names not mentioned); Müller and Henle, 1839: 81. Type species not designated, two species named, ***H. cinereus*** "Raf." (Rafinesque, = ***Squalus cinereus*** Gmelin, 1789, a junior synonym of ***S. perlo*** Bonnaterre, 1788) and ***H. indicus*** Müller and Henle, 1839 (= ***Notidanus indicus*** Agassiz, 1835, usually ascribed to the genus ***Notorynchus***). Genus ***Heptancus*** Agassiz, 1846: 178; Agassiz, 1848: 514 (emended spelling of ***Heptanchus*** "Rafinesque" and ***Heptranchias*** Rafinesque, 1810, cited as such); Jordan and Gilbert, 1883: 34. Genus ***Heptranchus*** Gray, 1851: 6 (emended spelling). Genus ***Heptrancus*** Costa, 1857: 5 (29) (emended spelling). Type species, ***Heptrancus angio*** Costa, 1857, by monotypy? Genus ***Heptabranchias*** Garman, 1885b (in part): 537, 538; Garman, 1888: 58, 67, 68, 72, 82, pl. 14. Possible emendation of ***Heptranchias*** Rafinesque, 1810, and ***Heptanchus*** Müller and Henle, 1837a. No type species indicated.

Diagnostic Features: Head acutely pointed in dorsoventral view, compressed and rounded or vertically oval in section at eyes level. Eyes large. Seven paired gill openings. Mouth very narrow and angular–parabolic. Five rows of lower comb–shaped anterolateral teeth on each side; these long and low, with a few short mesial cusplets, and an abruptly high cusp, up to 7 or 8 distal cusplets in adults that increase and then decrease in size distal to cusp; total tooth counts including smaller posteriorlateral teeth 23 to 43 upper jaw, 20 to 33 lower jaw. Caudal peduncle elongated. Lateral line canal closed. Clasper apopyle dorsal, clasper groove and hypopyle dorsolateral; hypopyle without a lateral flap on its dorsal edge; clasper sack small, not pleated, not expanded far onto dorsomedial surface of clasper, and without a large dorsal fold; clasper with three enlarged mucous glands with corrugated surfaces along the clasper groove, a dorsal gland near the apopyle, a ventral gland on midlength of clasper, and a terminal gland at the clasper tip; clasper shaft large and stout. Vertebral counts: total vertebral counts 141 to 159, precaudal vertebral counts 72 to 94, monospondylous vertebral counts 51 to 58, diplospondylous vertebral counts 28 to 38, caudal vertebral counts 60 to 67. Intestinal valve count ranges from 18 to 22. Maximum total length 139 cm. **Colour:** uniform pale grey to olive above, lighter to white below; spots absent from body, dorsal fin and upper caudal–fin lobe with black tips, faded or absent in adults but prominent in young.

Local names: No information.

Remarks: Following Garrick and Paul (1971), Ebert (1990, 2013), Ebert and Stehmann (2013), and Ebert, Fowler and Compagno (2013) only a single wide–ranging species is recognized for this genus, ***Heptranchias perlo*** (Bonnaterre, 1788). Earlier references (Bigelow and Schroeder, 1948; Whitley, 1931) to other regional species within this genus prove to be related to sexual dimorphism in the position of the anal fin (more posterior in males than in females) relative to the dorsal fin (Garrick and Paul, 1971; Ebert, 1990).

Heptranchias perlo (Bonnaterre, 1788)

Squalus perlo Bonnaterre, 1788, *Tabl. encyclop. method. trois reg. Nat., Ichthyol., Paris*: 10. Holotype unknown. Type locality: "La Méditerranée", = Mediterranean Sea.

Synonyms: ***Squalus cinereus*** Gmelin, *in* Linnaeus and Gmelin, 1789: 1497. Holotype unknown. Type locality "in Mari Mediterraneo", = Mediterranean Sea. ***Squalus cinereus*** Walbaum, 1792: 517. No locality, independently proposed from ***S. cinereus*** Gmelin, 1789 and possibly not conspecific or confamilial according to Eschmeyer (2013). ***Heptrancus angio*** Costa, 1857: 5, pl. 13, 14, fig. 3. Existence of types uncertain. Type locality, Mediterranean Sea. ***Notidanus (Heptanchus) cinereus***, var. ***pristiurus*** (var. ***aetatis***) Bellotti, 1878: 60. Syntypes: Two, whereabouts unknown according to Eschmeyer (2013). Type locality, Mediterranean Sea. ***Heptranchias deani*** Jordan and Starks, 1901: 384. Holotype, Stanford University, Division of Systematic Biology, SU–12620, 954 mm TL adult (?) female, Misaki, Japan. ***Heptranchias dakini*** Whitley, 1931: 310. New name for ***Heptranchias perlo*** of McCulloch, 1911: 2, pl. 1, fig.1. Holotype as designated by Whitley is the female specimen figured by McCulloch, 1911, approximately 69 cm TL, one of seven specimens from off Cape Everard, southeastern Australia, in 110–128 m depth. This is possibly Australian Museum, Sydney, AMS I.10825 according to Paxton *et al.* (1989: 26) and Eschmeyer (2013), approximately 97 km South of Cape Everard, Victoria. Two other specimens (AMS I.10794–95) in the series are considered paratypes by Eschmeyer (2013).

Other Combinations: ***Heptanchus perlo*** (Bonnaterre, 1788), ***Heptanchus*** or ***Heptranchias cinereus*** (Gmelin, 1789).

FAO Names: En – Sharpnose sevengill shark; **Fr** – Requin perlon; **Sp** – Cañabota bocadulce.

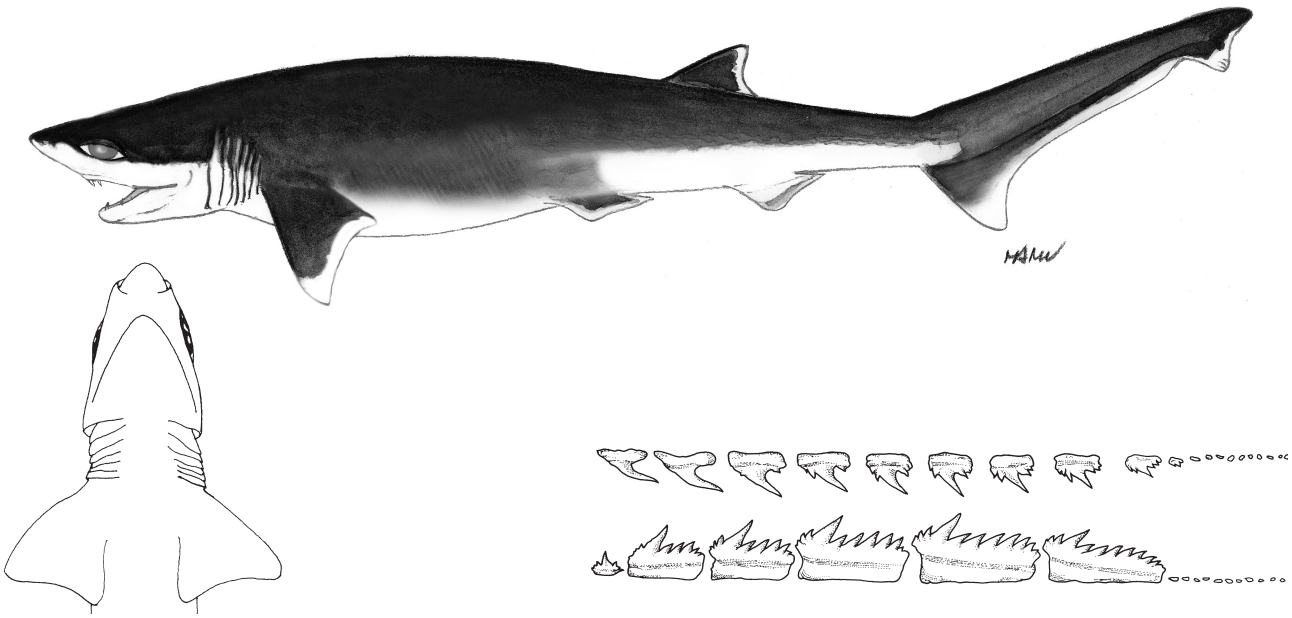


Fig. 38 ***Heptranchias perlo***

Field Marks: A narrow–headed, big–eyed, small seven–gilled shark with one dorsal fin, no dark spots, and a black blotch on the dorsal fin (inconspicuous in large individuals).

Diagnostic Features: See genus ***Heptranchias***.

Distribution: Southeastern Pacific Ocean: Peru and possibly northern Chile, but records from the latter location require confirmation. Elsewhere wide–ranging but somewhat patchily distributed, the sharpnose sevengill shark is found in most tropical and warm temperate seas.

Habitat: A primarily deepwater benthic and epibenthic species on the continental and insular shelves and upper slopes. Possibly moving well off the bottom but details little known. Depth mostly between 27 to 720 m, but usually below 100 m and down to 1000 m, although sometimes in shallower water close inshore.

Biology: Yolk–sac viviparous, with 6 to 20 young per litter. Although common in some regions, nothing is known about its reproductive biology, except in the Mediterranean Sea and off Japan where these sharks seem to be reproductively active throughout the entire year.

Their diet includes crustaceans, mostly shrimps, crabs, lobsters, and cephalopods including squid (Ommastrephidae and Loliginidae) and cuttlefish (Sepiidae), and a wide variety of small to moderately large demersal and pelagic bony fishes, including lanternfishes (Myctophidae), lightfishes (Phosichthyidae), cods (Gadidae), lings (Phycidae), hake (Merlucciidae), grenadiers (Macrouridae), roughies (Trachichthyidae), hairtails (Trichiuridae), jack mackerels (***Trachurus,*** Carangidae), scorpionfish (Scorpaenidae), flatfish (Citharidae), dragonets (Callionymidae), and small elasmobranchs including catsharks (Scyliorhinidae), lanternsharks (***Etmopterus,*** Etmopteridae), smaller hexanchids (including other ***Heptranchias perlo***), and skates (Rajidae).

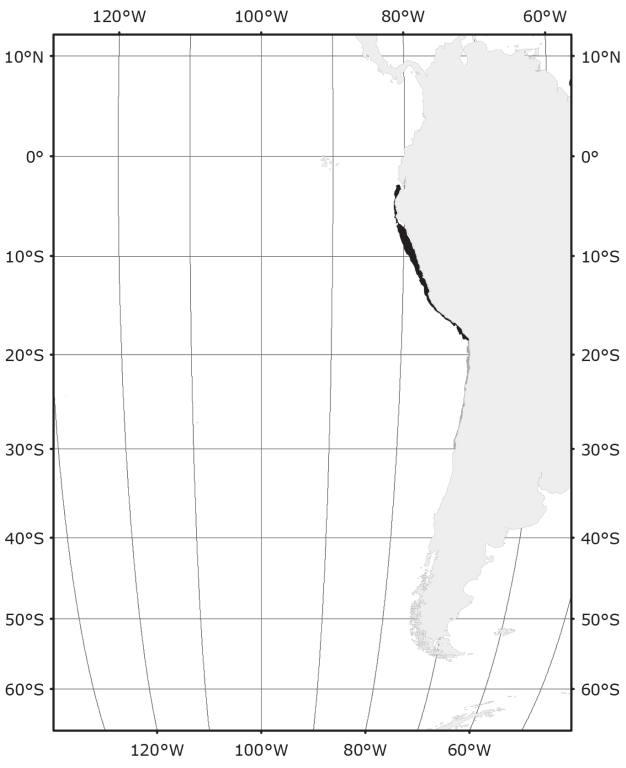


Fig. 39 ***Heptranchias perlo***

The presence of pelagic bony fishes, cephalopods and crustaceans in their diet suggest that these sharks are feeding well off the bottom (Ebert, 1990). The narrow jaws and prominent narrow needle–sharp cusps and cusplets on the teeth of these sharks suggest that they are well equipped for grabbing, holding and swallowing small, soft–bodied prey, but less capable of dismembering large–bodied tough prey than ***Hexanchus griseus***.

Size: Maximum total length 139 cm; reports of it reaching a total length of 214 cm or over 300 cm in literature (see Bigelow and Schroeder, 1948) are most likely erroneous. Size at maturity varies slightly by region, but generally males adolescent between 70 and 78 cm, adult at 75 to 107 cm; females adolescent between 89 and 98 cm, but adult at 97 cm and larger. Size at birth is about 26 to 27 cm.

Interest to Fisheries and Human Impact: Of no importance commercially in the southeastern Pacific Ocean, records of this species are rare and require confirmation. Elsewhere, they may be taken as a bycatch of deepwater fisheries utilizing bottom trawls or bottom longlines. Used for human consumption, said to be good eating, and presumably for fishmeal. There is no data available on current and past catches, although species–specific catch data is desirable.

Although this shark is very active and will snap vigorously when captured there are no records of it having attacked divers. Its deepwater habitat likely precludes it from coming into contact with divers. It has been maintained occasionally in captivity at public aquariums in Japan.

Conservation status is considered Near Threatened due to suspected declines that may have occurred in places such as southern Mozambique, Taiwan (Province of China), and portions of the Mediterranean Sea where deepwater demersal trawl fisheries for shrimp and bony fishes have been operational over the past few decades. There is no information available for the southeastern Pacific population of this species.

Local Names: Tiburón de 7 agallas (Peru).

Literature: Tanaka and Mizue (1977a, b); Capapé (1980); Ebert (1990, 2013, 2015); Frentzel–Beyme and Köster (2002); Paul and Fowler (2003); Braccini (2008); Barnett *et al.* (2012); Ebert, Fowler and Compagno (2013); Ebert and Stehmann (2013); Bustamante, Vargas-Caro, and Bennett (2014); Cornejo *et al.* (2015); D.A. Ebert (unpubl. data).

Hexanchus Rafinesque, 1810

Genus: ***Hexanchus*** Rafinesque, 1810, *Caratt. gen. sp. anim. piant. Sicilia, Palermo*, pt. 1: 14.

Type species: "***Squalus griseus*** Lacépède", by original designation, a junior synonym of ***Squalus griseus*** Bonnaterre, 1788.

Number of Recognized Deep–sea Southeastern Pacific Ocean Species: 1.

Synonyms: Subgenus ***Monopterhinus*** Blainville, 1816 (Genus ***Squalus*** Linnaeus, 1758): 121. Type species: ***Squalus griseus*** Blainville, 1816, by subsequent designation of Jordan and Evermann, 1917: 95. Subgenus ***Notidanus*** Cuvier, 1816 (Genus ***Squalus*** Linnaeus, 1758): 128. Type species, ***Squalus griseus*** Bonnaterre, 1788, by subsequent designation of Jordan and Evermann, 1917: 97. Genus ***Hexanchias*** Swainson, 1838: 148 (emended or erroneous spelling of ***Hexanchus*** Rafinesque, 1810). Genus ***Holodus*** Agassiz, 1845: 3; Agassiz, 1846: 183; Agassiz, 1848: 529. Attributed by Agassiz, 1845 to "Msc. Coll." and indicated as "= ***Notidanus***". Apparently a manuscript name without description, but a valid junior synonym of ***Notidanus*** Cuvier, 1816 and a senior homonym of the lungfish genus ***Holodus*** Pander, 1858 according to Jordan (1923: 97) and White and Moy–Thomas (1940: 101). Genus ***Notidamus*** Münster, 1842: 66 (erroneous or emended spelling of ***Notidanus*** Cuvier, 1816). Genus ***Hexancus*** Agassiz, 1846: 181; Agassiz, 1848: 522 (emended spelling of ***Hexanchus*** Rafinesque, 1810).

Diagnostic Features: Head narrowly or broadly parabolic in dorsoventral view, depressed and transversely oval in section at eyes. Eyes small to large. Six paired gill openings. Mouth moderately wide to very wide and parabolic or arcuate. Five or 6 rows of lower comb–shaped anterolateral teeth on each side, these long and low in adults but higher in young; mesial edge smooth in young but with serrations in adults; a low to moderately high cusp, 8 to 10 distal cusplets present in adults that decrease in size distal to the cusp; total tooth counts including smaller posteriorlateral teeth 25 to 46 upper jaw, 15 to 38 lower jaw. Caudal peduncle is short to elongated. Lateral line canal closed. Clasper apopyle ventral, clasper groove ventral, hypopyle ventrolateral; hypopyle with a large triangular lateral flap on its dorsal edge; clasper sack greatly enlarged and baglike, pleated, expanded far onto dorsomedial surface of clasper and outside clasper sheath, and with a large dorsal fold; clasper without mucous glands; clasper shaft slender. Vertebral counts: total vertebral counts 118 to 155, precaudal vertebral counts 67 to 87, monospondylous vertebral counts 41 to 57, diplospondylous vertebral counts 18 to 30, caudal vertebral counts 50 to 77. Intestinal valve counts 22 to 39. Maximum size depending on the species can be either about 180 or up to 500 cm or more in length. **Colour:** body without spots or irregular brown spots; no black tips on fins.

Local names: No information.

Remarks: Following Springer and Waller (1969), Ebert (1990, 2013), Barnett *et al.* (2012), Ebert and Stehmann (2013), Ebert, Fowler and Compagno (2013), and Ebert and Compagno (In press), two living species are presently recognized here for this genus, ***Hexanchus griseus*** (Bonnaterre, 1788) and ***H. nakamurai*** Teng, 1962 (senior synonym of ***H. vitulus*** Springer and Waller, 1969). However, a recent molecular study (Naylor *et al*., 2012a) suggested that two species of the latter species might indeed exist; an Atlantic form (?***H. vitulus***) and an Indian Ocean form (?***H. nakamurai***). The issue is currently under investigation (Ebert, White, and Ho, 2013) by the present author (D.A. Ebert, unpubl. data). The smaller sixigill shark (***H. nakamurai***) is not known to occur in the southeastern Pacific Ocean region. The larger sixgill shark species (***H. griseus***) appears to be a single wide–ranging species (Ebert, 2013, 2015; Ebert, Fowler and Compagno, 2013).

Hexanchus griseus (Bonnaterre, 1788)

Squalus griseus Bonnaterre, 1788*, Tabl. encyclop. method. trois reg. Nat., Ichthyol., Paris:* 9. Types unknown according to Boeseman *in* Hureau and Monod (1973, *CLOFNAM. Check–list. fish. NE Atlantic Mediterranean,* 1: 9). Type locality: "La Méditerranée", = Mediterranean Sea.

Synonyms: ***Hexanchus griseus australis*** de Buen, 1960: 8. Holotype: EBMC 10365. Type locality: Off Valparaiso, Chile.

FAO Names: En – Bluntnose sixgill shark; **Fr** – Requin griset; **Sp** – Cañabota gris.

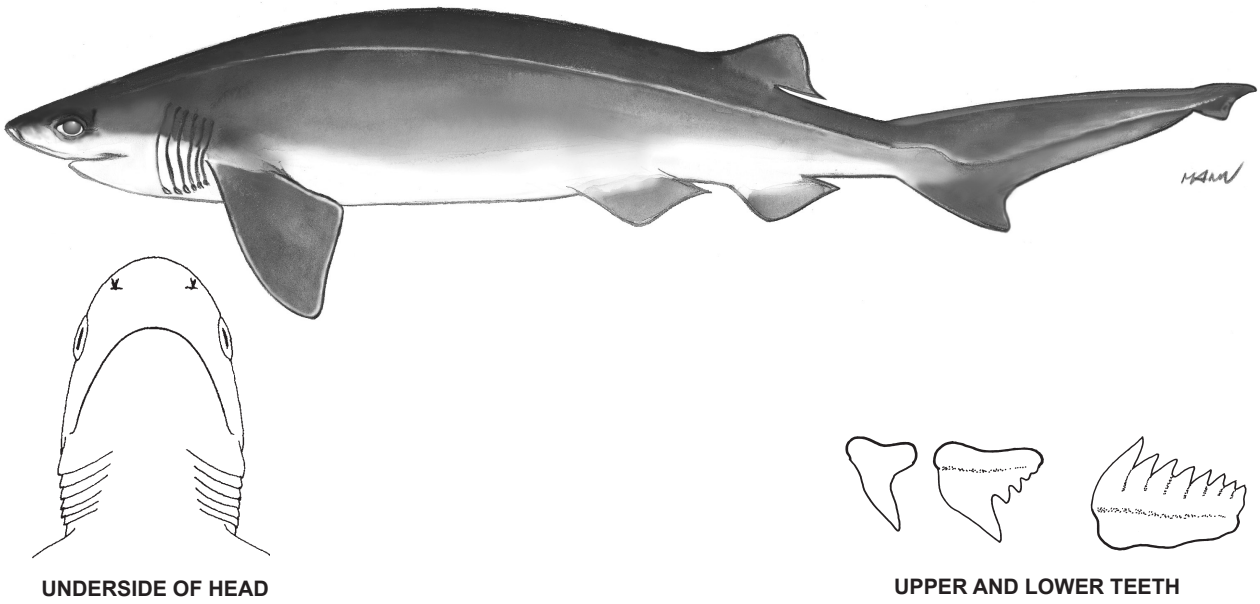


Fig. 40 ***Hexanchus griseus***

Field Marks: A heavy–bodied, broad–headed sixgill shark with a ventral mouth with 6 rows of lower bladelike, comb–shaped teeth on each side, one dorsal fin, a dark pupil prominently ringed with white, colour grey or tan to blackish with a conspicuous lighter lateral line and sometimes with darker spots on the sides and underside often lighter than the dorsal surface in newborn young but more uniform in larger juveniles and adults.

Diagnostic Features: Head broadly parabolic or bluntly pointed in dorsoventral view. Snout bluntly rounded to rounded–angular in dorsoventral view, preoral length short and 4.3 to 5.4% of total length. Eyes small. Mouth very broad with width over 2 times mouth length. Upper jaw and dental arcade is a rounded v–shape in ventral view. Six rows, usually, of lower comb–shaped anterolateral teeth; total tooth counts, including smaller posterior lateral teeth 26 to 46 upper jaw, 19 to 38 lower jaw. Body rather stout, body and fins very soft and supple. Caudal peduncle is short and stout. Pectoral fins broadly triangular. Ventral caudal–fin lobe poorly developed at all stages, postventral margin weakly concave to straight and not subdivided. Vertebral counts: total vertebral counts 118 to 148, monospondylous precaudal vertebral counts 41 to 52, diplospondylous vertebral counts 18 to 30, precaudal vertebral counts 67 to 77, and caudal vertebral counts 50 to 77. Intestinal valve counts 35 to 39. A giant shark, with a maximum length of at least 482 cm. **Colour:** body not sharply bicoloured (except in some neonatal animals), either dark above and below or with underside somewhat lighter than dorsal surface; fins with light posterior margins but not abruptly white (except in some neonates).

Distribution: Southeastern Pacific Ocean: Colombia to Chile. Elsewhere, a wide-ranging, common large deep-sea shark species, it occurs in boreal, temperate and tropical seas, possibly absent in the Arctic and Antarctic oceans.

Habitat: This is a mostly deepwater benthic and pelagic shark of the continental and insular shelves and slopes and

off seamounts and underwater ridges, found close to and well off the bottom. It occurs at the surface in the tropics and close inshore near beaches, at the heads of submarine canyons, and in bays in cold temperate waters, but extending down to at least 2500 m on the upper continental slope. It may show equatorial submergence in the tropics as with some other deepwater sharks, and may not normally penetrate warm tropical inshore waters although it has been known to rise to the surface offshore in response to fishing operations.

Young are often found close inshore, occasionally in enclosed bays; adults, especially males are often in deeper water below 200 m in temperate areas, although adults and sub adults will enter shallow water in open and enclosed bays with adjacent deepwater canyons. These sharks are often associated with areas of upwelling and high biological productivity. Hydrographic data variously taken in areas where bluntnose sixgill sharks occur reveals a bottom temperature of 6.1 to 10.0 °C in waters with high nutrient levels.

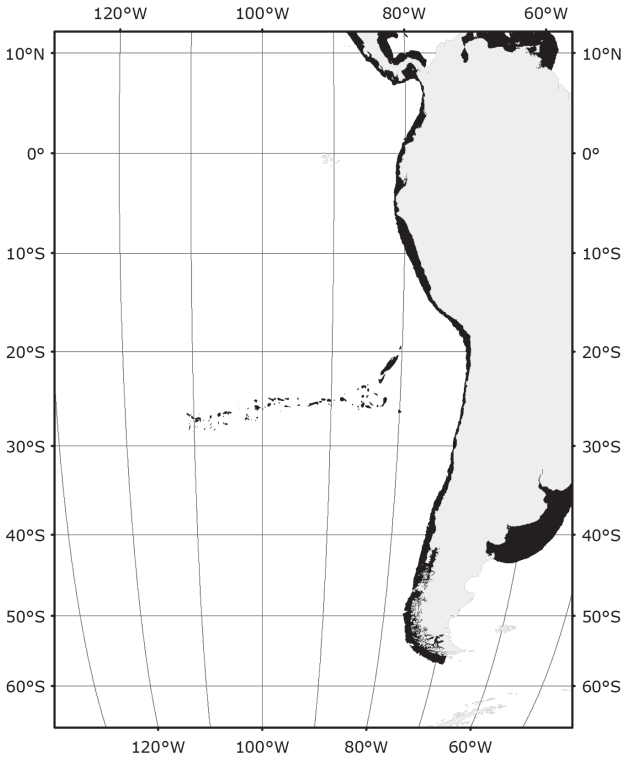


Fig. 41 ***Hexanchus griseus***

Known distribution

Biology: Yolk–sac viviparous, with litters very large, 47 to 108. Reproductive cycle poorly defined, but may be biannual with females having a 12 month resting phase followed by a 12 month gestation period. Pupping grounds occur on the upper slopes and outer continental shelves. Furthermore, Ebert (1990, 1994, 2002, 2003) suggested that this shark segregates over its life cycle with neonates living near the bottom on the upper slopes, outer shelves, and in high latitude nearshore areas where the continental shelf is relatively narrow to the continental landmass. Neonates and younger bluntnose sixgills feed largely on cephalopods and teleosts, but with growth in size, larger individuals move into deeper water and feed on a wide range of benthic and pelagic marine vertebrates and cephalopods. This species may be long–lived but it has yet to be aged. A study by McFarlane, King and Saunders (2002) found bands on the neural arches of these sharks, but were unable to determine if they were related to age.

The bluntnose sixgill shark is a voracious feeder consuming a wide range of marine organisms, but principally cephalopods and marine vertebrates, with cartilaginous fishes, bony fishes, marine mammals and cephalopods being the most important prey categories. It eats other cartilaginous fishes including catsharks (Scyliorhinidae), spurdogs (***Squalus***, Squalidae), houndsharks (Triakidae), skates (Rajidae), elephantfish (Callorhinchidae), hooked conspecifics (which it attacks and sometimes follows up to the surface from deep water); demersal and pelagic bony fish including anchovies (Engraulidae), sardines and round herrings (Clupeidae), lanternfish (Myctophidae), hake (Merlucciidae), cod and ling (Gadidae), grenadiers (Macrouridae), mackerel (Scombridae), snoek (***Thyrsites***, Gempylidae), swordfish (Xiphiidae), marlins (Istiophoridae), dolphinfishes (Coryphaenidae), flounders (Pleuronectidae), gurnards (Triglidae) and anglers (Lophiidae); marine mammals including unspecified seals (probably phocids), and dolphins (Delphinidae); carrion; gastropods, squids (Ommastrephidae and Loliginidae), crabs, and shrimps.

The diet of bluntnose sixgill sharks changes with growth as those below 120 cm feed primarily on cephalopods and secondarily on bony fishes, with very little chondrichthyan prey evident, while those 120 to 200 cm long feed primarily on cephalopods, bony fishes and chondrichthyans with small marine mammals comprising a small component. Large sixgills, those above 200 cm, feed primarily on marine mammals (South African fur seals and cetaceans) and large pelagic teleosts, with smaller components of cartilaginous fishes and cephalopods (Ebert, 1994). An indication of the voracious dietary nature of these sharks was demonstrated by an electric ray (***Torpedo cowleyi***) that had the distinct scars of an immature ***Hexanchus griseus***, estimated at about 100 cm in length, but apparently was able to fend off the attacking predator by discharging an electric shock to halt the attack. A larger bluntnose sixgill likely would have been more successful. Sixgills apparently feed on the bottom and well above it, and may be able to take large active prey such as eared seals, cetaceans, and large pelagic bony fishes by stealthy stalking them. This is an infrequently taken bycatch species on pelagic longlines where these sharks are often caught hundreds of meters off the bottom.

Bluntnose sixgill sharks in some areas exhibit both seasonal and diurnal activity with these sharks appearing in high concentrations during summer months, but disappearing during the rest of the year. When present, these sharks appear to respond to environmental signals whereby they move onto relatively shallow reefs during the afternoon, but retreat later in the day. The wide bathymetric and geographic range of the species, the large size of adults, its ability to prey on pelagic organisms, and its scattered occurrence off seamounts and oceanic islands and well away from the bottom suggest that it may be capable of long–distance migration in the open ocean.

Larger captive individuals become greatly disturbed at even moderately high light levels, indicating a great sensitivity to light at very low levels, while those attracted to baits near submersibles either did not react or gave a minor to violent response when the lights were turned on. Smaller individuals in public aquaria appear to adapt better to artificial light with some individuals having been maintained for nearly a year. Large individuals offer little resistance when captured, but small ones may snap and thrash vigorously when boated.

The bluntnose sixgill shark has been observed both singly and in groups, and will readily attack conspecifics especially if injured, however very little else is known of their social behaviour.

Size: Maximum total length at least 482 cm and probably to about 550 cm (large, possibly gravid female sighted from a submersible). Males immature up to 281 cm, adolescent at 273 to 308 cm, mature at 309 to 330 cm and possibly reaching about 430 cm; females immature up to 320 cm, possibly adolescent or newly mature at 350 to 420 cm, mature at 421 cm, and reaching about 550 cm. Size at birth about 61 to 74 cm.

Interest to Fisheries and Human Impact: Bluntnose sixgill sharks are typically taken by line gear, gillnets, traps and pelagic and bottom trawls and utilized fresh, frozen, and dried and salted for human consumption, and for fishmeal and oil. These sharks are largely caught as a bycatch of other fisheries.

The global conservation status of the bluntnose sixgill shark is listed as Near Threatened. Although the species is taken in small numbers regionally, mostly as retained bycatch in other fisheries, there is inadequate population and fisheries data to show declines in its population. There is no regional conservation assessment for this species in the southeastern Pacific.

Local Names: Tiburón de 6 agallas (Peru); Gato de mar, Peje humo, Tiburón, Tollo–fume, Peje gato (Chile).

Remarks: The bluntnose sixgill shark is one of the most common and wide–ranging shark species worldwide, ranking alongside the picked or spiny dogfish (***Squalus acanthias***) and blue shark (***Prionace glauca***).

De Buen (1960) described ***Hexanchus griseus australis*** from the eastern South Pacific as a subspecies, and recognized two additional subspecies, the eastern North Pacific ***H. g. corinus*** and the typical ***H. g. griseus*** from the Atlantic Ocean. De Buen (1960) suggested that ***H. g. corinus*** differed from Atlantic ***H. g. griseus*** in having fewer (6, versus 7 to 9) “cuspides” (cusp + cusplets), but this does not hold, as the number of cusplets increases with size from 6 to 9 in specimens of North Pacific ***H. griseus*** and does likewise for southern African specimens (Ebert, 1990). Furthermore, De Buen’s (1960) description of his ***H. g. australis*** indicated that this subspecies differed from typical ***H. g. griseus*** in having only 5 rows of large, comb-like anterolateral teeth on each side of the lower symphysis and a more elongated, more prominent ventral caudal–fin lobe. ***Hexanchus griseus*** normally has 6 rows of comb-like lower anterior teeth on each side and a weakly developed ventral caudal–fin lobe. ***Hexanchus nakamurai*** also differs from typical ***H. griseus*** in having a stronger, more narrowly angular ventral caudal–fin lobe and only 5 rows of comb-like lower anterolateral teeth, but other descriptive information and measurements in De Buen (1960) indicate that ***H. griseus australis*** has fin and body proportions and lower teeth that are otherwise similar to typical ***H. griseus*** rather than ***H. nakamurai***. Ebert (1990) examined ***Hexanchus*** material from the type location in Chile where ***H. g. australis*** was collected, but could find no differences between it and ***H. griseus***; the holotype of ***H. g. australis*** is apparently lost.

Nominal regional names all appear to be referable to ***Hexanchus griseus*** based on the study by Ebert (1990) who examined available type material and collected morphological and meristic data from most geographic regions where this shark is known to occur.

Literature: de Buen (1960); Springer and Waller (1969); Ebert (1984, 1986a, b, 1990, 1994, 2002, 2003, 2013, 2015); McFarlane, King and Saunders (2002); Mejia-Falla *et al.* (2007); Barnett *et al.* (2012); Ebert, Fowler and Compagno (2013); Ebert and Stehmann (2013); Bustamante, Vargas-Caro, and Bennett (2014); Cornejo *et al.* (2015); D.A. Ebert (unpubl. data).

2.2 Order ECHINORHINIFORMES – Bramble sharks

Order: Echinorhiniformes: Pfeil, 1983, *Palaeo Ichthyologica*, 1: 24

Number of Recognized Deep–sea Southeastern Pacific Ocean Families: 1.

Synonyms: Order Plagiostomata, suborder Selachoidei Squatiniformes, suborder Echinorhinoidei: Günther, 1870: 428; Woodward, 1889: 30; Regan, 1906a; 723; Goodrich, 1909; 151; Engelhardt, 1913; 100; Bigelow and Schroeder, 1957: 134; Norman, 1966: 24; Glikman, 1967: 215; Nelson, 1976: 38; Nelson, 1984: 56; Nelson, 2006: 65; de Carvalho, 1996: 33. Order Squalida, suborder Squalina, superfamily Echinorhinicae: Fowler, 1969a: 73. Order Squaliformes, suborder Echinorhinoidea: Chu and Meng, 1979: 114, tab. 2. Order Echinorhiniformes: Pfeil, 1983: 24; Shirai, 1992: 122; de Carvalho, 1996: 55; Shirai, 1996: 33.

FAO Names: En – Bramble sharks; **Fr** – Squales boucles; **Sp** – Tiburones espinosos.

Field Marks: Moderately large, cylindrical, heavy–bodied sharks with a short–snout, flattened head, five paired lateral gill openings, two small, spineless, posteriorly set dorsal fins, the first behind the pelvic–fin origins, a short–tail and no anal fin; body covered with coarse spiky denticles or enlarged tack–like thorns.

Diagnostic Features: Head broad and flat. Snout flat and broadly rounded in dorsoventral view. Spiracles very small and far behind eyes. Fifth gill opening much larger than first four. Nostrils wide–spaced with internarial width much greater than nostril width; nostrils with a small, simple anterior nasal flap. Mouth broadly arched, elongated, with thin, non–papillose lips. Labial furrows short, not encircling mouth, confined to mouth corners and falling well behind level of eyes, not elongated posteriorly into postoral grooves or anteriorly into preoral grooves. Labial folds thin and not papillose. Teeth with dignathic heterodonty, poorly developed, upper teeth about as large as lowers. Teeth of both jaws compressed, low–crowned, broad, bladelike, and forming a saw–like cutting edge, not arranged in a quincunx pattern but forming a single flat non–imbricated series in either jaw. Teeth with an oblique compressed, sharp–edged cusp (smooth–edged, undulated or serrated); one to three (usually two) pairs of mesial and distal cusplets on anterolateral teeth of adults (absent mesially and distally replaced by a blade in posterior teeth) but cusplets absent in young which have undivided mesial edges and distal blades on most teeth. Total tooth row counts 18 to 28 upper jaw, 18 to 27 lower jaw. Trunk broad and cylindrical with a circular cross section. Abdomen with weak lateral ridges. Interdorsal space very short and less than half the length of first dorsal–fin base. Pelvic–caudal space very short and less than half length of pelvic–fin bases. Caudal peduncle compressed, very short, and without lateral keels and precaudal pits. Body without photophores. Denticles large to enormous, sessile and not pedicellate. Denticle crowns flattened and leaf–shaped, but with a median cusp. Pectoral fins low, broadly rounded–angular and not falcate or leaf–shaped, anterior margins moderately large and about equal to or somewhat smaller than the prespiracular length, rear tips rounded and not elongated. Pelvic fins about as large or slightly larger than pectoral fins, over twice area of dorsal fins. Claspers with a lateral spine only. Dorsal fins rounded–angular, not falcate, and without spines. First dorsal fin very small, with length less than prespiracular length. First dorsal–fin base over the pelvic–fin bases and origin behind the pelvic–fin origins. Second dorsal fin about as large as first dorsal fin, base mostly behind pelvic–fin bases with origin over to slightly anterior or posterior to pelvic–fin insertions. Caudal fin moderately heterocercal, with ventral lobe poorly developed in adults, but absent in young and with subterminal notch absent or barely indicated. Vertebral counts: total vertebral counts 86 to 102, monospondylous vertebral counts 50 to 59, precaudal vertebral counts 58 to 62. Intestinal valve with 8 to 16 turns. Adults from 150 cm to over 400 cm total length. **Colour:** light grey to blackish, plain or mottled, without black photophore markings on tail.

Distribution: Circumglobal, although patchily distributed in temperate to tropical seas of the Atlantic, Indian, and Pacific oceans.

Habitat: Bramble sharks are found on the continental and insular shelves and upper slopes, at the heads of submarine canyons, down to at least 1100 m, and on or near soft bottom substrate. They move up submarine canyons into shallow water and in cold–temperate areas with strong upwelling. They appear to occupy a similar habitat to sleeper sharks (***Somniosus***) and the bluntnose sixgill shark (***Hexanchus griseus***).

Biology: The biology of bramble sharks is sketchily known. They exhibit yolk–sac viviparity in their reproductive mode, but little else is known about their reproductive cycle. Bramble sharks are large, soft–bodied and sluggish, but are formidable bottom predators that reach a maximum size of 310 to 450 cm. They feed on a variety of benthic and neritic bony fishes, other sharks, chimaeroids, as well as crabs and cephalopods. They have a moderately large mouth, a very large and long pharynx, and are believed to suck in their prey by suddenly expanding their mouths and pharynxes.

Interest to Fisheries and Human Impact: Bramble sharks attain a large size (326 to 450 cm), and are uncommon to rare in most areas where they occur; hence they are of minimal interest to fisheries. They generally occur as a sporadic and largely unutilized bycatch of other fisheries, including those for other sharks, although targeted fisheries for bramble sharks have occurred off of southwestern India and Namibia. They are taken by longline gear, deepset gillnets, and bottom trawls. No world or local fisheries records are available for these sharks.

The conservation status is poorly known, but depending on the species is Data Deficient or Near Threatened.

Local names: No information.

Remarks: The family Echinorhinidae and genus ***Echinorhinus*** is divergent from all other squaloids and has been placed in its own separate order (Echinorhiniformes) by some authors (Pfeil, 1983; Shirai, 1992, 1996; de Carvalho, 1996; Nelson, 2006) or separate suborder (Echinorhinoidei) by others (Günther, 1870; Woodward, 1889; Regan, 1906a; Goodrich, 1909; Engelhardt, 1913; Bigelow and Schroeder, 1957; Nelson, 1976, 1984, 2006; de Carvalho, 1996) with the remaining families being placed in the suborder Squaloidei as their probable primitive sister group. Molecular studies have tended to support the separation of the bramble sharks as a separate order, and to be a sister taxon to a clade consisting of the Pristiophoriformes and Squatiniformes (Naylor *et al.*, 2012a, b). The order Echinorhiniformes is recognized here, and consists of a single family and genus, with at least two recognized species; a possible third species in the genus is currently under investigation (Henderson *et al.*, 2016).

2.2.1 Family ECHINORHINIDAE

Family: Echinorhinoidae Gill, 1862, *Ann. Lyceum Nat. Hist. New York*, 7(32): 406.

Type genus: ***Echinorhinus*** Blainville, 1816. Emended to family Echinorhinidae by Gill, 1893, *Natn. Acad. Sci. USA, Mem.* 6, 6: 129.

Number of Recognized Deep–sea Southeastern Pacific Ocean Genera: 1.

Synonyms: None.

FAO Names: En – Bramble sharks; **Fr** – Squales boucles; **Sp** – Tiburones espinosos.

Field Marks: See order account above.

Diagnostic Features: See order account above.

Distribution: This family includes two large, inshore to deepwater species with a patchy but virtually circumglobal distribution in cold temperate to tropical seas.

Habitat: See order account above.

Biology: See order account above.

Interest to Fisheries and Human Impact: See order account above.

Local names: No information.

Remarks: This family has a single living genus ***Echinorhinus*** with two valid species, although recent molecular evidence suggests that a third species may occur in the northern Indian Ocean.

Literature: Garman (1913); Bigelow and Schroeder (1948, 1957); Garrick (1960a); Compagno (1984a); Shirai (1992, 1996); Ebert (2003, 2013, 2015); Naylor *et al.* (2012a, b); Ebert and Stehmann (2013); Ebert, Fowler and Compagno (2013); Henderson *et al.* (2016).

List of Deep–sea Species Occurring in the Area:

Echinorhinus cookei (Pietschmann, 1928)

Echinorhinus Blainville, 1816

Genus: Subgenus ***Echinorhinus*** Blainville, 1816, *Bull. Sci. Soc. Philomat. Paris*, (8): 121 (genus ***Squalus*** Linnaeus, 1758).

Type species: "***Spinosus***" = ***Squalus spinosus*** Gmelin, *in* Linnaeus and Gmelin, 1788, by monotypy.

Number of Recognized Deep–sea Southeastern Pacific Ocean Species: 1.

Synonyms: Genus ***Goniodus*** Agassiz, 1835: Pl. E, fig. 13. Genus name only, with illustration of entire tooth set. *Ibid.*, 1838, 94. Apparently proposed as a replacement name for ***Echinorhinus*** Blainville, 1816, as this name was mentioned as being equivalent to ***Goniodus***. No type designation, but the only species mentioned was "***Sq. spinosus*** Schn." (= ***Squalus spinosus*** Gmelin, *in* Linnaeus and Gmelin, 1788) as the type of ***Echinorhinus***. *Ibid.*, 1843, *Tab. Mat.*: 12. Type species: "***Squalus spinosus*** de Blainville", by original designation, = ***Squalus spinosus*** Gmelin, *in* Linnaeus and Gmelin, 1788. Genus ***Echinorrhinus*** (Blainville) Müller and Henle, 1837a: 116; Müller and Henle, 1837b: 399. Probable emendation of or error for ***Echinorhinus*** Blainville, 1816. Müller and Henle (1838b: 65; 1839: 96) reverted to Blainville's original spelling. Genus ***Echinarrhinus*** (Blainville) Müller and Henle, 1838a: 89. Probable error for ***Echinorrhinus*** Müller and Henle, 1837a. Subgenus ***Rubusqualus*** Whitley, 1931: 311 (genus ***Echinorhinus*** Blainville, 1816). Type species: ***Echinorhinus (Rubusqualus) mccoyi*** Whitley, 1931, by original designation. Genus ***Echynorhynus*** Nobre, 1935: 410. Apparent error for ***Echinorhinus*** Blainville, 1816.

Field Marks: See order account above.

Diagnostic Features: See order account above.

Local Names: See order account above.

Echinorhinus cookei Pietschmann, 1928

Echinorhinus cookei Pietschmann, 1928, *Anz. Akad. Wiss. Wien*, 27: 297; also separately described by Pietschmann, 1930, *Bull. Bernice P. Bishop Mus.* (73): 3, fig. 1, pl.1. Holotype: Bernice P. Bishop Museum, 2033 mm adult male, from deep water along south coast of Kauai Island, Hawaiian Islands, disintegrated according to Eschmeyer (1998). Neotype: National Museum of New Zealand, NMNZ P.2774, 1980 mm adult (or adolescent?) male, Cook Strait, designated by Garrick, 1960, *Trans. R. Soc. New Zealand*, 88(1): 110.

Synonyms: None.

Other Combinations: ***Echinorhinus brucus*** (not Bonnaterre, 1788), for some Pacific records.

FAO Names: En – Prickly shark; **Fr** – Squale boucle du Pacifique; **Sp** – Tiburón negro espinoso.

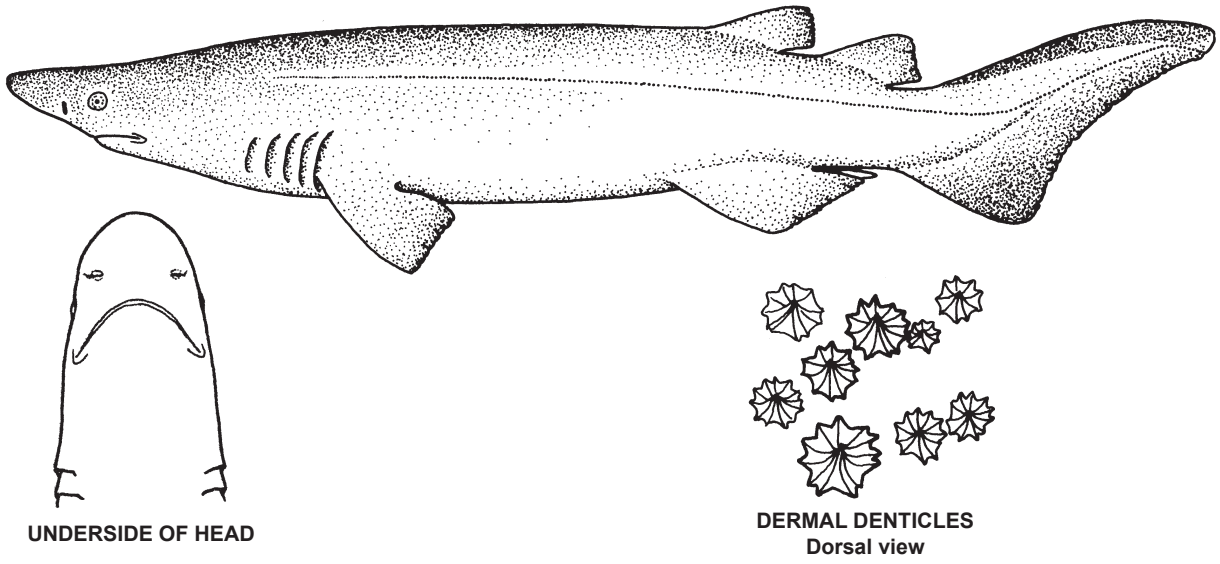


Fig. 42 ***Echinorhinus cookei***

Field Marks: A large, flat headed, short–nosed, cylindrical, heavy–bodied shark, with dorsal fins spineless and far back, first dorsal fin behind pelvic–fin origins, denticles moderately large, relatively close–set, with stellate bases and not formed as large, flat thorns and no anal fin. Colour light to medium grey, grey–brown, or blackish on the dorsal surface, often lighter below, denticles lighter but inconspicuous.

Diagnostic Features: Dermal denticles on body are moderate–sized, close–set and with relatively small, stellate bases, less than 5 mm in diameter. Denticles not expanded into large bucklers or thorns and not fused together. Denticles of newborn specimens are widely spaced but also have prominently stellate bases. Ventral surface of snout and area around mouth have very few minute denticles. Teeth similar in both jaws, blade–like, with a single smooth–edged cusp and 1 to 3 smaller cusplets; tooth counts 21 to 25 upper jaw, 20 to 27 lower jaw. Vertebral counts: total vertebral counts 88 to 92, precaudal vertebral count 59. Intestinal valve counts 8 to 13 turns. Maximum total length about 400 cm. **Colour:** uniform brown to salty grey or black, with lighter coloring around the mouth and ventral surface of snout; posterior fin margins blackish.

Distribution: Southeastern Pacific Ocean: Ecuador (Galápagos Islands), Peru and Chile (including Nazca and Sala y Gomez submarine ridges at 20°46'S, 80°52'W and 21°28'S, 81°38'W). Elsewhere, scattered throughout the eastern and western Pacific Ocean, including islands and seamounts.

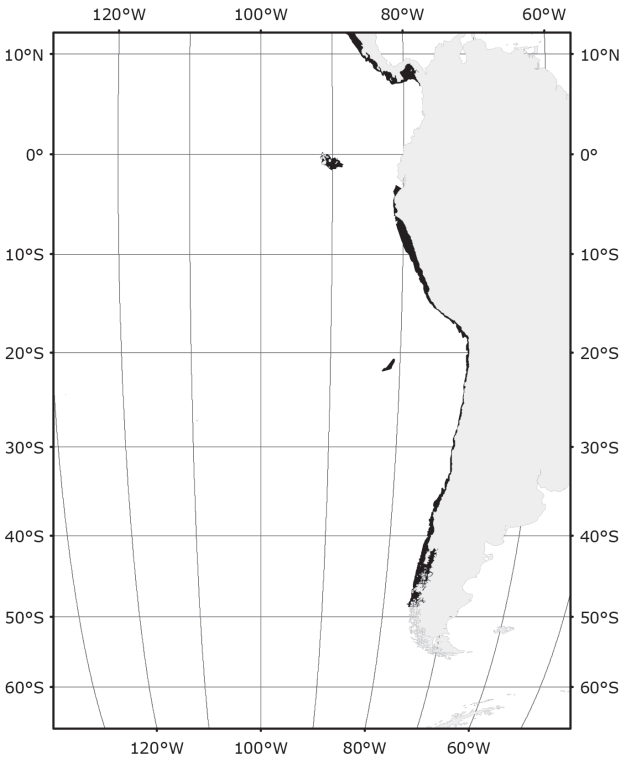


Fig. 43 ***Echinorhinus cookei***

Known distribution

Habitat: A large, sluggish bottom shark, rare to uncommon in parts of its range. This benthic shark occurs on continental and insular shelves and upper slopes at depths from 11 to 1 100 m. In California it is caught in gillnets and observed by SCUBA divers in the Monterey submarine canyon at depths of 11 to 35 m. It is observed on the bottom or near the walls of the canyon and often is found close inshore; one individual swam inside the Moss Landing Harbor (California, USA) and was captured at 4 m depth. Off the Nazca and Sala y Gomez submarine ridges at 300 to 340 m, where it apparently preferred areas with soft bottoms and swam 0.3 to 1.3 m off the bottom (Golovan and Pakhorukov, 1987). Ebert (2003) noted that this shark preferred deep cool waters at 7 to 10°C and could tolerate low oxygen levels in deep ocean basins.

Biology: Yolk–sac viviparity, with the litter size of one 305 cm female from Hawaii having 114 foetuses, compared to 10 to 52 from the smaller ***Echinorhinus brucus***. Nothing else is known about the reproductive cycle or age structure of this species.

The relatively small mouth, large pharynx and sluggish swimming of prickly sharks suggests that they may ambush prey including pelagic species by approaching them slowly and suddenly sucking them into their mouths. This shark eats a variety of demersal and pelagic bony fishes, including herring (Clupeidae), hake (Merlucciidae), topsmelt (Atherinidae), jack mackerel (Carangidae, ***Trachurus***), flounders (Paralichthyidae), rockfish (Scorpaenidae, ***Scorpaena***) and lingcod (***Ophiodon***, Hexagrammidae). Cartilaginous fishes are eaten including spiny dogfish (***Squalus acanthias***, Squalidae), the young of the sixgill shark (***Hexanchus griseus***), catshark (***Apristurus***, Scyliorhinidae) eggcases and elephantfish (***Callorinchus***, Callorhynchidae). Young prickly sharks are in turn eaten by the sixgill shark (***Hexanchus griseus***), which is an example of two sympatric, macropredatory and trophically overlapping deepwater sharks that prey on each other's young. Other shark predators of this species are not known although the white shark (***Carcharodon carcharias***) is one likely suspect. Diet consists of demersal and pelagic cephalopods (octopuses and squids); the holotype apparently had injuries inflicted by cephalopods on the ventral surface of its head.

In the Monterey submarine canyon off central California (USA), research divers have observed prickly sharks singly and in groups from two to over 30 sharks near the bottom at depths of 15 to 35 m (Crane and Heine, 1992). These sharks were either stationary or slowly swimming, but could swim off swiftly when startled. A large group of 30, or more, prickly sharks were observed in close proximity, with up to four individuals visible at once in water of limited visibility (2 m). They swam in several directions relative to one another and apparently did not exhibit polarized schooling. They were seemingly not disturbed by the divers and even allowed contact on occasion, although they may also flee rapidly when approached. Prickly sharks were also observed from submersibles on seamounts in the Pacific in water 300 m deep or more, including the Nazca and Sala y Gomez submarine ridges off Chile (Golovan and Pakhorukov, 1987) and on sandy bottom at Cross Seamount near the Hawaiian Islands (Chave and Mundy, 1994). The sharks swam around the submersibles without being disturbed and sometimes approached them. They avoided areas lighted by the submersible (Nazca and Sala y Gomez) or investigated them when equipment was being deployed (Cross Seamount). A tracking study on the movements of subadult prickly sharks in the Monterey Canyon off central California showed that they exhibited a high degree of site fidelity and demonstrated pronounced diel movements, moving along the axis of the canyon offshore to discrete areas during the day and inshore at night (Dawson and Starr, 2009). Prickly sharks were found to be sedentary during the day, but actively swimming in the water column at night and were especially active during crepuscular and at night–time periods. Of the 15 sharks tracked during this study, 10 females (size range 175 to 270 cm TL) and 5 males (170 to 200 cm TL), all were below the minimum size at maturity.

Size: Maximum total length about 400 cm (based on a large specimen from New Zealand) to 450 cm (sighting of a large adult female off central California, C.L. Dawson, Moss Landing Marine Laboratories, pers. comm.). Three males (150, 188 and 226 cm) from California were immature, but the 203 cm holotype from Hawaii, the 198 cm neotype from New Zealand and seven males 183 to 233 cm long from Hawaii were mature (Pietschmann, 1930, Garrick, 1960, Crow, Lowe and Wetherbee, 1996; D.A. Ebert, unpubl. data). A Peruvian female 113 cm long and California females 254 and 275 cm were immature; a Hawaiian female 184 cm long had small eggs 6 cm wide and may have been adolescent. Females are adult at 299 to 305 cm. Apparently, this is a somewhat larger species than ***Echinorhinus brucus***, but it is not known if these sharks vary in size

at maturity in different regions. Size at birth around 35 to 45 cm; smallest free–living young, with healed umbilical scars, were measured at 37.7, 45 and 47 cm TL.

Interest to Fisheries and Human Impact: Unimportant for fisheries, occasionally taken by line gear, gillnets and bottom trawls, but currently not utilized. The meat is soft and reported to be of poor quality (Ebert, 2003). Research divers encountering large prickly sharks singly or in groups in shallow water in California have found them unaggressive and docile. Ecotouristic diving to view these sharks has not occurred in the Monterey Canyon and is problematical because of cold, dark water conditions as well as sentiments against shark diving in the area.

The conservation status is Near Threatened due to potential deep–sea fisheries that may develop in areas where this shark occurs.

Local Names: Tiburón negro (Ecuador); Tiburón negro espinoso (Peru).

Remarks: ***Echinorhinus cookei*** occurs mostly in the Pacific, but appears to be absent from the Atlantic and Indian oceans. It does co–occur with ***Echinorhinus brucus*** around New Zealand and southern Australia. However, recent molecular research has identified a third species within the genus from the northern Indian Ocean, thus throwing into question the distributional limits of the two known species and the at present undescribed Indian Ocean species.

Literature: Pietschmann (1930); Garrick (1960); Kato, Springer and Wagner (1967); Crane and Heine (1992); Last and Stevens (2009); Barry and Maher (2000); Ebert (2003); Rojas, Fuentes, and Hernández (2006); Dawson and Starr (2009); Long *et al.* (2011); Kyne *et al.* (2012); Ebert, Fowler, and Compagno (2013); C.L. Dawson (pers. comm.); D.A. Ebert (unpubl. data).

2.3 Order SQUALIFORMES – Dogfish sharks

Order: Squali, suborder Squali: Gill, 1862, *Ann. Lyc. Nat. Hist. New York*, 7: 367, 394, 396.

Number of Recognized Deep–sea Southeastern Pacific Ocean Families: 4.

Synonyms: Part 1 Squali, Abtheilung [Division] 4: Müller and Henle, 1839, *Syst. Besch. Plagiost*. (2): 83. Ordo Plagiostomi, subordo Squalini, Sectio Aproctopterides: Bleeker, 1859: xii. Order Squali, suborder Galei: Gill, 1872: 23, 24. Order Plagiostomi Diplospondyli, suborder Plagiostomi Cyclospondyli, group 1. Laemargi: Hasse, 1879: 41. Order Plagiostomi Diplospondyli, suborder Plagiostomi Cyclospondyli, group 2. Spinacidae: Hasse, 1879. Order Plagiostomi Diplospondyli, suborder Plagiostomi Cyclospondyli, group 3. Echinorhini: Hasse, 1879: 41. Order Selachii, suborder Tectospondyli: Woodward, 1889: 30. Order Tectospondyli: Gill, 1893: 129. Order Cyclospondyli, suborder Cyclospondyli: Jordan and Evermann, 1896: 52, 53. Order Euselachii, suborder Pleurotremata, division Squaloidei: Regan, 1906a: 723. Order Selachii, group 2, division B, subdivision 2, suborder Squaliformes: Goodrich, 1909: 151. Order Plagiostoma, suborder Antacea, "group" Squaloidei: Garman, 1913: 11, 13. Order Pleurotremata, suborder Squaloidei: Engelhardt, 1913: 100. Order Tectospondyli, suborder Squaloidei: Jordan, 1923: 101. Order Plagiostomi, suborder Squaliformes or Esqualiformes: Lozano y Rey, 1928: 281. Order Squalea, suborder Squalida, superfamily Squaloidea: White, 1936: 5; White, 1937: 37, tab. 1. Order Euselachii, suborder Squaliformes: Bertin, 1939: 10. Order Squaliformes: Berg, 1940, *Trudy Zool. Inst. Akad. Nauk SSSR*, 5(2): 138 (for squaloids, pristiophoroids, and squatinoids); Berg and Svetovidov, 1955, *Trudy Zool. Inst. Akad. Nauk SSSR*, 20: 68 (for squaloids and squatinoids); Arambourg and Bertin, 1958: 2041; Rass and Lindberg, 1971: 304; Lindberg, 1971: 259; Compagno, 1973: 26; Applegate, 1974: 743; Nelson, 1976: 38; Chu and Meng, 1979: 114, tab. 2; Pfeil, 1983: 24; Compagno, 1984a: 24; Nelson, 1984: 56; Gubanov, Kondyurin and Myagkov, 1986: 3, 168; Cappetta, 1987: 26, 50; Eschmeyer, 1990: 437; Shirai, 1992: 122; Nelson, 1994: 54; de Carvalho, 1996: 55; Shirai, 1996: 33; Eschmeyer, 1998. Order Squaliformes, Suborder Squaloidei: Berg, 1940: 138; Berg and Svetovidov, 1955: 68; Arambourg and Bertin, 1958: 2042; Lindberg, 1971: 259; Nelson, 1976: 38; Nelson, 1984: 56; de Carvalho, 1996. Order Tectospondyli, suborder Squaloidei, superfamily Squaloidea: Whitley, 1940: 69. Order Cyclospondyli Fowler, 1941: 4, 222; Smith, 1949: 37, 55. Order Selachii, suborder Squaloidea: Romer, 1945: 577; Bigelow and Schroeder, 1948: 77, 449; Romer, 1966: 350; Order Squaloidea, suborder Squaloidea: Schultz and Stern, 1948: 225. Order Lamnida, suborder Squalina: Matsubara, 1955: 1–789. Order Pleurotremata, suborder Squaloidea: Norman, 1966: 24. Order Squatiniformes, suborder Squaloidei: Glikman, 1967: 215. Order Squatiniformes, suborder Echinorhinoidei: Glikman, 1967: 215. Order Lamniformes, suborder Squaloidei: Patterson, 1967: 670. Order Squalida, suborder Squalina: Fowler, 1968: 203, 204. Order Squalida, suborder Squalina, superfamily Squalicae: Fowler, 1968: 203, 204. Order Euselachii, suborder Squaloidei: Blot, 1969: 702–776. Order Pleurotremata, suborder Squaliformes: Budker and Whitehead, 1971: 6, tab. 2. Order Squaliformes, suborder Squaloidea: Chu and Meng, 1979: 114, tab. 2. Order Squaliformes, suborder Dalatioidea: Chu and Meng, 1979: 114, tab. 2.; Shirai, 1992: 122; de Carvalho, 1996: 55; Shirai, 1996: 33. Order Dalatiiformes: Shirai, 1992: 122; Shirai, 1996: 33. Order Centrophoriformes: Shirai, 1992: 122; Shirai, 1996: 33. Order Squalomorpha, suborder Squaloidea: Carroll, 1988: 599. Order Squaliformes, suborder Dalatioidei: de Carvalho, 1996: 55.

FAO Names: En – Dogfish sharks; **Fr** – Squales; **Sp** – Galludos.

Field Marks: Small to very large sharks with a cylindrical or compressed body, a flattened or conical snout, five paired lateral gill openings, two dorsal fins with or without spines, and no anal fin.

Diagnostic Features: Head conical to moderately depressed, but not expanded laterally. Snout short to moderately long, conical to moderately depressed, not laterally expanded and without sawteeth or rostral barbels. Eyes lateral or slightly dorsolateral on head, without nictitating lower eyelids, secondary lower eyelids or subocular pouches; upper eyelids not fused to eyeballs. Spiracles small to very large, close behind and about opposite level of eyes. Five pairs of gill openings present on sides of head, last in front of pectoral–fin origins. Nostrils transverse on snout, without separate barbels but with anterior nasal flaps expanded into barbels and reaching mouth in ***Cirrhigaleus barbifer*** but not in other squaloids; nasoral grooves and circumnarial grooves and folds absent from nostrils. Mouth small to large, usually subterminal on head (terminal in ***Trigonognathus***), Y–shaped, narrowly to broadly arched and parabolic to transverse and nearly straight, ending below or behind eyes. Labial furrows well developed on both jaws. Teeth weakly to strongly differentiated along the jaws, with (***Trigonognathus***) or usually without enlarged anterior teeth and without enlarged molariform posterior teeth; without a gap or small intermediate teeth between anterior and lateral teeth in the upper jaw. Trunk cylindrical to slightly depressed or somewhat compressed but not depressed and ray like. Tail without long thick lateral dermal folds that reach to caudal base but sometimes with short caudal keels. Denticles covering almost entire body (sparsely distributed in one species of ***Centroscyllium***), usually not enlarged as thorns or spines. Pectoral fins small to moderately large, not expanded and ray–like, without triangular anterior lobes that cover the gill slits. Pelvic fins small to moderately large, inner margins continuous with margin of vent. Two dorsal fins present, with spines on both fins in many taxa, a spine on the first dorsal fin only in one genus (***Squaliolus***), and spines absent in most Dalatiidae and some Somniosidae; origin of first dorsal fin over the pectoral–fin bases or gill slits. Anal fin absent. Caudal fin with a moderately long dorsal lobe and the ventral lobe absent to strong. Vertebral counts: total vertebral counts 35 to 131, precaudal vertebral counts 44 to 95, monospondylous vertebral counts 29 to 67, diplospondylous vertebral counts 4 to 49, and caudal vertebral counts 50 to 82. Intestinal valve of conicospiral or ring type, with 4 to 42 turns. Dwarf to very large sized sharks with adults ranging from 22 cm to 600 cm or more in total length. **Colour:** variable but may range from light to very dark hues or with intermediate

shades of grey, brown, or black; some species uniformly coloured, while others are lighter below; prominent markings such as spots are present on some species, while others are relatively plain coloured.

Distribution: Circumglobal in tropical, temperate, cold boreal, polar and subantarctic marine waters. Most species occur in temperate and tropical seas and are most diverse in the Atlantic and Indo–West Pacific, and the least diverse in the eastern Pacific. Some of the small to moderate–sized oceanic species, and certain slope or epibenthic species, are circumglobal or wide–ranging. Many smaller benthic species have more limited ranges, with centres of endemicity in the North Atlantic and western Pacific oceans.

Habitat: These sharks occur in most marine habitats from shallow enclosed and open bays, on continental shelves, slopes and rises of continental and insular waters, on submarine ridges, and in epipelagic, mesopelagic and bathypelagic zones. They inhabit rocky reefs, estuaries, sandy beaches, and under the ice pack in Arctic waters. They range in depth from the intertidal to the outer shelves, slopes and rises to below 4000 m. Dogfish sharks generally dominate deepwater benthic shark faunas in diversity and abundance, and are the only sharks present in polar seas.

Biology: Reproductive mode is yolk–sac viviparity, with litters ranging from 1 to perhaps 300 in some of the larger species. Dogfish sharks feed on small to large bony fishes and invertebrates, with some of the larger species known to consume chondrichthyans and, at least as carrion, marine mammals. Many are formidable predators, having large teeth and efficient cutting dentitions, with the lower teeth or teeth of both jaws forming a saw–like cutting edge. A few species are facultative parasites, and core plugs of flesh out of other chondrichthyans, large bony fishes, seals, and cetaceans. Dogfish sharks are active to sluggish swimmers and highly varied in size, however most species are small. Information on movements is limited or absent for most species; the picked dogfish (***Squalus acanthias***) is migratory, and changes habitat seasonally. Many dogfishes are social and are found in aggregates or schools, some of which are huge, but the sociobiology of most species is poorly known as is most other aspects of their behaviour.

Interest to Fisheries and Human Impact: Several members of this shark group are of moderate to major importance to fisheries, particularly members of the Squalidae. Some species are regular components of targeted shark fisheries and as utilized or discarded bycatch of other fisheries targeting teleost fishes or marine invertebrates. These sharks are caught in bottom and pelagic trawls, in fixed and pelagic gillnets, in fish traps, on bottom longlines, with harpoons, with hook and line and rod and reel. Several species are used for human consumption; the flesh of some species is excellent. Most squaloids are small (less than 100 cm long), have relatively small fins, and seem to have very limited importance for the oriental soup–fin trade.

The conservation status for the majority of squaloids is Least Concern or Data Deficient due to a lack of life history information and data on population trends. However, several species are considered Endangered to Critically Endangered due to impacts from either targeted or non–targeted fisheries.

Local names: No information.

Remarks: The arrangement of the order as restricted here follows Ebert, Fowler and Compagno (2013) in recognizing seven families in the order. Four families are represented in the southeastern Pacific. The Key to Families below reflects only those genera occurring in the region and may not be applicable to other regions.

Key to Deep–sea Southeastern Pacific Ocean Families:

1a. Underside of body, flanks, and tail usually with more or less conspicuous black markings with light organs (photophores); second dorsal fin much larger than first, and second dorsal–fin spine height more than twice height of first dorsal–fin spine height (Fig. 44) . . . . . **family Etmopteridae**

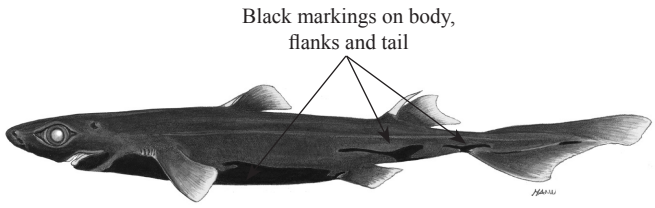


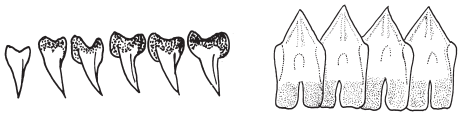
Fig. 44 Etmopteridae

1b. Underside of body, flanks, and tail without conspicuous black markings with light organs (photophores). second dorsal fin similar in size or smaller than first, and second dorsal–fin spine height similar to or shorter than first dorsal–fin spine height **2**

UPPER AND LOWER TEETH

Fig. 45 Centrophoridae

2a. Upper teeth relatively broad and bladelike, lowers low and wide (Fig. 45) . . . . . **family Centrophoridae**



UPPER AND LOWER TEETH

Fig. 46 Dalatiidae

2b. Upper teeth relatively narrow and not blade–like, lowers high and wide (Fig. 46) **3**

3a. Head moderately broad and somewhat flattened or conical. Snout flat and narrowly rounded to elongate–rounded in dorsoventral view. Dorsal–fin spines present, except for ***Scymnodalatias*** and ***Somniosus*** (Fig. 47) . . . . . **family Somniosidae**

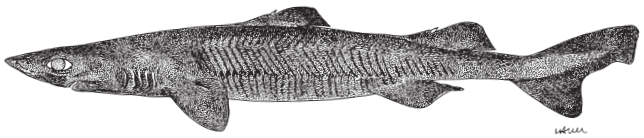


Fig. 47 Somniosidae

3b. Head narrow and rounded–conical; snout conical and narrowly rounded to elongate–rounded in dorsoventral view. No dorsal–fin spines (Fig. 48). . . . . **family Dalatiidae**

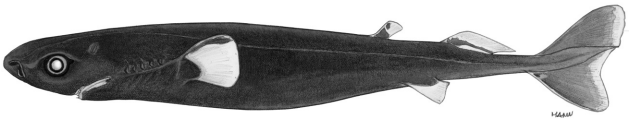


Fig. 48 Dalatiidae

2.3.1 Family CENTROPHORIDAE

Family: Centrophoroidei Bleeker, 1859, *Act. Soc. Sci. Ind. Neerl*. 4(3): xii.

Type genus: ***Centrophorus*** Müller and Henle, 1837a.

Number of Recognized Deep–sea Southeastern Pacific Ocean Genera: 2.

Synonyms: Subfamily Centrophorus (family Acanthias) Hasse, 1879: tab. 2. Type genus: ***Centrophorus*** Müller and Henle, 1837a. Subfamily Deaniinae Compagno, 1973: 26 (family Squalidae). Type genus: ***Deania*** Jordan and Snyder, 1902.

FAO Names: En – Gulper sharks; **Fr** – Squale chagrins; **Sp** – Quelvachos.

Field Marks: Short to long–nosed, cylindrical to somewhat compressed sharks with denticles small to large and variable in shape, with leaf–shaped, tricuspidate or polycuspidate crowns and slender pedicels, high pitchfork–shaped erect crowns on high pedicels, or low ridged sessile crowns, no keels on the caudal peduncle, two dorsal fins with strong grooved spines, first dorsal fin with origin usually opposite the pectoral–fin bases or pectoral–fin inner margins and exceptionally just behind the pectoral–fin free rear tips, second dorsal fin not falcate and with its origin usually opposite the pelvic–fin bases or inner margins, but exceptionally somewhat behind the pelvic–fin free rear tips, no anal fin, and caudal fin with a strong subterminal notch.

Diagnostic Features: Head moderately broad to narrow and somewhat flattened. Snout flat and narrowly rounded to elongate–rounded in dorsoventral view. Spiracles large, close behind eyes. Fifth gill opening about as large as first four. Nostrils wide–spaced with internarial width greater than nostril width. Nostrils with simple anterior nasal flaps and no medial barbels. Mouth nearly transverse and very short, with thin, non–papillose lips. Labial furrows short, not encircling mouth, confined to mouth corners but extending anteriorly to below eyes, elongated posteriorly into postoral grooves and sometimes anteromedial preoral grooves (***Deania***); thin labial folds. Teeth with dignathic heterodonty well developed, upper teeth much smaller than lowers. Teeth of both jaws moderately compressed, high–crowned, broad–based and bladelike; upper teeth not imbricated or weakly so, with broad high roots that are closely adjacent and sometimes overlapping and not forming a quincunx pattern; lower teeth forming a deep, strongly imbricated series and a continuous saw–like cutting edge; all teeth with a compressed cusp, a distal blade, sometimes a medial blade, and no cusplets; upper cusps narrow, erect to oblique, and broad–based; lower cusps oblique to semierect. Tooth rows 22 to 45 upper jaw, 24 to 35 lower jaw; upper teeth usually somewhat more numerous than lowers (averaging 1.2:1). Trunk cylindrical or slightly compressed, abdomen without lateral ridges. Interdorsal space elongated and usually greater than length of first dorsal–fin base but subequal to or slightly longer than it in a few species. Pelvic–caudal space moderately long and about two or three times pelvic–fin bases. Caudal peduncle slightly compressed, short to moderately elongated, and without lateral keels or precaudal pits. Body without photophores. Denticles moderate–sized and pedicellate or sessile, when pedicellate having flattened, narrow to broad–keeled, leaf–shaped (***Centrophorus***) or pitchfork–like (***Deania***) crowns, slender pedicels and low bases. Pectoral fins low, angular or rounded, and not falcate; anterior margins moderately large and about 0.5 to 1.2 times the prespiracular length; pectoral–fin rear tips rounded and short to angular and greatly elongated. Pelvic fins smaller than pectoral and first dorsal fins, and subequal to or smaller than second dorsal fin. Claspers with a lateral spine only (***Centrophorus***), or with no spine (***Deania***). Dorsal fins large, broad, angular or rounded–angular but not falcate, with strong grooved spines. First dorsal fin large, with length usually greater than prespiracular space, exceptionally slightly shorter, and up to over 2.5 times its length; first dorsal–fin base over pectoral–pelvic space and well anterior to pelvic fins, first dorsal–fin origin over pectoral–fin bases or inner margins (slightly behind them in some ***Deania*** species). Second dorsal fin usually smaller than or sometimes as large as first dorsal fin; second dorsal–fin base partly over or just behind pelvic–fin bases; second dorsal–fin origin usually over rear halves of pelvic–fin bases, pelvic–fin insertions, or pelvic–fin inner margins but

sometimes slightly behind pelvic–fin free rear tips (some ***C. moluccensis*** specimens). Caudal fin heterocercal, with ventral lobe poorly to strongly developed in adults, and with a strong subterminal notch. Vertebral centra strongly calcified, primary double cones well developed. Vertebral counts: total vertebral counts 106 to 131, monospondylous vertebral counts 49 to 65, diplospondylous precaudal vertebral counts 24 to 37. Intestinal valve with 10 to 25 turns. Adults are small to moderate–sized, between 43 to 170 cm total length. **Colour:** plain or with light or dark markings on fins, without black photophore markings on tail or flanks.

Distribution: The family Centrophoridae has an almost circumglobal range in cold temperate to tropical seas, in association with landmasses including continents, islands, seamounts and ridges. Gulper sharks are generally absent from very high latitudes, except ***Centrophorus squamosus*** that ranges up to Iceland in the North Atlantic, and are most diverse in warm temperate waters and in the tropics. Several of the species are wide–ranging in the Atlantic but the greatest known diversity of the family is in the Indo–West Pacific. These sharks are apparently absent from the eastern North Pacific but ***C. squamosus*** and ***Deania calcea*** occur in the southeastern Pacific off South America; recently a single juvenile specimen of ***Centrophorus granulosus*** was collected off the Pacific coast of Central America. Geographic and bathymetric ranges are imperfectly known for most species, a result of problems in identifying individual centrophorid species and uneven sampling of deepwater slope–dwelling sharks.

Habitat: Members of the Centrophoridae are primarily bottom dwelling, deepwater bathic inhabitants of the continental and insular slopes and more rarely the upper rises, but also occur on submarine ridges and seamounts. They range in depth from 200 to below 4000 m, but most species do not appear to extend below 1500 m. These sharks occasionally occur on the continental and insular shelves offshore in water up to 50 m depth, although this is most exceptional. The family apparently lacks specialized epipelagic species but at least one bottom dwelling centrophorid may venture into the open ocean: ***Centrophorus squamosus*** was once collected at a depth between the surface and 1250 m in water about 4000 m deep.

Biology: Reproductive mode is viviparous with a yolk sac, with females having from one to 17 young in a litter. There have only been a few studies on the age and growth of these sharks, but most appear to be very slow growing, maturing between 8.5 and 30 years, with a maximum age estimated at 70 years or more for at least one species. Gulper sharks feed mostly on bony fishes and cephalopods but also eat crustaceans (lobsters and shrimps), small sharks (including batoids and chimaeras), and tunicates. Centrophorids have moderately strong to very powerful jaws with a shear–like cutting dentition in the lower jaw, and holding or cutting dentition in the upper jaw.

Several centrophorids are social, and form small to huge schools or aggregations, making them among the commonest deepwater sharks in temperate and tropical seas, but general biology, including behaviour, sociobiology and population biology is little known.

Interest to Fisheries and Human Impact: Globally, the Centrophoridae are perhaps one of the most important families of deepwater sharks as they are the subject of targeted and non–target deepwater fisheries. In the western Indo–Pacific and eastern North Atlantic, these sharks are commonly fished as part of targeted deepwater shark fisheries and also form an important bycatch of deepwater fisheries for bony fishes. Some species are regularly caught as discarded bycatch of fisheries for deepwater teleosts. They are caught with longlines, bottom trawls, and fixed bottom gillnets. Gulper sharks are used for human consumption: dried–salted or fresh, for fishmeal, and for their livers, which are extremely large, oily, and have a high squalene content.

The conservation status of gulper sharks is poorly known largely due to the poor taxonomic resolution of this group, inadequate monitoring in most areas, and limited knowledge on their biology, and possibly from the extreme limits in life–history parameters such as fecundity, life span, age at maturity, and gestation period.

Local names: No information.

Remarks: The current arrangement of the Centrophoridae is comprised of two genera, with 15 nominal species currently recognized. Both genera and 2 species have been reported from the southeastern Pacific Ocean.

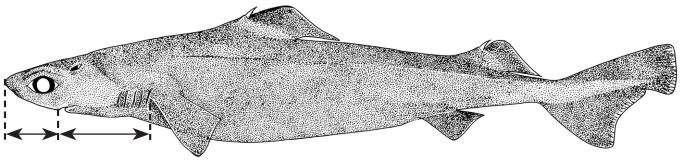
Literature: Regan (1908a); Garman (1913); Bigelow and Schroeder (1948, 1957); Bass, D'Aubrey and Kistnasamy (1976); Cadenat and Blache (1981); Compagno (1984a, 1999); Muñoz–Chapuli and Ramos (1989b); Shirai (1996); Last and Stevens (2009); Kyne and Simpfendorfer (2010); Ebert (2013); Ebert, Fowler and Compagno (2013); Ebert and Stehmann (2013); White *et al.* (2013); Ebert and Compagno (In press).

List of Deep–sea Species Occurring in the Area:

Centrophorus squamosus (Bonnaterre, 1788)
Deania calcea (Lowe, 1839)

Key to Deep–sea Southeastern Pacific Ocean Gene

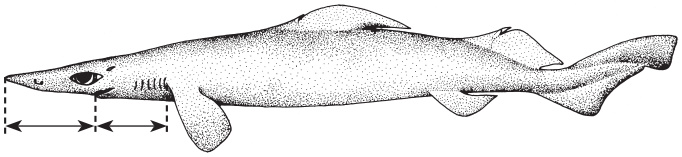
1a. Preoral snout length less than distance from mouth to pectoral–fin origin (Fig. 49) . . . . . ***Centrophorus***



LATERAL VIEW

Fig. 49 ***Centrophorus***

1b. Preoral snout length greater than distance from mouth to pectoral–fin origin (Fig. 50) . . . . . ***Deania***



LATERAL VIEW

Fig. 50 ***Deania***

Centrophorus Müller and Henle, 1837

Genus: ***Centrophorus*** Müller and Henle, 1837a, *Ber. K. preuss. Akad. wiss. Berlin*, 2: 115; Müller and Henle, 1837b, *Arch. Naturg*., 3: 398.

Type species: ***Squalus granulosus*** Bloch and Schneider, 1801, by monotypy. "***Sq. squamosus*** Bl. Schn." (= ***Squalus squamosus*** Bonnaterre, 1788) was mentioned by Müller and Henle (1837a, b) in the account of ***Centrophorus***, but who thought a new genus was required. Müller and Henle (1838a, *Mag. Nat. Hist*., n. ser., 2: 89) confusingly included one species in ***Centrophorus***, "***S. squamosus***, Bl. Schn." (possibly a mistake for ***S. granulosus***), but also noted that "***Squalus squamosus***, Bl. Schn." was allied to ***Centrophorus*** but probably belonged to a new genus. Bonaparte (1838, *Nuov. Ann. Sci. Nat., Bologna, ser*. 1, 2: 207) apparently followed their suggestion and named a new genus ***Lepidorhinus*** for ***S. squamosus***, but Müller and Henle (1839, *Syst. Beschr. Plagiost*., pt. 2: 90) reversed their previous opinion and included ***S. squamosus*** in ***Centrophorus***.

Number of Recognized Deep–sea Southeastern Pacific Ocean Species: 1.

Synonyms: Genus ***Lepidorhinus*** Bonaparte, 1838: 207. Type species: "***Squalus Squamosus*** Brousson (–et? 1788), Lac. 1. X. 3." by monotypy, equals ***Squalus squamosus*** Bonnaterre, 1788. Genus ***Machephilus*** Johnson, 1867: 713. Type species: ***Machephilus Dumérilli*** Johnson, 1867, by original designation. Genus ***Atractophorus*** Gilchrist, 1922: 48. Type species: ***Atractophorus armatus*** Gilchrist, 1922, by monotypy. Genus ***Actractophorus*** Gilchrist, 1922: 48. Probable error for ***Atractophorus*** Gilchrist, 1922. Subgenus ***Gaboa*** Whitley, 1940: 146 (genus ***Centrophorus*** Müller and Henle, 1837a). Type species: ***Centrophorus harrissoni*** McCulloch, 1915, by original designation. Subgenus ***Somnispinax*** Whitley, 1940: 146 (genus ***Centrophorus*** Müller and Henle, 1837a). Type species: ***Centrophorus nilsoni*** Thompson, 1930, by original designation; a junior synonym of ***Squalus squamosus*** Bonnaterre, 1788. Subgenus ***Somnisphinax*** Neave, 1950: 252. Probable error for ***Somnispinax*** Whitley, 1940. Genus ***Encheiridiodon*** Smith, 1967: 128. Type species: ***Encheiridiodon hendersoni*** Smith, 1967, by original designation; a junior synonym of ***Squalus squamosus*** Bonnaterre, 1788. Genus ***Attractophorus*** Bass, D'Aubrey and Kistnasamy, 1976: 27. Apparent error for ***Atractophorus*** Gilchrist, 1922. Genus ***Encheridiodon*** Shiino, 1976: 11. Apparent error for ***Encheiridiodon*** Smith, 1967. Genus ***Pseudocentrophorus*** Chu, Meng, and Liu, 1981: 100. Type species: ***Pseudocentrophorus isodon*** Chu, Meng, and Liu, 1981, by original designation.

Field Marks: Deepwater sharks with a moderately long and broad snout, and huge, iridescent green eyes, bladelike upper and lower teeth without cusplets, lower teeth imbricated and much larger than uppers, cylindrical bodies with very tough skin and large leaf–like, thornlike or pebble–shaped denticles, pectoral–fin free rear tips more or less angular to attenuated, two dorsal fins each with a strong grooved spine, no anal fin, caudal fin with a strong subterminal notch, body coloration light grey or grey–brown to blackish grey, sometimes lighter below and fin webs dusky or with dark and light bars.

Diagnostic Features: Snout flattened and broadly parabolic to slightly pointed in dorsoventral view, angular to rounded–angular in lateral view; snout short to moderate with preoral length less than distance from mouth to pectoral–fin origins and half length of head or less. Labial furrows not extended anteromedially as elongated preoral grooves. Upper and lower teeth with broader, thicker crowns and roots. Lower teeth with vertical basal grooves on their lingual roots and with broader cusps than the upper teeth; edges of lower teeth often serrated in adults. Tooth rows 30 to 45 upper jaw, 24 to 35 lower jaw. Dermal denticles with low, flat, ridged crowns, varying from leaf–shaped and with low pedicels and posterior cusps, to cuspless, block–shaped, and without pedicels; denticle crowns flat and not elevated or pitchfork–like, with a short medial cusp (sometimes absent), lateral cusps short or absent, and single or multiple ridges; denticle bases broader and quadrangular. Surface of skin rough in the leaf–scaled ***Centrophorus squamosus*** but smooth in species with sessile crowns and low bases. Pectoral fins with free rear tips varying from squared–off and angular to elongated and acutely pointed, not broadly lobate. Claspers with a lateral spine. Second dorsal fin smaller than first and with its base about half to 3/4 length of first dorsal–fin base; second dorsal–fin origin varying from over last third of pelvic–fin bases to slightly posterior to pelvic–fin free rear tips; second dorsal–

fin spine equal to or slightly larger than first dorsal–fin spine but not greatly enlarged, spine moderately curved, spine apex usually falling well below fin apex. Vertebral counts: total vertebral counts 106 to 131, monospondylous vertebral counts 49 to 64, precaudal vertebral counts 77 to 92. Intestinal valve with 10 to 30 turns. Adults are small to moderately large from 90 to 170 cm total length. **Colour:** light to dark grey, greyish brown to black above, usually lighter below; depending on the species fin edges may be plain to light or dark edged.

Local names: No information.

Remarks: The genus ***Centrophorus*** has a complex and convoluted taxonomic history, in part because many researchers have had difficulty interpreting differences in denticles, fin spines, teeth, body and fin morphology within and between species that are related to growth and sexual dimorphism. Also, until recently researchers have tended to concentrate on the same few external characters without examining other characters that are less subject to growth and sexual changes. Poor or inadequate sampling of ***Centrophorus*** species from most localities where these deepwater sharks occur has exacerbated these problems.

The genus currently has 11 recognized species, but the taxonomic status of most ***Centrophorus*** species is very poor with most species having been inadequately described and with type material missing or in poor condition. At present, 1 nominal ***Centrophorus*** species has been reported from the southeastern Pacific Ocean.

Centrophorus squamosus (Bonnaterre, 1788)

Squalus squamosus Bonnaterre, 1788, *Tabl. Encyclop. Method. Trois Reg. Nat., Ichthyol.*, Paris: 12. Holotype: Museum National d'Histoire Naturelle, Paris, MNHN–A7829, head only, no locality, according to Krefft and Tortonese *in* Hureau and Monod (1973, *CLOFNAM. Check–list. fish. NE Atlantic Mediterranean*, 1: 44) and Eschmeyer (2013).

Synonyms: ***Encheiridiodon hendersoni*** Smith, 1967: 129, pls. 24–27. Holotype: J.L.B. Smith Institute of Ichthyology, RUSI–663, 1080 mm adult male, Port Elizabeth, Algoa Bay, South Africa, procured by a diver in shallow water (3–4 m), possibly a discarded trawl catch. Catalog number from Eschmeyer (2013).

Other Combinations: ***Centrophorus dumerilli*** (Johnson, 1867), ***Lepidorhinus foliaceus*** (Günther, 1877), ***Lepidorhinus squamosus*** (Bonnaterre, 1788); ***Squalus (Acanthorhinus) squamosus*** Bonnaterre, 1788.

FAO Names: En – Leafscale gulper shark; **Fr** – Squale–chagrin de l'Atlantique; **Sp** – Quelvacho negro.

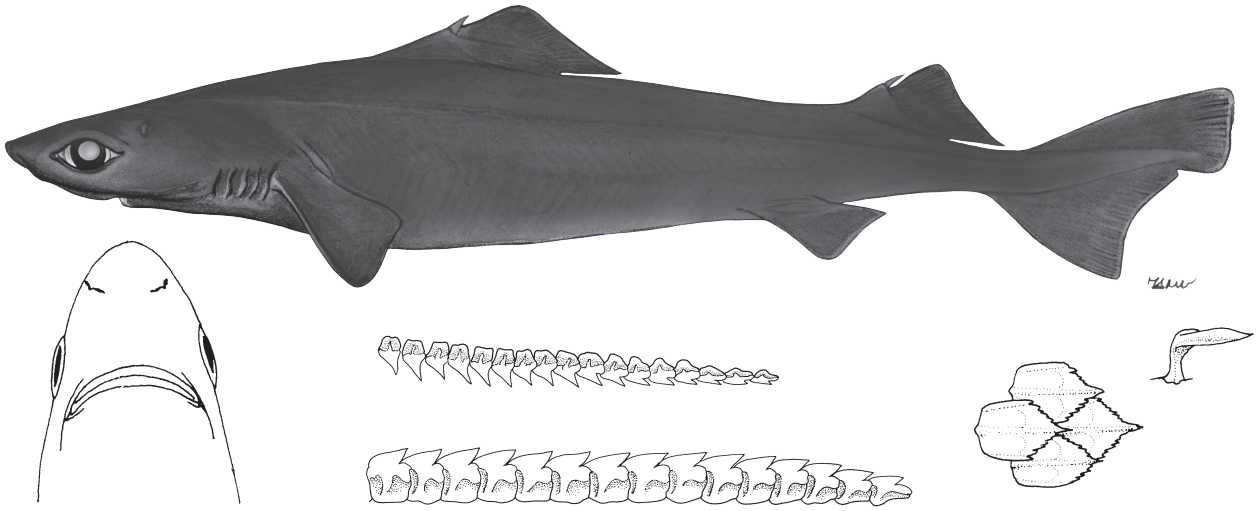


Fig. 51 ***Centrophorus squamosus***

Field Marks: Snout short and thick or somewhat flattened, blade–like, monocuspidate teeth in upper and lower jaws, with lowers much larger than uppers, high, leaf–shaped, tricuspidate or multicuspidate lateral trunk denticles, rear tips of pectoral fins hardly angular and slightly elongated, two dorsal fins with large grooved spines, first dorsal fin very long and low, usually slightly lower although larger than second dorsal fin, second dorsal fin with spine base usually opposite pelvic–fin inner margins or free rear tips. Colour grey, grey–brown or reddish brown above, usually similar below, with dusky fin webs and margins but no prominent markings.

Diagnostic Features: Snout moderately long. Preoral length 0.8 to 1.3 times mouth width, 0.9 to 1.8 in space from mouth to pectoral–fin origins, and 0.6 to 0.9 times head width at mouth level. Snout broadly parabolic in dorsoventral view, broad

to narrow and wedge–shaped in lateral profile, depth at mouth 1.2 to 2.3 times in preoral length. Mouth width 6.4 to 10.3% of total length. Upper anterolateral teeth with erect to semi–oblique cusps, lower teeth with oblique cusps; tooth row counts 30 to 38 upper jaw, 24 to 32 lower jaw. Body relatively stocky. Distance from first dorsal–fin insertion to second dorsal–fin spine origin 22.2 to 27.7% of total length. Dorsal–caudal space 3.8 to 7.0% of total length. Lateral trunk denticles with flat, leaflike crowns on narrow, high pedicels; crowns of lateral trunk denticles partly overlapping one another, with an angular medial cusp, either a pair of lateral cusps (young) or several small lateral cusps like large serrations (adults), and a strong high medial ridge. Pectoral–fin free rear tips not greatly elongated, forming angular corners to very short narrow, angular lobes that end well in front of first dorsal–fin spine base. Pectoral–fin inner margin 5.4 to 8.8% of total length. First dorsal fin low and long, height 2.7 to 4.6 in base length; base length 11.9 to 21.6% of total length. Second dorsal fin height 0.9 to 1.3 times first dorsal–fin height (usually slightly higher than first); second dorsal–fin base 9.4 to 18.2% of total length and about 0.5 to 0.9 times first dorsal–fin base; second dorsal–fin spine origin usually opposite pelvic–fin inner margins or free rear tips, sometimes just behind tips. Caudal fin with nearly straight to weakly concave postventral margin in adults. Vertebral counts: total vertebral counts 106 to 120, monospondylous precaudal vertebral counts 55 to 60, precaudal vertebral counts 82 to 88. Intestinal valve counts 12 to 14. Size relatively large, adults 103 to 164 cm total length. **Colour:** uniform dark grey, medium to light greyish brown, brown or reddish–brown above and below, underside may be slightly lighter although not conspicuously so. Fin webs may be slightly darker than body, but without prominent markings on fins.

Distribution: Southeastern Pacific Ocean: Chile (Gulf of Ancud) and Galápagos Islands (Ecuador). Elsewhere, wide ranging throughout the Atlantic, Indian, and western Pacific oceans

Habitat: A large deepwater gulper shark of the continental slopes from 229 to 2359 m deep, but off the coast of Namibia and the west and south coasts of South Africa it occurs primarily in water 370 to 809 m deep, with most records between 400 to 660 m deep. Also found in the epipelagic or mesopelagic zone between the surface and 1250 m depth over water 1000 to over 3900 m deep, but it is uncertain if this species regularly occurs in oceanic waters. One was collected dead by a spear–fisherman in water 3 to 4 m deep off the south coast of South Africa, but the species does not normally stray onto the continental shelves off southern Africa and the specimen may have been a longline or trawl discard. A common species in some localities, but does not appear to be very common in the southeastern Pacific.

Biology: Viviparous with a yolk–sac, with litters of four to eight or possibly nine young. Age at maturity is about 30 years for males and 35 years for females, with a maximum estimated age of 70 years. Eats bony fishes including hake (Merlucciidae), codfish (Gadidae), grenadiers (Macrouridae), slickheads (Alepocephalidae), horse mackerel (Carangidae: ***Trachurus***), and spinyfins (Diretmidae), also chimaeras (Chimaeridae), cephalopods (including ommastrephid and histioteuthid squids), and crustaceans (euphausiid and penaeid shrimps).

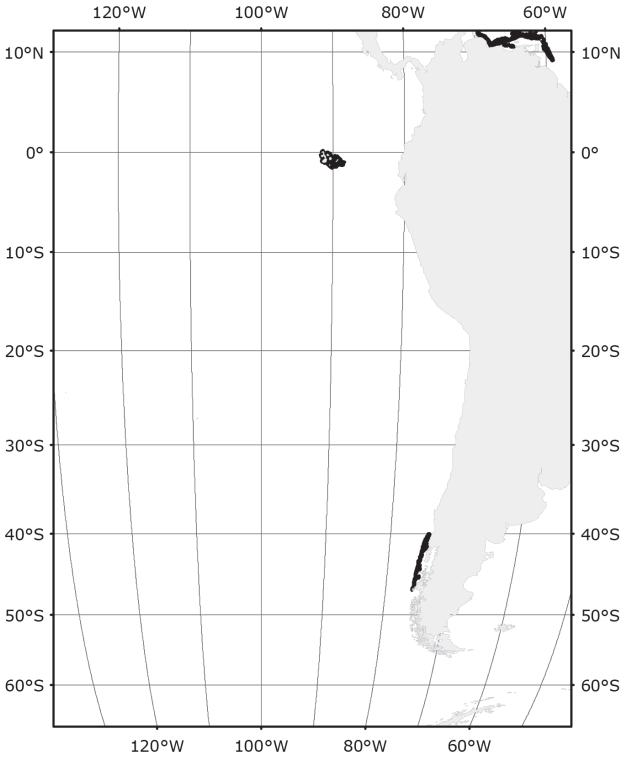


Fig. 52 ***Centrophorus squamosus***

Known distribution

Size: Maximum total length about 164 cm. Males mature at about 100 to 110 cm, and adult females at 110 to 125 cm. Size at birth is from 30 to 40 cm.

Interest to Fisheries and Human Impact: Interest to fisheries limited in the southeastern Pacific where it is taken, as bycatch on occasion, but is not a common species in bycatch landings.

Conservation status is listed as Vulnerable globally, although regionally its status may vary from Data Deficient (Australia, New Zealand, and South Africa) to Endangered in the eastern North Atlantic because of deepwater bycatch fisheries and targeted deep–shark fisheries. It has not been assessed regionally for the southeastern Pacific.

Local names: No information.

Remarks: The nomenclature and systematic status of this species is currently undergoing an extensive revision by the author and W.T. White (CSIRO, Hobart, Tasmania, Australia).

Literature: Ebert, Compagno and Cowley (1992); Meléndez and Céspedes (1996); White (2003); Bañón, Piñeiro and Casas (2008); Last and Stevens (2009); Acuña-Marrero *et al.* (2013); Ebert (2013, 2015); Ebert, Fowler and Compagno (2013); Ebert and Stehmann (2013); White *et al.* (2013); W.T. White (pers. comm.).

Deania Jordan and Snyder, 1902

Genus: ***Deania*** Jordan and Snyder, 1902, *Proc. U.S. Natn. Mus*. 25(1279): 80.

Type species: ***Deania eglantina*** Jordan and Snyder, 1902, by monotypy, a junior synonym of ***Acanthidium calceum*** Lowe, 1839.

Number of Recognized Deep–sea Southeastern Pacific Ocean Species: 1.

Synonyms: Genus ***Acanthidium*** Lowe, 1839, *Proc. Zool. Soc. Lond*., pt. 7: 92, Type species: without designation of type species, new based in part on ***Acanthidium calceus*** and ***A. pusillum***. Type location Madeira. Genus ***Nasisqualus*** Smith and Radcliffe, *in* Smith, 1912: 681. Type species: ***Nasisqualus profundorum*** Smith and Radcliffe, *in* Smith, 1912, by original designation. Genus ***Deaniops*** Whitley, 1932: 326. Type species: ***Acanthidium quadrispinosum*** McCulloch, 1915, by original designation. Genus ***Daeniops*** Bigelow and Schroeder, 1957: 101. Apparently an error for ***Deaniops*** Whitley, 1932.

Field Marks: Deepwater sharks with an extremely long and broad snout, bladelike upper and lower teeth without cusplets, and lower teeth much larger than uppers and imbricated, cylindrical or compressed bodies with delicate but rough skin and large erect or semierect denticles with pitchfork–like crowns and three sharp cusps, pectoral–fin free rear tips rounded, not angular or attenuated, two dorsal fins with strong grooved spines on both dorsal fins but with the second dorsal–fin spine much larger than the first, no anal fin, caudal fin with a strong subterminal notch, body colour light grey or grey–brown to blackish, fin webs dusky and without conspicuous markings, eyes huge and iridescent green or yellowish.

Diagnostic Features: Snout spatulate in dorsoventral view, a thin depressed elongated wedge in lateral view; snout greatly elongated with preoral length over half head length and greater than distance from mouth to pectoral–fin origins. Labial furrows extended anteromedially as elongated preoral grooves. Upper and lower teeth with narrower and more compressed crowns and roots. Tooth rows 22 to 36 upper jaw, 24 to 32 lower jaw. Dermal denticles with high pedicels, high erect crowns resembling tiny pitchforks, with slender narrow elongate triple cusps and ridges; bases narrow and stellate. Surface of skin very rough due to the erect large denticles. Pectoral fins with narrowly rounded or angular free rear tips but not acutely attenuated. Claspers without a lateral spine. Second dorsal fin about as large or slightly larger than first, with its base subequal to about 2/3 length of first dorsal–fin base. Second dorsal–fin origin about over middle of pelvic–fin bases; second dorsal–fin spine usually more than twice as long as first and with a broader base, strongly curved and with spine usually reaching apex of fin. Vertebral counts: total vertebral counts 118 to 128, precaudal vertebral counts 85 to 95. Intestinal valve turn counts not available. Moderately large, with adults from 97 to 122 cm total length. **Colour:** blackish brown or grey to greyish brown above and below.

Local names: No information.

Remarks: The genus currently has four species recognized, but there are several problems with the present arrangement, including identifying criteria for separation of ***Deania hystricosa*** from ***D. calcea*** other than larger denticles and often but not always a darker coloration; the former may be a junior synonymy of the latter species. Bigelow and Schroeder (1957) and Compagno (1984a) had synonymized ***D. rostrata*** (Garman, 1906) with ***D. eglantina*** or ***D. calcea***, but Yano and Tanaka (1983) suggested that it was separable from ***D. calcea*** without giving details on how the two species differed. This problem needs to be further investigated. Although ***D. profundorum*** and ***D. quadrispinosa*** are readily separable from each other and from ***D. calcea*** or ***D. hystricosa***, it is necessary to critically compare adequate samples within all of the ***Deania*** species and across their very broad ranges to confirm the current arrangement. Dr. Sho Tanaka is currently revising the genus.

Deania calcea (Lowe, 1839)

Acanthidium calceum Lowe, 1839, *Proc. Zool. Soc. London*, 1839 (7): 92. No type material, Madeira. Eschmeyer (2013) notes that the whereabouts of types for this species was unknown.

Synonyms: ***Deania eglantina*** Jordan and Snyder, 1902: 80, fig. 2. Holotype: U.S. National Museum of Natural History, USNM–49524, ca. 305 mm immature female, Albatross Sta. 3735, off Numazu, Totomi Bay, Omai Zaki Light, east coast of Honshu, Japan, “N 15° E. 11.4 m”, 36 fm” (figure coordinates). Status of holotype confirmed by Howe and Springer (1993: 7). ***Acanthidium aciculatum*** Garman, 1906: 207. Holotype: Museum of Comparative Zoology, Harvard, MCZ–1128–S, 88 cm (34 1/2”) adult male, Yokohama, Sagami Bay, Japan, illustrated by Garman (1913: pl. 12, fig. 1–4). Status of holotype confirmed by Hartel and Dingerkus (1997, *in* Garman: xl), who give the current length as 870 mm ?***Acanthidium rostratum*** Garman, 1906: 206. Holotype: Museum of Comparative Zoology, Harvard, MCZ–1047–S, 86 cm (34”) adult female, Yenoura, Suruga Gulf, Japan, illustrated by Garman (1913: pl. 11, fig. 1–4). Status of the holotype confirmed by Hartel and Dingerkus (1997, ***in*** Garman, The Plagiostoma: xl), who give the current length as 870 mm ***Centrophorus kaikourae*** Whitley, 1934: 199, no type designation or description. New species name based on the description of ***Centrophorus calceus*** by Thompson (1930: 275, pl. 42, fig. a–i) from Kaikoura, New Zealand. Thompson based his account on a 107 cm female in the collection of the Canterbury Museum, New Zealand, which he regarded as representing a range extension of the Northern Hemisphere

C. calceus (= ***Deania calcea***) to New Zealand waters. This specimen becomes the holotype of ***C. kaikourae*** Whitley, 1934, but may be lost. Garrick (1960b: 490) synonymized this species with ***Deania calcea*** and noted that "Thompson's specimen can no longer be found in the Canterbury Museum".

Other Combinations: ***Acanthidium eglantina*** or ***Acanthidium eglantinum*** (Jordan and Snyder, 1902), ***Centrophorus calceus*** (Lowe, 1839), ***Centrophorus rostratus*** (Garman, 1906), ***Deania calceus*** (Lowe, 1839), ***Deania calceus calceus*** (Lowe, 1839), ***Deania kaikourae*** (Whitley, 1934).

FAO Names: En – Birdbeak dogfish; **Fr** – Squale savate; **Sp** – Tollo pajarito.

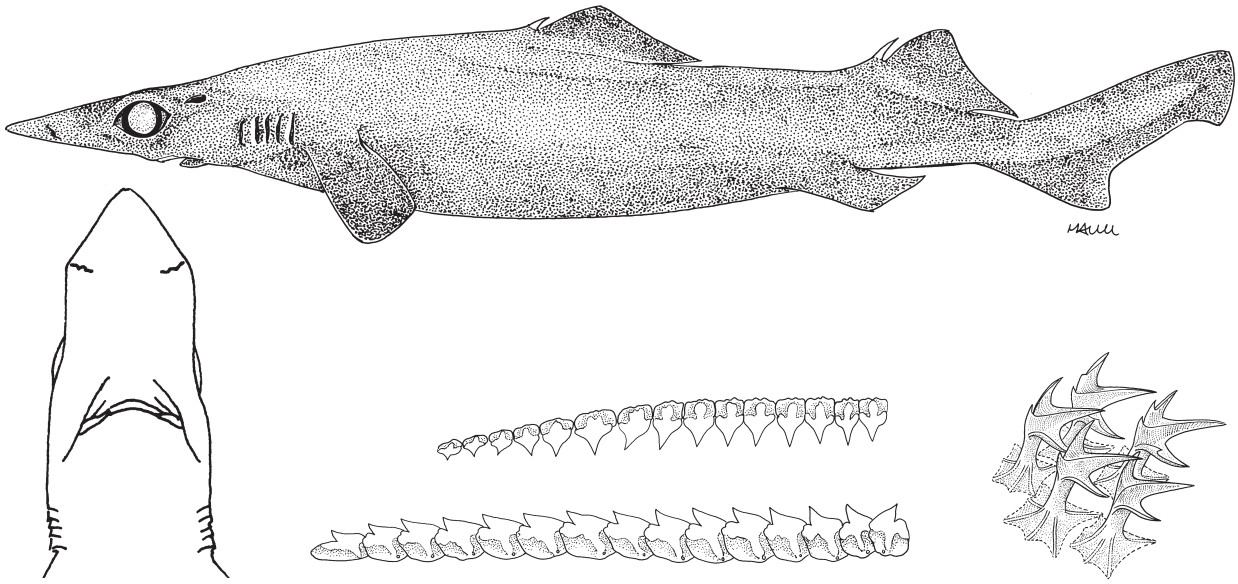


Fig. 53 ***Deania calcea***

Field Marks: Extremely long flat snout, compressed cutting teeth in both jaws, small pitchfork–shaped denticles that make the skin rough, extremely long and low first dorsal fin, grooved dorsal–fin spines with the second dorsal–fin spine much higher than the first, no anal fin and no subcaudal keel on caudal peduncle, coloration often grey or grey–brown.

Diagnostic Features: Snout extremely long and flattened. Teeth dissimilar in shape; upper teeth with a single, erect cusp, lowers with a single smooth–edged, blade–like cusp; tooth counts 25 to 35 upper jaw, 27 to 33 lower jaw. No subcaudal keel on underside of caudal peduncle. Denticles fairly small, crown length about 0.5 mm long in adults. First dorsal fin long and low, origin over bases of pectoral fins; distance from origin of first dorsal–fin spine to first dorsal–fin rear tip equal or greater than distance from free rear tip to second dorsal–fin spine. Vertebral counts: total vertebral counts 118 to 127, precaudal vertebral counts 85 to 95. Intestinal valve counts not available. Maximum size about 122 cm total length. **Colour:** varying from uniform light or dark grey or grey–brown above and below to dark brown, fins darker, fin webs dusky to blackish.

Distribution: Southeastern Pacific Ocean: Chile and Peru. Wide–ranging, although scattered in the Atlantic, Indian and Pacific oceans.

Habitat: A common deepwater dogfish, sometimes collected in large groups, of the outer continental and insular shelves and upper, middle, and lower slopes from 60 to 1490 m depth, on or near the bottom or well above it.

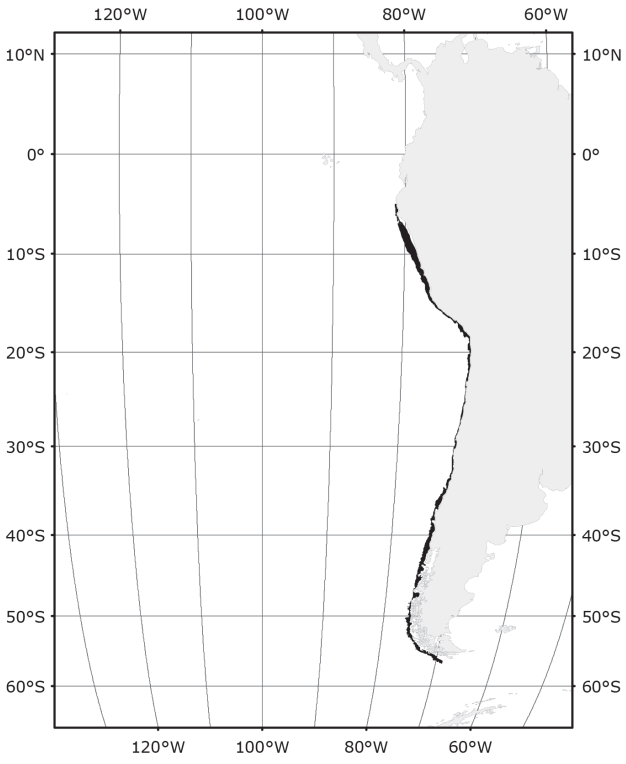


Fig. 54 ***Deania calcea***

Biology: Viviparous with a yolk sac, with litters of 1 to 17, averaging 7. Estimated ages range from 11 to 35 years for females and 13 to 29 years for males. Length at fifty–percent maturity for females is estimated at 105 cm total length and at 25 years. Age at maturity in Australia waters is about 14 years for males and 22 years for females with a maximum age of 24 to 33 and 31 to 37 years. A two year reproductive cycle has been proposed for the south Australian population of this species, which if accurate allows for only a maximum of seven litters, or about 42 pups, over the life time of an individual female.

Diet includes hatchetfish (Sternoptychidae), scaly dragonfishes, black dragonfishes (Stomiidae), barracudinas (Paralepididae), lanternfish (Myctophidae), cod–like fishes, scorpionfish (Scorpaenidae), squids (Ommastrephidae and ***Abraliopsis* sp.**) and shrimps (including penaeids). Off the west coast of South Africa a single species of lanternfish (***Diaphus ostenfeldi***) was by far the dominant prey, with small fractions of cephalopods, black dragonfish (***Melanostomias spilorhynchus***), and other fishes and penaeid shrimps (Ebert *et al.*, 1992).

Size: Maximum total length about 122 cm; males mature at 73 to 94 cm; females mature at 93 to 106 cm. Size at birth about 28 to 34 cm.

Interest to Fisheries and Human Impact: The species is not common and only taken occasionally as bycatch in the southeastern Pacific. Elsewhere it is taken in considerable numbers as bycatch of demersal trawl fisheries off southern Africa and Australia, with catch rates of up to 500 kg per hour off Australia. A fishery in southern Australia peaked at 1500 tonnes in 2000 and because of concerns a combined deep–water dogfish catch limit of 30 tonnes was implemented across southern Australia with most commercial fishing below 700 m banned. In Australia it is marketed for their flesh and squalene–rich liver. It is caught in bottom trawls, and by longline and gillnets fisheries.

The global conservation status is Least Concern.

Local Names: Sargento, Tollo pajarito (Chile).

Literature: Ebert, Compagno and Cowley (1992); Nakaya and Shirai (1992); Long (1997); Clarke *et al.* (2002b); Stevens (2003c); Irvine (2004); Last and Stevens (2009); Irvine *et al.* (2012).

2.3.2 Family ETMOPTERIDAE

Family: Subfamily Etmopterinae Fowler, 1934, *Proc. Acad. Nat. Sci. Philadelphia*, 85: 239 (family Squalidae).

Type genus: ***Etmopterus*** Rafinesque, 1810.

Number of Recognized Deep–sea Southeastern Pacific Ocean Genera: 3.

Synonyms: Subfamily Spinacini Bonaparte, 1838: 206 (family Squalidae). Also as family Spinaces Müller and Henle, 1839 (1): 83; family Spinacidae Owen, 1846: 51; family Spinacoidae Gill, 1862: 404; and family Spinacida Schmarda, 1871: 309. Type genus: ***Spinax*** Cuvier, 1816. Subfamily Centroscyllium (family Acanthias) Hasse, 1879 *(1)*: tab. 2. Type genus: ***Centroscyllium*** Müller and Henle, 1841.

FAO Names: En – Lantern sharks; **Fr** – Sagres lanterne; **Sp** – Tollos linternas.

Field Marks: Dwarf to moderate–sized sharks (usually less than 100 cm long and mostly below 80 cm long) with short to long snouts, cylindrical to slightly depressed bodies, teeth similar in both jaws or varying between jaws, upper teeth with a cusp and sometimes cusplets, lower teeth similar to upper teeth (***Aculeola***, ***Centroscyllium***, ***Trigonognathus***) or compressed and bladelike (***Etmopterus***) with a cusp and cusplets, except for ***Etmopterus sheikoi*** that has a cusp and blade (***Etmopterus***), denticles small to moderately large and variable in shape, with slender to stout, pointed, wedge–shaped or hooked erect crowns without pedicels, or with low concave sessile crowns, no keels on the caudal peduncle, two dorsal fins with strong grooved spines, the first dorsal fin usually smaller than the second and with origin varying from opposite the pectoral–fin inner margins or somewhat behind the pectoral–fin free rear tips, the second dorsal fin falcate or not and with its origin usually opposite the pelvic–fin bases or inner margins, no anal fin and caudal fin with subterminal notch moderately strong to lacking. Body and fin bases with photophores, inconspicuous and diffuse or in black photophore patches on the ventrolateral surface.

Diagnostic Features: Head moderately broad to narrow and somewhat flattened or cylindrical. Snout flat to conical and narrowly to broadly rounded, undulated or distally truncated in dorsoventral view. Spiracles moderate–sized to large and close behind eyes. Fifth gill opening not enlarged relative to first four but gill openings may increase slightly in width from first to fifth. Nostrils wide–spaced and with internarial width greater than or subequal to nostril width. Nostrils with simple, anterior nasal flaps that lack medial lobes or barbels. Mouth varying from broadly arched or Y–shaped and elongated to nearly transverse and very short, with thin, non–papillose lips. Labial furrows rudimentary to short, not encircling mouth, confined to mouth corners and under or exceptionally posterior to level of eyes, elongated posteriorly into postoral grooves or not; labial folds thin where present. Teeth with dignathic heterodonty well developed or not, upper teeth as large as lowers or with uppers smaller than lowers. Upper teeth high–crowned, never compressed and blade–like and not forming

a cutting edge, usually arranged in a quincunx pattern (except ***Trigonognathus***) and not overlapping, with narrow erect or flexed conical cusps and often one to three pairs of conical cusplets (***Centroscyllium*** and ***Etmopterus sheikoi***); lower teeth either similar to upper teeth (***Aculeola***, ***Centroscyllium***, ***Trigonognathus***) or compressed, high–crowned, broad and blade–like, imbricating, and forming a saw–like cutting edge, with a compressed oblique cusp and either a distal blade (***Etmopterus***) and no cusplets or with compressed cusplets (***Etmopterus sheikoi***). Tooth rows 15 to 68 upper jaw, 15 to 68 lower jaw; upper teeth about as numerous as lowers or much fewer than lowers. Trunk cylindrical and without lateral ridges on abdomen. Interdorsal space usually longer than first dorsal–fin base but ranging from about 0.6 to several times its length; pelvic–caudal space elongated or short and equal to about twice pelvic–fin bases. Caudal peduncle cylindrical or slightly compressed, short to moderately elongated, and without lateral keels or precaudal pits. Head, trunk, and tail with photophores in many species and possibly all members of the family; denticles small to moderate–sized, either sessile and without cusps or with spike–like hooked crowns on low bases; denticles without flattened leaf–shaped crowns and slender pedicels and low bases. Pectoral fins low, rounded–angular or almost circular, not falcate, anterior margins shorter than prespiracular length, rear tips rounded or rounded–angular and not greatly elongated. Pelvic fins subequal in size or larger than pectoral fins. Claspers usually with both medial and lateral clasper spines. Dorsal fins small to moderately large, broad, angular or rounded–angular, both with strong grooved spines; second dorsal–fin spine usually much larger than the first dorsal–fin spine. First dorsal fin small, not falcate, with length usually less than prespiracular space (except ***Aculeola***, in which it is longer than the prespiracular space); first dorsal–fin base over pectoral–pelvic space and well anterior to pelvic fins; first dorsal–fin origin varying from exceptionally over pectoral–fin bases to more commonly over pectoral–fin inner margins or behind pectoral–fin rear tips. Second dorsal fin usually much larger than first dorsal fin but sometimes about as large as it; second dorsal–fin base partly over or just behind pelvic–fin bases with second dorsal–fin origin over pelvic–fin bases or above inner margins of pelvic fins. Caudal fin heterocercal, with ventral lobe weakly to moderately developed in adults, and with subterminal notch weak to (usually) strong. Vertebral counts: total vertebral counts 71 to 99, monospondylous vertebral counts 35 to 56, diplospondylous precaudal vertebral counts 7 to 27, total precaudal vertebral counts 50 to 73, caudal vertebral counts 18 to 31. Intestinal valve with 4 to 19 turns. Adults dwarf to moderate–sized, from 16 to 107 cm total length but mostly below 80 cm total length. **Colour:** plain or with conspicuous light or dark markings on fins and body. Head, trunk, tail and fin bases with photophores, sometimes forming distinct black photomarks or broad black areas on the ventrolateral surface of the abdomen, flanks or tail. Photophores sometimes confined to ventral surface but often–denser there than on dorsal surface.

Distribution: Lantern sharks have an essentially circumglobal range in boreal, austral, temperate and tropical seas.

Habitat: These are primarily bottom–dwelling deepwater bathic inhabitants of the continental and insular slopes and more rarely the upper rises, but also occur on submarine ridges and seamounts and on the outer continental shelves in water greater than 50 m deep. They range in depth between 70 to at least 2250 m, with one species (***Etmopterus princeps***) descending to between 3550 and 4500 m on the lower rises of the eastern North Atlantic but with most species not found below 1500 m or above 200 m. A few species (***E. gracilispinis***, ***E. pusillus***, and possibly several others) are semioceanic and occur in the epipelagic and mesopelagic zones of the open ocean as well as on the continental and insular slopes, but as currently known the family apparently lacks specialized oceanic species such as some members of Somniosidae and most Dalatiidae.

Biology: Reproductive biology is sketchily known for most species, but those species for which information is available are viviparous with a yolk sac, and have between 3 and 20 young per litter. The reproductive cycle for most species is unknown, while other species for which some data is available have an undefined reproductive cycle. Age and growth studies for this group are few, but depending on the species may have a maximum longevity of 13 years or as long as 57 years.

Lantern sharks feed mostly on bony fishes including sardines (Clupeidae), lanternfish (Myctophidae), viperfish (Stomiidae), barracudinas (Paralepididae), cod–like fishes (gadoids) including grenadiers (Macrouridae), mackerel (Scombridae), and cephalopods (including cuttlefish and histioteuthid squids), but also eat small squaloid sharks, crustaceans (decapod crabs, penaeid and euphausiid shrimp), jellyfish, and brittle stars. Several etmopterid species are highly social, and form small to huge schools or aggregations, and it has been hypothesized that these sharks may hunt in packs to subdue larger prey items such as cephalopods.

Recent studies by Claes, Aksnes and Mallefet (2010), Claes *et al.* (2010, 2011) and Claes and Mallefet (2008, 2010a, b) have demonstrated the functionality and bioluminescence of the photophores of ***Etmopterus spinax***. It appears that at least for ***E. spinax***, and likely many other etmopterids, the photophores provide a means of camouflage for these sharks in the midwater. This ability allows them to both hide from potential predators and ambush prey items. The diet of many etmopterids, which includes midwater fishes, crustaceans, and cephalopods, supports this foraging behaviour.

Interest to Fisheries and Human Impact: Lantern sharks have little importance for fisheries because of the generally small size (below 60 cm) of most species. In part because of limited fisheries interest, the biology of the family is sketchily known compared to other, more important fisheries for dogfish such as members of the families Squalidae and Centrophoridae. Lantern sharks are often caught and discarded as bycatch of fisheries utilizing bottom trawls, pelagic trawls, fixed bottom nets, line gear including hook–and–line, and in sablefish traps. Some of the more abundant species are dried–salted for human consumption and processed for fishmeal and probably liver oil, which has a high content of squalene. However, the livers of most species are small and probably not of much commercial use except for the few relatively large (over 60 cm maximum length) species of ***Etmopterus*** and ***Centroscyllium***. Separate fisheries statistics are seldom reported for the family or for individual species at present.

The conservation status of lantern sharks globally is very poorly known, but with expanding deepwater fisheries worldwide, inadequate monitoring of deepwater sharks in most areas, limited interest in this group, a high degree of regional endemism, and low public profile these sharks may be of concern. Some etmopterid species may be protected and managed under existing regional governmental legislation, but imperfect monitoring of etmopterid bycatch and mortality from trawling makes conservation difficult even in protected areas.

Local names: No information.

Remarks: Most etmopterids have distinctive black patches with densely arrayed spherical, multicellular light–emitting organs or photophores on the ventral and lateral surfaces of the body and caudal fins. These luminescent markings are useful for the systematics of many etmopterids, particularly the genus ***Etmopterus***. The use of photophores or photomarks, and there terminology, in etmopterid taxonomy and identification is presented in Ebert and Compagno (In press).

Literature: Günther (1870); Garman (1913); Bigelow and Schroeder (1948, 1957); Shirai and Nakaya (1990a, b); Shirai (1992, 1996); Shirai and Tachikawa (1993); Schaaf–Da Silva and Ebert (2006); Claes and Mallefet (2008, 2010a, b); Claes, Aksnes and Mallefet (2010), Claes *et al.* (2010, 2011); Straube *et al.* (2010); Straube, Kriwet and Schliewen (2011); Ebert (2013, 2015); Ebert, Fowler and Compagno (2013); Ebert and Stehmann (2013); D.A. Ebert (unpubl. data).

List of Deep–sea Species Occurring in the Area:

Aculeola nigra de Buen, 1959
Centroscyllium granulatum Günther, 1887
Centroscyllium nigrum Garman, 1899
Etmopterus granulosus (Günther, 1880)
Etmopterus litvinovi Parin and Kotlyar, 1990
Etmopterus pusillus (Lowe, 1839)
Etmopterus pycnolepis Kotlyar, 1990

Key to Deep–sea Southeastern Pacific Ocean Genera:

1a. Teeth in both jaws with strong narrow cusps, but with cusplets absent or greatly reduced (Fig. 55a). Dorsal–fin spines very short, much lower than the fins (Fig. 55b) . . . . . ***Aculeola***

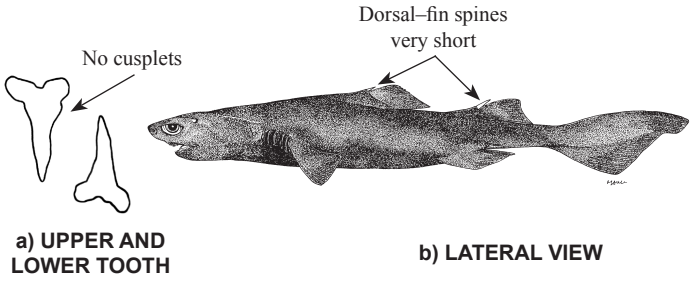


Fig. 55 ***Aculeola***

1b. Cusps and large cusplets present on upper teeth and cusplets present or absent on lower teeth (Figs. 57 and 58). Dorsal–fin spines long, especially that of second dorsal fin, which usually is as tall or taller than the fin (Fig. 56) **2**

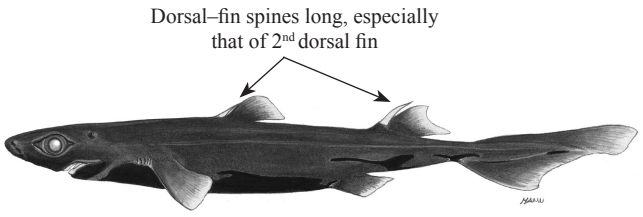


Fig. 56 ***Etmopterus***

2a. Lower teeth similar to uppers, not compressed and blade–like, and overlapping or abutting one another (Fig. 57). Mouth arcuate and moderately long . . . . . ***Centroscyllium***

2b. Lower teeth dissimilar to uppers, compressed, blade–like, and with adjacent teeth overlapping or abutting one another (Fig. 58). Mouth short, nearly straight and transverse . . . . . ***Etmopterus***

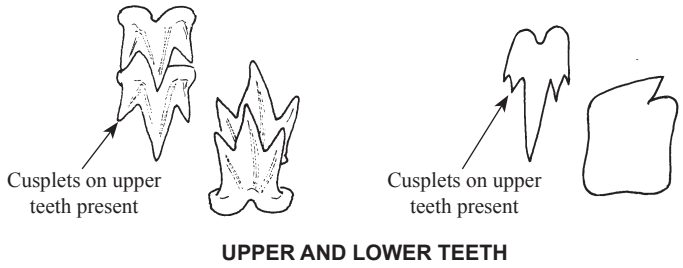


Fig. 57 ***Centroscyllium*** **Fig. 58** ***Etmopterus***

Aculeola de Buen, 1959

Genus: ***Aculeola*** de Buen, 1959, *Bol. Mus. Nac. Hist. Nat. Santiago Chile*, 27(3): 180.

Type Species: ***Aculeola nigra*** de Buen, 1959, by original designation.

Number of Recognized Species: 1.

Synonyms: None.

Field Marks: See the single species.

Diagnostic Features: Head broad and flattened, wider than deep. Snout broadly rounded or subangular, flattened and truncated; snout short, preoral length about 0.5 to 0.6 of mouth width. Spiracles subangular–oval and much shorter than eyes. Gill openings increasing in width posteriorly. Mouth subterminal on head, not extending anterior to eye and ending far behind nostrils. Mouth relatively long and broadly arcuate, length 0.4 to 0.5 of width. Labial furrows without post–labial grooves. A shallow groove between upper lips and upper jaws. Teeth similar in upper and lower jaws, small, not fang–like, with conical hooked cusps, without cusplets or with at most one pair of reduced cusplets, not compressed and blade–like and not imbricate; tooth row counts 60 to 74 upper jaw, 60 to 63 lower jaw. Body stocky. Lateral trunk denticles with thorn–like cusps and stellate bases, denticles sparse and spaced well apart. Claspers elongated, extending well behind free rear tips of pelvic fins. Dorsal–fin spines very short, weak and nearly straight, second dorsal–fin spine not greatly enlarged, slightly larger than first but with its tip falling well below apex of second dorsal fin. Dorsal fins low and elongated, length of first dorsal fin greater than interdorsal space; first dorsal–fin origin over pectoral–fin bases or inner margins; second dorsal fin about as large as first dorsal or slightly smaller. Body with photophores more dense on the ventral surface than the dorsal surface, but no conspicuous black photomarks on underside of head and abdomen, flanks, tail and caudal fin. Vertebral counts: total vertebral count 79, monospondylous vertebral counts 35 to 38, diplospondylous precaudal count 15, total precaudal vertebral counts 50 to 59, caudal vertebral count 20. Intestinal valve with 12 to 14 turns. Moderate sized with a maximum total length of 67 cm. **Colour:** blackish above and below; fins not abruptly lighter than fin bases; no patch of naked white skin on edge of upper eyelid.

Local names: No information.

Remarks: This monotypic genus is very distinctive in anatomical features, including jaw, cranial, and vertebral structure, as well as in external morphology. It may be the most plesiomorphic of etmopterids by comparison with ***Echinorhinus*** as an out group, but has some unusual unique derived features including its hook–like teeth and septate vertebral column without calcified centra.

Aculeola nigra de Buen, 1959

Aculeola nigra de Buen, 1959, *Bol. Mus. Nac. Hist. Nat. Santiago Chile*, 27(3): 180. Holotype: Estacion de Biologia Marina de Montemar, Universidad de Chile, EBMCh 10.191, apparently lost, 488 mm female, off Concon, Chile, 110 m.

Synonyms: None.

Other Combinations: None.

FAO Names: En – Hooktooth dogfish; **Fr** – Squale noir; **Sp** – Tollo negro de cachos.

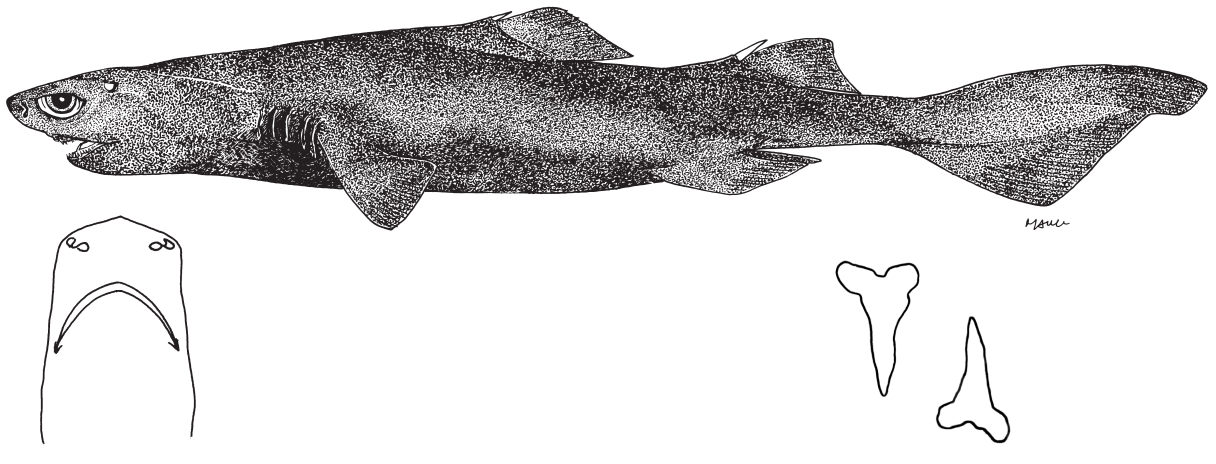


Fig. 59 ***Aculeola nigra***

Field Marks: A blackish brown stocky dogfish with a broad blunt snout, broad long arched mouth with small hook–like teeth in both jaws, short dorsal–fin spines on low, subangular dorsal fins, and no anal fin.

Diagnostic Features: See generic account.

Distribution: Southeastern Pacific Ocean: Peru to central Chile.

Habitat: A little known, benthic, pelagic and mesopelagic shark of the Pacific South American continental shelf and upper slope, at depths of 110 to 735 m; most records between 200 to 500 m.

Biology: Viviparous with a yolk–sac, number of young 3 to 19, with an increase in the number of embryos with increased size of the female. Feeding habits of this shark includes deep–sea shrimps, euphausiids, and hake (***Merluccius gayi***). This species appears to migrate into the water column where it commonly feeds on mesopelagic and pelagic prey items.

Size: Maximum total length about 67 cm; females mature between 39 and 52 cm and reach 67 cm; males mature at 38 to 42 cm and reach a maximum length of 54 cm. Size at birth about 13 to 17 cm (size of full–term fetuses).

Interest to Fisheries and Human Impact: Interest to fisheries none at present, presumably caught and discarded as bycatch of demersal trawl fisheries. No statistics are available on fisheries catches.

Conservation status of the hooktooth dogfish is Data Deficient, but may be of concern due to its narrow geographic and bathymetric distribution and limited knowledge on its biology.

Local Names: Tollo negro (Chile).

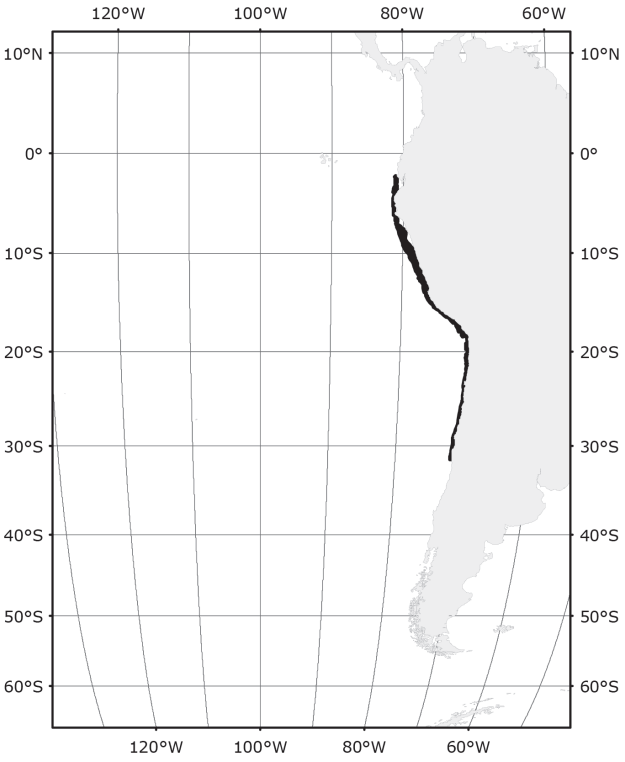


Fig. 60 ***Aculeola nigra***

Remarks: A little known species, but it appears to be quite common where it occurs.

Literature: de Buen (1959a); Kato, Springer and Wagner (1967); Compagno (1984); Burgess and Springer (1986); Shirai (1992, 1996); Acuña and Villarroel (2010); Gatica and Acuña (2011); Ebert, Fowler, and Compagno (2013); Bustamante, Vargas–Caro, and Bennett (2014); Cornejo *et al.* (2015).

Centroscyllium Müller and Henle, 1841

Genus: ***Centroscyllium*** Müller and Henle, 1841, *Syst. Beschr. Plagiost.*, pt. 3, suppl.: 191.

Type Species: ***Centroscyllium fabricii*** Müller and Henle, 1841 (new combination) by monotypy, equals ***Spinax fabricii*** Reinhardt, 1825.

Number of Recognized Deep–sea Southeastern Pacific Ocean Species: 2.

Synonyms: Genus ***Paracentroscyllium*** Alcock, 1889, *Ann. Mag. Nat. Hist.* (6), 4(23): 379. Type species: ***Paracentroscyllium ornatum*** Alcock, 1889, by monotypy. Genus ***Centrocyllium*** Jordan and Fowler, 1903, *Proc. U.S. Natn. Mus*. 26 (1324): 635. Apparent misspelling for ***Centroscyllium*** in two places (species account and figure legend of ***C. ritteri***), but properly spelled elsewhere in their account.

Field Marks: Short to moderately long snout, comb–like teeth with cusps and cusplets in both jaws, dorsal–fin spines present and large and no anal fin. Colour greyish or blackish–brown.

Diagnostic Features: Head broad and flattened, wider than deep. Snout moderately rounded or slightly pointed, flattened and truncated; snout short to moderately long, preoral length about 0.5 to 1.0 of mouth width. Gill openings about equally wide or increasing in width posteriorly. Spiracles subangular–oval and much shorter than eyes. Mouth subterminal on head, not extending anterior to eye and ending far behind nostrils; mouth broadly arcuate and relatively long to short, length 0.2 to 0.5 of width. Labial furrows usually with post–labial grooves present. A shallow groove between upper lips and upper jaws. Teeth similar in upper and lower jaws, not fang–like, small, with conical straight cusps and one or two pairs of prominent cusplets, not compressed

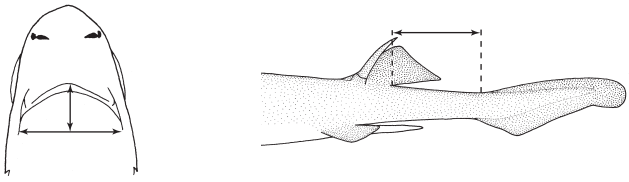
and blade–like and not imbricated; tooth row counts 45 to 75 upper jaw, 43 to 76 lower jaw. Body stocky to moderately slender. Lateral trunk denticles, where present, with bluntly conical, thorn or bristle–like cusps and stellate bases, denticles usually sparse and spaced well apart. Dorsal–fin spines long, usually stout, and curved, second dorsal–fin spine much larger than the first and with its tip extending just below or opposite apex of second dorsal fin. Dorsal fins high and short, first dorsal–fin length much less than interdorsal space; first dorsal–fin origin usually about opposite or just behind pectoral–fin free rear tips; second dorsal fin usually larger than first but slightly larger or subequal in some species. Body with photophores more dense on the ventral surface than the dorsal surface or absent from the dorsal surface, but usually no conspicuous black photomarks on underside of head and body, flanks, tail and caudal fin (except in ***Centroscyllium ritteri***, which has discrete photomarks). Vertebral counts: total vertebral counts 81 to 97, monospondylous vertebral counts 37 to 46, diplospondylous vertebral counts 14 to 22, total precaudal vertebral counts 54 to 67, caudal vertebral counts 29 to 31. Intestinal valve with 4 to 10 turns. Size small to moderate with adults to 84 cm, and possibly 107 cm total length. **Colour:** greyish to blackish–brown above and below; fin webs varying from mostly about as dark as bases to abruptly white or with black and white markings; no naked patch of white skin on edge of upper eyelid.

Local names: No information.

Remarks: Seven species are currently recognized, with two species, ***Centroscyllium granulatum*** and ***C. nigrum***, known to occur in the southeastern Pacific Ocean.

Key to Deep–sea Southeastern Pacific Ocean Species:

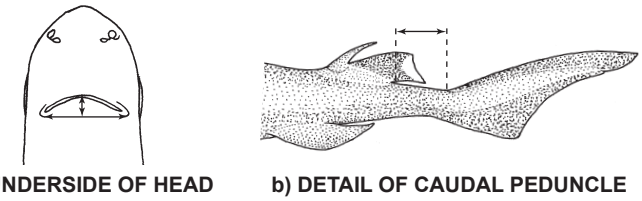
1a. Mouth elongated and about 50% as long as wide (Fig. 61a). Caudal peduncle apparently elongated, dorsal–caudal space about 15% of total length (Fig. 61b). Fins without prominent white tips and margins . . . . . ***Centroscyllium granulatum***



a) UNDERSIDE OF HEAD b) DETAIL OF CAUDAL PEDUNCLE

Fig. 61 ***Centroscyllium granulatum***

1b. Mouth shorter and about 22 to 36% as long as wide (Fig. 62a). Caudal peduncle short, dorsal–caudal space 11 to 15% of total length (Fig. 62b). Fins with prominent white tips and margins . . . . . ***Centroscyllium nigrum***



a) UNDERSIDE OF HEAD b) DETAIL OF CAUDAL PEDUNCLE

Fig. 62 ***Centroscyllium nigrum***

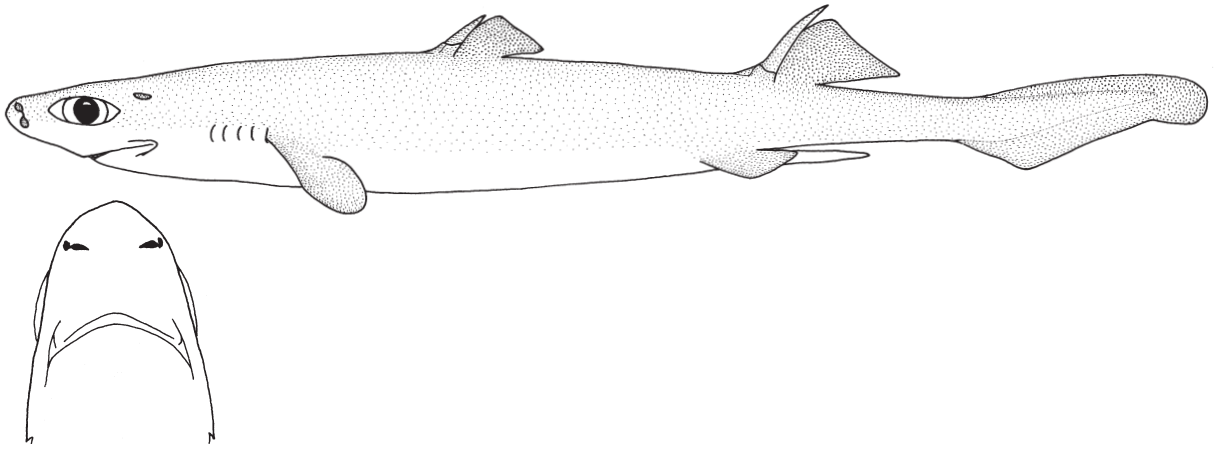
Centroscyllium granulatum Günther, 1887

Centroscyllium granulatum Günther, 1887, *Rep. Sci. Res. Voy. H.M.S. Challenger, Zool.*, 22: 7. Holotype: British Museum (Natural History), BMNH–1887.12.7.2, 265 mm TL adult male (11" or 279 mm in original description), NW Straits of Magellan, Southeast Pacific, Challenger Sta. 311, 52°45.5'S, 73°46'W, BT = 46.0°F, 448 m.

Synonyms: None.

Other Combinations: ***Centroscyllium fabricii*** (not Reinhardt, 1825), ***Etmopterus granulosus*** (not Günther, 1880).

FAO Names: En – Granular dogfish; **Fr** – Aiguillat râpe; **Sp** – Tollo negro raspa.



UNDERSIDE OF HEAD

Fig. 63 ***Centroscyllium granulatum***

Field Marks: Teeth with narrow cusps and cusplets in both upper and lower jaws, denticles high, conical and sharp–cusped, dense and numerous on dorsal and ventral surfaces of body, skin firm, first dorsal fin with a low subangular fin web, two grooved dorsal–fin spines, the first high and the second very high, abdomen and caudal peduncle long, and no anal fin. Colour uniform blackish–brown above and below, without white fin markings or discrete black photomarks on body.

Diagnostic Features: Preoral snout about 33% of head length. Mouth rather narrowly arched and almost 50% as long as wide. Body slender and cylindrical. Caudal peduncle elongated with dorsal–caudal space about 15% of total length. Denticles close–set and numerous on body; lateral trunk denticles conical and with sharp hooked cusps. Pectoral–fin apices when laid back ending well anterior to first dorsal–fin spine origin. First dorsal fin low, with height about 0.5 to 0.6 times base length, fin possibly subtriangular in shape; first dorsal–fin spine short, much lower than second dorsal–fin spine, possibly about as high as first dorsal–fin apex and ending just anterior to it. Second dorsal fin much larger than first dorsal fin; second dorsal–fin spine very large, probably extending above second dorsal fin apex and extending posteriorly to about opposite it; origin of second dorsal–fin spine over or slightly anterior to pelvic–fin insertions. Vertebral counts not available. Maximum total length about 61.5 cm. **Colour:** body brownish–black above and below, without conspicuous black areas or markings on underside of body or caudal peduncle; fins without white markings.

Distribution: Southeastern Pacific Ocean: central and southern Chile. Reported to occur in the southwestern Atlantic around the Falkland Islands (Malvinas), but apparently there are no confirmed records of it.

Habitat: A poorly known deepwater shark caught off the upper slope of southern South America at 300 to 500 m.

Biology: Essentially unknown, yolk–sac viviparous with litters of at least 16.

Size: Maximum total length at least 61.5 cm; males adult at 31 cm total length. Size at birth 13 cm.

Interest to Fisheries and Human Impact: Interest to fisheries none, although it is caught as bycatch in shrimp fisheries.

Conservation status of this poorly known shark is Data Deficient.

Local Names: Tollo negro raspa (Chile).

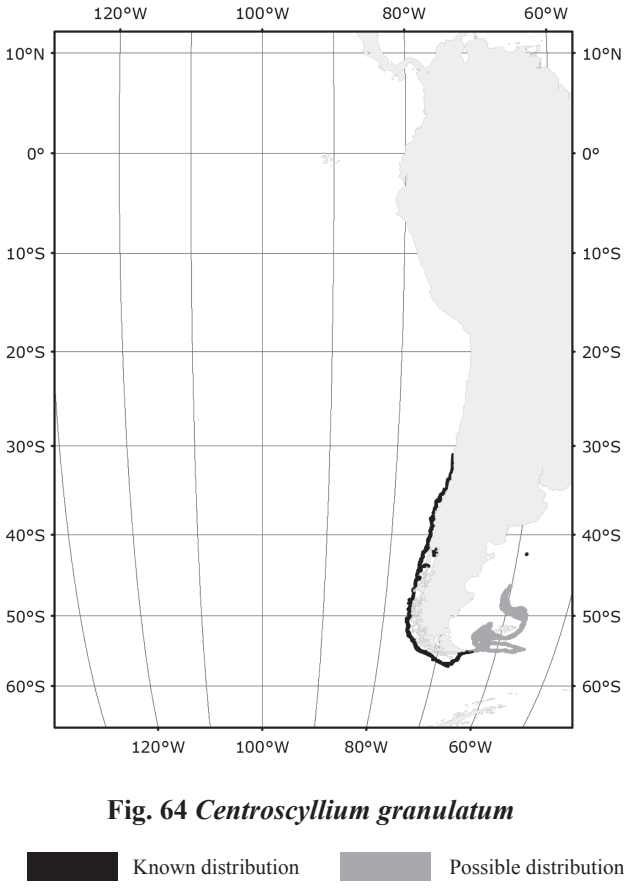


Fig. 64 ***Centroscyllium granulatum***

Remarks: ***Centroscyllium granulatum*** was confused with ***Etmopterus granulosus*** (Günther, 1880) by de Buen (1959) and with ***E. granulosus*** and ***Centroscyllium nigrum*** by Kato, Springer and Wagner (1967) but is quite distinct (Krefft, 1968). Compagno (1984) examined the holotypes of ***E. granulosus*** and ***C. granulatum*** in the British Museum (Natural History), and was able to confirm the validity of this species. This species needs careful comparison with other members of its genus utilizing more adequate material than the holotype. Lahille (1921) synonymized this species with ***C. fabricii***, which has subsequently been reported from the Beagle Channel by Menni, Burgess and Garcia (1993). In addition, Long (1994) reported ***C. nigrum*** from the Chilean sector of the Straits of Magellan. There may be problems with the identity of ***Centroscyllium*** from the southern tip of South America (D.A. Ebert, unpubl. data, is investigating the problem).

Literature: Günther (1887); Regan (1908); Garman (1913); Bigelow and Schroeder (1957); de Buen (1959); Kato, Springer and Wagner (1967); Krefft (1968); Compagno (1984); Kong and Melendez (1991); Menni, Burgess and Garcia (1993); Long (1994); Acuña and Kyne (2004); Ebert, Fowler and Compagno (2013); Bustamante, Vargas–Caro, and Bennett (2014); D.A. Ebert (unpubl. data).

Centroscyllium nigrum Garman, 1899

Centroscyllium nigrum Garman, 1899, *Mem. Mus. Comp. Zool. Harvard*, 24: 28, pl. 1, fig. 2, pls. 4–5, pl. 69, fig. 1. Syntypes: Two specimens, 11.5 in long (used for most of the description and the illustrations), and 4.75 in long (with additional descriptive notes) were mentioned by Garman without catalog numbers, without specific reference to appended data for two RV *Albatross* stations from which they were collected, and without type designations; both were collected off the

Pacific Coast of Panama. Regan (1908, *Ann. Mag. Nat Hist.*: 41) and Garman (1913, *Mem. Mus. Comp. Zool. Harvard*, 36: 231) gave abbreviated accounts of this species without designating types. According to Hartel and Dingerkus (in Garman, 1997, The Plagiostoma: xli), these are respectively MCZ–106–S, 295 mm female, RV *Albatross* sta. 3356, 7°9'30"N, 81°8'30"W, 999 m, and MCZ–107–S, 120 mm immature male, 6°30'N, 81°44'W, 1016 m. Hartel and Dingerkus consider MCZ–106–S the holotype and MCZ–107–S the sole paratype without explanation. Compagno (1984) and Eschmeyer (2012) considered these specimens as syntypes based on Garman's (1899) account. Hartel and Dingerkus (1997) can be considered as first revisors in selecting MCZ–106–S as the most appropriate syntype of the two for a lectotype, although they did not specifically designate it as such.

Synonyms: ***Centroscyllium ruscosum*** Gilbert, 1905, *Bull. U.S. Fish Comm.* 23(2): 580, fig. 230. Holotype: U.S. National Museum of Natural History, USNM–51585, 222 mm TL immature male, Albatross Sta. 3997, vicinity of Kauai, Hawaiian Islands, 18–26°N, 156–172°W, 765–785 m. Status of holotype confirmed by Howe and Springer (1993, *Smiths. Contr. Zool.* [540]: 12).

Other Combinations: None.

FAO Names: En – Combtooth dogfish; **Fr** – Aiguillat peigne; **Sp** – Tollo negro peine.

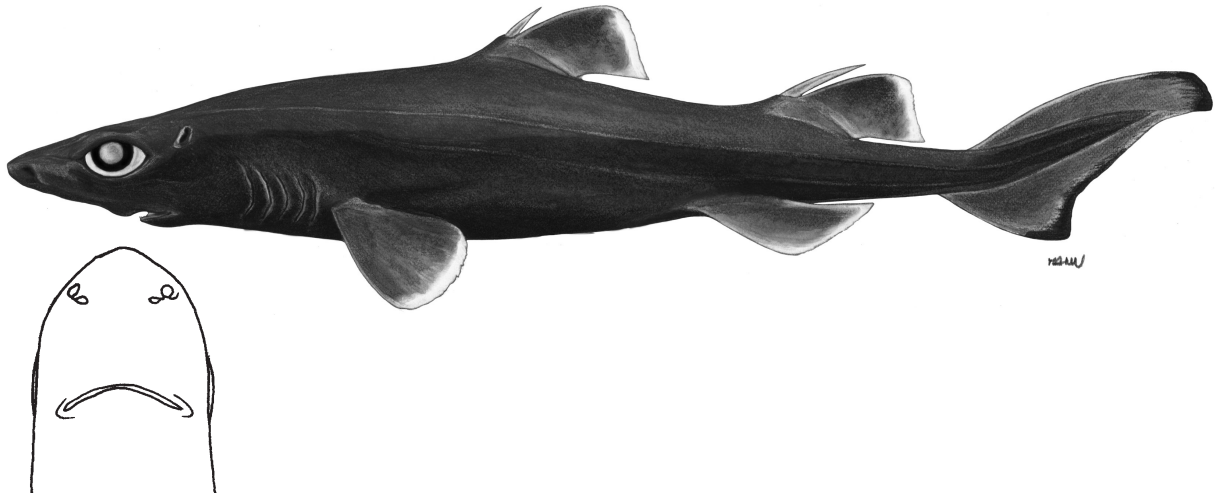


Fig. 65 ***Centroscyllium nigrum***

Field Marks: Teeth with narrow cusps and cusplets in both upper and lower jaws, denticles high, conical and sharp–cusped, dense and numerous on dorsal and ventral surfaces of body, skin firm, first dorsal fin with a low subangular fin web, two grooved dorsal–fin spines, the first low and the second moderately high, abdomen long, caudal peduncle short to moderately long, and no anal fin. Colour uniform blackish–brown above and below, with conspicuous white fin markings but without discrete black photomarks on body.

Diagnostic Features: Preoral snout about 28 to 38% of head length. Mouth very broadly arched and 22 to 36% as long as wide. Teeth similar in both jaws, with a large central cusp flanked by one or two lateral cusplets; tooth counts range from 40 to 66 for the upper jaw and 40 to 60 on the lower. Body moderately stout and compressed. Caudal peduncle short to elongated with dorsal–caudal space about 11 to 15% of total length. Denticles close–set and numerous on body; lateral trunk denticles conical and with sharp hooked cusps. Pectoral–fin apices when laid back reaching level of first dorsal–fin spine origin or ending just anterior or posterior to it. First dorsal fin low with height 0.4 to 0.8 times base length, fin semi–elliptical in shape; first dorsal–fin spine short, much lower than second dorsal–fin spine, and ending below or about as high as first dorsal–fin apex but far anterior to it. Second dorsal fin about as large as first dorsal fin or slightly larger; second dorsal–fin spine fairly high, as high as or higher than second dorsal–fin apex but ending well anterior to it, and with origin over or somewhat anterior to pelvic–fin insertions. Vertebral counts: total vertebral counts 81 to 85, precaudal vertebral counts 54 to 57, monospondylous precaudal vertebral counts 37 to 39. Intestinal valve counts 4 to 6. Size moderate, with adults 35 to 51.4 cm total length. **Colour:** body blackish brown above and below, without conspicuous black markings on ventral surface or sides of tail; fins with prominent white tips and margins.

Distribution: Southeastern Pacific Ocean: Colombia, Ecuador, including the Galápagos Islands, Peru, and Chile to the Straits of Magellan. Elsewhere, scattered in the eastern and western central Pacific, including the Hawaiian Islands.

Habitat: A little known deepwater dogfish of the eastern Pacific and Hawaiian continental and insular slopes, on or near the bottom at depths of 400 to 1145 m. Caught on soft mud and sand bottom.

Biology: Viviparous with a yolk–sac, litter size 4 to 15 young. Feeds on deepwater shrimp, cephalopods, and mesopelagic bony fishes, suggesting that it feeds off the bottom as well as on it.

Size: Maximum total length 51.4 cm. Males adult at 32 to 39 cm and females adult at 32 to 43 cm, and to at least 50 cm. Size at birth 11 to 15 cm.

Interest to Fisheries and Human Impact: Interest to fisheries none, although taken as bycatch in deep–sea shrimp fisheries. In California it has been incidentally caught in sablefish (***Anoplopoma fimbria***) traps, but not utilized.

Conservation status is Data Deficient.

Local Names: Tollo negro peine (Chile), Tiburón perro (Colombia), Tollo negro (Spanish)

Remarks: This species has been confused with ***Etmopterus granulosus*** (Günther, 1880) and ***Centroscyllium granulatum*** (Günther, 1887) by Kato, Springer and Wagner (1987), but is distinct. Comparison of eastern Pacific material from off southern California with material from southern Chilean from the Straits of Magellan reveal morphological differences that are under investigation to determine if it is the same species or may be a different species (D.A. Ebert, unpubl. data).

Literature: Garman (1899, 1913); Kato, Springer and Wagner (1967); Compagno (1984); Long (1994); Crow and Crites (2002); Ebert (2003); Gatica and Acuña (2011); Ebert, Fowler and Compagno (2013); Bustamante, Vargas–Caro, and Bennett (2014); D.A. Ebert (unpubl. data).

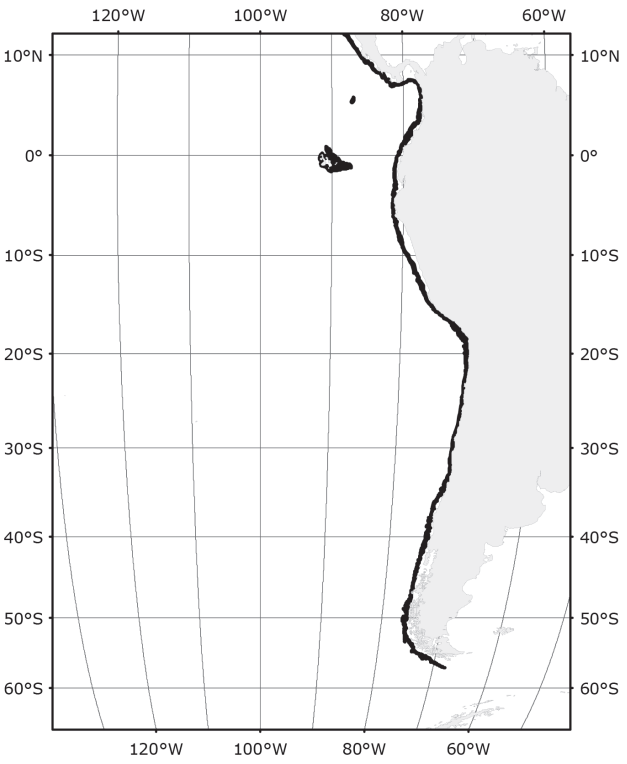


Fig. 66 ***Centroscyllium nigrum***

Known distribution

Etmopterus Rafinesque, 1810

Genus: ***Etmopterus*** Rafinesque, 1810, *Caratt. gen. sp. anim. piant. Sicilia, Palermo*, pt. 1: 14.

Type Species: ***Etmopterus aculeatus*** Rafinesque, 1810, by monotypy, equals ***Squalus spinax*** Linnaeus, 1758.

Number of Recognized Deep–sea Southeastern Pacific Ocean Species: 4.

Synonyms: Genus or subgenus ***Spinax*** Cloquet, 1816, *Dict. Sci. Nat.*, ed. 1 (2?), 1, suppl., 93 (not seen); Subgenus ***Spinax*** Cuvier, 1816, *Reg. Anim.*, ed. 1, 2: 129 (genus ***Squalus*** Linnaeus, 1758). Type species: ***Squalus spinax*** by absolute tautonymy. Probably also subgenus ***Spinax*** Bosc 1816–1819, *Nouvelle Dictionnaire d'Histoire Naturelle*, according to Whitley, 1935, *Aust. Zool*. 8[2]: 136. Genus ***Centrina*** Lowe, 1833, *Proc. Zool. Soc. London*, 1833 (1): 144; not ***Centrina*** Cuvier, 1816 = ***Oxynotus*** Rafinesque, 1810. Genus ***Acanthidium*** Lowe, 1839, *Proc. Zool. Soc. London*, 1839 (7): 91. Type species: ***A. pusillum*** Lowe, 1839 (= ***Etmopterus pusillus***), by subsequent designation by Jordan and Evermann (1896, *Bull. U.S. Natn. Mus*. (47, pt. 1): 55) and Goode and Bean (1896, *Oceanic Ichthyol., Smithson. Inst. Spec. Bull*.: 10); genus ***Acanthidim*** Sollas, 1906, *Zool. Rec*. 43, Pisces, 1907: 58. Erroneous spelling.

Field Marks: Moderately long snout, upper teeth with cusp and cusplets, lower teeth blade–like, second dorsal fin and spine larger than first dorsal fin and spine and no anal fin.

Diagnostic Features: Head broad and flattened, wider than deep, or cylindroconical and about as wide as deep. Snout broadly rounded to slightly pointed and with a wedge–shaped tip, flattened or subconical; snout moderately elongated, preoral length about 0.9 to 1.7 of mouth width. Spiracles subangular–oval and much shorter than eyes. Gill openings about equally wide. Mouth subterminal on head, not extending anterior to eye and ending far behind nostrils; mouth short and very broadly arched, nearly transverse, length 0.2 to 0.5 of mouth width. Labial furrows with postlabial grooves present. A shallow groove between upper lips and upper jaws. Teeth strongly differentiated in upper and lower jaws, upper teeth small, not fang–like, with a strong, conical nearly straight cusp and one, two or several pairs of prominent cusplets; lower dentition compressed, imbricated, and blade–like, with a flattened cusp, no cusplets, and a distal blade; tooth row counts upper jaw 18 to 38, lower jaw 24 to 55. Body stocky to slender. Lateral trunk denticles with thorn or bristle–like conical or hooked cusps, or flat, truncate, and without cusps, bases cross–shaped; denticles usually spaced close together. Dorsal–fin spines usually large and strongly curved; second dorsal–fin spine usually much larger than first and extending to apex of second dorsal fin. Dorsal fins high and short; first dorsal–fin length much less than interdorsal space; first dorsal–fin origin varying from opposite pectoral–fin free rear tips to well behind them; second dorsal fin noticeably larger than first. Vertebral column with primary calcification present, including centra with calcified double cones, notochord constricted, without septa; vertebral column with haemal arches extending five to nine centra anterior

to the monospondylous–diplospondylous transition. Vertebral counts: total vertebral counts 68 to 99, precaudal vertebral counts 51 to 73, monospondylous vertebral counts 36 to 56. Intestinal valve with 8 to 19 turns. Small to moderate sized sharks with a maximum total length of about 90 cm. **Colour:** variable, from blackish to tan above, often black below; fin webs varying from not much lighter than the bases to abruptly lighter; a semicircular or elongated patch of white skin on edge of upper eyelid in some species. Body often with photophores more dense on the ventral surface than the dorsal surface, conspicuous black photophore patches often present on underside of head and abdomen, flanks, tail and caudal fin but obscure or absent in some species.

Biology: Reproduction is yolk–sac viviparous with litters ranging from 1 to 21. Virtually nothing is known on the reproductive cycle of these sharks. Most of those whereby some data is available indicates that they have an undefined reproductive cycle with gravid females being present in some populations year round. Virtually nothing is known about the age and growth of these sharks. Depending on the species some may mature in as little as 5 to 8 years or as much as 20 to 30 years. Some species may live for only 13 years while others may have longevity of up to 57 years.

It has long been speculated that the social behavior of some ***Etmopterus*** species to forage in packs (pack–hunting) allows these relatively small sharks to capture and consume prey items that a single individual would not be able to capture alone. The elaborate photomarks and photolines of many ***Etmopterus*** species may help groups or schools to coordinate their movements while hunting or when engaged in other social activities. ***Etmopterus*** species may be successful by combining relatively small size, social feeding, and powerful feeding structures (a grabbing, cutting and dismembering dentition in strong, short jaws), which allows them to take advantage of a broad variety of small to large prey on the slopes including bony fish and invertebrates that are larger than they can swallow whole and are too large for a single individual to overcome.

Local names: No information.

Remarks: This is one of the most speciose genera of sharks worldwide with 38 nominal species currently recognized, of which four species are currently recognized as occurring in the southeastern Pacific Ocean deep–sea. The genus has several species–complexes that will likely reveal additional species making it, along with the ***Apristurus***, among the most species–rich genera of sharks. The group appears to exhibit a high degree of endemism with several species having a restricted distributional range. The scientific names for several of these nominal species will likely change with improved taxonomic resolution of the group.

The vernacular name 'lantern shark' is descriptive of the minute photophores of these sharks that are also found in other members of the family.

Key to Deep–sea Southeastern Pacific Ocean Species (Provisional):

1a. Skin smooth, denticles with low, flat, concave, sessile crowns atop low bases (Fig. 67) . . . . . ***Etmopterus pusillus***

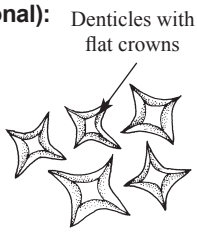
1b. Skin with a fuzzy or rough texture, denticles with erect, thorn–like, cuspidate crowns, more or less elevated from their bases (Figs. 68 and 69) **2**

2a. Denticles on dorsal surface of head arranged in linear rows (Fig. 68), which extend to the flanks, caudal peduncle and caudal–fin base . ***Etmopterus pycnolepis***

2b. Denticles on dorsal surface of head not arranged in linear rows (Fig. 69); flanks, caudal peduncle and caudal–fin base with or without linear rows of denticles . **3**

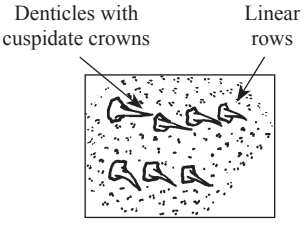
3a. Lateral flank markings present, but indistinct (Fig. 70); flanks, caudal peduncle and caudal–fin base with linear rows of denticles . . . . . ***Etmopterus granulosus***

3b. Lateral flank markings absent (Fig. 71); flanks, caudal peduncle and caudal–fin base without linear rows of denticles . . . . . ***Etmopterus litvinovi***



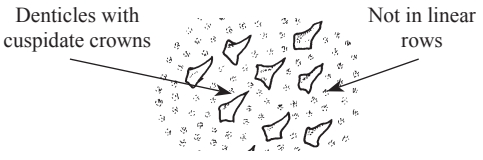
DERMAL DENTICLES
(dorsal view)

Fig. 67 ***E. pusillus***



DERMAL DENTICLES
(dorso–lateral view)

Fig. 68 ***E. pycnolepis***



DERMAL DENTICLES
(dorso–lateral view)

Fig. 69 ***E. litvinovi***

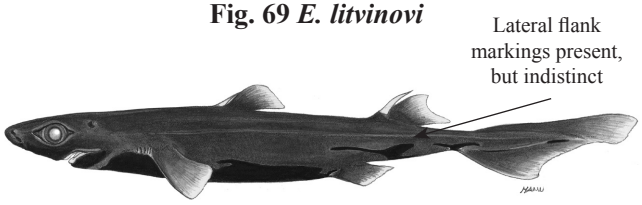


Fig. 70 ***E. granulosus***

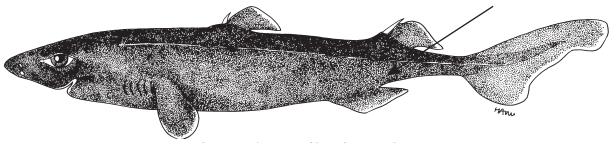


Fig. 71 ***E. litvinovi***

Etmopterus granulosus (Günther, 1880)

Spinax granulosus Günther, 1880, *Rep. Sci. Res. Voy. H. M. S. Challenger, Zool.*, 1(6): 19, pl. 2C. Holotype: British Museum (Natural History), BMNH–1879.5.14.460, 256 mm TL adol. male, off Chile, *Challenger* Sta. 305A, 47°47'S to 47°48.5'S, 74°47'W to 74°46'W, 220 m.

Synonyms: None.

Other Combinations: None.

FAO Names: En – Southern lanternshark; **Fr** – Sagre long nez; **Sp** – Tollo negro narigón.

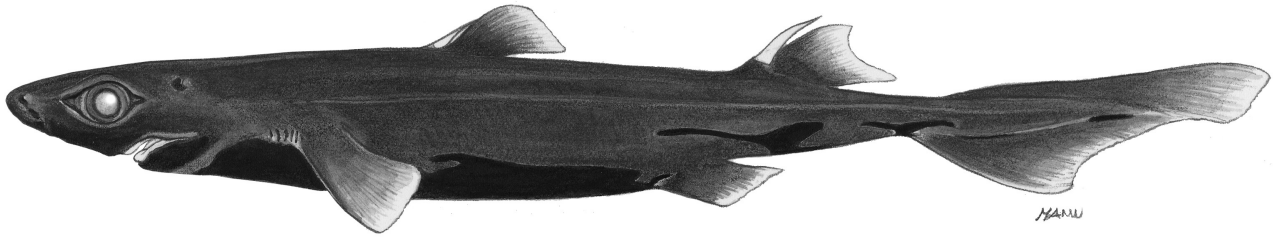


Fig. 72 ***Etmopterus granulosus***

Field Marks: Body stocky, conspicuous lines of denticles on body, blade–like unicuspidate teeth in lower jaw and teeth with cusps and cusplets in upper jaw, two spined dorsal fins, no anal fin, conspicuous black markings on underside of body and tail, with tail marking short and not extending far posteriorly.

Diagnostic Features: Head shallow and flattened, not deep and conical; head relatively long, about 22 to 24% of total length and 2.3 times in snout–vent length; head width about 1.1 times preoral snout; head low, height 11% of total length. Prespiracular length 1.2 times spiracle–pectoral space. Snout broad and flattened, not bulbous; preoral length short and 9.5 to 11% of total length. Eyes narrow and elongated; upper eyelid apparently without a pale naked patch. Gill openings about as wide as spiracle; width of third gill opening less than one–third of eye length. Mouth relatively broad and 1.4 times eye length. Total tooth row counts upper jaw 27, lower jaw 28 (holotype); upper teeth with one or two pairs of cusplets, cusps expanded, about 2.5 times higher than adjacent cusplets; upper teeth of adolescent males with a cusp and a pair of long cusplets. Body moderately firm, cylindrical or slightly depressed, and moderately stout. Predorsal spine length about 35% of total length; interdorsal space slightly shorter than prebranchial length; pectoral–pelvic space about equal to head length in adolescent; snout tip to rear flank marking base 105% of snout tip to second dorsal–fin spine origin; dorso–caudal space about 9% of total length and about 2.1 in interdorsal space; pelvic–caudal space 16% of total length, about 1.5 times first dorsal fin length, 1.2 in interdorsal space, 0.8 of prebranchial length, slightly greater than prespiracular length, much shorter than head, and about 1.5 times in pectoral–pelvic space. No rows of greatly enlarged denticles on flanks above pectoral fins; denticles largely absent from underside of snout except for lateral patches; denticles on head not in longitudinal rows, but in regular longitudinal rows on flanks, tail, and caudal base; denticles present on second dorsal fin, densely covering it; lateral trunk denticles short, robust, wide spaced, with moderately stout, high, curved conical crowns. Distal margins of fins not fringed with naked ceratotrichia. Pectoral fin small with anterior margin length about 9% of total length, rounded–angular in shape. First dorsal–fin origin slightly in front of pectoral–fin free rear tips and over inner margins, base considerably closer to pectoral–fin bases than pelvic fins; first dorsal–fin spine stout, short, and lower than first dorsal–fin apex, origin nearer to snout tip than upper caudal–fin origin. Second dorsal fin much larger than first but less than twice its area, height 31% of second dorsal–fin length, apex more or less pointed, posterior margin broadly concave; second dorsal–fin spine stout and strongly recurved, but with its tip obliquely vertical in subadult. Dorsal caudal–fin margin slightly longer than head length. Vertebral counts: total vertebral counts 86 to 94, precaudal vertebral counts 59 to 67, caudal vertebral counts 23 to 33, monospondylous vertebral counts 46 to 53. Intestinal valve counts 10 to 13. Size large with adults to 88 cm total length. **Colour:** grey–brown on dorsal surface, underside of snout, branchial region and abdomen abruptly black, dorsal surface lighter in preservative, ventral surface conspicuously dark; fins light distally, no conspicuous dark bands at tip and through middle of caudal fin; apparently no small white pineal blotch on dorsal surface of head. No photolines on body although individual photophores are scattered on flanks. Suprapelvic photomark present anteriorly on pelvic–fin bases but not extending behind pelvic fins. Flank photomarks present; flank photomark base well behind second dorsal–fin spine; anterior branch of flank photomark long, slender and tapering posteriorly, much longer than posterior branch, posterior branch 27% of anterior branch; posterior branch of flank photomark short broad and extending slightly behind pelvic fins, not merging ventrally with post–pelvic photomark, and not extending behind free rear tip of second dorsal fin. Ventral saddle–shaped precaudal photomark absent from middle of caudal peduncle. Caudal photomarks present; caudal base photomark present, with anterior branch very narrow, not enveloping ventral surface and not extending onto sides of caudal peduncle; caudal base photomark with a sharp–tipped, moderately elongated posterior branch about 4% of total length; oval central caudal photomark absent. Upper caudal photomark present, straight and short, and about 3% of total length.

Distribution: Southeastern Pacific Ocean: southern Chile. Wide–ranging in the Southern Ocean, including the southern Indian, southern Pacific and southwestern Atlantic Oceans, but records of large etmopterids from Southern Ocean islands and seamounts should be closely examined for this species.

Habitat: A large lantern shark from the upper continental and insular slopes, found on or near the bottom at depths of about 250 to 1500 m, commoner below 600 m. Recorded at 383 to 1300 m off South Africa, 830 to 1200 m off Australia, and about 250 to 1500 m off New Zealand. Where it occurs this species is typically very common.

Biology: Viviparous with a yolk–sac, with litter size of 9 to 16 off Australia and 6 to 15 off New Zealand. Wetherbee (1996) counted 7 to 30 large ovarian eggs (over 10 mm in diameter) and 9 to 15 large uterine eggs (40 to 55 mm in diameter) in each uterus and up to 39 in both uteri for New Zealand females, suggesting larger litters than indicated by fetal counts alone. New Zealand sharks may breed all year long, as there were mature males with semen–filled seminal vesicles and mature females with large ovarian and uterine eggs in July (winter) and October (late spring) off New Zealand (Wetherbee, 1996). Southeastern Pacific population reproductive cycle little known, but neonates are quite common in the midwater, often several hundred meters off the bottom.

Age at maturity has been estimated at 30 years for females and 20 years for males, with a maximum age estimated for females and males of 57 and 48 years, respectively.

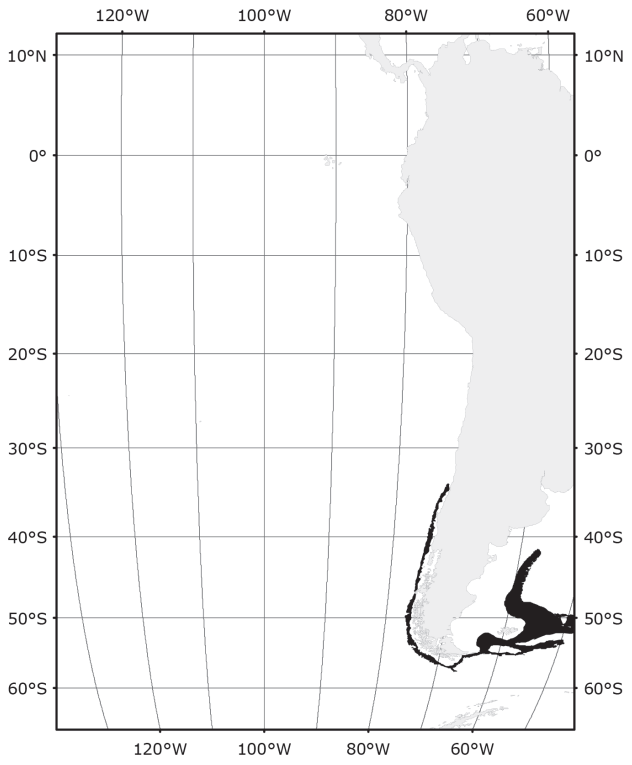


Fig. 73 ***Etmopterus granulosus***

Known distribution

Off South Africa this shark feeds heavily on the large deepwater histioteuthid squid ***Histioteuthis miranda*** and is capable of dismembering individual squid much larger than it can swallow whole. It also eats the squid ***Todarodes angolensis*** (Ommastrephidae), unidentified octopuses, penaeid shrimp, unidentified decapod crustaceans, lanternfish (Myctophidae, including ***Diaphus* sp.**), barracudina (Paralepididae), deepwater eels (Synaphobranchidae), and other, unidentified teleosts (Ebert, Compagno and Cowley, 1992, and unpubl. data). Clark, King and McMillan (1989) found that off New Zealand this shark eats primarily bony fishes, cephalopods and decapod crustaceans (mostly unidentified), but also salps (Thaliacea), sponges (Porifera), and ribbonworms (Nemertina). Fish prey from New Zealand ***Etmopterus granulosus*** included oreo dories (Oreosomatidae), lanternfish (Myctophidae), hake (Merlucciidae including hoki, ***Macruronus novaezelandiae***), rattails (Macrouridae), Bathylagidae, and Idiacanthidae; cephalopod prey included octopods and squids (particularly ***Brachioteuthis* sp.**); and crustaceans included unidentified decapods, euphausiids, and mysids. Some of the prey fish found in New Zealand ***Etmopterus granulosus*** may have been scavenged from fisheries catches (oreo dories and ***Macruronus***), but also suggested active feeding on small fishes (swallowed whole) and on larger fishes (eaten in bite–sized chunks).

Size: Maximum total length 88 cm; size at maturity varies by region, but this may be an artefact of multiple species being involved. In general, males are adult at 46 to 68 cm and females are adult at 62 to 88 cm. Size at birth about 17 to 20 cm.

Interest to Fisheries and Human Impact: Interest to fisheries none, although taken as an incidental bycatch of trawl fisheries.

Conservation status is Least Concern.

Local Names: Tollo lucero (Chile).

Remarks: A recent taxonomic study of this species has concluded that it appears to be a large, wide–ranging, Southern Hemisphere etmopterid species and not endemic to southern Patagonia as previously thought (N. Straube, pers. comm.). The Australian and New Zealand ***Etmopterus baxteri*** is a junior synonym of this species.

Literature: Günther (1880); Ebert, Compagno and Cowley (1992); Wetherbee (1996); Yano (1997); Irvine, Stevens and Laurenson (2006a); Kyne and Lamilla (2007); Last and Stevens (2009); Straube, Kriwet and Schliewen (2011); Ebert (2013); Ebert, Fowler and Compagno (2013); Bustamante, Vargas–Caro, and Bennett (2014); Straube *et al.* (2015); P.C. Clerkin (pers. comm.); D.A. Ebert (unpubl. data)

Etmopterus litvinovi Parin and Kotlyar, 1990

Etmopterus litvinovi Parin and Kotlyar, in Kotlyar, 1990, T*rans. P.P. Shirshov Inst. Oceanol.* 125: 141, fig. 8. Holotype: ZIN 49228, 505 mm TL female, 25°53'S, 84°34'W, ridges NW of the Juan Fernandez Islands, Chile, 1030–1050 m.

Synonyms: None.

Other Combinations: None.

FAO Names: En – Smalleye lanternshark; **Fr** – Sagre à petits yeux; **Sp** – Linterna ojuelo.

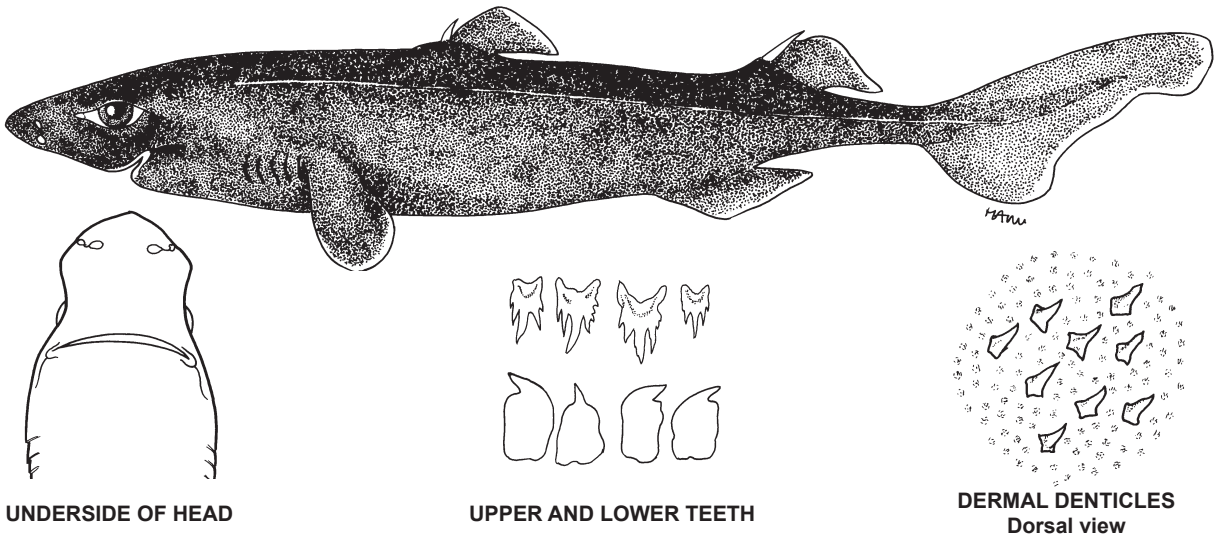


Fig. 74 ***Etmopterus litvinovi***

Field Marks: A moderately large and stout lantern shark with a large flattened head, gill openings somewhat elongate, upper teeth with a large median cusp flanked by 1 to 3 smaller lateral cusplets, lateral trunk denticles stout, conical and hook–like in appearance, and in irregular rows, first dorsal fin originating over or just posterior to pectoral–fin free rear tips, second dorsal fin slightly larger than first, interdorsal space short, and a moderately long caudal fin. Uniformly coloured dark grey to black, without any conspicuous flank markings.

Diagnostic Features: Head flattened and moderately broad, somewhat conical; snout broadly flattened, relatively short. Eyes suboval, relatively large. Gill openings near equal in height; openings greater than spiracle length. Mouth relatively broad. Total tooth row counts for upper jaw 30 to 40 and lower jaw 40 to 50; upper teeth generally with a prominent median cusp and one to three pairs of lateral cusplets; lower teeth unicuspid, oblique, and blade–like. Lateral trunk denticles stout, conical and hook–like in appearance, and in irregular rows. Pectoral fins relatively small and broadly rounded. First dorsal–fin origin about over or just posterior to pectoral–fin free rear tips; first dorsal–fin spine stout, short, height less than 50% of anterior margin of associated fin. Second dorsal fin larger than first; second dorsal–fin spine originates over insertion of pelvic fins; spine height about equal to second dorsal fin height. Interdorsal and caudal–dorsal spaces short. Dorsal caudal–fin margin elongate. Vertebral counts: total vertebral counts 79 to 82, precaudal vertebral counts 52 to 55, monospondylous vertebral counts 41 to 43. Intestinal valve counts 8 to 9. Size moderate up to at least 61 cm total length. **Colour:** uniformly dark grey to black with no conspicuous lateral flank or caudal photomarkings.

Distribution: Southeastern Pacific Ocean: only known from the Nazca and Sala y Gomez ridges off Chile and Peru. May be endemic to this region.

Habitat: Upper slopes on or near the bottom between 630 and 1100 m.

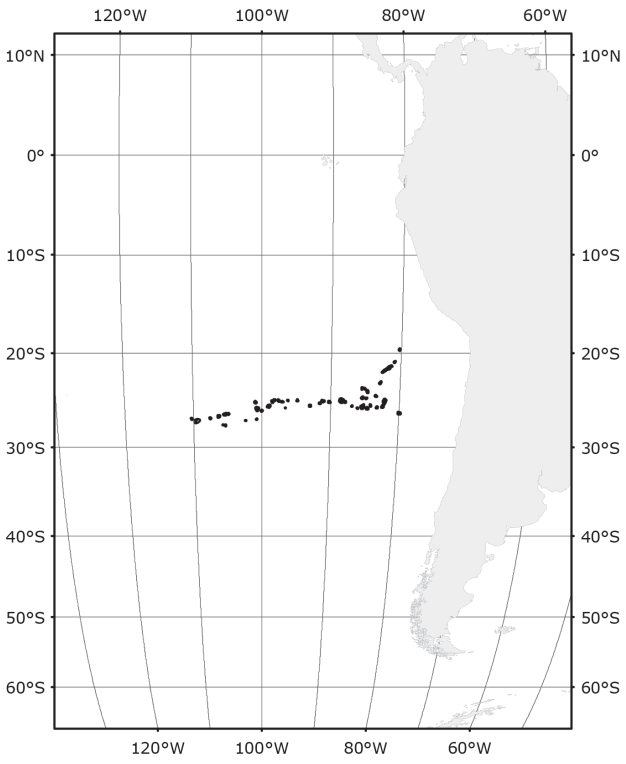


Fig. 75 ***Etmopterus litvinovi***

Biology: Reproductive mode presumably viviparous with yolk–sac similar to other members of this family.

Size: Maximum total length to 61 cm for females and to 55.4 cm for males. Size at birth unknown, but smallest free–swimming individual was about 17 cm in length.

Interest to Fisheries and Human Impact: Probably none at the present time other than it may be taken on occasion as bycatch.

Conservation status is Data Deficient.

Local names: No information.

Remarks: This poorly known shark, possibly endemic, lacks any obvious flank markings and appears to be closest to other members of the ***Etmopterus spinax*** group.

Literature: Parin and Kotlyar (1990); Ebert, Fowler and Compagno (2013); Vásquez, Ebert and Long (2015).

Etmopterus pusillus (Lowe, 1839)

Acanthidium pusillum Lowe, 1839, *Proc. Zool. Soc. London,* 1839 (7): 91. Replacement name for ***Centrina nigra*** Lowe,1833. Syntypes: Four specimens mentioned by Lowe, 1839, 11–12" long, from Madeira. Two specimens in British Museum (Natural History), BMNH–1855.11.29.27 from Madeira and presumably received from Lowe are considered syntypes by Krefft and Tortonese (1973, *in* Hureau and Monod, *Check–list. fish. NE Atlantic Mediterranean*, 1: 43) and by Shirai and Tachikawa (1993, *Copeia* 1993[2]: 484–485) but these specimens, a 332 mm female and a 213 mm immature male, do not fall in the size range indicated by Lowe (1839, *loc. cit.*) if he is taken literally (280–305 mm). Günther (1870, *Cat. Fish. British Mus*. 8: 425) noted the following material: "a, b, c, d, e–f, g–i, k–m. Adult examples (12 inches long). Madeira. Among them the typical examples". This suggests that some eleven examples of the species were received from Madeira (possibly all from Lowe) by Günther's time, and that the specimens considered as types by Krefft and Tortonese may not be so. A search of the BM (NH) collection will be necessary to see if any additional Lowe specimens are present that might be the real syntypes. According to P. Whitehead *in* Shirai and Tachikawa (1993, *Copeia* 1993[2]: 489), two of the syntypes of this species were lost.

Synonyms: None.

Other Combinations: None.

FAO Names: En – Smooth lanternshark; **Fr** – Sagre nain; **Sp** – Tollo lucero liso.

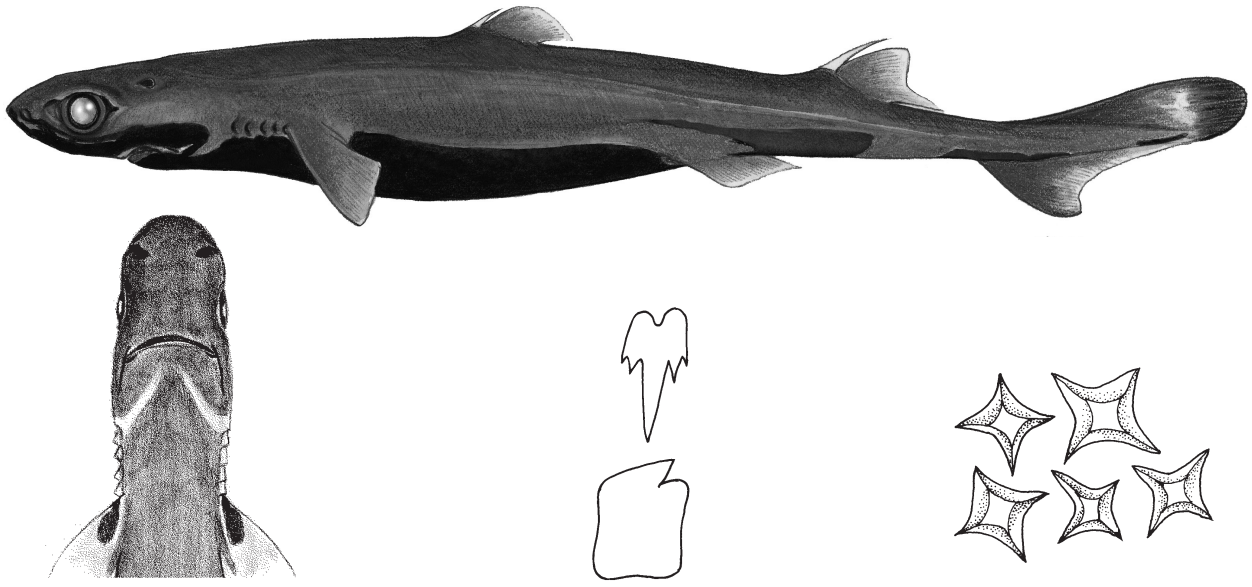


Fig. 76 *Etmopterus pusillus*

Field Marks: A moderately large, slender, broad–headed, long–tailed, lanternshark with a short thick flat snout, upper teeth with a slender cusp and one or more pairs of cusplets, lower teeth compressed and knife–like, with a cusp and blade, lateral trunk denticles cuspless, truncated, and wide–spaced, giving the body a smooth texture, not in longitudinal rows on

head, body or tail, two dorsal fins with fin spines, first dorsal fin smaller than second dorsal fin, first dorsal–fin spine slender and lower than fin, second dorsal–fin spine slightly recurved and pointing posterodorsally, no anal fin, flank and caudal photomarks present and inconspicuous.

Diagnostic Features: Head flattened and moderately broad, not deep and conical; head relatively long, 22 to 26% of total length and 2.2 to 2.8 times in snout–vent length; head width 0.9 to 1.4 times preoral snout; head low, height 6 to 9% of total length. Prespiracular length 1.2 to 1.4 times spiracle–pectoral space. Snout flattened and broadly rounded, not bulbous; preoral length moderately long and 9 to 11% of total length. Eyes narrow and elongated–oval; upper eyelid with a pale naked patch. Gill openings slightly wider than spiracle; width of third gill opening one–third eye length or less. Mouth relatively broad and 1.2 to 1.7 times eye length. Total tooth row counts upper jaw 23 to 30, lower jaw 35 to 44; upper teeth generally with less than 3 pairs of cusplets, with cusps greatly expanded, over twice as high as adjacent cusplets; upper teeth of mature males large with a cusp and a pair of long cusplets. Body moderately firm, slightly compressed, and moderately slender. Predorsal spine length about 36 to 39% of total length; interdorsal space about 1.2 to 1.5 times prebranchial length, subequal to head length; pectoral–pelvic space about 1.1 to 1.4 times head length in adults; snout tip to rear flank marking base about 103 to 106% of snout tip to second dorsal–fin spine origin; dorso–caudal space 9 to 11% of total length, about 1.8 to 2.9 times in interdorsal space; pelvic–caudal space 15 to 18% of total length, about 1.8 to 2.3 times first dorsal–fin length, about 1.1 to 1.6 in interdorsal space, subequal or somewhat shorter than prebranchial length, and about 1.5 to 2.0 times in pectoral–pelvic space. No rows of greatly enlarged denticles on flanks above pectoral fins; denticles covering underside of snout; denticles on head, flanks and tail not in regular longitudinal rows; denticles present on second dorsal fin, densely covering base but absent from posterior margin; lateral trunk denticles short, robust, close–set but not overlapping, with truncated, hollow, sessile, low crowns, not thorn or bristle–like. Distal margins of fins not fringed with naked ceratotrichia. Pectoral fin small with anterior margin length 8 to 9% of total length, rounded–angular in shape. First dorsal–fin origin just behind pectoral–fin free rear tips, base much closer to pectoral–fin bases than pelvic fins; first dorsal–fin spine stout, short, and usually lower than first dorsal–fin apex, spine origin nearer to snout tip than upper caudal–fin origin. Second dorsal fin much larger than first and nearly or quite twice its area, height 32 to 39% of second dorsal–fin length, apex more or less pointed or narrowly rounded, posterior margin usually deeply concave; second dorsal–fin spine stout and recurved, with its tip diagonally vertical. Dorsal caudal–fin margin about 80% of head length. Vertebral counts: total vertebral counts 82 to 88, precaudal vertebral counts 59 to 66, monospondylous vertebral counts 47 to 53. Intestinal valve counts 10 to 13. Size moderate with adults to about 50 cm total length. **Colour:** pale or dark brown to blackish on dorsal surface, underside of snout and abdomen abruptly black, dorsal surface dark in life, conspicuously lighter in preservative, ventral surface conspicuously dark; precaudal fins light distally, no conspicuous dark bands at tip and through middle of caudal fin; a small conspicuous round white pineal blotch on dorsal surface of head. No conspicuous photolines on body. Suprapelvic photomark present but not running behind pelvic fins. Flank photomarks present; flank photomark base opposite and behind second dorsal–fin spine; anterior branch of flank photomark long and broad, much longer than posterior branch, posterior branch about 10% of anterior branch and truncate, merging ventrally with post–pelvic photomark, and not extending behind free rear tip of second dorsal fin. Ventral saddle–shaped precaudal photomark absent from middle of caudal peduncle. Caudal photomarks present; caudal–fin base photomark present, with anterior branch broad, partly enveloping ventral surface of caudal peduncle but not extending onto its sides; caudal–fin base photomark with elongated, blunt–tipped posterior branch over 7% of total length. No central caudal photomark. Upper caudal photomark present and straight.

Distribution: Southeastern Pacific Ocean: Chile. Elsewhere, widespread, but scattered in the Atlantic, Indian and western Pacific oceans.

Habitat: A lantern shark of the continental slopes, on or near bottom at a depth of 274 to 1000 m or more (possibly to 1998 m); also oceanic in the South Atlantic and central North Pacific, at depths between the surface and 110 to 708 m over deepwater (Krefft, 1980; D.A. Ebert, unpubl. data).

Biology: Viviparous with yolk–sac, litters range from 1 to 6 with an average of 3.5 embryos; the number of ovarian eggs present in adult females is slightly higher, ranging from 2 to 18 (averaging 10 to 11), suggesting that fecundity may be slightly higher than reported. Males mature between 5 and 9 years, and females between 8 and 11 years. Maximum age estimates range up to 13 years for males and 17 years for females.

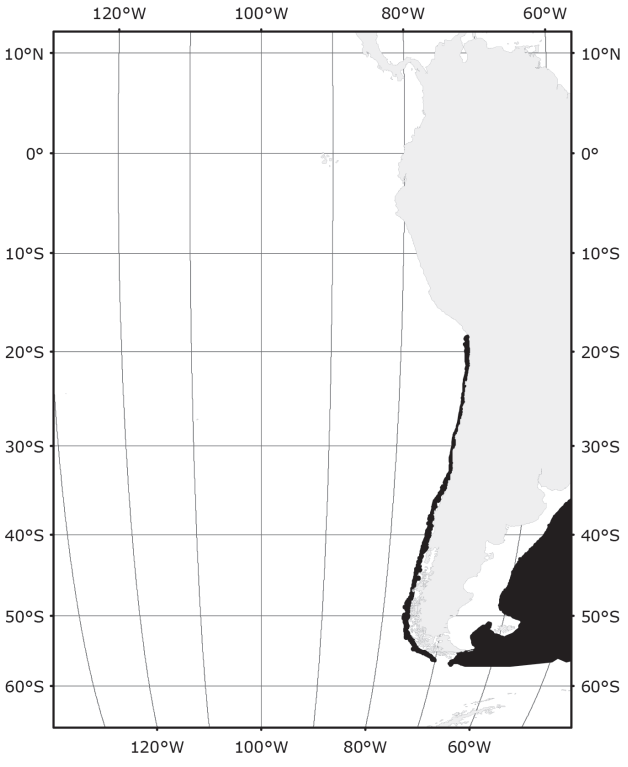


Fig. 77 ***Etmopterus pusillus***

Diet includes fish eggs, lanternfishes, cephalopods, teleost fishes, and other small dogfish.

Size: Maximum total length at least 50.2 cm; males immature at 15.8 to 41.7 cm, adult at 31.0 to 47.9 cm; females immature at 15.9 to 45.5 cm and adult at 38 to 50.2 cm. Size at maturity may vary regionally. Size at birth is from 15 to 16 cm.

Interest to Fisheries and Human Impact: Interest to fisheries none in the southeastern Pacific, most likely captured as bycatch in bottom trawl and nets, and on longline gear.

This species is listed as Least Concern given its widespread geographic and bathymetric distribution.

Local names: No information.

Remarks: Examination of regional ***Etmopterus pusillus*** specimens, especially from the central and western North Pacific and Indian oceans suggests that this species may form a complex that may include multiple species. One form has a more angular pectoral fin and is generally found to occur in association with continental slopes, while a second form with broadly rounded pectoral fins seems to inhabit a more oceanic environment usually occurring around offshore islands, seamounts, and deep–sea ridges far from continental land masses (D.A. Ebert and J.D.S. Knuckey, unpubl. data).

Literature: Bigelow and Schroeder (1957); Ebert, Compagno and Cowley (1992); Shirai and Tachikawa (1993); Coelho and Erzini (2005, 2007, 2008); Coelho, Tanaka and Compagno (2009); Last and Stevens (2009); Ebert (2013, 2015); Ebert, Fowler and Compagno (2013); Bustamante, Vargas–Caro, and Bennett (2014); D.A. Ebert and J.D.S. Knuckey (unpubl. data).

Etmopterus pycnolepis Kotlyar, 1990

Etmopterus pycnolepis Kotlyar, 1990, Trans. P.P. Shirshov Inst. Oceanol. 125: 135, fig. 6. Holotype: ZIN 49226, 455 mm TL female, 25°40'S, 85°27'W, ridges NW of the Juan Fernandez Islands, Chile, 350 m.

Synonyms: None.

Other Combinations: None.

FAO Names: En – Dense–scale lanternshark; **Fr** – Sagre à denticules denses; **Sp** – Linterna opaco.

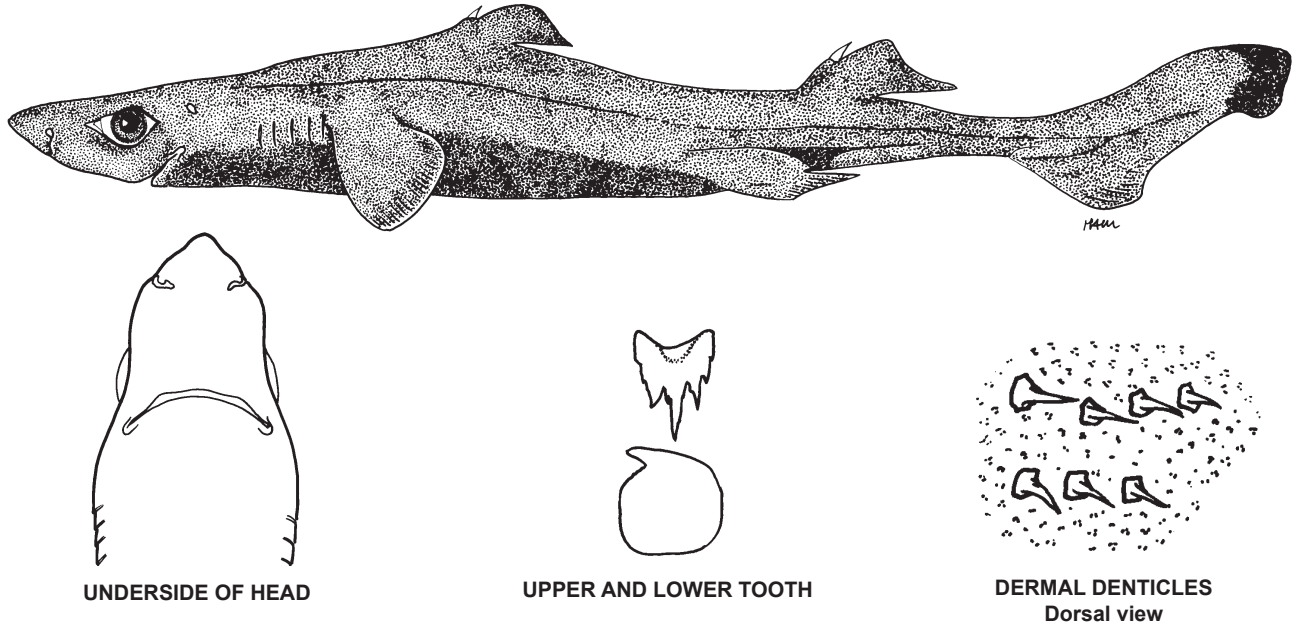


Fig. 78 ***Etmopterus pycnolepis***

Field Marks: A small, slender lantern shark with a narrow head, upper teeth with a large median cusp flanked by 1 to 3 smaller lateral cusplets, gill openings somewhat elongate, lateral trunk denticles very small, conical and hooked, and arranged in linear rows on head, trunk, and caudal fin, first dorsal–fin origin anterior to pectoral–fin free rear tips, interdorsal space long, and a moderately long caudal fin. Uniformly plain coloured except for dark black tipped caudal fin; lateral flank markings conspicuous.

Diagnostic Features: Head narrow, snout short, flattened. Eyes suboval. Gill openings near equal in height except for fifth that is slightly smaller; openings greater than spiracle length. Mouth transverse, relatively broad. Total tooth row counts for upper jaw 28 and lower jaw 36 to 40; upper teeth generally with a prominent median cusp and one to three pairs of lateral cusplets; lower teeth unicuspid, oblique, and blade–like. Lateral trunk denticles very small, conical and hooked, arranged in regular linear rows and densely spaced on head, trunk, and caudal fin. First dorsal fin origin anterior to pectoral fin free rear tips; first dorsal fin spine very short, height less than 50% of anterior first dorsal fin margin. Second dorsal fin larger than first; second dorsal fin spine height less than height of associated fin; fin origin anterior to pelvic–fin insertion. Interdorsal dorsal space short. Pectoral fin large, broadly rounded. Caudal peduncle short, narrowing to caudal fin origin. Dorsal caudal margin elongate. Vertebral counts not reported. Intestinal valve count 10 to 12. Size moderate up to at least 45.5 cm total length. **Colour:** plain, grey to black above becoming darker below; caudal fin tip black. Lateral flank photomarks prominent, anterior and posterior branches thin, about equal in length; anterior branch extending past origin of pelvic fin.

Distribution: Southeastern Pacific Ocean: Nazca and Sala y Gomez ridges off Chile and Peru.

Habitat: Upper slopes on or near the bottom from 330 to 763 m.

Biology: Unknown.

Size: Known from only a few specimens ranging in size from 41.2 to 45.5 cm total length.

Interest to Fisheries and Human Impact: Unknown, but may be caught as bycatch in deepwater fisheries.

Conservation status is Data Deficient.

Local names: No information.

Remarks: ***Etmopterus pycnolepis*** was placed in the "***E. lucifer*–subgroup**" based on its linear rows of lateral flank denticles, and prominent flank photomarkings. It appears to be closest to ***Etmopterus brachyurus***, ***E. lucifer***, and ***E. molleri***, but with smaller, more close–set dermal denticles and lateral flank markings branches (anterior and posterior) that are near equal in length.

Literature: Kotlyar (1990); Ebert, Fowler and Compagno (2013).

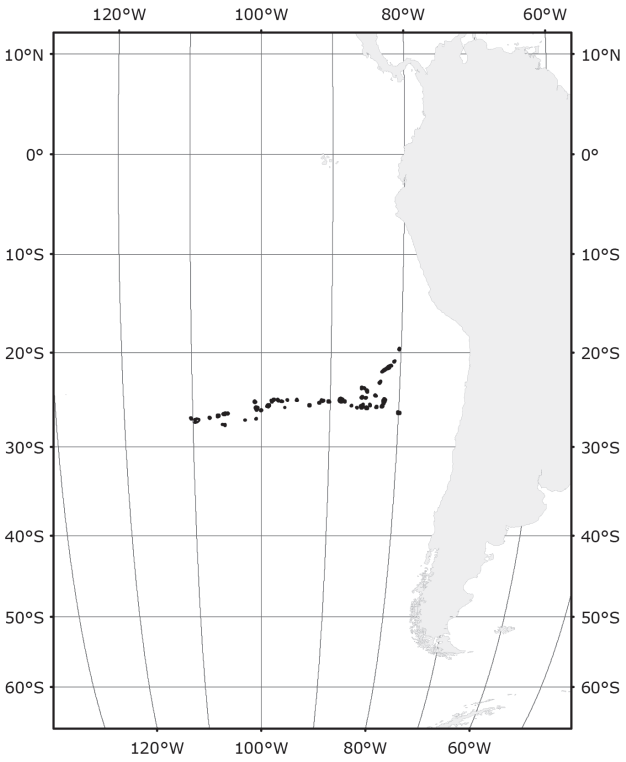


Fig. 79 ***Etmopterus pycnolepis***

Known distribution

2.3.3 Family SOMNIOSIDAE

Family: Somniosidae Jordan, 1888, *Man. Vert. Ani. Northern U.S.*, ed. 5: 15.

Type genus: ***Somniosus*** Lesueur, 1818.

Number of Recognized Deep–sea Southeastern Pacific Ocean Genera: 6.

Synonyms: None.

FAO Names: En – Sleeper sharks; **Fr** – Laimargue dormeurs; **Sp** – Tiburones Tollos.

Field Marks: Short to long–nosed, cylindrical to somewhat compressed sharks with two dorsal fins with or without spines, the first with origin in front of pelvic–fin origins and usually opposite the pectoral–fin bases or pectoral–fin inner margins and exceptionally just behind the pectoral–fin free rear tips, the second dorsal fin not falcate and with its origin usually opposite the pelvic–fin bases or inner margins, but exceptionally somewhat behind the pelvic–fin free rear tips, no anal fin, caudal fin with a strong subterminal notch, no keels on the caudal peduncle, denticles small to large and variable in shape, with leaf–shaped, tricuspidate or polycuspidate crowns and slender pedicels, high pitchfork–shaped erect crowns on high pedicels, or low ridged sessile crowns.

Diagnostic Features: Head moderately broad and somewhat flattened or conical. Snout flat and narrowly rounded to elongate–rounded in dorsoventral view. Spiracles large, close behind eyes. Fifth gill opening about as large as first four. Nostrils wide–spaced with internarial width greater than nostril width; nostrils with simple anterior nasal flaps. Mouth nearly transverse and usually very short (more elongated in ***Scymnodon ringens***), with thin, non–papillose lips. Labial furrows short to greatly elongated, encircling mouth or not, confined to mouth corners or extending partway around mouth (***Centroselachus crepidater***) and under posterior corners of eyes, elongated posteriorly into postoral grooves and also anteromedial preoral grooves (***C. crepidater***); labial folds thin. Teeth with dignathic heterodonty well–developed, upper teeth much smaller than lowers. Teeth of upper jaw lanceolate, high–crowned, needlelike, with narrow erect to semioblique cusps and no cusplets or blades, in quincunx arrangement and not imbricated; lower teeth compressed, high–crowned, narrow and bladelike, imbricated, forming a saw–like cutting edge, with a compressed erect to oblique cusp, a distal blade, and no cusplets. Tooth rows 30 to 70 upper jaw, 31 to 68 lower jaw. Trunk cylindrical or slightly compressed, abdomen with lateral ridges. Interdorsal space elongated and greater than length of first dorsal–fin base; pelvic–caudal space short and between one and two times pelvic–fin bases. Caudal peduncle slightly compressed, short to moderately elongated, and without lateral keels or precaudal pits (some ***Somniosus*** with low keels on the caudal base). Body without photophores. Denticles moderate–sized and pedicellate, with flattened, narrow to broad–keeled or smooth leaf–shaped, round, or narrow thornlike crowns, slender pedicels and low bases. Pectoral fins low, angular or rounded, and not falcate, anterior margins moderately large and shorter or equal to the prespiracular length, rear tips rounded and short. Pelvic fins subequal or larger than pectoral fins and first dorsal fin and subequal to or smaller than second dorsal fin. Claspers with a lateral spine only. Dorsal fins small, broad, rounded–angular but not falcate, with small grooved spines on both dorsal fins or no spines. First dorsal fin length variable from slightly larger, subequal to, or slightly smaller than second dorsal fin in size; first dorsal–fin base over pectoral–pelvic space and well anterior to pelvic fins, origin over pectoral–fin bases or inner margins. Second dorsal fin usually smaller than first dorsal fin or about as large, base partly over pelvic–fin bases with origin over to slightly anterior to pelvic–fin insertions. Caudal fin heterocercal, with ventral lobe weakly to strongly developed in adults, and with subterminal notch strong. Vertebral counts: total vertebral counts 35 to 120, monospondylous vertebral counts 43 to 67, diplospondylous precaudal vertebral counts 13 to 23. Intestinal valve with 12 to 41 turns. Adults small to gigantic, total length to between 49 and 600 cm or more. **Colour:** plain or with light or dark markings on fins and body, without photophores and black photomarks on tail or flanks.

Distribution: The family has an almost circumglobal range in polar, boreal and austral to tropical seas, mostly in association with land masses including continents, islands, submarine peaks and ridges. The giant sleeper sharks of the genus ***Somniosus*** (subgenus ***Somniosus***, ***S. antarcticus***, ***S. microcephalus***, and ***S. pacificus***) are among the few non–batoid sharks penetrating deeply into polar waters, but the family is most diverse in cool to warm temperate seas and possibly in the tropics (in deep water, but with distributions poorly known). Several of the species are wide–ranging in both the Eastern and Western Hemispheres. These sharks have very low diversity in the eastern Pacific, with only the sleeper shark ***S. pacificus*** in the eastern North Pacific and ***S. antarcticus*** and ***Centroselachus crepidater*** in the eastern South Pacific off South America. Several of the species are wide–ranging in the Atlantic but the greatest known diversity of the family is in the Indo–West Pacific. Geographic and bathymetric ranges are imperfectly known for most species, and reflect uneven sampling of deepwater slope–dwelling sharks as well as problems in identifying somniosid species.

Habitat: The Somniosidae are primarily bottom dwelling, deepwater inhabitants of continental and insular slopes and occasionally on upper rises (***Centroscymnus coelolepis*** and possibly ***Somniosus*** species), but also occur on submarine ridges and seamounts. They range in depth between 200 to at least 3675 m but most species are not known to extend below 1000 to 1500 m. Most species are bottom dwellers, but some species are apparently oceanic. These sharks occasionally occur on the continental and insular shelves offshore in water up to 50 m depth, although this is most exceptional. In high latitudes members of the genus ***Somniosus*** occur on the continental shelves to the intertidal. The family has one apparently epipelagic species (***Scymnodalatias albicauda***) and one bottom–dwelling species that is semioceanic (***Zameus squamulosus***) and may occur in the epi– and mesopelagic zones of the open ocean.

Biology: Reproduction is yolk–sac viviparous, with 4 to 59 young per litter. Virtually nothing is known about the age and growth of these sharks although where some information is available (particularly for the large ***Somniosus*** species) they appear to be quite long–lived and very slow growing. Sleeper sharks feed on bony fishes, other chondrichthyans, cephalopods and other molluscs, crustaceans, seals, whale meat, carrion, sea birds, echinoderms and jellyfish; at least one species (***Centroscymnus coelolepis***) takes chunks of meat out of living marine mammals and bony fishes.

Interest to Fisheries and Human Impact: In the southeastern Pacific these sharks are likely taken as bycatch to other fisheries.

Local names: No information.

Remarks: The family is small, but rather diverse with seven genera and about seventeen species globally, of which six species occur within the area.

Literature: Müller and Henle (1839); Gray (1851); Duméril (1865); Günther (1870); Regan (1908a); Garman (1913); Bigelow and Schroeder (1948, 1957); Garrick (1959a, b, 1960b); Compagno (1984a, 2005); Taniuchi and Garrick (1986); Yano, Stevens and Compagno (2004); Last and Stevens (2009); Ebert (2013, 2015); Ebert, Fowler and Compagno (2013); White *et al.* (2015); D.A. Ebert (unpubl. data).

List of Deep–sea Species Occurring in the Area:

Centroscymnus owstonii Garman, 1906
Centroselachus crepidater (Bocage and Capello, 1864)
Scymnodalatias oligodon Kukuev and Konovalenko, 1988
Scymnodon macracanthus (Regan, 1906)
Somniosus antarcticus Whitley, 1939
Zameus squamulosus (Günther, 1877)

Key to Deep–sea Southeastern Pacific Ocean Genera:

1a. Dorsal–fin spines present, though sometimes short and partly covered by skin (Fig. 80a) **2**

1b. Dorsal–fin spines absent **5**

2a. Snout greatly elongated, preoral length about equal to distance from mouth to pectoral–fin origins (Fig. 80b). Upper labial furrows greatly elongated, their lengths greater than distance between their anterior ends . . . . . ***Centroselachus***

2b. Snout shorter, preoral length much less than distance from mouth to pectoral–fin origins (Fig. 81a). Upper labial furrows shorter, their lengths less than distance between their anterior ends **3**

3a. Lateral trunk denticles enlarged, with smooth, rounded, non–ridged denticles in adults, resembling bony fish scales (Fig. 81b). . . . . ***Centroscymnus***

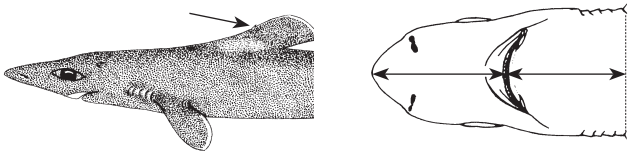
3b. Lateral trunk denticles small, tricuspidate, and with 3 to 5 ridged crowns in adults, not resembling bony fish scales (Fig. 82b) **4**

4a. Snout broad and short to moderately long. Mouth very wide and broadly arched. Pectoral fins large, their apices nearly or quite reaching first dorsal–fin spine when laid back (Fig. 82a). Caudal fin with a weak subterminal notch . . . . . ***Scymnodon***

4b. Snout narrow and moderately long. Mouth short, narrow, and nearly transverse. Pectoral fins smaller, their apices falling well in front of first dorsal–fin spine when laid back (Fig. 83). Caudal fin with a strong subterminal notch . . . . . ***Zameus***

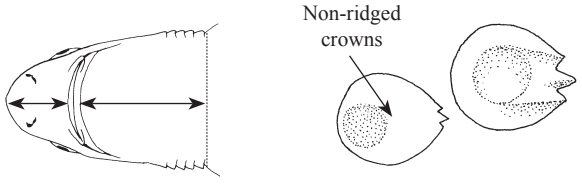
5a. Lower teeth with high, erect cusps (Fig. 84). Second dorsal fin larger than first. Caudal fin asymmetrical, with short lower lobe. Eyes horizontally elongated . . . . . ***Scymnodalatias***

5b. Lower teeth with low, oblique cusps (Fig. 85). Second dorsal fin smaller than first. Caudal fin paddle–shaped, with long lower lobe. Eyes nearly circular . . . . . ***Somniosus***



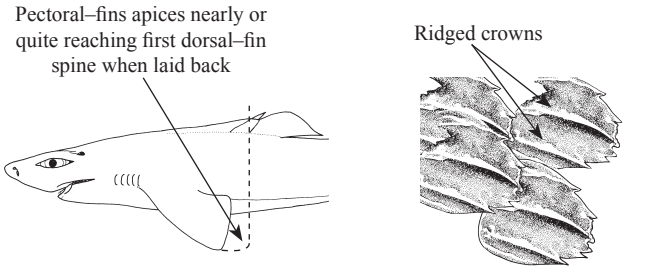
a) LATERAL VIEW b) UNDERSIDE OF HEAD

Fig. 80 ***Centroselachus***



a) UNDERSIDE OF HEAD b) DERMAL DENTICLES

Fig. 81 ***Centroscymnus***



a) LATERAL VIEW b) DERMAL DENTICLES

Fig. 82 ***Scymnodon***

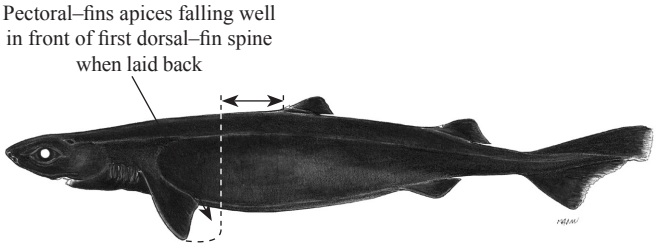
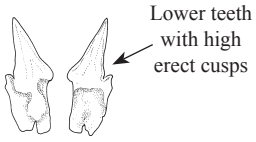
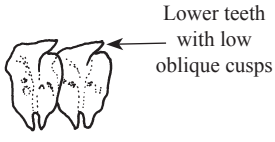


Fig. 83 ***Zameus***



LOWER TEETH

Fig. 84 ***Scymnodalatias***



LOWER TEETH

Fig. 85 ***Somniosus***

Centroscymnus Bocage and Capello, 1864

Genus: ***Centroscymnus*** Bocage and Capello, 1864, *Proc. Zool. Soc. London*, 24: 263.

Type species: ***Centroscymnus coelolepis*** Bocage and Capello, 1864, by monotypy.

Number of Recognized Deep–sea Southeastern Pacific Ocean Species: 1.

Synonyms: None.

Field Marks: Short to moderately long snout, slender–cusped teeth without cusplets in upper jaw, bladelike, oblique and short–cusped, interlocked cutting teeth in lower jaw, small fin spines present on both dorsal fins though sometimes inconspicuous (***Centroscymnus owstonii***), pectoral fins with broadly rounded free rear tips, no anal fin and caudal fin with a strong subterminal notch. Colour generally greyish or blackish–brown.

Diagnostic Features: Anterior nasal flaps short, not expanded as barbels. Snout flattened, broadly parabolic, length varying from about equal to distance from mouth to pectoral–fin origins to considerably less than that space, and about half length of head or less. Gill openings moderately wide and about equal–sized. Lips thick but not pleated or suctorial. Teeth very different in upper and lower jaws, uppers with very slender, acute cusps and no cusplets, not bladelike, lower teeth high compressed, bladelike, interlocked with short, oblique cusps, distal blades, and no cusplets; tooth rows 39 to 70 upper jaw, 32 to 42 lower jaw. Small, grooved fin–spines present on both dorsal fins, these sometimes covered with skin and inconspicuous. First dorsal–fin origin varying from over the pectoral–fin bases to well posterior to their free rear tips, insertion well in front of pelvic–fin origins and closer to the pectoral–fin bases than the pelvic–fin bases; second dorsal–fin origin about over the middle of the pelvic–fin bases; second dorsal fin about as large or slightly smaller than first, but first often with an anteriorly elongated base up to about twice as long as that of first. Pectoral fins with short, broadly rounded free rear tips and inner margins, not broadly lobate or acute and attenuated. Caudal fin asymmetrical, not paddle–shaped, upper lobe long, lower lobe short but well–developed, subterminal notch present and strong. No precaudal pits or lateral keels on caudal peduncle. Dermal denticles with low, pedicellate, flat, ovoid crowns, varying from triridged and tricuspidate to smooth and acuspidate in adults, triridged and tricuspidate in young. Cloaca without a luminous gland. Vertebral counts: total vertebral counts 96 to 114, monospondylous vertebral counts 54 to 64, precaudal vertebral counts 68 to 84. Intestinal valve with 11 to 21 turns. Moderately large, adults up to 122 cm total length. **Colour:** blackish brown or greyish brown above and below.

Local names: No information.

Remarks: The main differences separating ***Centroscymnus*** and ***Scymnodon***, two very similar genera, by previous authors stem from divergent views on the relative importance of lower tooth shape as opposed to dermal denticle morphology as the primary criteria separating these two genera. Compagno (1984a) commented that the separation of this genus from ***Scymnodon*** was unsatisfactory with the criteria in current usage at the time, but hesitated to merge them pending further work on the problem. Subsequently, Taniuchi and Garrick (1986) clarified the situation somewhat by re–examining these primary characters and concluded that those species with "***Scymnodon***" denticles (***ringens***, ***plunketi***, ***ichiharai***, and ***macracanthus***) lacked ridges on the juvenile denticles, but these were replaced by fully ridged denticles in adults. Those species with "***Centroscymnus***" denticles (***coelolepis***, ***owstonii***, and ***crepidater***) by contrast had partly ridged juvenile denticles, but are replaced by denticles in which the ridging is progressively reduced with growth. These authors further went on to note that the cusp height to root height values, although not as well defined, could be used as a subjective means to separate these genera. However, among the aforementioned species they examined, ***S. ringens*** had a significantly higher cusp height to root height ratio (124%) than the other seven species they considered which ranged from 14 to 74%. Taniuchi and Garrick (1986) stated that if ***Scymnodon*** were only to include ***S. ringens***, as there is clearly a defined demarcation between it and the other species, and the others remained in ***Centroscymnus*** it would agree with Compagno (1984a). Compagno (1999) somewhat followed this generic framework, except left ***ichiharai*** within ***Scymnodon***, but later and without explanation (Compagno, 2005) moved ***ichiharai*** to ***Zameus*** and resurrected the genera ***Centroselachus*** (***crepidater***) and ***Proscymnodon*** (***macracanthus*** and ***plunketi***) leaving ***coelolepis*** and ***owstonii*** as the only species within the genus ***Centroscymnus***. The arrangement of this genus follows the recent revision by White *et al.* (2015) in placing ***Proscymnodon*** as a junior synonym of ***Scymnodon***.

Centroscymnus owstonii Garman, 1906

Centroscymnus owstonii Garman, 1906, *Bull. Mus. Comp. Zool. Harvard*, 46(11): 207, January, 1906. Holotype: Museum of Comparative Zoology, Harvard, MCZ–1037, 79 cm (31 1/4") adult male, Yenoura, Suruga Gulf, and Sagami Bay, Japan.

Synonyms: ***Centroscymnus cryptacanthus*** Regan, 1906b, *Ann. Mag. Nat. Hist*. (7), 18(108): 437, December, 1906. Holotype: British Museum (Natural History), BMNH–1865.5.20.14, 780 mm. adult male, off Madeira.

Other combinations: None.

FAO Names: En – Roughskin dogfish; **Fr** – Pailona rapeux; **Sp** – Sapata lija.

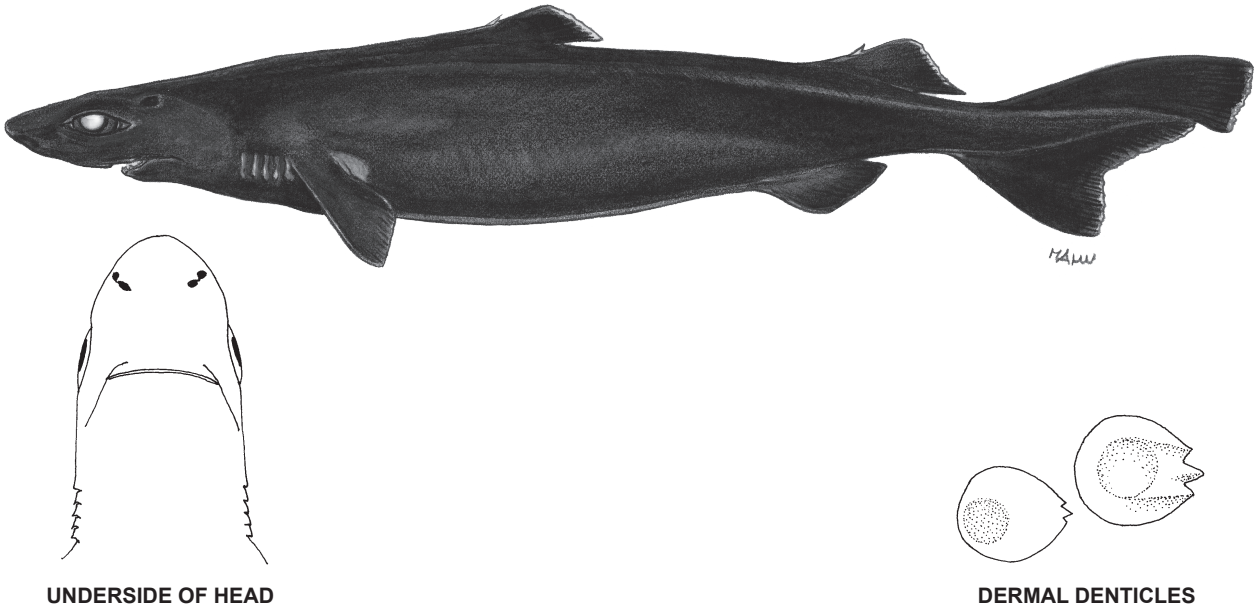


Fig. 86 ***Centroscymnus owstonii***

Field Marks: Body fairly stocky that does not taper abruptly from pectoral region, moderately long snout, lanceolate upper teeth and bladelike lower teeth with short, oblique cusps, large lateral trunk denticles with mostly smooth, circular, cuspidate and acuspidate crowns in adults and subadults, dorsal fins with fin spines buried in the fins or with tips slightly protruding, and no anal fin. Uniformly dark brown to black with no conspicuous markings.

Diagnostic Features: Body stocky, not strongly tapering back from pectoral region. Snout moderately long, preoral length about as long as distance from mouth to first gill slits and about equal to mouth width. Lips moderately thick and fleshy. Upper labial furrows very short, their lengths much less than distance between their front ends. Lower teeth with short, oblique cusps and fairly high, narrow roots; total tooth counts for upper jaw 36 to 39 and for the lower jaw 32 to 40. Lateral trunk denticles large, with mostly smooth, oval, partly ridged and cuspidate or ridgeless and acuspidate crowns. Pectoral fins moderately large, apices falling well in front of first dorsal–fin spine when laid back. Free rear tips of pelvic fins below or slightly in front of second dorsal–fin insertion. Second dorsal fin considerably higher than first, fin spines small and with tips protruding from fins or buried in the skin. First dorsal fin extending forwards as a short and inconspicuous to prominent ridge, origin behind or over pectoral–fin bases. Second dorsal–fin base much longer than space between it and upper caudal–fin origin, free rear tip just in front of or about opposite to upper caudal–fin origin. Vertebral counts: total vertebral counts 96 to 114, monospondylous vertebral counts 54 to 60, precaudal vertebral counts 71 to 82. Intestinal valve with 11 to 15 turns. Moderately large, with adults up to 120 cm total length. **Colour:** light grey or brown to dark brown or black, without any conspicuous markings.

Distribution: Southeastern Pacific Ocean: northern and central Chile and Nazca and Sala y Gomez ridges. Also found in the eastern Atlantic, western Atlantic, western Indian, and western Pacific oceans.

Habitat: A little known deepwater dogfish of the outer continental shelves and upper continental slopes on or near bottom at depths of 150 to 1459 m, but mostly below 600 m.

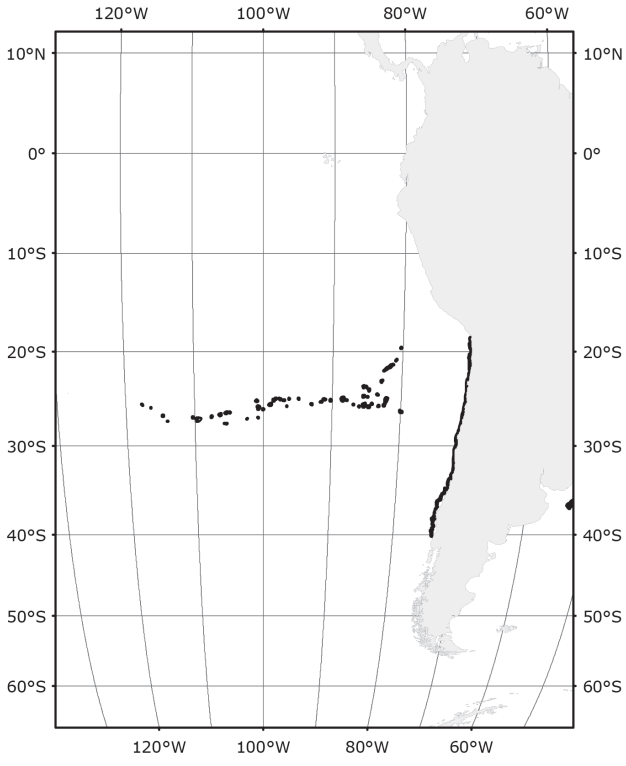


Fig. 87 ***Centroscymnus owstonii***

Biology: Viviparous with yolk–sac, females with litters of 5 to 31 fertilized eggs or embryos *in utero*, but females may have as many as 34 ovarian eggs. The number of embryos or eggs increases slightly with the total length of the mother. There does not appear to be a defined reproductive season since partition appears to occur year–round. These sharks segregate by size, sex, and reproductive stage with depth with adult females occurring at greater depths than males.

The diet of this shark is poorly known, but includes bony fishes and cephalopods. As far as known it does not appear to remove core flesh from live cetaceans, deep–diving pinnipeds, or large fishes, as does its congener ***Centroscymnus coelolepis***.

Size: Maximum total length about 120 cm; adult males 67 to 84 cm; adult females 95 to 104 cm. Size at birth about 25 to 35 cm.

Interest to Fisheries and Human Impact: Of no interest to fisheries in the southeastern Pacific, the species is uncommon, and mostly a discarded bycatch.

The conservation status of this species is currently listed as Least Concern.

Local Names: Tollo, Sapata lija (Chile), Tollo lija (Spanish).

Remarks: This species is uncommon in this region, but may be more common in those areas where deep–sea fisheries occurs.

Literature: Garman (1906, 1913); Bigelow and Schroeder (1957); Garrick (1959a); Yano and Tanaka (1983, 1987, 1988); Compagno (1984a); Last and Stevens (2009); Last and Stevens (2009); Kyne and Simpfendorfer (2010); Ebert (2013, 2015); Ebert, Fowler and Compagno (2013); Ebert and Stehmann (2013); Bustamante, Vargas–Caro, and Bennett (2014); D.A. Ebert (unpubl. data).

Centroselachus Garman, 1913

Genus: ***Centroselachus*** Garman, 1913, *Mem. Harvard Mus. Comp. Zool*., 36: 206.

Type species: ***Centroselachus crepidater*** Garman, 1913, new combination, by monotypy, equals ***Centrophorus crepidater*** Bocage and Capello, 1864 (listed in synonymy).

Number of Recognized Deep–sea Southeastern Pacific Ocean Species: 1.

Synonyms: None.

Field Marks: See the single species.

Diagnostic Features: Body fairly slender, not strongly tapering back from pectoral region. Snout very long, preoral length about equal to distance from mouth to pectoral–fin origins and much greater than mouth width. Lips not thick and fleshy. Upper labial furrows very long, their lengths greater than distance between their front ends. Lower teeth with moderately long, semioblique cusps and moderately high, fairly broad roots; total tooth counts for upper jaw 36 to 51 and for the lower jaw 30 to 36. Lateral trunk denticles moderately large, with anteriorly smooth but posteriorly ridged, oval, cuspidate crowns. Pectoral fins moderately large, apices falling well in front of first dorsal–fin spine when laid back. Free rear tips of pelvic fins extending to about opposite second dorsal–fin insertion. Dorsal fins about equal in size and height, fin spines very small but with tips protruding from fins. First dorsal–fin base expanded forwards as a prominent ridge, origin over pectoral–fin bases. Second dorsal–fin base longer than space between it and upper caudal–fin origin, free rear tip nearly reaching upper caudal–fin origin. Vertebral counts: total vertebral counts 105 to 119 and precaudal vertebral counts 73 to 85. Intestinal valve turn counts unavailable. Moderate sized, with a maximum total length of 105 cm. **Colour:** blackish brown.

Local names: No information.

Centroselachus crepidater (Bocage and Capello, 1864)

Centrophorus crepidater Bocage and Capello, 1864, *Proc. Zool. Soc. London*, 24: 262, fig. 3. Holotype**:** Museum Bocage, Lisbon, MB T112 (49), destroyed in fire, off Portugal.

Synonyms: None.

Other combinations: None.

FAO Names: En – Longnose velvet dogfish; **Fr** – Pailona à long nez; **Sp** – Sapata negra.

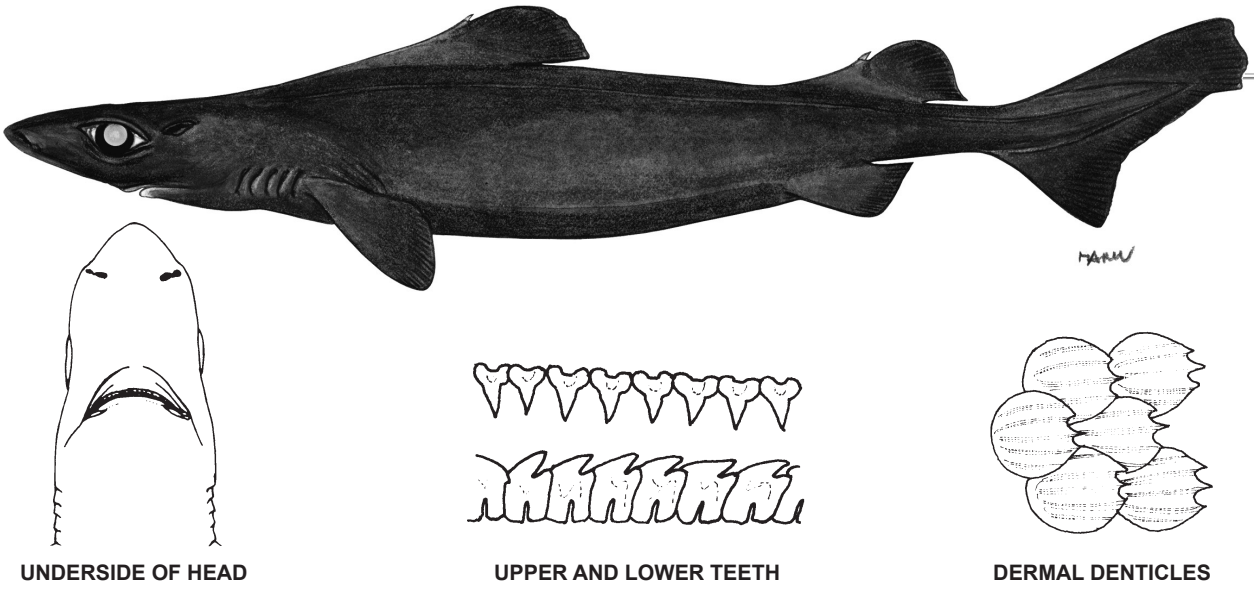


Fig. 88 ***Centroselachus crepidater***

Field Marks: Body fairly slender that does not taper abruptly from pectoral region, very long snout, greatly elongated labial furrows that nearly encircle mouth, lanceolate upper teeth and bladelike lower teeth with moderately long, oblique cusps, moderately large lateral trunk denticles with partly smooth, oval, cuspidate crowns in adults and subadults, dorsal fins with very small fin spines, and no anal fin. Colour a uniform black or blackish brown.

Diagnostic Features: See genus ***Centroselachus***.

Distribution: Southeastern Pacific Ocean: Chile and Peru. Elsewhere, wide–ranging in the eastern Atlantic and Indo–Pacific.

Habitat: A little–known but common deepwater dogfish found on the upper continental and insular slopes on or near the bottom at depths of 200 to 1500 m.

Biology: Yolk–sac viviparity; litters range from 1 to 9, with an average of 6. Females appear capable of breeding throughout the year. Age at maturity is about 9 years for males and 20 years for females; oldest individual was a female estimated at 54 years and the oldest male about 34 years. Diet consists of bony fishes, including lanternfishes (Myctophidae), crustaceans and cephalopods.

Size: Maximum total length about 105 cm; males mature at 60 to 68 cm; females mature at 77 to 88 cm. Size at birth about 28 to 35 cm.

Interest to Fisheries and Human Impact: Interest to fisheries limited. It is caught as bycatch, but not utilized in the southeastern Pacific.

Conservation status for this species is Least Concern due to its wide, but patchy distribution and apparent population increases in some regions.

Local Names: Tollo, Sapata negra (Chile).

Remarks: None.

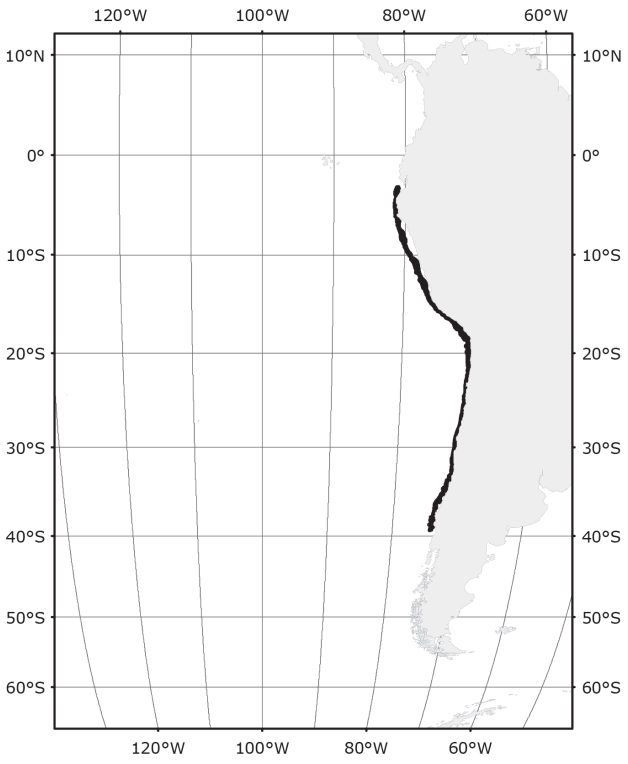


Fig. 89 ***Centroselachus crepidater***

Literature: Bigelow and Schroeder (1948, 1957); Compagno (1984a); Ebert, Compagno and Cowley (1992); Stevens (2003a); Irvine, Stevens and Laurenson (2006b); Last and Stevens (2009); Kyne and Simpfendorfer (2010); Ebert (2013, 2015); Ebert, Fowler and Compagno (2013); Bustamante, Vargas–Caro, and Bennett (2014); Cornejo *et al.* (2015); D.A. Ebert (unpubl. data).

Scymnodalatias Garrick, 1956

Genus: ***Scymnodalatias*** Garrick, 1956, *Trans. Roy. Soc. New Zealand*, 83(3): 564.

Type species: ***Scymnodon sherwoodi*** Archey, 1921, by original designation.

Number of Recognized Deep–sea Southeastern Pacific Ocean Species: 1.

Synonyms: None.

Field Marks: Snout broadly rounded, elongated, somewhat flattened, not bulbous, mouth long and broadly arched, eyes horizontally elongated, upper teeth smaller than lowers, narrow, acute, without cusplets, lower teeth larger, blade–like, lacking serrations, imbricate, two spineless dorsal fins, the second being slightly larger than the first which originates about mid–body, pectoral fins elongated, caudal fin asymmetrical, upper caudal–fin margin nearly twice the length of the lower caudal–fin margin with a short lower lobe, dark brown to mottled grey above, lighter below, fins with or without conspicuous fin markings or prominent light edges and light blotches on caudal–fin base.

Diagnostic Features: Head length 17.8 to 28.1% of total length, snout moderately long, pointed and flattened, preorbital snout 4.2 to 8.4% of total length. Anterior nasal flaps short, not expanded into barbels. Gill openings moderately wide, fifth one slightly broader than first four; upper teeth with straight slender cusps; cusps of lower teeth erect or slightly oblique, cusp covering root and apparently without a small distal blade; tooth row counts upper jaw 33 to 62, lower jaw 32 to 42, upper rows more numerous than lowers. Dermal denticles with moderately high, narrow pedicels and broad, flat, leaf–shaped, tricuspidate and tri–ridged crowns. Predorsal length less than to nearly half of total length. Both dorsal fins spineless; first dorsal–fin free rear tip anterior to pelvic–fin origins. Second dorsal–fin origin above rear third of pelvic–fin base, free rear tip just anterior to upper caudal–fin origin; second dorsal–fin origin above pelvic–fin midbase, free rear tip just anterior to upper caudal–fin origin. Pectoral fins broadly angular or leaf–shaped, with angular or bluntly rounded apices, anterior margins 10.6 to 18.6% of total length. Cloaca normal, not expanded as a luminous gland. No precaudal pits, lateral or midventral keels on caudal peduncle. Caudal fin asymmetrical. Vertebral counts: total vertebral counts 81 to 84, monospondylous vertebral counts 43 to 45, and precaudal vertebral counts 57 to 61. Adult size to at least 111 cm total length. **Colour:** dark brown or mottled greyish above, dark to lighter brown or grey below; fins with or without whitish grey margins, or conspicuous white blotches on caudal–fin base.

Local names: No information.

Remarks: This genus is very close to the genus ***Scymnodon***, as suggested by the original placement of ***Scymnodon*** (=***Scymnodalatis***) ***sherwoodi*** in it own genus by Archey (1921) based on a specimen found stranded on a beach on the east coast of the South Island, New Zealand. Garrick (1956) later in a detailed revision erected a new genus (***Scymnodalatias***) separating it from other squaloid genera. In addition to lacking fin spines, this genus differs from ***Scymnodon*** in having the first dorsal fin slightly more posterior on the back; see Garrick (1956) and Taniuchi and Garrick (1986) for a detailed discussion of this genus and comparison to other closely related genera.

Scymnodalatias oligodon Kukuev and Konovalenko, 1988

Scymnodalatias oligodon Kukuev and Konovalenko, 1988, *Vopr. Ikthiol.*, (2): 318?, fig. 2. Holotype: Zoological Institute, Leningrad, ZIL (ZIN)–48191, 260 mm TL immature male, west of Chile, 33°31'S, 96°07'W, 0–200 m.

Synonyms: None.

Other combinations: None.

FAO Names: En – Sparsetooth dogfish; **Fr** – Squale grogneur à dents éparses; **Sp** – Bruja dentuda.

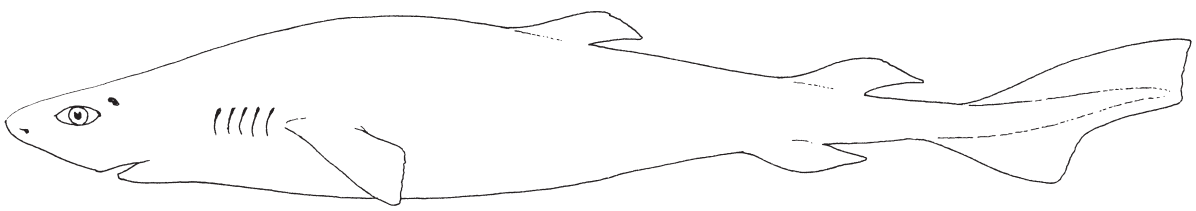
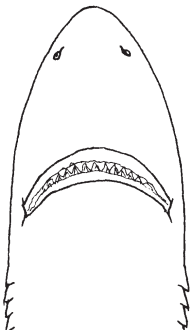
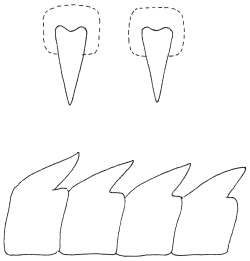


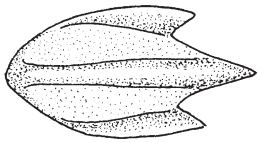
Fig. 90 ***Scymnodalatias oligodon***



UNDERSIDE OF HEAD



UPPER AND LOWER TEETH



DERMAL DENTICLE

Field Marks: Snout long, broad and somewhat pointed, eyes horizontally elongated, mouth long, broadly arched, teeth of upper jaw smaller than those on lower jaw that are blade–like, lack serrations and are imbricate, first dorsal fin about on middle of back, its free rear tip elongated, terminating anterior to pelvic–fin origin, second dorsal–fin originating above pelvic–fin base, no dorsal–fin spines and no anal fin. Colour is dark brown above, lighter below and with light margins on gill openings and pectoral fins.

Diagnostic Features: Head length 24.6% and preorbital snout, 8.4% of total length. Upper teeth with straight stout cusps; cusps of lower teeth strongly oblique, cusp covering part of root and with small distal blade; tooth row counts 33 upper jaw, 42 lower jaw, upper rows much fewer than lowers, ratio 1:1.3. Predorsal length less than half or 42.3% of total length. Pectoral fins broadly angular and not leaf–shaped, apices bluntly rounded and not acute, anterior margins 10.6% of total length. First dorsal–fin free rear tip far anterior to pelvic–fin origins by over dorsal–fin base length. Second dorsal–fin origin above pelvic–fin midbase, free rear tip just anterior to upper caudal–fin origin. Ventral caudal–fin lobe weakly developed. Vertebral and intestinal valve turn counts unavailable. Maximum total length to at least 26 cm. **Colour:** dark brown above and below, no white blotches on caudal fin.

Distribution: Southeastern Pacific Ocean: open ocean about 2300 km WNW of Santiago, Chile.

Habitat: Apparently oceanic. Caught near the surface at 0 to 200 m in water 2000 to 4000 m deep.

Biology: Presumably viviparous with yolk–sac, but nothing known about its biology.

Size: Maximum total length to at least 26 cm (holotype and only known specimen). The holotype is an immature male.

Interest to Fisheries and Human Impact: None as currently known.

The conservation status of this shark is Data Deficient.

Local names: No information.

Remarks: The diagnosis and placement of this species is from its original description. Its lateral trunk denticles agree with other ***Scymnodalatias*** and with ***Scymnodon*** in having slender pedicels and leaf–shaped crowns with three cusps and ridges. It is uncertain whether its denticles have cross ridges as in ***Scymnodalatias sherwoodi*** and ***S. albicauda***.

Literature: Kukuev and Konovalenko (1988); Nakaya and Nakano (1995); Ebert, Fowler, and Compagno (2013); Bustamante, Vargas–Caro, and Bennett (2014).

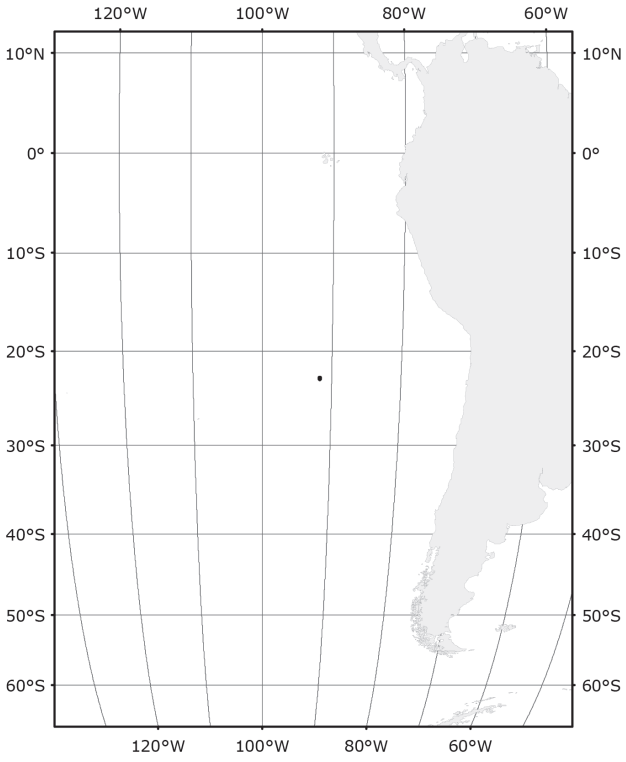


Fig. 91 ***Scymnodalatias oligodon***

Known distribution

Scymnodon Bocage and Capello, 1864

Genus: ***Scymnodon*** Bocage and Capello, 1864, *Proc. Zool. Soc. London*, 24: 263.

Type Species: ***Scymnodon ringens*** Bocage and Capello, 1864, by monotypy.

Number of Recognized Deep–sea Southeastern Pacific Ocean Species: 1.

Synonyms: ***Proscymnodon*** (subgenus of ***Scymnodon***) Fowler 1934: 239 (type species ***Centrophorus plunketi*** Waite 1910, by original designation, also monotypic).

Field Marks: See species account below.

Diagnostic Features: Body stocky, tapering posteriorly from pectoral region. Head rather thick and high. Snout broad and short, preoral length less than mouth width and less than distance from lower symphysis to first gill slits. Mouth very wide, short to moderately long and broadly arched. Postoral grooves very short, to longer than upper labial furrows. Teeth dissimilar in upper and lower jaws, small, lanceolate, without lateral cusplets in upper jaw; lower teeth relatively large, triangular, blade–like; total tooth counts upper jaw 40 to 58, lower jaw 28 to 35. Gill slits rather long, longest over half eye length. Lateral trunk denticles tridentate in shape, but without cross–ridges on crowns. Caudal peduncle short, distance from second dorsal–fin base to upper caudal–fin origin about half second dorsal–fin base. Pectoral fins narrow and leaf–shaped; apices of pectoral fins nearly reaching base of first dorsal–fin spine. Caudal fin with a weak subterminal notch and lower lobe short or absent. Vertebral counts: total vertebral counts 100 to 119, monospondylous vertebral counts 53 to 66, precaudal vertebral counts 72 to 87. Spiral valve turn counts 12 to 15. Moderate–sized sharks with a maximum total length of 170 cm. **Colour:** uniformly black to dark brown or grey brown; some species with lighter edges.

Local names: No information.

Remarks: Bocage and Capello (1864) established a new genus ***Scymnodon*** in describing their new species ***Scymnodon ringens*** from the eastern North Atlantic. Subsequently, Günther (1877) described ***Zameus*** (=***Scymnodon***) ***squamulosus*** from Japan originally placing it in the genus ***Centrophorus***. This species was later placed in the newly proposed genus ***Zameus*** Jordan and Fowler (1903), but was reassigned to the genus ***Scymnodon*** by Regan (1906) and Garman (1913) who each also included ***Scymnodon macracanthus*** and ***S. plunketi*** in this same genus, but treated ***S. obscurus*** as a junior synonym of ***S. ringens***. Fowler (1934, 1941) considered ***Scymnodon*** to include several subgenera ***Proscymnodon***, ***Scymnodon*** and ***Zameus***, but Bigelow and Schroeder (1957) considered the genus ***Scymnodon*** to include ***S. ringens***, ***S. squamulosus*** and ***S. obscurus*** (now a junior synonym of ***S. squamulosus***) and placed ***S. plunketi*** and ***S. maracanthus*** in ***Centroscymnus***. Yano and Tanaka (1984) revised the genus to include ***S. plunketi***, ***S. ringens***, ***S. squamulosus*** and their new species ***S. ichiharai***. Taniuchi and Garrick (1986) later revised the ***Scymnodalatias*** and help clarify the status of these other closely related genera, including ***Scymnodon***. Recent studies using molecular markers and re–examination of morphological characteristics confirms that ***Scymnodon*** and ***Proscymnodon*** lack any differences, thus relegating ***Proscymnodon*** to junior synonym of ***Scymnodon*** (Naylor *et al.*, 2012a, b; Straube *et al.* 2013; White *et al.*, 2015).

Scymnodon macracanthus (Regan, 1906)

Centroscymnus macracanthus Regan, 1906, *Ann. Mag. Nat. Hist.*, (7), 18(108): 436. Holotype: British Museum (Natural History), BMNH–1884.2.6.7, 680 mm TL female, Straits of Magellan.

Synonyms: ***Etmopterus paessleri*** Lönnberg, 1907, Fische, *Hamb. Magalhaens. Sammelreise*, 8(6):5. Syntypes: Zoologisches Museum, University of Hamburg, three specimens, apparently lost, Smyth Channel, Island Harbor, Straits of Magellan. ***Centroscymnus macracanthus*** Bustamante, Vargas–Caro, and Bennett, 2014, *J. Fish Biol.*, 6.

Other combinations: None.

FAO Names: En – Largespine velvet dogfish; **Fr** – Pailona jume; **Sp** – Sapata espinuda.

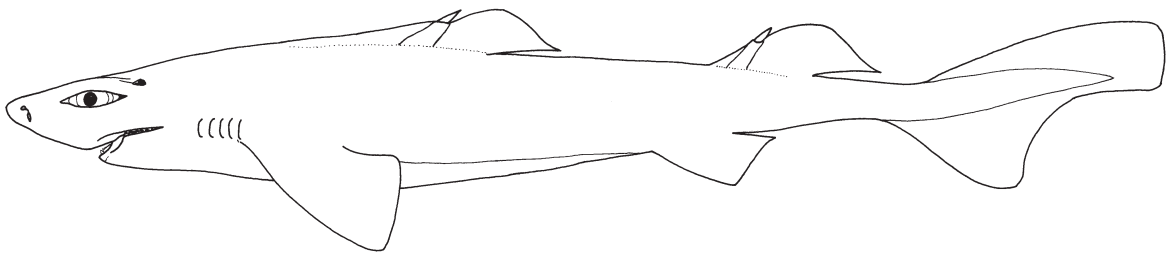
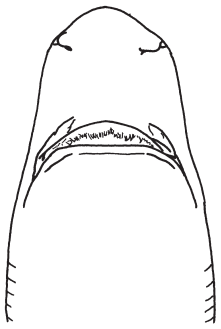


Fig. 92 ***Scymnodon macracanthus***

Field Marks: Body stocky, tapering abruptly from pectoral region, moderately long snout, lanceolate upper teeth and blade–like lower teeth with short, oblique cusps, moderately large tricuspidate and tricarinate lateral trunk denticles, dorsal fins with fairly prominent fin spines, and no anal fin. Coloration a dark brown or blackish.



UNDERSIDE OF HEAD

Diagnostic Features: Body stocky, strongly tapering back from pectoral region. Snout moderately long, preoral length about equal to distance from mouth to first gill slits and equal to mouth width. Lips thick and fleshy. Upper labial furrows very short, their lengths much less than distance between their front ends. Upper teeth lanceolate and blade–like, lower teeth with short, oblique cusps and moderately high, fairly broad roots. Tooth counts not available. Lateral trunk denticles large, with strong triple ridges and cusps in the holotype and only extant specimen. Pectoral fins large, apices falling about opposite to first dorsal–fin spine when laid back. Free rear tips of pelvic fins falling well in front of second dorsal–fin insertion. Second dorsal fin somewhat higher than first, fin spines stout and with at least a third of their lengths protruding from fins. First dorsal fin not extending forwards as a prominent ridge, origin over pectoral–fin bases. Second dorsal–fin base about as long as space between it and upper caudal–fin origin, free rear tip well in front of upper caudal–fin origin. Vertebral counts: total vertebral count 112, monospondylous vertebral count 66, and precaudal vertebral count 85. Maximum total length to at least 68.7 cm. **Colour:** black to dark brown with a narrow light posterior fin margins.

Distribution: Southeastern Pacific Ocean: Chile and the Straits of Magellan (including the southwestern Atlantic). Nominal record from New Zealand requires confirmation.

Habitat: A poorly known deep–sea dogfish, known at present only from the holotype from the Straits of Magellan, depth not recorded, and from nominal New Zealand records at 650 to 920 m.

Biology: Nothing known.

Size: The holotype and only known specimen is a female, 68.7 cm total length; presumably the species attains a larger size than this, but this is uncertain.

Interest to Fisheries and Human Impact: Interest to fisheries none at present.

Conservation status of this poorly known species is Data Deficient.

Local Names: Tollo, Sapata espinuda (Chile).

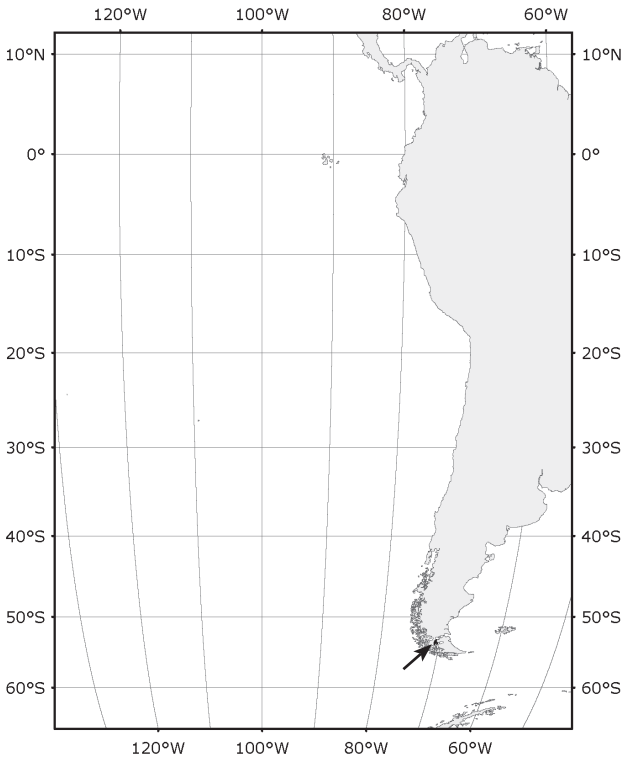


Fig. 93 ***Scymnodon macracanthus***

Known distribution

Remarks: The holotype of ***S. macracanthus*** in the British Museum (Natural History) was examined by L.J.V. Compagno, upon which the illustration and present account is mostly based. Lönnberg (1907) described ***Etmopterus paessleri*** from Smyth Channel in the Straits of Magellan, from three small syntypes deposited in the Zoologisches Museum of the University of Hamburg. These are apparently lost (Krefft, 1968), but Lonnberg presented a photograph in dorsal view of one of the syntypes. This species was accepted as an aberrant species of ***Etmopterus*** by Regan (1908), Garman (1913) and Bigelow and Schroeder (1957), but careful consideration of Lonnberg's description, measurements and illustration and a lateral–view reconstruction made from this information, caused the writers to strongly suspect that ***Etmopterus paessleri*** is a junior synonym of ***Centroscymnus macracanthus***. Particularly the broad head, large pectoral fins, large broad caudal fin, upper teeth without lateral cusplets, denticles with lateral cusps and second dorsal–fin spine slightly smaller than first, as well as the general morphology of ***E. paessleri*** all fit ***S. macracanthus*** as studied from the holotype. Hence this species is placed in tentative synonymy of ***S. macracanthus***.

This is a very rare species that should be retained if caught and deposited into a museum collection for further taxonomic examination.

Literature: Regan (1906); Lönnberg (1907); Bigelow and Schroeder (1957); Compagno (1984a); Taniuchi and Garrick (1986); Cox and Francis (1997); Ebert, Fowler, and Compagno (2013); Bustamante, Vargas–Caro, and Bennett (2014); White *et al.* (2015).

Somniosus Lesueur, 1818

Genus: ***Somniosus*** Lesueur, 1818, *J. Acad. Sci. Philadelphia* 1(2): 222. Proposed as a subgenus of ***Squalus*** Linnaeus, 1758, but used in generic form.

Type species: ***Somniosus brevipinna*** or ***Squalus brevipinna*** Lesueur, 1818, by monotypy; a junior synonym of ***Squalus microcephalus*** Bloch and Schneider, 1801.

Number of Recognized Deep–sea Southeastern Pacific Ocean Species: 1.

Synonyms: Subgenus ***Somnolentus*** (Lesueur) Swainson, 1838, *Nat. Hist. Fish. Amphib. Rept., Monocard. Anim*., 1: 146. Apparently an erroneous misspelling or correction of ***Somniosus*** Lesueur, 1818; regarded by Swainson as a synonym of ***Scymnus*** Cuvier, 1816. Genus ***Laemargus*** Müller and Henle, 1837a, *Ber. K. preuss. Akad. wiss. Berlin*, 2: 116; Müller and Henle, 1837b, *Arch. Naturg*. 3: 399; Müller and Henle, 1838, *Mag. Nat. Hist., n. ser*., 2: 89; Müller and Henle, 1838, L'Institut, 6: 65 (no species mentioned). Reduced to subgenus ***Laemargus*** Müller and Henle, 1839, *Syst. Beschr. Plagiost*., pt. 2: 93 (Genus ***Scymnus*** Cuvier, 1816), with three species. Type species: "***Squalus borealis*** Scoresby", by subsequent designation of Jordan, 1919, *Stanford U. Pub., U. Ser., Gen. Fish.* (3): 192, equals ***Scymnus borealis*** Fleming, 1828 as cited by Müller and Henle, 1839, a junior synonym of ***Squalus microcephalus*** Bloch and Schneider, 1801. Genus ***Leiodon*** Wood, 1846, *Proc. Boston Soc. Nat. Hist*., 2, 174. Type species: ***Leiodon echinatum*** Wood, 1846, by monotypy. Genus ***Rhinoscymnus*** Gill, 1864 (published 1865?), *Proc. Acad. Nat. Sci. Philadelphia*: 264, ftn. 5. Type species: ***Scymnus rostratus*** Risso, 1826, by monotypy. Genus ***Heteroscymnus*** Tanaka, 1912, *Fig. Descr. Fish. Japan*, 6: 102. Type species: ***Heteroscymnus longus*** Tanaka, 1912, by original designation. Subgenus ***Brevisomniosus*** Quéro, 1976, *Rev. Trav. Inst. Peches Marit*. 39(4): 463, 467. (Genus ***Somniosus*** Lesueur, 1818). Type species not indicated, two species, ***Somniosus rostratus*** (Risso, 1826) and ***S. bauchotae*** Quéro, 1976, included in it.

Field Marks: Short to moderately long snout, slender–cusped teeth without cusplets in upper jaw, bladelike, oblique and relatively short–cusped teeth in lower jaw, denticles with narrow, hooked, cuspidate crowns, lips not fringed and pleated, first dorsal fin on middle of back and usually behind pectoral fins, but well ahead of pelvic fins, second dorsal fin slightly smaller than first, no fin spines on dorsal fins, no anal fin, caudal fin somewhat paddle–shaped, with a long lower lobe, and size moderately large to very large.

Diagnostic Features: Anterior nasal flaps short, not expanded into barbels; snout short to moderately long, broadly rounded to pointed and somewhat flattened, length 2/5 to less than 1/3 of head length and 2/3 to less than 2/5 of distance from mouth to pectoral–fin origins; gill openings moderately wide, last one about as long as first four; lips thin, not fringed, pleated or suctorial; teeth strongly different in upper and lower jaws, upper small, with narrow, acute, erect cusps and no cusplets, not bladelike, lowers much larger, bladelike, interlocked, with a low to moderately high, oblique or semierect cusps and distal blade, edges serrated or not; tooth counts 30 to 60 upper jaw, 31 to 63 lower jaw. Both dorsal fins spineless; first dorsal fin on middle of back, with origin sometimes extended forward as a low ridge over pectoral–fin bases but usually well behind pectoral fins, insertion far in front of pelvic–fin origins but slightly closer to pelvic–fin bases than pectoral fins; second dorsal fin slightly smaller than first and with base 3/4 length of first dorsal–fin base or less; origin of second dorsal fin varying from over anterior half of pelvic–fin bases to somewhat posterior to pelvic–fin free rear tips; pectoral fins with short, narrowly to broadly rounded free rear tips and inner margins, not expanded and acute or lobate; caudal fin semi–symmetrical and paddle–shaped, with a relatively short upper lobe and long lower lobe, and a strong subterminal notch. No precaudal pits, or lateral keels, or midventral keels on caudal peduncle. Dermal denticles with oblique to erect, ridged hooked, cuspidate narrow crowns, not flat, depressed and block–like. Cloaca normal, not expanded as a luminous gland. Vertebral counts: total vertebral counts 35 to 78, monospondylous vertebral counts 21 to 46, and precaudal vertebral counts 28 to 59, caudal vertebral counts 6 to 10. Intestinal valve with 23 to 41 turns. Moderate to gigantic sharks with adults from 140 to more than 600 cm total length. **Colour:** medium grey to blackish, without conspicuous light fin edges.

Local names: No information.

Remarks: Following Yano, Stevens and Compagno (2004), five species are recognized with one species occurring in the southeastern Pacific Ocean. However, Parin *et al.* (1997) reported a possible record of ***Somniosus longus*** from the Nazca and Sala y Gomez submarine ridges, but Bustamante, Vargas–Caro, and Bennett (2014) considered this record doubtful. This species is not discussed further here.

Somniosus antarcticus Whitley, 1939

Somniosus antarcticus Whitley, 1939, *Aust. Zool*. 9(3): 242. Macquarie Island. Based on the ***Somniosus* sp.** of Waite (1916, *Australas. Antarct. Exped*., 1911–1914, *Sci. Rept. C*, vol. 3(1): 51, fig. 10), a 249 cm shark apparently of this genus.

Synonyms: ***Somniosus pacificus*** Cornejo *et al.* 2015, *Check List* 11(6): 1809, 2.

Other Combinations: ***Somniosus pacificus***, ***Somniosus microcephalus***.

FAO Names: En – Southern sleeper shark; **Fr** – Laimargue de l'Antarctique; **Sp** – Tollo meridional dormilón.

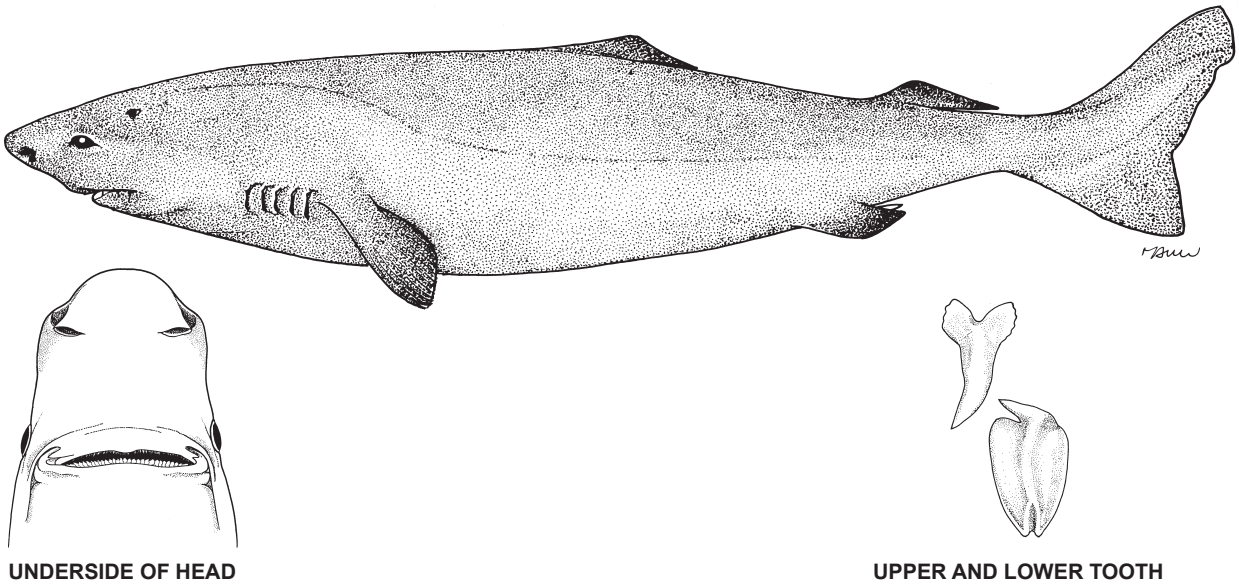


Fig. 94 *Somniosus antarcticus*

Field Marks: Heavy cylindrical body, short, rounded snout, upper teeth lanceolate, lower teeth with short, low, strongly oblique cusps and high, narrow roots, small precaudal fins, two spineless, equal–sized dorsal fins, first dorsal fin on back slightly closer to pelvic fins than pectoral fins, interdorsal space greater than distance from snout to second gill slits, no anal fin, no keels on base of caudal fin and long ventral caudal–fin lobe.

Diagnostic Features: Snout short and broadly rounded. Head moderately long, length from snout to pectoral fins 23% of total length in a specimen of 299 cm total length. Cusps of lower teeth short and low, strongly oblique, roots very high. Total tooth counts upper jaw 37 to 48, lower jaw 49 to 59. Lateral trunk denticles with erect, narrow–crowns and hooked cusps, giving skin a rough, bristly texture. Insertion of first dorsal fin slightly closer to pelvic–fin bases than pectoral–fin bases. Interdorsal space greater than distance from snout tip to second gill slits. No lateral keels present on base of caudal fin. Caudal peduncle short, distance from second dorsal–fin insertion to upper caudal–fin origin less than twice second dorsal–fin base; distance from pelvic–fin insertions to lower caudal–fin origin less than dorsal caudal–fin margin. Vertebral column without well–defined calcified centra, notochord secondarily expanded. Vertebral counts: total vertebral counts 36 to 38, precaudal vertebral counts 30 to 31. Spiral valve turn counts: 36 to 41 (mode = 39). Size large, exceeding 400 cm total length. **Colour:** uniformly grey to blackish, without conspicuous light or dark fin edges.

Distribution: Southeastern Pacific Ocean: Chile and Peru. Also widely distributed in the southern Pacific, Indian and Atlantic oceans.

Habitat: An abundant littoral and epibenthic shark of the continental and insular shelves and upper slopes down to at least 1440 m. It is commonly encountered on seamount and submarine ridges in the southern oceans. Water temperatures of places inhabited by these sharks range from 0.6 to 12 °C.

Biology: Viviparous with a yolk sac, but litter sizes mostly unknown. Diet consists of fishes, pinnipeds, cetaceans, and especially cephalopods where they appear to target giant squid (***Mesonychoteuthis hamiltoni***). Much like the other giant members of this genus these sharks consume fast–swimming prey, but whether it is taken as carrion or alive is unknown.

Size: Maximum total length to at least 456 cm, but possibly 600 cm or more; males adult at about 400 cm and females at about 435 cm. Size at birth about 40 cm.

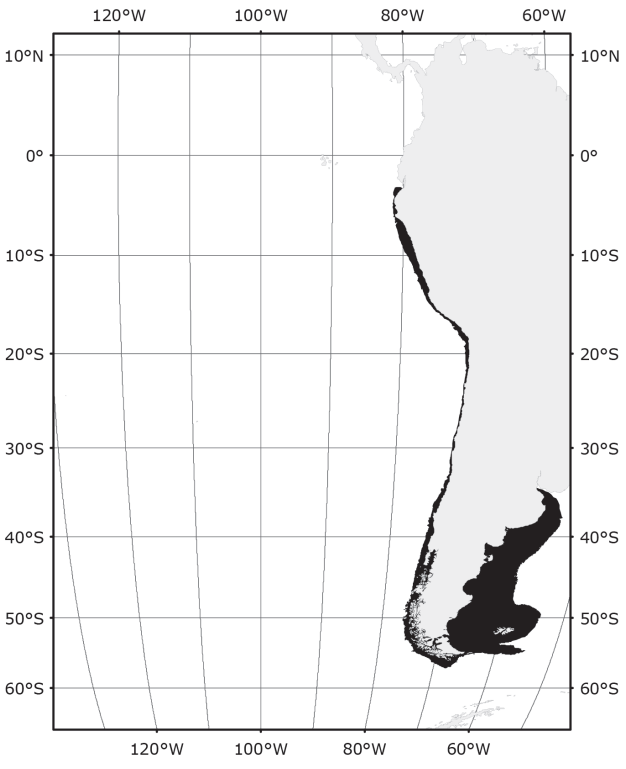


Fig. 95 *Somniosus antarcticus*

Interest to Fisheries and Human Impact: Taken as non–utilized bycatch of trawl and longline fisheries for hake, Patagonian toothfish (***Dissostichus eleginoides***, Nototheniidae), and other bottom fishes throughout most of its range.

The conservation status is Data Deficient.

Local Names: Gata grande, Tiburón dormilón (Chile).

Remarks: ***Somniosus antarcticus*** was named by Whitley (1939) based on a sketch and descriptive data from a ***Somniosus*** specimen found dead on a beach at Macquarie Island in the Antarctic. The specimen itself was not preserved, but teeth and skin samples were saved; however, it is uncertain whether these samples still exist. The descriptive data and sketch definitely indicate that the specimen represented a member of the subgenus ***Somniosus*** closest to ***S. microcephalus***, but these are sufficiently generalized to prohibit the differentiation of ***S. antarcticus*** from ***S. microcephalus***. As with certain other sharks, Whitley apparently named ***S. antarcticus*** primarily because of its Southern Hemisphere locality. However comparison of large southern oceans ***Somniosus*** to the two Northern Hemisphere forms have revealed that this species is indeed valid and could be separated by morphometric characteristics, and meristics including tooth, vertebral, and spiral valve turn counts (Yano, Stevens and Compagno, 2004). A molecular study (Murray *et al*., 2008) on the three large ***Somniosus*** species confirm the separation of ***S. microcepahlus*** from ***S. pacificus***, but the genetic structure within the ***S. antarcticus–S. pacificus*** clade was more ambiguous and showed little to no variation. Furthermore, molecular examination using mtDNA and nuclear markers is required to determine the species status of ***S. antarcticus*** and ***S. pacificus***.

Literature: Whitley (1939); Bigelow and Schroeder (1948); Compagno (1984a); Stevens (2003c); Yano, Stevens and Compagno (2004, 2007); Murray *et al.* (2008); Ebert (2013, 2015); Ebert, Fowler and Compagno (2013); Bustamante, Vargas–Caro, and Bennett (2014); Cornejo *et al.* (2015); White *et al.* (2015).

Zameus Jordan and Fowler, 1903

Genus: ***Zameus*** Jordan and Fowler, 1903, *Proc. U.S. Natn. Mus*. 26 (1324): 632.

Type species: ***Centrophorus squamulosus*** Günther, 1877, by monotypy.

Number of Recognized Deep–sea Southeastern Pacific Ocean Species: 1.

Synonyms: ***Scymnodon*** Barbosa du Bocage and Brito Capello, 1864, *Proc. Zool. Soc. Lond*., 24: 263.

Field Marks: Small to moderate, slender bodied sharks, with low flat head, snout moderately long to short, mouth short, narrow, transverse, upper labial furrows short, teeth of upper jaw small, spear–like, lower jaw teeth larger, highly erect, knife–like, fin spine preceding each dorsal fin, pectoral fins small, leaf–shaped to rounded, no anal fin, caudal fin with strong subterminal notch and short lower lobe, colour a uniform black to dark brownish.

Diagnostic Features: Head rather low and flat. Snout narrow, relatively long to short. Eyes moderately large. Mouth broad to fairly narrow and transverse. Teeth dissimilar in upper and lower jaws; upper teeth small, with a single cusp, smooth–edged, lanceolate, lower teeth triangular, oblique, erect–cusped, knife–like. Tooth counts for upper jaw 42 to 60, lower jaw 28 to 38. Gill slits rather short, longest less than half eye length. Lateral trunk denticles with or without tricuspidate ridges. First dorsal fin dissimilar in shape to second dorsal fin; length of first dorsal–fin base greater than second. Dorsal–fin spines present; first dorsal–fin spine relatively large, but decreases proportionally with growth; second dorsal–fin spine slightly shorter than first. Pectoral fins narrow to moderately broad, rounded, or leaf–shaped; apices of pectoral fins fall anterior to, or posterior to origin of first dorsal–fin spine. Pelvic fins small, about equal to second dorsal fin. Caudal peduncle long, distance from second dorsal–fin base to upper caudal–fin origin about equal to second dorsal–fin base. Caudal fin with a strong subterminal notch and a short lower lobe. Vertebral counts: total vertebral counts 93 to 105, precaudal vertebral counts 66 to 76, monospondylous vertebral counts 50 to 57. Spiral valve turns: 12 to 16. Small to moderate sized sharks between 84 to 101 cm total length. **Colour:** uniformly black to dark brownish with no conspicuous markings.

Local names: No information.

Remarks: Taniuchi and Garrick (1986) based on distinct morphological, including dermal denticles, and meristic (tooth and vertebral) differences from ***Scymnodon*** resurrected the genus ***Zameus***. The species name ***Scymnodon*** (=***Zameus***) ***obscurus*** is sometimes seen in the literature for the North Atlantic, but that species appears to be a junior synonym of ***Z. squamulosus*** (See Remarks section below species account).

The genus until recently had two species recognized, ***Zameus squamulosus*** and ***Zameus ichiharai,*** but a re–examination by White *et al.* (2015) concluded that ***Zameus ichiharai*** should be placed into the genus ***Scymnodon***.

Zameus squamulosus (Günther, 1877)

Centrophorus squamulosus Günther, 1877, *Ann. Mag. Nat. Hist. ser*. 4, 20(119): 433. Holotype: British Museum (Natural History), BMNH–1880.5.1.1, 670 mm female, *Challenger* sta. 232, off Inosima, Japan, 35°11'N, 139°28'E, BT – 41.4°F, 631 m.

Synonyms: None.

Other combinations: None.

FAO Names: En – Velvet dogfish; **Fr** – Squale–grogneur velouté; **Sp** – Bruja terciopelo.

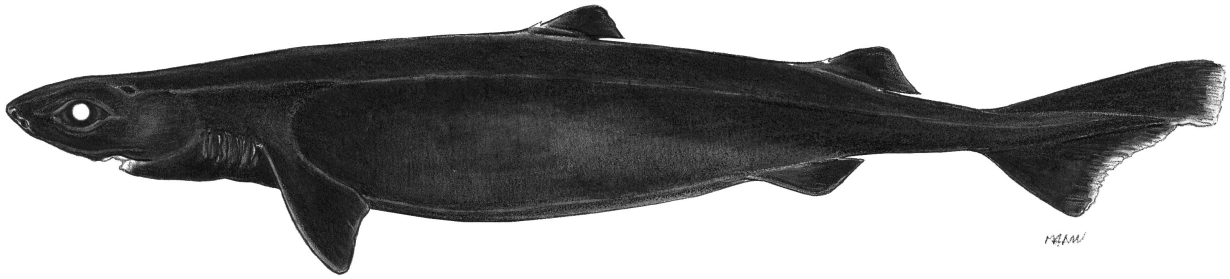


Fig. 96 *Zameus squamulosus*

Field Marks: A small slender bodied shark, with a low flat head, fairly long snout, short narrow mouth, nearly transverse, postoral grooves much longer than the short upper labial furrows, small lanceolate teeth without cusplets in upper jaw and large high, knife–cusped cutting teeth in lower jaw, a small fin spine preceding each dorsal fin, no anal fin, caudal fin with strong subterminal notch and short lower lobe. Colour uniformly black to dark brownish.

Diagnostic Features: Head rather low and flat. Snout rather narrow and long, preoral length greater than mouth width and almost equal to distance from lower symphysis to first gill slits. Mouth fairly narrow, short and transverse. Postoral grooves very long, much longer than upper labial furrows. Teeth of upper jaw small, spear–like, lower jaw high–cusped, knife–like. Tooth counts for upper jaw 47 to 60, lower jaw 32 to 38. Gill slits rather short, longest less than half eye length. Lateral trunk denticles with cross–ridges on crowns. Dorsal–fin spines present, relatively small. Pectoral fins narrow to moderately broad and leaf–shaped; apices of pectoral fins falling well in front of first dorsal–fin spine. Pelvic fins small, about equal to second dorsal fin. Caudal peduncle long, distance from second dorsal–fin base to upper caudal–fin origin about equal to second dorsal–fin base. Caudal fin with a strong subterminal notch and a short lower lobe. Spiral valve turns: 16. Vertebral counts: total vertebral counts 93 to 105, monospondylous vertebral counts 50 to 54, precaudal vertebral counts 66 to 76. Moderate size with a maximum total length of 84 cm. **Colour:** uniformly black to dark brownish with no conspicuous markings.

Distribution: Southeastern Pacific Ocean: Chile and Peru. Elsewhere, occurs throughout the Atlantic, Indian, and Pacific oceans.

Habitat: A poorly known epipelagic and oceanic deepwater shark usually found off continental and insular slopes, on or near the bottom at depths of 550 to 1450 m, but also well off the bottom at depths between 0 to 580 m in water 2000 to 6000 m deep.

Biology: Viviparous with a yolk sac, litter of 3 to 10, but little else known about their reproductive cycle. A predator on bottom fishes and invertebrates, but its smaller teeth and mouth, and weaker jaws suggest that it is a predator less capable of killing large prey than ***Scymnodon ringens***.

Size: Maximum total length about 84 cm; adult males 47 to 51 cm, and adult females 59 to 69 cm total length. Size at birth about 20 cm.

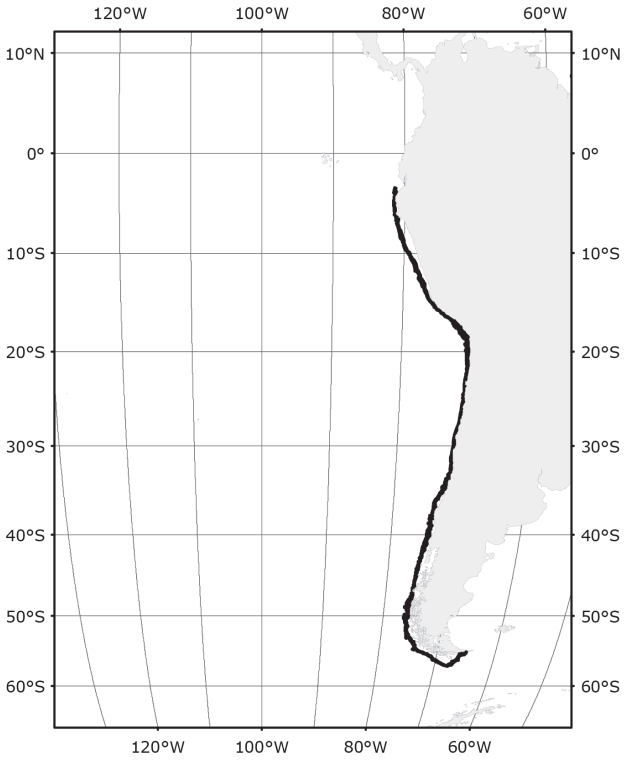


Fig. 97 *Zameus squamulosus*

Known distribution

Interest to Fisheries and Human Impact: This relatively small somniosid is of limited fisheries interest. It is caught incidentally by bottom trawls and by bottom and pelagic longline gear. There is no species–specific information on the numbers of these sharks that are caught as bycatch, but it is likely low since they do not seem to be abundant where they are known to occur. Also caught infrequently by tuna longliners in the epipelagic zone.

Conservation status is Data Deficient due to a lack of information on the life history, abundance, and population status of this widespread, but sporadically distributed dogfish shark.

Local Names: Tollo, Bruja terciopelo (Chile).

Remarks: None.

Literature: Bigelow and Schroeder (1957); Yano and Tanaka (1984); Taniuchi and Garrick (1986); Ebert, Compagno and Cowley (1992); Burgess and Chin (2006); Ebert (2013, 2015); Ebert, Fowler and Compagno (2013); Bustamante, Vargas–Caro, and Bennett (2014); Cornejo *et al.* (2015). D.A. Ebert (unpubl. data).

2.3.4 Family DALATIIDAE

Family: Tribe Dalatiana Gray, 1851, *List Fish British Mus., Pt. 1,* Chondropterygii, British Mus. (Nat. Hist.): 74 (Family Squalidae).

Type genus: ***Dalatias*** Rafinesque, 1810.

Number of Recognized Deep–sea Southeastern Pacific Ocean Genera: 5.

Synonyms: Subfamily Scymnini Bonaparte, 1838: 207 (Family Squalidae). Type genus: ***Scymnus*** Cuvier, 1816. Family Scymni Müller and Henle, 1839: 91. Type genus: ***Scymnus*** Cuvier, 1816. Family Scymnorhinidae Gill, *in* Goode and Bean, 1896: 6. Type genus: ***Scymnorhinus*** Bonaparte, 1846. Family Isistiidae Garman, 1899: 32. Type genus: ***Isistius*** Gill, 1865. Subfamily Euprotomicrinae (Family Dalatiidae) Shirai, 1992: 122. Type genus: ***Euprotomicrus*** Gill, 1865.

FAO Name: En – Kitefin sharks.

Field Marks: Short to moderately long–nosed, usually cylindrical or somewhat compressed (***Euprotomicroides***) sharks with snout and head narrow and conical, denticles small and mostly sessile, but with short pedicels and elongated lanceolate crowns in a few genera, keels present or absent on the caudal peduncle, two dorsal fins usually without spines (***Squaliolus*** with spined first dorsal fin but with spineless second dorsal fin), the first dorsal fin with origin varying from opposite to pectoral–fin bases to far behind the pectoral fins and somewhat anterior to pelvic–fin origins, the second dorsal fin not falcate and with its origin usually opposite to pelvic–fin bases or inner margins, but exceptionally slightly anterior to the pelvic–fin origins (***Euprotomicroides***), no anal fin, caudal fin with a strong subterminal notch, mostly small (50 cm long or less) to dwarf (less than 30 cm) oceanic species, often dark brown or blackish with light fins and ventral photophores (***Dalatias*** moderately large at up to 182 cm long and without photophores).

Diagnostic Features: Head narrow and rounded–conical. Snout conical and narrowly rounded to elongate–rounded in dorsoventral view. Photophores on the ventral surface of the head and body dense in the genera ***Euprotomicrus***, ***Isistius*** and ***Squaliolus***, but ***Dalatias*** apparently lack them. Spiracles large, close behind eyes. Fifth gill opening about as large as first four in most genera; ***Euprotomicroides*** with gill openings increasingly wider posteriorly. Nostrils wide to narrow–spaced with internarial width equal to or much greater than nostril width; nostrils with simple anterior nasal flaps. Mouth nearly transverse and short, with lips thin and smooth or thickened and fringed or pleated. Labial furrows short to moderately long, not encircling mouth or partially encircling it, confined to mouth corners and under or behind posterior corners of eyes, elongated posteriorly into postoral grooves and anteromedial preoral grooves; labial folds thin or thickened. Teeth with dignathic heterodonty well–developed, upper teeth much smaller than lowers; tooth row counts 16 to 37 upper jaw, 17 to 34 lower jaw. Upper teeth small, lanceolate, with narrow erect cusps and no cusplets or blades, in quincunx formation and not imbricated; lower teeth highly compressed, high–crowned, broad and bladelike, imbricated, forming a saw–like cutting edge, teeth with a compressed, erect to oblique cusp, a distal blade present or absent, and no cusplets. Trunk cylindrical or slightly compressed, abdomen without lateral ridges. Interdorsal space elongated and usually much greater than length of first dorsal–fin base (subequal to it in ***Isistius plutodus***); pelvic–caudal space short to moderately long and about equal to over twice pelvic–fin bases. Caudal peduncle cylindrical, short to moderately elongated, with or without lateral keels but without precaudal pits. Body with or without photophores. Denticles small and usually with low ridged sessile crowns but some genera (***Dalatias*** and ***Mollisquama***) with leaf–shaped, monocuspidate and lanceolate crowns on low pedicels. Pectoral fins rounded–angular or rounded–lobate, not lanceolate or falcate, anterior margins short and mostly shorter than or sometimes subequal to the prespiracular length, rear tips rounded and short. Pelvic fins subequal to or smaller than pectoral fins, smaller to larger than dorsal fins. Claspers with or without a lateral spine. Dorsal fins small or moderate–sized, angular or rounded–angular but not falcate, without spines except for a small fin spine on the first dorsal fin of ***Squaliolus***. First dorsal fin small to moderate–sized, with length less than prespiracular space; first dorsal–fin base usually over pectoral–pelvic space and behind pectoral–fin bases and well anterior to or partially over pelvic fins, first dorsal–fin origin usually

behind pectoral fins (over pectoral–fin inner margins in ***Squaliolus*** and over the pectoral–fin bases in ***Heteroscymnoides***). Second dorsal fin subequal, slightly larger, or much larger than first dorsal fin, second dorsal–fin base over or just behind pelvic–fin bases, second dorsal–fin origin slightly anterior to pelvic–fin origins to posterior to pelvic–fin insertions. Caudal fin markedly heterocercal to almost diphycercal, with ventral lobe low (***Dalatias***) to strongly developed in adults, and with subterminal notch weak to strong. Vertebral counts: total vertebral counts 60 to 92, monospondylous vertebral counts 29 to 46, diplospondylous precaudal vertebral counts 8 to 22. Intestinal valve with 6 to 42 turns. Adults dwarf to moderately large, between 15 to about 182 cm total length. **Colour:** plain or with fin edges transparent, without black photophore markings on tail or flanks but with photophores, where present, often very closely spaced on the ventral surface.

Distribution: An almost circumglobal range in most temperate to tropical seas, but most species distribution sketchily to poorly known, particularly for the oceanic species, which may reflect uneven and inadequate sampling and patchy distributions.

Habitat: The Dalatiidae include species that represent at least two ecomorphotypes (Compagno, 1990), with most showing the oceanic or *microceanic habitus* of spindle–shaped bodies, large eyes, small smooth denticles, long abdomens, small precaudal fins (often transparent), and more or less symmetrical caudal fins and the bathic or *bathic habitus* with larger fins but resembling oceanic dalatiids in having a narrower head and stronger jaws and larger teeth than is typical of other bathic squaloids such as echinorhinids, large centrophorids, and many somniosids. The oceanic species are best known from epipelagic records with some species being caught at or near the surface at night drawn by surface lights or in surface gill–nets; trawl records of these sharks extend down to at least 3500 m, and they have been caught near the surface at night in waters over 9000 m deep. Some oceanic species seem to be vertical migrators with a daily cycle, and may make transits of 1500 to 3000 m or more to rise to the surface at night and descend to the ocean bottom during the day. The bottom–dwelling deepwater bathic species are mostly inhabitants of continental and insular slopes, submarine ridges and seamounts, with occasional records from inshore in shallow water on the continental shelves (***Dalatias***). The bathic species range in depth between 20 m to at least 1800 m but with most records between 200 and 1000 m.

Biology: The family is very poorly known biologically. Reproduction is yolk–sac viviparous with litters of 6 to 16 young, but virtually nothing is known about their life cycle or age and growth. These sharks, relative to their size, proportionally have very powerful jaws with large teeth interlocked to form a shear–like cutting dentition in the lower jaw, and a holding dentition of very small hook–like teeth in the upper jaw, which allow them to capture and dismember relatively large prey. ***Dalatias licha*** feeds on a wide variety of bony fishes, cartilaginous fishes, crustacea, cephalopods, polychaetes, siphonophores, and tunicates. Species of ***Isistius*** are ectoparasitic on larger pelagic marine vertebrates including cetaceans, phocid seals, elasmobranchs, and especially large bony fishes and attach to the skin of these animals with their suctorial lips and cut out plugs of flesh with their lower teeth; they can also catch and consume smaller fishes and cephalopods. Proportionately, ***Isistius*** species have the largest teeth relative to their body–size of any modern shark species. Their mouth and jaw apparatus are uniquely designed to remove large chunks of flesh from prey items many times their size. Very little is known of their socio–biology except that of the commoner species, ***Dalatias licha*** may be solitary while ***Isistius*** and ***Squaliolus*** species may occur in aggregations as well as single individuals.

Interest to Fisheries and Human Impact: This family is of limited interest for fisheries purposes, as most of the species are apparently oceanic or semioceanic and are far too small to be caught in conventional pelagic fishing gear. Most catches of the small species are from research vessels, at night lights at the surface or with pelagic or bottom trawls. Exceptions include species of ***Isistius*** and ***Squaliolus*** that are caught as bycatch by commercial bottom trawlers and oceanic gillnets. The large bathic ***Dalatias licha*** is an exception by being the only known commercial species in the family. It is commonly fished in targeted deepwater shark fisheries in many places where it occurs and also is taken as bycatch in deep benthic fisheries for bony fishes. Kitefin sharks are not regularly kept in public aquaria and are apparently too deep–dwelling or sparse in oceanic waters to be a current subject of conventional ecotouristic diving. There is at least one confirmed account of a cookie–cutter shark (***Isistius* spp.**) biting a swimmer at the surface in the open ocean off the Hawaiian Islands as well as several anecdotal accounts of this species biting swimmers in the open ocean.

The conservation status of kitefin sharks is poorly known, but given their general small size and the rarity with which many are caught, most are either Least Concern or Data Deficient. The one exception though is ***Dalatias licha***, which is listed as Data Deficient worldwide.

Local names: No information.

Remarks: The family Dalatiidae is comprised of seven genera, five of which are monotypic genera, and ten species worldwide. Several of these genera (***Euprotomicroides, Euprotomicrus, Heteroscymnoides, Isistius,*** and possibly ***Mollisquama***) are considered to be oceanic. The geographic and bathymetric ranges are poorly known for all species within this family.

Five genera and species occur in the deep waters of the southeastern Pacific Ocean.

Literature: Garman (1913); Bigelow and Schroeder (1948, 1957); Hubbs and McHugh (1951); Hubbs, Iwai and Matsubara (1967); Compagno (1984a); Last and Stevens (2009); Ebert (2013, 2015); Ebert, Fowler and Compagno (2013); Ebert and Stehmann (2013); Bustamante, Vargas–Caro, and Bennett (2014); Cornejo *et al.* (2015).

List of Deep–sea Species Occurring in the Area:

Euprotomicroides zantedeschia Hulley and Penrith, 1966
Euprotomicrus bispinatus (Quoy and Gaimard, 1824)
Heteroscymnoides marleyi Fowler, 1934
Isistius brasiliensis (Quoy and Gaimard, 1824)
Mollisquama parini Dolganov, 1984

Key to Deep–sea Southeastern Pacific Ocean Genera:

1a. A conspicuous glandular dermal pocket on the shoulder above the pectoral–fin base on each side (Fig. 98) . . . . . ***Mollisquama***

1b. No dermal pockets on the shoulders **2**

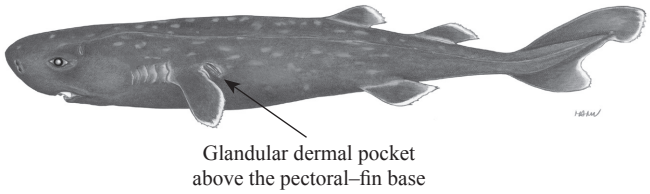


Fig. 98 ***Mollisquama***

2a. Gill openings increasing in width posteriorly, the fifth very wide. Pectoral–fin inner margin and free rear tip greatly expanded and lobate. Second dorsal–fin origin anterior to pelvic–fin origins. Cloaca greatly expanded as a luminous gland, with yellow papillae within it (Fig. 99) . . . ***Euprotomicroides***

2b. Gill openings of uniform or near–uniform width. Pectoral–fin inner margin and free rear tip not greatly expanded and lobate. Second dorsal–fin origin posterior to pelvic–fin origins. Cloaca not expanded as a luminous gland, without papillae **3**

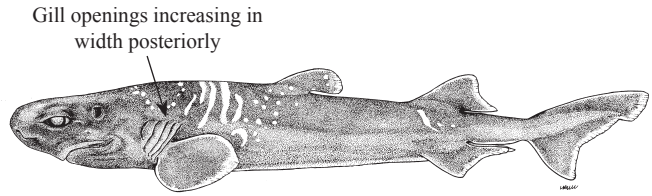


Fig. 99 ***Euprotomicroides***

3a. First dorsal–fin insertion about over pelvic–fin origins (Fig. 100). Cusps of lower teeth covering the entire crown foot, without a convex accessory blade separated from the cusp by a notch . . . . . ***Isistius***

3b. First dorsal–fin insertion well anterior to pelvic–fin origins (Fig. 101). Cusps of lower teeth covering part of the crown foot, with a convex distal blade separated from the cusp by a notch **4**

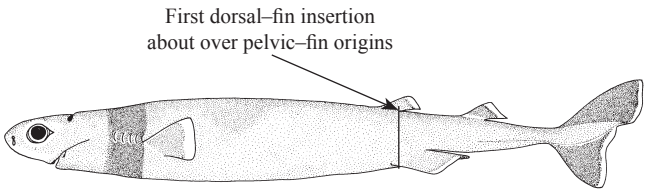


Fig. 100 ***Isistius***

4a. Second dorsal–fin base as long as first dorsal–fin base or shorter. Upper caudal–fin lobe not shortened, not paddle–shaped (Fig. 101). . . . . ***Heteroscymnoides***

4b. Second dorsal–fin base about 4 times as long as base as first dorsal–fin base. Upper caudal–fin lobe shortened, caudal paddle–shaped (Fig. 102) . . . . . ***Euprotomicrus***

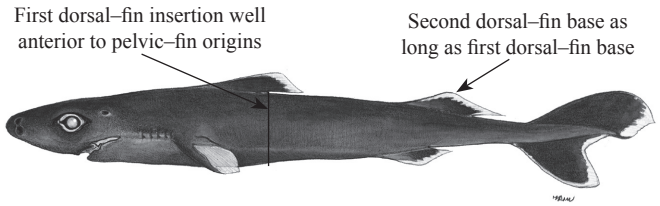


Fig. 101 ***Heteroscymnoides***

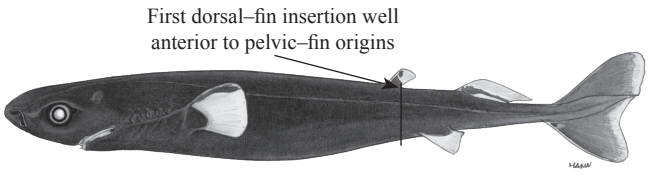


Fig. 102 ***Euprotomicrus***

Euprotomicroides Hulley and Penrith, 1966

Genus: ***Euprotomicroides*** Hulley and Penrith, 1966, *Bull. Mar. Sci.* 16(2): 222.

Type species: ***Euprotomicroides zantedeschia*** Hulley and Penrith, 1966, by original designation (new genus and species formula).

Number of Recognized Deep–sea Southeastern Pacific Ocean Species: 1.

Synonyms: None.

Diagnostic Features: Anterior nasal flaps very short, not expanded into barbels; snout moderately long, compressed and conical, length about 2/5 of head length and less than distance from mouth to pectoral–fin origins; gill openings increasing in size from front to back, fifth over twice length of first; lips thick, fringed, but not suctorial; teeth strongly different in upper and lower jaws, uppers small, with narrow, acute, erect cusps and no cusplets, not bladelike, lowers much larger, bladelike, interlocked, with a high, broad, nearly erect cusp and distal blade, edges not serrated; tooth rows 29 upper jaw, 29 to 34 lower jaw. Both dorsal fins spineless; first dorsal–fin origin well behind free rear tips of pectoral fins, insertion about equidistant between pectoral and pelvic–fin bases and well ahead of pelvic–fin origins; second dorsal fin somewhat larger than first, base less than 1.5 times length of first dorsal–fin base; origin of second dorsal well ahead of pelvic–fin origins; pectoral fins with greatly expanded, broadly lobate free rear tips and inner margins, much as in chimaeras; caudal fin asymmetrical, not paddle–shaped, upper lobe long, lower lobe moderately long subterminal notch well–developed. No precaudal pits or lateral keels on caudal peduncle, but with a midventral keel. Dermal denticles flat and block–like, not pedicellate, no posterior cusps on flat, depressed crowns. Cloaca greatly expanded and modified as a luminous gland with secretory papillae. Vertebral counts: total vertebral counts 80 to 86, monospondylous vertebral counts 45 to 46, caudal vertebral counts 35 to 40. Spiral valve turn counts not available. Maximum total length to about 53 cm. **Colour:** blackish brown with conspicuous light fin margins.

Local names: No information.

Remarks: Trawlers operating in the South Pacific collected only the third and fourth known specimens, one in 1985 and another in 2008 (Stehmann, van Oijen, and Kamminga, 2016.

Euprotomicroides zantedeschia Hulley and Penrith, 1966

Euprotomicroides zantedeschia Hulley and Penrith, 1966, *Bull. Mar. Sci.* 16(2): 222, fig. 1–4. Holotype: South African Museum, SAM–23577, 176 mm TL immature male, west of Cape Town, 458–641 m.

Synonyms: None.

Other combinations: None.

FAO Names: En – Taillight shark; **Fr** – Squale à queue claire; **Sp** – Tollo rabo claro.

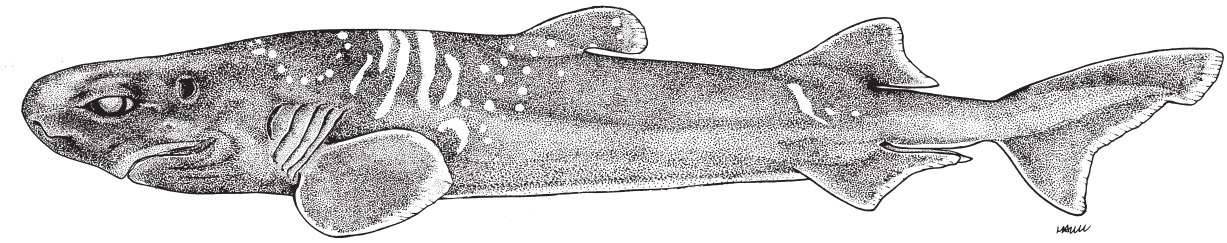


Fig. 103 ***Euprotomicroides zantedeschia***

Field Marks: Conical, moderately long, blunt, compressed snout, compressed body, no dorsal fin spines, cloacal gland, lobate, chimaera–like pectoral fins, no anal fin, gill slits increasing greatly in size from front to back, midventral keel on caudal peduncle, asymmetrical caudal fin, needle–like upper teeth and blade–like lowers, dark colour with conspicuous light fin margins.

Diagnostic Features: See genus.

Distribution: Southeastern Pacific Ocean: two individuals in the vicinity of the Juan Fernandez Islands off Chile. South Atlantic: west of Cape Town, South Africa and east of Uruguay.

Habitat: A little–known, extraordinarily specialized, oceanic dwarf shark, known only from four specimens, including two from off the Juan Fernandez Islands, Chile; both specimens were caught in midwater trawls, one was at a depth of 75 m during the daytime. The southeastern Atlantic specimen was caught offshore on the continental slope in a bottom trawl (holotype), but a second specimen caught in the southwestern Atlantic was captured near the surface (0 to 25 m deep) far offshore in the epipelagic zone (Krefft, 1980).

Biology: Mode of reproduction unknown, probably viviparous with a yolk–sac and with few young. The cloaca of this shark is greatly expanded into a gland with internal villi that secrete a blue luminous substance (M. Stehmann, pers. comm.); this will be reported in detail elsewhere. The broadly lobate, muscular–based pectoral fins, situated on the compressed body

in a position similar to the pectoral fins of chimaeras, suggest that pectoral propulsion or at least pectoral hovering is important in this shark. Food unknown; the powerful jaws and sharp lower teeth suggest that this species can capture and dismember relatively large prey.

Size: Maximum total length to about 53 cm; male maturity between 41.6 and 45.5 cm total length; female maturity uncertain, but a 53 cm total length individual taken off Chile may be mature. The 17.6 cm holotype was originally recorded as an adult male, but turned out to be an immature female.

Interest to Fisheries and Human Impact: Interest to fisheries none.

The conservation status of this species is Data Deficient.

Local names: No information.

Remarks: None.

Literature: Hulley and Penrith (1966); Bass, D'Aubrey and Kisnasamy (1976); Krefft (1980); Compagno (1984); Stehmann and Krefft (1988); Compagno, Ebert, and Smale (1989); Ebert, Fowler, and Compagno (2013); Ebert (2015); Ebert and van Hees (2015); Stehmann, van Oijen, and Kamminga (2016); M. Stehmann (pers. comm.).

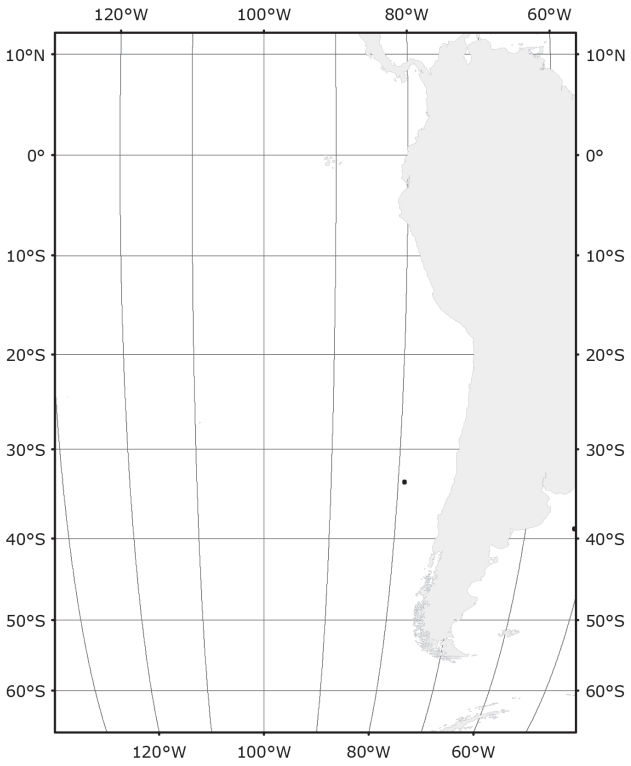


Fig. 104 ***Euprotomicroides zantedeschia***

Known distribution

Euprotomicrus Gill, 1865

Genus: ***Euprotomicrus*** Gill, 1865 (listed 1864), *Proc. Acad. Nat. Sci. Philadelphia*: 264, ftn. 4.

Type species: ***Scymnus labordii*** "Müller and Henle", 1839, by monotypy, equals ***Scymnus bispinatus*** Quoy and Gaimard, 1824.

Number of Recognized Deep–sea Southeastern Pacific Ocean Species: 1.

Synonyms: None.

Field Marks: See species.

Diagnostic Features: Snout moderately long, bulbously conical, length about 2/5 of head length and less than distance from mouth to pectoral–fin origins. Anterior nasal flaps very short, not expanded into barbels. Gill openings very small, uniformly broad. Lips thin, not fringed, pleated or suctorial. Teeth strongly different in upper and lower jaws, uppers small, with narrow, acute, erect cusps and no cusplets, not bladelike, lowers much larger, bladelike, interlocked, with a high, broad, nearly erect cusp and distal blade, edges not serrated; tooth rows 19 to 21 upper jaw, 19 to 23 lower jaw. Both dorsal fins spineless; first dorsal–fin origin far behind free rear tips of pectoral fins, insertion well ahead of pelvic–fin origins but much closer to pelvic–fin bases than pectoral fins; second dorsal fin much larger than first, with its base about 4 times as long as base of tiny first dorsal fin. Origin of second dorsal fin over rear end of pelvic–fin bases. Pectoral fins with short, broadly rounded free rear tips and inner margins, not expanded and acute or lobate. Caudal fin nearly symmetrical, paddle–shaped, with short, strong upper lobe and long lower lobe; subterminal notch well–developed. No precaudal pits but with low lateral keels on caudal peduncle, no midventral keel. Dermal denticles flat and block–like, not pedicellate, no posterior cusps on flat, depressed crowns. Cloaca normal, not expanded as a luminous gland. Vertebral counts: total vertebral counts 60 to 70, monospondylous vertebral counts 31 to 32, precaudal diplospondylous vertebral counts 15 to 20, total precaudal vertebral counts 46 to 52, caudal vertebral counts 11 to 19. Intestinal valve turn counts 12 to 13. Maximum total length 27 cm. **Colour:** blackish with conspicuously light–edged fins.

Local names: No information.

Euprotomicrus bispinatus (Quoy and Gaimard, 1824)

Scymnus bispinatus Quoy and Gaimard, 1824, *Zoologie, Poissons*, *in* L. de Freycinet, Voyage aut. monde corv. S.M. *l'Uranie* et *La Physicienne*, 1817–1820: 197, pl. 44, figs. 1, 2. Holotype: Museum National d'Histoire Naturelle, Paris, MNHN–1216, 196 mm male, Mauritius, Indian Ocean.

Synonyms: None.

Other combinations: None.

FAO Names: En – Pygmy shark; **Fr** – Squale pygmée; **Sp** – Tollo pigmeo.

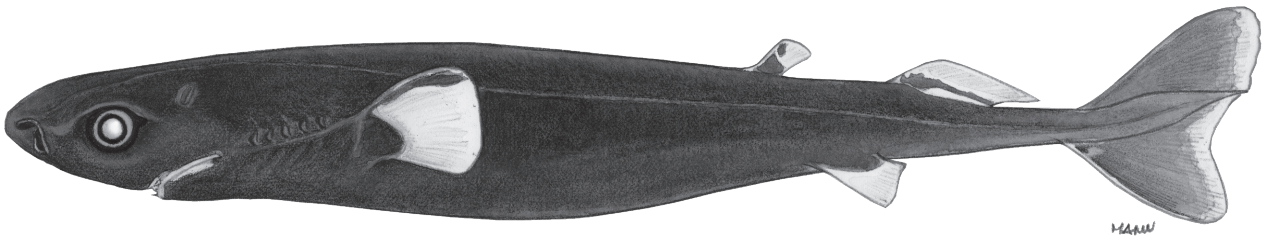


Fig. 105 ***Euprotomicrus bispinatus***

Field Marks: Small size, bulbous snout, cylindrical body, no dorsal–fin spines, tiny flag–like first dorsal fin, this over abdomen and closer to pelvic fins than pectoral fins and well behind pectoral fins, second dorsal–fin base about four times larger than first, no anal fin, blackish colour with conspicuous light–edged fins.

Diagnostic Features: See genus.

Distribution: Southeastern Pacific Ocean: Chile and Peru. Elsewhere, oceanic and amphitemperate, scattered throughout most ocean basins.

Habitat: The pygmy shark is an epipelagic, mesopelagic, and perhaps bathypelagic inhabitant of the central water masses of the North and South Pacific, South Atlantic, and southern Indian Ocean, at water depths from 1829 to 9938 m. It occurs at or near the surface at night and apparently descends to at least midwater depths, to probably well below 300 m during the day; sand grains in the stomach of one specimen suggests that it may have been feeding on the bottom, presumably below 1800 m depth. All known specimens have been caught at the surface at night while none have been taken in midwater trawls at night or during the day. This also suggests that the diel vertical migrations of this little shark are enormous, at least 1500 m or more each way to put it below the normal range of midwater trawl hauls in the day. In human terms this would be roughly equivalent to someone climbing at least 11 km up and down each day.

Biology: Development viviparous with a yolk sac and with 8 young per litter. This shark eats deepwater squid and bony fishes, including hatchetfishes, lanternfishes, and lightfishes, with some crustaceans, but apparently does not take prey as relatively large as the squid taken by ***Isistius brasiliensis***. Its jaws are moderately strong but far weaker than those of ***Isistius*** and ***Dalatias***, and there is no evidence that the pygmy shark cuts plugs of flesh from fishes and other animals. Its lips are apparently not suctorial.

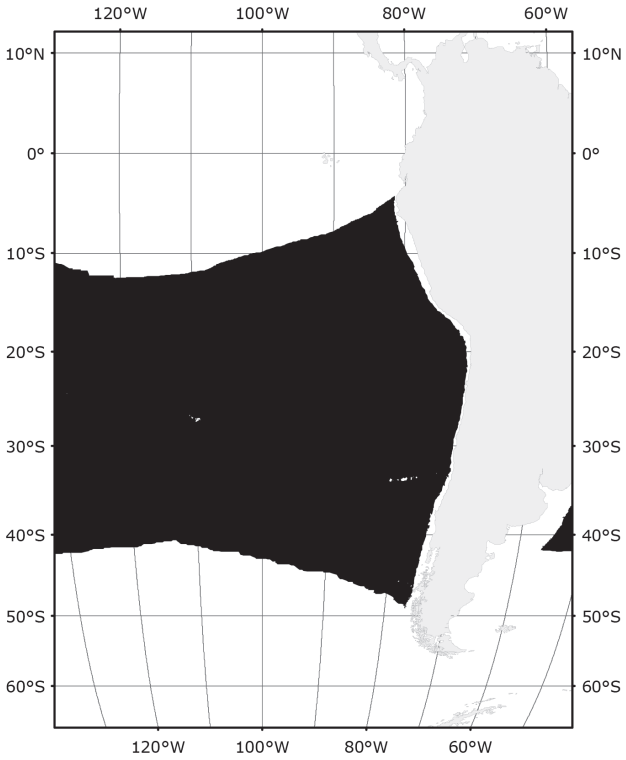


Fig. 106 ***Euprotomicrus bispinatus***

Size: Maximum total length 27 cm; males mature between 17 to 19 cm and reach 22 cm, females mature between 22 and 23 cm and reach 27 cm. Size at birth greater than 6 cm and less than or about 10 cm.

Interest to Fisheries and Human Impact: Interest to fisheries none.

The conservation status of this shark is Data Deficient.

Local Names: Tollo pigmeo (Chile).

Remarks: Pygmy sharks possess luminescent organs on their ventral surfaces that may serve to camouflage them from predators when they are at the surface. These organs may also play an important role in feeding and social recognition.

Literature: Hubbs and McHugh (1951); Bigelow and Schroeder (1957); Hubbs, Iwai and Matsubara (1967); Seigel (1978); Compagno (1984a); Last and Stevens (2009); Ebert (2003, 2013, 2015); Last and Stevens (2009); Ebert, Fowler and Compagno (2013); Ebert and Stehmann (2013); Bustamante, Vargas–Caro, and Bennett (2014); Cornejo *et al.* (2015).

Heteroscymnoides Fowler, 1934

Genus: ***Heteroscymnoides*** Fowler, 1934, *Proc. Acad. Nat. Sci. Philadelphia*, 85: 239.

Type species: ***Heteroscymnoides marleyi*** Fowler, 1934, by original designation.

Number of Recognized Deep–sea Southeastern Pacific Ocean Species: 1.

Synonyms: Genus ***Heteroscymnodes*** Fowler, 1969a, *Quart. J. Taiwan Mus*. 22(1–2): 70. Apparent typographical error for ***Heteroscymnoides***.

Field Marks: See species.

Diagnostic Features: Anterior nasal flaps very short, not expanded into barbels. Snout very long, bulbously conical, length almost half head length and about equal to distance from mouth to pectoral–fin origins. Gill openings very small, uniformly wide. Lips thin, not fringed, pleated or suctorial. Teeth strongly different in upper and lower jaws, uppers small, with narrow, acute, erect cusps and no cusplets, not bladelike, lowers much larger, bladelike, interlocked, with a high, moderately broad, semi–erect cusp and distal blade, edges not serrated; tooth rows 22 upper jaw, 23 lower jaw. Both dorsal fins spineless. First dorsal–fin well forward, origin over pectoral–fin bases, insertion far ahead of pelvic–fin origins and much closer to pectoral–fin bases than pelvic fins. Second dorsal fin slightly larger than first but with base about equal to first dorsal–fin base. Origin of second dorsal fin over midbase of pelvic fins. Pectoral fins with short, narrowly rounded free rear tips and inner margins, not expanded and acute or lobate. Caudal fin semi–symmetrical, almost paddle–shaped, with moderately long upper lobe and well–developed lower lobe, subterminal notch strong. No precaudal pits, lateral or midventral keels on caudal peduncle. Dermal denticles flat but with pedicels, with lanceolate, ridged, wedge–shaped, monocuspidate crowns. Cloaca normal, not expanded as a luminous gland. Vertebral counts: total vertebral count 70, precaudal vertebral count 52. Maximum total length 36.5 cm. **Colour:** brown with conspicuous light and dark banded fin margins.

Local Names: No information.

Heteroscymnoides marleyi Fowler, 1934

Heteroscymnoides marleyi Fowler, 1934, *Proc. Acad. Nat. Sci. Philadelphia*, 85: 240, fig. 4. Holotype: Academy of Natural Sciences, Philadelphia, ANSP–53046, 128 mm newborn female, Durban coast at Point Ocean Beach, Natal.

Synonyms: None.

Other combinations: None.

FAO Names: En – Longnose pygmy shark; **Fr** – Squale mignon; **Sp** – Tollo pigmeo trompudo.

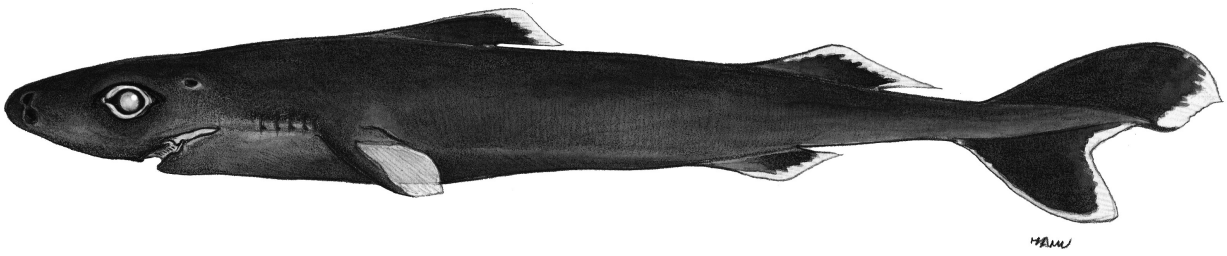


Fig. 107 ***Heteroscymnoides marleyi***

Field Marks: Small size, bulbous elongated snout, no dorsal–fin spines, first dorsal fin far forward, with origin over pectoral–fin bases, second dorsal fin only slightly larger than first, no anal fin, dark brown colour with light–edged fins.

Diagnostic Features: See genus.

Distribution: Southeastern Pacific Ocean: Known from a single specimen caught at 32°35.7'S, 85°25.2'W. Elsewhere, this species is possibly circumglobal in cold temperate waters of the Southern Hemisphere (Stehmann, Kukuev, and Konovalenko, 1999).

Habitat: A dwarf oceanic shark. The holotype was found on a beach in a subtropical area (KwaZulu–Natal, South Africa), but additional specimens have been collected in the open ocean in the epipelagic zone in cold southern waters, in the South Atlantic and eastern South Pacific between the surface and 502 m in water over 830 to over 4000 m deep (Krefft, 1980; Stehmann, Kukuev and Konovalenko, 1999). The Walvis Ridge and Selkirk Island specimens were found in cold current systems (Benguela and Humboldt Currents respectively).

Biology: A rare species (known from six individuals), with biology poorly known. Reproductive mode is unknown but likely yolk–sac viviparous and possibly with few young as suggested by the large size of a presumably neonate female (12.8 cm) compared with an adult female (33.3 cm). Food habits unknown, but presumably pelagic fish and invertebrates.

Size: Maximum total length 36.5 cm. Adult males (two) were 36.0 and 36.5 cm. Of the two larger females reported, Krefft's (1980) 28.5 cm female was not examined for maturity but Stehmann, Kukuev and Konovalenko (1999) indicated that a 33.3 cm female was an adult. The 12.8 cm female holotype was immature and had an umbilical scar, indicating it was close to the size at birth.

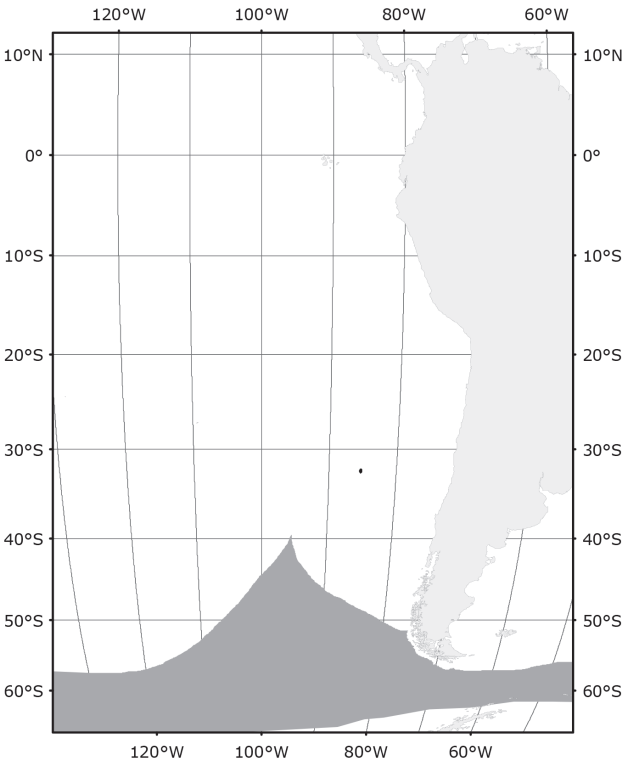


Fig. 108 ***Heteroscymnoides marleyi***

Interest to Fisheries and Human Impact: Interest to fisheries none; catches by fisheries unknown at present.

Conservation status of this poorly known species is Least Concern.

Local Names: No information.

Literature: Fowler (1934, 1941); Bigelow and Schroeder (1948, 1957); Bass, D'Aubrey and Kistnasamy (1976); Krefft (1980); Compagno (1984a); Stehmann, Kukuev and Konovalenko (1999); Burgess (2006b); Ebert (2013); Ebert, Fowler and Compagno (2013); Ebert (2015).

Isistius Gill, 1865

Genus: ***Isistius*** Gill, 1865 (listed 1864), *Proc. Acad. Nat. Sci. Philadelphia*: 264, ftn. *2.

Type species: ***Scymnus brasiliensis*** "Müller and Henle, 1839", by monotypy, equals ***Scymnus brasiliensis*** Quoy and Gaimard, 1824. Published Nov. 22, 1864 according to Garman, 1899, *Mem. Mus. Comp. Zool. Harvard*, 24: 33; listed as 1865 according to Dean, 1916, *Bibliogr. Fish*., 1: 460 and Eschmeyer (2013).

Number of Recognized Deep–sea Southeastern Pacific Ocean Species: 1.

Synonyms: Genus ***Leius*** Kner, 1864, *Anz. Akad. Wiss. Wien*, 1: 186; Kner, 1864, *Ann. Mag. Nat. Hist*., 3, ser. 15: 185–187; Kner, 1865, *Denkschr. Akad. Wiss. Wien, Math.–nat. Kl*., 24: 9, pl. 4, figs. 2–2a. Type species: ***Leius ferox*** Kner, 1865, by original designation? The latter was published Nov. 10, 1864 according to Garman, 1899, *Mem. Mus. Comp. Zool. Harvard*, 24: 33; 1865, according to Dean, 1916, *Bibliogr. Fish*., 1: 695. See also Eschmeyer, 2013, *Cat. Gen. Fish*., who indicates type by monotypy.

Field Marks: Small size, cigar–shaped body with long abdomen and short tail, short, bulbous snout, suctorial lips, large to huge, triangular–cusped lower teeth without blades, small, spineless, nearly equal–sized dorsal fins far posterior on back, caudal fin with short to long ventral lobe and no anal fin.

Diagnostic Features: Anterior nasal flaps very short, not expanded into barbels. Snout short, bulbously conical, length less than 2/5 of head length and much less than distance from mouth to pectoral–fin origins. Gill openings small, uniformly broad. Lips expanded, fleshy, suctorial, allowing the shark to attach to its prey like a lamprey. Teeth strongly different in upper and lower jaws; uppers small, with narrow, acute, erect cusps and no cusplets, not bladelike, lowers very large, bladelike, interlocked, with a high broad, erect cusp but no blade, edges not serrated; tooth row counts 29 to 43 upper jaw, 17 to 31 lower jaw. Both dorsal fins spineless; first dorsal fin far posterior, origin far behind pectoral fins and somewhat anterior to pelvic–fin origins, insertion over pelvic–fin bases. Second dorsal fin slightly larger than first but with base about equal to first dorsal–fin base; origin of second dorsal fin about over pelvic–fin rear tips. Pectoral fins with short, narrowly to broadly rounded free rear tips and inner margins, not expanded and acute or lobate. Caudal fin varying from asymmetrical to nearly symmetrical, paddle–shaped or not, with a short upper lobe, short to long lower lobe, and a strong subterminal notch. No precaudal pits but with low lateral keels on caudal peduncle, no midventral keel. Dermal denticles flat and block–like, not pedicellate, no posterior cusps on flat, depressed crowns. Cloaca normal, not expanded as a luminous gland. Vertebral counts: total vertebral counts 81 to 92, precaudal vertebral counts 60 to 66, caudal vertebral counts 20 to 27. Intestinal valve turn counts 8 to 10. Small sharks with a maximum total length of about 50 cm. **Colour:** medium grey or grey–brown with light–edged fins; usually with a dark collar–like band around the gill region.

Local names: No information.

Remarks: The arrangement of this genus follows Garrick and Springer (1964).

Isistius brasiliensis (Cuvier, *In* Quoy and Gaimard, 1824)

Scymnus brasiliensis Cuvier, *in* Quoy and Gaimard, 1824, *Zoologie, Poissons*, *in* L. de Freycinet, Voyage aut. monde corv. S.M. l'Uranie et La Physicienne, 1817–1820: 198. Holotype: Museum National d'Histoire Naturelle, Paris, MNHN–A.7787, 140 mm total length, female, off Brazil.

Synonyms: None.

Other combinations: None.

FAO Names: En – Cookiecutter shark; **Fr** – Squalelet féroce; **Sp** – Tollo cigarro.

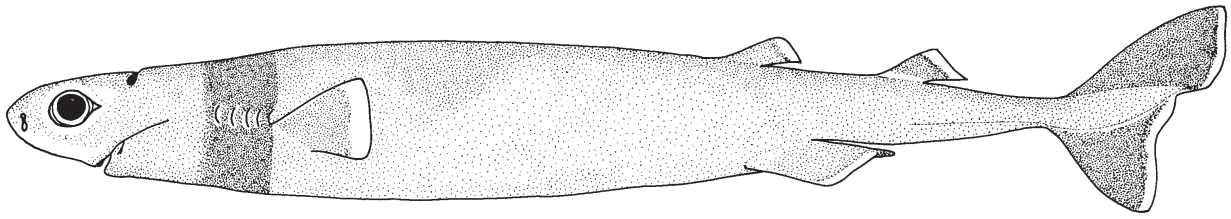


Fig. 109 *Isistius brasiliensis*

Field Marks: Small sized sharks with cigar–shaped body, short, bulbous snout, suctorial lips, small, triangular–cusped lower teeth without blades and in 25 to 31 rows, spineless dorsal fins far posterior on back, no anal fin, nearly symmetrical caudal fin with long ventral lobe and a prominent dark collar–marking over branchial region.

Diagnostic Features: Snout moderately short, about length of eye. Eyes anterior on head but sufficiently far back to lack an extensive anterior binocular field. Teeth in upper jaw 30 to 37, lower jaw 25 to 31; lowers moderately large. Interdorsal space over twice first dorsal–fin base, space between second dorsal–fin insertion and upper caudal–fin origin over twice second dorsal–fin base. Pectoral fins subquadrate, pelvic fins larger than dorsal fins. Second dorsal–fin height about equal to first. Caudal fin large and nearly symmetrical, with a long ventral caudal–fin lobe over 2/3 length of dorsal caudal–fin margin. Vertebral counts: total vertebral counts 81 to 89, precaudal vertebral counts 60 to 66, caudal vertebral counts 20 to 24. Intestinal valve turn counts 8 to 10. A small shark with a maximum total length of about 56 cm. **Colour:** pale brown above, becoming lighter below, with a conspicuous dark collar–like marking around the gill region; fins dark, but with pale to translucent edges.

Distribution: Southeastern Pacific Ocean. Elsewhere, known from scattered records throughout the Atlantic, Indian, and Pacific oceans.

Habitat: A wide–ranging tropical oceanic shark, epipelagic to bathypelagic in distribution. It is caught at night, sometimes at the surface, but usually below it at depths between 85 to 3500 m, however its preferred depth range and maximum depth are uncertain. Apart from those captured at the surface specimens are generally taken in midwater nets fished over a wide

depth range, and it is difficult to tell at what depth these sharks were captured. This shark is thought to be a vertical migrator on a diel cycle, coming to the surface and to the level of midwater trawl hauls at night and presumably dropping below this during the daytime as few if any of these sharks have been taken during the daytime. This implies a long vertical distance travelled, in excess of 2000 to 3000 m up and down in the ocean basins. These sharks are often caught near islands; this may imply an inshore pupping ground or merely the distribution of large potential victims. The cookiecutter shark may be capable of living in water of lower oxygen content than ***Euprotomicrus bispinatus*** or ***Squaliolus* spp.**, but this is hypothetical.

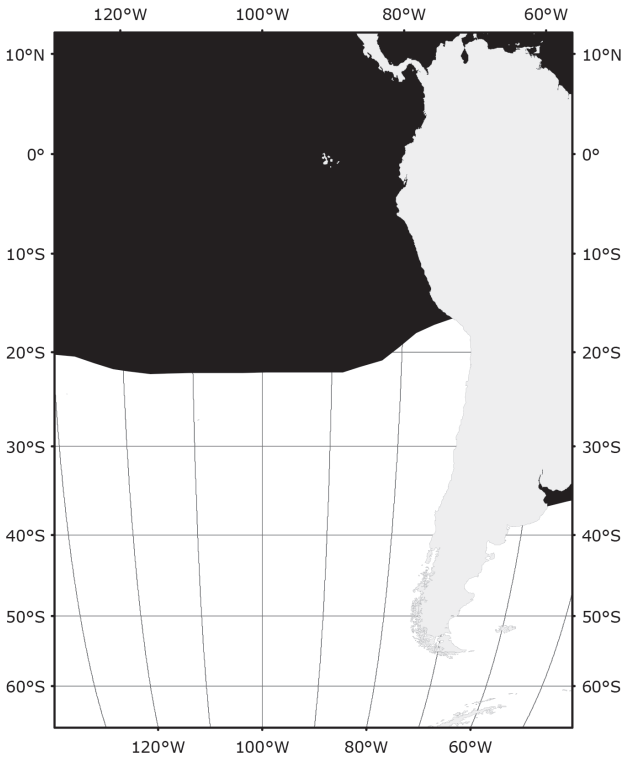


Fig. 110 ***Isistius brasiliensis***

Known distribution

Biology: Viviparous with a yolk sac, 6 or 12 large eggs have been found in ovaries and a 46.5 cm pregnant female had nine near–term foetuses, but little else is known about their reproductive biology.

This shark has very powerful jaws and large teeth. It feeds on free–living deepwater prey, including squid with bodies almost as large as itself, gonostomatid fishes, and crustaceans, but is also a facultative ectoparasite on larger marine organisms. It has highly specialized suctorial lips and a strongly modified pharynx that allows it to attach to the sides of large bony fishes such as marlin, tuna, albacore, wahoo, and dolphinfish, as well as phocid seals, dolphins and other cetaceans (including the melon–headed whale, ***Peponocephala electra***) and even the megamouth shark (***Megachasma pelagios***), deep–sea stingray (***Plesiobatis daviesi***) and sixgill stingray (***Hexatrygon bickelli***). Off Brazil in the Santos area ***Isistius* spp.** (including this species and ***I. plutodus***) bit swordfish (***Xiphias***), snake mackerel (***Ruvettus*** and ***Lepidocybium***), marlin and sailfish (***Tetrapturus*** and ***Istiophorus***), yellowfin tuna and albacore (***Thunnus albacares*** and ***T. alalunga***), dolphinfish (***Coryphaena hippurus***), bramids (***Brama brama***) and bigeye thresher (***Alopias superciliosus***). The shark drives its razor–sharp saw–like lower dentition into the skin and flesh of its victim, twists about to cut out a conical plug of flesh, then pulls free with the plug cradled by its scoop–like lower jaw and held by the hook–like upper teeth. This method of feeding leaves 'crater wounds' on victims, which were long thought to be caused by bacteria or invertebrate parasites, until Jones (1971) connected them to the cookiecutter or cigar shark. It has been hypothesized that the strong luminescence shown by this shark may serve to lure in other predators to attack it, with the result that the shark attacks or parasitizes them instead. It has been suggested (Widder, 1998) that the dark collar marking of this shark, banded by luminescent areas on the head and abdomen, specifically serves as a lure to attract upward–looking pelagic predators, which are killed and eaten or 'cored'. Incomplete crater wounds often show that the cookiecutter shark attacked its victim's head on, perhaps after they attacked it. Aggregations of these sharks may appear as schools of prey fishes to large pelagic fishes such as tuna or swordfish, which proves to be an unwelcome surprise as the fishes are in turn bitten by the cookiecutters.

The small paired fins, long body cavity and enormous, oily liver of this shark point to its being neutrally buoyant and not dependent on forward motion and its fins for dynamic lift. The liver and body cavity is proportionately much larger than in ***Euprotomicrus bispinatus*** or ***Squaliolus* spp.**, and much more oil is present in its body cavity and gut. This may be an adaptation for greater depths than those attained by the other species, but may also compensate for its more highly calcified skeleton, which in turn may be necessary for supporting its activities in taking larger prey and gouging flesh from large animals. It can be quite quick and active when caught and can nip its captors if they are unwary.

This shark has luminous organs that cover the entire lower surface of its trunk with the exception of its fins and the dark collar marking. It is reported as glowing a bright, ghastly green.

An unusual habit of this shark, perhaps related to maintaining sufficient calcium levels in its body for its relatively well–calcified skeleton and replacing its massive dentition, is swallowing and possibly digesting its own lower teeth as they are replaced and become loose in entire series.

Size: Maximum total length about 56 cm; males mature at about 31 to 37 cm and reach at least 42 cm, females mature between 38 and 44 cm and reach at least 56 cm. Size at birth between 14 to 15 cm.

Interest to Fisheries and Human Impact: Of little interest to fisheries because of its small size and low abundance, but reportedly captured by bottom trawls and used for fishmeal in the eastern Atlantic. It has been also caught in experimental pelagic gillnets targeting pelagic ommastrephid squid in the North Pacific. ***Isistius brasiliensis*** might be of slight negative

interest to fisheries because the species gouges plugs of flesh from commercially important fishes, which may increase their mortality rate, but this is uncertain. Also, extensively damaged or scarred fishes are of less valuable than undamaged ones.

Unusual non–edible and non–living victims of this shark include nuclear submarines of the U.S. Navy, which have had rubber sonar domes bitten by ***I. brasiliensis***. Despite its rather vampire–like mode of feeding, it is not of much concern to people because of its small size and oceanic habitat preferences. The chances of it biting a swimmer or diver are remote though possible. There is at least one confirmed attack by this shark on an open ocean swimmer off the Hawaiian Island of Maui. The attack occurred at night while an open ocean swimmer was attempting to cross 30–mile Alenuihaha Channel from the Big Island to Maui. There are other anecdotal accounts of swimmers, including a swimmer off a ship in mid–ocean, being nipped by dwarf sharks.

Conservation status is Least Concern, but may be of some concern regionally due to its presence as bycatch in fisheries targeting large bony fishes and squid.

Local Names: Tollo cigarro (Chile), Tiburón cigarro (Spanish).

Literature: Bigelow and Schroeder (1948, 1957); Hubbs, Iwai and Matsubara (1967); Jahn and Haedrich (1987); Gasparini and Sazima (1996); Widder (1998); Gadig and Gomes (2002); Ebert (2003, 2013, 2015); Papastamatiou *et al.* (2010); Honebrink *et al.* (2011); Ebert, Fowler and Compagno (2013); Bustamante, Vargas–Caro, and Bennett (2014); Cornejo *et al.* (2015) Ebert, Pien, and Kamikawa (2015).

Mollisquama Dolganov, 1984

Genus: ***Mollisquama*** Dolganov, 1984, Zool. Zh. 63(10): 1589.

Type Species: ***Mollisquama parini*** Dolganov, 1984, by original designation.

Number of Recognized Deep–sea Southeastern Pacific Ocean Species: 1.

Synonyms: None.

Other combinations: None.

Field Marks: See ***Mollisquama parini***, below.

Diagnostic Features: Snout short, blunt, conical; body small cylindrical, stocky. Medium–sized gill openings, the fifth almost twice the length of the first. Lips thick, fringed. Teeth dissimilar in upper and lower jaws; uppers erect, single–cusped, dagger–like, with prominent medial ridge; lowers oblique, erect, single–cusped with no lateral cusplets. Total tooth counts for upper jaw 19 to 23, lower jaw 31. First dorsal fin well behind pectoral fins, base just in front of pelvic bases. Second dorsal fin about as large as first, base length slightly longer than base of first. Large pocket–like gland with a conspicuous slit–like opening just above each pectoral–fin base (possibly secreting a pheromone or luminous fluid) and dark fins with light margins. Caudal fin asymmetrical, not paddle–shaped with weak lower lobe. Vertebral counts: total vertebrae 83, monospondylous vertebral counts 37 to 42, diplospondylous precaudal vertebral count 17 to 19, total precaudal vertebral counts 54 to 61, and caudal vertebral count 14 to 22. Spiral valve count with 23 turns. Size more than 40 cm total length. **Colour:** dark brown with small lighter spots on the back and sides, dark fins, but lighter margins on all fins; the mouth cavity is light.

Mollisquama parini Dolganov, 1984

Mollisquama parini Dolganov, 1984, *Zool. Zh.*, 63(10): 1589, fig. 1. Holotype: Zoological Institute, Leningrad, ZIL–45988, 400 mm TL adult female, Nazca ridge off northern Chile, 21°32'S, 81°38'W, 330 m. Depth on a plateau 1216 km ESE of Iquique, Chile.

Synonyms: None.

Other combinations: None.

FAO Names: En – Pocket shark. **Fr** – Squale à peau douce; **Sp** – Tiburón bolsillo.

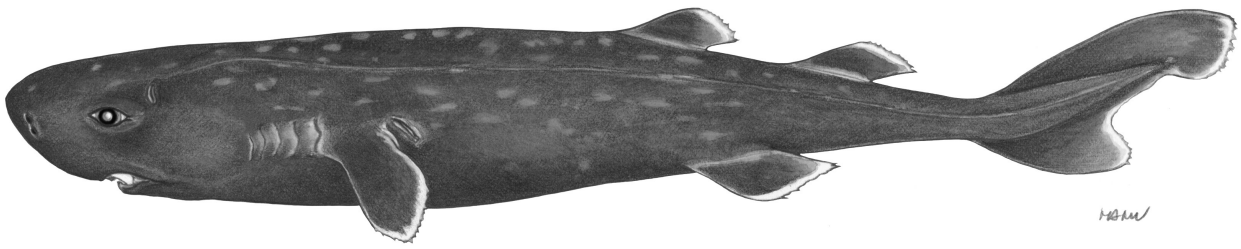


Fig. 111 ***Mollisquama parini***

Field Marks: A small cylindrical, stocky dark brown shark with a large shoulder gland with a conspicuous slit–like aperture over each pectoral–fin base, two spineless equal–sized dorsal fins, first dorsal–fin base just anterior to the pelvic–fin bases, no anal fin, and an asymmetrical caudal fin.

Diagnostic Features: See the genus ***Mollisquama***.

Distribution: Southeastern Pacific Ocean: Nazca submarine ridge off Chile. A second specimen of this rare species was recently caught in the Gulf of Mexico.

Habitat: Little–known, upper slope at 330 m, presumably on or near the bottom.

Biology: The only known specimen was an adolescent female with small (ca. 3 mm eggs) in its two ovaries. The shoulder glands are equally large on both sides and have their lumens lined with fine papillae. Dolganov (1984) suggested that the glands might secrete pheromones for attracting other pocket sharks. It is also possible that the shoulder glands secrete a luminous fluid similar to the cloacal gland of ***Euprotomicroides zantedeschia*** and as in the shoulder glands of the teleost family Platytroctidae.

Size: Maximum total length to at least 40 cm (adolescent female holotype); species is known only from single type specimen.

Interest to Fisheries and Human Impact: Of no fisheries interest given its small size, but may be a possible bycatch of deep–sea fisheries.

Conservation status is Data Deficient.

Local names: No information.

Literature: Dolganov (1984); Ebert, Fowler, and Compagno (2013); Bustamante, Vargas–Caro, and Bennett (2014); Grace *et al.* (2015).

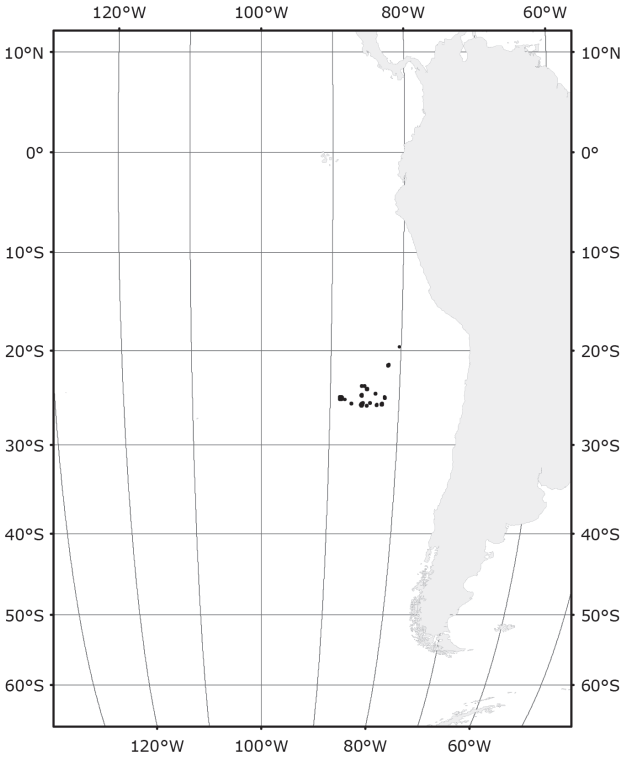


Fig. 112 ***Mollisquama parini***

2.4 Order LAMNIFORMES – Mackerel sharks

Order: Lamniformes Garman, 1885, *Bull. Mus. Comp. Zool. Harvard*, 12(1): 30 (emendation by Compagno 1984a of "group" Lamnae Garman, 1885).

Number of Recognized Deep–sea Southeastern Pacific Ocean Families: 4.

Synonyms: Part 1 Squali, Abtheilung 2: Müller and Henle, 1838: 27; Müller and Henle, 1839: 27. Part 1 Squali, Abtheilung 2, Unterabtheilung 3: Müller and Henle, 1839: 66. Ordo Plagiostomi, Subordo Squalini, Sectio Proktopterides, Tribus Dinotopterini: Bleeker, 1859: xi. Order Squali, Suborder Squali: Gill, 1862: 394, 396. Order Squali, Suborder Galei: Gill, 1872: 22, 23. Order Plagiostomi diplospondyli, Suborder Plagiostomi asterospondyli, Group 2 Scylliolamnidae: Hasse, 1879: 51. Order Selachii, Suborder Asterospondyli: Woodward, 1889: 157. Order Asterospondyli: Gill, 1893: 130; Fowler, 1941: 4, 13; Smith, 1949: 37, 39. Order Asterospondyli, Suborder Galei: Jordan and Evermann, 1896: 19, 21. Order Euselachii, Suborder Pleurotremata, Division Galeoidei: Regan, 1906a: 723. Order Selachii, Group 2, Division B, Subdivision 1, Suborder Scylliodei: Goodrich, 1909: 148. Order Pleurotremata, Suborder Galeoidei: Engelhardt, 1913: 97. Order Plagiostoma, Suborder Antacea, Group Carcharoidei: Garman, 1913: 10, 11. Order Plagiostoma, Suborder Antacea, Group Isuroidei: Garman, 1913: 10, 12. Order Euselachii, Suborder Galei, Series Lamnoidei: Jordan, 1923: 99. Order Plagiostomi, Suborder Galeiformes: Lozano y Rey, 1928: 280. Order Galea, Suborder Isurida, Superfamily Odontaspoidea: White, 1936: 4; White, 1937: 36, tab. 1. Order Galea, Suborder, Isurida, Superfamily Isuroidea: White, 1936: 4; White, 1937: 36, tab. 1. Order Euselachii, Suborder Lamniformes: Berg, 1940: 137; Berg and Svetovidov, 1955: 65; Patterson, 1967: 670; Rass and Lindberg, 1971: 303; Lindberg, 1971: 8, 257; Compagno, 1973: 28; Applegate, 1974: 743; Nelson, 1976: 33; Compagno, 1984a: 212; Nelson, 1984: 51; Gubanov, Kondyurin and Myagkov, 1986: 3, 49; Cappetta, 1987: 26, 85; Compagno, 1988: 382; Eschmeyer, 1990: 435; Nelson, 1994: 51; de Carvalho, 1996: 55; Shirai, 1996: 32; Eschmeyer, 1998. Order Lamniformes, Suborder Lamnoidei: Berg, 1940: 137; Berg and Svetovidov, 1955: 65; Patterson, 1967: 670; Lindberg, 1971: 8, 257; Nelson, 1976: 33; Nelson, 1984: 51; Nelson, 2006: 57. Order Euselachii, Suborder Galei, Superfamily Odontaspoidea: Whitley, 1940: 68. Order Euselachii, Suborder Galei, Superfamily Isuroidea: Whitley, 1940: 68. Order Selachii, Suborder Galeoidea: Romer, 1945: 576; Bigelow and Schroeder, 1948: 77, 95; Romer, 1966: 350. Order Lamnoidea, Suborder Galeoidea: Schultz and Stern, 1948: 224. Order Lamnida, Suborder Lamnina: Matsubara, 1955: 1–789. Order Galeiformes, Suborder Isuroidea: Arambourg and Bertin, 1958: 2029. Order Pleutrema, Suborder Galeoidea: Norman, 1966: 7. Order Carchariida, Suborder Carchariina, Superfamily Carchariicae: Fowler, 1967a: 92, 140. Order Carchariida, Suborder Carchariina, Superfamily Lamnicae: Fowler, 1967a: 92, 104. Order Squatinida, Suborder Squaloidei: Glikman, 1967: 215. Superorder Lamnae, Order Odontaspidida: Glikman, 1967: 229, 230. Order Odontaspidida, Superfamily Odontaspidoidea: Glikman, 1967: 230. Order Odontaspidida, Superfamily Isuroidea: Glikman, 1967: 232. Order Odontaspidida, Superfamily Scapanorhynchoidea: Glikman, 1967: 233. Order Euselachii, Suborder Galeoidei: Blot, 1969: 702–776. Order Pleurotremata, Suborder Galeiformes: Budker and Whitehead, 1971: 5, tab. 2. Order Carcharhiniformes: Rass and Lindberg, 1971: 303; Gubanov, Kondyurin and Myagkov, 1986: 3, 61. Order Isuriformes: Chu and Meng, 1979: 114, tab. 2. Order Isuriformes, Suborder Carchariodea: Chu and Meng, 1979: 114, tab. 2. Order Isuriformes, Suborder Isuroidea; Chu and Meng, 1979: 114, tab. 2. Order Isuriformes, Suborder Cetorhinoidea: Chu and Meng, 1979: 114, tab. 2. Order Isuriformes, Suborder Alopioidea: Chu and Meng, 1979: 114, tab. 2. Order Galeomorpha, Suborder Lamnoidea: Carroll, 1988: 599.

FAO Name: En – Mackerel sharks.

Field Marks: The external appearance of each of the several members of this group appears to be unique and unrelated, but they share a number of features including a short to moderately long pointed snout, eyes usually lateral on the head (except dorsolateral on ***Carcharias***), eyes without a nictitating membrane, spiracles if present usually very small and located behind the eyes, no nasal barbels, a large to very large mouth extending well behind the eyes, five paired gill openings with the last two in some groups occurring above the pectoral–fin origins, two spineless dorsal fins, and an anal fin. Colour may range from light to dark brown, reddish, yellowish, or even pink above, usually lighter below; some species may have spots or light and dark blotches, and with darker or lighter fin edges.

Diagnostic Features: Body shape cylindrical, fusiform, or somewhat compressed, but not flattened or ray–like; body stout to very slender, and firm or very soft and flabby. Head conical to moderately depressed, relatively short to very long, but not expanded laterally. Snout relatively short to extremely long, flattened and blade–like. Eyes nearly circular, relatively small to very large, located lateral on head, except dorsolateral on ***Carcharias***, without nictitating lower eye membrane. Nostrils without barbels, nasoral or circumnarial grooves, and separated from mouth; anterior nasal flaps short and not reaching mouth. Gill openings numbering five on each side of head; length short to extremely long, nearly encircling the head; posteriormost two gill openings located just anterior to or above pectoral–fin origins. Spiracles, if present, very small and situated behind level to eyes. Mouth very large, broadly rounded and highly protrusible. Labial furrows very small or absent. Teeth weakly to strongly differentiated along jaws, usually with a gap or small intermediate teeth between anterior and lateral teeth of upper jaw; tooth counts number from 19 to over 200 rows in upper jaw, and 20 to over 200 rows in lower jaw. Caudal peduncle with lateral keels, depending on the family, present or absent, if present may number 1 or 2; precaudal pits variably present or absent depending on the group. Dermal denticles covering entire body, small and relatively smooth or enlarged, very rough and thorn–like. Pectoral fins small to very long, and broadly rounded to moderately angular. Pelvic fins small to moderately large. Two spineless dorsal fins; first dorsal fin may be much larger than second dorsal fin, very high, erect, and nearly triangular or small, rounded and similar in size to second; first dorsal fin originating over abdomen, well in front of pelvic–fin origins. Second dorsal fin may be minute, much smaller than first dorsal fin or similar in size.

Anal fin present; size may be similar to second dorsal fin or possibly larger depending on species. Caudal fin with long to extremely long upper dorsal lobe and a strong to absent ventral lobe. Vertebral counts: total vertebral counts 107 to 477, precaudal vertebral counts 50 to 126, and caudal vertebral counts 55 to 356. Intestinal valve of conicospiral type, with 18 to 55 turns. Size small, from less than 1 m in length, to gigantic, up to 10 m in length. **Colour:** dorsal surface ranges from a pinkish white, bluish, grey, grey–brown, brown or blackish, ventral surface may be similar in colour to dorsal surface or lighter to white; dark spotting or darker and lighter blotches may be present on some species and may vary depending on size and stage of development.

Distribution: Circumglobal from cold temperate to tropical seas, with some species occurring in polar seas.

Habitat: Mackerel sharks occur from close inshore, in shallow bays and estuaries to the outer coast, and the open ocean. They are found over sandy beaches, rocky and coral reefs, and in pelagic waters far from landmasses, and from the surface to over 1600 m depth and over bottom depths of over 5000 m. No mackerel sharks are known to occupy freshwater habitats, such as rivers and lakes.

Biology: Mackerel sharks, with a few exceptions, are highly active, fast swimming, migratory sharks, with most being quite wide–ranging in their geographic distribution. They are viviparous in their reproductive mode, but have uterine cannibalism with the young embryos consuming uterine eggs (oopghagy) or feeding on other embryos (adelphophagy). The reproductive cycle of most species is unknown, although in some species they are known to make long distance migrations to specific nursery areas. The number of young per litter is not well known, but appears to be relatively small, and depending on the species, may only be from 2 to 16 young per cycle. Depending on the species, maturity is attained in 4 to 5 years with a maximum estimated longevity of 20 to 30 years. The diet of these sharks may range from small planktonic organisms to invertebrates, large bony and cartilaginous fishes, and even marine mammals, reptiles, and sea birds.

Interest to Fisheries and Human Impact: Some mackerel shark species are the subject of important target and non–target fisheries worldwide, especially members of the families Alopiidae and Lamnidae. Other groups, Cetorhinidae and Odontaspididae, were the subjects of intense fisheries previously, but they are largely protected in some areas of the world since their populations have declined from previous fisheries exploitation.

Several species, particularly the white shark (***Carcharodon carcharias***), are well known to attack humans engaged in ocean activities including swimming, diving, surfing, kayaking, and boating, among other activities. In temperate waters, the white shark has been implicated in more attacks on people than any other shark species. This is most likely due to its being more easily recognized and a lack of other species, mainly Carcharhinidae species that tend to be more prominent in tropical seas.

In recent years, the great white shark and shortfin mako shark, among other lamnoids, have become popular ecotourist attractions for thrill seeking cage divers. The sandtiger shark (***Carcharias taurus***) is another popular species and one that has been maintained in public aquaria for decades. Small white sharks have recently been maintained at the Monterey Bay Aquarium, California (USA), for short time periods, of up to about six months. However, they usually outgrow their surroundings and are released back into the wild.

The conservation status of mackerel sharks have been a concern for several species, but some such as the white shark and basking shark due to their high–profile have received considerable protection through the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and more regional protective measures. The conservation status of other poorly known species such as the goblin (***Mitsukurina owstoni***), megamouth (***Megachasma pelagios***), and bigeye sand tiger (***Odontaspis noronhai***) sharks are Least Concern or Data Deficient due to a lack of information on their populations and basic biological information.

Local Names: No information.

Remarks: The present account is modified from, and follows Compagno (2001) in recognizing seven families, of which four are considered to inhabit the deep-sea; four deep-sea families occur in the southeastern Pacific. See Compagno (2001) for detailed discussion of the order.

Key to Deep–sea Southeastern Pacific Ocean Families:

1a. Caudal fin about as long as trunk of body (Fig. 113). . . . . **family Alopiidae**

1b. Caudal fin much shorter than trunk of body. **2**

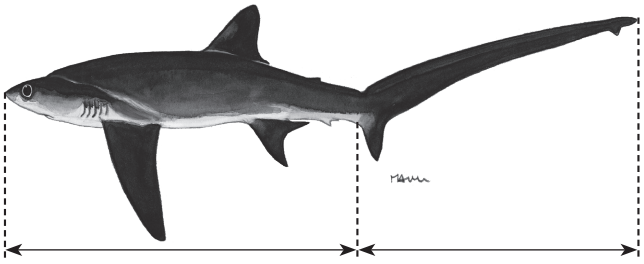


Fig. 113 ***Alopias superciliosus***

2a. Upper precaudal pit present (Fig. 116); lower pit and lateral keels absent or weak; caudal fin heterocercal, not crescent shaped. **3**

2b. Upper and lower precaudal pits and strong lateral keel present; caudal fin crescent shaped; gill slits extremely large, extending dorsally onto surface of head (Fig. 114a); teeth minute, hook shaped, not bladelike (Fig. 114b). . . . . **family Cetorhinidae**

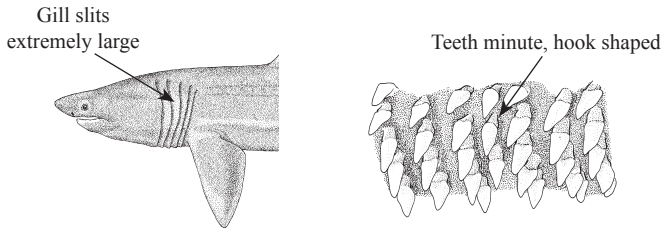


Fig. 114 ***Cetorhinus maximus***

3a. Eyes very large, body slender; anal fin narrow–based, pivoting; caudal peduncle with both upper and lower precaudal pits and low lateral keels on each side; gill slits extending onto dorsal surface of head (Fig. 115). . . . . **family Pseudocarchariidae**

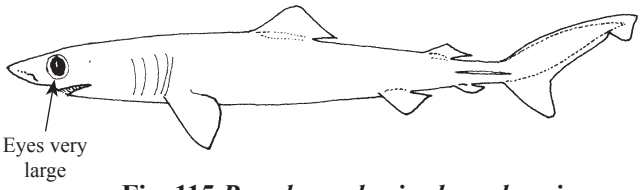


Fig. 115 ***Pseudocarcharias kamoharai***

3b. Eyes relatively small, body stout; anal fin broad–based, not pivoting; caudal peduncle with an upper precaudal pit, but without a lower pit or lateral keels; gill slits not extending onto dorsal surface of head (Fig. 116). . . . . **family Odontaspididae**

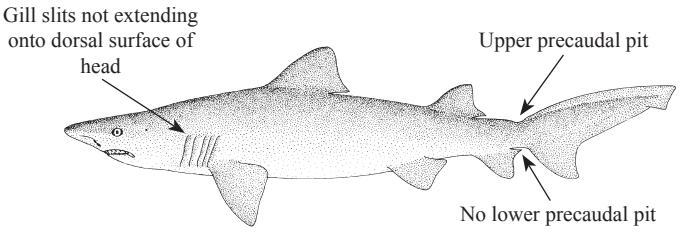


Fig. 116 ***Odontaspis***

2.4.1 Family ODONTASPIDIDAE

Family: Family Odontaspides Müller and Henle, 1839, *Syst. Beschr. Plagiost*., pt. 2: 73. Emended to Family Odontaspididae Müller and Henle, 1839. The corrected form Odontaspididae was placed on the Official List of Family–Group Names in Zoology (Name no. 385) but Odontaspides was placed on the Official Index of Rejected and Invalid Family–Group Names in Zoology (Name no. 414) by the International Commission on Zoological Nomenclature (1965, Opinion 723, *Bull. Zool. Nomencl*., 22: 33, 34). Odontaspididae was given special endorsement by the International Commission on Zoological Nomenclature (1987, Opinion 1459.6, *Bull. Zool. Nomencl*., 44(3): 216) to take precedence over Carchariidae Müller and Henle, 1838 when the two were synonymized.

Type genus: ***Odontaspis*** Agassiz, 1838.

Number of Recognized Deep–sea Southeastern Pacific Ocean Genera: 1.

Synonyms: Subfamily Triglochidini Bonaparte, 1838: 208 (Family Squalidae). Type genus: ***Triglochis*** Müller and Henle, 1837a. Family Carchariae Müller and Henle, 1838: 27. Type genus: ***Carcharias*** Rafinesque, 1810. Rejected by the International Commission on Zoological Nomenclature (1965, Opinion 723: 33) but reinstated by the Commission (1987, Opinion 1459.5: 216) in the corrected form Family Carchariidae Müller and Henle, 1838 on the Official List of Family–Group Names in Zoology, with the special endorsement that it is not to be given precedence over Odontaspididae Müller and Henle, 1839 when considered a synonym of it. This name was widely used by earlier writers for members of the Carcharhinidae, following Müller and Henle's original usage, but Jordan and Gilbert (1883: 27) and many subsequent writers used it for members of the Odontaspididae with the assignment of ***Carcharhias*** to this family. Family Carchariidae Jordan and Gilbert, 1883: 27. Emended spelling for Family Carchariae Müller and Henle, 1838. Type genus: ***Carcharias*** Rafinesque, 1810.

FAO Names: En – Sand tiger sharks; **Fr** – Requins de sable; **Sp** – Solrayos, Toros.

Field Marks: Large fusiform–shaped sharks, with a conical snout, large subterminal mouth, teeth large with slender cusps and lateral cusplets, eyes small to moderately large without nictitating membranes, five moderately long paired gill slits that do not extend onto the dorsal surface of head, two large spineless dorsal fins, an anal fin, upper precaudal pit present, lower precaudal pit absent, caudal fin asymmetrical, upper margin less than one–third total length.

Diagnostic Features: Body fusiform, moderately stout, and firm. Head relatively short to moderately long; snout short to moderately long, conical and pointed, not greatly elongated, or flattened. Eyes are small to moderately large, without nictitating membranes, diameter length 1.4 to 4.1% precaudal length. Spiracles present, but very small. Gill openings

relatively long, but not extending onto dorsal surface of head; first gill opening 6.2 to 9.2% precaudal length; fifth gill openings anterior to pectoral–fin bases; no internal gill rakers. Nostrils subterminal, entirely separate from mouth, no nasoral grooves, and anterior margins without barbels. Mouth large, broadly arched, subterminal on head; jaws strongly protrusible. Teeth large, awl–shaped, with lateral cusplets present; 2 to 3 rows of large anterior teeth on each side of jaw followed by 1 to 5 rows of smaller intermediate teeth; tooth counts 34 to 56 upper jaw, 36 to 46 lower jaw. Caudal peduncle not greatly compressed or laterally expanded; upper precaudal pit present, but without lower precaudal pit or precaudal keels. Dermal denticles smooth and moderately large; crowns flattened and with small ridges and cusps; flank denticles posteriorly directed. Pectoral fins broadly angular and moderately long; origin posterior to fifth gill opening. Pelvic fins relatively large, similar in size to first dorsal fin. Dorsal fins large, angular, relatively high and erect; fin spines absent; first dorsal fin originates over or posterior to pectoral–fin free rear tips. Second dorsal and anal fins size similar to or smaller than first dorsal fin; second dorsal and anal fins with broad non–pivoting bases. Caudal fin asymmetrical, upper lobe moderately long, less than one–third length of precaudal length, ventral lobe much shorter. Vertebral counts: total vertebral counts 156 to 183, precaudal vertebral counts 80 to 95, diplospondylous caudal counts 71 to 88. Intestinal valve with 28 to 34 turns. Size large with adults to at least 450 cm total length. **Colour**: light grey, grey–brown, to dark reddish brown or black above; ventral surface lighter or similar to dorsal colour; spots present on some species.

Distribution: Wide–ranging, but patchily distributed, in most warm–temperate and tropical waters.

Habitat: Sand tiger sharks occur mostly in tropical to warm–temperate seas and depending on the species inhabit nearshore coastal areas including bays and harbors, but also offshore, on outer continental shelves, upper slopes, and on seamounts down to 1600 m. The bigeye sand tiger shark (***Odontaspis noronhai***) may be oceanic in the epipelagic and possibly the mesopelagic zone. These are relatively slow moving, but active sharks.

Biology: Viviparous with oophagy, with litters of possibly only two very large young, but little else known about the reproductive biology of this shark family. The diet of sand tiger sharks mostly consists of other elasmobranchs, bony fishes, cephalopods, and crustaceans.

Interest to Fisheries and Human Impact: Most species within this family tend to occur in deeper water and have a very scattered distribution, and as such are generally not important in fisheries other than begin taken on occasion as bycatch. Virtually nothing is known about the population trends for ***Odontaspis ferox*** or ***O. noronhai***. However, ***Carcharias taurus*** is an exception in that it occurs mostly in nearshore waters, may be quite common where it occurs, and has been targeted by commercial and recreational fishers in some areas or has been subjected to eradication programs.

Despite their fearsome, toothy appearance and large size, these sharks are generally not aggressive towards swimmers or divers and in fact ***C. taurus*** and ***O. ferox*** have become the popular subjects for ecotourism by divers in Australia, Mediterranean Sea, South Africa, the east coast of the U.S.A. and in the eastern Pacific off Malpelo Island. There have been a few incidents of people being bitten by ***C. taurus***, but no reported incidents by either of the ***Odontaspis*** species. ***Carcharias taurus*** is also a common and popular species in public aquaria given their hardiness and longevity.

The conservation status for most of these sharks is Vulnerable since some species have experienced declines due to overfishing. However, ***Odontaspis noronhai*** is Data Deficient since very few specimens have ever been observed.

Local Names: No information.

Remarks: The family has two genera and three species of which the monotypic genus ***Carcharias*** with a single species, ***C. taurus***, is a nearshore coastal species of warm temperate and tropical seas. The genus ***Odontaspis*** has two species, both of which are deep–sea Indian Ocean inhabitants. The family and genus account is modified after Compagno (2001).

Literature: Garman (1913); Bigelow and Schroeder (1948); Compagno (2001); Ebert (2003, 2013); Last and Stevens (2009); Ebert, Fowler, and Compagno (2013); Ebert and Stehmann (2013).

List of Deep–sea Species Occurring in the Area:

Odontaspis ferox (Risso, 1810)

Odontaspis Agassiz, 1838

Genus: ***Odontaspis*** Agassiz, 1838, *Recher. Poiss. Foss*., 3: 86, 87. Placed on the Official List of Generic Names in Zoology (name no. 1659) by the International Commission on Zoological Nomenclature (1965, Opinion 723.3c, *Bull. Zool. Nomencl*., 22(1): 33).

Type species: ***Carcharias ferox*** Risso, 1826, by monotypy, equals ***Squalus ferox*** Risso, 1810. This genus takes precedence over ***Carcharias*** Rafinesque, 1810 when the two are considered synonyms, by special endorsement of the International Commission on Zoological Nomenclature (1987, Opinion 1459.3, *Bull. Zool. Nomencl*., 44(3): 216).

Number of Recognized Deep–sea Southeastern Pacific Ocean Species: 1.

Synonyms: None.

Field Marks: Large stout–bodied sharks with a conical, bulbous snout, first dorsal fin closer to pectoral fins than to pelvic fins, and much larger than second dorsal and anal fins, caudal peduncle with precaudal pit present, lateral keels absent, and caudal fin asymmetrical but with a strong ventral lobe. Colour greyish brown, dark brown or blackish above, and depending on species ventral surface may be lighter; scattered dark brown to reddish spots may be present on some species.

Diagnostic Features: Body fusiform and stout, with head slightly to strongly depressed. Snout moderately long, conical, preoral length 0.8 to 1.2 times mouth width, 4.4 to 7.8% total length. Eyes small to moderately large, less than 3 to more than 4 times snout length, and about 1.6 to 2.8% total length. Teeth similar in both jaws, awl–shaped, with a long central cusp, flanked by 1 to 3 lateral cusplets. Tooth counts 34 to 56 upper jaw, 36 to 48 lower jaw. First dorsal fin closer to pectoral–fin bases than to pelvic fins. Second dorsal fin about one–half size of first dorsal. Anal fin smaller than second dorsal fin, origin over or posterior to second dorsal–fin origin. Vertebral counts: total vertebral counts 177 to 183, precaudal vertebral counts 95 to 98, caudal vertebral counts 71 to 85. Spiral valve turn count 30 to 34. Large sharks with adults to 450 cm in length. **Colour:** dorsal surface light grey, greyish–brown to dark brown or black; ventral may be lighter or same colour as dorsal surface; depending on species, scattered dark brown or reddish spots may be present and posterior edges of fins may be darker. Iris of eyes dark brown or black with lighter tones.

Local Names: No information.

Remarks: The genus consists of two species, the smalltooth sand tiger (***Odontaspis ferox***) and the bigeye sand tiger shark (***Odontaspis noronhai***). The below account is modified after Compagno (2001).

Odontaspis ferox (Risso, 1810)

Squalus ferox Risso, 1810, *Ichthyol. Nice, Paris*: 38. Holotype unknown; type locality off Nice, France, in the Mediterranean Sea. Also, ***Carcharias ferox*** Risso, 1826, *Hist. nat. Princip. Prod. Europe Méred., Paris, Poissons*, 3: 122. Description virtually verbatim that of ***Squalus ferox*** Risso, 1810, and quite evidently a generic translocation, not a new species name. Placed on the Official List of Specific Names in Zoology (Name no. 2057) by the International Commission on Zoological Nomenlcature (1965, Opinion 723.4.c: 33).

Synonyms: ***Odontaspis herbsti*** Whitley, 1950: 234, fig. 1, pl. 17, fig. 1. Holotype: Australian Museum, Sydney, AMS–IB.2136, 168 cm immature male, Gabo Island, New South Wales, 137 m depth.

Other Combinations: None.

FAO Names: En – Smalltooth sand tiger; **Fr** – Requin féroce; **Sp** – Solrayo.

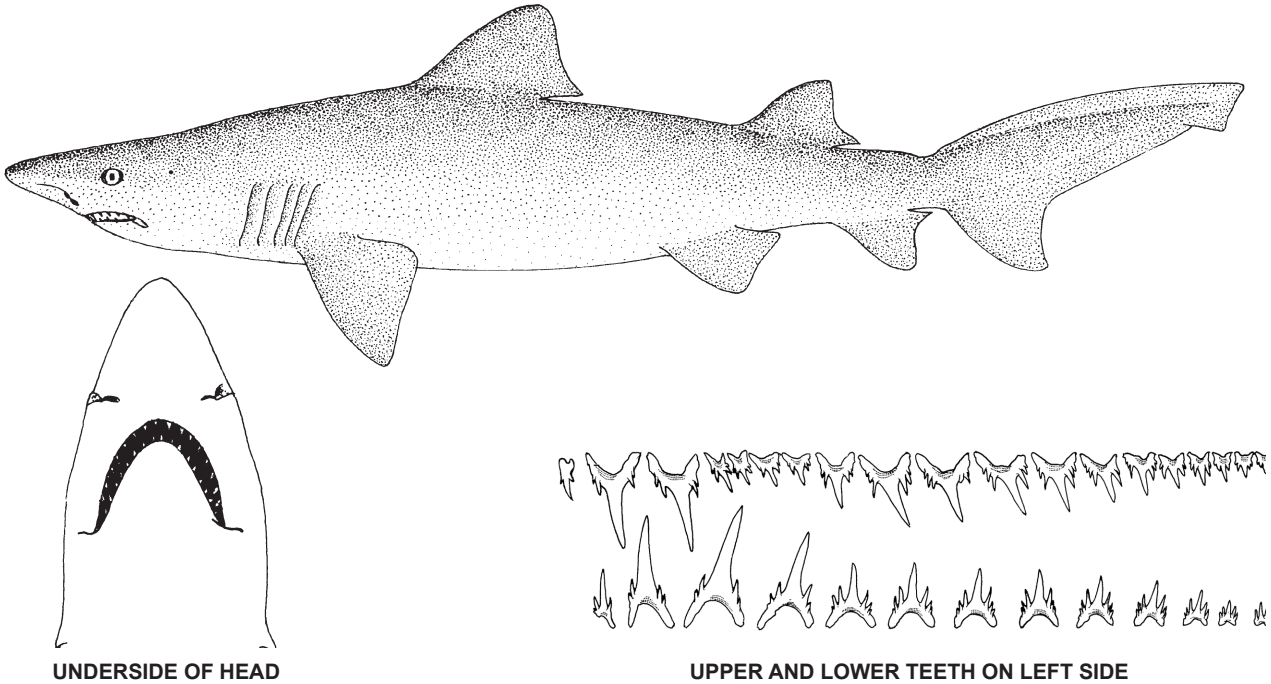


Fig. 117 ***Odontaspis ferox***

Field Marks: A large, stout–bodied shark with a conical to slightly flattened snout, a long mouth extending past the eyes, teeth prominent, long and narrow with a central cusp flanked by two or three smaller cusplets on each side, a first dorsal fin that originates over the pectoral–fin free rear tips, and is much larger than the second dorsal and anal fins. Colour grey, brownish grey or olive above, lighter below, some specimens with dark reddish spots scattered over their body.

Diagnostic Features: Head flattened, snout conical and relatively long. Eyes small, without nictitating membrane. Teeth awl–shaped, with long central cusp, flanked by two to three smaller cusplets on each side, similar in both jaws; upper intermediate two to five tooth rows much smaller than anterior or posterior tooth rows; tooth counts 46 to 56 upper jaw, 36 to 48 lower jaw. Dorsal fins subangular, weakly falcate; first dorsal fin much larger than second dorsal and anal fins. Anal–fin posterior margin strongly concave, height 4.6 to 6.0% total length. Caudal fin asymmetrical, with slight bump posterior to upper precaudal pit; ventral caudal lobe short, stout. Vertebral counts: total vertebral counts 177 to 183, precaudal vertebral counts 95 to 98, caudal vertebral counts 71 to 85. Spiral valve turn count 32 to 34. A large shark with adults to 450 cm total length. **Colour:** light grey to grey brown above, lighter below, sometimes with dark reddish or brown spots scattered on the body; fin tips in young juveniles darker with black edges. A piebald coloured specimen has been reported.

Distribution: Southeastern Pacific Ocean: San Ambrosio Island (Chile), the Galápagos Islands (Ecuador), and Malpelo Island off Colombia. Elsewhere, circumglobal, but patchily distributed.

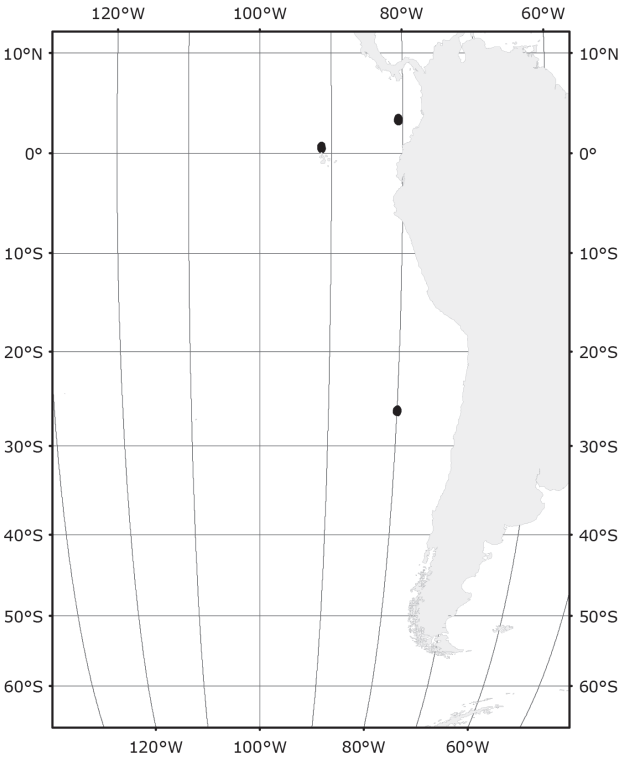


Fig. 118 ***Odontaspis ferox***

Known distribution

Habitat: A large, wide ranging shark found in most warm–temperate and tropical seas on continental and insular shelves and upper slopes. A survey of known records by Fergusson *et al.* (2008) found smalltooth sand tiger sharks range from 10 to 883 m deep, but with most specimens being found at less than 300 m deep. There appears to be some segregation by size and depth as small juveniles, less than about 150 cm total length mostly occur between 300 and 600 m deep, while those over about 350 cm in length also tend to occupy a similar depth range. However, individuals over 150 cm to about 350 cm appear to be more common at shallower depths of less than 150 m. Although usually associated with mud, sand, or rocky reef bottom habitats, smalltooth sand tiger sharks appear to make excursions into the water column as demonstrated by individuals having been caught in midwater trawls within 70 to 500 m of the surface over water depths of 2000 to 4000 m. Water temperature where these sharks have been caught show a broad range from about 6 °C to more than 20 °C.

Biology: Very little is known about their reproductive cycle or litter size, as few mature females have been observed. Their diet includes elasmobranchs, including a 130 cm long ***Dalatias licha*** in a 290 cm individual, teleosts, cephalopods, and crustaceans. There are no known predators on smalltooth sand tiger sharks, but an ***Isistius* spp.** bite wound was observed on one individual caught off the Canary Islands. Nothing is known about the movements of these sharks, but Fergusson *et al.* (2008) speculated that these sharks might move over large distances by following submarine ridges, adjacent island archipelagoes, or seamounts. Support for this comes from captures of these sharks in mid–ocean waters on or adjacent to deep–sea ridges and seamounts.

Size: Maximum total length to 450 cm; males mature at 200 to 250 cm, with a maximum length of 344 cm; females mature at 300 to 350 cm, and have a maximum length of 450 cm. Size at birth about 100 cm.

Interest to Fisheries and Human Impact: Smalltooth sand tiger sharks are taken incidentally in longline and trawl fisheries, but are too patchily distributed to be of interest for directed fisheries. However, with increasing deepwater fishing efforts, these sharks may become more susceptible to fishing pressure than is currently assumed. Currently, there are no estimates as to the numbers of these sharks that may be caught incidentally as bycatch.

Interestingly, in recent years smalltooth sand tiger aggregations in relatively shallow waters off Lebanon in the Mediterranean, Malpelo Island in the eastern Pacific, and elsewhere have enabled SCUBA divers to regularly encounter these sharks.

The conservation status of this species is Vulnerable due to suspected declines in its population in the Mediterranean and eastern North Atlantic. However, given the patchy distribution and occurrence of this species, much still remains to be learned about its population structure and status.

Local Names: No information.

Remarks: Individuals of this species may or may not have dark scattered spots. This variation has lead some authors to consider those individuals with spots to be a different species, ***Odontaspis herbsti***. However, the presence of spots appears to reflect individual variation within a single species.

Literature: Compagno (2001); Ebert (2003, 2013); Fergusson, Graham and Compagno (2008); Last and Stevens (2009); Pollard *et al.* (2009); Ebert, Fowler, and Compagno (2013); Long *et al.* (2014).

2.4.2 Family PSEUDOCARCHARIIDAE

Family: Pseudocarchariidae Compagno, 1973, *J. Linn. Soc. (Zool.)*, 53, suppl. 1: 28.

Type genus: ***Pseudocarcharias*** Cadenat, 1963.

Number of Recognized Deep–sea Southeastern Pacific Ocean Genera: 1.

Synonyms: Family Pseudocharinidae Shirai, 1996: 34. Probable error for Pseudocarchariidae.

FAO Names: En – Crocodile sharks; **Fr** – Requins crocodile; **Sp** – Tiburones cocodrilo.

Field Marks: See species account below.

Diagnostic Features: Head much shorter than trunk. Snout moderately long, pointed and bulbously conical, not greatly elongated or flattened and blade–like. Eyes very large, length 3.6 to 4.9% of precaudal length. Gill openings moderately long, length of first 5.4 to 8.2% of precaudal length, extending onto dorsal surface of head; all gill openings in front of pectoral–fin bases; no gill rakers on internal gill slits. Mouth large, parabolic, ventral on head; jaws strongly protrusible to almost opposite snout tip but not greatly distensible laterally. Teeth large, the anteriors narrow and awl–like, the laterals more compressed and blade–like; tooth counts 26 to 29 upper jaw, 21 to 26 lower jaw; two rows of enlarged anterior teeth on each side of upper jaw, the uppers separated from the smaller upper lateral teeth by a row of small intermediate teeth; three rows of lower anteriors on each side, the first two rows enlarged but the third about as large as laterals; symphysials absent. Trunk cylindrical and slender. Caudal peduncle slightly depressed and with low lateral keels and upper and lower crescentic precaudal pits present. Dermal denticles small and smooth, with flat crowns, small ridges and cusps, and with cusps directed posteriorly on lateral denticles. Pectoral fins small, short, and broad, much shorter than head in adults. Pelvic fins large, somewhat smaller than pectoral and first dorsal fins. First dorsal fin small, low, and angular. Second dorsal fin smaller than first, but larger than anal fin; second dorsal fin with a broad non–pivoting base but anal fin pivotable. Caudal fin not lunate, dorsal lobe moderately long but less than half as long as rest of shark, ventral lobe short but strong. Vertebral counts: total vertebral counts 146 to 158, precaudal vertebral counts 80 to 88, caudal vertebral counts 60 to 71. Intestinal valve ring type with 24 to 27 turns. Size small with adults to 122 cm total length. **Colour:** grey to grey–brown above, lighter below, and with lighter fin edges.

Distribution: Wide–ranging in all major tropical and subtropical oceans.

Habitat: See species account.

Biology: See species account.

Interest to Fisheries and Human Impact: See species account.

Local Names: No information.

Literature: Compagno (2001); Last and Stevens (2009); Ebert (2013); Ebert, Fowler and Compagno (2013).

List of Deep–sea Species Occurring in the Area:

Pseudocarcharias kamoharai (Matsubara, 1936)

Pseudocarcharias Cadenat, 1963

Genus: Subgenus ***Pseudocarcharias*** Cadenat, 1963 (Genus ***Carcharias*** Rafinesque, 1810), *Bull. Inst. Francaise Afrique Noire, ser. A*, 25(2): 526 (proposed as a subgenus of ***Carcharias*** Rafinesque, 1810, but used throughout in generic form).

Type species: ***Pseudocarcharias pelagicus*** Cadenat, 1963, by original designation, a junior synonym of ***Carcharias kamoharai*** Matsubara, 1936.

Number of Recognized Deep–sea Southeastern Pacific Ocean Species: 1.

Synonyms: None.

Field Marks: See species account below.

Diagnostic Features: See family Pseudocarchariidae above.

Local Names: No information.

Pseudocarcharias kamoharai (Matsubara, 1936)

Carcharias kamoharai Matsubara, 1936, *Zool. Mag. Tokyo*, 48(7): 380. Holotype: Imperial Fisheries Institute, Japan, Kyoto University, Department of Fisheries, Faculty of Agriculture, Japan (housed at Maizuru, Japan) FAKU, Fish Spec. 1823, 735 mm male, Koti Fish Market, Koti, Japan, apparently lost according to Eschmeyer (2013).

Synonyms: ***Carcharias yangi*** Teng, 1959: 1, fig. 1. Holotype; Taiwan Fisheries Research Institute, TFRI 2895, 1000 mm total length, adult male, Su–ao fish market, from off Su–ao, Taiwan (Province of China). ***Pseudocarcharias pelagicus*** Cadenat, 1963: 529, figs. 1–5. Holotype: Museum National d'Historie Naturelle, Paris, MNHN 1963–1, 975 mm adult male, off the Guinea coast, West Africa.

Other Combinations: ***Odontaspis kamoharai*** (Matsubara, 1936).

FAO Names: En – Crocodile shark; **Fr** – Requin crocodile; **Sp** – Tiburón cocodrilo.

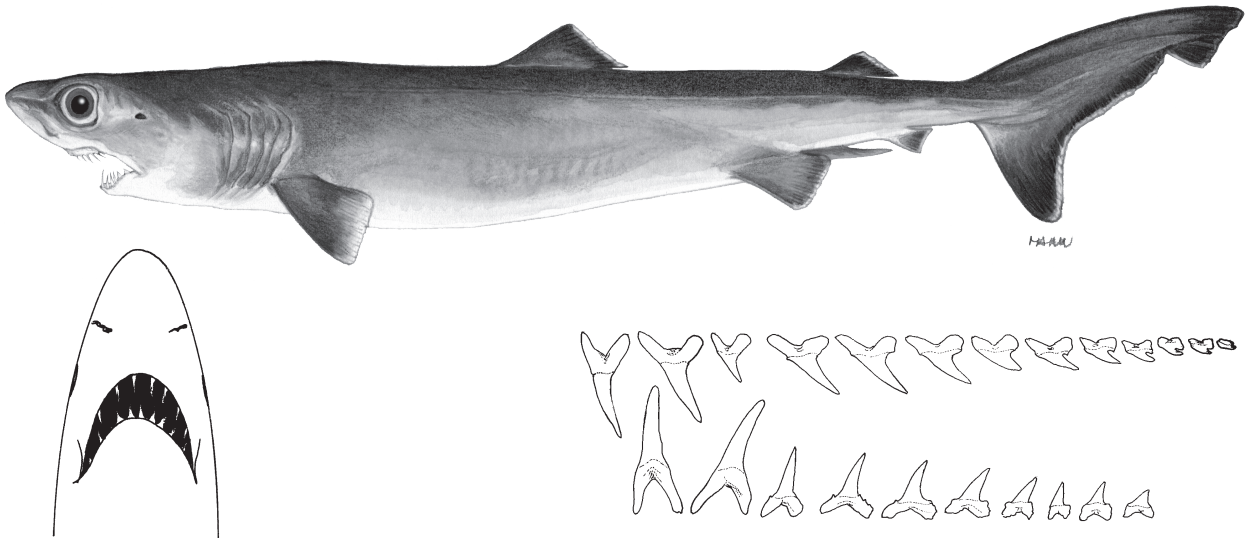


Fig. 119 ***Pseudocarcharias kamoharai***

Field Marks: A small, very distinctive oceanic shark, with huge eyes lacking nictitating eyelids, long gill slits, slender, spindle–shaped body, long–cusped prominent teeth in a long angular mouth with highly protrusible jaws, small pectoral fins, two small spineless dorsal fins, an anal fin, weak keels and precaudal pits on the caudal peduncle, an asymmetrical caudal fin with a long ventral lobe. Colour a grey to grey–brown above, lighter ventrally, and with light–edged fins; some individuals with a lighter spot on the cheeks.

Diagnostic Features: As for Family Pseudocarchariidae above.

Distribution: Southeastern Pacific Ocean: recorded off Chile, Peru, Ecuador, and Colombia. Circumtropical, found throughout most tropical seas.

Habitat: An uncommon to locally abundant oceanic, epipelagic, and possibly mesopelagic shark, usually found offshore and far from land, but sometimes occurs inshore and near the bottom at depths from the surface to at least 590 m. Its bicoloured countershading colour pattern, lack of an expanded iris and prominent green or yellow retinal reflection, and frequent occurrence in pelagic longline catches suggest that it primarily inhabits the epipelagic zone.

Biology: Viviparous with uterine cannibalism; the young have yolk sacs at 3 to 4 cm long, but reabsorb them and subsist on the eggs and possibly smaller embryos. Litter size is usually four, two per uterus with one male and female per uterus;

up to nine fertilized eggs per uterus have been recorded. There does not appear to be any seasonality to their reproductive cycle as pregnant females are found year–round.

The diet is not well known, but appears to include midwater bony fishes and cephalopods.

Size: Maximum total length about 122 cm; males adult at 74 to 81 cm, largest male 110 cm; females adult at 87 to 98 cm, largest female 122 cm. Size at birth about 41 cm.

Interest to Fisheries and Human Impact: Interest to fisheries none, it is usually taken as bycatch in longline and trawl fisheries. The small size and poor quality of its flesh makes this a relatively undesirable species for human consumption.

The crocodile shark has been listed as Near Threatened.

Local names: No information.

Remarks: None.

Literature: Compagno (2001); Mejia *et al.* (2007); Last and Stevens (2009); Oliveira *et al.* (2010); Dai *et al.* (2012); Ebert (2013, 2015); Ebert, Fowler and Compagno (2013); Ebert and Stehmann (2013); Bustamante, Vargas-Caro, and Bennett (2014); Cornejo *et al.* (2015).

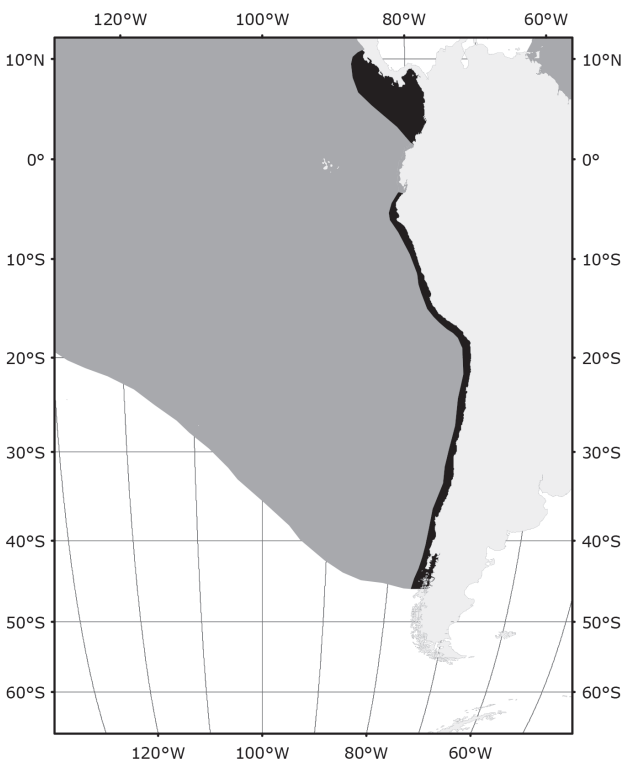


Fig. 120 ***Pseudocarcharias kamoharai***

2.4.3 Family ALOPIIDAE

Family: Subfamily Alopiadini Bonaparte, 1838 (Family Squalidae), *Nuov. Ann. Sci. Nat., Bologna*, ser. 1, 2: 209. Emended to Family Alopiidae Bonaparte, 1838 by Jordan and Gilbert (1883, *Bull., U.S. Nat. Mus*., 16: 26).

Type genus: ***Alopias*** Rafinesque, 1810.

Number of Recognized Deep–sea Southeastern Pacific Ocean Genera: 1.

Synonyms: Family Alopeciae Müller and Henle, 1839: 74. Type genus: ***Alopecias*** Müller and Henle, 1837a. Family Vulpeculidae Garman, 1913: 12, 30. Type genus: ***Vulpecula*** Garman, 1913.

FAO Names: En – Thresher sharks; **Fr** – Renards; **Sp** – Zorros.

Field Marks: See generic account below.

Diagnostic Features: Body cylindrical, moderately stout, firm and not flabby. Head short, length one–third of total length; snout conical, moderately long, not flattened or blade–like. Eyes moderately large to extremely large, diameter 1.8 to 4.3% of precaudal length; nictitating membrane absent. Spiracles present, but small, pore–like. Gill openings relatively short, first opening 3.1 to 5.2% of precaudal length, third to fifth openings over pectoral–fin bases; no gill rakers on internal gill slits. Nostrils small and with nasal flaps, but without barbels or oronasal grooves. Mouth small, broadly arched, below and extending posterior to eyes. Labial furrows variably present or absent. Teeth small, blade–like, with a single erect cusp; depending on species cusplets may or may not be present; tooth counts 19 to 52 upper jaw, 20 to 51 lower jaw. Caudal peduncle moderately compressed laterally, with crescentic shaped upper and lower precaudal pits and no lateral keels. Dermal denticles very small, smooth, with small ridges and cusps pointed posteriorly on lateral flanks. Pectoral fins very long and narrow, anterior margins nearly straight to curved, apices broadly tipped to pointed. Pelvic fins very large, similar in size to first dorsal fin. Dorsal fins noticeably dissimilar in size; first dorsal fin very large, erect, high, and subtriangular. Second dorsal fin minute, low and with pivoting bases; base anterior to anal–fin base. Anal fin very small, similar in size to second dorsal fin. Caudal fin extremely elongated, dorsal lobe length about equal to precaudal length; ventral lobe much shorter. Vertebral counts: total vertebral counts 278 to 477, precaudal vertebral counts 98 to 126, diplospondylous caudal vertebral counts 180 to 356. Intestinal valve with 33 to 45 turns. Size moderately large to very large with adults up to 550 cm long. **Colour:** depending on the species dorsal colour can range from a brilliant dark metallic blue, to a silvery bluish grey or a violet to purplish brown; ventral surface white.

Distribution: Wide ranging in most tropical to temperate seas.

Habitat: Thresher sharks occur from nearshore coastal waters, including bays, to oceanic habitats far from land. They occur from near the surface to depths of at least 723 m, but most are found within 65 m of the surface. Like many other lamnoids for which information is available these sharks are able to maintain their body temperatures above that of the surrounding seawater. The habitats of these shark broadly overlap with each other in some areas, but differences in their spatial distribution and foraging behaviour suggests that they partition the available habitat and preferred prey items.

Biology: Reproductive mode is yolk–sac viviparous with oophagy. Litters are small, ranging from 2 to 7 depending on the species. Gestation is from nine to 12 months with a defined birthing only known for one species (***Alopias vulpinus***), while the other two species do not appear to have a defined birthing season. Thresher sharks feed on a wide variety of schooling fishes and cephalopods. These are the only modern sharks, along with the sawsharks (Pristiophoridae), known to use a structure other than their jaws and teeth to subdue their prey. Thresher sharks use their elongated caudal fins to herd prey species into a tight school and then by rapidly whipping their tails stun and kill their prey before consuming it.

Interest to Fisheries and Human Impact: Worldwide, the thresher sharks are an important fisheries because their meat is of high quality for human consumption and the long fins are highly desirable in the shark–fin trade. However, despite their being a common bycatch component in drift gillnets and longline fisheries, they are often reported in mixed catches with little detailed species–specific information.

All members of the genus ***Alopias*** are considered Vulnerable globally due to apparent declining populations.

Local Names: Tiburones zorro.

Remarks: The genus can be subdivided into two distinct groups; one group consisting of those thresher sharks with relatively small eyes, a thin caudal fin, and no marked grooves on the top of the head. This group includes the common thresher shark (***Alopias vulpinus***) and the pelagic thresher shark (***A. pelagicus***). The other group includes the bigeye thresher shark (***A. superciliosus***) with its extremely large eyes, broad caudal fin, and distinct grooves on the top of the head, running from a central point over the eyes, out and back over the gill region.

The family has a monotypic genus ***Alopias*** with three described species, two (***A. pelagicus*** and ***A. vulpinus***) of which generally occur from nearshore to offshore waters and usually inhabit a more pelagic environment, while one species (***A. superciliosus***) generally occurs in much deeper water than the others. The family, genus, and species accounts are modified and updated from Compagno (1984a, 2001).

Literature: Gruber and Compagno (1981); Compagno (2001); Ebert (2003, 2013, 2015); Last and Stevens (2009); Ebert, Fowler and Compagno (2013); Ebert and Stehmann (2013).

List of Deep–sea Species Occurring in the Area:

Alopias superciliosus Lowe, 1841

Alopias Rafinesque, 1810

Genus: ***Alopias*** Rafinesque, 1810, *Caratt. Gen. sp. anim. piant. Sicilia, Palermo*, pt. 1: 13.

Type species: ***Alopias macrourus*** Rafinesque, 1810, by monotypy, a junior synonym of ***Squalus vulpinus*** Bonnaterre, 1788, *Tabl. Encyclop. Method. Trois Reg. Nat. Ichthyol.*, Paris: 9.

Number of Recognized Deep–sea Southeastern Pacific Ocean Species: 1.

Synonyms: Genus ***Vulpecula*** Jarocki, 1822: 454. Probably based on ***Vulpecula marina*** Valmont, 1768 (work not consistently binomial), equivalent to ***Squalus vulpinus*** Bonnaterre, 1788. Genus ***Alopecias*** Müller and Henle, 1837a: 114. Type species: "***Carcharias vulpes*** Cuv[ier]" by original designation, equals ***Squalus*** (***Carcharias***) ***vulpes*** Cuvier, 1816. Genus ***Alopius*** Swainson, 1838: 91 (unjustified emendation of ***Alopias*** Rafinesque, 1810). Genus ***Vulpecula*** Garman, 1913: 3, 30. Type species: ***Vulpecula marina*** Garman, 1913, by monotypy: "Valmont, 1768, gives a description of ***V. marina*** of earlier authors. His species is ***Squalus vulpinus*** Bonn., 1788, the ***Alopias macrourus*** Raf., 1810, ***A. vulpes*** Bonap. 1841. The genus and species are adopted from Valmont" (Garman, 1913: 3). Revival of ***Vulpecula*** Valmont (1768: 740). Valmont's names were rejected as being inconsistently binomial by the International Commission on Zoological Nomenclature (1925, Opinion 89: 27–33).

Field Marks: A distinctive shark group with an extremely long caudal fin that is about as long as the body trunk, very long, narrow pectoral fins, a very large first dorsal fin and comparatively minute second dorsal fin, and large to very large eyes.

Diagnostic Features: See family account above.

Local names: No information.

Alopias superciliosus Lowe, 1841

Alopecias superciliosus Lowe, 1841, (Jan.), *Proc. Zool. Soc. London*, 1840(8): 39. Also Lowe, 1849, *Trans., Zool. Soc. London*, 3(1): 18 (sometimes dated 1839). Holotype unknown (Compagno, 2001), type locality Madeira, eastern Atlantic.

Synonyms: ***Alopias profundus*** Nakamura, 1935: 2, pl. 1, fig. 1, pl. 2. Syntypes: three large specimens, 332, 352, and 366 cm total length, a large female illustrated and of uncertain size (Nakamura, 1935, pl. 1, fig. 1); also, a 72 cm total length foetus, presumably the same as illustrated (Nakamura, 1935, pl. 2); all specimens from So–au fish market, Taiwan (Province of China). Whereabouts of syntypes unknown according to Compagno (2001); syntypes may possibly have never been accessioned into a research collection.

Other Combinations: None.

FAO Names: En – Bigeye thresher; **Fr** – Renard à gros yeux; **Sp** – Zorro ojón.

Fig. 121 ***Alopias superciliosus***

Field Marks: A large thresher shark with extremely large eyes extending onto the dorsal head surface, head with distinct lateral grooves extending from above the eyes to behind the gill slits (appearing helmet–like), pectoral fins with curved anterior margin and broadly tipped at the apices, caudal fin extremely long, about same length as precaudal length, broad at fin tip, colour purplish brown to violet above, light below, without white patches extending above pectoral or pelvic fins.

Diagnostic Features: Body stout, cylindrical. Head broad, with deep grooves extending along each side of head from behind eyes to above gill openings. Snout moderately long and bulbous. Eyes huge, extending onto the dorsal head surface; interorbital space nearly flat. Labial furrows absent. Teeth large, with a long slender, smooth–edged cusp, no lateral cusplets, similar in both jaws; no symphysial or intermediate teeth; tooth counts 19 to 27 upper jaw, 19 to 24 lower jaw. Pectoral fins falcate with curved anterior margins and broadly tipped apices. Claspers moderately slender, not whip–like. First dorsal midbase closer to pelvic–fin bases than to pectoral–fin bases. Caudal tip broad with wide terminal lobe. Vertebral counts: total vertebral counts 278 to 308, monospondylous vertebral count 66, diplospondylous vertebral count 39, total precaudal vertebral counts 98 to 106, caudal vertebral counts 175 to 204. Intestinal valve counts 43 to 45. Maximum total length about 484 cm. **Colour:** upper body surface violet to purplish–brown, fading to grey or white on sides, becoming lighter ventrally, but not extending over pectoral–fin bases; no white blotches or spots extending onto upper pectoral fin tips.

Distribution: Southeastern Pacific Ocean: Chile, Peru, Ecuador, and Colombia. Elsewhere, found worldwide in all major oceans.

Habitat: Bigeye thresher sharks are usually found over continental shelves, but also on the high seas in the open ocean far from land. They may occur at the surface and down to at least 723 m over very deep water. They are usually found in areas where the surface temperature ranges from 16 to 25 °C. This shark appears to exhibit a strong diel movement pattern by remaining at depth, usually between 300 and 500 m where the water temperature is between 6 and 12 °C, during the day, migrating at night to within 10 and 100 m from the surface where the water temperature warms to between 20 and 26 °C.

Biology: Viviparous with a yolk sac, but oophagous, and with litters of 2 to 4, mostly 2. The gestation period may be 12 months, but since there does not appear to be a defined birthing season this has not been confirmed. Gravid females with embryos in various developmental stages are found year–round. Males mature in about 9 to 10 years and live at least 19 years, while females mature in 12 to 14 years and live about 20 years.

The diet of bigeye threshers consists primarily of benthic and pelagic fishes, cephalopods, and crustaceans. The large eyes

are especially well adapted for low light levels, and the expanded orbits allow the eyes to roll upward enabling these sharks to hunt by searching for silhouettes of potential prey items above them.

The bigeye thresher, as well as the other members of this genus and the family Lamnidae is able to maintain its body temperature several degrees above that of the surrounding water.

Size: Maximum total length about 484 cm; males adult between 270 to 290 cm; females mature between 332 to 356 cm. Size at birth 100 to 140 cm.

Interest to Fisheries and Human Impact: The bigeye thresher is taken in drift gillnets and by longline, but very little is known as to how many are typically caught since landings are not generally reported to species.

The conservation status of this thresher shark species is Vulnerable due to apparent declining populations, possibly resulting from a combination of its life history characteristics and high levels of largely unmanaged and unreported mortality from targeted and non-targeted fisheries.

Local Names: Peje zorro ojón (Chile); Tiburón zorro de ojo grande (Peru).

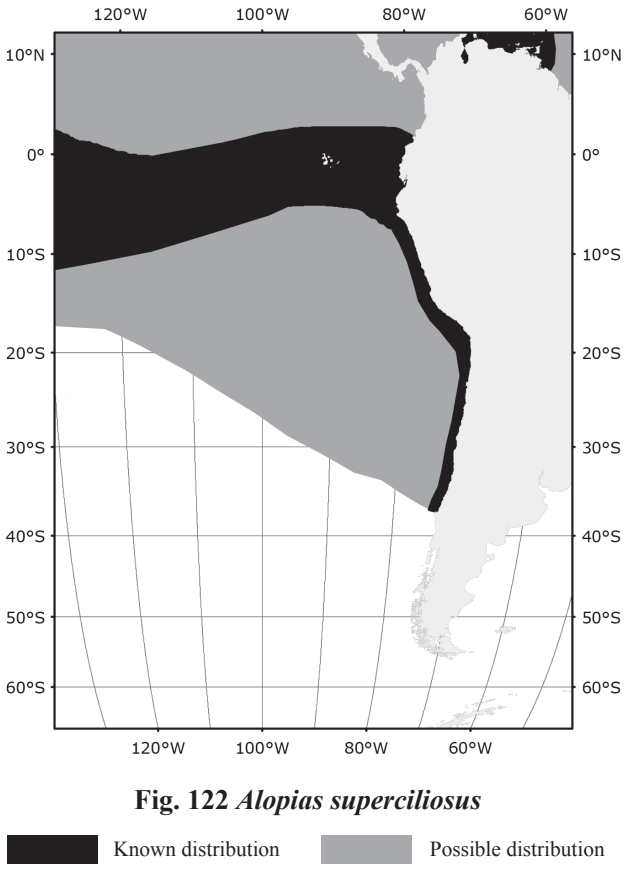


Fig. 122 ***Alopias superciliosus***

Literature: Gruber and Compagno (1981); Gilmore (1983, 1993); Chen, Liu and Chang (1997); Liu, Chiang and Chen (1998); Compagno (2001); Ebert (2003, 2013); Mejia *et al.* (2007); Last and Stevens (2009); Ebert, Fowler and Compagno (2013); Ebert and Stehmann (2013); Bustamante, Vargas-Caro, and Bennett (2014); Cornejo *et al.* (2015).

2.4.4 Family CETORHINIDAE

Family: Subfamily Cetorhinidae Gill, 1862, *Ann. Lyceum Nat. Hist. New York*, 7(32): 397–398 (Family Lamnoidae). Emended to Family Cetorhinidae Gill, 1862, by Gill (1872, *Smiths. Misc. Coll.*, [247]: 24).

Type genus: Subgenus ***Cetorhinus*** Blainville, 1816 (Genus ***Squalus*** Linnaeus, 1758).

Number of Recognized Deep–sea Southeastern Pacific Ocean Genera: 1.

Synonyms: Group ***Selachina*** Günther, 1870 (Family Lamnidae): 389, 394. Emended to Family Selachidae Günther, 1870, by Poey, 1875: 85. Also Subfamily ***Selache*** (Family Lamna) Hasse, 1879: tab. 2. Type genus: Subgenus ***Selache*** Cuvier, 1816 (Genus ***Squalus*** Linnaeus, 1758). Family Halsydridae Whitley, 1934: 196. Type genus: ***Halsydrus*** Neill, 1809a, b.

FAO Names: En – Basking sharks; **Fr** – Requins pélerin; **Sp** – Peregrinos.

Field Marks: See species account below.

Diagnostic Features: Body fusiform, stout, and firm, not flabby; body stoutest from about pectoral fins to first dorsal fin, tapering posteriorly to moderately stout dorso–ventrally flattened caudal peduncle. Head moderately long, much shorter than trunk length, and slightly compressed laterally opposite to mouth. Snout short, conical with rounded tip in larger specimens (over 360 cm), but in smaller individuals (less than about 360 cm) snout length much longer, forming a subcylindrical proboscis, becoming oblique, truncated, and terminating in an acutely pointed tip. Eyes nearly circular, relatively small, diameter about 0.8 to 1.3% of precaudal length, located just posterior to front of mouth. Spiracles minute, circular, about opposite to or just posterior to front of mouth. Gill openings enormous, nearly encircling the head; first gill opening largest, each subsequent opening descending in length to the fifth (smallest) opening; all five paired gill openings anterior to pectoral–fin base; internal gill openings with modified gill rakers. Nostrils small, transverse, closer to mouth than to snout tip. Mouth huge, rounded in adults, but variable in young juveniles. Lower labial furrow at mouth corners very short, upper labial furrows absent. Teeth minute, with a single smooth–edged, hook–shaped cusp, similar shaped in both jaws; tooth counts number over 200 rows on upper and lower jaws. Caudal peduncle with strong lateral keels and crescentic shaped upper and lower precaudal pits. Dermal denticles close–set, numerous, varying in size, very rough, erect and thorn–like with strong cusps and ridges; cusps

of lateral denticles angled in various directions. Pectoral fins very large and broad, less than head length. Pelvic fins about two–thirds height of first dorsal fin anterior margin. Anal fin similar in size to second dorsal fin; origin below posterior half of second dorsal fin. First dorsal fin very high, erect, nearly triangular; midbase between snout tip and caudal fork. Second dorsal–fin anterior margin only about 20% to 25% height of first dorsal fin. Caudal fin crescent–shaped, large, but less than one–third length of shark; dorsal lobe about one–third longer than ventral lobe. Vertebral counts: total vertebral counts 107 to 116, precaudal vertebral counts 50 to 54, diplospondylous caudal vertebral counts 55 to 62. Intestinal valve of ring type with 47 to 51 turns. The second largest fish in the world with adults to about 10 m and possibly to 12 m long. **Colour:** mottled bluish grey to grey or brown above, becoming variably lighter or darker below.

Distribution: Circumglobal, most commonly observed in temperate and boreal waters, but known to occur at depth, usually below 300 m in tropical seas.

Habitat: Coastal and pelagic oceanic, these sharks will dive to several hundred meters and remain at depth as they move through warm temperate to tropical waters migrating between Hemispheres. In cooler waters, they are often seen slowly cruising at the surface. These sharks are known to make transoceanic and transequatorial migrations.

Biology: See species account below.

Interest to Fisheries and Human Impact: See species account below.

Local Names: No information.

Remarks: The family, genus, and species accounts are modified and updated after Compagno (2001) who also provides a detailed account on the history of the spelling and usage of the various scientific names for this shark.

The family has a single genus and species, which occurs in all major oceans.

Literature: Compagno (2001); Ebert (2003); Last and Stevens (2009); Ebert (2013); Ebert and Stehmann (2013).

List of Deep–sea Species Occurring in the Area:

Cetorhinus maximus (Gunnerus, 1765)

Cetorhinus Blainville, 1816

Genus: Subgenus ***Cetorhinus*** Blainville, 1816 (Genus ***Squalus*** Linnaeus, 1758), *Bull. Sci. Soc. Philomat. Paris*, (8): 121.

Type species: Not designated; Blainville included the species "***Gunneri***; ***Peregrinus***; ***Shavianus***; ***Homianus***?" in ***Cetorhinus*** without further comment. Gill (1862, *Ann. Lyceum Nat. Hist. New York*, 7(32): 398), designated ***Squalus maximus*** "Linnaeus" (=Gmelin, 1788) as type of ***Cetorhinus***, but this was not an included species. Jordan and Gilbert (1883, *Bull. U.S. Nat. Mus*., 16: 31) designated "***Cetorhinus gunneri*** Blainv. = ***S. maximus*** L." (a junior synonym of ***Squalus maximus*** Gunnerus, 1765) as type of ***Cetorhinus***, which may be the earliest valid type designation. Eschmeyer (1998, Cat. Fish.) cited Jordan and Evermann (1896, *Bull. U.S. Natn. Mus*., (47), pt. 1: 51) as a later, similar type designation.

Number of Recognized Deep–sea Southeastern Pacific Ocean Species: 1.

Synonyms: Subgenus ***Selache*** Cuvier, 1816 (Genus ***Squalus*** Linnaeus, 1758): 129. Type species, "***Sq. maximus*** L." by monotypy (***Squalus maximus*** Gmelin, 1788, a junior synonym of ***Squalus maximus*** Gunnerus, 1765). Genus ***Selanche*** Jarocki, 1822: 452 (error for ***Selanche***, Cuvier, 1816). Genus ***Selanchus*** Minding, 1832: 52 (unjustified emendation of ***Selache*** Cuvier, 1816). Genus ***Polyprosopus*** Couch, 1862: 67.

Field Marks: See species account below.

Diagnostic Features: See family account above.

Local names: No information.

Cetorhinus maximus (Gunnerus, 1765)

Squalus maximus Gunnerus, 1765, *K. Norske Vidensk–selsk. Scr. Trondh*.: 33, pl. 2. Holotype, apparently none. Type Locality: Trondhjem, Norway.

Synonyms: ***Squalus gunnerianus*** Blainville, 1810 (71): 256, pl. 2, fig. 3; Types? ***Squalus homianus*** Blainville, 1810: 257, pl. 2, fig. 1. Types? ***Squalus pelegrinus*** Blainville, 1810: 256, pl. 2, fig. 2. Holotype: Museum National d'Histoire Naturelle, Paris, MNHN 9853. ***Halsydrus pontoppidiani*** Fleming, 1817: 713. Stronsa, Orkney Islands. Holotype: National Museum of Scotland, NMSZ–1979.012. ***Squalus elephas*** Lesueur, 1822: 350, pl. Types: based on a large adult male specimens, about 10 m TL from the New Jersey coast, not saved. ***Squalus rashleighanus*** Couch, 1838: 51. Type locality, Cornwall. Types? ***Polyprosopus macer*** Couch, 1862: 68, pl. 15, fig. 2. Type locality, Startpoint, Cornwall, England. No types. ***Cetorhinus blainvillei*** Capello, 1870: 233, 1 pl. Type locality, Portugal. Types? ***Selachus pennantii*** Cornish, 1885: 351. Type locality: Cornwall. No types.

Other Combinations: ***Halsydrus maximus*** (Gunnerus, 1765), ***Selache maxima***, ***Selache maximus*** or ***Selache maximum*** (Gunnerus, 1765), ***Selache elephas*** (Lesueur, 1822)

FAO Names: En – Basking shark; **Fr** – Pélerin; **Sp** – Peregrino.

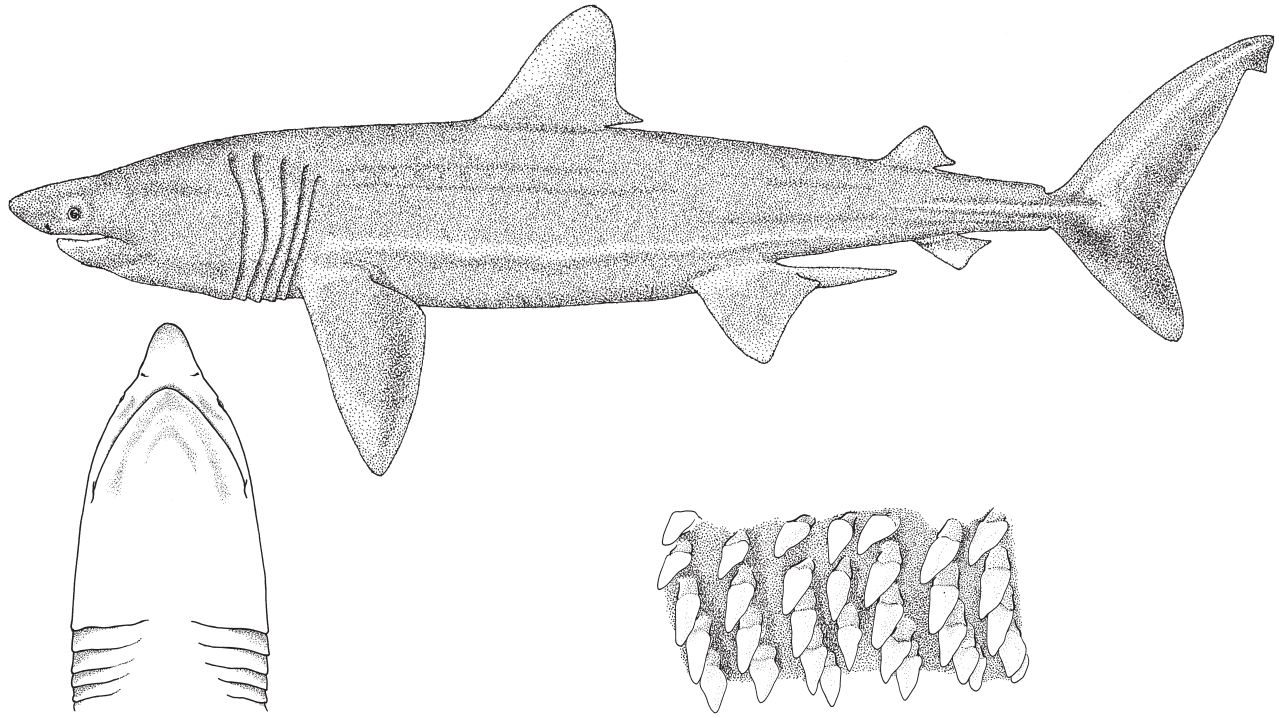


Fig. 123 ***Cetorhinus maximus***

Field Marks: The great size, enormous gill slits that virtually encircle the head, modified gill rakers, pointed snout, huge, subterminal mouth with minute hooked teeth, caudal peduncle with strong lateral keels, and lunate caudal fin distinguish this shark from all others. Colour blackish to grey–brown, grey or blue–grey above and below on body and fins, undersurface sometimes lighter, often with irregular white blotches on the underside of the head and abdomen; flanks sometimes with lighter linear striping and spots.

Diagnostic Features: See family Cetorhinidae above.

Distribution: Southeastern Pacific Ocean: Chile, Peru, Ecuador, and Colombia. Circumglobal.

Habitat: Basking sharks are coastal pelagic, usually observed at the surface in areas where the water temperature is between 5 and 21 ^{o}C. They may be found close inshore, including enclosed bays, from the surfline and over the continental shelf, to well offshore at depths of over 1200 m. This is a very social species and is often seen swimming in small groups of 3 to 10 or in larger groups numbering in the hundreds. At lower latitudes, these sharks will dive to depth and remain between 250 and about 1000 m depth for five months or more without coming to the surface. In warm temperate and tropical seas, these sharks tend to follow distinct water masses while at depth; one shark was found to follow the 5 ^{o}C thermocline at 300 to 400 m depth off Brazil, while another individual followed the 5 ^{o}C thermocline at 750 to 1000 m depth off the Bahamas. In the eastern Pacific, one shark tagged off San Diego, California (USA), travelled over 2500 km to just off the northeastern Hawaiian Islands in eight months. The shark remained at depth, mostly below 300 m, following a cooler water thermocline during this time.

Biology: Reproduction oophagous, with 1 to 6 young per litter; reproductive cycle including gestation period unknown. Records of juvenile sharks less than 300 cm for this species are rare, suggesting pupping and nursery grounds are located

in planktonic–rich oceanic waters far from populated coastal areas. Previous age estimates for this species are now known to be erroneous as vertebral bands are associated with growth and not age.

These filter–feeding giants consume vast quantities of zooplankton including copepods and planktonic larvae. An individual basking shark may have half a ton of food in its stomach at any time. Adult basking sharks when feeding will cruise at a speed of about two knots per hour and will pass about 2000 tons of water over their gills per hour. They will close their mouths every 30 to 60 seconds to ingest the filtered plankton that is trapped in their gill rakers. Basking sharks feed along thermal fronts where their food may be especially abundant. They will dive to great depths in warm temperature and tropical seas following thermoclines and will remain at depth for extended periods of time.

Basking sharks appear to have few natural predators, although white sharks (***Carcharodon carcharias***), killer whales (***Orcinus orca***), and sperm whales (***Physeter macrocephalus***) are known predators; a 2.5 m juvenile was once found in a sperm whale stomach in the Azores.

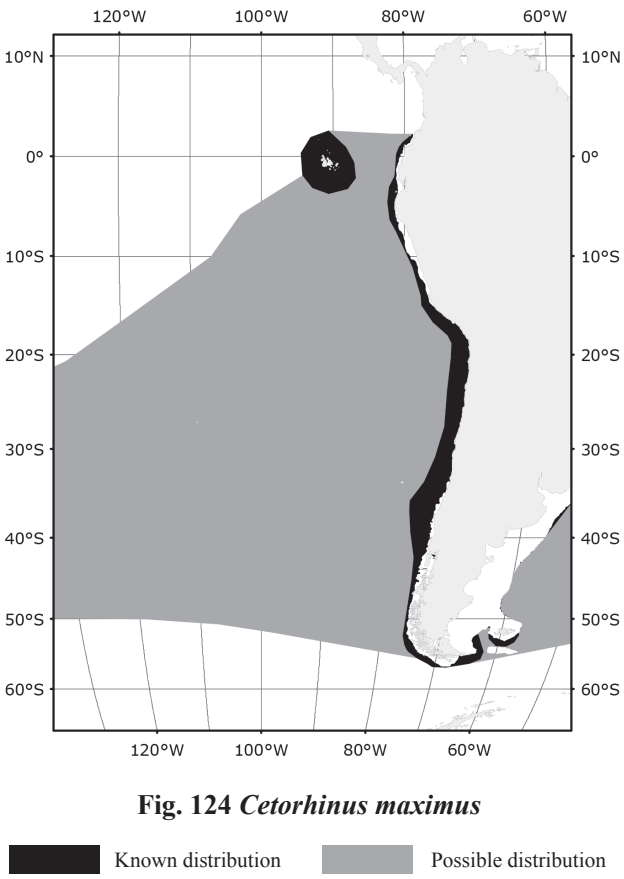


Fig. 124 ***Cetorhinus maximus***

Basking sharks are now known to make extensive transoceanic and trans–equatorial movements in the Atlantic and Pacific often moving thousands of kilometers. The North Atlantic population may be contiguous with evidence of movements between the eastern and western North Atlantic. Also, some sharks tagged off southern New England, U.S.A., were found to move southwards to the Caribbean and as far as Brazil, South America. Similarly, a shark tagged off California travelled 2500 km to just off the Hawaiian Islands, suggesting that these sharks may utilize entire ocean basins during their life cycle. Information on this species in the southeastern Pacific Ocean is scant, as it does not appear to be very common, with very few confirmed records.

Size: Maximum total length about 10 to 12 m; males mature at about 4 to 5 m and females at about 8 to 9 m TL. Size at birth about 1.5 to 2 m total length; smallest free–swimming individual measured 1.7 m in length.

Interest to Fisheries and Human Impact: Of little importance in the southeastern Pacific Ocean as this species does not appear to be very common. Elsewhere, these sharks have been fished historically in the North Atlantic since at least the seventeenth and eighteenth centuries primarily for their liver oil for vitamin A, and lamp oil, skin for leather, and flesh for human consumption. In recent years, their fins have become quite valuable in the shark–fin trade industry. Since 2003, basking sharks have been largely protected by most nation states with only bycatch landings allowed for in some regions.

The basking shark is quite docile allowing boats and ecotourist divers to approach them. Although considered harmless, divers approaching these sharks should take care as the extremely rough dermal denticles on its skin can cause severe abrasions and lacerations to uncovered human skin.

It has been estimated that the global population of these sharks may be quite low, which raises concerns over its conservation status. It is considered Vulnerable globally. In 2002, the basking shark was listed by the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) on Appendix II.

Local names: Tiburón peregrino, Playero (Chile); Tiburón canasta (Peru).

Literature: Compagno (2001); Izawa and Shibata (1993); Ebert (2003, 2013, 2015); Hoelzel *et al.* (2006); Mejia *et al.* (2007); Gore *et al.* (2008); Natanson *et al.* (2008); Last and Stevens (2009); Skomal *et al.* (2009); Ebert, Fowler and Compagno (2013); Ebert and Stehmann (2013); Bustamante, Vargas-Caro, and Bennett (2014); Cornejo *et al.* (2015).

2.5 Order CARCHARHINIFORMES – Ground Sharks

Order: Carcharhiniformes Compagno, 1973, *J. Linn. Soc*. (*Zool*.) London, 53, suppl. 1.

Number of Recognized Deep–sea Southeastern Pacific Ocean Families: 1.

Synonyms: [Part] 1 Squali, Abtheilung [Division] 1: Müller and Henle, 1838, *Syst. Besch. Plagiost*. (1): 3 (division 1 equivalent to suborder for scyliorhinids and most orectoloboids, Squali equivalent to order for all living sharks). [Part] 1 Squali, Abtheilung [Division] 2: Müller and Henle, 1838 (in part), *Syst. Besch. Plagiost*. (1): 27; Müller and Henle, 1839 (in part), *Syst. Besch. Plagiost*. (2): 27 (division 2 equivalent to suborder for most carcharhinoids, all lamnoids, heterodontoids, and the family Rhincodontidae, Squali equivalent to order for all living sharks). [Part] 1 Squali, Abtheilung [Division] 2, Unterabtheilung [Subdivision] 1: Müller and Henle, 1838 (in part), *Syst. Besch. Plagiost*. (1): 27; Müller and Henle, 1839 (in part), *Syst. Besch. Plagiost*. (2): 27 (subdivision 1 equivalent to superfamily for carcharhinids and sphyrnids). [Part] 1 Squali, Abtheilung [Division] 2, Unterabtheilung [Subdivision] 2: Müller and Henle, 1839, *Syst. Besch. Plagiost*. (2): 57 (subdivision 2 equivalent to superfamily for some carcharhinids and triakids). Ordo Plagiostomi, Subordo Squalini, Sectio Proktopterides, Tribus Dinotopterini: Bleeker, 1859, *Acta Soc. Sci. Indo–Neerl*. 6: xi (tribus and sectio of equivalent rank to superfamily and infraorder, tribe for heterodontoids, lamnoids, carcharhinoids, orectoloboids, and hybodonts, section for all sharks with anal fins, suborder for all sharks, order for all Elasmobranchs). Order Squali, Suborder Squali: Gill, 1862 (in part), *Ann. Lyc. Nat. Hist. N.Y.* 7: 394, 396 (suborder for all sharks except squatinids, order for all sharks). Order Squali, Suborder Galei: Gill, 1872 (in part), *Smithsonian Misc. Colln*. (247): 22, 23 (order for all sharks, suborder for all sharks except squatinids). Order Plagiostomi diplospondyli, Suborder Plagiostomi asterospondyli, Group 1 Scyllia: Hasse, 1879 (in part), *Nat. Syst. Elasmobr*. (1): 52 (suborder for 'galeoid' sharks and heterodontoids, group ranked as infraorder or superfamily and including most carcharhinoids and family 'Cheiloscyllium' = Hemiscylliidae). Order Selachii, Suborder Asterospondyli: Woodward, 1889 (in part), *Cat. fossil fish*. BM(NH) (1): 157 (suborder for hexanchoids, cochliodonts, heterodontoids, hybodonts, palaeospinacids, lamnoids, orectoloboids, and carcharhinoids, order for other living Elasmobranchs, psammodonts, petalodonts, and pristodonts). Order Asterospondyli: Gill, 1893 (in part), *Natn. Acad. Sci. (U. S.) Mem*. 6, 6: 130 (carcharhinoids in unnamed suborder [Galei?] with other 'galeoid' sharks and pristiophorids in apposition to suborder for squatinoids); Fowler, 1941 (in part), *Bull. U. S. Natn. Mus*. (100) 13: 4, 13 (group for heterodontoids and 'galeoids'); Smith, 1949 (in part), *Sea fishes Southern Africa*: 37, 39 (group for "typical sharks" including heterodontoids and 'galeoids'). Order Asterospondyli, Suborder Galei: Jordan and Evermann, 1896 (in part), *Bull. US Nat. Mus*. 47(1): 19, 21 (order for heterodontoids and 'galeoid' sharks, suborder for 'galeoids'). Order Euselachii, Suborder Pleurotremata, Division Galeoidei Regan, 1906a (in part), *Proc. Zool. Soc. London* (1906): 723 (division ranking as infraorder or superfamily for all 'galeoid' sharks including lamnoids, orectoloboids, and carcharhinoids). Order Selachii, Group 2, Division B, Subdivision 1, Suborder Scylliodei Goodrich, 1909 (in part), *In* R. Lankester, *ed.*, *A treatise on Zoology* (9), Vertebrata Craniata: 148 (subdivision and suborder for 'galeoid' sharks). Order Pleurotremata, Suborder Galeoidei: Engelhardt, 1913 (in part), *Abh. math.–phys. Klasse K. Bayer. Akad. Wiss., Suppl., Beitr. Naturg. Ostasiens*, 4: 97 (suborder for 'galeoid' sharks: carcharhinoids, lamnoids, and orectoloboids). Order Plagiostoma, Suborder Antacea, "Group" Carcharinoidei: Garman, 1913 (in part), *Mem. Mus. Comp. Zool. Harvard* 36: 11, 12 (group corresponding to infraorder or superfamily, and including the carcharhinoid families Carcharinidae [= Carcharhinidae in large part], Cestracionidae [= Sphyrnidae] and Galeorhinidae [= Triakidae in large part]). Order Plagiostoma, Suborder Antacea, "Group" Catuloidei: Garman, 1913 (in part), *Mem. Mus. Comp. Zool. Harvard* 36: 11, 12 (group corresponding to infraorder or superfamily, and including the carcharhinoid families and including the carcharhinoid families Catulidae [= Scyliorhinidae] and Pseudotriakidae as well as all orectoloboids except the whale shark). Order Euselachii, Suborder Galei, [Series] Scyllioidei: Jordan, 1923 (in part), *Stanford Univ. Publ., Univ. Ser., Biol. Sci.*, 3: 97 (group for scyliorhinids and orectoloboids). Order Euselachii, Suborder Galei, Series Galeoidei: Jordan, 1923 (in part), *Stanford Univ. Publ., Univ. Ser., Biol. Sci*., 3: 100, 101 (group for triakids, higher carcharhinids, and pristiophoroids). Order Plagiostomi, Suborder Galeiformes: Lozano y Rey, 1928 (in part), Fauna Iberica. Peces. Vol. 1: 280 (suborder for 'galeoid' sharks: lamnoids, orectoloboids, and carcharhinoids). Order Galea, Suborder Carcharinida, Superfamily Catuloidea: White, 1936, *Amer. Mus. Novit*. (837): 4; White, 1937, *Bull. Amer. Mus. Nat. Hist*. 74: 37, tab. 1 (superfamily includes scyliorhinids, proscylliids and pseudotriakids, suborder all carcharhinoids, and order for all 'galeoid' sharks). Order Galea, Suborder Carcharinida, Superfamily Carcharinoidea: White, 1936, *Amer. Mus. Novit*. (837): 4; White, 1937, *Bull. Amer. Mus. Nat. Hist*. 74: 37, tab. 1 (superfamily includes triakids, hemigaleids, carcharhinids and sphyrnids, suborder all carcharhinoids, and order for all 'galeoid' sharks). Order Euselachii, Suborder Lamniformes: Bertin, 1939 (in part), *Bull. Inst. Oceanogr. Monaco* (775): 9 (suborder for lamnoids + pseudotriakids, order for all living Elasmobranchs). Order Euselachii, Suborder Scylliformes: Bertin, 1939 (in part), *Bull. Inst. Oceanogr. Monaco* (775): 9 (suborder for scyliorhinids, proscylliids and orectoloboids, order for all living Elasmobranchs). Order Euselachii, Suborder Musteliformes: Bertin, 1939 (in part), *Bull. Inst. Oceanogr. Monaco* (775): 9 (suborder for triakids, hemigaleids, proscylliids, carcharhinids, and sphyrnids, order for all living Elasmobranchs). Order Lamniformes, Suborder Scyliorhinoidei: Berg, 1940, *Trudy Zool. Inst. Akad. Nauk SSSR*, 5(2): 137 (suborder exclusively for carcharhinoids, order also for lamnoids and orectoloboids); Berg and Svetovidov, 1955 (in part), *Trudy Zool. Inst. Akad. Nauk SSSR*, 20: 66; Patterson, 1967, *in* W. B. Harland *et al.*, *Geol. Soc. London, Spec. Pub.* 2: 671 (suborder exclusively for carcharhinoids, order also includes squaloids, squatinoids, lamnoids, orectoloboids, squalicoracids, protospinacids, and orthacodontids); Lindberg, 1971, *Fishes of the world* (trans. 1974): 8, 258 (suborder exclusively for carcharhinoids, order also for lamnoids and orectoloboids); Nelson, 1976 (in part), *Fishes of the world*: 33 (suborder exclusively for carcharhinoids, order for 'galeoid' sharks including lamnoids and orectoloboids); Nelson, 1984, *Fishes of the world*, ed. 2: 53. Order Euselachii,

Suborder Galei, Superfamily Scyllioidea: Whitley, 1940, *Fishes Australia. Part I. Aust. Zool. Handbook*: 68 (scyliorhinids). Order Euselachii, Suborder Galei, Superfamily Galeoidei: Whitley, 1940, *Fishes Australia. Part I. Aust. Zool. Handbook*: 68 (triakids and higher carcharhinoids). Order Selachii, Suborder Galeoidea: Romer, 1945 (in part), *Vert. Paleont*. (ed. 2): 576 (suborder for lamnoids, orectoloboids, and carcharhinoids, order for all living sharks and protospinacids, hybodonts, coronodonts, and edestoids); Bigelow and Schroeder, 1948 (in part), *Mem. Sears Fnd. Mar. Res*. (1) 1: 77, 95 (suborder for lamnoids, orectoloboids, and carcharhinoids, order for all living sharks); Romer, 1966 (in part), *Vert. Paleont*. (ed. 3): 350 (suborder for lamnoids, orectoloboids, carcharhinoids, and orthacodonts, order for all living sharks and protospinacids, ptychodonts, hybodonts, coronodonts, and edestoids). Order Lamnoidea, Suborder Scyliorhinoidea: Schultz and Stern, 1948 (in part), *Ways of Fishes*: 224 (suborder exclusively for carcharhinoids, order also including lamnoids and orectoloboids). Order Lamnida, Suborder Lamnina: Matsubara, 1955 (in part), *Fish morphology hierarchy*, (1): 1–789 (suborder for lamnoids, orectoloboids, and carcharhinoids, order for all living sharks). Order Galeiformes, Suborder Carcharhinoidei: Arambourg and Bertin, 1958, *In* P.–P. Grasse, *ed*, *Traité de Zoologie*, 13: 2037 (suborder exclusively for carcharhinoids, order also for orectoloboids and lamnoids). Order Pleurotrema, Suborder Galeoidea: Norman, 1966 (in part), *draft syn. Recent fishes*: 7 (suborder for lamnoids, orectoloboids, and carcharhinoids, order for all living sharks). Order Carcharhinida: Glikman, 1967 (in part), *in* Y. A. Orlov, *ed.*, *Fundamentals Paleontology*, 11: 222 (for carcharhinoids and palaeospinacids). Order Carchariida, Suborder Galeorhinina, Superfamily Galeorhinicae: Fowler, 1967b, *Q. J. Taiwan Mus*. 20(3–4): 342, 360 (superfamily for triakids, hemigaleids and proscylliids, suborder for all carcharhinoids, order for 'galeoids'). Order Carchariida, Suborder Galeorhinina, Superfamily Scyliorhinicae: Fowler, 1967b, *Q. J. Taiwan Mus*. 20(3–4): 343 (superfamily for scyliorhinids). Order Carchariida, Suborder Galeorhinina, Superfamily Pseudotriakicae: Fowler, 1968, *Q. J. Taiwan Mus*. 21(3–4): 197 (superfamily for pseudotriakids). Order Carchariida, Suborder Galeorhinina, Superfamily Sphyrnicae: Fowler, 1968, *Q. J. Taiwan Mus*. 21(3–4): 197 (superfamily for sphyrnids). Order Euselachii, Suborder Galeoidei: Blot, 1969 (in part), *in* J. Piveteau, *ed*. Traité de Paleontologie. 2: 702–776 (suborder for lamnoids, orectoloboids, and carcharhinoids, order for all living sharks except hexanchoids and heterodontoids). Order Pleurotremata, Suborder Galeiformes: Budker and Whitehead, 1971 (in part), life of sharks: 5, tab. 2 (suborder for lamnoids, orectoloboids and carcharhinoids, order for all living sharks). Order Carcharhiniformes: Rass and Lindberg, 1971 (in part), 1971, *J. Ichthyol*. (Trans. Voprosy Ikhtiologii) 11(3): 304 (includes orectoloboids, carcharhinoids, and the lamnoid family Cetorhinidae); Compagno, 1973, *J. Linn. Soc. (Zool.) London*, 53, suppl. 1: 28 (exclusively for all carcharhinoids); Applegate, 1974, *J. Mar. Biol. Ass. India*, 14(2): 743 (exclusively for all carcharhinoids); Chu and Meng, 1979, *Monogr. Fish. China, Sci. Tech. Press, Shanghai*: 114, tab. 2 (exclusively for carcharhinoids); Compagno, 1984b, *FAO Fish. Synops.* (125)4(2): 251; Gubanov, Kondyurin and Myagkov, 1986 (in part), *Sharks World Ocean*: 3, 61 (for orectoloboids, carcharhinoids, and the lamnoid families Cetorhinidae and Megachasmidae); Cappetta, 1987, *Handb. Paleoichthyol*. 3B: 27, 111 (exclusively for carcharhinoids); Compagno, 1988, *Sharks Order Carcharhiniformes*: 87 (exclusively for carcharhinoids); Eschmeyer, 1990, *Cat. gen. Recent fish*.: 436 (exclusively for carcharhinoids); Nelson, 1994, *Fishes of the world*, ed. 3: 48; de Carvalho, 1996, *in* Stiassny *et al.*, *Interrelationships fishes*: 55 (exclusively for carcharhinoids); Shirai, 1996, *in* Stiassny *et al.*, *Interrelationships fishes*: 33 (exclusively for carcharhinoids); Eschmeyer, 1998, *Cat. Fish. Order Carcharhiniformes*, Suborder Carcharhinoidea: Chu and Meng, 1979, *Monogr. Fish. China, Sci. Tech. Press, Shanghai*: 114, tab. 2 (suborder for Family Carcharhinidae). Order Carcharhiniformes, Suborder Scyliorhinoidea: Chu and Meng, 1979, *Monogr. Fish. China, Sci. Tech. Press, Shanghai*: 114, tab. 2 (suborder for Family Scyliorhinidae). Order Carcharhiniformes, Suborder Sphyrnoidea: Chu and Meng, 1979, *Monogr. Fish. China, Sci. Tech. Press, Shanghai*: 114, tab. 2 (suborder for Family Sphyrnidae). Order Carcharhiniformes, Suborder Triakoidea: Chu and Meng, 1979, *Monogr. Fish. China, Sci. Tech. Press, Shanghai*: 114, tab. 2 (suborder for Family Triakidae). Order Galeomorpha, Suborder Carcharhinoidea: Carroll, 1988, *Vertebrate paleont. evolut*.: 599 (suborder exclusively for carcharhinoids, order also for palaeospinacids, hexanchoids, orectoloboids, lamnoids, and heterodontoids).

FAO Name: En – Ground sharks.

Field Marks: These sharks exhibit a wide range in external body morphology, but are generally characterized by having two spineless dorsal fins (except for 1 or 2 species which may have a single dorsal fin), five paired gill openings, a nictitating lower eyelid, a long mouth extending to or behind the eyes, and an anal fin. This group has some of the smallest and largest known shark species.

Diagnostic Features: Trunk cylindrical to slightly compressed or depressed but not raylike. Head conical to depressed and usually not anteriorly expanded, except for the prebranchial head in Sphyrnidae; 5 pairs of gill slits present on sides of head (partly dorsolateral in some Scyliorhinidae), with the last 1 to 3 over pectoral–fin bases; spiracles present in many species, small to large and close behind eyes, or absent; nostrils usually without barbels and nasoral grooves and always without circumnarial grooves, barbels when present developed from anterior nasal flaps rather than from lateral surfaces of flaps, anterior nasal flaps varying from well separated from mouth to overlapping it posteriorly; eyes lateral or dorsolateral on head, with true nictitating lower eyelids; snout varying from very short to moderately long and almost bladelike, but not greatly elongated and not formed as a rostral saw with lateral teeth and barbels; mouth moderately large to very large, arched, and extending behind anterior ends of eyes; labial furrows varying from large and on both jaws to absent; teeth variably differentiated along jaws, but usually without enlarged molariform posterior teeth and with anterior teeth not separated by small intermediate teeth or a gap from the lateral teeth. Two dorsal fins (possibly only one in ***Pentanchus***, family Scyliorhinidae), without spines, the first with origin varying from over the gill slits to behind the pelvic–fin bases; pectoral fins moderate–sized to large but not raylike, without triangular anterior lobes; pelvic fins

small to moderately large, with vent continuous with their inner margins; anal fin present; caudal fin with a long dorsal lobe but with ventral lobe varying from long (but considerably shorter than the dorsal lobe) to absent. Vertebral counts: total vertebral counts 100 to 244, monospondylous vertebral counts 23 to 68, diplospondylous vertebral counts 23 to 66, precaudal vertebral counts 41 to 137. Intestinal valve of spiral or scroll type. Size small to very large, maturing at less than 100 cm to over 400 cm in length. **Colour:** depending on the family and genera these sharks are highly variable in colour ranging from rather striking brilliant colour patterns to rather plain without prominent markings.

Distribution: Circumglobal from cold temperate to tropical seas, with one of eight families inhabiting the southeastern Pacific Ocean deep-sea.

Habitat: Ground sharks occur in a variety of marine habitats from the intertidal and enclosed bays, estuaries, including freshwater rivers, to the deep sea, and to the open ocean pelagic realm. They occur over sandy and mud bottoms, rocky and coral reefs, and in kelp forests.

Biology: These are very active to sluggish swimming sharks with some species being highly migratory while others having a more limited geographic range. They exhibit a variety of reproductive strategies with some (Scyliorhinidae) being oviparous by depositing egg cases on the bottom while most other groups are live bearing, but exhibit various forms of viviparity, with some providing nutrition by yolk sac and others maternally with the developing embryos being supplied directly by the mother. One family (Pseudotriakidae) exhibits oophagy. There are no known filter feeders in this order, but ground sharks feed on a wide variety of prey items including crustaceans, cephalopods, bony fishes, other chondrichthyans, and even marine mammals in some of the larger species. Many ground sharks are social, with some species occurring in large aggregates or schools, often segregating by sex and life stage.

Interest to Fisheries and Human Impact: Many carcharhinoids are the subject of moderate to major targeted and non–targeted fisheries. Members of the families Carcharhinidae, Sphyrnidae, and Triakidae are the subject of major fisheries globally, while many of the demersal bottom–dwelling species, primarily the Scyliorhinidae, are taken in considerable numbers as bycatch. This group contains some of the most well known species that have been implicated in shark attacks around the world. The bull shark (***Carcharhinus leucas***), oceanic whitetip shark (***Carcharhinus longimanus***), and tiger shark (***Galeocerdo cuvier***) are among the species that have been implicated in shark attacks mostly in tropical and open ocean environments.

Local names: No information.

Remarks: The present account follows Compagno (1988, 2005) and Ebert, Fowler and Compagno (2013) in recognizing eight families of which one family (Scyliorhinidae) has representative species occurring in the southeastern Pacific Ocean deep–sea. See Compagno (1988) for detailed discussion of this order.

2.5.1 Family SCYLIORHINIDAE

Family: Scylliorhinoidae Gill, 1862, *Ann. Lyceum Nat. Hist. New York*, 7(32): 393, 396, 406, 412.

Type Genus: "***Scylliorhinus*** Blainville, 1816", unjustified emendation of ***Scyliorhinus*** Blainville, 1816 by Gill, *ibid*.: 407. Emended to family Scyliorhinidae by Jordan and Fowler, 1903, *Proc. U. S. Natn. Mus.* 26: 600.

Number of Recognized Deep–sea Southeastern Pacific Ocean Genera: 2.

Synonyms: Family Scyllia or Scyllium Müller and Henle, 1838a, *Mag. Nat. Hist*., n. ser., 2: 34; 1838, *Syst. Beschr. Plagiost*., pt. 1: 3 Type genus: ***Scyllium*** Cuvier, 1816, junior synonym of ***Scyliorhinus*** Blainville, 1816. Subfamily Scyllini Bonaparte, 1838, *Nuov. Ann. Sci. Nat., Bologna*, ser. 1, 2: 130 (Family Squalidae). Type genus: ***Scyllium*** Cuvier, 1816, junior synonym of ***Scyliorhinus*** Blainville, 1816. Family Pentanchidae Smith and Radcliffe, *in* Smith, 1912, *Proc. U.S. Natn. Mus*. 41(1872): 489. Type genus: ***Pentanchus*** Smith and Radcliffe, *in* Smith, 1912. Family Catulidae Garman, 1913, *Mem. Harvard Mus. Comp. Zool*., 36: 68. Type genus: ***Catulus*** Garman, 1913, equals ***Catulus*** Valmont, 1768, rejected by the International Commission on Zoological Nomenclature (Opinion 89, 1925, *Smithsonian Misc. Colln*. 73: 27); also, ***Catulus*** Smith, 1837, junior synonym of ***Scyliorhinus*** Blainville, 1816 and junior homonym of ***Catulus*** Kniphof, 1759 in Insecta). Subfamily Galeinae Fowler, 1934, *Proc. Acad. Nat. Sci. Philadelphia*, 85: p. 234 (Family Scyliorhinidae). Type genus: ***Galeus*** Rafinesque, 1810. Family Halaeluridae White, 1936, *Amer. Mus. Novit*. (837), 4; White, 1936, *Amer. Mus. Novit*. (879), 18. Type genus: ***Halaelurus*** Gill, 1862. Family Atelomycteridae White, 1936, *Amer. Mus. Novit*. (837), 4; White, 1936, *Amer. Mus. Novit*. (879), 19. Type genus: ***Atelomycterus*** Garman, 1913. Subfamily Cephaloscylliinae Fowler, 1947, *Notul. Nat. Acad. Nat. Sci. Philadelphia* (187): 11 (Family Scyliorhinidae). Type genus: ***Cephaloscyllium*** Gill, 1862. Subfamily Schroederichthyinae Compagno, 1988, *Sharks Order Carcharhiniformes*: 107 (Family Scyliorhinidae). Type genus: ***Schroederichthys*** Springer, 1966.

FAO Names: En – Catsharks; **Fr** – Chiens, Holbiches; **Sp** – Alitanes, Pejegatos.

Field Marks: Usually elongated, catlike eyes with nictitating eyelids, nostrils usually without nasoral grooves but when present these are broad and shallow, mouth long, arched and reaching past anterior ends of eyes, small cuspidate teeth, two small, spineless dorsal fins, the first dorsal–fin base over or behind pelvic–fin bases, anal fin present, no precaudal pits, and the caudal fin without a strong ventral lobe or lateral undulations on its dorsal margin.

Diagnostic Features: Head without laterally expanded blades. Eyes elongated and fusiform, oval, or slitlike, with lengths over 1.5 times height. Nictitating eyelids rudimentary. Spiracles present and moderately large. Anterior nasal flaps variably formed, but not barbel–like, except for one genus (***Poroderma***) with a barbel formed from a separate ridge on each anterior nasal flap. Internarial width about 0.6 to 1.3 times nostril width. Labial furrows absent or very short to very long. Teeth small, with acute narrow cusps, often lateral cusplets, and basal ledges, not bladelike and similar in both jaws; posterior teeth comblike or not; tooth rows 36 to 120 upper jaw, 31 to 111 lower jaw. Precaudal pits absent. Pectoral fins with radials confined to bases of fins. First dorsal fin small and not keel–like, much shorter than caudal fin; first dorsal–fin base over or behind pelvic–fin bases, origin either slightly ahead of pelvic–fin origins (***Cephalurus***) or well behind them; midpoint of first dorsal–fin base always posterior to pelvic–fin origins. Ventral caudal–fin lobe absent or very weak; no undulations or ripples in dorsal caudal–fin margin. Vertebral centra with or without strong, wedge–shaped intermedial calcifications. Vertebral counts: total vertebral counts 85 to 163, monospondylous vertebral counts 28 to 48, diplospondylous precaudal vertebral counts 24 to 61, precaudal vertebral counts 65 to 107. Valvular intestine with a spiral valve of 5 to 23 turns. Most catsharks are small, less than 80 cm long, and while some may be mature at about 30 cm, a few may reach about 160 cm total length. **Colour:** many species with variegated colour patterns, some without them.

Distribution: This is by far the largest family of sharks, with a broad worldwide geographic range in tropical to cold–temperate and arctic waters.

Habitat: Catsharks occur from the intertidal and shore side to the edges of the continental and insular shelves and down the slopes to depths greater than 2000 m. Catsharks are generally found on or near the bottom in coastal waters inshore and offshore; none are oceanic, although some deepwater species may range a considerable distance off the bottom.

Biology: Most catshark species are very poorly known biologically. The reproductive mode for many species is single oviparity, in which only one fertilized egg enters each oviduct and is deposited on the substrate at a time; the large eggs, encapsulated in tough egg–cases with corner tendrils to anchor them, have most of their embryonic development outside the mother shark and may take two years or more to produce a hatchling shark. Others, possibly in areas of intense egg predation, have multiple oviparity, in which several encased eggs remain in the oviducts for an extended period, during which time the embryos develop to advanced stages before the eggs are laid; such eggs may hatch in less than a month. Still other species have eliminated oviparity altogether and are viviparous, retaining the eggs until the young are ready to be born. Catsharks feed chiefly on invertebrates and small fishes, and are harmless to people. Catsharks are generally weak swimmers and do not migrate over great distances; this is shown in their geographic distribution, which is often much more localized than families with strong swimming species. Some inshore species are nocturnal, sleeping often in groups in rocky crevices in the day and dispersing to feed at night.

Interest to Fisheries and Human Impact: A minority of the species in this family is of importance to fisheries, particularly the spotted catsharks (***Scyliorhinus***) of the eastern Atlantic, which are much utilized for human food consumption. Some are rather common and regularly taken as a bycatch in the trawl fisheries worldwide, and may be used for fishmeal and oil. Many are deepwater sharks and are not utilized to any great extent although they may be a minor component of the catch of large, deep–fishing offshore trawlers. Several inshore species are commonly caught by sportsfishers. Many species are hardy and make attractive if somewhat sluggish exhibits in public aquaria; some readily breed in captivity.

Local Names: Pejes-gato, Pintarroja (Peru).

Remarks: The Scyliorhinidae is the most diverse shark family with 17 genera and over 150 species. Of the 17 recognized genera within this family, 12 are considered to be deep–sea, of which 2 genera have representatives in the southeastern Pacific Ocean. The deep–sea genera are mostly the less colorful members of the family. The arrangement of this family follows revisions by Compagno (1988), Last, White and Pogonoski (2008) and the various chapters therein, Last and Stevens (2009), Ebert (2013) and Ebert, Fowler and Compagno (2013).

List of Deep–sea Species Occurring in the Area:

Apristurus brunneus (Gilbert, 1892)
Apristurus kampae Taylor, 1972
Apristurus nasutus de Buen, 1959
Bythaelurus canescens (Günther, 1878)
Bythaelurus giddingsi McCosker, Long, and Baldwin, 2012

Key to Deep–sea Southeastern Pacific Ocean Genera:

1a. Head broadly flattened and spatulate (Fig. 125a), snout elongated and usually greater than mouth width. Labial furrows very long, uppers reaching upper symphysis (Fig. 125b) . . . . . ***Apristurus***

1b. Head moderately or little–flattened, not spatulate (Fig. 126a), snout equal or usually less than mouth width. Labial furrows shorter or absent, when present not reaching upper symphysis (Fig. 126b) . . . . . ***Bythaelurus***

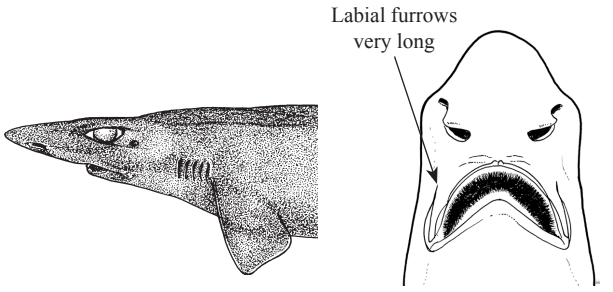


Fig. 125 *Apristurus*

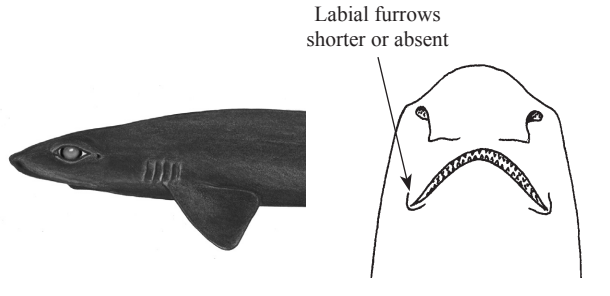


Fig. 126 *Bythaelurus*

Apristurus Garman, 1913

Genus: ***Apristurus*** Garman, 1913, *Mem. Harvard Mus. Comp. Zool*., 36: 96.

Type Species: ***Scylliorhinus indicus*** Brauer, 1906, by original designation.

Number of Recognized Deep–sea Southeastern Pacific Ocean Species: 3.

Synonyms: Genus ***Apristurius*** Schulze, Kükenthal and Heider, 1926, *Nomencl. animal. gen. subgen., Berlin*, 1: 244. Apparent error for ***Apristurus*** Garman, 1913. Subgenus ***Parapristurus*** Fowler, 1934, *Proc. Acad. Nat. Sci. Philadelphia*, 85: 237 (Genus ***Pentanchus*** Smith and Radcliffe, 1912). Type species: ***Catulus spongiceps*** Gilbert, 1895, by original designation. Subgenus ***Compagnoia*** Springer, 1979, *Nat. Ocean. Atmosp. Admin. Tech. Rept., Nat. Mar. Fish. Serv. Circ*. (422): 102 (Genus ***Parmaturus*** Garman, 1906). Type species: ***Parmaturus*** (***Compagnoia***) ***manis*** Springer, 1979, by original designation. Subgenus ***Campagnoia*** Gubanov, Kondyurin, and Myagkov, 1986, *Sharks World Ocean, Ident. Handbk., Moscow*, Agropromizdat, 116 (Genus ***Parmaturus*** Garman, 1906). Apparently a consistent erroneous spelling of ***Compagnoia*** Springer, 1979.

Field Marks: Scyliorhinids with “the ***Apristurus*** look” with a long, laterally expanded snout and head, enlarged nostrils with reduced anterior nasal flaps, very long labial furrows, small rear–sited spineless dorsal fins, very large, elongated anal fin separated from elongated caudal fin by a notch only. Coloration is uniform.

Diagnostic Features: Body not tadpole–shaped, stocky and more or less compressed, increasing in height up to the pectoral and trunk region and tapering posteriorly; body very soft and flabby, with thin skin and weakly calcified dermal denticles; stomach not inflatable. Tail short, length from vent to lower caudal–fin origin about 2/5 to 3/5 of snout–vent length. Head greatly depressed, pointed and wedge–shaped in lateral view; head rather elongated, but usually slightly less than 1/4 of total length in adults. Snout elongated, about equal to mouth width or greater, greatly flattened, narrow and pointed in lateral view; snout expanded laterally, narrowly spade–shaped to broadly spatulate and usually more or less bell–shaped in dorsoventral view. Ampullae pores enlarged and prominent on snout. Nostrils more or less enlarged, with incurrent and excurrent apertures broadly open to exterior; anterior nasal flaps reduced to angular lobes, without barbels, widely separate from each other and falling far anterior to mouth; internarial space 0.8 to 1.7 times nostril width; no nasoral grooves. Eyes dorsolateral on head, broad sub–ocular ridges present below eyes. Mouth angular or broadly arched, with lower symphysis well behind upper so that upper teeth are exposed in ventral view. Labial furrows present along both upper and lower jaws, these long and reaching nearly or quite to level of upper symphysis of mouth. Tooth rows 36 to 102 upper jaw, 31 to 106 lower jaw. Branchial region not greatly enlarged, distance from spiracles to fifth gill slits less than half head length; gill slits lateral on head. Pectoral fins variable in size, their width less to greater than mouth width. Inner margins of pelvic fins not fused over claspers in adult males. Claspers short, thick, and distally pointed, not extending more than 2/3 of their lengths behind the pelvic–fin tips and sometimes not extending past their tips. Two dorsal fins present, equal–sized or with the second dorsal larger than the first. Origin of first dorsal fin varying from over the pelvic–fin midbases to over the pelvic–fin free rear tips. Origin of second dorsal fin about over or slightly behind the anal–fin midbase. Anal fin enlarged and more or less elongated, larger than pelvic and dorsal fins, base length at least twice second dorsal–fin base; origin of anal fin just behind pelvic–fin bases, and insertion separated from lower caudal–fin origin by a narrow notch. Caudal fin more or less elongated, over a fifth, and often over a fourth of total length. A crest of enlarged denticles absent or variably developed on the dorsal caudal–fin margin. Supraorbital crests absent from cranium. Vertebral centra with or without strong,

wedge–shaped intermedial calcifications. Vertebral counts: total vertebral counts 104 to 122, monospondylous vertebral counts 28 to 47, diplospondylous precaudal vertebral counts 24 to 44. Valvular intestine with a spiral valve of 6 to 22 turns. **Colour:** uniformly jet black, brownish–black, brown, pinkish or whitish; no distinctive colour patterns.

Local Names: No information.

Remarks: This is one of the largest and perhaps least known shark genera, having some 37 valid species, with several additional species of uncertain validity or still remaining to be described. Springer (1966, 1979) and Nakaya and Sato (1999) revised the genus while Nakaya (1975, 1988a, b, 1989, 1991) and others have revised and described new species, most recently from the western South Pacific (Nakaya, Sato, and Iglésias, 2008; Kawauchi *et al.* 2008; Sasahara, Sato, and Nakaya, 2008; White, Last, and Pogonoski, 2008; Sato, Nakaya, and Yorozu, 2008; Iglésias, 2012; Sato, Steward and Nakaya, 2013). Despite these efforts, several species are still of uncertain validity, with over a third of the species known from the holotypes only, at least four species having the holotypes lost, and less than a third of the species known from a modest to good series of specimens. Judging from the frequency that new species are discovered, the wide geographic range of the genus, and the paucity of knowledge of slope faunas in many areas of the world, the number of new species is likely to increase. At least 3 species occur within the southeastern Pacific Ocean deep–sea.

Key to Deep–sea Southeastern Pacific Ocean Species:

1a. Body slender. Upper labial furrows longer than lowers (Fig. 127). Supraorbital sensory canal discontinuous. Spiral valve turn counts 13 to 22. Egg cases with long, coiled tendrils . . . . . **2** (***Apristurus brunneus*–group**)

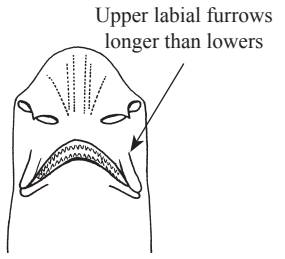


Fig. 127 *Apristurus brunneus*

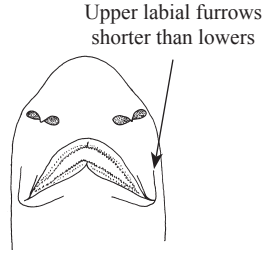


Fig. 128 *Apristurus kampae*

1b. Body stout. Upper labial furrows subequal to or shorter than lowers (Fig. 128). Supraorbital sensory canal continuous. Spiral valve turn counts 7 to 12. Egg cases without tendrils. . . . . ***Apristurus kampae***

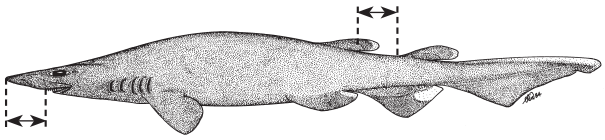


Fig. 129 *Apristurus brunneus*

2a. Interdorsal space about equal to preoral snout length (Fig. 129) . . . . . ***Apristurus brunneus***

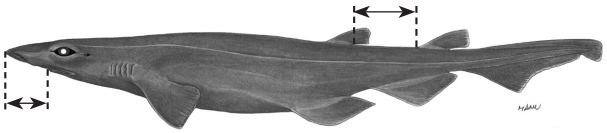


Fig. 130 *Apristurus nasutus*

2b. Interdorsal space greater than preoral snout length (Fig. 130) . . . . . ***Apristurus nasutus***

Apristurus brunneus (Gilbert, 1892)

Catulus brunneus Gilbert, 1892, *Proc. U.S. Natn. Mus.*, 14(880): 542. Holotype, U.S. National Museum of Natural History, USNM 51708, 500 mm total length adult (gravid) female, Albatross Sta. 2936, 32°49'00"N, 117°27'30"W, South of San Clemente Island and near La Jolla, California, 706 m.

Synonyms: None.

Other Combinations: None.

FAO Names: En – Brown catshark; **Fr** – Holbiche brune; **Sp** – Pejegato marrón.

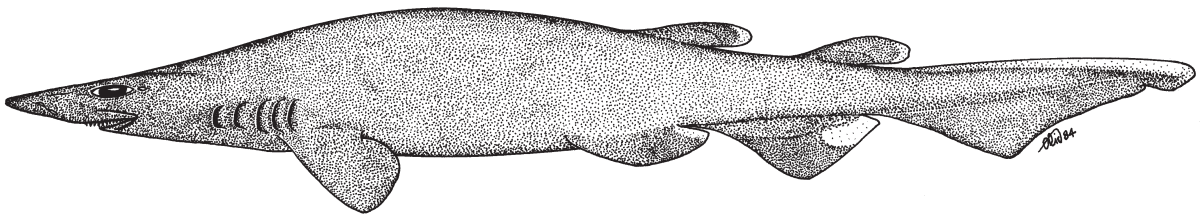


Fig. 131 *Apristurus brunneus*

Field Marks: A slender bodied, uniformly brown ***Apristurus*** with a broadly rounded snout, upper labial furrows longer than lowers, and interdorsal space equal to preoral snout length.

Diagnostic Features: Body relatively slender, trunk slightly tapering towards head. Snout moderately long, rather broad, and bell-shaped, preoral snout about 7% of total length. Gill slits moderately large, longest about equal to eye length; gill septa more or less incised, not pleated and without projecting medial lobes. Eyes rather small in adults, about 2.5% of total length. Nostrils broad, width about equal to internarial space; incurrent and excurrent apertures moderately large and transversely oval, anterior nasal flaps fairly long. Mouth moderately long, not greatly enlarged, and broadly arched, with dental bands slightly expanded and with lower ones falling just behind uppers; mouth and labial furrows under eyes, upper labial furrows longer than lowers. Labial folds not enlarged, with lowers diagonal to body axis. Mouth and teeth not greatly enlarged in males. Tooth counts 58 to 74 upper jaw, and 48 to 69 lower jaw. Lateral trunk denticles with crowns somewhat elevated, body surface with a felt-like or fuzzy texture. Pectoral fins rather small, anterior margins about 12% of total length; inner margins long, nearly the length of pectoral–fin bases. Interspace between pectoral and pelvic–fin bases moderately long, about equal to prebranchial length and about 16% of total length in adults. Pelvic fins fairly high and broadly rounded. Interdorsal space equal or slightly greater than first dorsal–fin base, slightly less than preorbital snout length, and about equal to preoral snout length. First dorsal fin about as large as second, bases about equally long. Origin of first dorsal fin slightly anterior to pelvic–fin midbases. Second dorsal–fin insertion in front of anal–fin insertion. Anal fin fairly short, high, and angular, slightly more than 2.5 times as long as high, base slightly greater than prespiracular space and 13% of total length in adults. Caudal fin rather broad, without a crest of enlarged denticles on dorsal margin. Vertebral counts: total vertebral counts 116 to 122. Spiral valve counts 14 to 19. Adults moderately large, to 69 cm total length. **Colour:** uniform brown, with fin edges being slightly lighter to translucent in life, but becoming slightly darker after death; occasionally fin edges appear lighter due to fungus.

Distribution: Southeastern Pacific Ocean: Chile, Peru, and Ecuador. It is also found off Panama, Mexico, and north to British Columbia, Canada.

Habitat: A relatively common shark where it occurs, this little-known deepwater catshark occurs from the outer continental shelf and upper slope from 33 to 1298 m, and also well off the bottom.

Biology: Oviparous, laying a single egg per oviduct at a time; egg cases about 5 cm long and 2.5 cm wide, with long tendrils. Incubation period of eggs may be 2 years or more. In Canadian waters females carry egg cases from February to August, but along the coasts of Washington, Oregon, and California females were found to carry egg cases year-round. However, gonadosomatic indices for this species indicate that mating likely takes place between April and June. Nursery grounds for this species have been identified from Monterey Bay, central California, USA, and elsewhere along the California and Oregon coasts.

Apristurus brunneus appears to use very site-specific areas to deposit its egg cases; these areas are also used by the co-occurring filetail catshark, ***Parmaturus xaniurus***, which also deposits its egg cases in the same egg case "clumps" as ***A. brunneus***. These habitat specific nursery areas occur along the shelf-slope break and upper continental slope and are characterized by high vertical relief, with increased water currents that appear to be important characteristics of these egg case aggregations sites. Water circulation may be important for providing adequate oxygenation for embryogenesis when egg cases are clumped together in these large aggregations.

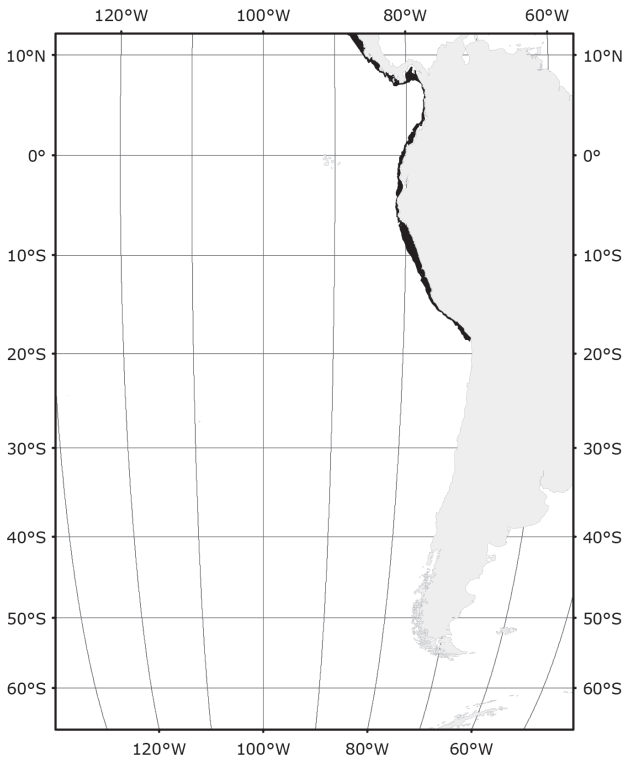


Fig. 132 ***Apristurus brunneus***

Known distribution

Diet includes pelagic crustaceans, squids, and small teleosts. These sharks appear to spend considerable time in the midwater as evidenced by their prey items and video images taken by submersibles.

Nothing is known about its biology in the southeastern Pacific, but it has been studied in the northeastern Pacific, especially off California (USA).

Size: Maximum total length 69 cm; males mature at 49 to 54 cm; females mature at 48.5 to 58 cm. Size at maturity varies slightly throughout its range with those from southern California (32° to 38° N) maturing at a slightly smaller total length than those from more northern ends (38° to 46° N) of its range. Size of young at hatching about 7 to 9 cm.

Interest to Fisheries and Human Impact: Interest to fisheries none. Commonly taken as bycatch in deeper bottom trawl hauls by commercial trawlers, but not utilized.

Conservation status is Data Deficient.

Local Names: Pejegato café (Chile).

Remarks: The species is relatively well known in the eastern North Pacific, but very poorly known south of Mexican waters. Records of the species from Central and South America are spotty, and should be carefully examined. Comparison of ***Apristurus brunneus*** specimens from throughout the eastern Pacific shows that this species although highly variable morphologically is meristically very similar. It may require the use of new molecular tools to determine whether more than a single ***brunneus***-like catshark occurs in the eastern Pacific.

Literature: Kato *et al.* (1967); Springer (1979); Compagno (1984, 1988); Cross (1988); Ebert (2003); Flammang *et al.* (2007, 2008, 2011); Bustamante, Vargas-Caro, and Bennett (2014); Cornejo *et al.* (2015); D.A. Ebert and B.E. Flammang (unpubl. data).

Apristurus kampae Taylor, 1972

Apristurus kampae Taylor, 1972, *Copeia*, 1972(1): 71, 73, fig. 1, 3a, 4-5. Holotype: Scripps Institution of Oceanography, SIO-70-248, 335 mm total length immature female, 27°22.4-10.1'N, 111°10.1-29.6'W, central Gulf of California, Mexico, 1830-1888 m.

Synonyms: None.

Other Combinations: None.

FAO Names: En – Longnose catshark; **Fr** – Holbiche tapir; **Sp** – Pejegato trompudo.

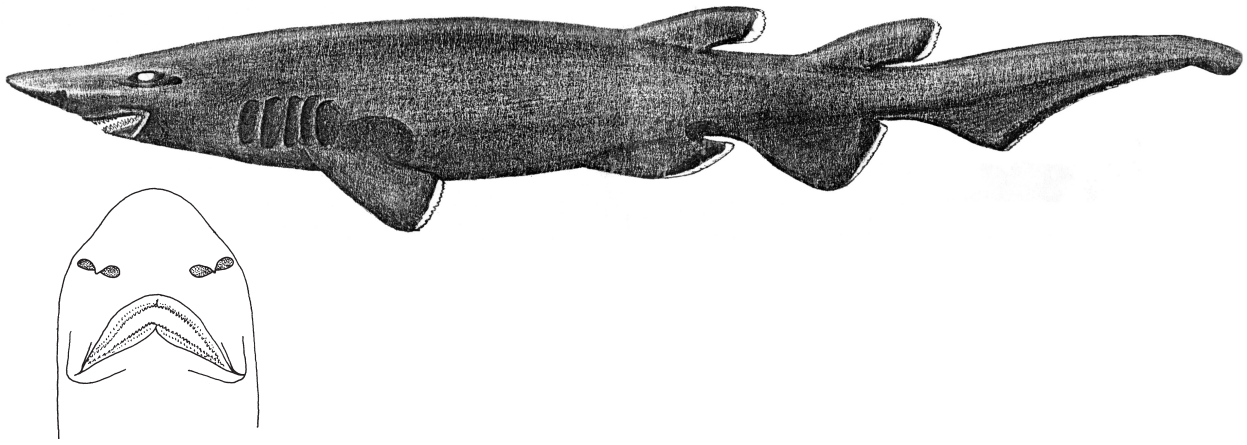


Fig. 133 ***Apristurus kampae***

Field Marks: An ***Apristurus*** with a broad internarial space, upper labial furrows subequal or shorter than lowers, very large gill slits, a very high rounded anal fin, and conspicuous white margins on the fins.

Diagnostic Features: Body moderately slender to rather stout, trunk strongly tapering towards head. Snout moderately long, broad, and bell-shaped, preoral snout about 8% of total length. Gill slits very large, somewhat greater than eye length; gill septa without projecting medial lobes. Eyes rather small in adults, about 3% of total length. Nostrils narrow, width about 1.5 to 1.8 in internarial space; incurrent and excurrent apertures enlarged and oval, anterior nasal flaps elongated and triangular. Mouth long, large, and broadly arched, with dental bands prominently expanded and with lower ones falling well behind uppers; mouth and labial furrows extending well in front of eyes, upper labial furrows subequal or shorter than lowers. Labial folds somewhat enlarged, with lower nearly transverse to body axis. Mouth and teeth enlarged in males. Total tooth counts upper jaw 49 to 59, lower jaw 42 to 52. Lateral trunk denticles of body with crowns fairly flat and close-set, surface fairly smooth and not with a felt-like or fuzzy texture. Pectoral fins rather small, anterior margins about 10 to 12% of total length; inner margins long, nearly the length of pectoral–fin bases. Interspace between pectoral and pelvic–fin bases moderately long, slightly less than prebranchial length and about 16% of total length in adults. Pelvic fins high and broadly rounded. Interdorsal space equal or slightly greater than first dorsal–fin base, slightly less than preorbital snout. First dorsal fin about as large as second, bases about equally long. Origin of first dorsal fin slightly anterior to pelvic–fin midbases. Second dorsal–fin insertion behind anal–fin insertion. Anal fin short, high, and rounded, slightly more than twice as long as high, base about equal to prespiracular space and 12% of total length in adults. Caudal fin rather broad, without a crest of enlarged denticles on dorsal margin. Vertebral counts: total vertebral counts 104 to 111. Spiral valve counts 9 to 12. Adults moderately large, to 65 cm total length. **Colour:** uniformly blackish, with conspicuous white posterior margins on precaudal fins.

Distribution: Southeastern Pacific Ocean: scattered records from off Peru. It is also found from off Cape Blanco, Oregon to southern California, USA, the Gulf of California, Mexico and Central America. Most records of this species are from off California, with records south of this area being scattered.

Habitat: A little-known deepwater bottom shark of the eastern Pacific upper continental slope from 180 to 1888 m, with it being most common below 1000 m depth. This species generally occurs deeper than the sympatric ***Apristurus brunneus***.

Biology: Reproductive cycle appears to be year round with gravid females being found to occur in most months. Most adults and gravid females along the California coast are concentrated between 1000 and 1200 m deep. Egg cases for this species have been described and fit the morphological characteristics of other ***Apristurus spongiceps***-group ***Apristurus***.

Diet includes deepwater shrimps, cephalopods, and small mesopelagic bony fishes.

Size: Maximum total length to 65 cm; males adult at 48.6 cm with a maximum length of 64.7 cm; females adult at 49 cm with a maximum length of 59 cm. Birth size about 7 to 14 cm.

Interest to Fisheries and Human Impact: Interest to fisheries none. Incidentally taken in deep trawls and traps, but usually discarded. It has been observed in situ from remote operated vehicles from off central California.

Conservation status is Data Deficient.

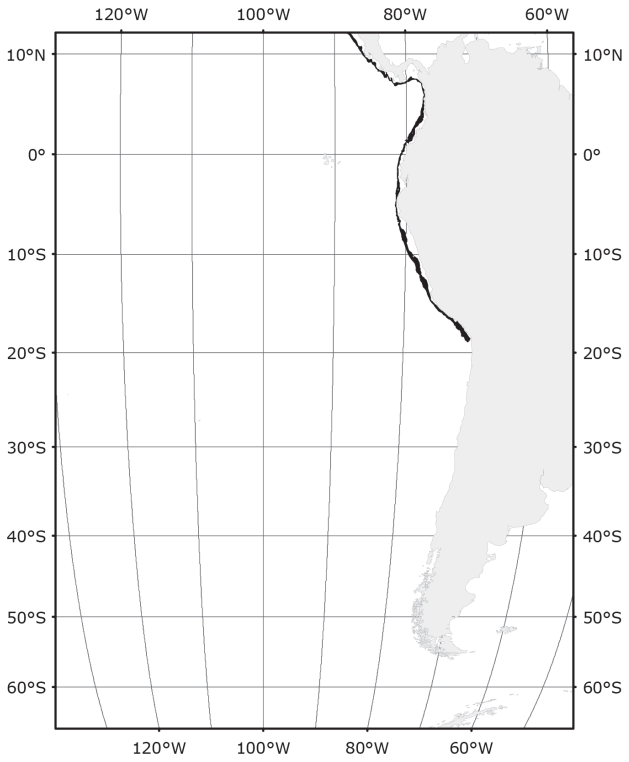


Fig. 134 ***Apristurus kampae***

Local Names: No information.

Remarks: Taylor (1972) recorded a second specimen of this species from the Galápagos Islands (Ecuador), but this appears to be another species of uncertain identity, possibly ***Apristurus stenseni*** (Springer, 1979; D.A. Ebert, pers. obs. of Galápagos specimen SIO 70-299, 201 mm immature male). However, recent surveys off Central America (Costa Rica and Panama) and Peru have confirmed this species as occurring in this region.

Literature: Taylor (1972); Springer (1979); Ebert (2003); Flammang *et al.* (2007, 2008, 2011); Cornejo *et al.* (2015); D.A. Ebert and B.E. Flammang (unpubl. data).

Apristurus nasutus de Buen, 1959

Apristurus nasutus de Buen, 1959, *Bol. Mus. Nac. Hist. Nat. Santiago Chile*, 27(3): 176. Holotype: Estacion de Biologia Marina de Montemar, Universidad de Chile, EBMCh 10.184, apparently lost, 594 mm total length adult male, near Valparaiso, Chile, 400 m.

Synonyms: None.

Other Combinations: None.

FAO Names: En – Largenose catshark; **Fr** – Holbiche cyrano; **Sp** – Pejegato hocicón.

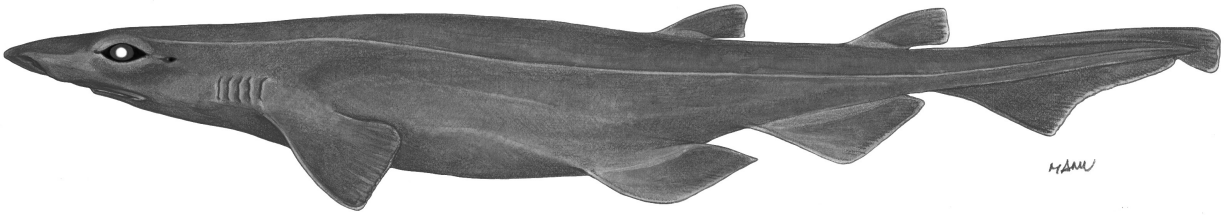
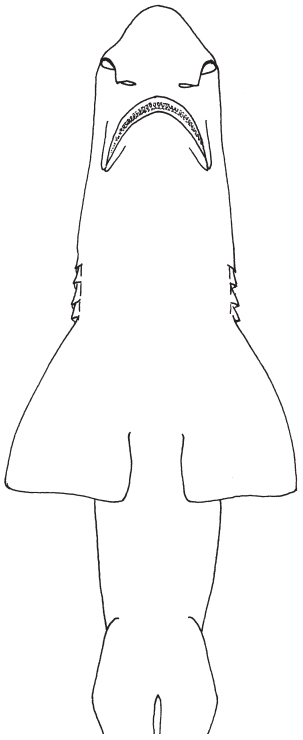


Fig. 135 ***Apristurus nasutus***

Field Marks: A slender bodied ***Apristurus***, with a broad and flattened head, elongated snout, mouth extending to just anterior of eyes, labial furrows long, uppers longer than lowers, first dorsal fin slightly smaller than second, its origin over pelvic–fin midbases, interdorsal space greater than preoral snout length, anal fin elongated, and angular, insertion separated from caudal–fin origin by a notch, and caudal fin elongated. Colour uniform brown to grey or greyish black, with pale posterior fin margins.



VENTRAL VIEW OF BODY

Diagnostic Features: Body moderately slender, trunk slightly tapering towards head. Snout moderately long, broad, and bell-shaped, preoral snout about 7 to 8% of total length. Gill slits of moderate size, much less than eye length; gill septa without projecting medial lobes or pleats but with incised margins. Eyes small in adults, between 3 to 4% of total length. Nostrils narrow, width about equal to internarial space; incurrent and excurrent apertures moderately large and oval, anterior nasal flaps long and angular. Mouth long, moderately large, and broadly arched, with dental bands not expanded and with lower ones falling just behind uppers; mouth and labial furrows extending slightly in front of eyes, upper labial furrows subequal or shorter than lowers. Labial folds not enlarged, with lowers diagonal to body axis. Mouth and teeth not enlarged in males. Lateral trunk denticles of body with crowns fairly flat, skin surface smooth and without a felt-like or fuzzy texture. Pectoral fins moderately large, anterior margins about 12 to 14% of total length; inner margins long, about 3/5 of pectoral–fin bases. Interspace between pectoral and pelvic–fin bases fairly short, about 2/3 of prebranchial length and about 14% of total length in adults. Pelvic fins low and angular. Interdorsal space about 1.5 times first dorsal–fin base, slightly greater than preorbital snout and considerably greater than preoral snout. First dorsal fin about as large as second, bases about equally long. Origin of first dorsal fin about opposite to pelvic–fin midbases. Second dorsal–fin insertion about opposite to anal–fin insertion. Anal fin moderately long, high, and angular, slightly more or less than three times as long as high, base slightly greater than prespiracular space and 12 to 15% of total length in adults. No dorsal crest of enlarged caudal denticles. Vertebral counts: monospondylous vertebral counts 35 to 39, diplospondylous vertebral counts 26 to 29. Spiral valve counts 15 to 18. Adults moderately large, to 56 cm. **Colour:** medium brown, grey or grey-blackish, without conspicuous markings on fins.

Distribution: Southeastern Pacific Ocean: Gulf of Panama, Ecuador, Peru, and central Chile.

Habitat: A little-known bottom shark of the upper continental slopes on or near the bottom at 400 to 925 m depth in the eastern Pacific.

Biology: Nothing known.

Size: Maximum total length 59 cm; adults males from 51 to 59 cm, females not reported.

Interest to Fisheries and Human Impact: Interest to fisheries none, likely taken as bycatch in deepwater fisheries.

Conservation status Data Deficient.

Local names: Pejegato hocicón (Chile); Tiburón negro narigón (Peru).

Remarks: It is uncertain at present if this species occurs in the eastern North Pacific or not, where it may have been confused with ***Apristurus brunneus***.

Literature: Springer (1979); Nakaya (2009); Bustamante, Vargas-Caro, and Bennett (2014); Cornejo *et al.* (2015).

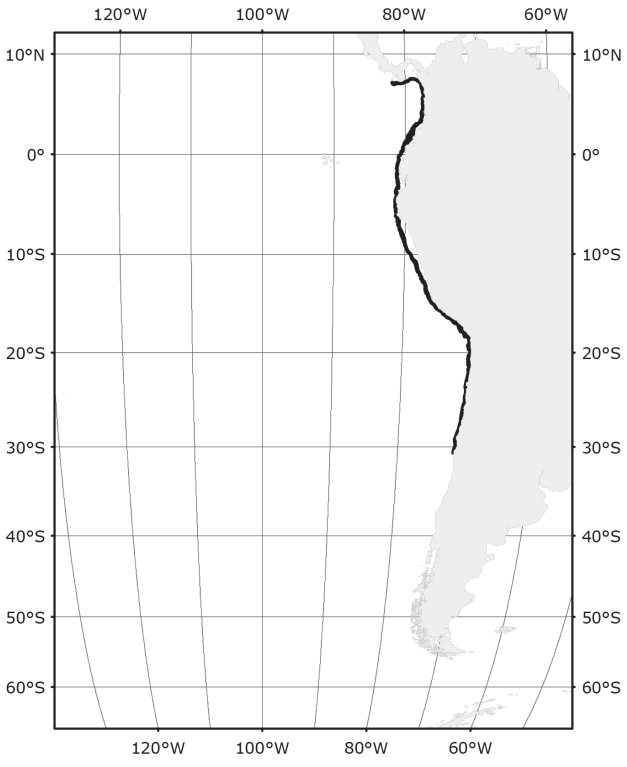


Fig. 136 ***Apristurus nasutus***

Known distribution

Bythaelurus Compagno, 1988

Genus: Subgenus ***Bythaelurus*** Compagno, 1988 (Genus ***Halaelurus*** Gill, 1862), Sharks Order Carcharhiniformes: 146.

Type species: ***Scyllium canescens*** Günther, 1878, by original designation.

Number of Recognized Deep–sea Southeastern Pacific Ocean Species: 2.

Synonyms: None.

Field Marks: Scyliorhinids with very short and rounded snouts, no nasoral grooves, anterior nasal flaps small and not reaching mouth, upper and lower labial furrows short, sometimes absent, gills on sides of head, inner margins of pelvic fins not connected, second dorsal fin not greatly smaller than first, caudal fin short, without enlarged denticles on dorsal–fin margin, and no supraorbital crests on cranium. Colour pattern poorly developed or absent.

Diagnostic Features: Body not tadpole–shaped, slender to moderately stout and cylindrical or fusiform, tapering slightly or moderately to caudal fin; body soft, with dermal denticles well–calcified or weakly so and erect, giving the body a velvety texture; stomach not inflatable. Tail fairly short, length from vent to lower caudal–fin origin about 0.5 to 0.6 of snout–vent length. Head moderately depressed, narrowly rounded in lateral view; head short to moderately long, between 1/4 and 1/5 to less than 1/5 of total length in adults. Snout short to moderately long, less than 4/5 of mouth width, thick, and slightly flattened, bluntly pointed in lateral view; snout not expanded laterally, rounded, parabolic, or somewhat bell–shaped in dorsoventral view but without a knob–like tip. Ampullae pores not greatly enlarged on snout. Nostrils of moderate size, with incurrent and excurrent apertures only partly open to exterior; anterior nasal flaps broadly triangular, narrow and elongated, or reduced and pointed, without barbels, well separate from each other and falling slightly to considerably anterior to mouth; internarial space about 0.6 to 1.1 times nostril width; no nasoral grooves. Eyes dorsolateral on head but not elevated, broad sub–ocular ridges present below eyes. Mouth angular, semiangular, or rounded, short to moderately long, with lower symphysis well behind upper so that upper teeth are exposed in ventral view. Labial furrows present along both upper and lower jaws, these short to moderately long, ending well behind level of upper symphysis of mouth. Branchial region not greatly enlarged, distance from spiracles to fifth gill slits 1/3 to slightly less than 3/5 of head length; gill slits lateral on head. Pectoral fins moderately large, their width subequal or somewhat greater than mouth width. Inner margins of pelvic fins not fused over claspers in adult males. Claspers moderately long, fairly slender to moderately stout, and distally pointed, extending about half of their lengths behind the pelvic–fin tips. Two dorsal fins present, about equal–sized or with second slightly smaller or larger than first. Origin of first dorsal fin varying from slightly in front of the pelvic–fin midbases to slightly in front of their insertions. Origin of second dorsal fin about opposite or in front of the anal–fin midbase. Anal fin moderately large but not greatly elongated, about as large as pelvic fins or slightly smaller or larger, subequal to larger than the dorsal fins; base length subequal to about 1.5 times second dorsal–fin base; origin of anal fin well behind pelvic–fin bases, and insertion separated from lower caudal–fin origin by a narrow notch or a moderately broad space slightly less than the anal–fin base. Caudal fin short and broad to narrow and moderately elongated, between 1/4 and 1/5 of total length in adults. No crests of denticles on the caudal–fin margins. Supraorbital crests absent from cranium. Vertebral counts: monospondylous vertebral counts 35 to 45, diplospondylous vertebral counts 47 to 54, total vertebral counts 120 to 142. **Colour:** light grey or brown to blackish, either plain or with light spots on body and sometimes dark bars on tail but without a prominent pattern of dark spots, saddles and vertical bars.

Local Names: No information.

Key to Deep–sea Southeastern Pacific Ocean Species:

1a. Coloration dark chocolate brown, without markings except for white fin tips in young (Fig. 137) . . . . . ***Bythaelurus canescens***

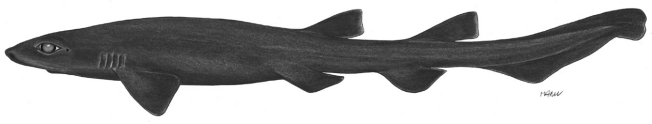


Fig. 137 ***Bythaelurus canescens***

1b. Coloration variegated, with irregularly distributed spots and blotches; markings not symmetrical (Fig. 138). . . . . ***Bythaelurus giddingsi***

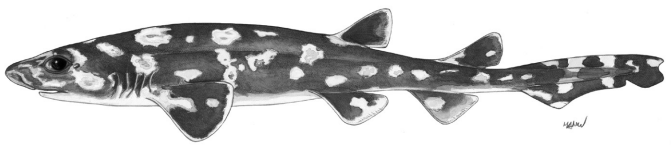


Fig. 138 ***Bythaelurus giddingsi***

Bythaelurus canescens (Günther, 1878)

Scyllium canescens Günther, 1878, *Ann. Mag. Nat. Hist.*, (5), 2(7): 18. Holotype: British Museum (Natural History), female ca. 275 mm, southwest coast of south America, Challenger Sta. 310, Southwestern coast of South America, 51°27.5'S, 74°03'W, bottom temperature, 46.5°F, at 732 m.

Synonyms: None.

Other Combinations: ***Halaelurus canescens*** (Günther, 1878).

FAO Names: En – Dusky catshark; **Fr** – Holbiche sombre; **Sp** – Pejegato oscuro.

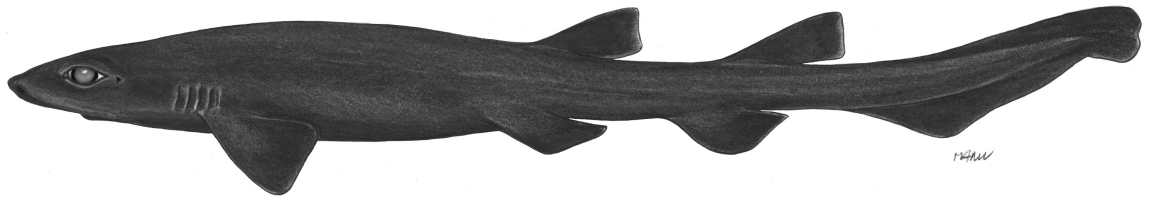
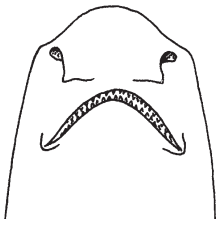


Fig. 139 ***Bythaelurus canescens***

Field Marks: ***Bythaelurus*** with a long abdomen, short anal–fin base about 1.3 times second dorsal–fin base, usually plain dark brown coloration, and moderately large size.



UNDERSIDE OF HEAD

Diagnostic Features: Eyes in adults 9 to 12 times in distance from snout to first dorsal–fin origin. Anterior nasal flaps subtriangular. Oral papillae present in pharynx. Abdomen moderately elongated in adults, distance between pectoral and pelvic–fin bases 1.2 to 1.5 times pectoral–fin anterior margin. First dorsal–fin origin over first third of pelvic–fin bases. Second dorsal fin slightly larger than first, origin anterior to anal–fin midbase. Length of anal–fin base about 1.3 times second dorsal–fin base, slightly shorter than distance between dorsal–fin bases. Vertebral counts: total vertebral counts 120 to 132, monospondylous vertebral counts 39 to 43. Adults moderately large, to 70 cm total length. **Colour:** dark chocolate brown, without markings except for white fin tips in young.

Distribution: Southeastern Pacific Ocean: Peru, Chile, Straits of Magellan.

Habitat: A common, temperate deepwater catshark of the upper continental slopes, primarily found on mud bottom, but also rock bottom at 200 to 700 m depth.

Biology: Oviparous, deposits a single egg per oviduct at a time. Egg cases are vase-shaped, dorsoventrally flattened, with 12 to 15 longitudinal striations, long coiled tendrils arise from the anterior and posterior horns, and are pale yellow in colour. They are affixed to the substrate when deposited. Feeds on small fishes, bottom invertebrates, especially deep-sea shrimps, cephalopods, siphonophores and other benthic invertebrates.

Size: Maximum total length to 70 cm, possibly to 124 cm; adult males 52 to 55 cm; adult females 59 to 66 cm. Size at birth unknown.

Interest to Fisheries and Human Impact: Interest to fisheries none at present, abundant in deepwater trawl hauls.

Conservation status of this little known catshark is Data Deficient.

Local names: Gata café (Chile); Peje gato (Peru).

Remarks: None.

Literature: Kato, Springer and Wagner (1967); Springer (1979); Acuña and Villarroel (2010); Concha *et al.* (2010); Ebert, Fowler, and Compagno (2013); Bustamante, Vargas-Caro, and Bennett (2014); Lopez *et al.* (2013); Cornejo *et al.* (2015); Ebert and Clerkin (2015).

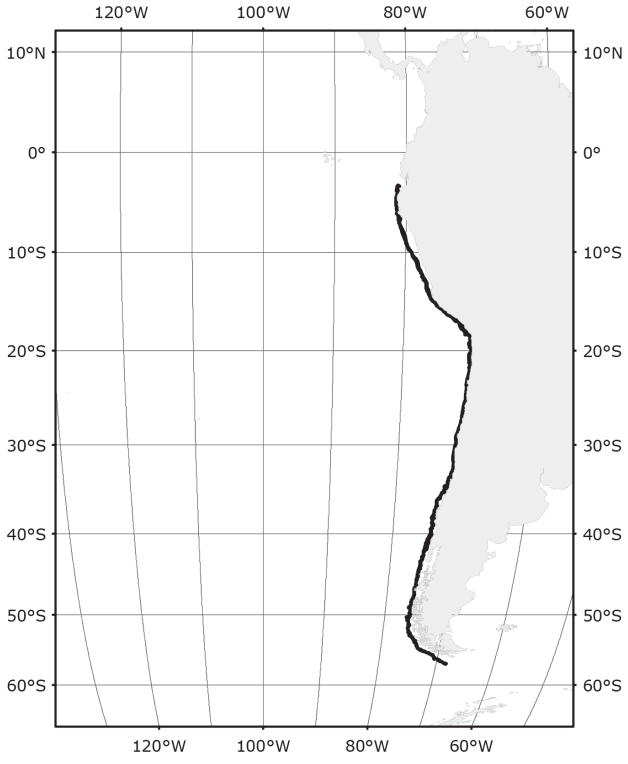


Fig. 140 ***Bythaelurus canescens***

Known distribution

Bythaelurus giddingsi McCosker, Long, and Baldwin, 2012

Bythaelurus giddingsi McCosker, Long, and Baldwin, 2012, *Zootaxa*, 3221: 48, figs. 1–4, Pls. 1–2, tabs. 1–2. Holotype: CAS 210091, 402 mm total length, female, Darwin Island, Galápagos Islands (Ecuador), 01° 42.0' N, 92° 00.0' W, (station number JSL 3103, field number JM 145), 428 m depth, collected by J.E. McCosker on 18 July 1998.

Synonyms: ***Bythaelurus* sp.** McCosker and Rosenblatt, 2010: The fishes of the Galápagos Archipelago: an update. *Proc. Cal. Acad. Sci.*, Series 4, 61, Supplement II, 167-195: 172, 187. Ruiz *et al.*, 2011: CDF checklist of Galápagos fish – FCD lista de especies de peces de Galápagos. *In*: Charles Darwin Foundation/Fundacion Charles Darwin, Puerto Ayora, Galápagos, Ecuador: 12. ***Bythaelurus* sp. B** Compagno *et al.*, 2005: *Sharks of the World*. Princeton University Press: 215, Pl. 35. Kyne and Simpfendorfer, 2007: A collation and summarization of data on deepwater Chondrichthyans: biodiversity, life history, and fisheries. A report prepared by the IUCN SSC Shark Specialist Group for the Marine Conservation Biology Institute, Gland, Sqitzerland, 137 pp.; 53. Hearn *et al.*, 2009: *In:* Cetaceans and other marine biodiversity of the eastern tropical Pacific: options for adapting to climate change. International Whaling Commission Full Document 61-18, Agenda Item 11.1.2, 50-54: 53.

Other Combinations: None.

FAO Name: En – Jaguar catshark.

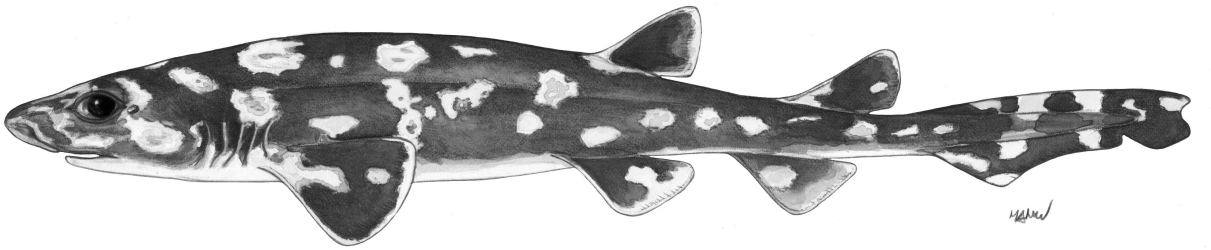


Fig. 141 ***Bythaelurus giddingsi***

Field Marks: ***Bythaelurus*** with a short, bluntly rounded snout, angular anterior nasal flaps, moderately short abdomen, large broadly rounded pectoral fins, and a relatively short tail. Colour chocolate brown with white spots and blotches above, lighter coloured below.

Diagnostic Features: Body slender, tapering, compressed posteriorly; trunk slightly shorter than caudal–fin length. Eyes with anterior and posterior eye notches; length 4.0 to 5.5 times into head length. Anterior nasal flaps broadly angular, with rounded tips. Mouth broadly angular, length 2.0 to 3.2 times into mouth width. Oral papillae present in pharynx. Tooth count for upper jaw 20 to 23, lower jaw 23 to 26. Abdomen moderately short, distance between pectoral and pelvic–fin bases 1.1 to 1.4 times pectoral–fin anterior margin. First dorsal fin high, narrowing at apex, not falcate; origin over middle of pelvic–fin bases; insertion above pelvic–fin insertions. Anal fin low, broadly rounded, similar in size to second dorsal fin; length of anal–fin base about 0.7 to 1.1 times second dorsal–fin base. Vertebral counts: monospondylous vertebral counts 39 to 42, diplospondylous vertebral counts 40 to 43, precaudal vertebral counts 81 to 85, caudal vertebral counts ~40 to ~51. A moderate sized catshark, to 46 cm. **Colour:** a rather strikingly variegated coloured catshark with a pattern of large white spots and blotches on a chocolate brown background above; lighter coloured below.

Distribution: Southeastern Pacific Ocean: known only from the Galápagos Islands (Ecuador).

Habitat: A little-known deepwater catshark, found on or near the bottom over flat or sloping sand and mud bottoms near lava boulders, from 428 to 562 m.

Biology: Nothing known.

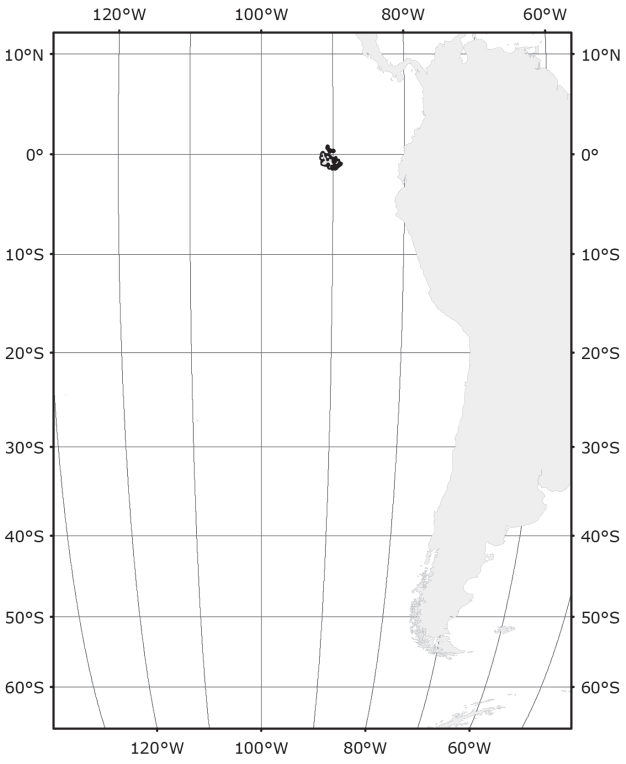


Fig. 142 ***Bythaelurus giddingsi***

Known distribution

Size: Maximum length at least 45.3 cm for an immature male and 40.2 cm for an immature female. Size at birth unknown.

Interest to Fisheries and Human Impact: Interest to fisheries none.

The conservation status of this recently described catshark has not been assessed.

Local Names: No information.

Remarks: None.

Literature: McCosker *et al.* (2012); Ebert and Clerkin (2015).

3. Subclass NEOSELACHII – Cohort BATOIDEA

3.1 Order TORPEDINIFORMES – Electric rays

Order: Order Hypotremi, Suborder Sarcura, (group) suborder Torpedinoidea: Gill, 1893, *Natn. Acad. Sci. (U. S.) Mem*. 6, 6: 130 (group ranked as infraorder or superfamily, exclusively for torpedinoids).

Number of Recognized Deep–sea Southeastern Pacific Ocean Families: 1.

Synonyms: Order Plagiostoma, Suborder Platosomia, "Group" Narcoidei: Garman, 1913 (in part), *Mem. Mus. Comp. Zool. Harvard,* 36: 257, 259 (group corresponding to infraorder or superfamily, and exclusively for the torpedinoids). Order Raiae, Suborder Pachyura: Gill, 1872 (in part), *Smithsonian Misc. Colln*. (247): 22, 23 (order for all batoids, suborder for all 'thick–tailed' batoids). Order Plagiostomi diplospondyli, Suborder Plagiostomi Tectospondyli, Group 2 Rajae Hasse, 1879 (in part), *Nat. Syst. Elasmobr*. (1): 48 (suborder for batoids, squatinids and pristiophorids, group equivalent to infraorder or superfamily and for rajoids and torpedinoids). Order Euselachii, Suborder Hypotremata, Division Narcobatoidei Regan, 1906a, *Proc. Zool. Soc. London* (1906): 723 (division ranking as infraorder or superfamily and exclusive to torpedinoids). Order Narcobatea, Suborder Narcaciontes, Superfamily Narcobatoidea: Whitley, 1940, *Fishes Australia. Part I. Aust. Zool. Handbook*: 69 (exclusive for torpedinoids). Order Batoidei, Suborder Sarcura: Jordan and Evermann, 1896 (in part), *Bull. US Nat. Mus*. 47(1): 59, 60 (common group for pristids, rhinobatoids, rajoids, and torpedinoids). Order Batoidei, Suborder Narcaciontes: Jordan, 1923, *Stanford Univ. Publ., Univ. Ser., Biol. Sci*., 3: 103 (exclusive for torpedinoids). Order Rajae, [group] Torpedinoidei Fowler, 1941, *Bull. U.S. Natn. Mus*. (100) 13: 290 (exclusive group equivalent to suborder or superfamily for torpedinoids). Order Rajae Smith, 1949, *Sea fishes Southern Africa*: 37, 62 (common group without subdivisions for all batoids). Order Selachii, Group 2, Division B, Subdivision 2, Suborder Rajiformes, Tribe 2, Group Torpedinoidei: Goodrich, 1909, *In* R. Lankester, *ed*., *A treatise on Zoology* (9), Vertebrata Craniata: 161 (tribe equivalent to infraorder, and group equivalent to superfamily and exclusive for torpedinoids). Order Narcobatea, Suborder Narcobatida, Superfamily Narcobatoidea: White, 1936 (in part), *Amer. Mus. Novit*. (837): 5; White, 1937 (in part), *Bull. Amer. Mus. Nat. Hist*. 74: 37, tab. 1 (taxa exclusive to torpedinoids). Order Hypotremata, Suborder Narcobatoidei: Engelhardt, 1913, *Abh. math.–phys. Klasse K. Bayer. Akad. Wiss., Suppl., Beitr. Naturg. Ostasiens*, 4: 101 (suborder exclusive to torpedinoids, order includes all living batoids). Order Torpediniformes: Berg, 1940, *Trudy Zool. Inst. Akad. Nauk SSSR*, 5(2): 139 (exclusive for torpedinoids); Berg and Svetovidov, 1955, *Trudy Zool. Inst. Akad. Nauk SSSR*, 20: 74; Arambourg and Bertin, 1958, *In* P.–P. Grasse, *ed*, *Traité de Zoologie*, 13: 2055 (exclusively for torpedinoids); Patterson, 1967, *in* W. B. Harland *et al*., *Geol. Soc. London, Spec. Pub*. 2: 673 (exclusively for torpedinoids); Lindberg, 1971, *Fishes of the world* (trans. 1974): 8, 263 (exclusively for torpedinoids); Rass and Lindberg, 1971, *J. Ichthyol*. (trans. *Voprosy Ikhtiologii*) 11(3): 305 (exclusively for torpedinoids); Compagno, 1973, *J. Linn. Soc. (Zool.)*, 53, suppl. 1: 27 (exclusively for torpedinoids); Applegate, 1974, *J. Mar. Biol. Ass. India*, 14(2): 743 (exclusively for torpedinoids); Chu and Meng, 1979, *Monogr. Fish. China, Sci. Tech. Press, Shanghai*: 114, tab. 2 (exclusively for torpedinoids); Eschmeyer, 1990, *Cat. gen. Recent fish*.: 437 (exclusively for torpedinoids); McEachran, Dunn and Miyake, 1996, *in* Stiassny, Parenti and Johnson, *Interrelationships fishes*: 80 (exclusively for torpedinoids); Eschmeyer, 1998, *Cat. Fish*. (exclusively for torpedinoids). Order Torpediniformes, Suborder Torpedinoidea: Chu and Meng, 1979, *Monogr. Fish. China, Sci. Tech. Press, Shanghai*: 114, tab. 2 (suborder exclusively for torpedinoids, including Families Torpedinidae and Narkidae). Order Torpediniformes, Superfamily Torpedinoidea: Compagno, 1973, *J. Linn. Soc*. (*Zool*.), 53, suppl. 1: 27 (superfamily for hypnids and torpedinids). Order Torpediniformes, Superfamily Narcinoidea: Compagno, 1973, *J. Linn. Soc*. (*Zool*.), 53, suppl. 1: 27 (superfamily for narcinids and narkids). Order Plagiostomi, Suborder Rajiformes or Rayiformes: Lozano y Rey, 1928 (in part), *Fauna Iberica. Peces*. Vol. 1: 281 (suborder for all batoids). Order Rajiformes: Nelson, 1976 (in part), *Fishes of the world*: 40 (order for all batoids; Nelson, ibid.: 41, suggests that torpedinoids could be recognized as a suborder Torpedinoidei following Compagno, 1973, but didn't utilize this taxon in his text or index). Order Rajiformes, Suborder Torpedinoidei: Nelson, 1984, *Fishes of the world*, ed. 2: 60 (suborder exclusively for torpedinoids, order for all batoids); Nishida, 1990, *Mem. Fac. Fish. Hokkaido Univ.* 37(1/2): 11 (suborder exclusively for torpedinoids, order for all batoids); Nelson, 1994, *Fishes of the world*, ed. 3: 58 (suborder exclusively for torpedinoids, order for all batoids). Order Squatinida, Suborder Rajoidei, Superfamily Torpedinoidea: Glikman, 1967 (in part), *in* Y. A. Orlov, *ed*., *Fundamentals Paleontology*, 11: 219 (superfamily for torpedinoids, suborder for all batoids, order also including squaloids, orectoloboids, cetorhinids, squatinoids, and pristiophoroids). Order Torpedinida, Suborder Torpedinina: Fowler, 1970, *Q.J. Taiwan Mus*. 23(1–2): 86 (exclusively for torpedinoids). Order Rajida, Suborder Torpedinina: Matsubara, 1955, Fish morphology hierarchy, (1): 1–789 (suborder exclusively for torpedinoids, order for all batoids). Order Batoidea: Romer, 1945, *Vert. Paleont*. (ed. 2): 577 (for all batoids). Order Batoidea, Suborder Torpedinoidea: Bigelow and Schroeder, 1953, *Mem. Sears Fnd. Mar. Res*. (1) 2: 14, 80 (suborder exclusively for torpedinoids, order for all batoids); Romer, 1966, *Vert. Paleont*. (ed. 3): 350 (suborder exclusively for torpedinoids, order for all batoids). Order Hypotremata, Suborder Narcobatoidea: Norman, 1966, draft syn. Recent fishes: 32 (suborder exclusively for torpedinoids, order includes all batoids). Order Rajiformes: Blot, 1969, *in* J. Piveteau, *ed*. *Traité de Paleontologie*. 2: 702–776 (group for all living batoids). Order Batoidea, Suborder Narcobatoidea: Schultz and Stern, 1948, *Ways of Fishes*: 226 (suborder for torpedinoids, order for all living batoids). Order Batoidea, Suborder Torpedinoidea: Carroll, 1988, *Vertebrate paleont. evolut*.: 599 (suborder exclusively for torpedinoids, order for all batoids). Order Torpediniformes: Cappetta, 1987, *Handb. Paleoichthyol*. 3B: 27, 160 (exclusively for torpedinoids). Order Torpediniformes, Superfamily Torpedinoidea: Cappetta, 1987, *Handb. Paleoichthyol*. 3B: 27, 160 (for torpedinids). Order Torpediniformes, Superfamily Narcinoidea: Cappetta, 1987, *Handb. Paleoichthyol*. 3B: 27, 162 (for narcinids). Ordo Plagiostomi, Subordo Rajini: Bleeker, 1859, *Acta Soc. Sci. Indo–Neerl*. 6: xiii (suborder for all batoids, order for

all elasmobranchs). Order Selachii, Suborder Tectospondyli: Woodward, 1889 (in part), *Cat. fossil fish*. BM(NH) (1): 30 (suborder for squaloids, squatinoids, pristiophoroids, batoids, psammodonts, petalodonts, and pristodonts, order for other living sharks, fossil neoselachians, hybodonts and cochliodonts). Order Torpediniformes, Suborder Torpedinoidei: McEachran, Dunn and Miyake, 1996, *in* Stiassny, Parenti and Johnson, *Interrelationships of fishes*: 80 (for hypnids and torpedinids). Order Torpediniformes, Suborder Narcinoidei: McEachran, Dunn and Miyake, 1996, *in* Stiassny, Parenti and Johnson, *Interrelationships fishes*: 80 (for narkids and narcinids). Order Rajiformes, Suborder Rajoidei, Superfamily Torpedinoidea: Shirai, 1996, *in* Stiassny, Parenti and Johnson, *Interrelationships fishes*: 34 (superfamily exclusively for torpedinoids, suborder also including rajoids and myliobatoids, order for all batoids).

FAO Name: En – Electric rays.

Field Marks: 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 (except torpedinid genus ***Hypnos***), as well as 0 to 2 dorsal fins.

Diagnostic Features: Disc oval, elliptical, rounded to circular, and with stout tail; snout not formed into a saw. Nostrils close together and close to the mouth, with anterior nasal flaps connected together to form a nasal curtain; nasoral grooves present; pectoral fins large. Teeth small and not fused into crushing plates; tooth counts 8 to 68 upper jaw, 7 to 75 lower jaw. Eyes small to obsolete, with several deepwater species that are blind. A stout to diminutive tail; trunk, head and pectoral fins forming a large disc; two, one or no dorsal fins present, usually large where present; the caudal fin usually large and well developed (tiny in ***Hypnos***); skin completely naked; no stinging spine on caudal fin; pectoral electric organs present, but no caudal electric organs; powerful electric organs derived from branchial muscles visible as large bean–shaped contour at both sides of head; the rostrum variable, absent, greatly reduced, or moderately large and wide. These are very large, up to 200 cm long to rather tiny, adults less than 30 cm, batoids. **Colour:** dorsal surface coloration in these batoids can be rather brilliant, with bars or lines, blotches, eye–spots, ocelli, rosettes, and various sized spots, or may be rather drab dark to light black or grey without any mottling or other descriptive patterns.

Distribution: Circumglobal in the Atlantic, Indian and Pacific oceans.

Habitat: All are bottom dwellers on mostly soft sandy and muddy bottoms; a very few are known to swim pelagically even far offshore into the open ocean (e.g. ***Tetronarce californica, T. nobiliana***). Most members of this order are found in tropical and subtropical waters, with a few species living in cool and warm temperate seas. They occur primarily inshore, on continental shelf waters, but a few species are considered deepwater inhabitants.

Biology: Reproductive mode is yolk–sac viviparous, but very little else is known on the life cycle of most species. The diet consists of a variety of benthic invertebrates and for the larger species also teleost fishes. As electric rays are sluggish swimmers, they usually narcotise their prey by electric shocks to immobilize it prior to feeding.

Interest to Fisheries and Human Impact: Electric rays are unwanted bycatch in inshore and shelf bottom fisheries, and fishermen avoid them carefully fearing their powerful electric shock discharges, and hence discard them promptly resulting in a fair survival rate. Their flesh is flabby, watery and disliked for human consumption.

The conservation status of most species is uncertain and as such many are considered Data Deficient or Least Concern due to a lack of fisheries and poor knowledge of their life history and population status.

Local names: No information.

Remarks: Following Aschliman, Claeson and McEachran (2012) the order as restricted here has two families recognized globally, with each family having two subfamilies. The Narcinidae has the Narcininae (Numbfishes) and Narkinae (Sleeper rays), while the Torpedinidae has the subfamilies Torpedininae (Torpedo rays) and Hypninae (Coffin rays). Some classifications recognize as many as four families within this order (Compagno, 2005).

Literature: Compagno (1973, 1977, 2005); Carvalho (1999a, b); Compagno and Last (1999a, b, c); McEachran and Aschliman (2004); Nelson (2006); Compagno and Heemstra (2007); Aschliman, Claeson and McEachran (2012); Aschliman *et al.* (2012); Ebert and Stehmann (2013); Ebert (2014); Carvalho (In press); D.A. Ebert (unpubl. data); L.J.V. Compagno (pers. comm. and unpubl. data).

3.1.1 Family TORPEDINIDAE

Family: Subfamily Torpedinini Bonaparte, 1838, *Nuov. Ann. Sci. Nat., Bologna, ser*. 1, 2: 130 (Family Rajidae). Also as Family Torpedinoidae Gill, 1862, *Ann. Lyceum Nat. Hist. New York*, 7(32): 386.

Type Genus: ***Torpedo*** Duméril, 1806, *Zoologie analytique, ou méthode naturelle de classification des animaux*. Paris. *Zool. anal.*: 102, 343.

Number of Recognized Deep–sea Southeastern Pacific Ocean Genera: 1.

Synonyms: Family Narcaciontoidae Gill, 1862, *Ann. Lyceum Nat. Hist. New York*, 7(32): 386, also Subfamily Narcaciontinae Gill, 1862, *ibid.*, 387. Type genus: ***Narcacion*** Gill, 1862, a revival of ***Narcacion*** Klein, 1776, 1777. Family Narcobatidae Gill, 1895, *Proc. U.S. Nat. Mus*. 18(1050): 163. Type genus: Subgenus ***Narcobatus*** Blainville, 1816 (Genus *Raia* Scopoli, 1777). Also as subfamily Narcobatinae Gill, 1895, *ibid.*, 164. Subfamily Torpedinae Fowler, 1934, *Proc. Acad. Nat. Sci. Philadelphia*, 85: 240 (Family Torpedinidae). Erroneous spelling.

FAO Names: En – Electric rays; **Fr** – Torpilles, raies électriq.; **Sp** – Tremielgas, torpedos.

Field Marks: Mouth broadly arched, distensible, without labial cartilages and folds at corners of mouth, two subequal sized dorsal fins, with the first much larger than the second. Colour of dorsal surface uniformly plain, sometimes with small spots or variegated with blotches or marbling, sometimes with eyespots on pectoral fins; ventral surface of most species creamy to white.

Diagnostic Features: Small to moderately large (maximum total length to about 180 cm, but most species less than 100 cm in length), heavy–bodied batoids with short stout shark–like tails; body depressed and dorso–ventrally flattened, typically soft and flabby, and entirely naked above and below, without dermal denticles or thorns (except in one eastern Central Atlantic species). Head, trunk and the broadly expanded pectoral fins forming a more or less circular disc. Anterior contour of disc conspicuously truncate or emarginate, snout extremely short. Two large powerful kidney–shaped electric organs at bases of pectoral fins, these visible through skin. Tail distinctly shorter than and marked off from body disc, with narrow dermal fold along either lower edge; tail abruptly narrower than trunk, no barbed sting (stinger or stinging spine) on dorsal surface of tail, and no electric organs in tail. Rostral cartilage absent or reduced. Eyes and spiracles small and close–set on top of head; posterior margins of spiracles either smooth, or set with knobs or tentacles. Nostrils transverse and relatively large, closer to mouth than to snout edge, their inner margins broadly expanded rearward and fused as a transverse nasal curtain, smooth free rear margin of which nearly overlaps upper jaw. Mouth broadly arched and broad, without prominent knobs and depressions and with labial furrows absent; strong grooves at distal ends of mouth but not around its periphery. Oral teeth small, with flat bases and a prominent cusp, not laterally expanded and plate–like, similar in shape and in 20 to 75 rows in upper and lower jaws. Five small gill openings on underside of front half of pectoral–fin bases, not visible in lateral view; no gill sieves or rakers on internal gill slits. Pectoral fins large, very thick toward their margins, completely fused to sides of head, and expanded rearward to, or slightly beyond origin of the single–lobed pelvic fins. Pelvic fins low, broadly rounded and not divided into anterior and posterior lobes. Two relatively large dorsal fins, the first much larger than the second and close to it, rounded–angular in shape with apices, anterior, posterior and inner margins, and free rear tips more or less confluent, not falcate. First dorsal fin originates far behind anterior half of total length, origin over or just behind rear fourth of pelvic–fin bases and well anterior to midlength of tail. Caudal fin large, subtriangular, paddle–shaped, much larger than dorsal fins and about size of pelvic fins or larger, not shark–like, nearly symmetrical, with vertebral axis hardly raised above body axis; lower caudal–fin lobe absent. Spiral valve turn counts: 9 to 13. Adults between 20 and 180 cm total length. **Colour:** variably plain or variegated above, from greyish or brownish to black; dark and light spots, blotches or marbling, variably present or absent, sometimes with eyelike spots (ocelli); usually lighter below, often uniformly white or with a dark margin to the pectoral and pelvic fins.

Distribution: Circumglobal, occurring from high latitude seas to the tropics and in most oceans, except for polar seas.

Habitat: Electric rays inhabit tropical to temperate shelf waters from inshore to about 100 m depth, but some have been reported from as deep as 1100 m. A few species are semi–pelagic, while others such as the Pacific electric ray (***Tetronarce*** [=***Torpedo***] ***californica***) have been observed swimming offshore at about 10 m below the surface in waters over 3000 m deep. A few species (e.g. ***T. nobiliana***) are highly migratory, with the adults swimming pelagically. Electric rays usually lie quietly on the bottom during the day, often buried on soft bottoms in sand or mud and will appear sluggish when swimming, but become quite active at night and will swim off the bottom in search of prey items.

Biology: All species are yolk–sac viviparous, but in addition adult females produce by villi and folds on their uterus walls a secretion commonly called “uterine milk”, which the embryos take up, depending on their development stage, through their external gills, or through the ectoderm of the yolk–sac and its stalk.

Electric rays feed mainly on bottom living small to large fishes and invertebrates; their jaws and mouths are highly distensible to allow them to swallow very large prey. At least some species will deliberately shock potential fish victims with their powerful electric organs to stun them, and then use their flexible pectoral discs as manipulators to guide the prey into their mouths. The electric organs are also defensive, and can successfully protect these rays against predators such as sharks and octopuses.

Interest to Fisheries and Human Impact: Electric rays may locally be quite abundant in some areas, but there is no targeted fisheries for them or any use for human consumption; this is mainly due to the flabby consistency of their bodies and because a large part of the pectoral fins is occupied by the electric organs of gelatinous texture. In some areas, such as southern California (U.S.A.) these rays are taken in small numbers for biological and medical research.

Fishermen are wary of these rays because of their discharge of strong electric shocks, so discard them quickly. Although

there are no confirmed fatalities from these rays, there are several suspicious, unexplained fatal scuba diving accidents that may have involved these rays; whereby divers possibly after being 'shocked' by these rays may have subsequently drowned.

The conservation status of these electric rays is poorly known due to a lack of life history data and information on population trends.

Local names: No information.

Remarks: The family consists of two subfamilies (Torpedininae and Hypninae), three genera, ***Hypnos***, ***Tetronarce***, and ***Torpedo***, and about 25 nominal species. The genus ***Torpedo*** until recently consisted of two subgenera, ***Tetronarce*** and ***Torpedo***, but Carvalho (In press) resurrected ***Tetronarce*** Gill, 1862 to full generic status. All three genera are primarily shelf dwelling species, but at least four ***Tetronarce*** species occur mainly on the upper slopes.

Literature: Compagno and Last (1999b); Carvalho, Stehmann and Manilo (2002b); Ebert (2003); Haas and Ebert (2006); Welter–Schultes and Feuerstein (2008); Ebert and Stehmann (2013); Ebert (2014); Carvalho (In press); L.J.V. Compagno (pers. comm.).

List of Deep–sea Species Occurring in the Area:

Tetronarce microdiscus (Parin and Kotlyar, 1985)

Tetronarce Gill, 1862

Genus: ***Tetronarce*** Gill, 1862, *Ann. Lyceum Nat. Hist. New York*, 7: 387.

Type species: ***Torpedo occidentalis*** Storer, 1843, by monotypy, a junior synonym of ***Torpedo nobiliana*** Bonaparte, 1835. According to Gill, 1895, *Proc. U.S. Nat. Mus*. 18(1050): 163, the spelling ***Tetronarce*** was a printer's error.

Number of Recognized Deep–sea Southeastern Pacific Ocean Species: 1.

Synonyms: Genus ***Gymnotorpedo*** Fritsch, 1886, *Arch. Anat. Phys. Leipsig*: 365. Genus ***Tetronarcine*** Tanaka, 1908, *Journ. Coll. Sci. Tokyo*, 23: 2. Type species: ***Tetronarcine tokionis*** Tanaka, 1908, by monotypy according to Fowler, 1941. Genus ***Notastrape*** Whitley, 1932, *Rec. Australian Mus*., 18(6): 327.

Field Marks: Similar to family account above, except that members of the genus ***Tetronarce*** are generally uniformly coloured a dark to light black, grey, or dark purplish above (some species with small dark spots, and white below), and have smooth–edged spiracles without knobs or papillae.

Diagnostic Features: Disc subcircular, soft and flabby, and naked above and below, without dermal denticles or thorns; anterior disc margin conspicuously truncate or emarginate, snout extremely short; rostral cartilage absent or reduced. Tail short, stout, distinctly marked off from disc, with narrow dermal fold along either lower edge abruptly tapering posteriorly from disc; electric organs absent in tail. Eyes relatively small, but fully developed. Spiracles small, moderately oblique, with smooth posterior margins, and no papillae; inner anterior margin with 8 to 14 pseudobranchial folds. Nostrils relatively large, oblique, closer to mouth than to snout edge; their inner margins broadly expanded rearward and fused as a transverse nasal curtain, smooth free rear margin of which nearly overlaps upper jaw. Mouth broadly arched and broad, without prominent knobs and depressions and with labial furrows absent; strong grooves at distal ends of mouth but not around its periphery. Teeth small, with flat bases and a prominent cusp, not laterally expanded and plate–like, similar in shape. Tooth counts 18 to 66 upper jaw, 19 to 61 lower jaw. Gill openings small, first and fifth slightly smaller than third and fourth openings. Electric organs kidney–shaped, length about one–half disc length, these visible through skin. Pelvic fins low, broadly rounded, not divided into anterior and posterior lobes. Dorsal fins relatively large, first much larger than second and close to it; rounded–angular in shape with apices, anterior, posterior and inner margins, and free rear tips more or less confluent, not falcate. Caudal fin large, subtriangular paddle–shaped, much larger than dorsal fins, similar in size to pelvic fins or slightly larger; lower caudal–fin lobe absent. Vertebral counts: total vertebral counts 95 to 106, monospondylous vertebral counts 25 to 36, precaudal vertebral counts 68 to 77, caudal fin vertebral counts 20 to 24. Spiral valve turn counts: 9 to 14. Adults up to 180 cm total length. **Colour:** dorsal surface variably plain, from purplish to greyish or brownish to black, some species with darker inconspicuous spots; usually lighter below, often uniformly white or with a dark margin along the pectoral and pelvic fins.

Local Names: No information.

Remarks: This genus until recently has been considered a subgenus of ***Torpedo***, but Carvalho (In press) recently resurrected ***Tetronarce*** to full generic status. Members of the genus ***Tetronarce*** can be distinguished from the genus ***Torpedo*** by their uniformly drab, often dark black, purplish–black to brown dorsal coloration, and smooth margined spiracles

that lack knobs or papillae. ***Torpedo*** species by contrast are usually ornately coloured on their dorsal surface, and have knobs or papillae around their spiracle margins.

The genus ***Tetronarce*** has about 11 nominal species, but many are poorly described. Most species occur along continental shelves, but at least four species are considered deep–sea inhabitants of upper continental and insular slopes.

The conservation status of most members of this group is poorly known and as such is assessed as Data Deficient.

Tetronarce microdiscus (Parin and Kotlyar, 1985)

Torpedo microdiscus Parin and Kotlyar, 1985, *Voprosy Ikhtiologii* 25(5): 709, figs 1a, 2. Holotype: ZIN 47251, 28.4 cm total length, immature male, Junction of Nazca and Sala y Gomez Ridges, southeastern Pacific, 25°39'S, 85°23'W, 180-280 m, 4 September 1983.

Synonyms: None.

Other Combinations: None.

FAO Name: En – Small disc torpedo ray.

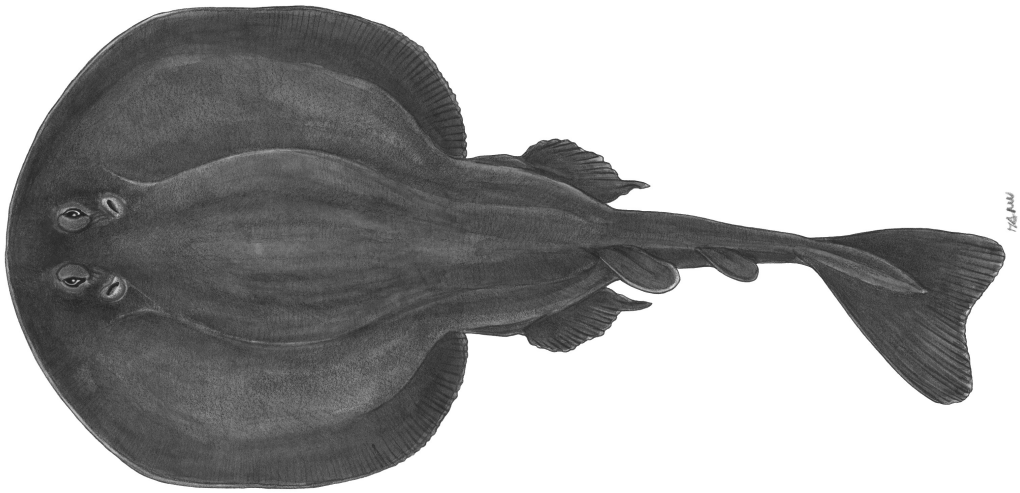


Fig. 143 ***Tetronarce microdiscus***

Field marks: Anterior disc margin broadly curved, length 2.1 to 2.2 times into total length, pelvic–fin origins separated from posterior disc margin by distance about equal to or more than first dorsal–fin base length, and distance between inner margins of spiracle 1.5 to 1.8 times into prespiracle distance. Dorsal surface coloration a dark chocolate brown, ventral surface white.

Diagnostic Features: Disc fleshy, narrowly circular, relatively short, length about 1.1 times tail length, anterior margin broadly rounded; disc widest at about one-third its length, thickest up to margins; disc does not overlap at origin of pelvic fins. Eyes small, oval shaped, orbital diameter about 3.4 to 3.6 times spiracle length, set close to spiracles, space between them about equal to interspiracular width. Spiracles with smooth margins, oblique, without tentacles or papillae. Mouth strongly arched. Teeth set in quincunx, similar in upper and lower jaws. Tooth counts 25 upper jaw, 26 to 29 lower jaw. Tail narrow, elongate, with long pelvic fins attached to sides of its origin; dorsal fins distinct and large, the first one about twice the size of the second one; caudal fin large, posterior margin concave, with upper and lower lobes of about equal size. Disc surfaces smooth on both sides, without dermal denticles or thorns. Vertebral counts: not available. Spiral valve turn counts: not available. Maximum total length unknown, largest individual is an immature male 36.6 cm long. **Colour:** in life dorsal surface is a uniform dark chocolate brown, without any blotches or spots, ventral surface white, except for a narrow darker margin along disc and pelvic fins.

Distribution: Southeastern Pacific Ocean: known only from the junction of the Nazca and Sala y Gomez ridges.

Habitat: A deep-sea species collected in the open sea on seamounts between 180 and 280 m deep; one of the two known specimens was caught in a midwater trawl, the other specimens on a bottom trawl.

Biology: Presumed to be yolk-sac viviparous, but nothing known about its litter size or reproductive cycle.

Size: Maximum total length is 36.6 cm for an immature male. Known from only two immature specimens.

Interest to Fisheries and Human Impact: Unknown, but maybe taken as bycatch in deep-sea fisheries for orange roughy, but nothing else is known about fishery impacts on this species.

The conservation status of this little known electric ray is Data Deficient.

Local names: Torpedo (Chile).

Remarks: ***Tetronarce microdiscus*** maybe synonymous with ***T. semipelagica***, a species that was also collected on the same cruise and in the same area. Furthermore, both these species should be compared closely with ***T. tremens*** de Buen, 1959.

Literature: Parin and Kotlyar (1985).

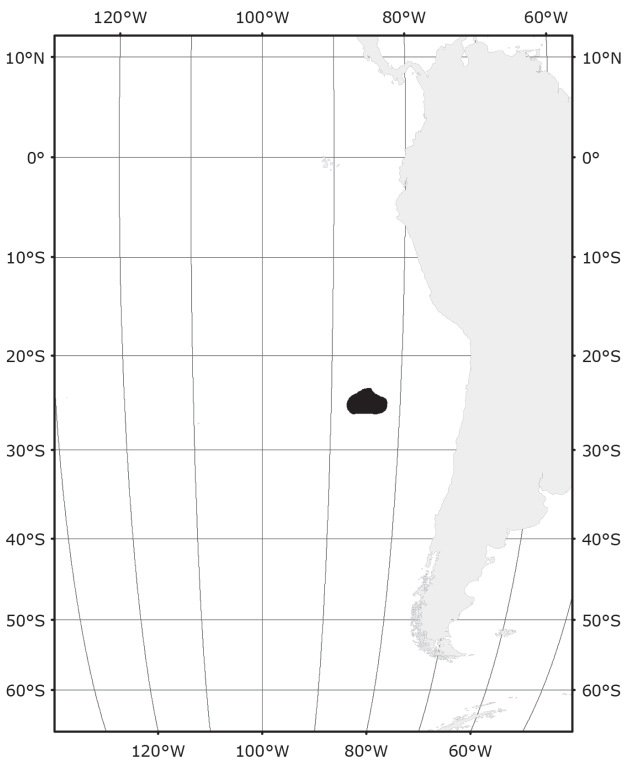


Fig. 144 ***Tetronarce microdiscus***

Known distribution

3.2 Order RAJIFORMES – Skates

Order: Rajae: Müller and Henle, 1841, *Syst. Besch. Plagiost*. [Part] 2, (3): 103 (group equivalent to order for batoids).

Number of Recognized Deep–sea Southeastern Pacific Ocean Families: 2.

Synonyms: Batoidei, Batoidea, Batoidimorpha (*partim*).

Field Marks: Skates have a completely dorsoventrally flattened body and greatly extended pectoral fins forming a disc, a slender tail sharply distinct from the disc, two dorsal fins small, or absent, a caudal fin rudimentary or absent and body and tail never completely covered by overlapping, very densely set placoid scales.

Diagnostic Features: Shape of disc varying from almost circular to inverse heart–shaped and subrhombic, with snout ranging from very short and blunt to very elongated and pointed; snout either supported by a firm rostral cartilage extending to snout tip, or by forward extension of anterior pectoral radials and their basal skeletal elements almost to snout tip because of lacking, incomplete or very delicate rostral cartilage; tail from moderately slender in most species to very thin thread–like, usually not much longer than disc; two dorsal fins small, or absent; caudal fin rudimentary or absent; pelvic fins with two lobes in majority of species; most species with a distinct upper side pattern of conspicuous thorns set in small patches on certain areas of head, and in longitudinal rows along back of trunk and tail; thorns on disc reduced in some genera, mostly so in the genus ***Bathyraja***, but less so in the genus ***Psammobatis***; mature males with a patch of malar thorns on cheeks, and across wing tips with a field of sharp, claw–like alar thorns being either retractable in dermal pockets, or permanently erect; very low powered electric organs along entire, or only part of tail length, which derive from lateral caudal musculature. Sizes ranges from pygmy to more than 200 cm total length. **Colour:** dorsal surface varying from whitish to pale, to darker colours, from reddish, brown, grey, purplish to black, with either plain surface or with blotches, reticulations, spots, ocelli, and lighter to darker variations; ventral surface mostly lighter, but some species darker coloured or with blotches.

Distribution: Circumglobal in the Atlantic, Indian and Pacific oceans, including Arctic and Antarctic waters (except for Rhinobatidae).

Habitat: The skates are mostly marine inhabitants, except for one uniquely endemic species found in estuarine waters, and are found in all oceans from tropical to polar latitudes and from shallow inshore waters down to the deep sea abyssal plains (to a depth over 4000 m). The majority of species are demersal on subtropical to polar shelves and upper slopes, where they can be locally rather abundant; a few large species mainly in deepwater are also benthopelagic and may migrate over long distances.

Biology: All skate species are oviparous, with some species producing relatively large numbers of eggs that are encapsulated in rather large, rectangular horny capsules with a pair of slender horns at both ends. The females deposit these egg capsules individually on the sea floor, where the embryos develop over many months to possibly years, until they hatch from capsules. The life span of these batoids may range from about 10 years to nearly 40 years or possibly more. All species feed primarily on benthic invertebrates, but larger size species also feed on small fishes; some of the larger sized deepwater species are active hunters on larger benthopelagic fishes, including other chondrichthyans.

Interest to Fisheries and Human Impact: There is a long tradition in many Asian and European countries of fishing for skates for human consumption. Modern trawler fisheries have overfished skate stocks in many places; catch quotas have been introduced slowly only in some areas, often only quite recently, because intensive fishing has led to severe depletion of stocks due to the slow growth, late maturity and low reproductive rate of skates.

The conservation status of many skates, especially the deep–sea species, is Data Deficient.

Local names: No information.

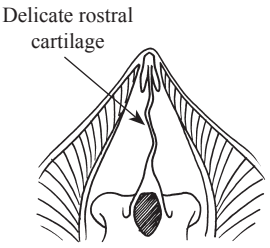
Remarks: The order Rajiformes is still largely unresolved with morphological and molecular data being strongly at odds regarding the relationship of the skates to other extant batoids (Aschliman, Claeson and McEachran, 2012; Aschliman *et al.*, 2012). Nelson (2006) combined five families of very different morphological appearance, Rhinidae, Rhynchobatidae, Rhinobatidae, Rajidae, and Arhynchobatidae into a single order, the Rajiformes, following McEachran and Konstantinou (1996), and McEachran and Aschliman (2004), who considered two rhinid genera *incertae sedis*. Compagno (2005) placed Rhinidae and Rhynchobatidae in two suborders under Rajiformes. The order as currently restricted is composed of five families, more than 30 genera, and over 350 species. The descriptive account above is based solely on the skate families Arhynchobatidae and Rajidae, to the exclusion of the other three families. The families Rhinidae, Rhynchobatidae, and Rhinobatidae mostly occur in warm temperate to tropical nearshore waters, while the families Arhynchobatidae and Rajidae contain many deep–sea species. Only the two latter skate families will be discussed further.

Literature: McEachran and Konstantinou (1996); McEachran and Aschliman (2004); Compagno (2005); Nelson (2006); Aschliman, Claeson and McEachran (2012); Aschliman *et al.* (2012).

Key to Deep–sea Southeastern Pacific Ocean Families:

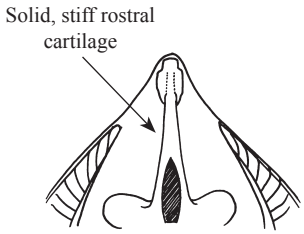
1a. Snout soft, flabby, due to delicate flexible rostral cartilage (Fig. 145) . . . . . **family Arhynchobatidae**

1b. Snout rigid, stiff, not flexible due to solid, stiff rostral cartilage (Fig. 146) . . . . **family Rajidae**



DETAIL OF SNOUT SKELETON
After Stehmann and Bürkel *in* Whitehead *et al.* (1984)

Fig. 145 Arhynchobatidae



DETAIL OF SNOUT SKELETON
After Stehmann and Bürkel *in* Whitehead *et al.* (1984)

Fig. 146 Rajidae

3.2.1 Family ARHYNCHOBATIDAE

Family: Subfamily Arhynchobatinae Fowler, 1934, *Proc. Acad. Nat. Sci. Phil.*, 85: 240.

Type Genus: ***Arhynchobatis*** Waite, 1909

Number of Recognized Deep–sea Southeastern Pacific Ocean Genera: 3.

Synonyms: Family Pseudorajidae Bigelow and Schroeder, 1954a, *Breviora Mus. Comp. Zool. Harvard*, (24): 2. Type genus: ***Pseudoraja*** Bigelow and Schroeder, 1954a. Tribe Pavorajini McEachran, 1984, *Copeia*, 1984(1): 55. Type genus: ***Pavoraja*** Whitley, 1939. Subfamily Arhynchobatidinae Steyskal, 1980, *Proc. Biol. Soc. Washington,* 93(1): 170, suggested emendation of Arhynchobatinae Fowler, 1934 according to the case of a basonym (batis) ending in –is for correct orthography.

FAO Name: En – Softnose skates.

Field Marks: Rostral cartilage flexible, delicate and extending to snout tip, or being incomplete not reaching rostral node in snout tip, or rostral cartilage basally segmented or separated from neurocranium, or limited to distal section of snout, anterior pectoral–fin radials and their basal elements extended forward to close to, or being in touch with snout tip. Snout characteristics can be checked by touch, or against strong light.

Diagnostic Features: Disc large, broad, and flat rhomboidal to heart–shaped, with a tail narrow and slender, slightly shorter to nearly twice as long as pectoral disc; dorsal disc either smooth or covered with small dermal denticles; more or less enlarged, sharp hooked denticles or thorns usually present on dorsal surface, on the midline of the tail and often on the midline of the disc, on the snout, orbits, and shoulders. Trunk depressed and flattened, not shark–like. Precaudal tail cylindrical or moderately depressed but not whip–like, with lateral ridges or folds on sides; tail abruptly narrower than trunk, no barbed sting (stinger or stinging spine) on dorsal surface of tail behind dorsal fins, electric organs present in tail. Head broad and depressed; snout short to long and bluntly to acutely angular or rounded–angular, supported by a more or less reduced, soft, slender rostral cartilage. Five small gill openings on underside of front half of pectoral–fin bases, not visible in lateral view. Eyes dorsolateral on head and just anterior to spiracles. Mouth transverse and straight to moderately arched, without prominent knobs and depressions. Nostrils just anterior to mouth and separated from it by less than half their own widths, connected by broad nasoral grooves with mouth; anterior nasal flaps elongated, posteriorly expanded and reaching mouth, but separate medially and not forming a nasal curtain. Teeth small, rounded–oval in shape, with or without cusps on their crowns, and not laterally expanded and plate–like, similar in shape and in over 20 rows in either jaw. Pectoral fins large, originating in front of mouth and reaching snout tip or not, attached to sides of head and forming a large pectoral disc with free rear tips ending posterior to pelvic–fin origins; disc not subdivided by a notch at eyes. No electric organs at bases of pectoral fins. Pelvic fins high, rounded–angular or angular, and distinctly bilobed (except in ***Pseudoraja***) through deep incision in joint outer margin. Claspers of mature males slender to relatively stout, and elongated, nearly extending to first dorsal fin in some species, and with the glans short and only slightly widened; external clasper glans components relatively few and very similar for most species. Alar thorns of mature males sharp, hooked, permanently erect, not retractable into dermal pockets. Usually two small, subequal and close to widely separated dorsal fins present, these of similar rounded or rounded–angular shapes with margins more or less confluent, not falcate; only one dorsal fin or none in some species. First dorsal fin when present originates far behind anterior half of total length, base far behind rear tips of pelvic fins and junction between trunk and tail, and well behind midlength of tail. Caudal fin small to rudimentary, and vertebral axis parallel to body axis; lower caudal–fin lobe absent. Maximum total length between 30 and 175 cm, with most species less than 100 cm. **Colour:** dorsal surface varying from whitish to dark brown, purplish, or black, either unmarked or with light or dark spots, blotches, or basal ocelli on pectoral fins; usually white below but often dark or blotched along midbody in dark–bellied species, or faint grey edging of disc and pelvic fins in light–bellied species.

Distribution: Worldwide in all oceans, including Antarctic waters, from continental shelves down the continental slopes to the deep–sea abyssal plains. Absent in tropical shelf waters.

Habitat: Demersal from close inshore in cold temperate and boreal latitudes down to the continental slopes, and from far offshore islands and on submarine elevations to deep–sea plains to more than 4000 m depth.

Biology: Oviparous, with long embryonic development due to low temperatures of environment. Egg capsules rectangular, with two pairs of long horns at both ends. Some deep–sea members of this family are very long lived and do not mature until over 20 years in age. Diet includes various bottom living invertebrates and fishes; larger species tend to consume more bony fishes.

Interest to Fisheries and Human Impact: Most members of this family are deep–sea species and are generally taken as bycatch rather than as targeted species. However, where these skates are caught there generally is very little species–specific information available on catch rates.

The conservation status of these skates in the southeastern Pacific Ocean is mostly Data Deficient, Least Concern, or Near Threatened, but one species is considered Vulnerable and another Endangered.

Local names: No information.

Remarks: The family Arhynchobatidae is considered a subfamily (Arhynchobatinae) by some authors (McEachran and Aschliman, 2004; Nelson, 2006; Aschliman, Claeson and McEachran, 2012; Aschliman *et al.*, 2012), but given full family status by others (Compagno, 1999, 2005; Last and Compagno, 1999; Ebert and Compagno, 2007). Aschliman *et al.* (2012) and Naylor *et al.* (2012a, b) analysed the phylogenetic relationships within the Rajoidei and concluded that the Arhynchobatidae is a monophyletic group, and should be retained as a full family (Ebert and Stehmann, 2013). The above account is modified after Last and Compagno (1999), Ebert and Stehmann (2013), and Ebert (2014).

The family has 13 genera and about 102 species, of which three genera (***Bathyraja, Notoraja*** and ***Psammobatis***) and 17 species occur in the southeastern Pacific Ocean deep–sea. Two poorly known shallow water ***Psammobatis*** species, ***P. normani*** and ***P. rudis***, found off Argentina have been reported from deeper waters off southern Chile, but these are known from only from a few specimens. Given the lack of descriptive and biological information on these species from this region further detailed accounts of these species from the area were not possible at this time

Literature: McEachran, Dunn and Miyake (1996); McEachran and Dunn (1998); Ebert and Compagno (2007); Aschliman, Claeson and McEachran (2012); Aschliman *et al.* (2012); Ebert and Stehmann (2013); Ebert (2014).

List of Species Occurring in the Area:

Bathyraja aguja (Kendall and Radcliffe, 1912)
Bathyraja albomaculata (Norman, 1937)
Bathyraja brachyurops (Fowler, 1910)
Bathyraja cousseauae Diaz de Astarloa and Mabragana, 2004
Bathyraja griseocauda (Norman, 1937)
Bathyraja longicauda (de Buen, 1959)
Bathyraja macloviana (Norman, 1937)
Bathyraja magellanica (Philippi, 1902)
Bathyraja meridionalis Stehmann, 1987
Bathyraja multispinis (Norman, 1937)
Bathyraja peruana McEachran and Miyake, 1984
Bathyraja schroederi (Krefft, 1968)
Bathyraja spinosissima (Beebe and Tee-Van, 1941)
Notoraja martinezi (Concha, Ebert and Long, 2016)
Psammobatis normani McEachran, 1983*
Psammobatis rudis Günther, 1870*
Psammobatis scobina (Philippi, 1857)

*Species account is not included

Key to Deep–sea Southeastern Pacific Ocean Genera:

1a. Moderate to large softnose skates with subrhombic disc shape (Fig. 147) . . . . . ***Bathyraja***

1b. Small softnose skates with heart-shaped to sub-circular disc (Fig. 148 and 149) **2**

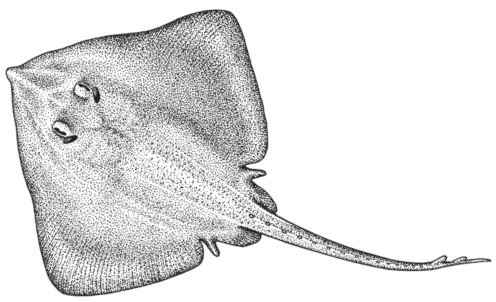


Fig. 147 ***Bathyraja***

2a. Nuchal, scapular, and midback thorns absent; tail with numerous large, irregularly arranged thorns giving it a barbedwired–like appearance (Fig. 148). . . ***Notoraja***

2b. Nuchal, scapular, and midback thorns present; 1 to 5 rows of tail thorns, lacking barbedwired–like appearance (Fig. 149) . . . . . ***Psammobatis***

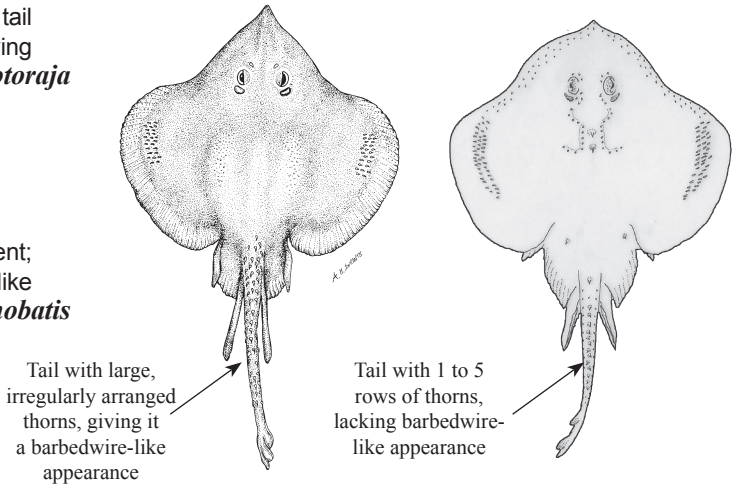


Fig. 148 ***Notoraja*** **Fig. 149** ***Psammobatis***

Bathyraja Ishiyama, 1958

Genus: ***Bathyraja*** Ishiyama, 1958: 325 (subgenus of ***Breviraja*** Bigelow and Schroeder, 1948), *J. Shimonoseki Coll. Fish.* 7 (2/3): 193–394; elevated to generic level by Ishiyama and Hubbs (1968) in context with a revision of genus ***Breviraja***, *Copeia* 1968(2): 407–410.

Type Species: ***Raja isotrachys*** Günther, 1877, by original designation.

Number of Recognized Deep–sea Southeastern Pacific Ocean Species: 13.

Synonyms: "Pseudogenus" (= subgenus) ***Zetaraia*** Leigh–Sharpe, 1924 (Genus ***Raja*** Linnaeus, 1758), *J. Morph*. 39: 568, 575. Type species: ***Raja brachyura*** Günther, 1880, by original designation, = ***Raja brachyurops*** Fowler, 1910. "Pseudogenus" (= subgenus) ***Thetaraia*** Leigh–Sharpe, 1924 (Genus ***Raja*** Linnaeus, 1758), *J. Morph*. 39: 568, 577. Type species: ***Raja eatoni*** Günther, 1876, by original designation. Subgenus ***Arctoraja*** Ishiyama, 1958 (Genus ***Breviraja*** Bigelow and Schroeder, 1948), *J. Shimonoseki Coll. Fish*. 7(2–3): 337. Type species: ***Raja smirnovi*** Soldatov and Pavlenko, 1915, by original designation. Subgenus ***Actoraja*** Stehmann, 1990 (Genus ***Breviraja*** Bigelow and Schroeder, 1948), *in* J.–C. Quero *et al.*, *eds.*, 1990, CLOFETA. *Check–list fish. E. trop. Atlantic*, 1: 29. Apparent error for ***Arctoraja*** Ishiyama, 1958.

FAO Names: En – Bathyraja rays; **Fr** – Raies Bathyraja; **Sp** – Rayas Bathyraja.

Field Marks: Large soft–nosed skates, with soft flexible, slender, uncalcified, rostral cartilage, sub–rhomboidal disc, with a broadly triangular, short to long pointed snout, pectoral tips angular or broadly rounded, tail length mostly shorter than disc width, disc dorsal surface depending on species without thorns or may have nuchal, midback, or scapular thorns present. Colour above uniform or with blotches or spots on some species; ventral surface mostly uniform except for disc edges may be darker in some species.

Diagnostic Features: Disc rhombic–shaped, rather broad, width usually greater than disc length, with lateral corners angular or broadly rounded at tips. Snout flabby, flexible, and soft. Mouth small to relatively wide, and slightly arched; teeth with single large cusp, arranged in quincunx. Tooth row counts upper and lower jaws 21 to 36. Anterior pelvic–fin lobes of moderate length, not extending to posterior margin of posterior lobe. Tail relatively short, its length equal to or less than disc width. Dorsal fins usually two, subequal, similar in shape. Skin smooth or roughly textured by dermal denticles on dorsal and ventral surfaces. Thorns on dorsal surface, if present, usually on nuchal, scapular, and midback areas; predorsal tail thorns mostly in single midline row; interdorsal thorns present or absent; ventral surface usually without thorns. Vertebral counts: trunk vertebral counts 31 to 39, predorsal vertebral counts 68 to 122. Spiral valve counts 8 to 15. Maximum total length is about 175 cm. **Colour:** dorsal surface varying from whitish to dark brown, purplish, or black; dorsal surface either unmarked or with blotches or spots on pectoral fins; ventral surface usually white but may have dark blotches between gills or on abdomen, or grey edging of disc and pelvic fins.

Remarks: Globally about 50 nominal valid species have been described and named, but with several additional mostly deepwater species remaining to be described; this genus is one of the most diverse of elasmobranchs.

Key to Deep–sea Southeastern Pacific Ocean Species:

1a. Dorsal surface uniformly coloured, without blotches or spots **2**

1b. Dorsal surface uniformly coloured, with blotches or spots **7**

2a. Ventral surface colour uniform, lighter than dorsal surface, usually white to yellowish (Fig. 150) . . . . . ***Bathyraja griseocauda***

2b. Ventral surface colour different from, or darker than dorsal surface **3**

3a. Dorsal and ventral surfaces similarly coloured **4**

3b. Dorsal and ventral surfaces with different colorations **5**

4a. A medium sized softnose skate (maximum total length 110 cm), uniformly coloured dark brown on dorsal and ventral surfaces, with lighter areas around nostrils, mouth, and bases of pelvic fins and tail; ventral surface texture smooth to the touch (Fig. 151) . . . . . ***Bathyraja peruana***

4b. A very large sized softnose skate (maximum total length over 200 cm), uniformly coloured whitish to pale grey on dorsal and ventral surfaces, without lighter areas around nostrils, mouth, and bases of pelvic fins and tail; ventral surface densely covered with numerous dermal denticles giving it a rough to the touch texture (Fig. 152) . . . . . ***Bathyraja spinosissima***

5a. Disc with 3 nuchal thorns followed by median row of 6 to 8 midback thorns (Fig. 153). . . . . ***Bathyraja meridionalis***

5b. Disc without nuchal thorns, with median thorn row absent or originating at about tail origin. **6**

6a. Disc dorsal surface with median thorn row originating at about tail origin (Fig. 154). . . . . ***Bathyraja longicauda***

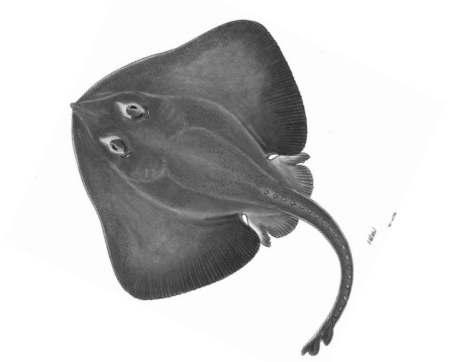


Fig. 150 ***Bathyraja griseocauda***

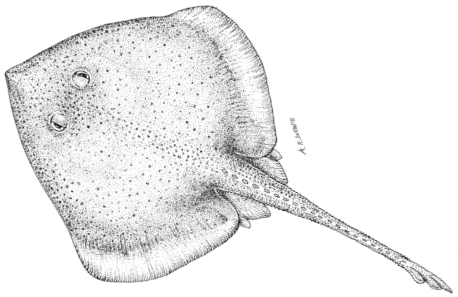


Fig. 151 ***Bathyraja peruana***

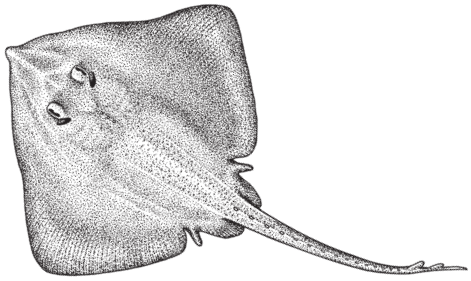


Fig. 152 ***Bathyraja spinosissima***

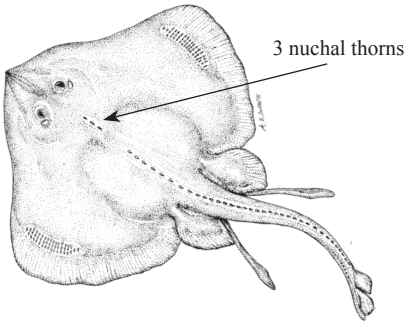


Fig. 153 ***Bathyraja meridionalis***

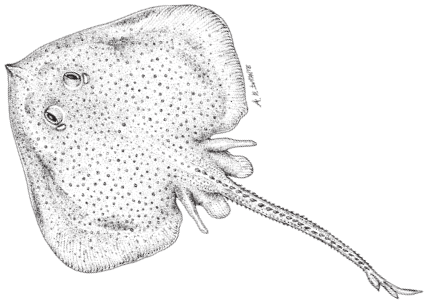


Fig. 154 ***Bathyraja longicauda***

6b. Disc dorsal surface without median thorn row (Fig. 155) . . . . . ***Bathyraja schroederi***

7a. Ventral surface uniformly coloured chocolate brown (Fig. 156) . . . . . ***Bathyraja aguja***

7b. Ventral surface mostly white to yellowish, occasionally with darker margins **8**

8a. Dorsal surface mostly smooth, with patches of minute, fine dermal denticles **9**

8b. Dorsal surface rough textured, with numerous prickles, denser along disc edges and midback. **11**

9a. A single scapular thorn on each shoulder (Fig. 157). . . . . ***Bathyraja multispinis***

9b. Scapular thorns absent **10**

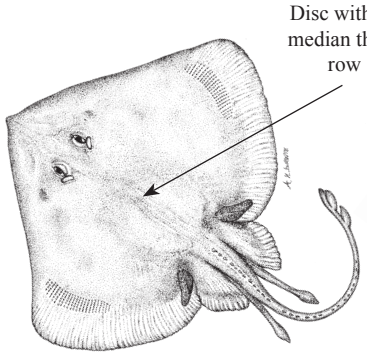


Fig. 155 ***Bathyraja schroederi***

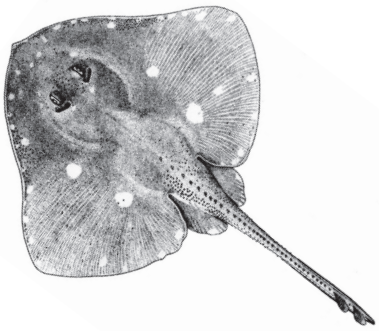


Fig. 156 ***Bathyraja aguja***

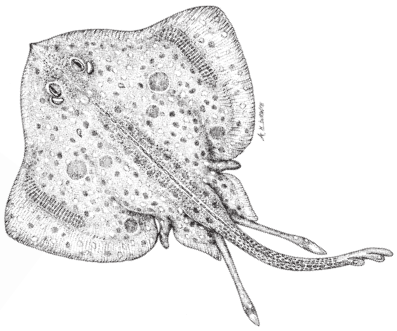


Fig. 157 ***Bathyraja multispinis***

10a. Tail length about equal to, or slightly longer that disc length from tip of snout to margin of cloaca; a single continuous median row of 17 to 23 midback and tail thorns; dorsal surface with numerous prominent scattered white spots; spots on tail do not give it a banded appearance (Fig. 158) . . . . . ***Bathyraja albomaculata***

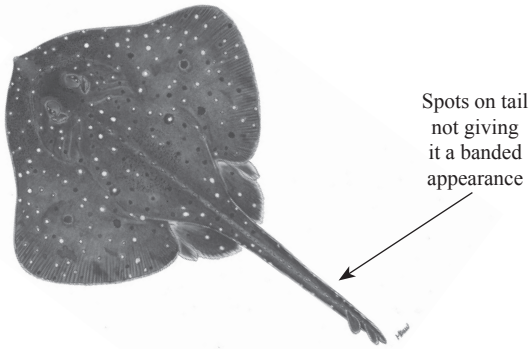


Fig. 158 ***Bathyraja albomaculata***

10b. Tail length slightly shorter that disc length from tip of snout to margin of cloaca; a single continuous median row of 16 to 20 midback and tail thorns; dorsal surface with symmetrically paired white spots of varying sizes; spots on tail giving it banded appearance (Fig. 159). . . . . ***Bathyraja brachyurops***

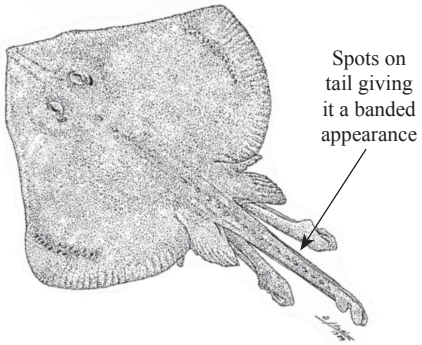


Fig. 159 ***Bathyraja brachyurops***

11a. Orbital and scapular thorns absent (Fig. 160) . . . . . ***Bathyraja cousseauae***

11b. Orbital (usually 2) and scapular thorns present . . **12**

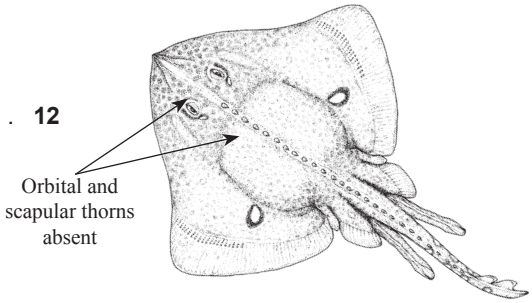


Fig. 160 ***Bathyraja cousseauae***

12a. One scapular thorn on each shoulder; dorsal coloration brownish, with indistinct scattered white spots, and a pair of larger distinct white spots with a brownish margin on pectoral–fin bases (Fig. 161). . . . . ***Bathyraja macloviana***

12b. Usually two scapular thorns on each shoulder; dorsal coloration ash-grey with numerous black spots, and a few paired white spots encircled by a rosette pattern of darker spots (Fig. 162) . . . . . ***Bathyraja magellanica***

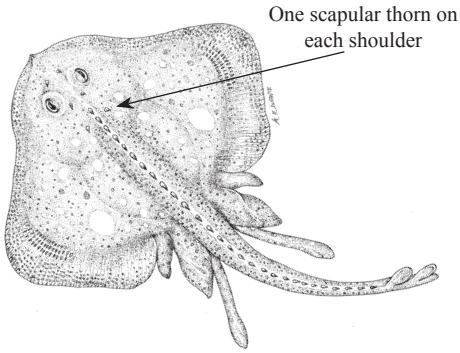


Fig. 161 ***Bathyraja macloviana***

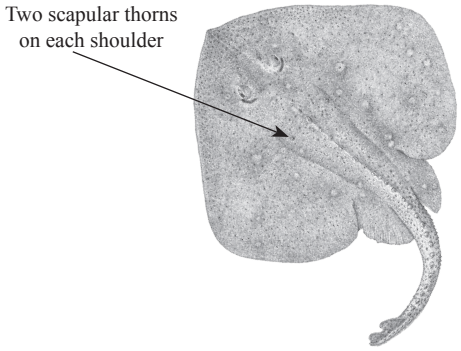


Fig. 162 ***Bathyraja magellanica***

Bathyraja aguja (Kendall and Radcliffe, 1912)

Raia aguja Kendall and Radcliffe, 1912, *Mem. Mus. Comp. Zool.*, 35: 78, figs. 1–2, Pl. 1. Holotype: United States National Museum, Smithsonian, USNM 65641, immature female, 480 mm total length, off Point Aguja, Peru, Albatross station 4653, 5°47'S, 87°24'W, 980 m.

Synonyms: None.

Other Combinations: ***Psammobatis aguja*** Chirichigno and Vélez, 1998: 85.

FAO Name: En – Aguja skate.

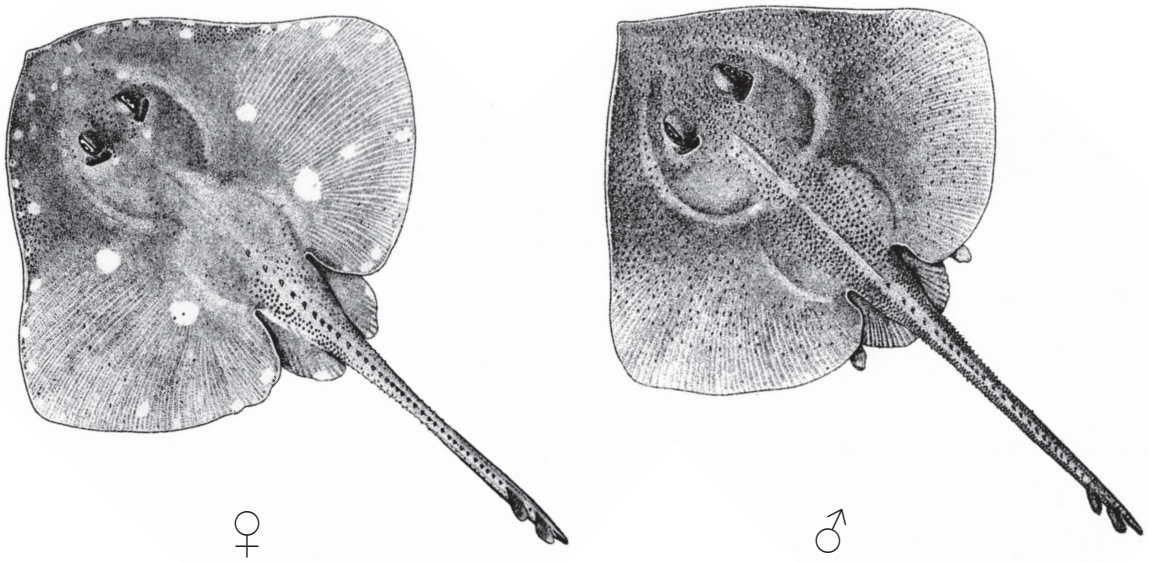


Fig. 163 ***Bathyraja aguja***

Field Marks: A distinctive skate with dorsal and ventral surfaces a uniform chocolate brown, with two distinctly light to pale coloured symmetrically arranged blotches on the dorsal surface of the pectoral fins, dorsal surface sparsely covered with denticles along the anterior margins, between the orbits, and along the tail, and a single row of thorns along the midback from about the tail origin extending to the first dorsal fin.

Diagnostic Features: Disc rhombic–shaped, length 80 to 86% of disc width; disc width 69% total length; anterior margins undulated; outer corners of disc broadly rounded; snout flexible, relatively short, about 12 to 14% total length; preorbital length about 2.8 to 3.7 times interorbital width; snout angle in front of spiracles over 90°. Pectoral–fin radials range from 72 to 81. Pelvic fins strongly incised, anterior pelvic–fin lobe 73 to 84% posterior lobe length; length not extending to posterior margin of posterior lobes. Tail very slender, moderately depressed, length 49 to 55% of disc length from tip of snout to margin of cloaca. Orbits of moderate size, diameter slightly less than interorbital width. Spiracles length slightly greater than one-half length of orbital diameter. Nasal curtain well developed and fringed along distal margin; internasal width about one-half preoral length. Mouth nearly straight; teeth arranged in quincunx, sexual dimorphism not reported. Tooth counts upper jaw 26 to 35, and lower jaw 28 to 32. Dorsal fins are similar in size and shape; interdorsal fin space separated by a distance less than base length. Disc surfaces sparsely covered with

denticles, except along anterior margin of disc, around and between orbital region of head, and along tail from origin to first dorsal fin. Thorn pattern on dorsal surface with single row of small midback thorns, about 33, posterior to maximum disc width extending to first dorsal fin; 0 or 1 interdorsal fin thorns; adult males with alar and malar thorns, details not available. Vertebral counts: trunk vertebral counts 31 to 35, predorsal caudal vertebral counts 62 to 66. Spiral valve counts not available. Maximum total length is about 76 cm. **Colour:** dorsal surface uniformly chocolate brown, with two symmetrically arranged large light spots at pectoral–fin bases and small, light coloured spots along disc margins and pelvic fins; ventral surface a uniform chocolate brown.

Distribution: Southeastern Pacific Ocean: Peru to Valparaiso, Chile.

Habitat: Upper continental slopes from 605 to 980 m.

Biology: Oviparous, but nothing else is known about the biology of this skate.

Size: Maximum total length is 76 cm; males mature at 76 cm, but female size at maturity is unknown. Size at birth is uncertain, although the smallest reported free-swimming specimen of this species measured 17.3 cm total length.

Interest to Fisheries and Human Impact: Of no commercial value, this uncommon deep-sea skate may be taken as bycatch and likely discarded.

The conservation status is Data Deficient.

Local names: Platillo (Peru).

Remarks: The original description of this species was based on two specimens, but re-examination of the paratype (MCZ 1364-S) found that it was a different species. McEachran and Miyake (1984) recognized it as a different species and described the former paratype as ***Bathyraja peruana***.

Literature: Kendall and Radcliffe (1912); McEachran and Miyake (1984); McEachran (2009); Cornejo *et al.* (2015).

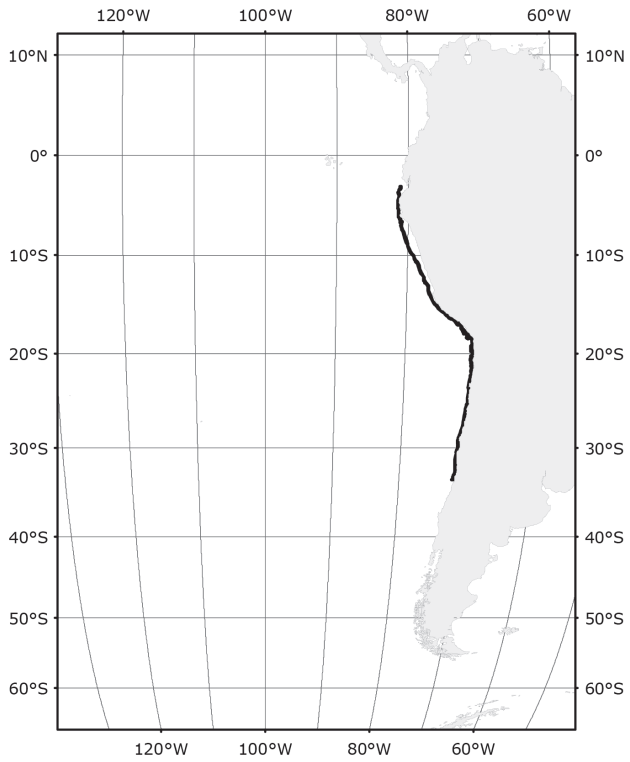


Fig. 164 ***Bathyraja aguja***

Known distribution

Bathyraja albomaculata (Norman, 1937)

Raja albomaculata Norman, 1937, *Discovery Repts.*, 16: 22, fig. 9, Pl. 5. Holotype: British Museum (Natural History), BMNH-1936.8.26.103, 630 mm TL, adult male, Patagonian-Falklands region, 53°30'15"S, 63°29'W, 403-434 m.

Synonyms: None.

Other Combinations: ***Rhinoraja albomaculata*** Compagno, 1999, 2005.

FAO Name: En – Whitedotted skate.

Field Marks: A moderately large softnose skate, with a disc length less than width, disc surface relatively smooth except for patches of small prickles on anterior of disc, snout, around eyes, and on midback; a single row of median thorns extending from nuchal region to first dorsal fin. Colour is dark to brownish or grey with numerous prominent, scattered white spots on the dorsal surface; ventral surface uniformly white.

Diagnostic Features: Disc broadly rhombic–shaped, width behind level of shoulder girdle greater

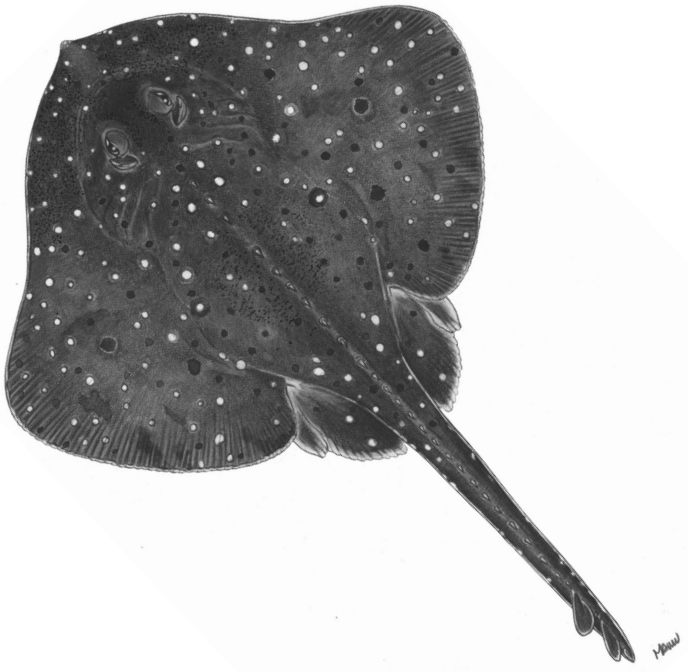


Fig. 165 ***Bathyraja albomaculata***

than disc length; disc width 66 to 75% total length; anterior margins not emarginated, slightly undulated; outer corners of disc broadly rounded; snout flexible, relatively short, about 17 to 20% total length; preorbital length about 1.8 to 2.0 times interorbital width. Pelvic fins deeply incised, anterior pelvic–fin lobes stout, of moderate length, not extending to posterior margin of posterior lobes. Tail slender and moderately depressed, length about equal to or slightly longer than disc length from tip of snout to margin of cloaca. Orbits moderately large, diameter about equal to or slightly less than interorbital width. Spiracles about one-half as long as orbits. Nasal curtain well developed and fringed along distal margin; internasal width more than one-half preoral length. Mouth nearly straight; teeth arranged in quincunx, sexual dimorphism not reported; teeth with single cusp, sometimes appearing worn and quite flat. Tooth counts upper and lower jaws 28 to 34. Dorsal fins are similar in size and shape, close-set, and with short interdorsal space. Disc surfaces mostly smooth, but with patches of minute coarse prickles, especially on anterior parts of pectoral fins, snout, around eyes, and on each side of median thorn row. Thorn pattern on dorsal surface: rostral, orbital, and scapular thorns absent; 2 to 4 nuchal thorns separated by a small gap from median thorn row; single continuous row of 17 to 23 median thorns from posterior of nuchal region to first dorsal fin, thorns most prominent on tail region; midline of tail with 14 to 16 prominent thorns; interdorsal space with 0 to 1 thorns; adult males with alar thorns in 3 to 4 longitudinal rows, and about 18 to 22 columns; malar thorns present, but reduced; ventral surface smooth, without thorns. Vertebral counts: not available. Spiral valve counts not available. Maximum total length is about 96 cm. **Colour:** dorsal surface dark brownish or grey, with numerous conspicuous small, scattered white spots, sometimes with dark brown margins; pelvic fins with narrowly edged white margins; ventral surface uniformly white.

Distribution: Southeastern Pacific Ocean: central and southern Chile. Elsewhere, the species is found in the southwestern Atlantic from the southern Patagonia shelf to Uruguay and around the Falkland Islands (Malvinas).

Habitat: Outer continental shelves and upper slopes from 55 to 861 m, and with a preferred water temperature ranging from 2.8 to 6.8 °C. This skate in the southwestern Atlantic appears to concentrate at different depths along the continental shelf; in the northern part of its range high densities have been found from 250 to 310 m deep, in the central part of its range between 100 and 130 m, and in the southern part of its range mostly from 160 to 190 m deep.

Biology: Oviparous with an estimated ovarian fecundity of 4 to 32. Eggs are deposited year round, with the autumn and winter months showing a slight increase in the proportion of gravid females. Egg cases for this skate have been described as yellowish-brown when first laid, but becoming dark brown during development. The surface of the egg case is relatively smooth, with small longitudinal striations; posterior horns are longer, thinner, and curved strongly inwards compared to the anterior horns; anterior edge of egg cases is concave relative to the more straight posterior edge; lateral keels are relatively narrow, less than 6% of egg case width.

The age at maturity is about 10 years for females and 11 years for males; maximum age has been estimated at 17 years.

The diet of this skate, unlike many skate species, is highly specialized as they consume primarily benthopelagic gammarids and polychaetes, and to a lesser extend isopods.

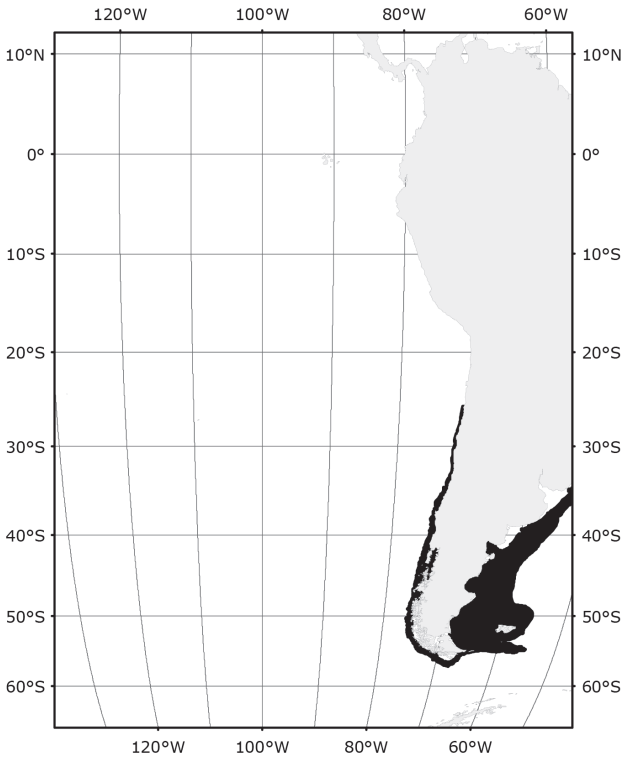


Fig. 166 ***Bathyraja albomaculata***

Known distribution

Size: Maximum total length is 96 cm; males mature at 59.4 to 62.8 cm and females at 57.2 to 65.3 cm. Size at birth is about 9 to 11 cm.

Interest to Fisheries and Human Impact: A regular bycatch in bottom trawl fisheries for bony fishes. Skates fisheries in Argentina have increased in recent years, but species-specific data is lacking for most fisheries.

The conservation status is Vulnerable due to possible declines in the abundance and biomass of this skate, especially in Argentine waters.

Local Names: Raya de manchas blancas (Chile), Rayas de lunares (Spanish).

Remarks: This species was placed in the genus ***Rhinoraja***, without explanation, by Compagno (1999, 2005) but the validity of this genus remains uncertain. Based on recent molecular data and a lack of definitive characters separating ***Rhinoraja*** from ***Bathyraja***, the species is allocated to this latter genus.

Literature: Norman (1937); Menni and Stehmann (2000); Agnew *et al.* (2003); Brickle *et al.* (2003); Henderson *et al.* (2005); Wakeford (2005); Ruocco *et al.* (2006); Cousseau *et al.* (2007); McCormack *et al.* (2007); Henderson and Arkhipkin (2010); Menni *et al.* (2010); Bustamante, Vargas-Caro, and Bennett (2014).

Bathyraja brachyurops (Fowler, 1910)

Raja brachyurops Fowler, 1910, *Proc. Acad. Nat. Sci. Philadelphia*, 62: 468. Syntypes: BMNH 1879.5.14.409-410 (2), Magellan Straits, Challenger station 313, depth 101 fathoms, Challenger station 314, 128 m. Replacement name for ***Raja brachyura*** Günther 1880, preoccupied by ***Raja brachyura*** Lafont 1873.

Synonyms: ***Raja brachyura*** Günther 1880, preoccupied by ***Raja brachyura*** Lafont 1873

Other Combinations: None.

FAO Name: En – Broadnose skate.

Field Marks: A moderately large softnose skate, with a disc length less than width, disc surface relatively smooth except for patches of small prickles on midback and anterior margin of disc. Colour dorsally is a uniform brownish grey with distinctive paired white spots on disc and tail; spots on tail give it a band-like appearance.

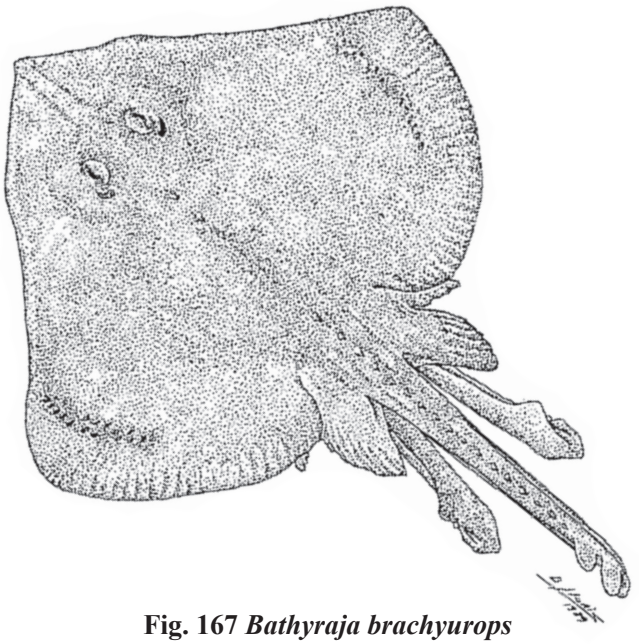


Fig. 167 ***Bathyraja brachyurops***

Diagnostic Features: Disc broadly rhombic–shaped, width behind level of shoulder girdle greater than disc length; anterior margins weakly undulated; outer corners of disc narrowly rounded; snout flexible; preorbital length greater than interorbital width. Pelvic fins deeply incised, anterior pelvic–fin lobes stout, not extending to posterior margin of posterior lobes. Tail stout and moderately depressed, length less than disc length from tip of snout to margin of cloaca. Orbits moderately large, diameter about equal to or slightly less than interorbital width. Spiracles about one-half as long as orbits. Nasal curtain well developed and fringed along distal margin. Mouth nearly straight; teeth arranged in quincunx, sexual dimorphism not reported; teeth with single cusp. Tooth counts not available. Dorsal fins are similar in size and shape, close-set, and with interdorsal space. Disc surfaces relatively smooth, with patches of minute, fine dermal denticles, on midback and anterior disc margins. Thorn pattern on dorsal surface: orbital, intraspiracular, and scapular thorns absent; 1 to 4 nuchal thorns followed by reduced or short gap from median thorn row; single continuous row of 16 to 20 median thorns from posterior of nuchal region to first dorsal fin; interdorsal space with 0 to 1 thorns; adult males with alar thorns in 3 to 6 longitudinal rows, and about 20 to 22 columns; ventral surface smooth, without thorns. Vertebral counts: not available. Spiral valve counts not available. Maximum total length is about 125 cm. **Colour:** dorsal surface dark uniform brownish or grey, with symmetrical paired white spots of varying sizes, spots on tail give it a banded appearance; ventral surface is white.

Distribution: Southeastern Pacific Ocean: southern Chile, south of Valdivia (40°S) to the Strait of Magellan. Southwestern Atlantic: southern Patagonia shelf, Argentina, around the Falkland Islands (Malvinas), Uruguay, and southern Brazil.

Habitat: Continental shelves and upper slopes from 28 to 604 m, and with a preferred water temperature ranging from 3.0 to 12.5 °C.

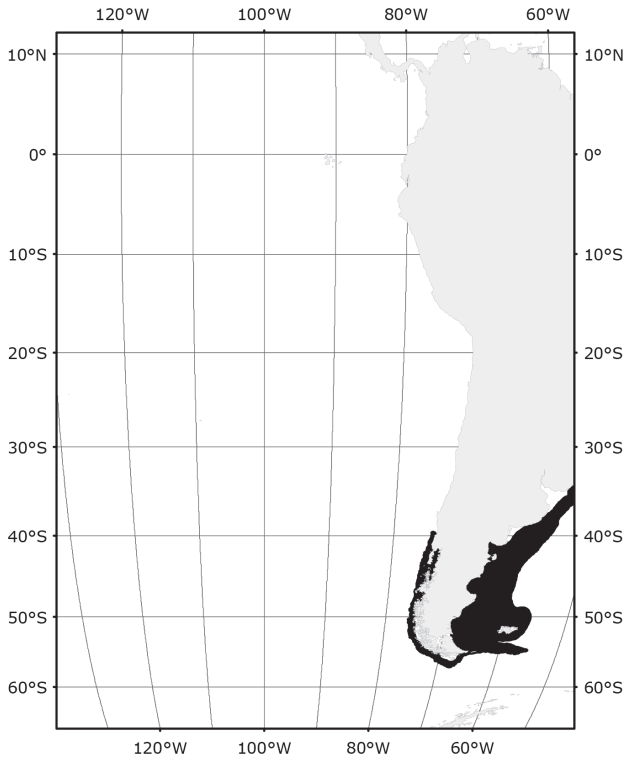


Fig. 168 ***Bathyraja brachyurops***

Biology: Oviparous, with egg cases moderately large, case length, excluding horns, 70 to 81% of maximum egg case width, surface relatively smooth, with finely striated, raspy denticles, without prickles; attachment fibers at bases of posterior horns and apron.

The age at maturity is about 8.2 years for females and 10 years for males; maximum age has been estimated at 20 years.

The diet of this skate changes with growth, with larger specimens consuming mostly small demersal fishes and smaller specimens feeding mostly on isopods; other prey items include cephalopods, amphipods, and polychaetes.

Size: Maximum total length is 125 cm; males mature at about 58 cm and females at 64 cm. Size at birth is about 9 to 11 cm.

Interest to Fisheries and Human Impact: A regular bycatch in Chilean waters in the ***Zearaja chilensis*** longline fishery and bottom trawl fisheries for bony fishes. This species is a significant component of the multi-species skate trawl fisheries around the Falkland Islands (Malvinas).

The conservation status is Least Concern.

Local Names: Raya De Los Canales (Chile), Raya Cola Corta (Spanish).

Remarks: A little known, but very common skate species where it occurs, it is best known from around the Falkland Islands (Malvinas), but less well-known from other parts of its range.

Literature: Fowler (1910); Bizikov *et al.* (2004); McCormack *et al.* (2007); Arkhipkin *et al.* (2008); Belleggia *et al.* (2008); Paesch and Oddone (2008); Mabragaña *et al.* (2011); Bustamante, Vargas-Caro, and Bennett (2014).

Bathyraja cousseauae Diaz de Astarloa and Mabragana, 2004

Bathyraja cousseauae Diaz de Astarloa and Mabragana, 2004, *Copeia* 2004(2): 327, figs. 1-5. Holotype: INIDEP 719, 617 mm TL, immature male, off northern Patagonian continental shelf, 41° 21S, 57° 25'W, 141 m deep.

Synonyms: None.

Other Combinations: None.

FAO Names: En – Joined-fins skate; **Sp** – Raja aletas juntas.

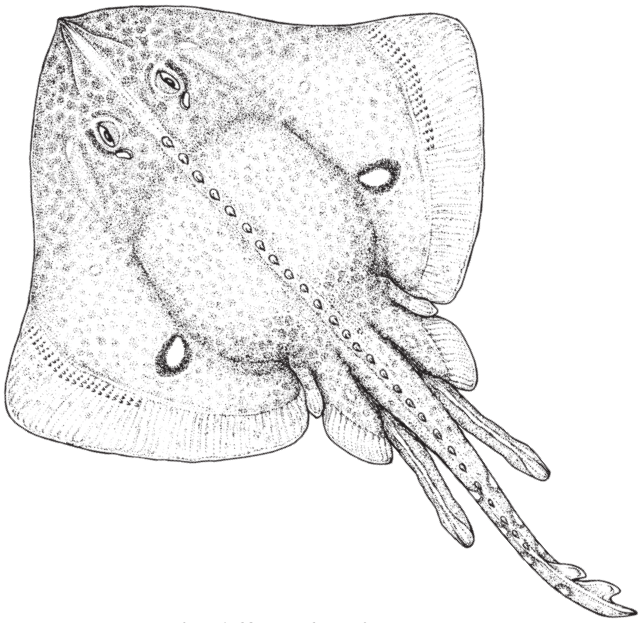


Fig. 169 ***Bathyraja cousseauae***

Field Marks: A moderately large softnose skate, with a disc length greater than width, numerous prickles on dorsal surface giving it a rough texture, and a midline on back with single row of enlarged thorns extending to the first dorsal fin. Colour is a dark brown with large, distinct pale ocellus-like area, numerous smaller dark and light spots, and darker brown margins on the posterior pectoral–fin edges.

Diagnostic Features: Disc broadly rhombic–shaped, width 1.3 times length; disc width 65 to 70% total length; maximum disc width broad, 71 to 87% of disc length, behind level of shoulder girdle; outer corners of disc acutely pointed; snout elongated, 17 to 21% total length; preorbital length about 2.3 to 3.0 times interorbital width. Pelvic fins deeply incised, anterior pelvic–fin lobes stout, of moderate length, not extending to posterior margin of posterior lobes. Tail slender and moderately depressed, length about equal to or slightly longer than disc length from tip of snout to margin of cloaca. Orbits moderately large, diameter about equal to or slightly less than interorbital width. Spiracles about one-half as long as orbits. Nasal curtain well developed and fringed along distal margin; posterior nasal flap less developed and smooth edged. Mouth nearly straight; teeth arranged in quincunx, sexual dimorphism not reported; teeth with single cusp, slightly arched posteriorly. Tooth counts upper and lower jaws 30 to 33. Dorsal fins are similar in size and shape, and overlapping with no interdorsal space. Disc surfaces covered with numerous coarse prickles, especially on inter-orbits, posterior pelvic lobes, tail, and dorsal fins. Thorn pattern on dorsal surface: single continuous row of 21 to 27 median thorns from nuchal region to first dorsal fin; midline of tail with 14 to 19 prominent thorns; adult males with alar thorns in 4 longitudinal rows; ventral surface smooth, without thorns. Vertebral counts: trunk vertebral counts 38 to 39, predorsal caudal vertebral counts 78 to 80. Spiral valve counts not available. Maximum total length is about 120 cm. **Colour:** dorsal surface dark brown with a conspicuous white or pale ocellus margined with brown on posterior part of pectoral fins, scattered indistinct pale and dark spots of various sizes, edge of pelvic–fin anterior lobes whitish, two to three incomplete bands across tail; ventral surface mostly a creamy white with posterior pectoral–fin margins and pelvic–fin lobe edges dusky brown.

Distribution: Southeastern Pacific Ocean: southern Chile and through the Magellan Straits into the southwestern Atlantic, including Argentina and around the Falkland Islands (Malvinas).

Habitat: Outer continental shelf and upper slope from 119 to 1011 m deep.

Biology: Oviparous, but very little else is known about its life history.

Size: Maximum total length 120 cm; males mature at 97 cm, female size at maturity unknown. Size at birth is about 12 cm.

Interest to Fisheries and Human Impact: Skates are targeted in Argentine fisheries for an export market, primarily to Korea. However, species-specific data for most skates landed is not available, including landing data for ***Bathyraja cousseauae***, which occurs throughout the areas where this fishery occurs.

The conservation status of this species is Near Threatened due to intense and increasing fisheries targeting skates in the region where this species occurs.

Local Names: No information.

Remarks: ***Bathyraja cousseauae*** was formerly referred to as a ***Bathyraja*** species from around the Falkland Islands (Malvinas). It was formerly misidentified with ***Bathyraja brachyurops***.

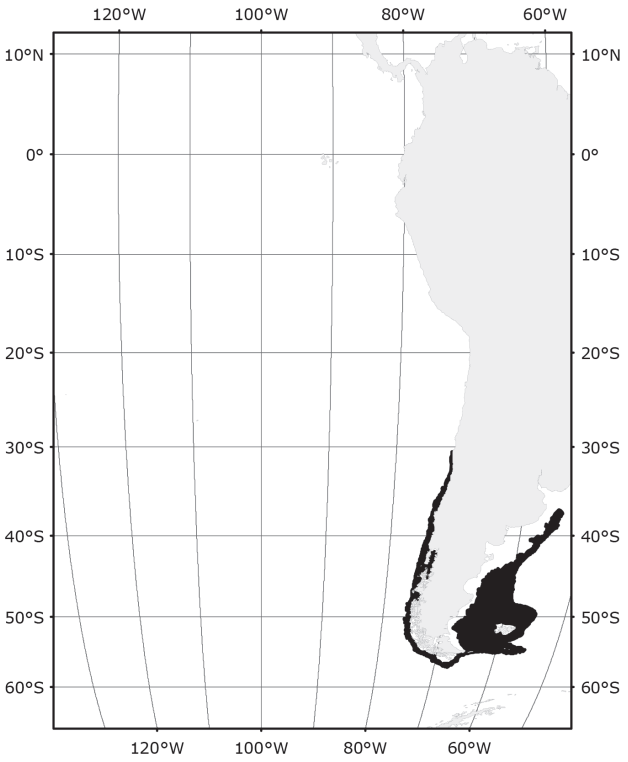


Fig. 170 ***Bathyraja cousseauae***

Known distribution

Literature: Diaz de Astarloa and Mabragana (2004); McCormack *et al.* (2007); Bustamante, Vargas-Caro, and Bennett (2014).

Bathyraja griseocauda (Norman, 1937)

Raja griseocauda Norman, 1937, *Disc. Repts.*, 16: 26, fig. 9. Holotype: British Museum (Natural History), BMNH-1936.8.26.157, 460 mm total length, female, Patagonia-Falklands region, Discovery station WS 817, 52°23'S, 64°19'W, 202 to 238 m.

Synonyms: ***Breviraja griseocauda***: Bigelow and Schroeder, 1965: 43, figs. 3 and 4.

Other Combinations: None.

FAO Name: En – Graytail skate.

Field Marks: A large softnose skate, with a disc width broader than its length, disc surface covered with patches of coarse prickles, a single median row of tail thorns, but no rostral, orbital, scapular, or midback thorns. Colour is uniform brown above, without any distinct markings, and white below.

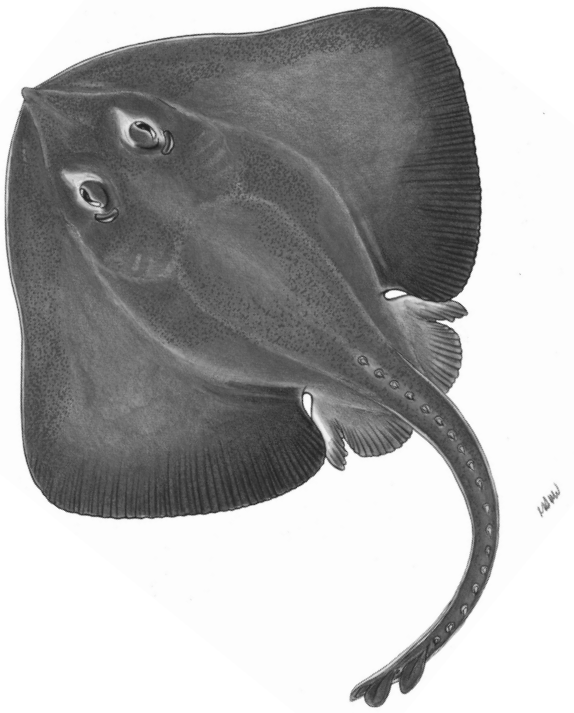


Fig. 171 ***Bathyraja griseocauda***

Diagnostic Features: Disc broadly rhombic–shaped, width broader than disc length; disc width about three-fourths total length; anterior margins nearly straight, not emarginated; outer corners of disc broadly rounded; snout flexible, about 16 to 17% total length; preorbital length about 2.3 to 2.5 times interorbital width. Pelvic fins deeply incised, anterior pelvic–fin lobes stout, of moderate length, not extending to posterior margin of posterior lobes. Tail stout, moderately depressed, length greater than disc length from tip of snout to margin of cloaca. Orbits moderate-sized, diameter longer than interorbital distance.

Spiracle length about one-half orbital diameter. Nasal curtain well developed and fringed along distal margin. Mouth nearly straight; teeth arranged in quincunx, sexual dimorphism not reported; teeth small, close-set, and with a single cusp. Tooth counts for upper and lower jaws about 22 to 36 in each jaw. Dorsal fins similar in shape and size, with a short inter-dorsal space between fin bases. Disc dorsal surface with areas of well-developed, rather widely spaced patches of coarse minute prickles; ventral surface smooth. Thorn pattern on dorsal surface: rostral, orbital, scapular, and midback thorns absent; single continuous row of 12 to 20 median thorns extending along tail to first dorsal fin, small dense prickles present on tail dorsal and lateral surfaces; interdorsal space with 0 or 1 thorn; 2 to 3 or more rows of alar thorns in adult males; ventral surface smooth, without thorns. Vertebral and spiral valve counts not available. Maximum total length is about 157 cm. **Colour:** dorsal surface uniformly brownish, darker on posterior pectoral–fin margins, dusky on pelvic fins, but without blotches, rings, or spots; ventral surface uniformly white or yellowish.

Distribution: Southeastern Pacific Ocean: southern Chile, and into the southwestern Atlantic, including Argentina and the Falkland Islands (Malvinas).

Habitat: Outer continental shelf and upper slopes from 82 to 1010 m off Argentina, but has a narrower depth range off Chile at 137 to 595 m. It appears to prefer water temperatures of 3 to 8 °C. Off the Falkland Islands (Malvinas) spatial segregation appears to take place with neonates moving from their hatching grounds at about 300 to 350 m deep into deeper water between 400 and 600 m. Larger immature skates move back into shallower water at between 200 and 400 m, but larger mature skates tend to remain in deeper water at 400 to 600 m or more.

Biology: Oviparous, with females laying egg cases year-round, but with slight peaks in the spring and autumn months. Age at maturity is about 17 to 18 years for females and about 14 years for males.

The diet is mostly composed of crustaceans and small benthic bony fishes. Smaller skates tend to feed more on crustaceans, while larger skates feeding more on bony fishes.

Size: Maximum total length about 157 cm; males mature at about 95 cm and female at 108 cm. Size at birth is about 12 to 16 cm.

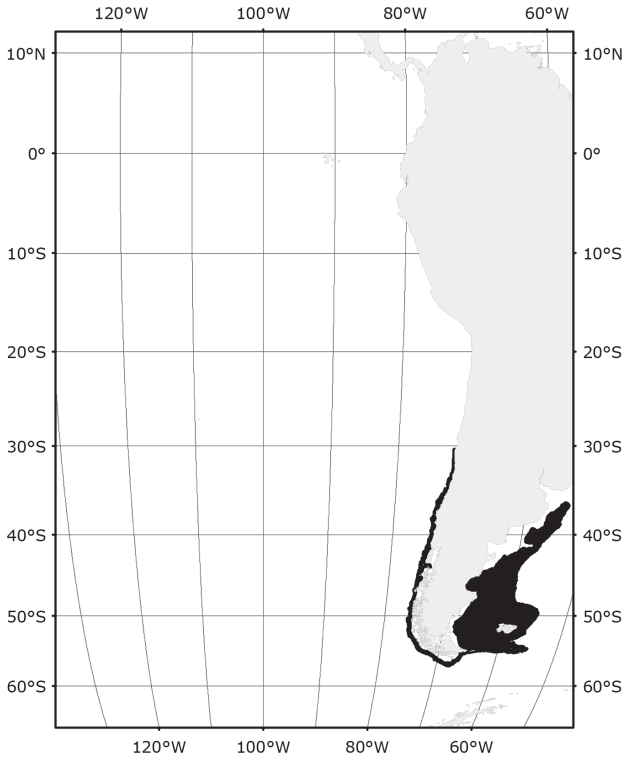


Fig. 172 ***Bathyraja griseocauda***

Interest to Fisheries and Human Impact: Taken in multispecies skate fisheries around the Falkland Islands (Malvinas) where it was once the dominant species, comprising around 70% of the catch. The proportion of ***B. griseocauda*** in catches dropped to around 5% in the mid-1990's. Similar declines have been reported throughout its range as it is taken in both targeted and non-targeted fisheries. In addition to bottom trawl fisheries it is taken as a retained bycatch in toothfish fisheries off Chile.

The conservation status of this skate species is listed as Endangered due to heavy fishing pressure throughout its known range and severe declines in the abundance of this skate since the 1970's.

Local names: Raya austral (Chile).

Remarks: Bigelow and Schroeder (1965) and Springer (1971) described this species, but Stehmann and Bürkel (1990) noted that this was actually an undescribed species.

Literature: Norman (1937); Springer (1971); Stehmann and Bürkel in Gon and Heemstra (1990); Agnew *et al.* (2000); Menni and Stehmann (2000); Brickle *et al.* (2003); Cousseau *et al.* (2007); McCormack *et al.* (2007); Arkhipkin *et al.* (2008, 2012); Menni *et al.* (2010); Bustamante, Vargas-Caro, and Bennett (2014).

Bathyraja longicauda (de Buen, 1959)

Breviraja longicauda de Buen, 1959, *Bolet. Mus. Nac. Chile*, 27(3): 182. Holotype (unique): EBMC 10181. Holotype figured in de Buen 1960: Fig. 9, immature male 293 mm total length, off Valparaíso, Chile.

Synonyms: None.

Other Combinations: None.

FAO Name: En – Slimtail skate.

Field Marks: Known from only four very small juvenile specimens, it can be separated from other species by its uniform tannish brown colour, slightly darker snout, and light blotches around its mouth, abdomen, anterior pelvic–fin lobes, and ventral tail surface, disc surface with denticles along anterior margins, snout, and between orbits, dorsal surface with 19 to 30 tail thorns, and ventral surface smooth.

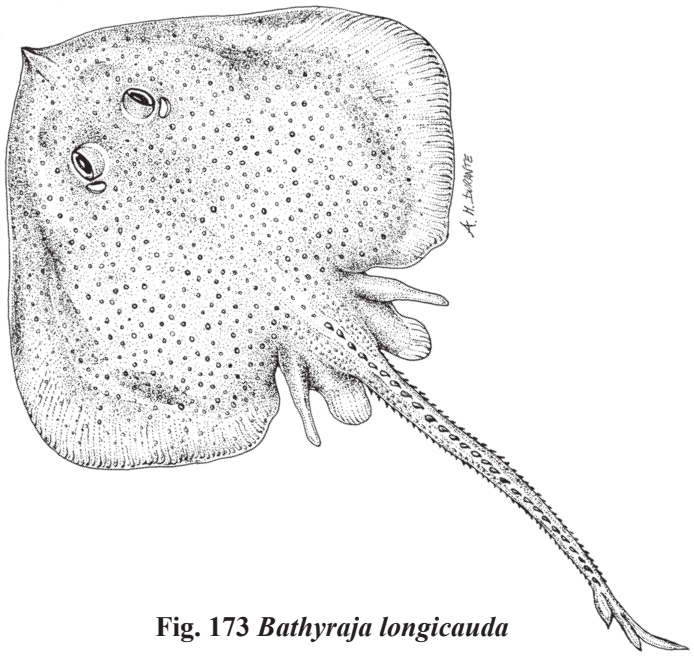


Fig. 173 ***Bathyraja longicauda***

Diagnostic Features: Disc rhombic–shaped, length 69 to 76% of disc width; disc width 64 to 67% total length; anterior margins undulated; outer corners of disc sharply rounded; snout flexible, relatively short, about 7.8 to 9.6% total length; preorbital length about 1.0 to 1.3 times interorbital width; snout angle in front of spiracles about 118° to 128°. Pectoral–fin radials 72. Pelvic fins strongly incised, anterior pelvic–fin lobes slender, acutely tipped, about equal to posterior lobes in length. Tail slender, with narrow lateral folds extending to caudal lobe origin, length 56 to 57% of disc length from tip of snout to margin of cloaca. Orbital diameter about equal to or slightly less than interorbital width. Spiracles length slightly less than one-half length of orbital diameter. Nasal curtain anterior nasal flaps fringed along posterior margin; posterior nasal flap poorly developed and weakly fringed; internasal width 60 to 75% preoral length. Mouth transverse; teeth arranged in quincunx, with short pointed cusps. Tooth counts upper jaw 32 to 34, lower jaw not available. First dorsal fin slightly larger than second; interdorsal fin space about equal to one-half base of first dorsal fin; second dorsal fin separated by short distance from weakly developed caudal lobe formed by confluence of lateral folds. Disc dorsal surface with dermal denticles or thornlets along anterior margin to level of second dorsal fin, and on snout and between orbits; ventral surface smooth. Thorns on disc dorsal surface originate at about tail origin and reach first dorsal–fin origin; tail with 19 to 30 small midrow thorns; 1 or 2 interdorsal thorns. Vertebral counts: trunk vertebral count 31, predorsal caudal vertebral count 62. Spiral valve counts not available. Maximum total length is uncertain, largest known specimen is an immature male 29.3 cm long. **Colour:** dorsal surface is a uniform tannish brown, except for darker brown snout tip and ampullar pores; ventral surface slightly darker brown than dorsal surface except for darker snout tip, and light tan blotches around mouth, abdominal center, pelvic–fin anterior lobes, and entire surface of tail.

Distribution: Southeastern Pacific Ocean: Chile and Peru.

Habitat: A little skate, known from only a few specimens, that occurs along the upper continental slopes from 580 to 735 m.

Biology: Nothing is known of its biology.

Size: Maximum total length unknown, the largest individual measured is a male 29.3 cm long. Adults are unknown at this time. Size at birth is uncertain, the smallest known free-swimming individual measured 18.3 cm total length.

Interest to Fisheries and Human Impact: None, the species appears to occur at depths beyond where fisheries occur.

The conservation status is Data Deficient, since the species is known only from a very few specimens.

Local Names: Raya (Chile); Raya de cola larga (Spanish).

Remarks: This species is extremely rare and only known from four small juveniles, all less than 30 cm total length. The external characteristics provided here may change ontogenetically with growth and maturity. Any specimens of this species should be retained for further examination.

Literature: de Buen (1959); McEachran and Miyake (1984); Lamilla (2004); Bustamante, Vargas-Caro, and Bennett (2014); Cornejo *et al.* (2015).

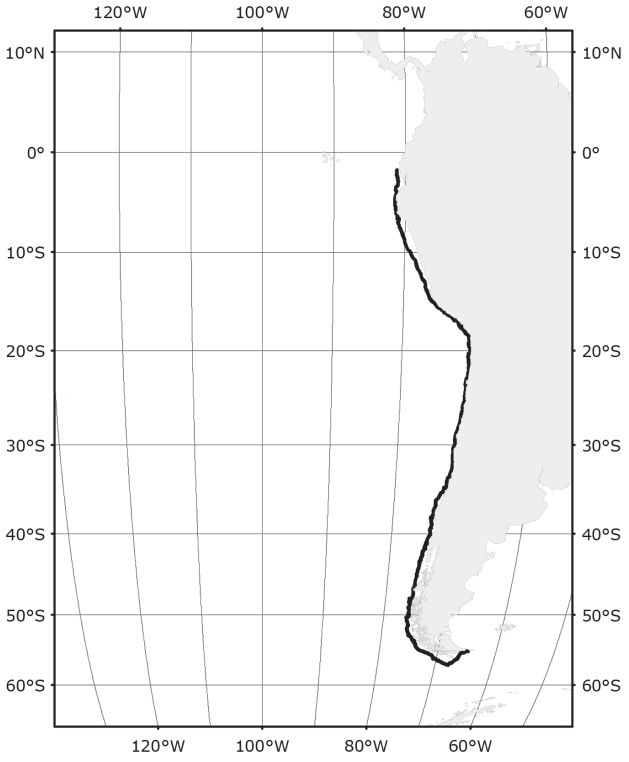


Fig. 174 ***Bathyraja longicauda***

Bathyraja macloviana (Norman, 1937)

Raja macloviana Norman, 1937, *Disc. Repts.*, 16: 17, fig. 5. Holotype: British Museum (Natural History), BMNH-1936.8.26.72, 425 mm, mature male, Patagoinan-Falklands region, Discovery station WS225, 50° 20'S, 62° 30'W, 161 to 162 m.

Synonyms: ***Rhinoraja macloviana***: Compagno, 1999: 489; Compagno, 2005: 533; Ebert and Compagno, 2007: 12.

Other Combinations: None.

FAO Name: En – Patagonia skate.

Field Marks: A moderate-sized softnose skate, with a disc length less than width, disc surface covered with numerous coarse prickles, an anterior and posterior orbital thorn, a pair of scapular thorns, and a single median thorn row extending from nuchal region to first dorsal fin. Colour is brown, with indistinct scattered white spots, with darker edges, a pair of large, distinct white spots, with a dark brown margin, on pectoral–fin bases; ventral surface uniformly white.

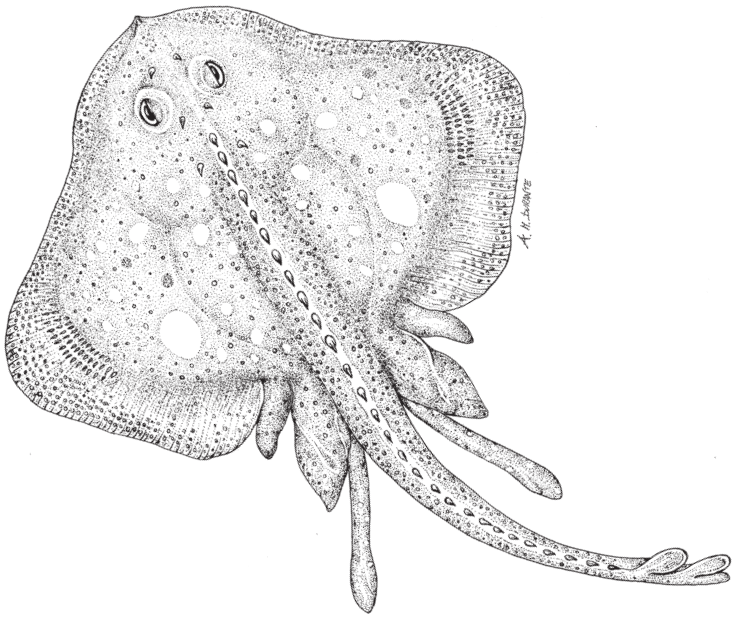


Fig. 175 ***Bathyraja macloviana***

Diagnostic Features: Disc broadly rhombic–shaped, width 1.5 times its length; disc width 65 to 70% total length; maximum disc width broad, distance slightly greater than disc length, behind level of shoulder girdle; anterior margins not undulated or emarginated, outer corners of disc broadly rounded; snout soft, flexible, relatively short, 14 to 17% total length; preorbital length greater than interorbital width. Pelvic fins deeply incised, anterior pelvic–fin lobes stout, of moderate length, not extending to posterior margin of posterior lobes. Tail relatively stout, moderately depressed, short, length about equal to disc length from tip of snout to margin of cloaca. Orbits moderately large, diameter about equal to or slightly less than interorbital width. Spiracles about one-half as long as orbits, and extending forward below eye. Nasal curtain well developed and fringed along distal margin; posterior nasal flap less developed and smooth edged; internasal width more than one-half preoral snout length. Mouth nearly transverse; teeth arranged in quincunx, sexual dimorphism not reported; teeth with flattened crown and a single cusp. Tooth counts upper and lower jaws 26 to 36. Dorsal fins are similar in size and shape, located near tail tip, fins not overlapping, interdorsal space small, usually with interdorsal thorn. Disc dorsal surface covered with numerous coarse prickles, especially numerous and close-set along anterior margins and midback; ventral surface smooth. Thorn pattern on dorsal surface: a single thorn in front of and behind the orbit; a single scapular thorn on each shoulder; single continuous row of 25 to 29 median thorns from nuchal region to first dorsal fin; midline of tail with 18 to 19 prominent thorns, with irregular rows of much smaller thorns along edges of tail; interdorsal space with 1 thorn; adult males with alar thorns in 2 to 3 longitudinal rows, and about 15 to 16 columns; malar thorns present, but reduced; ventral surface smooth, without thorns. Vertebral counts: not available. Spiral valve counts not available. Maximum total length is about 77 cm. **Colour:** dorsal surface brownish, with some indistinct scattered round white spots, margins edged in dark brown or blackish; a pair of larger, more distinct white spots, ringed with dark brown, on posterior portion of pectoral–fin bases; posterior pectoral and pelvic–fin margins with lighter, white edges in young; ventral surface uniformly white or yellowish.

Distribution: Southeastern Pacific and southwestern Atlantic oceans: southern Chile and around southern Patagonia to Argentina, Uruguay, and the Falkland Islands (Malvinas).

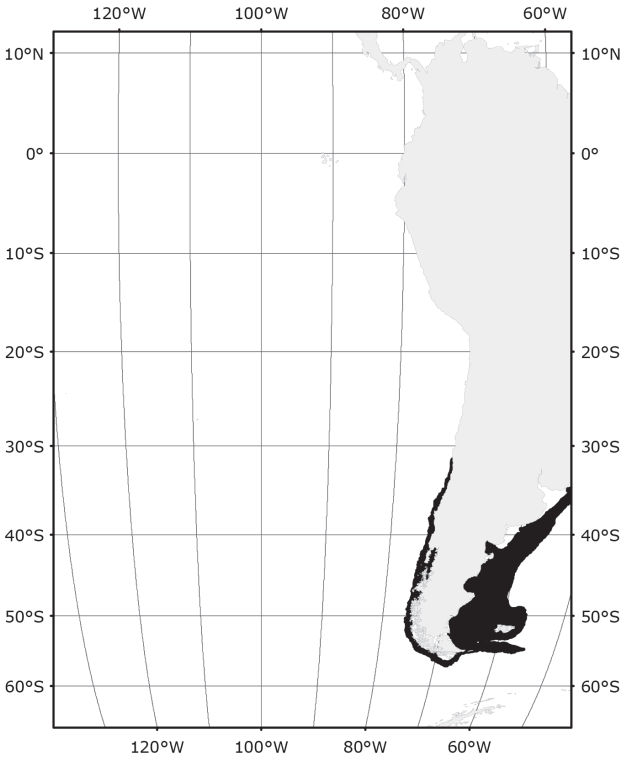


Fig. 176 ***Bathyraja macloviana***

Habitat: A common, but little known species found on continental shelves and upper and insular slopes from 53 to 514 m deep. The bottom water temperature ranges from 3.5 to 7.3 °C where these skates occur.

Biology: Oviparous, but little else known. The diet consists of polychaetes and to a lesser extent on amphipods, isopods, and decapods.

Size: Maximum total length is 77 cm; males adult at 53 cm and females adult at 55 cm. Size at birth about 13 cm based on smallest free-swimming individual.

Interest to Fisheries and Human Impact: This species is regularly taken by directed skate skate fisheries and as bycatch in hake (***Merluccius* spp.**) and toothfish (***Dissostichus* spp.**) fisheries, but there is no species-specific information on what percentage this species comprises of the catch.

The conservation status of this species is Near Threatened.

Local names: Raya blanca (Chile).

Remarks: This species is sometimes placed in the genus ***Rhinoraja***, but the validity of that genus is uncertain, and is currently under investigation.

Literature: Norman (1937); Pequeño and Lamilla (1993); Agnew *et al.* (2000); Menni and Stehmann (2000); Brickle *et al.* (2003); Wakeford *et al.* (2005); McCormack *et al.* (2007); Bustamante, Vargas-Caro, and Bennett (2014).

Bathyraja magellanica (Philippi, 1902)

Raja magellanica Philippi, 1902, *Anal. Univ. Chile*, 109: 312 [12], on p. 12 of separate. Holotype: MNHNCh. Magellan Strait, Chile.

Synonyms: None.

Other Combinations: ***Rhinoraja magellanica*** (Philippi, 1902): Compagno, 1999: 489.

FAO Name: En – Magellan skate.

Field Marks: A moderate sized softnose skate, with an ash-grey dorsal disc surface, numerous prominent black spots, some forming rosettes on disc, with lighter spots and tail with 2 or 3 light spots giving it a banded appearance, 1 or 2 thorns on inner orbital margin, 2 scapular thorns on each shoulder, and a median row of thorns extending from nape to first dorsal fin.

Fig. 177 ***Bathyraja magellanica***

Diagnostic Features: Disc rhombic–shaped, width behind level of shoulder girdle greater than disc length; disc width slightly greater than total length; anterior margins slightly undulated; outer corners of disc broadly rounded; snout flexible, moderately short, and blunt. Pelvic fins deeply incised, anterior fin lobes stout, not extending to posterior margin of posterior lobes. Tail stout, slender, moderately depressed, length about equal to or slightly less than disc length from tip of snout to margin of cloaca. Orbits moderately large. Spiracles about one-half orbital length. Nasal curtain with short fringed margin. Mouth transversely straight, relatively small; teeth arranged in quincunx; teeth with short, blunt, single cusp. Tooth counts not available. Dorsal fins are similar in shape, with short interdorsal space. Dorsal disc surface with coarse dermal denticles, most dense along midback and disc margins, less dense at pectoral–fin bases; ventral surface mostly smooth. Thorn pattern on dorsal surface: orbital thorns small, 1 or 2 located between orbits, scapular thorns 2 on each shoulder, a single median row of 25 to 32 thorns extending from the nuchal region to the first dorsal fin, interdorsal thorns 1; alar thorns of adult males arranged in 2 to 4 rows with 18 to 20 columns; ventral surface without thorns. Vertebral counts: not available. Spiral valve counts not available. Maximum total length is at least 105 cm. **Colour:** dorsal surface an ash-grey with numerous black spots, with a few white spots circled by a rosette pattern of darker spots; tail with lighter spots giving it a band-like appearance; ventral surface white.

Distribution: Southeastern Pacific Ocean: southern Chile. Southwestern Atlantic: southern Patagonia shelf, Uruguay, and around the Falkland Islands (Malvinas).

Habitat: A little known deep-sea skate of the outer continental shelves and upper slopes from 51 to 600 m, and with a preferred water temperature ranging from 3.5 to 11.0 °C.

Biology: Oviparous, but little is known in Chilean waters. Egg cases for this skate are large, 8.0 to 8.8 cm in length, with a wide

lateral keel, no attachment fibers, and a light coloration. The surface of the egg case is relatively smooth, with fine longitudinal striations, and coarse prickles; posterior horns are relatively short, but slightly longer than the anterior horns.

The age at maturity has been estimated at 4 years for both sexes, with a maximum age estimate of 9 years.

The diet of this skate is primarily on teleosts, amphipods, isopods, and decapods, with a pronounced shift in preference from invertebrates to bony fishes with growth.

Size: Maximum total length is 105 cm; males mature at 58.0 to 63.8 cm and females at 58.0 to 65.3 cm. Size at birth is about 14 to 16 cm.

Interest to Fisheries and Human Impact: A bycatch in bottom trawl fisheries for bony fishes, the species is best known in the southwestern Atlantic, but data from Chile is lacking.

The conservation status is Data Deficient.

Local names: Raya de Magallanes (Chile).

Remarks: This species was placed in the genus ***Rhinoraja***, without explanation, by Compagno (1999, 2005) but the validity of this genus remains uncertain. Based on recent molecular data and a lack of definitive characters separating ***Rhinoraja*** from ***Bathyraja***, the species is allocated to this latter genus.

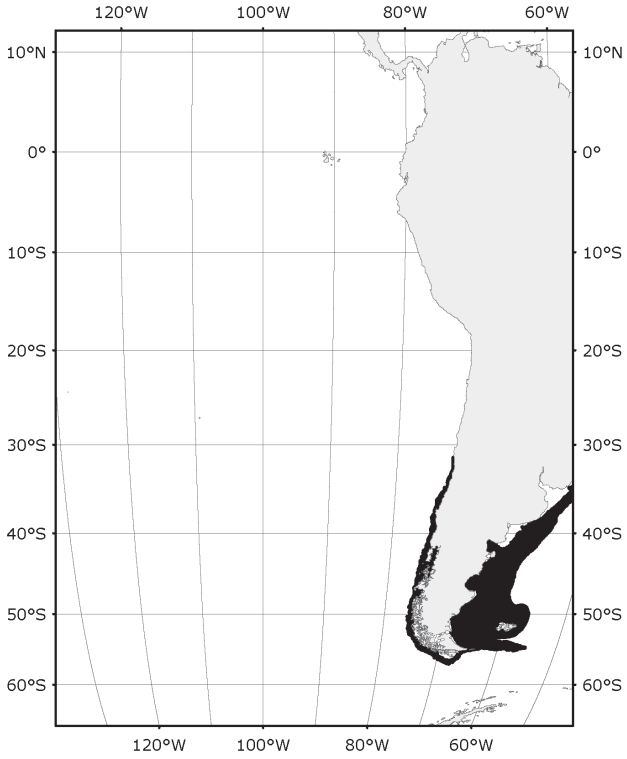


Fig. 178 ***Bathyraja magellanica***

Literature: Compagno (1999, 2005); Buecker (2006); McCormack *et al.* (2007); Barbini *et al.* (2010); Mabragaña *et al.* (2011); Bustamante, Vargas-Caro, and Bennett (2014); Scenna and Díaz de Astarloa (2014).

Bathyraja meridionalis Stehmann, 1987

Bathyraja meridionalis Stehmann, 1987, *Arch. Fischereiwiss.*, 38 (1-2): 37, Figs. 1-9. Holotype: ZMH 24933 [ex ISH 328-1976], eastern slope off South Georgia Island, South Atlantic, Walther Herwig station 33/76, 53°56'S, 35°40'W, 800 m.

Synonyms: None.

Other Combinations: None.

FAO Name: En – Darkbelly skate.

Field Marks: A large softnose skate, with a plain coffee to blackish brown coloration, and lighter to whitish coloured thorns and dermal denticles, a plain dark greyish brown, with lighter patches around nostrils, mouth, gill openings, and pelvic–fin lobes. A single median row of 37 to 39 thorns extending from the nuchal region to the first dorsal fin.

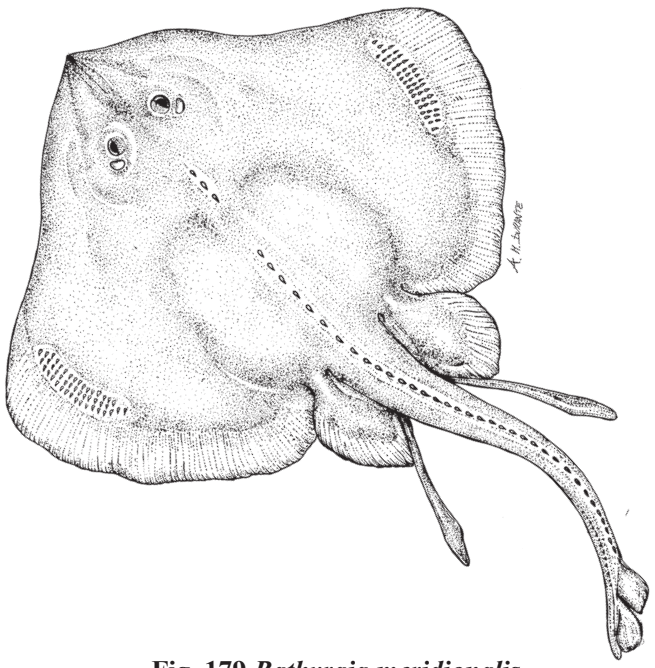


Fig. 179 ***Bathyraja meridionalis***

Diagnostic Features: Disc broadly rhombic–shaped, width behind level of shoulder girdle 1.2 to 1.3 times greater than disc length; disc width 63.7 to 68.5% total length; anterior margins slightly undulated; outer corners of disc broadly rounded; snout flexible, moderately short, about 12.3 to 13.5% total length; preorbital length 2.5 to 3.0 times interorbital width; snout angle in front of spiracles about 115° to 117°. Pectoral–fin radials 88. Pelvic fins deeply incised, anterior fin

lobes stout, not extending to posterior margin of posterior lobes; pelvic–fin radials 1 + 24 to 25. Tail slender, moderately depressed, tapering towards tip, length about 1.1 to 1.2 times longer than disc length from tip of snout to margin of cloaca. Orbits moderately large, diameter 80 to 84% of interorbital width. Spiracles about 1.7 to 1.9 times as long as orbits. Nasal curtain undulated at outer margins, posterior margins short, relatively straight, with short fringed margin; internasal width more than one-half preoral length. Mouth transversely straight, relatively small; teeth arranged in quincunx; teeth with short, blunt, single cusp. Tooth counts upper jaw 28 to 29, and lower jaw 23 to 29. Dorsal fins are similar in shape, second slightly smaller than first in size, with short interdorsal space. Dorsal disc surface with coarse prickles, except smooth on snout tip, orbits, sides of trunk, posterior pelvic–fin lobes, and along disc margins; denser along trunk midback; ventral surface mostly smooth except at tail base. Thorn pattern on dorsal surface: rostral, orbital, and scapular thorns absent; 3 nuchal thorns separated by a small gap from median thorn row; single continuous row of 6 to 8 trunk thorns, followed by 28 tail thorns; interdorsal space with 1 thorn; adult males with alar thorns in 3 longitudinal rows, and about 15 to 18 columns; malar thorn details unavailable; ventral surface smooth, without thorns. Vertebral counts: trunk vertebral counts 32 to 38, predorsal caudal vertebral counts 80 to 82. Spiral valve counts not available. Maximum total length is at least 158 cm. **Colour:** dorsal surface a plain coffee to blackish brown with milky white dermal denticles and thorns; ventral surface a plain dark greyish brown, except for nasal flaps, nasal curtain edge, jaws, gill openings, and anterior pelvic–fin lobe distal edges which are a distinct creamy-white.

Distribution: Southeastern Pacific Ocean: southern Chile. Southwestern Atlantic and Southern Ocean: southern Patagonia and around the Falkland Islands (Malvinas), South Georgia Island, and possibly circumglobal in the Southern Ocean.

Habitat: Upper slopes and around submarine ridges and seamounts from 65 to 2240 m, but may occur deeper.

Biology: Oviparous, but nothing else known of its biology.

Size: Maximum total length is 158 cm; males mature at 115 to 130 cm and females at 113 to 125 cm. Size at birth is uncertain.

Interest to Fisheries and Human Impact: Very little is known on the impact from fishing operations, but it is taken as bycatch in longline fisheries, especially for Patagonian Toothfish (***Dissostichus eleginoides***).

Conservation status Data Deficient due to a lack of information on its biology, catch data, and occurrence.

Local names: No information.

Remarks: A very poorly known species that may have a wider distribution than currently known, but may be misidentified with other similar deep-sea skates in the region.

Literature: Stehmann (1987); Stehmann and Pompert (2009); Ebert and Winton (2010); Bustamante, Vargas-Caro, and Bennett (2014).

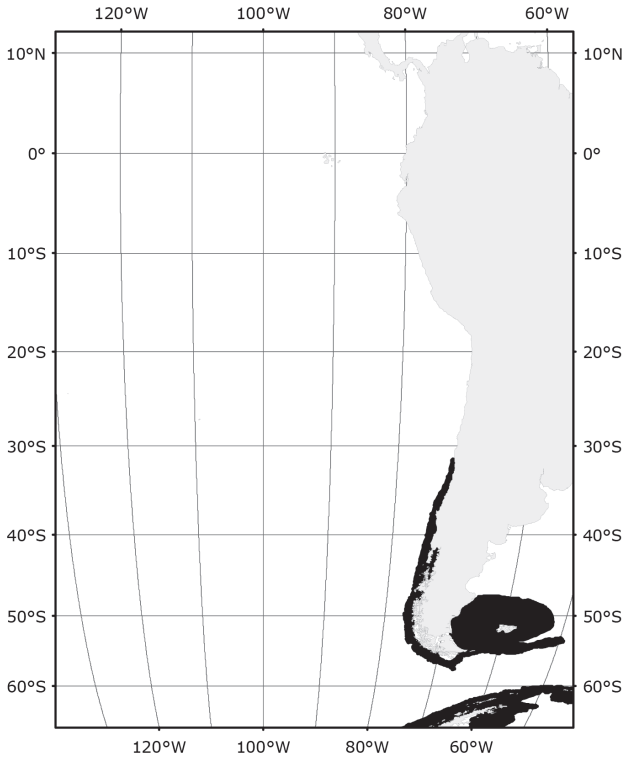


Fig. 180 ***Bathyraja meridionalis***

Known distribution

Bathyraja multispinis (Norman, 1937)

Raja multispinis Norman, 1937, *Disc. Repts.*, 16: 20, fig. 6. Holotype: British Museum (Natural History), BMNH-1936.8.26.95, 320 mm TL immature male, 51°39'30"S, 62°01'15"W, NW of Falkland Islands (Malvinas), 221 to 197 m.

Synonyms: ***Rhinoraja multispinis***: Compagno, 1999: 489; Compagno, 2005: 533; Ebert and Compagno, 2007: 12.

Other Combinations: None.

FAO Name: En – Multispine skate.

Field Marks: A large softnose skate, with a disc length shorter than width, disc surface relatively smooth with patches of prickles on snout, around eyes, and posterior portion of pectoral fins, a single scapular thorn on each shoulder, a single median thorn row extending from nuchal region to first dorsal fin, median tail thorns with 3 to 4 lateral rows of smaller thornlets. Colour is a greyish-brown, with scattered faint dark and pale spots; ventral surface uniformly white.

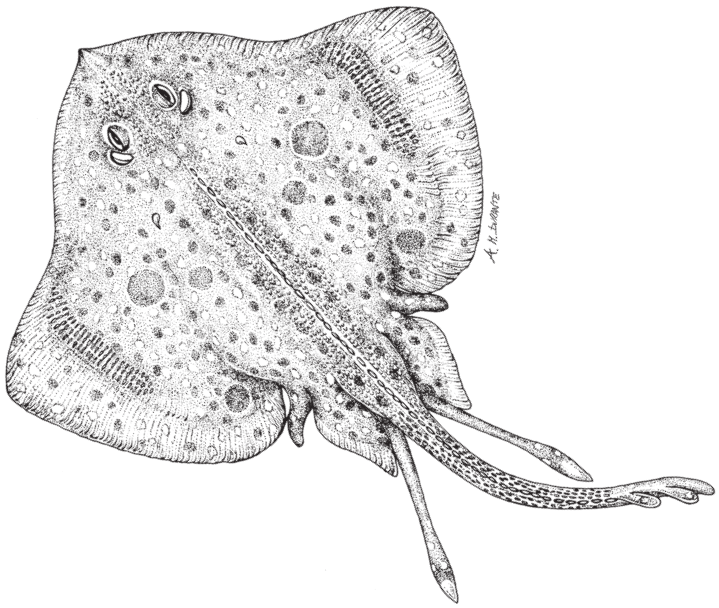


Fig. 181 ***Bathyraja multispinis***

Diagnostic Features: Disc broadly rhombic–shaped, width broader than disc length; disc width about 75% total length; anterior margins nearly straight, not emarginated on juveniles and females, becoming undulated on adult males; outer corners of disc broadly rounded; snout flexible, relatively short, about 16 to 17% total length, with very short triangular projection at tip; preorbital length about 2.4 times interorbital width. Pelvic fins deeply incised, anterior pelvic–fin lobes stout, of moderate length, not extending to posterior margin of posterior lobes. Tail slender and moderately depressed, length greater than disc length from tip of snout to margin of cloaca. Orbits moderate-sized, diameter longer than interorbital distance. Spiracle length about one-half orbital diameter. Nasal curtain well developed and fringed along distal margin; internasal width about one-half preoral length. Mouth nearly straight; teeth arranged in quincunx, sexual dimorphism not reported; teeth close-set, with flattened crowns, and a single cusp. Tooth counts upper and lower jaws about 24 in each jaw. Dorsal fins similar in shape, first dorsal fin slightly larger than second, with a short interdorsal space between fin bases; distance from second dorsal fin to tail tip about length of first dorsal–fin base. Disc dorsal surface mostly smooth, but with areas of well-developed, rather widely spaced minute prickles on snout, around eyes, on anterior parts of pectoral fins, and along midback on each side of median thorn row; ventral surface smooth. Thorn pattern on dorsal surface: rostral and orbital thorns absent; a single scapular thorn on each shoulder; single continuous row of 42 median thorns extending from posterior of nuchal region to first dorsal fin, thorns more prominent on tail region; midline of tail with single row of about 23 prominent thorns and 3 to 4 rows of very small thornlets on each side; interdorsal space with 1 thorn; ventral surface smooth, without thorns. Vertebral and spiral valve counts not available. Maximum total length is about 119 cm. **Colour:** dorsal surface greyish-brown, with areas of faint pale and darker spots; ventral surface uniformly white.

Distribution: Southeastern Pacific Ocean: southern Chile, and into the southwestern Atlantic, from Argentina to southern Brazil, and the Falkland Islands (Malvinas).

Habitat: This species appears to occupy an outer shelf-upper slope habitat, on soft bottoms of sand or mud, mostly between about 180 and 250 m deep, but with an overall depth range of 82 to 740 m. It appears to have a very stenothermic-stenohaline behaviour compared to other regional skates. Its movements are tied to water temperatures, with a preference for bottom temperatures of 4º to 6ºC.

Biology: Oviparous, but very little else is known about its biology. The diet of this skate includes decapod crustaceans.

Size: Maximum total length about 119 cm; males mature at about 93.4 cm, female maturity uncertain. Size at birth uncertain, but smallest free-swimming individual measured 12.6 cm long.

Interest to Fisheries and Human Impact: Of minimal fisheries importance, this species is taken as bycatch in bottom trawl and longline fisheries. In Argentina and Uruguay it is a regular bycatch component in hake (***Merluccius hubbsi***) fisheries, with a decline in its biomass having been reported. It is also taken as bycatch in fisheries around the Falklands and southern Chile.

The conservation status of this species is Near Threatened due to declines in portions of its range. This skate appears to be rarer than other species in terms of biomass.

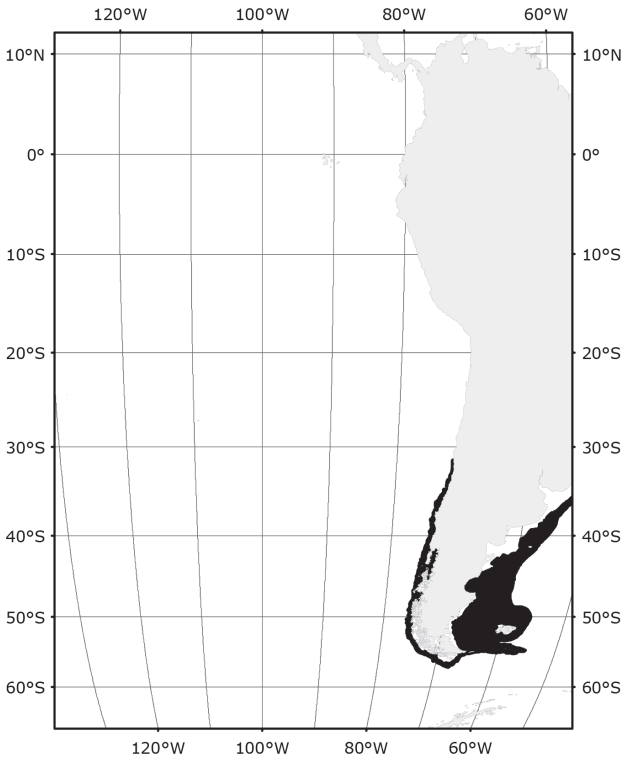


Fig. 182 ***Bathyraja multispinis***

Known distribution

Local names: Raya aserrada (Chile).

Literature: Norman (1937); Lamilla and Pequeño (1999); Menni and Stehmann (2000); Rovedder and Vooren (2003); McCormack *et al.* (2007); Arkhipkin *et al.* (2012); Bustamante, Vargas-Caro, and Bennett (2014).

Bathyraja peruana McEachran and Miyake, 1984

Bathyraja peruana McEachran and Miyake, *Proc. Biol. Soc. Washington*, 97(4): 774, figs 1-4. Holotype: Museum of Comparative Zoology, MCZ 1364-S, 286 mm total length, immature male, off Point Aguja, Peru, Albatross station 4653, 5°47'S, 87°24'W, 980 m.

Synonyms: None.

Other Combinations: None.

FAO Name: En – Peru skate.

Field Marks: A medium sized softnose skate, with dorsal and ventral surfaces uniformly dark brown coloured, no disc thorns, dermal denticles covering the dorsal disc surface, and a single row of small tail thorns distinguishes this skate from others in the region.

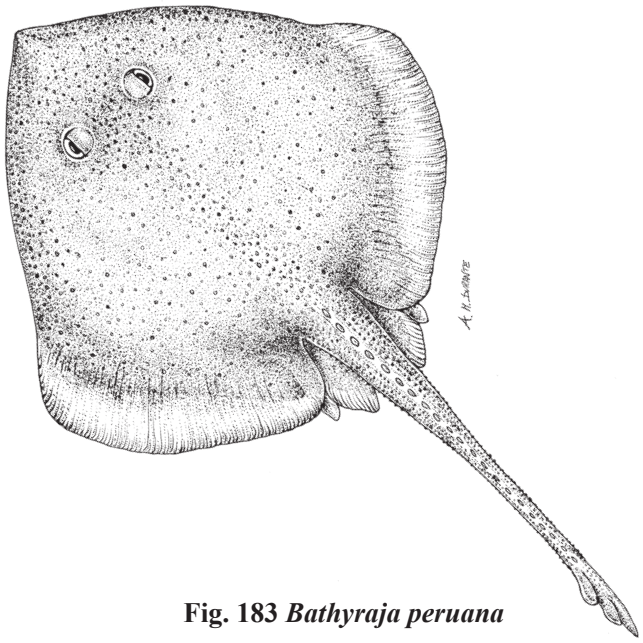


Fig. 183 ***Bathyraja peruana***

Diagnostic Features: Disc rhombic–shaped, length 78 to 83% of disc width; disc width 64 to 71% total length; anterior margins slightly undulated; outer corners of disc rounded; snout flexible, relatively short, about 9.8 to 13.4% total length; preorbital length about 2.4 to 3.4 times interorbital width; snout angle in front of spiracles about 100° to 125°. Pectoral–fin radials range from 70 to 77. Pelvic fins strongly incised, tapering distally, anterior pelvic–fin lobe 72 to 87% posterior lobe length; length not extending to posterior margin of posterior lobes. Tail moderately narrow at base, slightly depressed, with moderately developed lateral fold, length 47 to 49% of disc length from tip of snout to margin of cloaca. Orbits of moderate size, diameter about equal to interorbital width. Spiracles length slightly greater than one-half length of orbital diameter. Nasal curtain coarsely fringed along distal margin; posterior nasal flap poorly developed, smooth to weakly fringed; internasal width more than one-half preoral length. Mouth weakly arched; teeth arranged in quincunx, with short pointed cusps; sexual dimorphism not reported. Tooth counts upper jaw 30 to 36, and lower jaw 30 to 32. Dorsal fins are similar in size and shape; interdorsal fin space separated by distance less than base length. Disc dorsal surface and tail covered with dermal denticles, more dense along anterior margin, on head, and along midback; ventral surface smooth to the touch. Thorns absent from disc dorsal surface; tail with 18 to 26 small midrow thorns; interdorsal thorns absent; adult males with alar and malar thorns, details not available. Vertebral counts: trunk vertebral counts 32 to 35, predorsal caudal vertebral counts 64 to 71. Spiral valve counts not available. Maximum total length is about 110 cm. **Colour:** dorsal surface is a uniform brownish grey, with no blotches or spotting; ventral surface uniform chocolate brown, with lighter areas around nares, mouth, base of pelvic fins and base of tail.

Distribution: Southeastern Pacific Ocean: Ecuador, Peru and Chile.

Habitat: Upper continental slopes from 605 to 1207 m.

Biology: Oviparous, but nothing else is known about the biology of this skate.

Size: Maximum total length is 110 cm; females mature at 97 to 98 cm, but male size at maturity is uncertain; largest reported male was immature at 47 cm. Size at birth is uncertain, but the smallest reported free-swimming specimen measured 17.3 cm total length.

Interest to Fisheries and Human Impact: None, this uncommon deep-sea skate may be taken as bycatch on occasion, but is most likely discarded.

The conservation status is Data Deficient.

Local Names: Raya peruana (Chile); Raya negra (Peru).

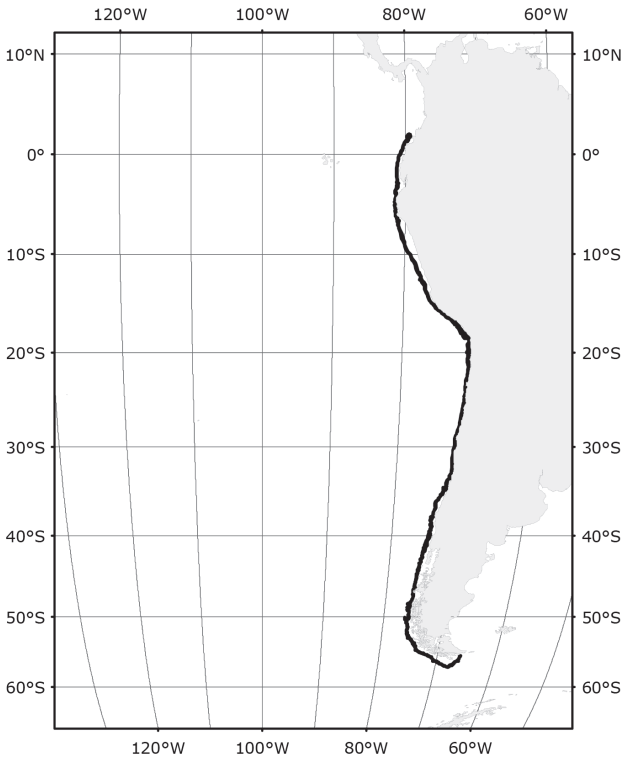


Fig. 184 ***Bathyraja peruana***

Known distribution

Remarks: This species was designated as a paratype (MCZ 1364-S) of ***Bathyraja aguja*** Kendall and Radcliffe, 1912, but a re-evaluation of the specimen combined with additional material convinced McEachran and Miyake (1984) that this was a distinctly different species.

Literature: Kendall and Radcliffe (1912); McEachran and Miyake (1984); McEachran (2009); Bustamante, Vargas-Caro, and Bennett (2014); Cornejo *et al.* (2015).

Bathyraja schroederi (Krefft, 1968)

Breviraja schroederi Kreff, 1968, *Arch. Fischereiwiss.*, 19 (1): 29, figs. 15-18. Holotype: ZMH 25399 [ex ISH 1531-1966a], off mouth of Río de la Plata, Argentina, 35°43'S, 52°43'W, 1000 m.

Synonyms: None.

Other Combinations: None.

FAO Name: En – Whitemouth skate.

Field Marks: A moderately large softnose skate, with dorsal surface plain ash-grey and ventral surface much darker than dorsal, without thorns, except for alar thorns on disc of adult males, and with a median row of tail thorns.

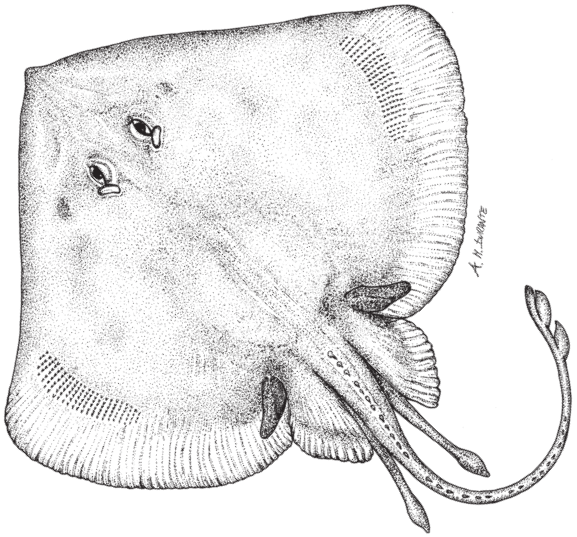


Fig. 185 ***Bathyraja schroederi***

Diagnostic Features: Disc subcircular, heart-shaped, width behind level of shoulder girdle 1.3 times greater than disc length; disc width 64.8 to 74.9% total length; anterior margins slightly undulated; outer corners of disc broadly rounded; snout flexible, relatively short, about 13.3 to 19.5% total length; preorbital length 3.7 to 4.1 times interorbital width; snout angle in front of spiracles about 82° to 95°; mature males 105°. Pectoral–fin radials range from 81 to 102. Pelvic fins deeply incised, anterior pelvic–fin lobes stout, of moderate length, not extending to posterior margin of posterior lobes; pelvic–fin radials 1 + 20 to 26. Tail slender, moderately depressed, tapering towards tip, length about 1.3 times longer than disc length from tip of snout to margin of cloaca. Orbits moderately large, diameter about equal to or slightly greater than interorbital width. Spiracles about three-quarters as long as orbits. Nasal curtain fringed along distal margin; internasal width more than one-half preoral length. Mouth weakly arched; teeth arranged in quincunx; teeth with single cusp. Tooth counts upper jaw 21 to 32, and lower jaw 21 to 33. Dorsal fins are similar in size and shape, length about 2 times height, upper margin broadly rounded, close-set, with short interdorsal space. Dorsal disc surface mostly with fine prickles, denser on snout tip and rostrum, around and between eyes, smooth around eyes and nape; outer anterior margins prickly, posterior margins with mostly smooth outer edge; ventral surface smooth. Disc dorsal surface without thorns, except for alar thorns set in six longitudinal rows with 21 to 23 columns, along outer pectoral margins of mature males; tail thorns irregularly arranged in single median row of 20 small thorns along anterior third of tail length, with tiny thorns appearing along posterior third to first dorsal fin; counting missing thorns in addition to small midline thorns along posterior third, up to 30 tail thorns maybe present. Vertebral counts: trunk vertebral counts 34 to 42, predorsal caudal vertebral counts 75 to 87. Spiral valve counts not available. Maximum total length is at least 128 cm. **Colour:** dorsal surface plain ash-grey, with narrow dark brown edge along disc margin; anterior pelvic–fin lobes blackish-brown, posterior lobes similar to disc, with brownish tinge; ventral surface much darker than dorsal surface, plain blackish-brown.

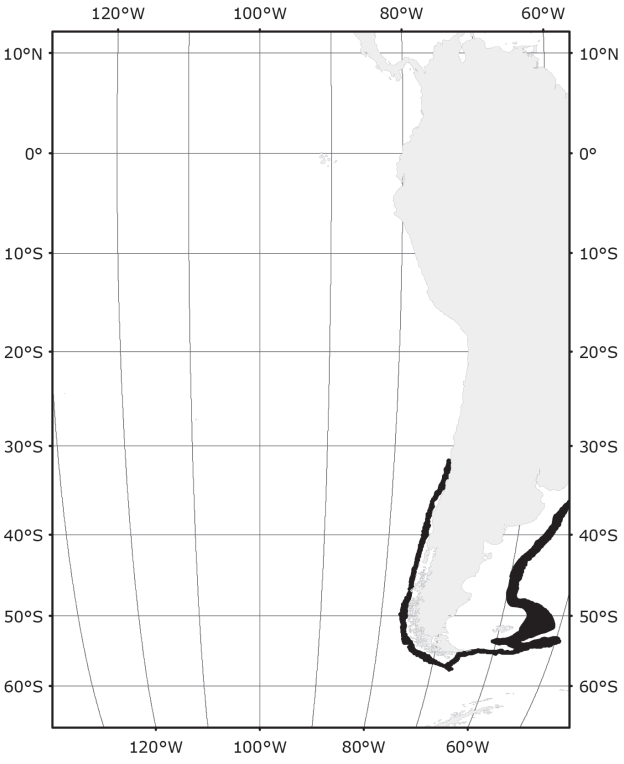


Fig. 186 ***Bathyraja schroederi***

Known distribution

Distribution: Southeastern Pacific Ocean: southern Chile. Southwestern Atlantic Ocean: Brazil to southern Patagonia shelf and around the Falkland Islands (Malvinas).

Habitat: Continental slopes from 800 to 2380 m.

Biology: Oviparous, but nothing else known.

Size: Maximum total length is 128 cm; males mature at 113.1 cm and females at 128.0 cm. Size at birth uncertain, smallest free-swimming individual measured 24.6 cm.

Interest to Fisheries and Human Impact: Of no interest, possibly taken on occasion as bycatch in deep-sea fisheries.

The conservation status is Data Deficient due to very little information concerning this species.

Local names: Raya (Chile).

Remarks: A rare deep-sea skate known from only a few specimens, mostly in the southeastern Atlantic.

Literature: Krefft (1968); Lamilla and Saéz (2003); Bustamante, Vargas-Caro, and Bennett (2014); Stehmann and Pompert (2014).

Bathyraja spinosissima (Beebe and Tee-Van, 1941)

Psammobatus spinosissimus Beebe and Tee-Van, 1941, *Zoologica, Scient. Contr. New York Zool. Soc.*, 26 (pt 3, no. 26): 259, Pl. 2, fig. 4. Holotype (unique): CAS-SU 46500 [ex NYZS 6132] (embryo), 60 miles south of Cocos Island, eastern Pacific, 4°50'N, 87°00'W, published locality agrees with sta. 74 and not 72, 1400 m.

Synonyms: None.

Other Combinations: ***Psammobatis spinosissimus***: original genus should have been ***Psammobatis***.

FAO Names: En – Spiny skate; **Fr** – Raye blanche; **Sp** – Raya blanca.

Field Marks: A very large softnose skate, whitish to pale grey on dorsal and ventral surfaces, without any distinct blotches or spotting patterns, both disc surfaces densely covered with numerous dermal denticles giving it a rough to the touch texture, and disc without thorns except for a single median row of tail thorns.

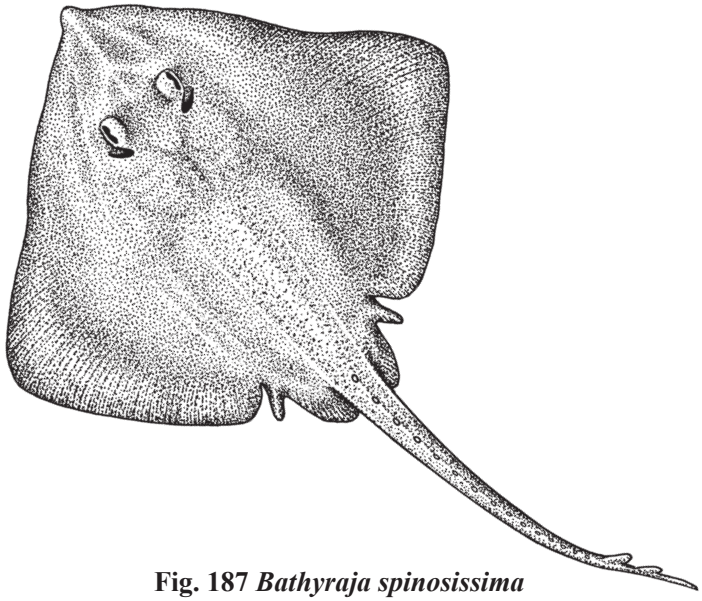


Fig. 187 ***Bathyraja spinosissima***

Diagnostic Features: Disc broadly rhombic–shaped, slightly wider than long; slightly undulated along anterior margins, broadly rounded at apices; snout flexible, relatively short, about 9.3% total length; preorbital length about 1.0 times interorbital width; snout angle about 85°. Total pectoral radial counts not available. Pelvic fins deeply incised, anterior pelvic–fin lobes slender, of moderate length, not extending to posterior margin of posterior lobes. Tail slender and moderately depressed, length slightly longer than disc length from tip of snout to margin of cloaca. Mouth nearly straight; teeth arranged in quincunx, sexual dimorphism not reported. Tooth counts upper jaw 34 and lower jaw 23. Dorsal fins similar in size and shape, with space between second dorsal and caudal fin. Disc dorsal and ventral surfaces densely covered with prickly dermal denticles giving it a rough texture; tail very roughly textured with numerous prickles. Thorns absent from disc dorsal surface except for a single median row of 23 to 29 tail thorns; alar thorns present, although counts not available (observed on adult males in situ from ROV video footage); ventral surface without thorns. Vertebral counts: predorsal caudal vertebrae 82. Spiral valve counts 12 to 13. Maximum total length is at least 203 cm. **Colour:** a uniform pale to salty grey on dorsal and ventral surfaces, outer disc margins slightly dusky, but no pattern of blotches or spotting.

Distribution: Southeastern Pacific Ocean: Galápagos Islands (Ecuador) to Cocos Islands, Costa Rica. Elsewhere, North Pacific ranging from Central America north to at least Port Waldport, Oregon (USA) and likely to the Sea of Okhotsk.

Habitat: This is one of the deepest living species, occurring about 800 m to at least 2938 m. The species is considered rare, but remote operated vehicle (ROV) observations have revealed that this skate is actually quite abundant at depths where it prefers a habitat with large boulders and steep rocky reefs. It is also found around hydrothermal vents and other geologically active sites in the deep-sea. This species also appears to be quite active and is usually observed swimming 1 to 3 m off the bottom.

Biology: Oviparous, with egg cases being deposited in clutches nested in boulder fields. Egg cases are very large, longitudinally striated and olive green in colour. Virtually, nothing else is known about their life history. The diet appears to include benthic fishes.

Size: Maximum total length is at least 203 cm, but based on video observations likely larger; maturity is unknown, but likely over 150 cm total length for males based on largest individual examined. Size at birth is about 26 cm.

Interest to Fisheries and Human Impact: A very deep-sea species that occurs over areas of steep rocky reliefs that it very rarely seen in fisheries landings from bottom trawling. If caught at all, it is most likely from deep-sea longline operations.

The conservation status is Least Concern due to its extremely deep-sea habitat and preferred habitat of steep rocky reliefs.

Local names: No information.

Remarks: This very rare species, at least in museum collections, appears to inhabit a very specific habitat and lives quite deep. If any specimens are caught they should be saved and deposited into museum fish collections for detailed examination.

Literature: Beebe-Tee-Van (1941); McEachran and Miyake (1984); Ebert (2003); Ebert and Davis (2007); D.A. Ebert (unpubl. data).

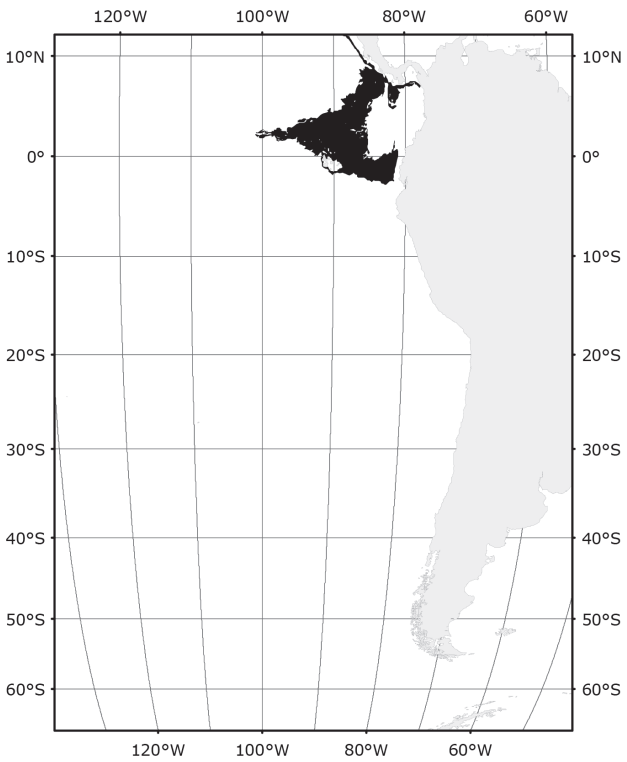


Fig. 188 ***Bathyraja spinosissima***

Known distribution

Notoraja Ishiyama, 1958

Genus: Subgenus ***Notoraja*** Ishiyama, 1958, *J. Shimonoseki Coll. Fish.* 7(2-3): 322 (Genus ***Breviraja*** Bigelow and Schroeder, 1948).

Type species: ***Raja tobitukai*** Hiyama, 1940, by original designation (also monotypic). Raised to genus level by Stehmann 1989, *Mem. Mus. Natn. Hist. Nat., Paris, Ser. A, Zool.*, 143: 258.

Number of Recognized Deep–sea Southeastern Pacific Ocean Species: 1.

Synonyms: None.

Field Marks: Small softnose skates, with a heart-shaped disc, width greater than length, tail length greater than disc width and nuchal and scapular thorns absent. Colour is a uniform bluish above, darker below, with pale patches around mouth and gills.

Diagnostic Features: Disc heart–shaped, width greater than length. Snout length relatively short, flexible, tip produced. Pelvic fins deeply incised, anterior pelvic–fin lobes narrow at base, tapering to blunt tip. Tail slender at base, moderately depressed, tapering posteriorly, length greater than disc length to cloaca. Eyes moderately large, diameter more than interorbital width. Spiracles less than eye diameter. Mouth small, slightly arched; teeth arranged in quincunx. Tooth counts upper and lower jaws 32 to 50. Dorsal fins similar in shape and size, relatively short. Caudal–fin upper lobe low, base longer than first dorsal–fin base. Thorn pattern on dorsal surface includes pre– and post–orbital thorns; tail with rows of irregular thorns on either side of midline, a single row of midline thorns along posterior half of tail; nuchal, scapular, and midback thorns absent; interdorsal thorns mostly absent; ventral surface smooth, without thorns. Vertebral counts: trunk vertebral counts 24 to 32, predorsal vertebral counts 95 to 119. Spiral valve counts 5 to 6. Maximum total length is about 65 cm. **Colour:** dorsal surface uniform pale to dark, sometimes with small spots or mottling; ventral surface light, except darker on disc margins and tail in some species.

Local names: No information.

Remarks: Formerly a subgenus of ***Breviraja***, but raised to full generic status by Stehmann (1989). The genus has 12 species, one of which occurs in the southeastern Pacific Ocean.

Notoraja martinezi Concha, Ebert and Long, 2016

Notoraja martinezi Concha, Ebert, and Long, 2016, *Zootaxa* 4098(1): 179, figs. 1-7, tab. 1. Holotype: MEPN 18198, 475 mm total length, adult male, off Ecuador, eastern Central Pacific Ocean, 0º 28 39.14"'S, 81º 7' 9.67"W, bottom trawl, 1256-1308 m, R/V/ Miguel Oliver, cruise "Ecuador 08", J. Martinez, 13 August 2008.

Synonyms: None.

Other Combinations: None.

FAO Names: En – Barbedwire-tailed skate; **Sp** – Raya de púas.

Field Marks: A small softnose skate, with a heart-shaped disc, its length slightly shorter than width, disc surface covered with fine randomly distributed denticles, and tail with prominent strong, posteriorly angled thorns giving it a barbedwire-like appearance. Colour is a uniform dark brownish above and below, with whitish edges around mouth.

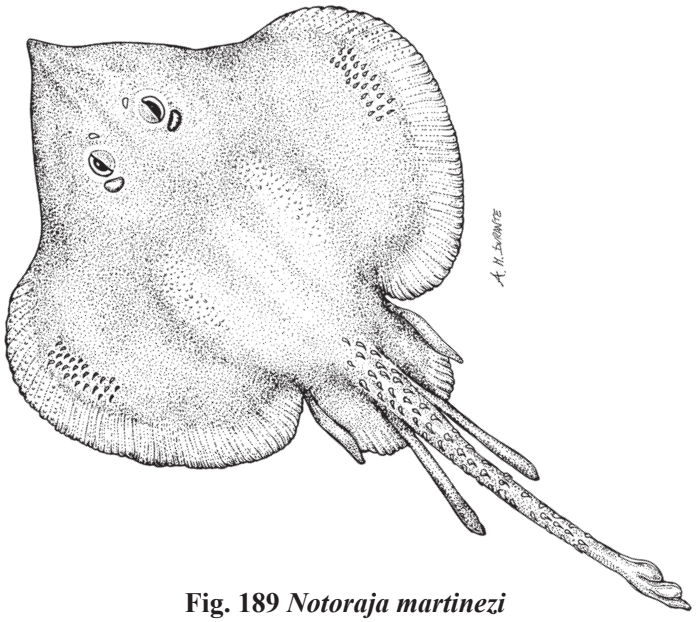


Fig. 189 ***Notoraja martinezi***

Diagnostic Features: Disc heart-shaped, greatest width 1.0 to 1.1 times its length; snout moderately long, length 13.0 to 14.9% total length, flexible, tip produced; angle in front of spiracles about 78.5° to 82.8° in females and juveniles, 66.2° in adult males. Disc anterior margin from snout tip to anterior first gill openings nearly straight in adult males to slightly convex in juveniles, becoming concave to broadly rounded. Pectoral fin tips with posterior margins and inner pectoral corners being broadly rounded. Total radial counts: pectoral–fin radial counts 63 to 65, pelvic–fin radial counts 10 to 12. Pelvic fins deeply incised, anterior pelvic–fin lobes narrow, acutely tipped, elongated, length about 130 to 212% of posterior lobe length. Tail long and slender, narrow at base, depressed over length, dorsally convex, ventrally flattened, tapering gradually posteriorly, very slender at tip; length about 1.1 to 1.3 times disc length to cloaca. Orbits moderately large, diameter about 0.7 to 0.8 times interorbital width. Spiracles about one-half to two-thirds as orbital length. Nasal curtain weakly developed, rounded along lateral margin at anterior margin of oro-nasal groove, posterior lobe broadly rounded, not fringed along posterior margin. Mouth weakly arched; teeth exhibit sexual dimorphism, adult males with teeth acutely pointed cusps, arranged in vertical rows; females and juveniles with short plate-like cusps arranged in quincunx. Tooth counts 38 to 44 upper jaw, 38 to 42 lower jaw. Dorsal fins similar in shape and size, relatively short, moderate in height, anterior margin evenly convex, posterior margin straight or slightly convex, with apex being acutely rounded or pointed; interdorsal space very short, 0.4 to 1.6 times first dorsal–fin base. Caudal fin upper lobe developed, base longer than second dorsal–fin base. Skin mostly smooth, except along disc anterolateral margins of pectoral fins. Thorn pattern on dorsal surface: a short, thick pre-orbital thorn posteromedially oriented; nuchal, scapular, and midback thorns absent; tail with numerous, posteriorly angled, large hook-like thorns and thornlets along dorsal surface, giving it a barbedwired-like appearance; adult males with alar thorns arranged in 2 longitudinal rows, and with about 10 thorns; malar thorns absent; ventral surface, including tail, smooth, without thorns. Vertebral counts: total vertebral counts 118 to 128, trunk vertebral counts 24 to 26, predorsal caudal vertebral counts 58 to 65, predorsal vertebral counts 83 to 91, diplospondylous vertebral counts 93 to 102. Spiral valve counts not available. Maximum total length is at least 47.5 cm. **Colour:** uniform purplish-brown, with outer disc margins narrowly bluish edged, and tail, dorsal fins, and tail folds brown dorsally; ventral surface disc, pelvic fins, and tail are uniformly dark brown to brownish black, except for white mouth edges.

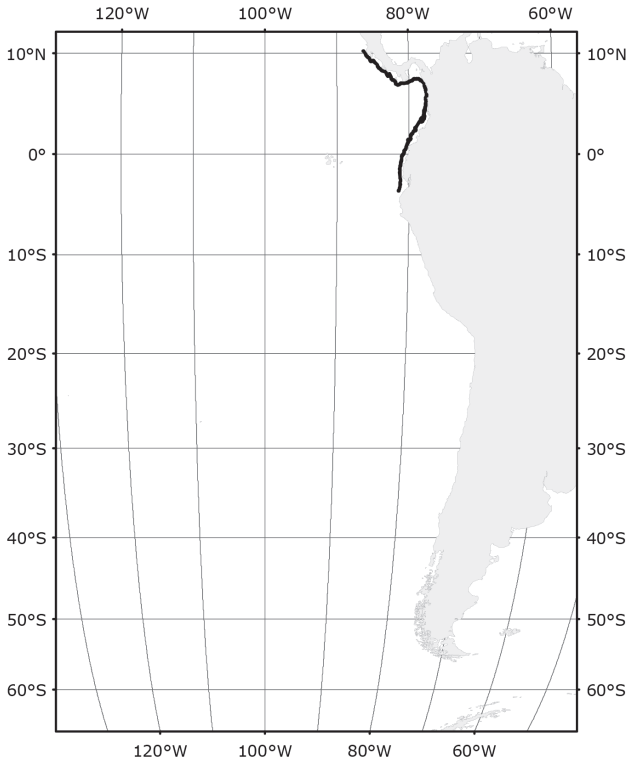


Fig. 190 ***Notoraja martinezi***

Known distribution

Distribution: Eastern Central and southeastern Pacific Ocean: Costa Rica to Ecuador.

Habitat: A little known species along upper continental slopes from 1256 to 1472 m deep.

Biology: Oviparous, nothing known.

Size: Maximum total length about 47.5 cm; males mature at about 47.5 cm, female size at maturity uncertain, immature at 34.6 cm total length. Size birth unknown, but smallest free-swimming specimen was 24.3 cm long.

Interest to Fisheries and Human Impact: None.

The conservation status of this species has not been assessed.

Local names: No information.

Remarks: This is the only known representative of the genus ***Notoraja*** found to occur outside the western Indo-Pacific.

Literature: Concha, Ebert, and Long (2016).

Psammobatis Günther, 1870

Genus: ***Psammobatis*** Günther, 1870, *Cat. Fish. Brit. Mus.*, 8: 470

Type Species: ***Psammobatis rudis*** Günther, 1870, type by monotypy

Number of Recognized Deep–sea Southeastern Pacific Ocean Species: 3.

Synonyms: ***Malacorhina*** (subgenus of ***Raja***) Garman, 1877, *Proc. Boston Soc. Nat. Hist.*, 19: 203, 207. Type species: ***Raja*** (***Malacorhina***) ***mira*** Garman, 1877.

Field Marks: Small softnose skates with subcircular disc, short snout, usually with fine dermal denticles and thornlets, broadly expanded nasal flaps, tail length slightly longer than disc length, 1 to 5 rows of thorns along midback and tail, narrow lateral tail folds, and most species with a distinctive colour pattern of blotches, reticulations, and spots.

Diagnostic Features: Disc heart-shaped (adults) to more circular (juveniles), width behind level of shoulder girdle 1.1 to 1.4 times greater than disc length; disc width 53 to 68% total length; anterior margins undulate; outer corners of disc broadly rounded; snout flexible, relatively short, about 9.0 to 12.9% total length; preorbital length 0.8 to 1.1 times interorbital width; snout angle in front of spiracles about 119° to 143°. Pectoral–fin radials 61 to 73. Pelvic fins deeply incised, anterior pelvic–fin lobes narrow, moderately long, not extending to posterior margin of posterior lobes; pelvic–fin radials 17 to 25. Tail slender, moderately depressed, tapering towards tip, length about 1.1 to 1.3 times longer than disc length from tip of snout to margin of cloaca. Orbits moderately large, diameter about equal to or slightly greater than interorbital width. Spiracles about half as long as orbits. Nasal curtain laterally slightly to greatly expanded, with fringed distal margin; internasal width greater than preoral length. Mouth weakly arched; teeth arranged in quincunx; teeth with single cusp. Tooth counts upper jaw 33 to 53, lower jaw counts not available. Dorsal fins are similar in size and shape, confluent to close-set, with short interdorsal space. Dorsal disc surface with fine prickles or thornlets on snout and along anterior disc margins and midback; ventral surface smooth. Disc dorsal surface with thorns on interorbits and spiracles, nuchal, suprascapular and scapular regions, not forming triangular patch; tail with 1 to 5 irregular rows of thorns on dorsal and lateral tail surface; ventral surface smooth, without thorns. Vertebral counts: trunk vertebral counts 23 to 31, predorsal caudal vertebral counts 47 to 70. Spiral valve counts not available. Maximum total length is 58 cm. **Colour:** dorsal surface a light tan to dark brown, with or without blotches, reticulations, or spots; ventral surface yellowish brown to whitish.

Remarks: The genus has about eight species, of which three are considered southeastern Pacific deep-sea species. Two species, ***Psammobatis normani*** and ***P. rudis***, are common in shallow continental shelf waters off Argentina, but in Chilean waters these two species occur in deeper waters and are considered rare, being known from only a few specimens. ***Psammobatis normani*** is known from only six specimens, and from a depth range of 70 to 358 m in Chilean waters, while ***P. rudis*** is more common, but little known other that it is caught in bottom trawls as bycatch at a depth range of 122 to 352 m.

The conservation status of most species in this little known genus is Data Deficient, with others evaluated as Least Concern.

Psammobatis scobina (Philippi, 1857)

Raja scobina Philippi, 1857, *Arch. Naturgesch.* 23(pt. 1): 270. Holotype: unknown, Valparaiso, Chile.

Synonyms: ***Raja (Malacorhina) mira*** Garman, 1877, *Proc. Boston Soc. Nat. Hist.*, 19: 207. ***Raja philippi*** Delfin, 1902, *Revista Chil.*, 6: 262, pl. 10.

Other Combinations: ***Uratera scobina*** Dumeril, 1865, *Hist. Nat. Pois.*, 1: 574.

FAO Names: En – Raspthorn sand skate; **Sp** – Raya pequén.

Field Marks: A small softnosed skate distinguished by a short snout, a dorsal surface with fine denticles along the anterior disc margin, and thorns present on the nuchal, suprascapular, and scapular regions, and with 3 to 5 longitudinal rows along the tail; dorsal disc surface brownish with small light and dark spots.

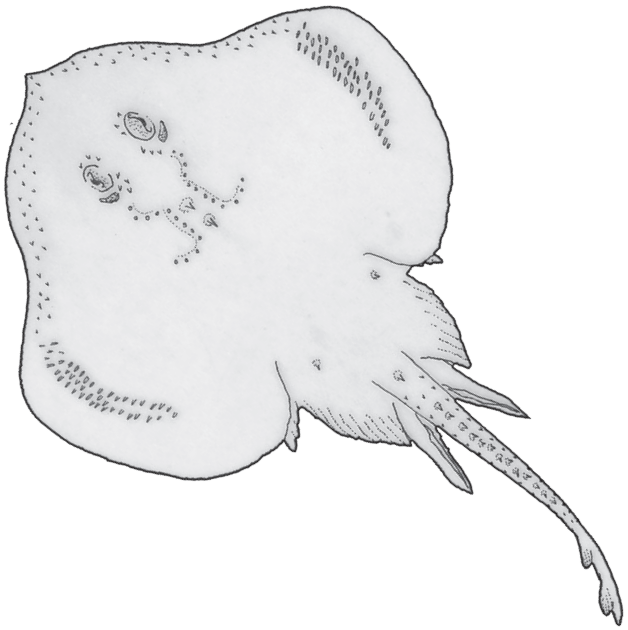


Fig. 191 ***Psammobatis scobina***

Diagnostic Features: Disc subcircular, heart-shaped, more circular in juveniles, width behind level of shoulder girdle 1.2 to 1.4 times greater than disc length; disc width 62% total length; anterior margins undulate; outer corners of disc broadly rounded; snout flexible, relatively short, about 10.2% total length; preorbital length 0.8 to 1.1 times interorbital width; snout angle in front of spiracles about 126° to 143°. Pectoral–fin radials average 66. Pelvic fins deeply incised, anterior pelvic–fin lobes narrow, of moderate length, not extending to posterior margin of posterior lobes; pelvic–fin radials average 19.3. Tail slender, moderately depressed, tapering towards tip, length about 1.1 to 1.3 times longer than disc length from tip of snout to margin of cloaca. Orbits moderately large, diameter about equal to or slightly greater than interorbital width. Spiracles about half as long as orbits. Nasal curtain laterally expanded, fringed along distal margin; internasal width about twice preoral length. Mouth weakly arched; teeth arranged in quincunx; teeth with single cusp. Tooth counts upper jaw 33 to 47, lower jaw counts not available. Dorsal fins are similar in size and shape, close-set, with short interdorsal space or confluent. Dorsal disc surface with fine prickles along anterior disc margins and midback; ventral surface smooth. Disc dorsal surface with thorns on nuchal, suprascapular and scapular regions, not forming triangular patch, midback from just posterior of scapular to tail origin, with a single irregular row of thorns, present or absent, on each side of midline; tail with 3 to 5 irregular rows of thorns on dorsal and lateral tail surface; ventral surface smooth, without thorns. Vertebral counts: trunk counts average 26.8, predorsal caudal vertebral counts 53 to 59. Spiral valve counts not available. Maximum total length is at least 49 cm. **Colour:** dorsal surface brown, occasionally with small light or dark spots; ventral surface yellowish brown.

Distribution: Southeastern Pacific Ocean: off Chile from Coquimbo to the Straits of Magellan.

Habitat: A little known skate from the continental shelf and upper continental slope from 40 to 450 m deep.

Biology: Oviparous, but nothing else known. Egg cases small, with anterior horns shorter than posterior horns, and tendrils longer than the egg case excluding the horns; surface longitudinally striated and brown in colour.

Size: Maximum total length about 49 cm; size at maturity unknown. Size at birth unknown.

Interest to Fisheries and Human Impact: This skate is taken as bycatch in bottom trawl fisheries for bony fishes and deep–sea crustaceans, but discarded.

The conservation status is Data Deficient.

Local names: Pequén (Chile).

Remarks: Two additional species, ***P. normani*** and ***P. rudis***, occur in southern Chile and are taken on occasion as bycatch, but usually discarded. Both these species are more common in Argentinean waters where they are considered shallow water, continental shelf species. The deepwater habitat of these two ***Psammobatis*** species and misidentification with the common ***P. scobina*** has precluded better information on the occurrences of these two species in Chilean waters.

Literature: Garman (1913); de Buen (1959); McEachran (1983); Pequeño and Lamilla (1985); Lamilla and Sáez (2003); Lamilla (2007); Concha, Hernández, and Oddone (2009).

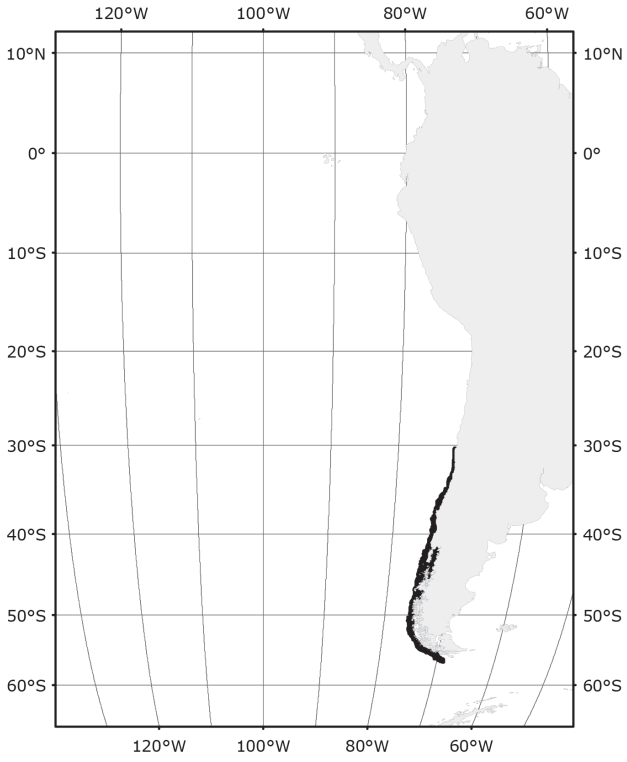


Fig. 192 ***Psammobatis scobina***

Known distribution

3.2.2 Family RAJIDAE

Family: Genus or Family Raia Blainville, 1816, *Bull. Sci. Soc. Philomat*. Paris, (8).

Type Genus: ***Raja*** Linnaeus, 1758

Number of Recognized Deep–sea Southeastern Pacific Ocean Genera: 5.

Synonyms: None.

FAO Names: En – Rays and skates; **Fr** – Rajidés; **Sp** – Rayidos.

Field Marks: Rostral cartilages solid and stiff to snout tip, anterior pectoral–fin radials and their basal elements distinctly falling short of snout tip. Snout skeleton characters can be checked by touch, or against strong light.

Diagnostic Features: Disc shape from nearly circular to subrhombic or subquadrate, with snout from very short and bluntly angled to very long and pointed. Pectoral fins large, originating in front of mouth and reaching snout tip or not, attached to sides of head and forming a large pectoral disc with free rear tips ending posterior to pelvic–fin origins; disc not subdivided by a notch at eyes. Eyes dorsolateral on head and just anterior to spiracles. Mouth transverse and straight to strongly arched, without prominent knobs and depressions. Nostrils just anterior to mouth and separated from it by less than half their own widths, connected by broad nasoral grooves with mouth; anterior nasal flaps elongated, posteriorly expanded and reaching mouth, but separate medially and not forming a nasal curtain. Oral teeth small, rounded–oval in shape and with or without cusps on their crowns, not laterally expanded and plate–like, similar in shape and in 30 to 70 rows in either jaw. Pelvic fins high, rounded–angular or angular, and subdivided into anterior narrow lobes, and posterior broad lobes with a connecting web. Mature male claspers from very long, nearly reaching first dorsal fin to rather short, about as long as one third tail length, and solid, with the glans elongated to at least one third of clasper length and widened; sharp, hooked male alar thorns not permanently erect, but retractable into dermal pockets. Tail solid, sharply marked off from disc, somewhat shorter than, to about as long as, or slightly longer than disc and gradually tapering to tip, with two small, subequal, close to widely separated dorsal fins at rear and rudimentary upper caudal fin. Upper and lower disc may be completely covered by rough dermal denticles, or partly or entirely smooth. Thorns on upper disc usually present, at least in juveniles, and arranged typically in pattern of orbital, nuchal, scapular and mid–dorsal thorns along trunk and tail in at least one median row, but mostly also parallel rows of thorns and often lateral thorns along tail do occur. Interdorsal thorns present or absent. Adults range between 20 and 250 cm total length. **Colour:** dorsal surface varying from whitish to dark brown or black, usually white below but often dark or blotched; dorsal surface either unmarked or with light or dark spots, blotches, or basal ocelli on pectoral fins; ventral surface white with dark edging and blotching, or dark with white markings, or totally dark.

Distribution: Worldwide in all oceans from inshore on continental shelves to upper slopes and to deep–sea plains, also at distant offshore islands and on submarine elevations; absent from shallow tropical shelf waters, but present in Arctic and Antarctic waters.

Habitat: Demersal from enclosed bays and estuaries, to coastal waters in boreal and cold temperate to subtropical latitudes down the continental slopes and far offshore islands and on submarine elevations to deep–sea plains to more than 4000 m depth. Larger deepwater species may be benthopelagic.

Biology: Oviparous, with embryonic development taking from a few months to possibly years depending on temperatures of environment. Egg capsules mostly rectangular, with two pairs of long horns at both ends. Skates feed on a variety of bottom living invertebrates and fishes.

Interest to Fisheries and Human Impact: Skates have been the subjects of target and non–target fisheries worldwide, mostly in temperate seas.

The conservation status of skates is variable as many are listed as Data Deficient, while others have largely been extirpated on a local scale. A problem in many regions where skates are caught is that species specific identification has been lacking.

Local names: No information.

Remarks: All rays and skates at one time were grouped in the family Rajidae, with just one genus ***Raja*** for all species, but over the past couple decades there have been considerable taxonomic changes with about 26 genera and nearly 200 species recognized. The above family account is modified after Last and Compagno (1999), Ebert and Stehmann (2013), and Ebert (2014).

Literature: Stehmann and Bürkel, *in*: Whitehead *et al.* (1984); McEachran and Dunn (1998); Ebert and Stehmann (2013); Ebert (2014); Aschliman and Ebert (In press).

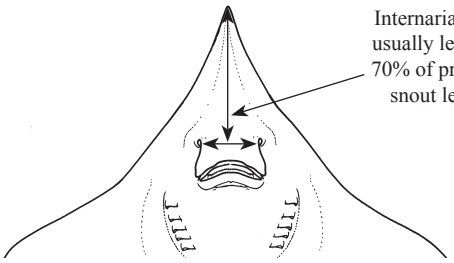
List of Species Occurring in the Area:

Amblyraja doellojuradoi (Pozzi, 1935)
Amblyraja frerichsi (Krefft, 1968)
Dipturus trachyderma (Krefft and Stehmann, 1975)
Gurgesiella furvescens de Buen, 1959
Rajella eisenhardti Long and McCosker, 1999
Rajella nigerrima (de Buen, 1960)
Rajella sadowskii (Krefft and Stehmann, 1974)
Zearaja chilensis (Guichenot, 1848)

Key to Deep–sea Southeastern Pacific Ocean Genera:

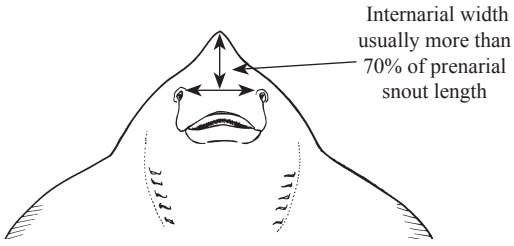
1a. Snout distinctly elongated, pointed; internarial width usually less than 70% of prenarial snout length (Fig. 193) **2**

1b. Snout moderately long to relatively short; internarial width usually more than 70% of prenarial snout length (Fig. 194) **3**



VENTRAL VIEW

Fig. 193 *Dipturus*



VENTRAL VIEW

Fig. 194 *Amblyraja*

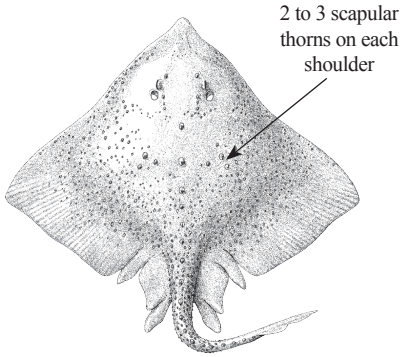
2. Externally the genera ***Dipturus*** and ***Zearaja*** cannot be separated morphologically; these two genera are only distinguished from each other based on adult male clasper characteristics.

2a. Clasper shield very long and slender, capable of minor rotation; clasper spike exposed and mobile; distal clasper lobe narrowly rounded or pointed; pseudorhipidon pointed and flexible . . . . . ***Dipturus***

2b. Clasper shield very short, robust, capable of extended rotation; clasper spike concealed by integument; distal clasper lobe extremely spatulate; pseudorhipidon truncate distally, flag-shaped . . ***Zearaja***

3a. Tail short, stout, length about equal to or shorter than precaudal length; 2 or 3 scapular thorns on each shoulder; median row of enlarged thorns extending from nuchal area to first dorsal fin may be incomplete or interrupted, but always present (Fig. 195) . . . ***Amblyraja***

3b. Tail length about equal to or usually longer than precaudal length **4**



DORSAL VIEW

Fig. 195 *Amblyraja*

4a. Thorns absent on disc (Fig. 196) . . . . . ***Gurgesiella***

4b. Thorns present on disc, with one to several similar sized thorns along midback of disc (Fig. 197) . . . . . ***Rajella***

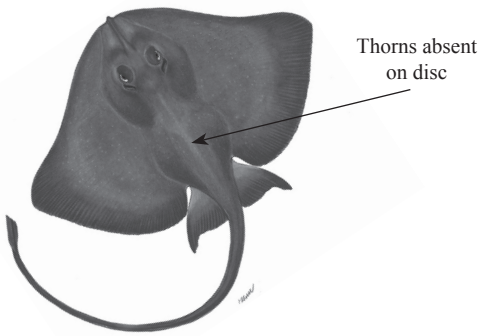


Fig. 196 *Gurgesiella*

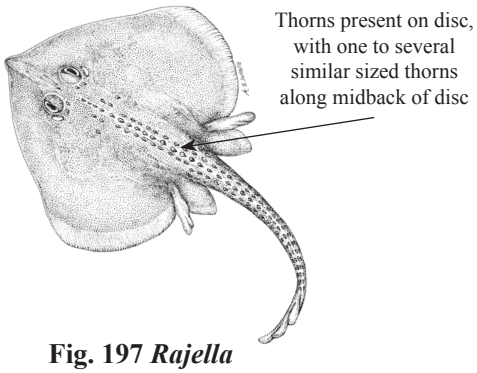


Fig. 197 *Rajella*

Amblyraja Malm, 1877

Genus: ***Amblyraja*** Malm, 1877, *Göteborgs och Bohusläns Fauna*: 607–608.

Type Species: ***Raja radiata*** Donovan, 1808 by subsequent designation of Jordan (1919).

Number of Recognized Deep–sea Southeastern Pacific Ocean Species: 2.

Synonyms: ***Raja*** (***Amblyraja***), subgenus (Stehmann, 1970).

Field Marks: Thick bodied skates with outer disc corners angular, a relatively short, stout tail usually less than the disc length, reduced thorns on snout, but conspicuous on orbital rims, nuchal, shoulder region, and midback and tail. Colour above greyish brown to dark brown or reddish, strikingly mottled with light blotches and spots in some species in life; creamy to white below.

Diagnostic Features: Disc shape subquadrate to subrhombic, outer corners angular. Tail rather massive along anterior one–half and shorter than precaudal length. Thorns on head set individually at orbits, on nape and shoulders; median row of relatively few conspicuously large thorns from nape to first dorsal fin always present; all thorns and thornlets with typically ribbed basal cone. Claspers of mature males massive, with club–shaped, widened glans. **Colour:** dorsal surface plain medium to dark brown or greyish–brown, without patterning or with obscure dark blotching or with rather lively pattern of dark and light blotches and spots, but also plain whitish; ventral surface white, but in deepwater species only in young becoming with growth increasingly dark blotched and finally almost totally dark, with only few white markings remaining along midbody.

Remarks: The genus comprises about 10 nominal species circumglobally, but the validity of some species is not clarified. Two species are recognized as occurring in the southeastern Pacific Ocean. The genus account follows Ebert and Stehmann (2013) and Ebert (2014).

Key to Deep–sea Southeastern Pacific Ocean Species:

1a. Dorsal disc surface coloration a pale to ash grey, with a pair of large dark spots at pectoral–fin bases and numerous smaller, darker spots; ventral surface uniformly white, becoming darker along disc margins (Fig. 198) . . . ***Amblyraja doellojuradoi***

1b. Dorsal disc surface coloration a greyish brown to dark brown, with lighter areas, and blackish brown distal margins, scapular region, pelvic fins, tail, dorsal and caudal fins; ventral surface dark-brown with whitish areas around nasal curtain, mouth, gill openings, anterior pelvic–fin lobes, and cloaca (Fig. 199) . . . . . ***Amblyraja frerichsi***

Fig. 198 ***Amblyraja doellojuradoi***

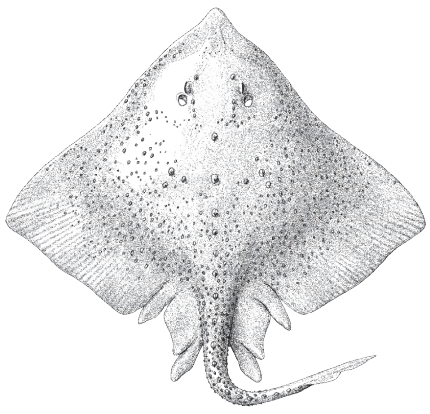


Fig. 199 ***Amblyraja frerichsi***

Amblyraja doellojuradoi (Pozzi, 1935)

Raja doellojuradoi Pozzi, 1935, *Physis* (Buenos Aires) 11: 49. Lectotype: MACN 3306 [ex MACN 1166], off Atlantic coast of Argentina, 39°12'00"S, 56°00'06"W, 91-128 m.

Synonyms: None.

Other Combinations: None.

FAO Name: En – Southern thorny skate.

Field Marks: Disc subrhombic, with narrowly angular outer corners; tail short, less than disc length; snout short, firm, covered with starry-shaped denticles giving a coarse texture; two or three scapular thorns on each shoulder, and a median row of 12 to 18 enlarged thorns on midback. Colour pale to ash grey above, with distinct pair of large dark spots at pectoral–fin bases and numerous smaller, darker spots; ventral surface white, becoming bluish along disc margins.

Fig. 200 ***Amblyraja doellojuradoi***

Diagnostic Features: Disc subrhombic, very broad, anterior margin undulated (most pronounced in adult males), with narrowly rounded pectoral–fin tips; disc length less than width, posterior margin slightly convex to almost straight; snout short, length about 2 times interorbital distance; angle anterior to spiracles not available. Pectoral–fin radial counts not available. Pelvic fins strongly incised, anterior lobe long and stout, length not extending to posterior margin of posterior lobes; pelvic–fin radial counts not available. Tail stout, tapering to tip; length from mid-cloaca to tip less than snout tip to cloaca. Dorsal fins broadly rounded, similar in shape; first slightly larger than second, with short space between dorsal fins; second dorsal fin confluent with caudal lobe. Eyes moderate in size. Nasal curtain fringed laterally and along distal margin; nasal flap posterior margin extending to near mouth corners. Mouth large, slightly arched in subadults and females, to curved in adult males; teeth arranged in quincunx, with single acute cusp; sexual dimorphism evident. Tooth count upper jaw 36 to 42, lower jaw 37 to 40. Dorsal disc surface covered with coarse star-like denticles and thornlets of varying sizes, and thorns giving it a very rough to the touch texture; rostrum and malar regions densely covered with thornlets; ventral disc surface mostly smooth. Thorn pattern on dorsal surface: 2 orbital thorns on each side of inner orbit; several small median nuchal thorns; 1 large, stout interspiracular thorn; 3 scapular thorns forming a triangle on each shoulder; 3 nuchal thorns; mid-dorsal thorns in single median row, 12 to 18 from mid-disc just behind scapular region to first dorsal fin, with 2 lateral rows of smaller thorns; interdorsal space, with 1 small thorn of variable size; alar thorns set in 2 to 3 longitudinal rows and 19 to 20 columns along outer pectoral margins on mature males. Vertebral counts: trunk vertebral counts 27 to 28, predorsal caudal vertebral counts not available. Spiral valve counts not available. Maximum total length is 91.5 cm. **Colour:** dorsal disc surface a pale to ash grey, with a pair of large dark spots at pectoral–fin bases and numerous smaller, darker spots; ventral surface mostly white, becoming a darker bluish along disc margins.

Distribution: Southeastern Pacific and southwestern Atlantic oceans: Punta Arenas, Chile through the Magellan Straits, to Argentina and the Falkland Islands (Malvinas).

Habitat: A common, but little known deep-sea skate found from 51 to 967 m deep and at bottom temperatures of 2.5 to 6.8 °C.

Biology: Oviparous, with egg capsules measuring 67 to 73 mm in length, excluding the horns, with a maximum case width of 66 to 80% of case length, and a distinctive lateral keel extending length of case; surfaces are striated and covered with fine fibers. The species appears to breed in the autumn month in Argentinean waters, but very little else is known of its reproductive biology.

The diet of this skate consists mainly of crabs, and to a lesser extent on polychaetes, bony fishes, isopods, and other crustaceans.

Size: Maximum known length is 91.5 cm; males mature at about 44.8 cm in length, females at 41.1. The size at birth is about 16 to 18 cm total length.

Interest to Fisheries and Human Impact: A regular bycatch in bottom trawl fisheries, but of minor commercial value in Chilean waters, it is increasingly being retained in Argentinean fisheries.

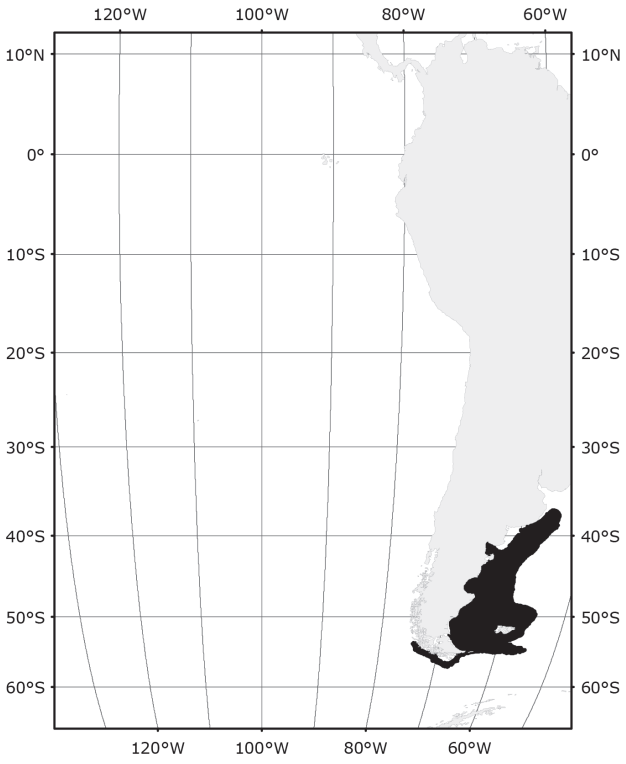


Fig. 201 ***Amblyraja doellojuradoi***

Known distribution

The conservation status of this skate is Least Concern.

Local names: Raya erizo (Chile).

Remarks: A poorly known skate species, but apparently very common around southern Patagonia and southern Chile through the Magellan Straits.

Literature: Pozzi (1935); Bizikov *et al.* (2004); McCormack *et al.* (2007); Delpiani, Spath, and Figueroa (2013); Bustamante, Vargas-Caro, and Bennett (2014); Delpiani (2016).

Amblyraja frerichsi (Krefft, 1968)

Raja frerichsi Krefft, 1968, *Arch. Fischereiwiss.*, 19(1): 22, figs. 10-14. Holoytpe: ZMH 25248 [ex ISH 1532-1966], off mouth of Río de la Plata, Argentina, 35°43'S, 52°43'W, 1000 m.

Synonyms: None.

Other Combinations: None.

FAO Name: En – Thickbody skate.

Field Marks: Disc subrhombic, with angular outer corners, a short firm snout, and a short tail, less than disc length; small thorns on snout, orbitals, shoulders, and midback with single row of about 25 enlarged median thorns. Colour above dark brown to greyish brown, with lighter and darker areas; ventral surface uniformly dark–brown except whitish around nasal curtain, mouth, gill openings, anterior pelvic–fin lobes, and cloaca.

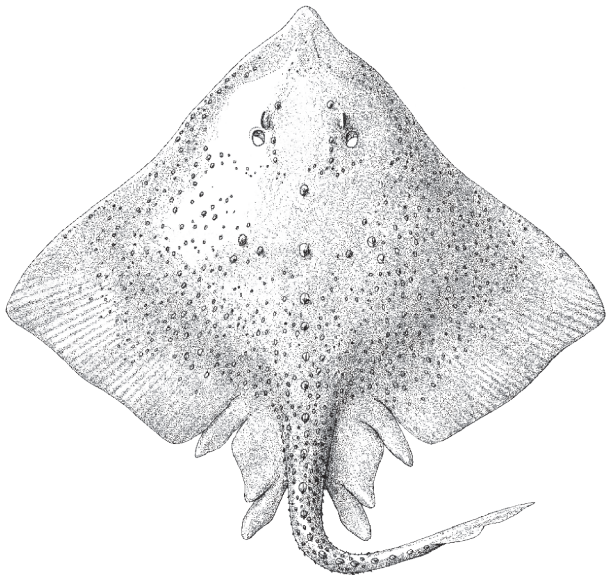


Fig. 202 ***Amblyraja frerichsi***

Diagnostic Features: Disc subrhombic, very broad, anterior margin undulated, with narrowly rounded pectoral– fin tips; disc length 1.3 times into width, posterior margin slightly convex to almost straight; snout short, length 1.9 times interorbital distance; angle anterior to spiracles 98° to 101°. Pectoral–fin radial counts not available. Pelvic fins strongly incised, anterior lobe long and stout, length not extending to posterior margin of posterior lobes; pelvic fin radial counts not available. Tail moderately long, tapering to tip; length from mid-cloaca to tip 1.3 times snout tip to cloaca; lateral tail folds well developed, extending anterior to dorsal fin origin to tail tip. Dorsal fins broadly rounded, similar in shape; first slightly larger than second, with short space between dorsal fins; second dorsal fin confluent with caudal lobe. Eyes moderate in size, diameter 2.5 times interorbital width. Nasal curtain well developed, anterior lobe laterally expanded, fringed laterally and along distal margin; nasal flap posterior margin extending to near mouth corners. Mouth large, slightly arched in subadults and females, to curved in adult males; teeth arranged in quincunx, with single acute cusp; sexual dimorphism evident. Tooth count upper jaw 36 to 48, lower jaw 37 to 50. Dorsal disc surface covered with denticles of varying sizes, thornlets, and thorns giving it a very rough to the touch texture; thornlets distributed densely on rostrum and malar regions; ventral disc surface mostly smooth. Thorn pattern on dorsal surface: 3 orbital thorns on each side of inner orbit; several small median nuchal thorns; 3 scapular thorns forming a triangle on each shoulder; mid-dorsal thorns in a single median row, 18 to 26 from mid-disc just behind scapular region to first dorsal fin; interdorsal space, if present, with 1 or 2 thornlets of variable size; alar thorns set in 6 to 8 longitudinal rows along outer pectoral margins on mature males. Vertebral counts: trunk vertebral counts 31 to 36, predorsal caudal vertebral counts 53 to 58. Spiral valve counts not available. Maximum total length is 176 cm. **Colour:** dorsal disc surface dark brown to greyish brown, with lighter areas, and blackish brown distal margins, scapular region, pelvic fins, tail, dorsal and caudal fins; thorns and thornlets distinctly white; ventral surface uniformly dark-brown with whitish nasal curtain, mouth, gill openings, anterior pelvic–fin lobes, and cloaca.

Distribution: Southeastern Pacific Ocean: Chile. Southwestern Atlantic Ocean: Uruguay and Argentina.

Habitat: A deep-sea skate known from a depth range of 720 to 2609 m deep.

Biology: Oviparous, with egg capsules dark brown in coloration, fading to a lighter brown at outer margins and lateral keels, and measuring 112 to 115 mm in length, excluding the horns; surfaces are finely striated giving it a smooth to the touch texture. Nothing known of its biology.

Size: Maximum known length is 176.2 cm for females and 120.0 cm for males; males mature at about 96 to 105 cm in length; females mature at 71 to 100 cm length. The size at birth is about 21.6 cm total length based on the smallest free-swimming specimen.

Interest to Fisheries and Human Impact: Unknown, although this species is apparently taken as bycatch in the Patagonian toothfish (***Dissostichus eleginoides***) fishery in southern Chile, but there is no species-specific information on it catch rate.

The conservation status of this skate is Data Deficient.

Local names: Raya de hondura (Chile).

Remarks: ***Amblyraja frerichsi*** is one of two species caught in southern Chilean waters, and is very similar morphologically to ***Amblyraja georgiana***, a species known from South Georgia Island and the Antarctica Peninsula. The genus ***Amblyraja*** is in need of revision to clarify the status of the various species, several of which are commonly taken as bycatch in Patagonian toothfish fisheries. In addition, the life history most ***Amblyraja*** species is very poorly known.

Literature: Krefft (1968); Lamilla and Kyne (2004); Bustamante *et al.* (2012); Bustamante, Vargas-Caro, and Bennett (2014).

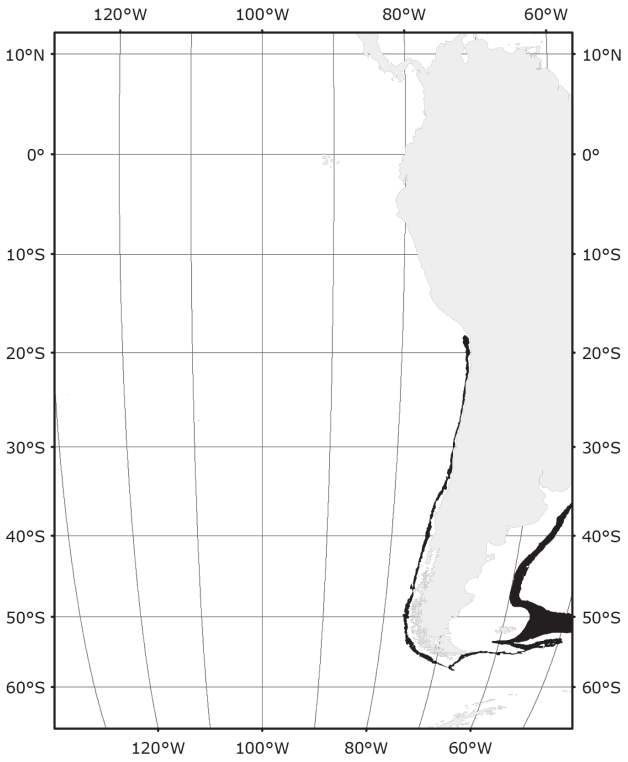


Fig. 203 ***Amblyraja frerichsi***

Known distribution

Dipturus Rafinesque, 1810

Genus: ***Dipturus*** Rafinesque, 1810, *Caratt. Gen. Spec. Sicil.*: 16.

Type Species: ***Raja batis*** Linnaeus, 1758 by original designation.

Number of Recognized Deep–sea Southeastern Pacific Ocean Species: 1.

Synonyms: ***Raja*** (***Dipturus***) as subgenus (Stehmann, 1970).

Field Marks: Most striking external morphological characteristics are the usually long and pointed snout (internarial width less than 70% of prenarial snout length), along with markedly concave anterior disc margins. Except for small juveniles, thorns on disc are usually absent, and present only in a median row along tail to first dorsal fin, along with often strong lateral thorns on low edges of tail and sometimes parallel rows on tail. Colour uniformly grey, brown to dark brown to blackish; ventral surface with an irregular pattern of numerous mucus and sensory pores marked as black dots and short streaks (often camouflaged through dark ground colour and/or blackish mucus coverage), as well as pores on upper side of head.

Diagnostic Features: Disc rhombic–shaped, moderate to very broad, with outer corners of disc sharply rounded to angular. Snout long to very long, generally exceeding 60% of head length, acutely angled, and moderate to greatly produced beyond anterior margin of disc. Eyes relatively small, diameter less than interorbital distance. Pelvic fins bilobed and continuous, with anterior lobe moderate to very long and approaching length of posterior lobe. Tail relatively short to moderately long and moderately narrow to narrow at base and slightly tapering to slightly broadening distally. Upper disc mostly free of denticles and with few moderately small to small thorns. Thorn pattern on dorsal surface: orbital thorns present or absent, if present 1 pre–orbital thorn to about 9 thorns on orbital margin; thorns either present or absent on remainder of disc, if present 1 to several thorns may occur on each shoulder girdle, on nuchal region and in single row from nuchal region to base of tail; usually males with 1 thorn row, females with 3 to 5 rows along midline of tail to origin of first dorsal fin. Vertebral counts: pre–dorsal caudal vertebral counts 42 to 72; trunk vertebral counts 30 to 35. Maximum total length may reach over 200 cm. **Colour:** dorsal surface usually grey, dark brown to almost black and plain or maybe vaguely patterned; ventral surface greyish white to greyish brown with ampullary pores and sometimes ampullary canals darkly pigmented.

Remarks: About 48 species, only one of which occurs in the southeastern Pacific Ocean deep–sea.

Dipturus trachyderma (Krefft and Stehmann, 1975)

Raja (Dipturus) trachyderma Krefft and Stehmann, 1975, *Arch. FischWiss.* 25(3): 77, 86, fig. 7-13. Holotype: ISH-130/71, 1135 mm total length, immature male, off southern Argentina, southwestern Atlantic Ocean, 49°00'S, 60°52'W, 195 to 200 m.

Synonyms: None.

Other Combinations: None.

FAO Names: En – Roughskin skate; **Sp** – Raya espinuda.

Field Marks: A very large skate, if not the largest of all skate species, reaching 250 cm total length, with very coarse dermal denticles on dorsal disc surface, giving it a rough texture, but lacking thorns, except for small thornlets around eyes and alar and malar thorns on adult males, tail with single median row of thorns flanked by 2 to 4 lateral longitudinal rows. Coloration is uniform greyish to nearly black, without any distinctive patterns; ventral surface lighter grey.

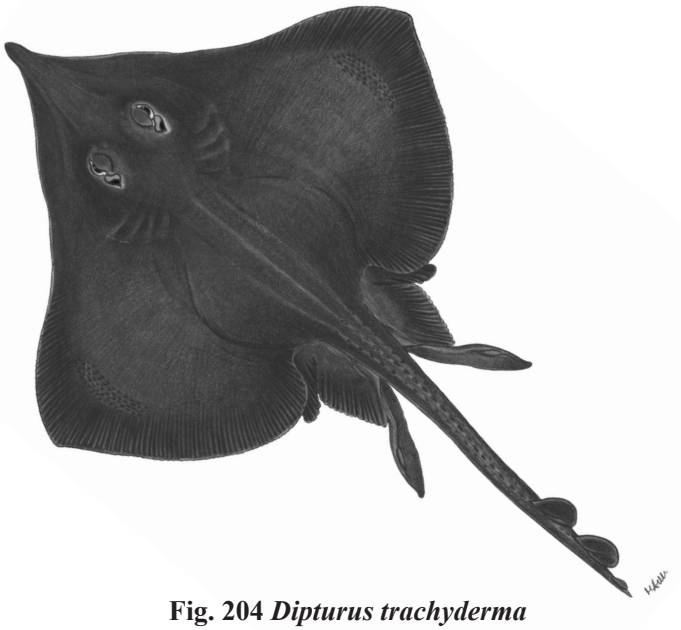


Fig. 204 ***Dipturus trachyderma***

Diagnostic Features: Disc rhombic–shaped, broad, 1.2 to 1.4 times as wide as long, and with lateral corners angled with slightly rounded tips; snout greatly produced, length 18 to 23% total length, acutely triangular; snout angle in front of spiracles about 93°. Total pectoral–fin radial counts 89 to 99. Mouth broad, slightly arched; nasal curtain not fringed; teeth sexually dimorphic, with a single large cusp on adult males, more or less flattened in females; arranged in quincunx. Tooth counts in upper and lower jaws 36 to 44. Anterior pelvic–fin lobes stout, moderately long, not extending to posterior margin of posterior lobe. Tail moderately long, about equidistant from tip of snout to posterior margin of cloaca, tapering distally to tip. Dorsal fins separated. Dermal denticles on dorsal disc surface coarse, with a rough to the touch texture; ventral surface mostly smooth except roughly textured rostrum. Disc dorsal surface without thorns except around orbits; orbital thorn pattern differs between adults and juveniles, with orbital thorn arrangement on juveniles with 2 large, stout thorns and 4 to 6 smaller thorns, adults with larger thorns absent or worn, and 3 to 5 smaller thorns; 1 to 2 spiracular thorns; tail with 1 median row flanked by 2 to 4 longitudinal rows of 11 to 43 large thorns; 0 to 4 interdorsal thorns; adult males with 17 to 48 alar thorns in 4 to 5 columns, and malar thorns not available; ventral surface smooth. Vertebral counts: trunk vertebral counts 30 to 33, predorsal vertebral counts 53 to 58, total vertebral count 98. Spiral valve counts not available. Maximum total length is at least 250 cm. **Colour:** dorsal surface uniformly dark grey to almost black, without any distinctive blotches or patterns; ventral surface uniformly grey, slightly lighter than dorsal surface.

Distribution: Southeastern Pacific Ocean: central Chile to the Beagle Channel. Southwestern Atlantic Ocean: Argentina, but records from off Uruguay and southern Brazil are uncertain.

Habitat: Deep temperate waters of the continental shelf and upper slope from 93 to 450 m deep, most common from 180 to 350 m deep, but also shallow based on a single specimen in the Beagle Channel at 20 to 22 m. It appears to prefer sandy and muddy bottoms.

Biology: Oviparous, with very large, possibly the largest of any elasmobranch species, stout shaped egg capsules, golden brown in utero in coloration, without grooves or striations on capsule surface, texture soft to the touch, anterior and posterior horns short, thin, curved inwards, capsule strongly keeled on each flank, aprons concave, anterior width slightly shorter than posterior.

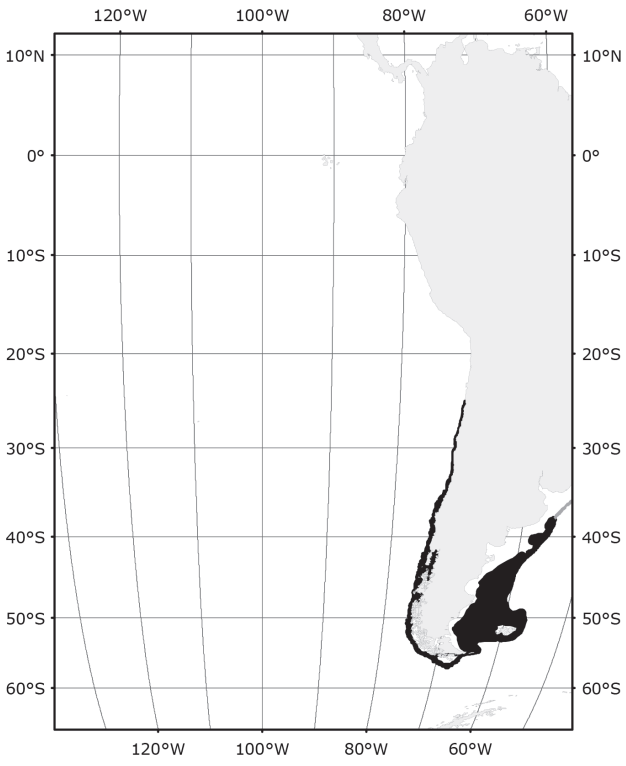


Fig. 205 ***Dipturus trachyderma***

Age at maturity has been estimated at 17.4 years for females, and 15.3 years for males, with the maximum age of at least 26 years for a 240 cm total length female and 25 years for males.

This is mainly a piscivorous feeding skate consuming ***Macruronus novaezelandiae***, ***Helicolenus lengerichi***, ***Merluccius australis*** and ***Merluccius gayi***, but also crustaceans, mainly ***Pterygosquilla armata***, in shallower depths.

Size: Maximum total length is 254 cm for females, 232 cm for males; females mature at 200 to 215 cm and males mature at 183 to 195 cm. Size at birth is uncertain, smallest free-swimming individuals measured 60 cm total length.

Interest to Fisheries and Human Impact: This species is taken in both directed and indirect fisheries operating in Chile and Patagonia, but species-specific data for skates in this region is lacking for most fisheries.

The conservation status of this large skate is Vulnerable.

Local names: Raya volantín espinosa (Chile).

Remarks: This is one of the largest, if not largest species of skates, attaining a total length of over 250 cm.

Literature: Krefft and Stehmann (1974); Leible and Stehmann (1987); Menni and Stehmann (2000); Licandeo, Cerna, and Céspedes (2006); Lamilla and Massa (2007); Bustamante, Vargas-Caro, and Bennett (2014); Vargas-Caro *et al.* (2015).

Gurgesiella de Buen, 1959

Genus: ***Gurgesiella*** de Buen, 1959, *Bol. Mus. Nac. Hist. Nat. Santiago*, *Chile*, 27(3): 185.

Type Species: ***Gurgesiella furvescens*** de Buen, 1959, by original designation (also monotypic).

Number of Recognized Deep–sea Southeastern Pacific Ocean Species: 1.

Synonyms: None.

Field Marks: Small skates with very short, blunt snout, no large thorns on dorsal disc surface, sparsely scattered minute dermal denticles, single lobed and laterally expanded pelvic fins, long slender tail about twice disc width, 0 or 1 dorsal fins, no terminal lobe on caudal fin, and mostly a plain uniform greyish to brown dorsal surface coloration, some species occasionally with light and dark blotches.

Diagnostic Features: Disc rhomboidal-shaped, width behind level of shoulder girdle 1.4 to 1.6 times greater than disc length; disc width 46 to 60% total length; snout relatively short, about 6 to 11% total length; preorbital length 2.5 to 3.3 times interorbital width; snout angle in front of spiracles about 118° to 154°. Pectoral–fin radials 66 to 75. Pelvic fins single lobed, greatly expanded, bluntly pointed at tips and with relatively straight posterior margins; pelvic–fin radials not available. Tail slender, long, about two times disc length, tapering distally. Eyes moderately large, diameter slightly greater than interorbital width. Spiracles about half as long as orbits. Nasal curtain with few or no fringes, outer nasal flap finely fringed. Mouth relatively small, strongly arched; teeth arranged in quincunx; sexual dimorphism evident. Tooth counts upper jaw 25 to 45, lower jaw 23 to 40. Dorsal fins absent or only 1 present. Dorsal disc and tail surface sparsely covered with minute denticles, with low cusps on stellate bases; ventral surface smooth. Thorns mostly absent from dorsal surface, except for alar and malar thorns on adult males. Vertebral counts: trunk vertebral counts 23 to 25, predorsal caudal vertebral counts 92 to 114. Spiral valve counts not available. Maximum total length is 57 cm. **Colour:** dorsal surface mostly plain, without spots or other patterns, some species occasionally with dark or light blotches; ventral surface mostly plain, occasionally with disc margins slightly darker, and whitish tail sometimes with irregular brown blotches.

Remarks: The genus has three species, of which one is considered a southeastern Pacific Ocean deep-sea species.

The conservation status of each species in this little known genus varies considerably, with one each being evaluated as Data Deficient (***Gurgesiella atlantica***), Least Concern (***Gurgesiella furvescens***), and Vulnerable (***Gurgesiella dorsalifera***).

Gurgesiella furvescens de Buen, 1959

Gurgesiella furvescens de Buen, 1959, *Bol. Mus. Nac. Hist. Nat. Santiago, Chile*, 27(3): 185. Holotype figured in de Buen 1960: fig. 11. Holotype: EBM Ch. 10.182, 520 mm total length, adult male, off Valparaiso, Chile, possibly lost.

Synonyms: None.

Other Combinations: None.

FAO Name: En – Dusky finless skate.

Field Marks: A short disc, lack of thorns, sparse dermal denticles covering dorsal disc surface and tail, pelvic fins with a single lobe, and lack of dorsal fins distinguishes this skate from all others in the region. Dorsal coloration is a uniform greyish to brown, without any spots or other distinctive patterns.

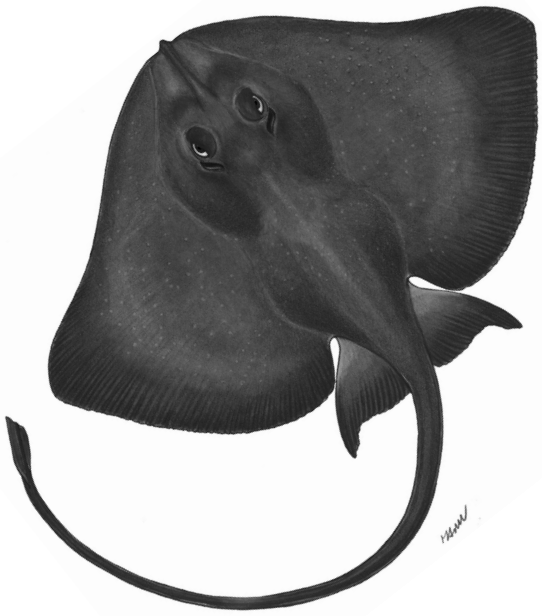


Fig. 206 ***Gurgesiella furvescens***

Diagnostic Features: Disc rhombic, short, length 65 to 70% width, with broadly rounded tips; disc length 1.5 to 1.6 times into width; snout soft, flexible, relatively short, length 1.5 to 2.1 times interorbital distance; angle anterior to spiracles 136° to 154°, angle slightly greater in females than males. Pectoral–fin radials range from 66 to 69. Pelvic fins single lobed, laterally expanded, with acute lateral tips and relatively straight posterior margins; pelvic–fin radials not available. Tail slender, depressed, tapering distally to tip; length from mid-cloaca to tip 62 to 63% total length; lateral tail folds well developed. Dorsal fins absent. Caudal fin with dorsal and caudal lobes. Eyes moderately large, diameter slightly greater than interorbital width. Nasal curtain with few or no fringes, outer nasal flap finely fringed. Mouth relatively small, strongly arched; teeth arranged in quincunx; sexual dimorphism evident, females and immature males with low cusps, and adult males sharply pointed. Tooth count upper jaw 27 to 43, lower jaw 26 to 36. Dorsal disc and tail surface sparsely covered with small denticles on stellate bases; ventral surface smooth. Thorns mostly absent from dorsal surface, except for alar and malar thorns on adult males. Vertebral counts: trunk vertebral counts 21 to 23, predorsal caudal vertebral counts 92 to 97. Spiral valve counts not available. Maximum total length is 56.8 cm. **Colour:** dorsal surface a uniform charcoal grey to chocolate brown; ventral surface mostly light tan, except for greyish coloration on ventral tail surface.

Distribution: Southeastern Pacific Ocean: Chile, Peru, and Ecuador, including the Galápagos Islands.

Habitat: Found along the upper continental slopes at depths of 400 to at least 960 m.

Biology: Oviparous, but nothing else known about its reproductive cycle.

Size: Maximum total length 56.8 cm; males mature from 50.9 to 52.0 cm, females 55.2 to 56.8 cm. Size at birth uncertain, smallest free-swimming individual measured 30.3 cm.

Interest to Fisheries and Human Impact: Uncertain, although likely taken on occasion as bycatch in local, seasonal artisanal deep-sea fisheries for toothfish (***Dissostichus eleginoides***) and shrimp.

The conservation status of this skate is Least Concern.

Local names: Raya abisal (Chile).

Remarks: A little known species that appears to be endemic to the upper continental slopes from Peru to Chile.

Literature: de Buen (1959, 1960); McEachran and Compagno (1979, 1980); Lamilla (2004); Bustamante, Vargas-Caro, and Bennett (2014); Cornejo *et al.* (2015).

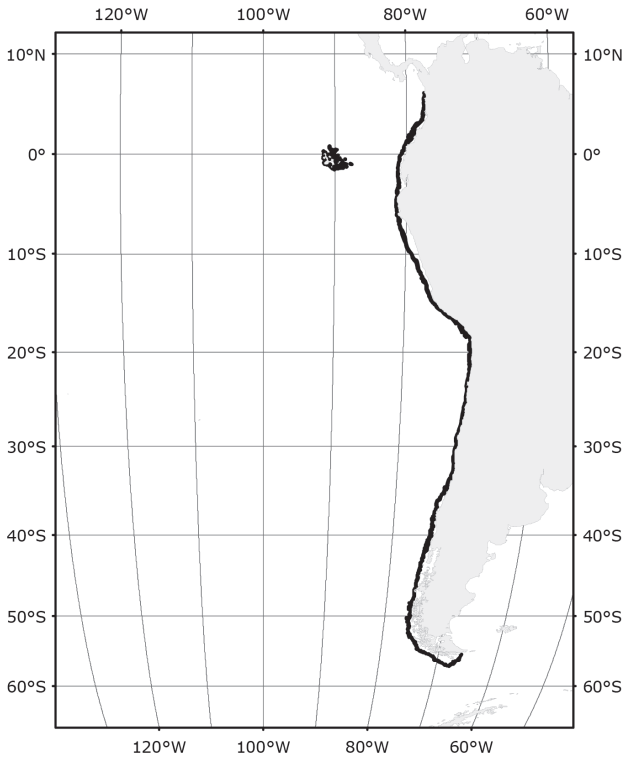


Fig. 207 ***Gurgesiella furvescens***

Rajella Stehmann, 1970

Genus: ***Rajella*** Stehmann, 1970, *Arch. FischWiss.* 21(2): 151.

Type Species: ***Raja fyllae*** Lütken, 1887 by original designation.

Number of Recognized Deep–sea Southeastern Pacific Ocean Species: 3.

Synonyms: ***Raja*** (***Rajella***), as subgenus (Stehmann, 1970).

Field Marks: Disc usually subrhombic, with outer corners rounded to angular, snout short and bluntly angled, or moderately elongated and pointed, median thorn rows on back of trunk and along tail range from one to several rows in parallel; except in small juveniles, thorns on orbital rims mostly set in continuous half–rings, and mostly many thorns over nape and shoulder regions forming a triangle. Colour is mostly uniformly dark or light.

Diagnostic Features: Disc heart–shaped to rhombic–shaped and narrow to moderately narrow, generally 49 to 61% of total length, with outer corners obtusely angled to broadly rounded. Snout moderately long to moderately short, acutely angled to broadly rounded and slightly to moderately produced beyond anterior margin of disc. Eyes of moderate size, diameter slightly greater to slightly less than interorbital distance. Pelvic fins bilobed, continuous, with anterior lobes short to moderately long but considerably shorter than posterior lobes. Tail moderately long to long, 51 to 60% of total length, and moderately broad at base and attenuated distally. Dorsal surface largely covered with denticles and relatively densely covered with moderate to large sized thorns; usually a complete row of thorns on orbital rim, triangular patch of thorns on nuchal shoulder region, and one to several rows of thorns extending from shoulder region to origin of first dorsal fin, with thorns of mid–row equal in size or larger than those of lateral rows, and one to several thorns between dorsal fins. Vertebral counts: predorsal caudal vertebral counts 55 to 73. Maximum total length to about 90 cm. **Colour:** dorsal surface uniformly light grey, brown to brownish black; ventral surface whitish to nearly black.

Remarks: The genus currently has 17 or 18 nominal species described with several additional species awaiting formal description. Three species occur in the southeastern Pacific Ocean.

Key to Deep–sea Southeastern Pacific Ocean Species:

1a. Five distinct rows of tail thorns (Fig. 208) . . . . ***Rajella nigerrima***

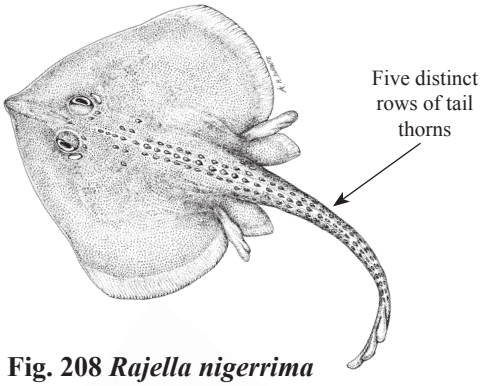


Fig. 208 ***Rajella nigerrima***

1b. Three distinct rows of tail thorns **2**

2a. Dorsal coloration purplish grey to light brown, with white blotches on pectoral–fin tips; ventral surface darker than dorsal, except for distinct lighter areas around nasal, mouth, gill, abdomen, cloaca, and pectoral–fin tips (Fig. 209) . . . . . ***Rajella eisenhardti***

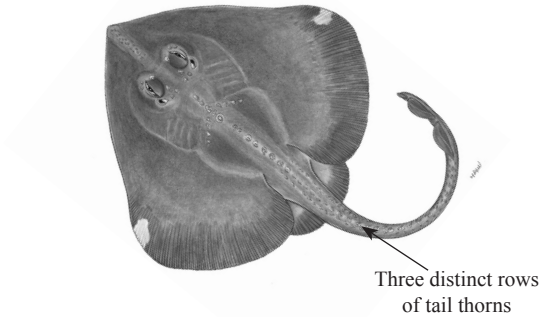


Fig. 209 ***Rajella eisenhardti***

2b. Dorsal coloration purplish grey to brownish, with darker purple pectoral and pelvic–fin margins, and dark greyish to blackish dorsal and caudal fins; ventral surface greyish with a white abdomen, and much darker pectoral and pelvic–fin margins (Fig. 210). . . . . ***Rajella sadowskii***

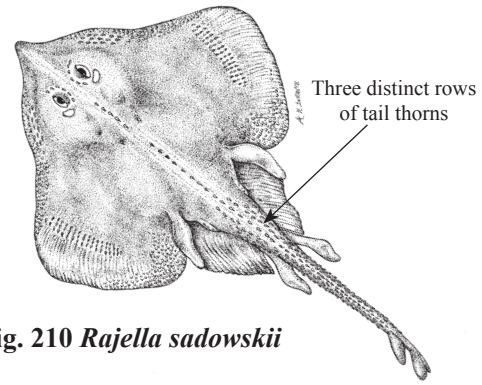


Fig. 210 ***Rajella sadowskii***

Rajella eisenhardti Long and McCosker, 1999

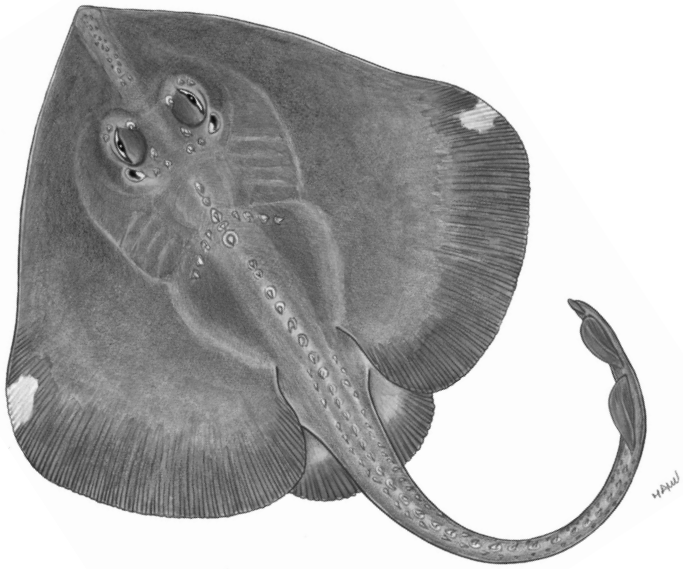


Fig. 211 ***Rajella eisenhardti***

Rajella eisenhardti Long and McCosker, 1999, *Proc. Biol. Soc. Washington* 112(1): 45, figs. 1-2, tab. 1. Holotype: CAS 86817, immature male 38.5 cm total length, off Cabo Rosa, 1°04.74'S, 91°11.08'W, Isla Isabella, Galápagos Islands, 757 m.

Synonyms: None.

Other Combinations: None.

FAO Name: En – Galápagos skate.

Field Marks: A little known ***Rajella*** species, distinct from others by a purplish grey to light brown dorsal disc surface, with pale brown to greyish tail, and white blotches on pectoral–fin tips, a darker ventral surface with distinct light areas from around nasal region, mouth, gill openings, abdomen, cloaca, and pectoral–fin tips, and a tail length greater than disc length, with 3 distinct rows of caudal thorns.

Diagnostic Features: Disc heart shaped, moderately broad, with broadly rounded tips; disc length 0.9 times into width; snout moderately long, length 3.5 to 4.0 times interorbital distance; angle anterior to spiracles 80.8° to 83.8°. Pectoral–fin radials range from 68 to 69. Pelvic fins strongly incised, anterior lobe long and narrow, length 1.5 to 1.6 times posterior lobe length; length extending to posterior margin of posterior lobes; pelvic–fin radials 17 to 19. Tail long, gradually tapering to tip; length from mid-cloaca to tip 1.2 to 1.3 times snout tip to cloaca; lateral folds originating well behind tail base, and continuing along length to just anterior caudal tip, terminating as a small lobed flap. Dorsal fins similar in shape, low, rounded; first slightly larger than second, without space between dorsal fins or between second dorsal fin and caudal lobe. Eyes of moderate size, diameter slightly shorter than interorbital width. Nasal curtain well developed, anterior lobe laterally expanded, weakly convex anteriorly, finely fringed laterally and along distal margin; nasal–flap posterior margin extending to near mouth corners; internasal width less than one-half preoral length. Mouth of moderate size, slightly arched; teeth arranged in quincunx, with small median cusps, becoming blunt and flattened distally; sexual dimorphism not reported. Tooth counts upper jaw 46 to 48, lower jaw 32 to 42. Dorsal disc surface covered with fine denticles, except for lateral and posterior pectoral fin margins; pelvic fins mostly smooth, except for fine denticles on bases; ventral disc surface smooth, except for small denticles along tail margins. Thorn pattern on dorsal surface: 1 or 2 orbital thorns anterior to each orbit, 3 posterior to each orbit, and a single thorn on each side of inner orbit; 5 median nuchal thorns; 3 scapular thorns on each shoulder; mid-dorsal thorns in single median row, 6 to 7 from nuchal region to tail origin; 3 rows of thorns on dorsal tail surface beginning at mid-level of pelvic fins, and extending to first dorsal fin; tail with median row of 23 to 24 thorns, and 19 to 39 lateral tail thorns, diminishing posteriorly along tail. Vertebral counts: trunk vertebral counts 28 to 29, predorsal caudal vertebral counts 67 to 68. Spiral valve counts not available. Maximum total length uncertain, largest known specimen is a 38.5 cm immature male. **Colour:** dorsal disc surface a purplish grey to light brownish grey, with disc midback, pelvic–fin bases, and tail a pale brown to greyish, and a whitish blotch on pectoral fin tips; ventral surface darker except for distinct whitish areas on anterior tip of rostrum, around nostrils, mouth, gill openings, abdomen, cloaca, pelvic fin tips, and at tail tip; light area between abdomen and gill openings connected by a V-shaped mark; thorns and larger denticles whitish, smaller denticles similar in colour as surrounding disc surface.

Distribution: Southeastern Pacific Ocean: Galápagos Islands.

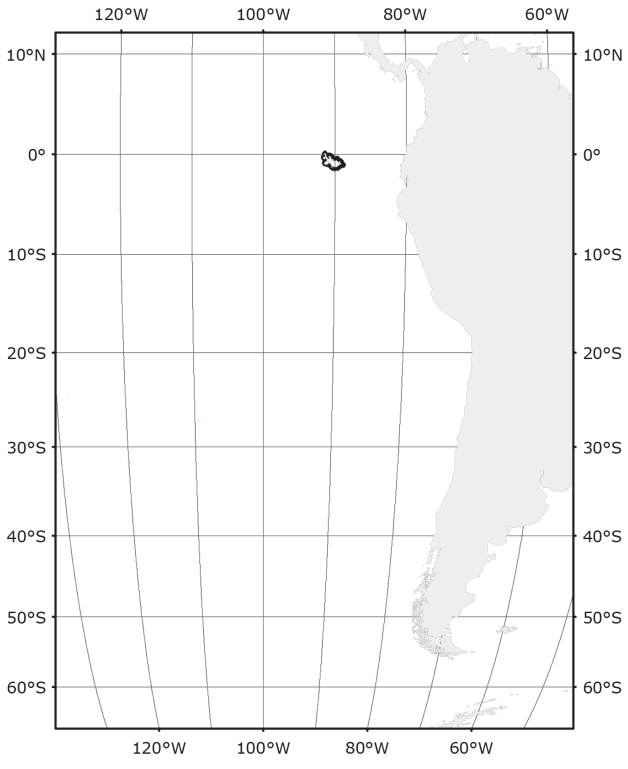


Fig. 212 ***Rajella eisenhardti***

Known distribution

Habitat: Found along steep slopes around the Galápagos Islands at depths of 757 to 907 m.

Biology: Oviparous, but nothing else known about its reproductive cycle.

Size: Known only from two immature males measuring 38.5 cm and 24.5 cm total length.

Interest to Fisheries and Human Impact: None.

The conservation status of this skate is Data Deficient due to limited information and a lack of fishing activities around the Galápagos Islands.

Local names: No information.

Remarks: This species appears to be endemic to the Galápagos Islands. Presently it is only known from two immature males and it is likely that larger individuals may exhibit some ontogenetic differences with growth. Additional specimens, especially larger adults, should be retained for detailed examination.

Literature: Long and McCosker (1999); McCormack and Kyne (2007).

Rajella nigerrima (de Buen, 1960)

Breviraja nigerrima de Buen, 1960, *Rev. Biol. Mar., Valparaiso* 10(nos 1-3): 28, fig. 10. Holotype: EBMC 10207, immature male 17.5 cm total length, about 20 miles off Algarrobo, Chile, 33°20'29"S, 71°59'00"W, 800 m. Neotype: USNM 267046 designated by McEachran and Miyake (1984), but without information on the loss of the original type species; type locality for the neotype is off Chile, 34°53.5'S, 72°44'W, 1295-1692 m.

Synonyms: ***Malacoraja nigerrima***: McEachran and Miyake, 1984: 785; Pequeño, 1989: 17; Chirichigno and Vélez, 1998: 89.

Other Combinations: None.

FAO Name: En – Blackish skate.

Field Marks: A poorly known ***Rajella*** species, distinct from its regional congeners by a relatively short snout, narrower disc length, and relatively long tail with 5 rows of tail thorns. Dorsal coloration is a uniform dark brown, with slightly blackish brown dorsal fins; ventral surface brown with indistinct lighter areas around mouth, abdomen, gill openings, and vent.

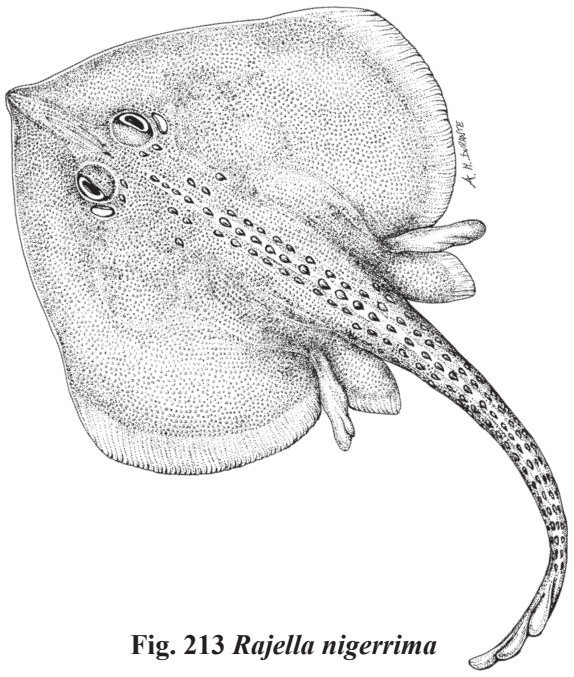


Fig. 213 ***Rajella nigerrima***

Diagnostic Features: Disc narrowly heart shaped, with broadly rounded tips; disc length 1.1 times into width; snout moderately long, length 3.1 to 3.6 times interorbital distance; angle anterior to spiracles 98° to 108°. Pectoral–fin radials range from 61 to 65. Pelvic fins strongly incised, anterior lobe narrow, tapering distally, length 0.8 to 0.9 times posterior lobe length; length not extending to posterior margin of posterior lobes; pelvic–fin radials not available. Tail moderately slender, depressed, tapering distally to tip; length from mid-cloaca to tip 1.3 to 1.5 times snout tip to cloaca; lateral folds originating just anterior to first dorsal–fin origin and reaching tip of tail. Dorsal fins similar in shape, first slightly larger than second, and confluent at bases; second dorsal fin confluent with poorly developed caudal lobe. Eyes moderately large, diameter slightly greater than interorbital width. Nasal–curtain anterior lobe flap laterally expanded, weakly convex, coarsely fringed laterally and along distal margin; posterior margin well developed, with finely fringed lateral lobe. Mouth relatively small, slightly arched; teeth arranged in quincunx, with very short, rounded to pointed cusps; sexual dimorphism not reported. Tooth counts upper jaw 36 to 46, lower jaw 36 to 46. Dorsal disc and tail surface densely covered with fine denticles, except for anterior pelvic–fin lobes smooth, posterior lobe sparsely covered; ventral surface smooth except for tail with densely covered dermal denticles excluding surrounding naked narrow midline. Thorn pattern on dorsal surface: several on rostrum, 4 along interorbital margin; 1 medial to each spiracle, with a triangular patch of 11 thorns over nuchal and scapular regions; 3 rows along disc midline posterior to scapular; 5 rows on dorsal and lateral aspects of tail extending to first dorsal–fin origin. Vertebral counts: trunk vertebral counts 27 to 30, predorsal caudal vertebral counts 59 to 66. Spiral valve counts not available. Maximum total length uncertain, largest known specimen is a

45.7 cm immature male. **Colour:** a uniform dark brown, expect for blackish brown dorsal fins; ventral surface yellowish brown anteriorly, becoming dark brown posteriorly, with indistinct lighter areas around mouth, abdomen, gill openings, and vent.

Distribution: Southeastern Pacific Ocean: Chile, Peru, and Ecuador.

Habitat: Found along the upper continental slopes at depths of 590 to at least 1295 m, and possibly to 1692 m.

Biology: Oviparous, but nothing else known about its reproductive cycle.

Size: Known only from a small number of immature males and females measuring to 45.7 cm total length. Size at birth uncertain, but smallest free-swimming individuals measured from 5.4 to 13.7 cm total length

Interest to Fisheries and Human Impact: Uncertain, in Chile, and possibly Peru, maybe taken on occasion as bycatch in seasonal artisanal deep-sea fisheries for toothfish (***Dissostichus eleginoides***) and shrimp.

The conservation status of this skate is Least Concern due to its deepwater habitat and a lack of deep-sea fisheries where it occurs.

Local names: Raya negra (Chile).

Remarks: This little known species appears to be endemic to the upper continental slopes from Ecuador to Chile. Presently, it is only known from immature specimens, but larger individuals should be retained for detailed examination as the adults for this species may exhibit ontogenetic differences with growth.

Literature: de Buen (1960); McEachran and Miyake (1984); Long and McCosker (1999); Lamilla (2004); Bustamante, Vargas-Caro, and Bennett (2014); Cornejo *et al.* (2015).

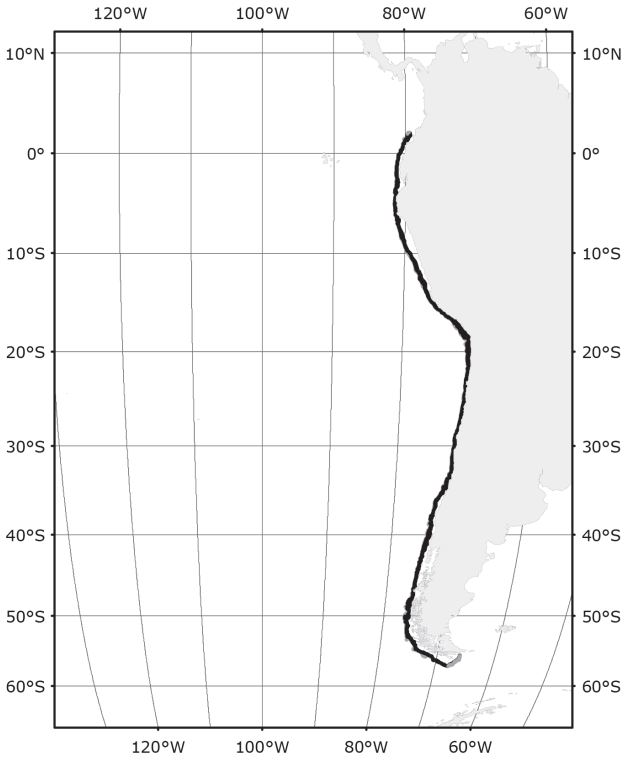


Fig. 214 ***Rajella nigerrima***

Known distribution

Rajella sadowskii (Krefft and Stehmann, 1974)

Raja (Rajella) sadowskii Krefft and Stehmann,1974, *Arch. FischWiss.* 25(S1): 34, figs 1-3. Holotype: ZMH 25262 [ex ISH 1807-1968], maturing male 50.7 cm total length, off Brazil, 29°57'S, 47°35'W, 1200 m.

Synonyms: None.

Other Combinations: ***Raja sadowskii*** Krefft and Stehmann,1974.

FAO Name: En – Brazilian skate.

Field Marks: A rare ***Rajella*** species, distinguished by a purplish grey to brownish dorsal disc surface with distinctly darker purplish pectoral–fin margins, and dark grey to black dorsal and caudal fins, and a blotchy white abdominal ventral surface surrounded by an overall greyish coloration, white pectoral and pelvic–fin margins and white ventral tail tip. Tail length much greater than disc length, and with 3 rows of tail thorns.

Diagnostic Features: Disc rhombic shaped, relatively broad, anterior margin undulated, with broadly rounded tips; disc length 0.9 times into width; snout relatively short, length 2.8 to 3.3 times interorbital distance; angle anterior to

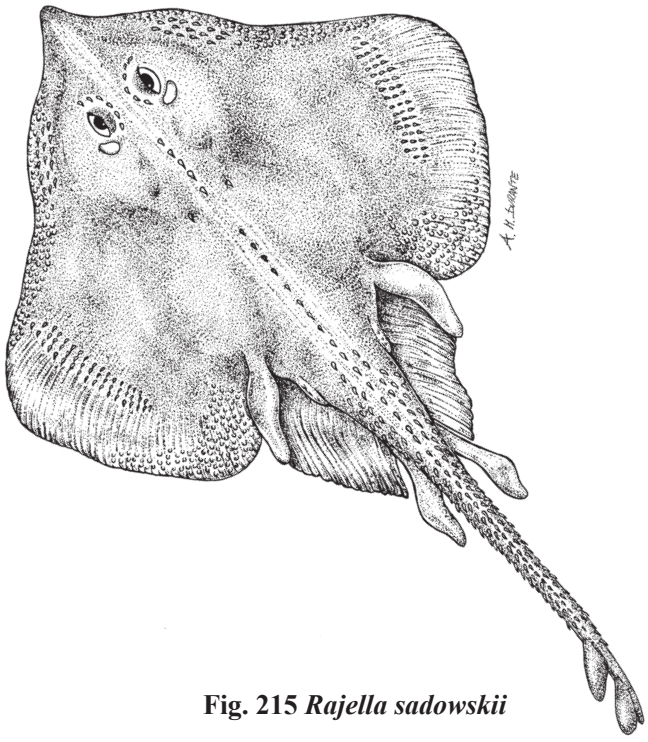


Fig. 215 ***Rajella sadowskii***

spiracles 81.5° to 119.5°. Pectoral–fin radials range from 61 to 72. Pelvic fins strongly incised, anterior lobe long and narrow, length extending to posterior margin of posterior lobes; pelvic–fin radials 17 to 22. Tail relatively long, tapering to tip; length from mid-cloaca to tip 1.4 to 1.5 times snout tip to cloaca. Dorsal fins broadly rounded, similar in shape; first slightly larger than second, without space between dorsal fins or between second dorsal fin and caudal lobe. Eyes of moderate size, diameter slightly longer than interorbital width. Nasal curtain well developed, anterior lobe laterally expanded, fringed laterally and along distal margin; nasal–flap posterior margin extending to near mouth corners. Mouth of moderate size, slightly arched; teeth arranged in quincunx, with small single median cusp; sexual dimorphism not reported. Tooth count upper jaw 37 to 44, lower jaw 34 to 41. Dorsal disc surface covered with fine denticles; ventral disc surface mostly smooth. Thorn pattern on dorsal surface: 2 to 5 orbital thorns on each side of inner orbit; 3 to 5 median nuchal thorns; 0 to 2 scapular thorns on each shoulder; mid-dorsal thorns in single median row, 6 to 7 from nuchal region to tail origin; 3 rows of thorns on dorsal tail surface beginning at mid-level of pelvic fins, and extending to first dorsal fin; tail with median row of 21 to 30 thorns, with 27 to 50 lateral tail thorns, diminishing posteriorly along tail. Vertebral counts: trunk vertebral counts 25 to 32, predorsal caudal vertebral counts 60 to 71. Spiral valve counts not available. Maximum total length is 75 cm. **Colour:** dorsal surface a purplish grey to brownish, with pectoral and pelvic–fin margins darker purple, dorsal and caudal fins dark greyish to blackish; ventral surface greyish with white abdomen, pectoral and pelvic–fin margins much darker, tail from about dorsal–fin region to tip lighter to whitish.

Distribution: Southeastern Pacific Ocean: Chile. Southwestern Atlantic Ocean: off Brazil.

Habitat: Unknown, except occurs along steep continental slopes at 800 to 1360 m deep. Based on ROV video footage, this skate lives on soft bottom substrate, possibly in association with deepwater gorgonians, hard coral, tube sponges, crinoids, ophiuroids and other deep-sea skate species. Bottom temperature where type specimens were collected ranged from 3.3 to 4.9 °C.

Biology: Oviparous, but nothing else known about its life history. Egg cases longitudinally striated, and coloured an olive brown.

Size: Maximum known total length is 75 cm for a female and 70.5 cm for a male; a 63.0 cm female was mature, but no other information on size at maturity or birth is available. Smallest free-swimming individuals measured 17 to 23 cm.

Interest to Fisheries and Human Impact: None, although taken as bycatch in longline fisheries for Patagonian toothfish (***Dissostichus eleginoides***). Species-specific catch data is not available.

The conservation status of this skate is Data Deficient due to limited information.

Local names: Raya morada (Chile).

Remarks: A little known deep-sea species from off southern Chile (Talcahuano and Valdivia), and off Brazil. Additional specimens, especially larger adults, should be retained for detailed examination.

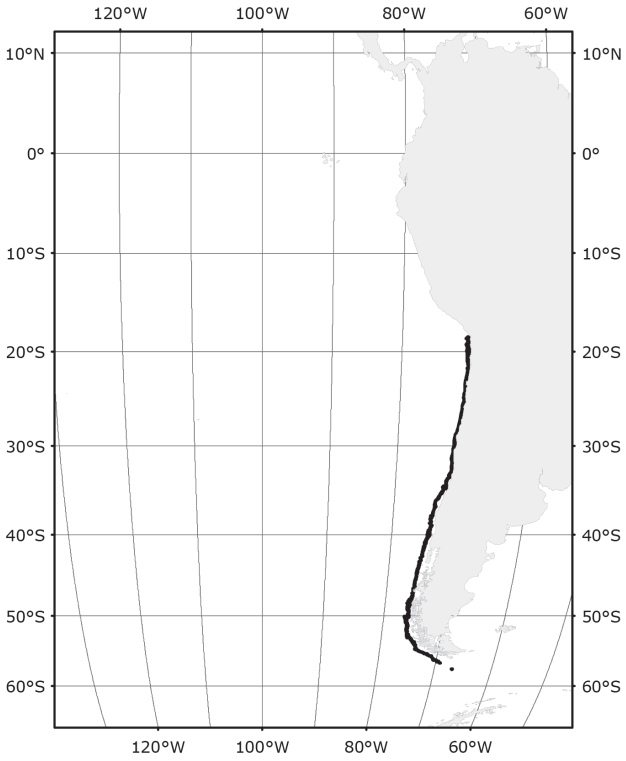


Fig. 216 ***Rajella sadowskii***

Known distribution

Literature: Krefft and Stehmann (1974); Lamilla (2004); Soto and Costa (2010); Bustamante, Vargas-Caro, and Bennett (2014).

Zearaja Whitley, 1939

Genus: ***Zearaja*** Whitley, 1939, *Austr. Zool.*, 9 (pt 3): 254.

Type Species: ***Raja nasuta*** Müller and Henle, 1841 by original designation (also monotypic).

Number of Recognized Deep–sea Southeastern Pacific Ocean Species: 1.

Synonyms: None.

Field Marks: Externally, members of this genus are identical with the genus ***Dipturus*** in having an exceptionally long, pointed snout (internarial width less than 70% of prenarial snout length), along with markedly concave anterior disc margins, thorns

on disc usually absent, being present only in a median row along tail to first dorsal fin, along with strong lateral thorns on low edges of tail and occasionally parallel rows on tail; juvenile thorn pattern may differ. Coloration is uniformly grey, brown to dark brown to blackish; ventral surface with an irregular pattern of numerous mucus and sensory pores marked as black dots and short streaks (often camouflaged through dark ground colour and/or blackish mucus coverage), as well as pores on upper side of head.

Diagnostic Features: See account of genus ***Dipturus*** above. Externally, there is no difference between ***Zearaja*** and ***Dipturus***. The primary difference is in the internal clasper morphology of mature males with the ***Zearaja*** having a greatly enlarged clasper, its length 24 to 32% of total length. Last and Gledhill (2007) provide a detailed clasper description.

Remarks: The genus ***Zearaja*** externally is morphologically similar to the genus ***Dipturus***. The characteristics Whitley used to separate it, e.g. produced snout, elevated pectoral girdle, rough disc, thorn distribution, and dark-edged ventral pores, apply to several other skate genera. Therefore, it was place in synonymy with ***Dipturus*** until Last and Yearsley (2002) resurrected ***Zearaja*** to subgeneric status within the ***Dipturus***, and subsequently to full status by Last and Gledhill (2007). The separation of these genera rests primarily on differences in clasper morphology (see Last and Gledhill, 2007, for detailed clasper description separating ***Zearaja*** from ***Dipturus***). However, molecular studies by Naylor *et al.* (2012) reveal that ***Zearaja*** nests within the ***Dipturus***, raising questions as to the separation of these genera. The genus ***Zearaja*** is treated as valid here, but recognizing it may be subject to change with further molecular and morphological studies.

The genus currently comprises 3 or 4 species, all regional endemics to Australia, New Zealand, and South America, with one deep-sea species occurring in the southeastern Pacific Ocean.

Zearaja chilensis (Guichenot, 1848)

Raia chilensis Guichenot, 1848, in *C. Gay, Hist. fisica y politica Chile, Zool.* 2: 367. No types known, Chile.

Synonyms: ***Raja flavirostris*** Philippi, 1892, *An. Mus. Nac. Zool.*, 1: 3, pl. 1, fig. 2. Holotype: whereabouts unknown (unique), Chile. ***Raja oxyptera*** Philippi, 1892, *An. Mus. Nac. Zool.*, 1: 4, pl. 2, fig. 1. Holotype: whereabouts unknown (unique). Chile. Placed by Menni (1973, *Physis*, 32(85): 421) in synonymy of ***R. (D.) flavirostris*** = ***R. (D.) chilensis***. ***Raja latastei*** Delfin, 1902, *Revista Chil. Hist. Nat.* 6: 264, pl. 11, fig. a-b. Syntypes: (2). Chile. ***Raia brevicaudata*** Marini, 1933, *Physis*, 11: 329. Holotype: Museo Nacional de Buenos Aires (unique), Argentina, 325 mm total length, Argentina.

Other Combinations: ***Raja chilensis*** (Pequeño and Lamilla, 1985: 249); ***Dipturus chilensis*** (McEachran and Dunn, 1998: 285).

FAO Name: En – Yellownose skate.

Field Marks: A moderately large skate, with a long, acutely pointed, sub-triangular snout, and a mostly smooth dorsal disc surface, except for prickles sparsely covering snout. Dorsal surface colour is brown to reddish brown or greenish brown, and with irregular smaller blotches, spots, and stripes giving it a camouflage-like appearance; ventral surface lighter than dorsal, and with numerous black mucous pores and white areas on abdomen and pelvic–fin bases; base of pectoral fins with distinct light to dark blotches encircled by darker spots giving it an ocellus appearance.

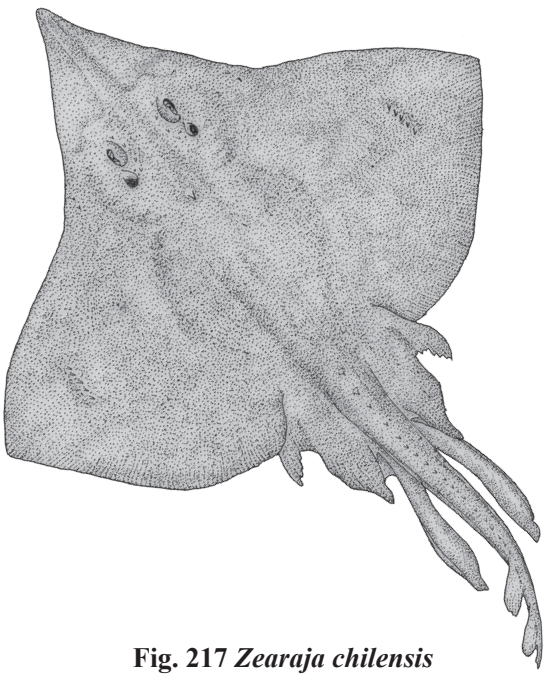


Fig. 217 ***Zearaja chilensis***

Diagnostic Features: Disc rhombic–shaped, broad, width 1.2 times greater than length, and with lateral corners angled with rounded tips; snout greatly produced, length 19 to 23% total length, acutely triangular. Total pectoral radial counts not available. Mouth broad, slightly arched; nasal curtain not fringed; teeth sexually dimorphic, with a single large cusp on adult males, more or less flattened in females; arranged in quincunx. Tooth counts in upper and lower jaws 30 to 46. Anterior pelvic lobes stout, moderately long, not extending to posterior margin of posterior lobe. Tail stout, tapering distally, relatively short, length from cloaca to tip less than distance from snout tip to cloaca. Dorsal fins separated, second dorsal fin not confluent with caudal fin. Dermal denticles on dorsal disc surface relatively smooth, excluding snout, with sparse prickles on dorsal surface; ventral surface mostly smooth except roughly textured rostrum. Thorn pattern on disc dorsal surface: pattern of 1 to 9 orbital thorns; 1 to 2 spiracle thorns; nuchal thorns either absent or if present 1 to 3; disc dorsal surface with small light coloured thorns irregularly scattered; tail with 3 to

5 longitudinal rows, including a single median row flanked by 1 or 2 lateral rows of 10 to 47 thorns; 1 or 2 interdorsal thorns; adult males with 9 to 33 alar thorns in 1 to 3 columns, and malar thorns not available; ventral surface of rostrum coarse, with dense dermal denticles and a few thorns, with small thorns occasionally on branchial region. Vertebral counts: not available. Spiral valve counts not available. Maximum total length is 158 cm. **Colour:** dorsal surface disc dark brown, reddish brown or greenish brown, usually patterned with irregular dark spots and blotches, and stripes giving it a camouflage-like appearance; base of each pectoral fin has a dark ocellus; ventral surface dark brown to pinkish grey, usually lighter than dorsal surface, and with numerous blackish mucous pores; whitish areas on abdomen and base of pelvic fins.

Distribution: Southeastern Pacific Ocean: central Chile to the Magellan Straits, and extending into the southwestern Atlantic to Uruguay and possibly to southern Brazil, and including the Falkland Islands (Malvinas).

Habitat: A common species found on continental shelves and slopes from depths of 28 to 450 m deep.

Biology: Oviparous, with egg capsules golden brown in coloration, becoming darker after deposition; egg capsules stout, without striations, texture soft to the touch. Size at maturity varies regionally, but on average females mature at 95 to 108 cm, and males at 82 to 88 cm. Breeding and nursery grounds are unknown, and there does not appear to be a defined season for egg deposition. Age at maturity is 12.8 to 14 years for females and 10.3 to 11 years for males. Maximum age varies regionally, but ranges from 21 to 27 years for females and 17 to 23 years for males.

The diet consists mostly of crustaceans for specimens less than 50 cm total length, but in larger specimens over that size teleost fishes and squids are more important in the diet.

Size: Maximum total length at least 158 cm, possibly 210 cm total length; males grow to about 155 cm and females to at least 158 cm total length. Size at birth is uncertain, but the smallest free-swimming individual measured 15.6 cm total length.

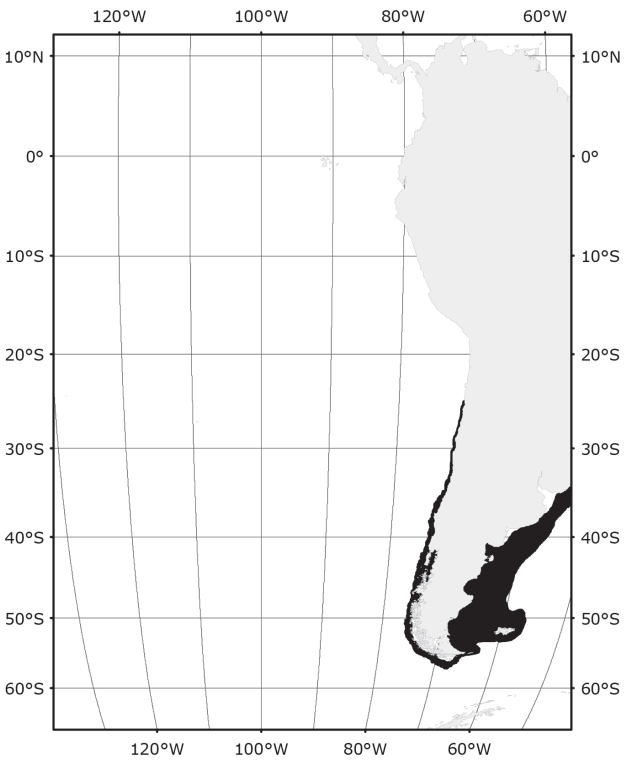


Fig. 218 ***Zearaja chilensis***

Known distribution

Interest to Fisheries and Human Impact: This species makes up a significant portion of the skate biomass landed in Chilean waters, possibly up to 85% of the catch, although species-specific data is not well documented since ***Dipturus trachyderma*** landings are not separated from this species. The species is now subject to quota regulations in Chilean waters.

The species is listed as Vulnerable due to heavy fishing pressure throughout most of its range, and suspected declining biomass in landings.

Local Names: Raya, Raya de ramales, Raya picuda, Raya roja, Raya trompa de cristal, Volantín, Raya volantín (Chile).

Remarks: This is an important targeted fishery species in Chile and Patagonia, including the Falkland Islands (Malvinas), but shows a remarkable difference in life history characteristics regionally.

Literature: Céspedes *et al.* (2005); Licandeo *et al.* (2006); Ebert and Bizzarro (2007); Kyne *et al.* (2007); Licandeo and Cerna (2007); Concha *et al.* (2011); Bustamante *et al.* (2012); Bustamante, Vargas-Caro, and Bennett (2014); Vargas-Caro *et al.* (2015).

4. Subclass HOLOCEPHALI

4.1 Order CHIMAERIFORMES – Chimaeras

Order: Chimaeriformes: Patterson, 1965, *Philos. Trans. R. Soc. London B Biol. Sci*. 249: 101–219.

Number of Recognized Deep–sea Southeastern Pacific Ocean Families: 2.

Synonyms: See Bigelow and Schroeder, 1953 Order Chimaerae page 516. See Garman 1901, 1906, 1911

FAO Names: En – Chimaeras; **Fr** – Chimères; **Sp** – Quimeras.

Field Marks: Body elongated and tapering rearwards to a filamentous tail, head very large, a prominent first dorsal–fin spine preceding a large, erect triangular dorsal fin, second dorsal fin low and elongated, broad pectoral fins, and noticeable open lateral–line canals on head and trunk. Colour variable from silvery to grey, brown, reddish, or black with lighter or darker shades of each; prominent spots or stripes may be present on some species.

Diagnostic Features: Body more or less compressed, elongate, tapering posteriorly from large head to slender filamentous tail. Snout either short and conically rounded, elongate and spear–like, or with hoe–like proboscis. Eyes relatively large, and in life bright green. Nostrils large, located in front of mouth, connected with outer corner of mouth by a deep groove covered by lateral lobe of upper lip. Mouth ventrally located on head, anterior to eye level, transverse and small. Teeth plate–like, paired, with two pairs on upper jaw, a single pair on lower; plates with more or less conspicuous ridges and bumps on surface. Gill openings anterior to pectoral fins, one on each side and covered by a fleshy operculum. Spiracles absent. Skin smooth, often deciduous. Lateral–line canals well developed, especially on head. Pectoral and pelvic fins broad, ovoid–shaped, and well developed. First dorsal fin triangular, erect, usually much higher than second, and preceded by an elongate, smooth or serrated edged spine; fin spine may or may not reach apex of first dorsal fin. Second dorsal fin lower than first, elongated, with margin either relatively straight or undulating distally, and terminating anterior to upper caudal–fin lobe. Second dorsal fin separated from first, elongated, and much lower in height than first; margin of second relatively straight to undulating distally, terminating before upper caudal–fin lobe. Anal fin absent or present; if present, small, low, and distinctly separated from caudal fin by a deep notch. Caudal fin lanceolate, with upper and lower lobes, dorsal lobe margin with or without tubercles; lower lobe without tubercles; whip–like tail filament variably present of absent. Sexual dimorphism strong, males (adults only) with bulbous, denticulate frontal tenaculum set in pouch atop head. Pre–pelvic tenaculum blade–like with or without large denticles along the medial edge, retractable into pouches anterior to the pelvic fins. Claspers may be slender and rod–like in some, bifurcate in others, or with some being tripartite. Size small (60 cm) to relatively large at 150 cm total length or possibly more. **Colour:** uniform pale to whitish, silvery, brown, grey, or black; some species lighter or darker ventrally; depending on the species some may or may not exhibit striking patterns of spots and stripes.

Distribution: Circumglobal in all oceans except Antarctic waters. The western Indo–Pacific has the highest diversity of these fishes followed by the North Atlantic region. The family Chimaeridae tends to exhibit a high degree of endemism with some species having very restricted ranges while members of the family Rhinochimaeridae generally have a broader, but widely scattered distribution; most members of both these families are primarily deep–sea. The shallow water family Callorhinchidae is restricted to the Southern Hemisphere.

Habitat: Chimaeroids are mostly deepwater inhabitants occupying outer continental shelves, slopes, seamounts, offshore island chains, and underwater ridges from depths of 500 m to more than 2500 m. A few species, mainly those in the family Callorhinchidae, occur in relatively shallow, coastal waters. Chimaeroids occur on both soft bottom and rocky reef habitats, some in areas of relatively high vertical relief.

Biology: Reproduction is oviparous, but for most species very little else is known about their reproductive cycle, fecundity, or age and growth. There have been some limited diet studies that suggest they consume mostly benthic invertebrates including polychaetes, amphipods, molluscs, including bivalves, gastropods and cephalopods, crustaceans, brittle stars, and small benthic fishes. The behavior of most chimaeroids is poorly known although it is well known that some species will form large aggregations, segregate by size and sex, while some species will occupy different habitats depending on the stage in life.

Interest to Fisheries and Human Impact: A few species, mostly the callorhinchids, are targeted in commercial fisheries, but most species are taken as bycatch and either discarded at sea or retained for market.

The conservation status of most species is either Data Deficient or Least Concern due to their deepwater habitat and lack of information on their abundance, life history, and population trend.

Local names: No information.

Remarks: The present arrangement of the Chimaeriformes families and genera follows recent revisions by Didier (1995, 2004) and Didier, Kemper and Ebert (2012). The shallow water occurring Callorhinchidae are not discussed further.

Literature: Garman (1901, 1908, 1911); Bigelow and Schroeder (1953, 1954b); Compagno, Stehmann and Ebert (1990); Didier (1995, 2002, 2004); Nelson (2006); Last and Stevens (2009); Ebert and Winton (2010); Didier, Kemper and Ebert (2012); Ebert (2014); Ebert and Stehmann (2013).

Key to Deep–sea Southeastern Pacific Ocean Families:

1a. Snout short and blunt (Fig. 219) . . . . . **family Chimaeridae**

1b. Snout elongated and tapering (Fig. 220). . . . . **family Rhinochimaeridae**

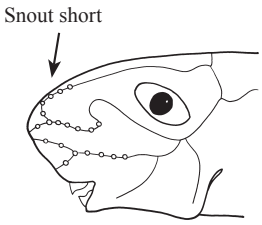


Fig. 219 Chimaeridae

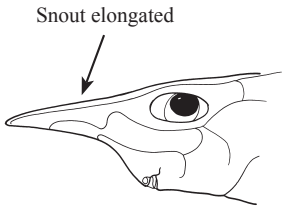


Fig. 220 Rhinochimaeridae

4.1.1 Family CHIMAERIDAE

Family: Chimaeridae Bonaparte, 1831, *Giornale Arcadico di Scienze*, 49: 1–77.

Type genus: ***Chimaera*** Linnaeus, 1758.

Number of Recognized Deep–sea Southeastern Pacific Ocean Genera: 2.

Synonyms: None.

FAO Name: En – Shortnose chimaeras.

Field Marks: Small to large bodied chimaeras, with massive heads, but tapering posteriorly to a filamentous whip–like tail, snout fleshy, short, conical, and pointed at tip, first dorsal fin triangular, preceded by a prominent fin spine, and anal fin variably absent or present. Body colour uniformly dark or light brown, grey, black, with spotting or lateral stripes in some species.

Diagnostic Features: Body elongate, compressed, tapering from very large head to a filamentous tail. Snout short, conical, fleshy, bluntly pointed at tip. Eyes large, bright green in life. Skin smooth, often deciduous, flaking off in patches during and after capture. Nostrils large, located in front of mouth. Gills, one opening on each side, located anterior to pectoral fins, and covered by a fleshy operculum. Spiracles absent. Mouth small, ventral on head, connected to nostrils by deep grooves. Teeth non–replaceable, in the form of three paired tooth plates; two pairs on upper jaw, one pair on lower jaw. Tooth plates robust with patches of dense hypermineralized tissue that appear as ridges and bumps on the surface. Lateral line canals appear as open grooves on head and flanks of body; canals on snout widening with regularly spaced expanded dilations. Pectoral and pelvic fins broad with delicate external fin webs supported by cartilaginous rays (ceratotrichia). First dorsal fin triangular, erect, preceded by an elongate, serrated spine. Second dorsal fin separated from first, elongated, and much lower in height than first; margin of second relatively straight to undulating distally, terminating before upper caudal–fin lobe. Anal fin, depending on the genera, absent or present; if present, small, low, and distinctly separated from caudal fin by a deep notch. Caudal fin lanceolate, with upper and lower lobes, and terminating with a whip–like tail filament of variable length. Sexual dimorphism strong, mature males with bulbous, denticulate frontal tenaculum set in pouch atop the head anterior to eyes. Pre–pelvic tenaculum blade–like with large denticles along the medial edge, hidden in pouches anterior to the pelvic fins. Claspers bifurcate or tripartite with fleshy, denticulate tips. Size variable, ranging from 60 to 150 cm total length. **Colour:** uniform brown, grey, or black, but with some species exhibiting striking patterns of spots and stripes.

Distribution: The Chimaeridae have an almost circumglobal distribution in arctic and cold temperate to tropical seas, although most species, especially in lower latitudes, occur in very deepwater. This is the most species–rich family of chimaeras with most species being regional endemics. The only area they do not appear to occur in is the Antarctic region.

Habitat: Members of the Chimaeridae generally inhabit the deep–sea, usually at depths greater than 200 m, with some species known to occur well over 2500 m deep. They occupy a wide range of benthic habitats from soft muddy or sandy bottoms to cobble and rocky reefs, sometimes in association with high vertical relief.

Biology: Reproductive mode is oviparous, but little is know about their fecundity or reproductive cycle. Females lay pairs of spindle–shaped egg cases that are deposited on the bottom. Embryological studies indicate that development may take as long as 9 to 12 months, but for some of the deeper living species the gestation time may be much longer.

Attempts to age chimaeras have met with mixed results, with the age not being validated for any species. Very little is known of their diet except where information is available they tend to feed on a variety of benthic invertebrates and small fishes.

Interest to Fisheries and Human Impact: Fisheries for chimaeras are poorly known with catches perhaps the least reported among any chondrichthyan group. Most shortnose chimaeras occur too deep and are not caught in sufficient

numbers to warrant a targeted fishery, but are often retained as bycatch. The North Atlantic ***Chimaera monstrosa*** is one shortnose chimaera species for which landings are reported.

The conservation status of most members of this family are Data Deficient or Least Concern, but some species are considered Near Threatened due to current or potential fisheries that may impact their populations.

Local Names: No information.

Remarks: The separation of the genera ***Chimaera*** and ***Hydrolagus*** has been subject to much debate as they are morphologically very similar with the primary difference being the presence (***Chimaera* spp.**) or absence (***Hydrolagus* spp.**) of an anal fin.

The current arrangement of this family follows Didier, Kemper and Ebert (2012) and Ebert (2014, 2015; unpubl. data) in recognizing two genera and 38 species. Six species, including the recently described ***Chimaera orientalis,*** and five ***Hydrolagus*** species are known to occur in the southeastern Pacific Ocean,

Literature: Garman (1901, 1908, 1911); Bigelow and Schroeder (1953); Krefft *in* Hureau and Monod (1973a); Stehmann and Bürkel *in* Whitehead *et al*. (1984); Didier (1995); Nelson (2006); Ebert and Winton (2010); Didier, Kemper and Ebert (2012); Ebert and Stehmann (2013); Ebert (2014); Kemper and Ebert (In press); D.A. Ebert (unpubl. data).

List of Species Occurring in the Area:

Chimaera orientalis Angulo, López, Bussing, and Murase, 2014
Hydrolagus alphus Quaranta, Didier, Long, and Ebert, 2006
Hydrolagus macrophthalmus de Buen, 1959
Hydrolagus mccoskeri Barnett, Didier, Long, and Ebert, 2006
Hydrolagus melanophasma James, Ebert, Long, and Didier, 2009
Hydrolagus trolli Didier and Séret, 2002

Key to Deep–sea Southeastern Pacific Ocean Genera:

1a. Anal fin present (Fig. 221). . . . . ***Chimaera***

1b. Anal fin absent (Fig. 222) . . . . . ***Hydrolagus***

Fig. 221 *Chimaera*

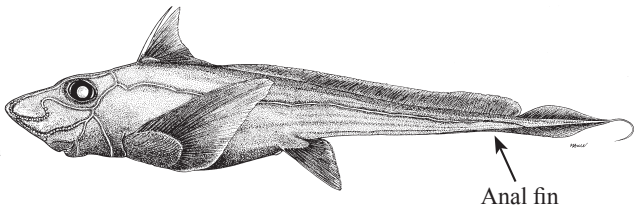


Fig. 222 *Hydrolagus*

Chimaera Linnaeus, 1758

Genus: ***Chimaera*** Linnaeus, 1758, *Syst. Nat.*, ed. 10, 1: 236.

Type species: ***Chimaera monstrosa*** Linnaeus, 1758, by subsequent designation of Jordan and Gilbert, 1883, 54.

Number of Recognized Deep–sea Southeastern Pacific Ocean Species: 1.

Synonyms: Genus ***Chimera*** Rafinesque, 1815, *An. Nat.*: 92; emended spelling for ***Chimaera*** Linnaeus, 1758, by ref. to Linnaeus. Genus ***Chimaira*** Duméril, 1856, *Mem. Acad. Sci. France*, 27(1): 155; emended spelling for ***Chimaera*** Linnaeus, 1758, by ref. to Linnaeus. Doubtful synonym Genus ***Callorhynchus*** Gronovius, 1772: 49. Type and only described species: ***Callorhynchus americanus***.

Field Marks: Blunt–snouted chimaeras with dorsal–fin spine attached to first one–third to one–half of dorsal fin, the upper half unattached, second dorsal–fin height even along its length, never indented, and anal fin separated from the anterior margin of the ventral caudal fin by a deep notch.

Diagnostic Features: See Field Marks above.

Local names: No information.

Remarks: The genus contains at least 16 species globally, with possibly up to four undescribed species from the southwestern Indian Ocean. Only a single species (***Chimaera orientalis***) is confirmed from the southeastern Pacific Ocean.

Chimaera orientalis Angulo, López, Bussing, and Murase, 2014

Chimaera orientalis Angulo, López, Bussing, and Murase, 2014, *Zootaxa*, 3861: 554–574, figs 3–5, tab. 3. Holotype: UCR 2909–05.01, adult male, 774 mm total length, 460 mm body length. Type locality: Cabo Blanco, 9°26'16.44"N, 85°29'56.04"W, Puntarenas, Costa Rica, collected by J.M. Carvajal, 560–620 m, 24 November 2010.

Synonyms: None.

Other Combinations: None.

FAO Name: En – Eastern Pacific black chimaera.

Fig. 223 ***Chimaera orientalis***

Field Marks: The only eastern Pacific ***Chimaera*** species, it can be separated from the five ***Hydrolagus*** species by the presence of an anal fin. Body coloration is a uniform dark brown, ventral trunk surface and all fins slightly darker, but no distinctive markings, mottling, or spot patterns. Second dorsal–fin distal margin relatively straight, not undulated.

Diagnostic Features: Body stout, uniform in height to about origin of pelvic–fin insertions, quickly tapering posteriorly to a thin caudal filament. Snout short, bluntly rounded. Eyes oval shaped, large, about 30 to 31% head length. Oral and preopercular canals share common branch from infraorbital canal. Trunk lateral line extends the length of body from junction of post-orbital, with sigmoid curve followed by wavy undulations to caudal region, where it curves ventrally and extends to caudal filament. Skin firm and robust, smooth, not deciduous. Pectoral fins large, triangular, anterior margin extends beyond pelvic–fin insertion when laid against the body. Pelvic–fins anterior margin straight to slightly convex, length about one-half of pectoral fin anterior margin, posterior margin convex. Adult male frontal tenaculum relatively broad, short stemmed, with a prominent bulbous tip with 10 to 11 longitudinal rows of 6 to 12 posteriorly pointed, needle-like denticles. Claspers forked for posterior most 40 to 43% of total clasper length, extending beyond distal edge of pelvic fins, and terminating with fleshy tips. Prepelvic tenacula not described. Adult females with anal pads, absent in males. First dorsal fin triangular shaped, with a convex anterior margin, and a short base, with concave posterior margin. Dorsal–fin spine prominent, robust, about 28 to 31% body length, preceding first dorsal fin, attached to fin two-thirds of spine length, slightly curved distally, with height greater than fin apex; distal posterior portion of spine with two parallel rows of serrations; spine and first dorsal fin extend beyond second dorsal–fin origin when depressed. Second dorsal fin long, nearly uniform in height throughout, not undulated, with base length more than three-fourths body length; second dorsal–fin height greater than caudal–fin dorsal lobe height; separation between second dorsal–fin insertion and caudal–fin dorsal lobe relatively long, space 2.0 to 2.5%. Caudal fin dorsal and ventral lobes elongate, becoming a filamentous whip-like tail, lobe heights about equal, both less than second dorsal–fin height; ventral lobe insertion posterior to dorsal caudal–fin insertion. Anal fin present, originating below second dorsal fin, and extending beyond second dorsal–fin insertion. Maximum total length at least 85.8 cm (50.5 cm body length). **Colour:** uniform dark brown with no distinct markings, mottling, or patterns; ventral trunk and fin surfaces slightly darker. Clasper bases lighter, becoming darker along rod, and lighter at tips.

Distribution: Southeastern Pacific Ocean: known from Costa Rica and Peru.

Habitat: Little known other than it occurs from 560 to 1138 m deep.

Biology: Unknown, only four specimens, three type specimens, and an adult female from the Gulf of Panama.

Size: Maximum total length is 85.8 cm (50.5 cm body length) for an adult female, and 77.4 cm and 76.0 cm total length (46.0 and 47.5 cm body length) for adult males.

Interest to Fisheries and Human Impact: None, although may be caught as bycatch in deep-sea fisheries.

The conservation status of this species has not been assessed.

Local names: No information.

Remarks: This is the only known ***Chimaera*** species from the eastern Pacific Ocean.

Literature: Nakaya *et al.* (2009); Angulo, López, Bussing, and Murase (2014); Cornejo *et al.* (2015); D.A. Ebert (unpubl. data).

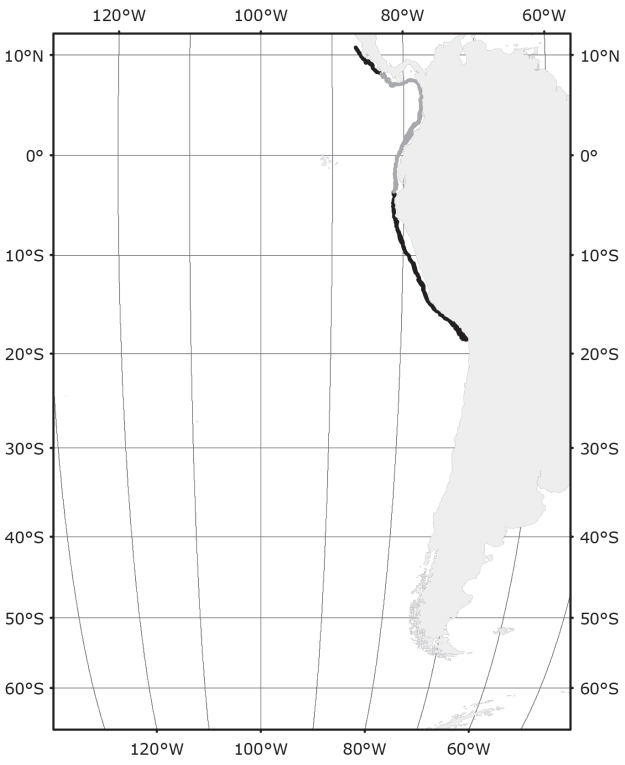


Fig. 224 *Chimaera orientalis*

Hydrolagus Gill, 1862

Genus: ***Hydrolagus*** Gill, 1862, *Proc. Acad. Nat. Sci. Philad*., 14: 331.

Type species: ***Chimaera colliei*** Lay and Bennett, 1839, off Monterey, California, U.S.A., by monotypy.

Number of Recognized Deep–sea Southeastern Pacific Ocean Species: 5.

Synonyms: Subgenus ***Bathyalopex*** Collett, 1904. *Forh. VidenskSelsk. Krist*., (9): 5. Type: ***Chimaera*** (***Bathyalopex***) ***mirabilis*** Collett, 1904 (by monotypy) as a subgenus to ***Chimaera***. Faroe Channel and Faroe Bank, 720 to 1200 m.

FAO Names: En – Ratfishes; **Fr** – Chimères; **Sp** – Quimeras.

Field Marks: Blunt–snouted chimaeras with a dorsal–fin spine either attached to first dorsal–fin entire length or free for distal one–half to one–third its length, second dorsal fin even in height along its length or with deep indentation separating the fin into anterior and posterior portions, and no deep notch separating an anal fin from the ventral caudal fin.

Diagnostic Features: As for family, but species placed into the genus ***Hydrolagus*** lack an anal fin.

Local names: No information.

Remarks: Worldwide there are 22 to 24 species recognized within this genus, of which five occur in the deep–sea southeastern Pacific Ocean.

Key to Deep–sea Southeastern Pacific Ocean Species (modified after Didier, Kemper and Ebert, 2012)**:**

1a. Dark brown to black in colour with few or no light markings on body or fins **2**

1b. Lightly coloured, either light brown or milky white **3**

2a. A well-defined white spot on the side of the body above the pectoral fins (sometimes one or more less defined spots present); snout blunt; large undulation in second dorsal fin; eyes large (eye length >40% head length); small claspers that do not extend beyond the tip of pelvic fin (Fig. 225) . . . . . ***Hydrolagus alphus***

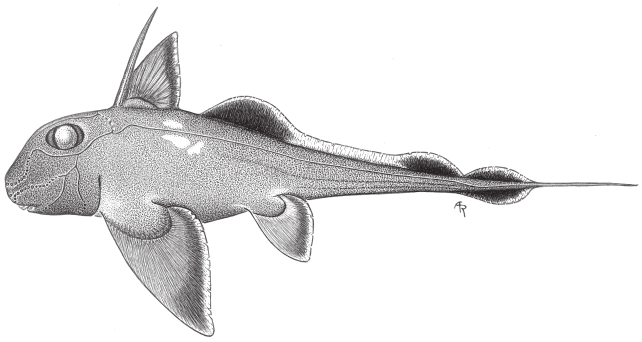


Fig. 225 ***Hydrolagus alphus***

2b. Light region in the middle of second dorsal fin with anterior and posterior edges being darker; snout defined and pointed with minimal sloping from orbit to snout; eye length <39.5% head length; the preopercular (POP) and oral (O) lateral– line canals join a shared branch before joining the infraorbital canal (OTM); long curved first dorsal–fin spine that extends beyond second dorsal–fin origin when depressed (Fig. 226). . . . . ***Hydrolagus macrophthalmus***

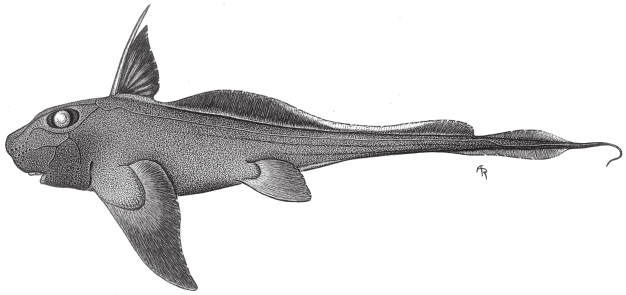


Fig. 226 ***Hydrolagus macrophthalmus***

2c. Light band across snout prior to preservation; body is a uniform dark brownish black after preservation; eye length 22.2 to 26% head length; large claspers that extend beyond the tip of pelvic fin (clasper total length 13.7% to 15.0% body length); long second dorsal fin with uniform height; large dorsal–fin spine that exceeds the height of the dorsal fin and extends beyond second dorsal–fin origin when depressed (Fig. 227). . . . . ***Hydrolagus melanophasma***

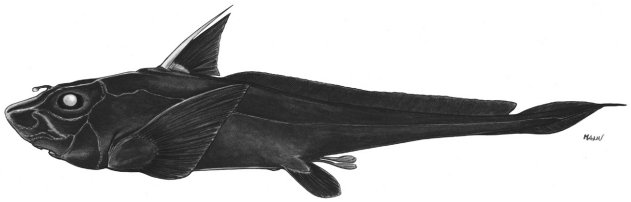


Fig. 227 ***Hydrolagus melanophasma***

3a. Body with numerous white markings on sides; second dorsal fin generally maintains a uniform height throughout with a small dip in the center; head small (head length 31% to 32% body length); the preopercular (POP) and oral (O) lateral–line canals join a shared branch before joining the infraorbital canal (OTM) (Fig. 228). . . . . ***Hydrolagus mccoskeri***

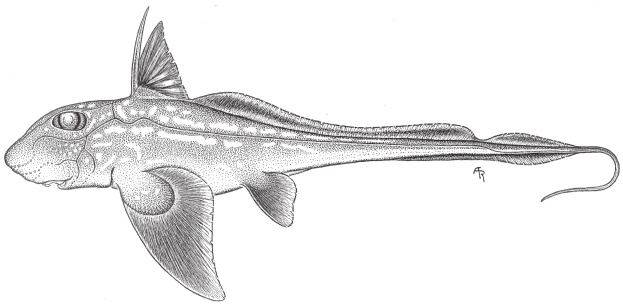


Fig. 228 ***Hydrolagus mccoskeri***

3b. Body colour milky white with no distinct markings; posterior edge of dorsal–fin spine is smooth; large bodied ***Hydrolagus*** reaching over a meter in total length when mature (Fig. 229) . . . . . ***Hydrolagus trolli***

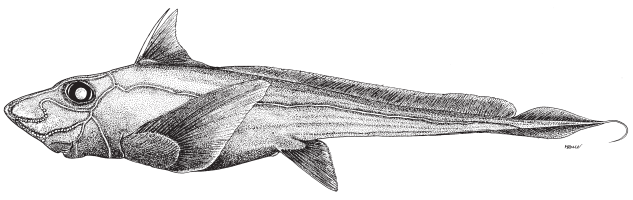


Fig. 229 ***Hydrolagus trolli***

Hydrolagus alphus Quaranta, Didier, Long, and Ebert, 2006

Hydrolagus alphus Quaranta, Didier, Long, and Ebert, 2006, *Zootaxa*, 1377: 33–45, figs 2–3, tabs. 1-2. Holotype: CAS 201902, adult male, 419 mm total length, 249 mm body length. Type locality: North end of Seymour Island, 0°21'42"S, 90°15'00"W, Galápagos Islands, Ecuador, by J.E. McCosker (California Academy of Sciences) and Carole Baldwin (United States National Museum, Smithsonian), aboard the Johnson Sea Link II (JSL dive #3113), depth 648 meters, 25 July 1988.

Synonyms: None

Other Combinations: None

FAO Name: En – Whitespot ghostshark.

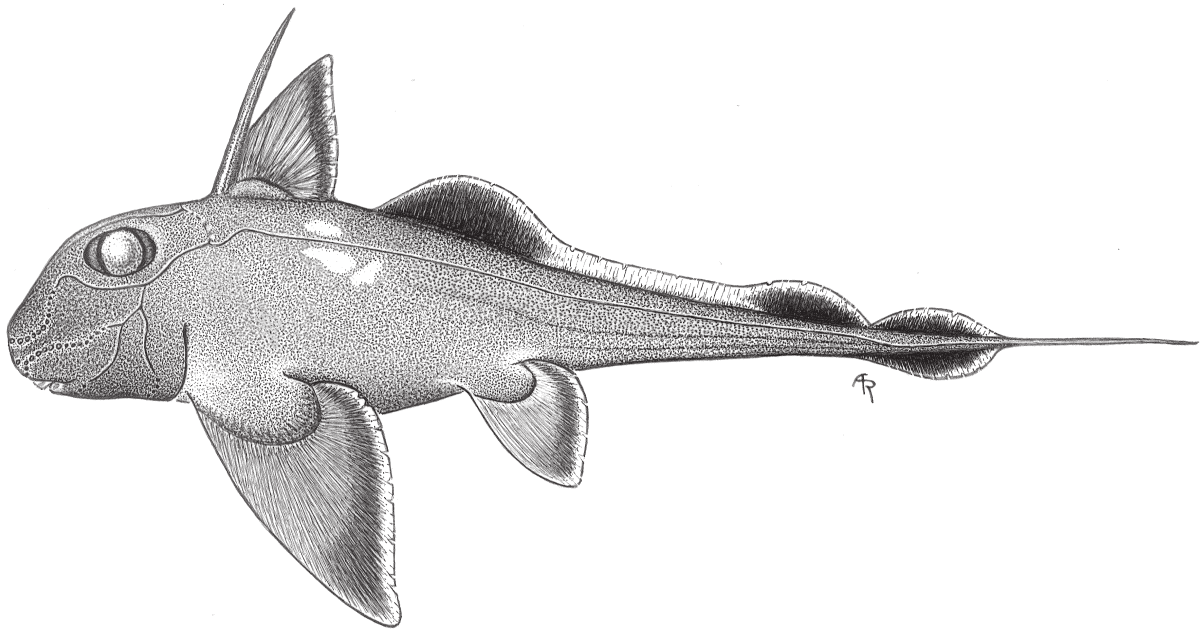


Fig. 230 *Hydrolagus alphus*

Field Marks: A uniform dark brown, with a distinctive white spot above each pectoral fin, paired fins with bluish hue and white fin margins, and second dorsal fin darker anteriorly and posteriorly, white in middle region. Dorsal–fin spine length greater than first dorsal–fin height when erect, and when depressed extending beyond the origin of the second dorsal fin.

Diagnostic Features: Body trunk stout, uniform in height to about pelvic–fin insertions, quickly tapering posteriorly to a thin caudal filament. Snout blunt, tip protruding slightly, squared off towards the mouth. Eyes slightly oval in shape, and large, 40.8–44.5% head length. Oral and preopercular head canals extend ventrally sharing a common branch from the infraorbital canal. Trunk lateral line canal extending length of body until reaching the caudal fin and extending ventrally onto tail filament. Skin deciduous, smooth. Pectoral fins large, triangular shaped, and extending just below first dorsal fin when depressed dorsally, to pelvic–fin insertions when depressed horizontally; posterior margins convex near base, progressing concavely to distal tip; anterior margin slightly convex. Pelvic fins large, oblong with convex margins. Adult males with long frontal tenaculum, moderately curved, terminating in bulbous tip with tenacular spines below dorsal surface and aligned vertically in rows with 6–8 denticles in each. Pelvic claspers bifid, slender, divided distally about one-half their length, with wrinkled fleshy pads at tips; pre-pelvic tenacula with at least four spines on outer margin. Adult females with anal pads, absent in males. First dorsal fin triangular, attached to dorsal spine at or below midpoint; both spine and fin depress into a groove situated on dorsal ridge. Dorsal–fin spine length greater than dorsal–fin height, serrated along anterior side from just below the distal tip to above the base; posterior side of dorsal–fin spine with two rows of long serrations extending from tip to midpoint; dorsal–fin spine when depressed, extends beyond second dorsal–fin origin. Anal fin absent. Second dorsal fin distinctly bilobed, anterior portion height about 7.2% body length, middle portion height less than 2.0% body length height, and posterior portion height about 4.4% body length; base long, extending from mid-body to about caudal–fin origin; second dorsal fin insertion separated from caudal origin by membrane. Caudal fin with rounded dorsal and ventral lobes, with ventral lobe slightly greater in height; ventral caudal–fin lobe base longer than dorsal caudal–fin base, with a fleshy membrane extending onto the posterior body region. Maximum total length at least 48.0 cm. **Colour:** in life, a uniform chocolate brown, with a bluish sheen; regions around opercular, rostral, predorsal, and abdomen slightly darker; medial, pectoral, pelvic, and caudal fins dark slate or blackish grey with a slight bluish hue; all fins have a narrow white margin along edges; second dorsal–fin anterior and posterior portions dark, contrasting sharply with median, lowest portion of second dorsal fin being entirely white; first dorsal, pectoral and pelvic fins show a narrow blackish band along posterior fin edges adjacent to white terminal band. Dorsal axial area of pectoral fin usually whitish, with a single prominent white spot located laterally and above pectoral fins; one or more white spots may occur on the abdomen or anterior caudal regions. Pigmentation around outer margins of eyes a blackish brown, with the *tapetum lucidum* reflecting a celadon green. After preservation, body coloration a uniform brown to dark brown, with white margins on the tips of fins and a distinct

white spot on the lateral side of mid-body above the pectoral fin; second dorsal fin is dark anteriorly and posteriorly, center region distinctly white in colour.

Distribution: Southeastern Pacific Ocean: known only from the Galápagos Islands (Ecuador).

Habitat: Occurs from 630 to 907 m deep, and is usually found around slopes and ledges of large volcanic boulders, cobbles, and gravel, often overlaid with, or interspersed with sand patches and coarse silt. Rocky areas usually with encrusted invertebrates of coral, sponges, crinoids, hydroids, gorgonians, and bryozoans.

Biology: Nothing known about its biology.

Size: Maximum recorded total length at least 48.0 cm for an immature female and 41.9 cm for an adult male.

Interest to Fisheries and Human Impact: The rocky, high relief habitat of this species likely precludes it from being caught in fisheries.

The conservation status of this species is Data Deficient.

Local names: No information.

Remarks: A little known species currently only recorded from the Galápagos Islands where it may be endemic.

Literature: Quaranta *et al.* (2006).

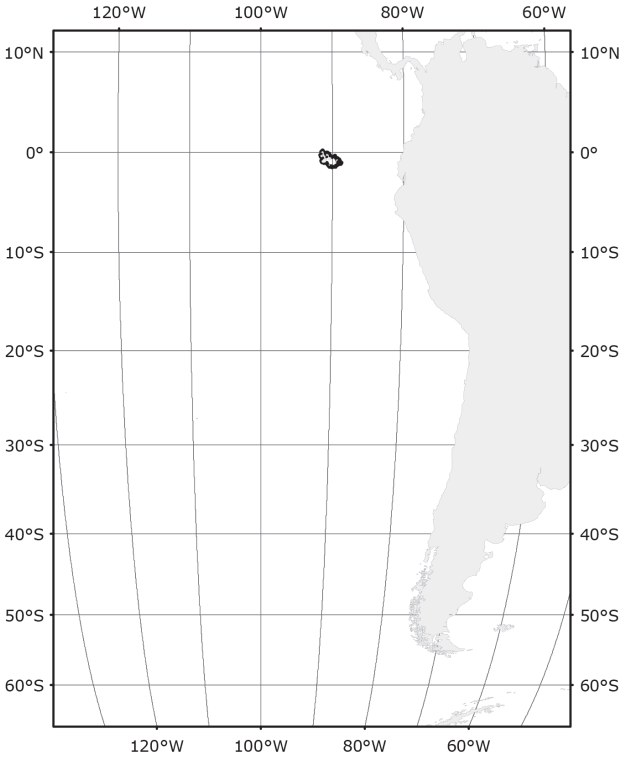


Fig. 231 ***Hydrolagus alphus***

Hydrolagus macrophthalmus de Buen, 1959

Hydrolagus macrophthalmus de Buen, 1959: 186, *Bol. Mus. Nac. Chile*, v. 27 (no. 3). Holotype: MNHNC P. 7282 [ex ENMC 10192], adult male, 625 mm total length, 296 mm body length. Type locality: preabysssal zone off Valpraiso, Chile, January 1959.

Synonyms: None.

Other Combinations: None.

FAO Name: En – Bigeye chimaera.

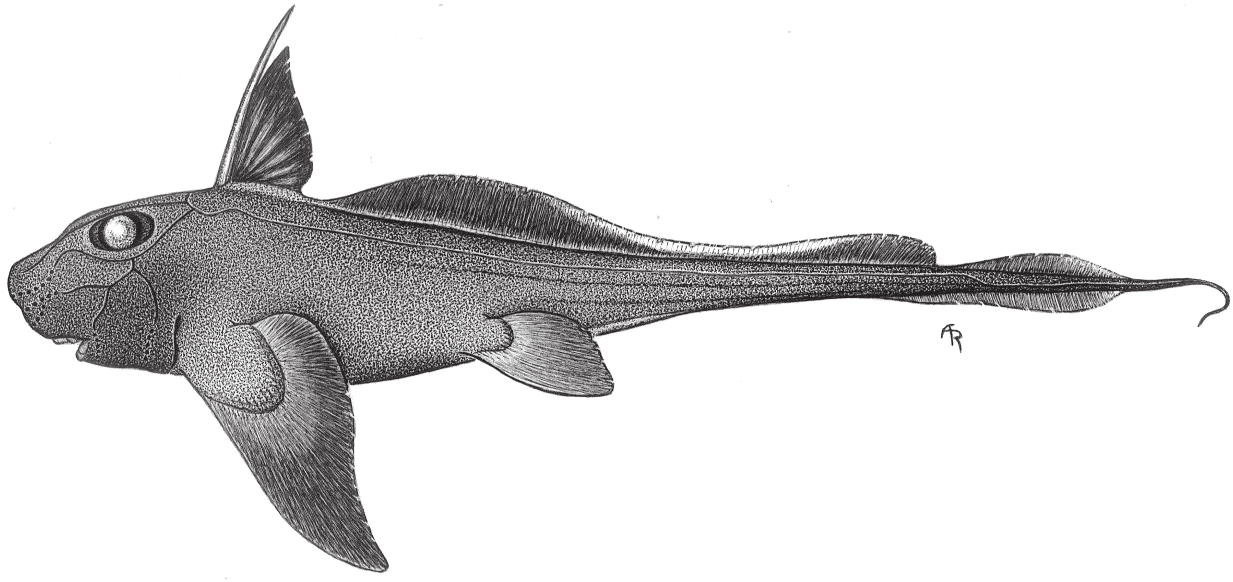


Fig. 232 ***Hydrolagus macrophthalmus***

Field Marks: A moderate-sized ***Hydrolagus*** species, with a uniform dark brown to black body coloration, with no distinctive mottling, except for a prominent light to whitish coloured area along middle of undulated second dorsal fin, eye diameter large, less than 39.5% head length, dorsal–fin spine curved posteriorly, and extending past second dorsal–fin origin when depressed, pectoral fins large, extending beyond pelvic–fin origins when depressed against body.

Diagnostic Features: Body trunk elongate, depth uniform to about pelvic–fin origins, tapering posteriorly to filamentous, whip-like tail. Snout bluntly rounded, short, sloping slightly from orbitals to snout tip. Eyes large, oval to rounded in shape, diameter less than 39.5% head length. Oral and preopercular canals joining before infraorbital canal, giving it a "Y-shaped" pattern. Trunk lateral line canal extending to entire body length, with slight downward dip anterior to caudal fin origin. Pectoral fins large, triangular shaped, anterior margin elongate, and extending past pelvic–fin origin when depressed; fin base fleshy. Pelvic fins smaller, base length about one-half length of pectoral fins. Adult male frontal tenaculum thin at base, curving rearwards to rounded bulbous tip, with numerous rows of spiny dermal denticles; medial, anterior most denticles largest. Claspers slender, bifid, forked about one-half total length; prepelvic tenacula with two rows of denticles along dorsal margin; rows with 3 to 7 enlarged denticles. Adult females with prominent anal pads; absent in males. First dorsal fin triangular, becoming slender towards apex, posterior margin rounded. Dorsal–fin spine elongate, curved to relatively straight, precedes first dorsal fin; distal portion of spine serrated; spine length greater than first dorsal–fin height; when depressed extends past second dorsal–fin origin. Second dorsal fin elongated, length about 70% body length, strongly undulated, with maximum anterior height 5.6 to 6.1% body length, median height 1.8 to 1.9% body length, and posterior maximum height 3.0 to 3.5% body length. Anal fin absent. Caudal–fin lobes similar in height, ventral lobe length slightly longer than dorsal lobe length; dorsal lobe length originates anterior to ventral lobe origin; caudal terminates in whip-like filament. Maximum total length 63.9 cm (34.9 cm body length). **Colour:** prior to preservation, body a uniform dark brownish to black without any mottling, patterns, or spots; ventral head surface near mouth darker than rest of body; first dorsal fin and distal portion of pectoral fins slightly darker; second dorsal fin dark brown to blackish along highest undulated portion, becoming translucent to whitish at lowest, and becoming darker again posteriorly with lighter distal margin.

Distribution: Eastern Pacific: Costa Rica, Central America and southwards to Chile.

Habitat: Unknown, except for a few scattered depth records ranging from 300 to 1160 m.

Biology: Nothing known about its biology.

Size: Maximum total length 63.9 cm (34.9 cm body length), females adult at about 62.7 cm total length (35.5 cm body length), males adult at 44.5 cm (29.6 cm body length) to 62.5 cm total length (38.5 cm body length). Size at birth is uncertain.

Interest to Fisheries and Human Impact: None, the species likely taken as bycatch in deep-sea fisheries on occasion.

The conservation status of this species is Data Deficient.

Local names: No information.

Remarks: ***Hydrolagus macrophthalmus*** is a very poorly known species that appears as bycatch on occasion, but virtually nothing is known about its biology. The species is confirmed as occurring from Costa Rica to Chile, but a single record of it from Mexico (Gonzalez-Acosta *et al.*, 2010) was actually a ***H. melanophasma*** and not ***H. macrophthalmus***.

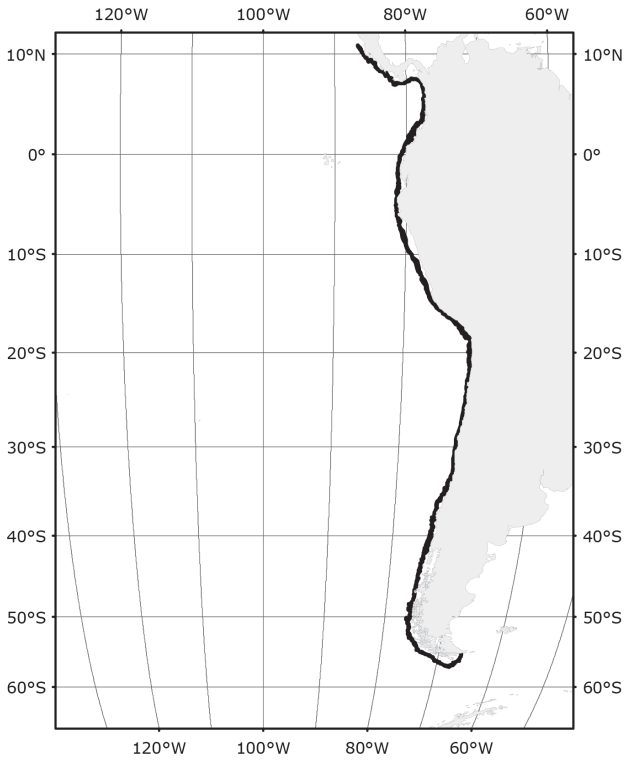


Fig. 233 ***Hydrolagus macrophthalmus***

The holotype was thought to be lost due to a massive earthquake and subsequent tsunami that destroyed the museum housing it and other de Buen type specimens, but it was subsequently found.

Literature: de Buen (1959); Dagit (2006); Quaranta, Didier, Long, and Ebert (2006); Nakaya *et al.* (2009); Gonzalez-Acosta *et al.* (2010); Angulo *et al*. (2014); Bustamante *et al.* (2014); Cornejo *et al.* (2015).

Hydrolagus mccoskeri Barnett, Didier, Long, and Ebert, 2006

Hydrolagus mccoskeri Barnett, Didier, Long, and Ebert, 2006, *Zootaxa*, 1328: 27–38, figs 1–3, tab. 1. Holotype: CAS 86558, immature female, 381 mm total length, 211 mm body length. Type locality: southeast of San Cristóbal Island, 01°05.98'S, 89°12.235'W, Galápagos Islands, Ecuador, by J.E. McCosker (California Academy of Sciences), R. Grant Gilmore (Harbor Branch Oceanographic Institute) and Bruce Robison (Monterey Bay Aquarium Research Institute), aboard the Johnson Sea Link II (JSL dive #3934), depth 396 meters, 17 November 1995.

Synonyms: None.

Other Combinations: None.

FAO Name: En – Galápagos ghostshark.

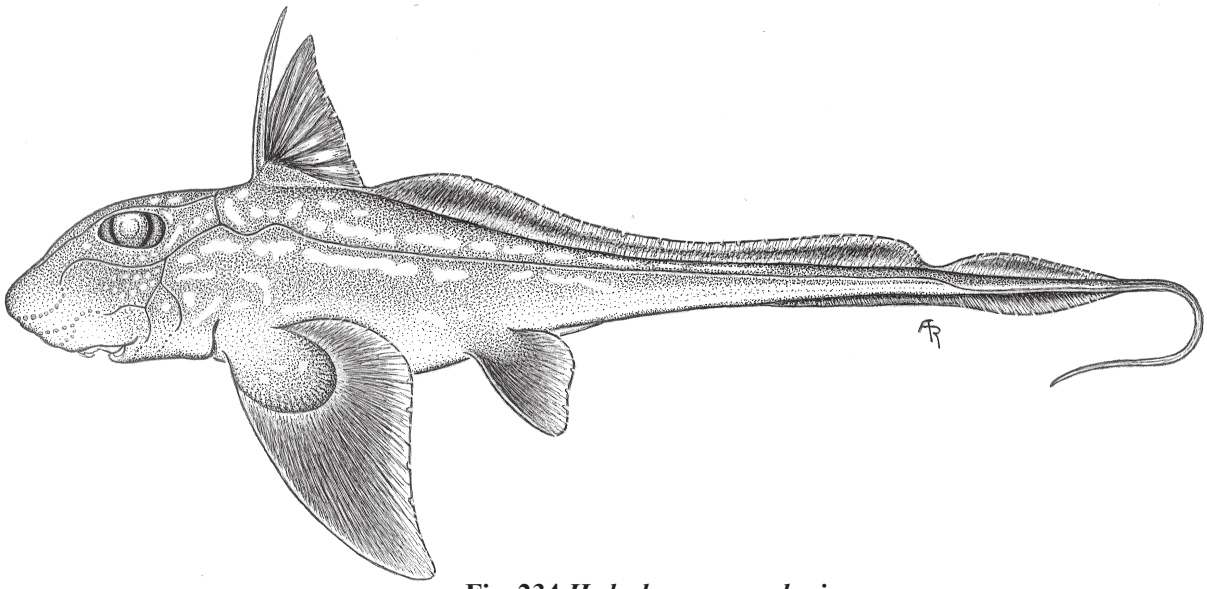


Fig. 234 ***Hydrolagus mccoskeri***

Field Marks: A distinctive medium brown dorsal coloration with numerous distinctive narrow, sharply delineated irregular circular and elongated white blotches, ventrally becoming white to tan with extremely fine brown mottling, small head with a short, blunt snout, dorsal–fin spine height greater than first dorsal–fin apex, and extending just beyond origin of second dorsal fin, preopercular and oral lateral–line canals branching from the same node off the infraorbital canal and sharing a short common branch, and second dorsal fin margin only slightly indented along its length.

Diagnostic Features: Body trunk height similar from head to origin of pelvic fins, quickly tapering posteriorly to filamentous whip-like tail. Snout short, rounded, with large eyes 9 to 13% body length. Tooth plates light yellow in preserved specimens, with white tritors. Vomerine tooth plates small and incisor-like with 5 tritors visible on the right and 5–6 on the left. Palatine tooth plates with 2–3 tritors along the oral surface originating at posterior edge and terminating prior to the anterior edge. Small protrusions are present along the anterior labial edge. Mandibular tooth plates incisor-like and large (three times wider than vomerine tooth plates), with 5 tritors per side. Lateral line canals on head are open grooves with wide dilation of canals on snout. Oral and preopercular lateral line canals branch from same node off infraorbital canal and share a short common branch. Lateral line of trunk and tail fairly straight, with very small asymmetrical undulations and a sigmoid curve at point where it meets head canals. Skin firm and robust, not deciduous. Pectoral fins large, anterior margin slightly convex, with curvature increasing toward acutely pointed distal tip; posterior margin straight, becoming concave at distal one-fourth of length; pectoral fins when depressed posteriorly extend past pelvic–fin insertion and distal tip of pelvic–fin lobe. Pelvic fins large, nearly triangular, anterior margin slightly convex, particularly at distal one-third; posterior margin nearly straight, slightly convex; distal tip slightly rounded to acutely pointed. Post-anal pad present, inconspicuous in juveniles. Anal fin absent. First dorsal fin nearly triangular, with a straight posterior margin and slightly convex anterior margin. Dorsal–fin spine preceding first dorsal fin, robust, triangular in cross section; spine serrated, with two narrowly spaced columns present on posterolateral edges of distal two-thirds to three-fourths spine length; spine only slightly curved posteriorly, with curvature occurring on distal one-third of spine. Second dorsal fin slightly indented along its length with the anterior lobe higher than posterior lobe. Dorsal and ventral caudal–fin lobes elongate, with a longer ventral caudal–fin lobe extending anteriorly; anterior portion of ventral caudal–fin lobe merges into a fleshy ridge, extending anteriorly an additional 26% of body length, nearly aligning vertically with midpoint of second dorsal fin; caudal fin lobes approximately equal in height. Caudal filament moderately stout. Maximum total length 38.1 cm, body length 21.1 cm. **Colour:** in life, a medium grey on dorsal and lateral sides extending nearly to ventral surface, with slight superficial silvery sheen; distinctive pattern of irregular, well defined silvery white spots, vermiculations, and stripes; snout and oral region slightly lighter grey; ventral surface light grey to whitish, with underside of caudal region from the pelvic insertion to the terminal end of the tail whitish, except for the dark grey caudal filament; first dorsal fin dark grey with slightly lighter greyish areas; second dorsal fin white, becoming dark grey medially; pectoral and pelvic fins darkish grey on lateral portion, slightly lighter grey on medial portion, with whitish posterior margin; pigment around the outer margins of eye dark grey, with a reflective emerald-green eye. After preservation colour is medium brown on the dorsal surface with numerous irregular, rounded to elongate white blotches.

Distribution: Southeastern Pacific Ocean: presently only known from the Galápagos Islands (Ecuador).

Habitat: ***Hydrolagus mccoskeri*** appears to be common around the Galápagos archipelago at depths of 396 to 506 m, slightly shallower than ***H. alphus*** that is usually below 600 m. Observations by Remote Operated Vehicles (ROVs) reveal this species to inhabit areas composed of igneous boulders, cobbles, and pebbles. Individuals were observed either alone or in groups along steep slopes, within a few meters of the seafloor.

Biology: Virtually nothing known about its biology.

Size: Maximum length uncertain since the only known specimens examined were immature females with total lengths measuring 38.1 cm (27.4 cm body length), and 22.7 cm (13.8 cm body length).

Interest to Fisheries and Human Impact: None, the species appears to be endemic to the Galápagos Islands, which has no deepwater fisheries. Also, the rugged steep terrain it inhabits makes it unlikely to appear as bycatch to other fisheries.

The conservation status of this species is Data Deficient.

Local names: No information.

Remarks: This species is one of two ghost shark species, the other being ***Hydrolagus alphus*** that appears to be endemic to the Galápagos Archipelagos.

Literature: Barnett *et al.* (2006).

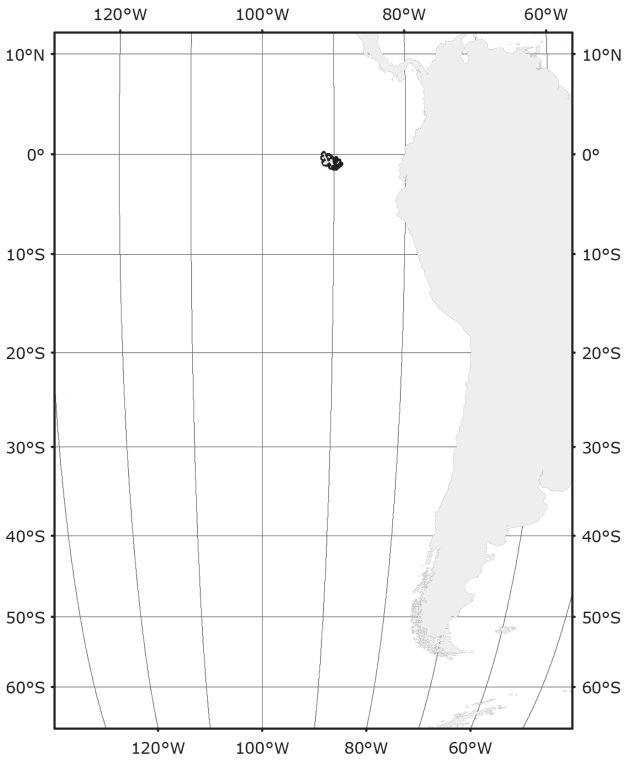


Fig. 235 ***Hydrolagus mccoskeri***

Hydrolagus melanophasma James, Ebert, Long, and Didier, 2009

Hydrolagus melanophasma James, Ebert, Long, and Didier, 2009, *Zootaxa*, 2218: 59–68, figs 1–4, tabs. 1–2. Holotype: SIO 77-211, adult male, 926 mm total length, 577 mm body length. Type locality: Punta Pescadera, 23°48'N, 109°42'W, Baja California, Mexico, depth 31 meters, 19 May 1977.

Synonyms: ***Hydrolagus* sp.** Hubbs, Follett, Dumpster, 1979: 5; Eschmeyer, Herald, and Hammond, 1983: 59; Ebert, 2003: 240-241, Ill.; Love, Mecklenburg, and Thorsteinson, 2005: 2.

Other Combinations: None.

FAO Name: En – Eastern Pacific black ghostshark.

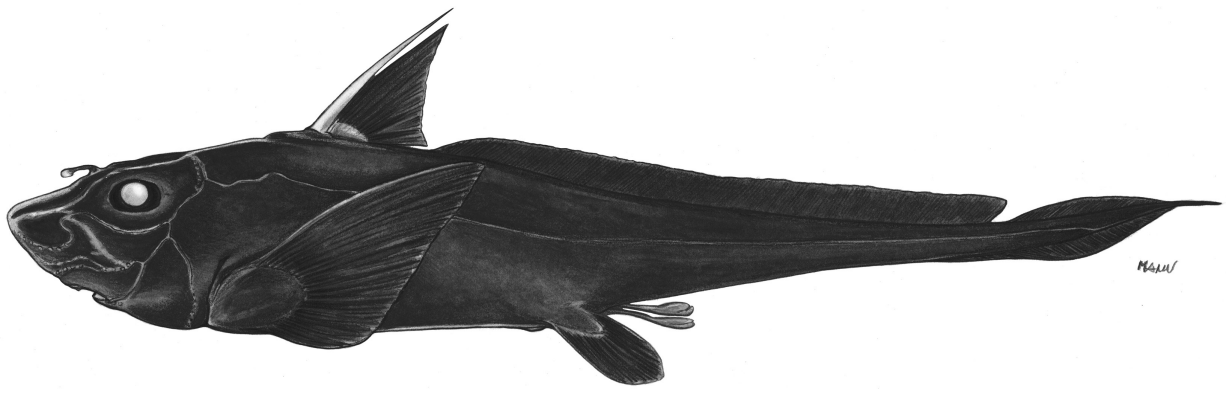


Fig. 236 ***Hydrolagus melanophasma***

Field Marks: A very large species, uniformly black with no distinctive markings or mottling, except for a lighter band across snout to midpoint between eyes in life that fades quickly after death. Snout blunt, sloping only slightly from eyes to snout tip, a large slightly curved dorsal–fin spine extending beyond first dorsal–fin apex, and a long second dorsal fin of uniform height throughout, and with pectoral fins large, reaching beyond pelvic–fin insertions when laid flat.

Diagnostic Features: Body trunk large, stout, tapering posteriorly behind pectoral–fin insertions to filamentous caudal tail. Snout blunt, sloping slightly from orbits to snout tip. Eyes of moderate size, about 22.2 to 26.0% head length. Head lateral–line canals are open grooves with wide dilation on the snout. Oral and preopercular canals either branch separately or may share a common branch from the infraorbital; preopercular canal discontinuous after branching from oral or infraorbital, and extending for about 24.0% head length or less before breaking into consecutively smaller pieces. Trunk lateral line extends the length of the body from junction with post-orbital to whip-like filament and is generally straight with no regular undulations. Skin firm and robust, not deciduous as in some ***Hydrolagus***. Pectoral fins large, triangular, anterior margin extends to or beyond pelvic–fin insertion when laid against the body. Pelvic–fins anterior margin straight, length about one-half of pectoral–fin anterior margin, posterior margin convex. Adult male frontal tenaculum with indistinct rows of 35 to 38 pointed, needle-like denticles. Claspers forked for posterior most one-quarter of total clasper length and extend beyond distal edge of pelvic fins. Prepelvic tenacula with 3 or 4 denticles along the medial edge. Adult females with anal pads, absent in males. First dorsal fin triangular shaped, base short, with concave posterior margin. Dorsal–fin spine prominent, about one-fourth body length, preceding first dorsal fin, attached to fin most of spine length, slightly curved, with height greater than fin apex; distal portion of spine serrated; spine and first dorsal fin extend beyond second dorsal–fin origin when depressed. Second dorsal fin long, uniform in height throughout, with base length more than three-fourths body length; height of second dorsal fin greater than height of caudal–fin dorsal lobe; no measurable separation between second dorsal– fin insertion and caudal–fin dorsal lobe. Caudal–fin dorsal and ventral lobe heights about equal; ventral lobe extends about one-fourth its length beyond insertion of dorsal lobe. Anal fin absent. Maximum total length at least 127.7 cm (91.8 cm body length). **Colour:** observed in situ by Remote Operated Vehicle (ROV) video footage shows a uniform black with a lighter band over snout and slightly anterior to midpoint between eyes. After preservation lighter band fades with specimens becoming a uniform dark brown or purplish, including all paired and unpaired fins, and with no distinct markings or mottling. Claspers are slightly lighter in colour.

Distribution: Eastern Pacific: a wide-ranging species first described from southern California (USA) and the Gulf of California (Baja Sur, Mexico), but now known to range from central California (Monterey Bay) all the way to southern Chile.

Habitat: ROV observations reveal that this species commonly inhabits soft-bottom or cobble patch substrates with little vertical relief. Individuals appear to have a close association with the sea floor, usually within a few meters, but not resting on the bottom. Water clarity where ***Hydrolagus melanophasma*** has been observed is usually poor, with large suspended particulate matter in the water column. ***Hydrolagus melanophasma*** has been observed to co-occur with conspecifics and other chimaera species, including ***Harriotta raleighana***. Furthermore, when approached by ROVs will take flight and quickly swim away, while ***H. raleighana*** and other ***Hydrolagus*** species will often approach the ROV. Depth range is from 565 to 1720 m.

Biology: Nothing known about its life history.

Size: Maximum total length for females is 127.7 cm (91.8 cm body length) and for males is 120 cm

Interest to Fisheries and Human Impact: Of no commercial value, but is occasionally taken as bycatch.

The conservation status of this species is Least Concern.

Local names: No information.

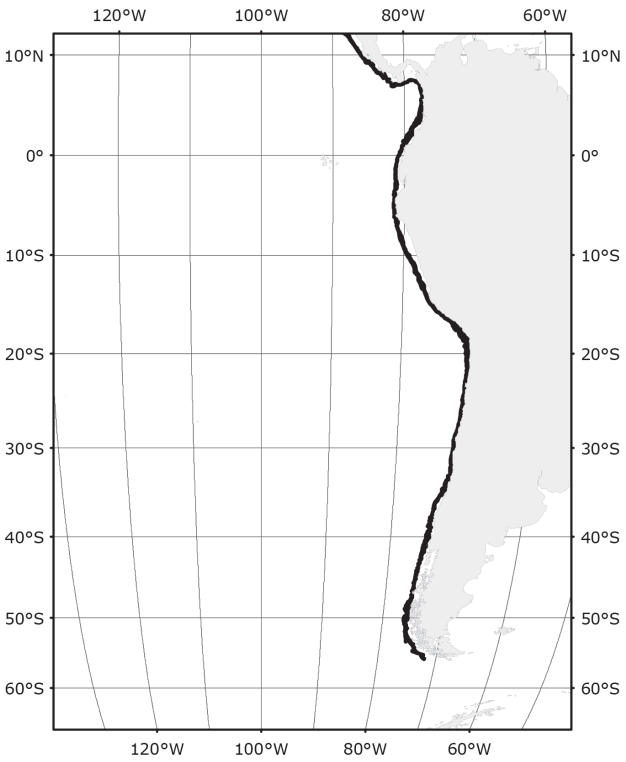


Fig. 237 ***Hydrolagus melanophasma***

Remarks: ***Hydrolagus melanophasma*** had long been recognized, since 1965, as a distinct species, but was only recently described. Since it was described this species is now known to range widely throughout the eastern Pacific at depth. A record of ***Hydrolagus macrophthalmus*** from off central Mexico (Gonzalez-Acosta *et al.*, 2010) is not that species, but actually a ***H. melanophasma***.

Literature: Ebert (2003); James, Ebert, Long, and Didier (2009); Gonzalez-Acosta *et al.* (2010); James and Ebert (2011); Bustamante *et al.* (2012); Kyne *et al.* (2012); Aguirre-Villaseñor *et al.* (2013); Bustamante, Vargas-Caro, and Bennett (2014); Marquez-Farias and Lara-Mendoza (2014).

Hydrolagus trolli Didier and Séret, 2002

Hydrolagus trolli Didier and Séret, 2002, *Cybium*, 26: 227, figs 3–6, tab. 1. Holotype: MNHN 1998-0679, Adult male, 1030 mm total length, 650 mm body length. Type locality: New Caledonia, South Pacific, 24°44.90'S, 167°43'W, R/V "Tangaroa", HALIPRO 2, sta. BT74, depth 1246–1213 m, 26 November 1996.

Synonyms: ***Hydrolagus* sp.** C Paulin *et al.*, 1989; ***Hydrolagus* sp. cf. *lemures***: Séret in Grandperrin *et al.*, 1997; ***Hydrolagus* sp.**: in Grandperrin *et al.*, 1999.

Other Combinations: None.

FAO Names: En – Pointy-nosed blue chimaera; **Fr** – Chimère bleue à museau pointu.

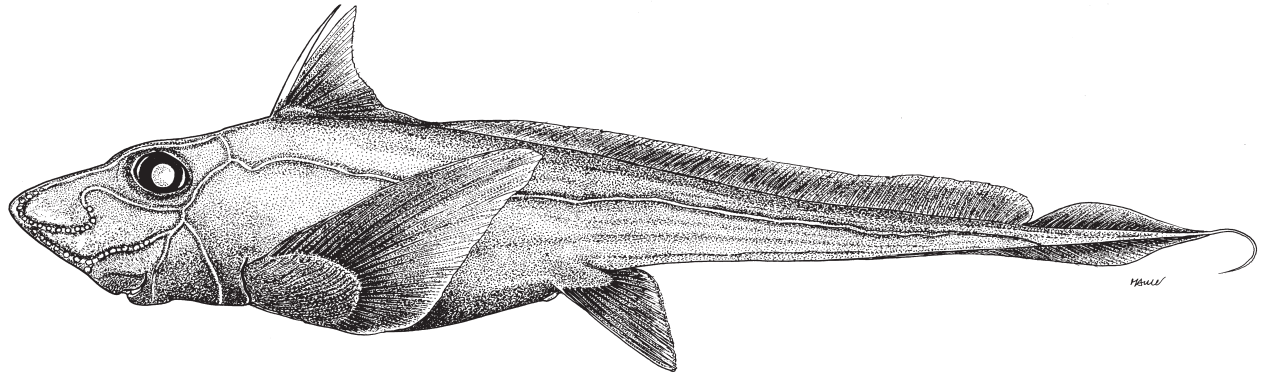


Fig. 238 *Hydrolagus trolli*

Field Marks: A large bodied species with an elongate, relatively slender body, distinguished by a uniform blue-grey to blue-brown coloration that fades to a pale blue when preserved; fins are an even, pale purple-brown, second dorsal fin with a thin dark line along distal edge; dark lines around orbits with dark edges sometimes visible along lateral–line canals.

Diagnostic Features: Body elongate, slender, height relatively even to pelvic–fin insertions, tapering rapidly posteriorly from pelvic–fin insertions to short caudal filament. Snout elongate, relatively short, and pointy. Eyes relatively small, 17 to 24% head length, with dark ring around orbits. Oral and preopercular canals usually share common branch from infraorbital canal. Trunk lateral line extends the length of body, is nearly straight, occasionally weakly undulated in mid-trunk region. Skin is firm and intact, not deciduous. Pectoral fins large, triangular, anterior margin extends to pelvic–fin base when depressed against body. Pelvic fins broad, square-shaped, anterior margin relatively straight, length about one-half of pectoral–fin anterior margin. Adult male frontal tenaculum relatively slender at base, curves gently to large bulbous tip, with 8 to 10 overlapping rows of denticles along ventral surface, and extending onto dorsal surface. Claspers bifurcate for one-third their length, with a third, fleshy lobe along dorsal side of slender medial branch, and terminating with fleshy tips. Prepelvic tenacula spatula shaped, curved along lateral edge, indented distally, and with a prominent medial point; a fleshy fold of skin partially covers lateral side of blade; 4 to 5 prominent denticles along medial ridge. Adult females with anal pads. First dorsal fin triangular shaped, anterior margin slightly convex, base short, with posterior margin distally concave. Dorsal–fin spine, preceding first dorsal fin, nearly equal to dorsal–fin height in adults, usually shorter than first dorsal–fin height in juveniles, slightly curved distally; distal posterior portion of spine with two parallel rows of serrations; spine and first dorsal fin just reach second dorsal–fin origin when depressed. Second dorsal fin elongate, nearly uniform in height throughout, not undulated, with base length more than three-fourths body length; second dorsal fin similar in height to caudal fin dorsal lobe height. Caudal–fin dorsal and ventral lobes elongate, transitioning to short filamentous tail; lobe heights about equal, both less than second dorsal–fin height; ventral lobe longer than dorsal lobe. Anal fin absent. Maximum total length at least 120.5 cm (78.8 cm body length). **Colour:** a uniform bluish grey to blue-brown, darker ventrally, except lighter on ventral portion of head and snout, fins a much darker blue; dark lines encircling orbits with edges visible along lateral–line canals; no other prominent mottling, patterns, or spots.

Distribution: Southeastern Pacific Ocean: known from a single specimen caught off Chile. Additional records of ***H. trolli*** from the eastern North Pacific have been reported, but whether it is that species or a closely related form is under investigation. The species is most common around New Caledonia and New Zealand, and maybe widespread throughout the southern Pacific, with possible records from the eastern North Pacific and Hawaiian Islands.

Habitat: Little known except it occurs in deepwater at depth of 612 to 1707 m, but mostly below 1000 m. Remote Operate

Vehicle (ROV) video footage of possible ***H. trolli*** indicate they prefer areas of steep rocky relief. Also, they appear to "hover" from 1 to several meters off the bottom, and will approach ROVs with curiosity.

Biology: Nothing known.

Size: Maximum total length 120.5 cm (78.8 cm), females mature at about 55.0 cm body length and males at 60.0 to 65.0 cm body length.

Interest to Fisheries and Human Impact: None. In the southeastern Pacific this species is known from a single specimen, but elsewhere likely caught on occasion by deep-sea fisheries. It extremely deepwater, rocky habitat likely precludes it from most fisheries.

The conservation status of this species is Least Concern.

Local names: No information.

Remarks: The one specimen from off Chile was initially identified as ***Hydrolagus pallidus***, a North Atlantic species, but was subsequently re-examined and determined to likely be ***H. trolli***. This species is most common around New Zealand, but other similar looking species are widespread throughout the southern Pacific and Indian oceans. Whether these look-alike species are the same or different species is currently under investigation.

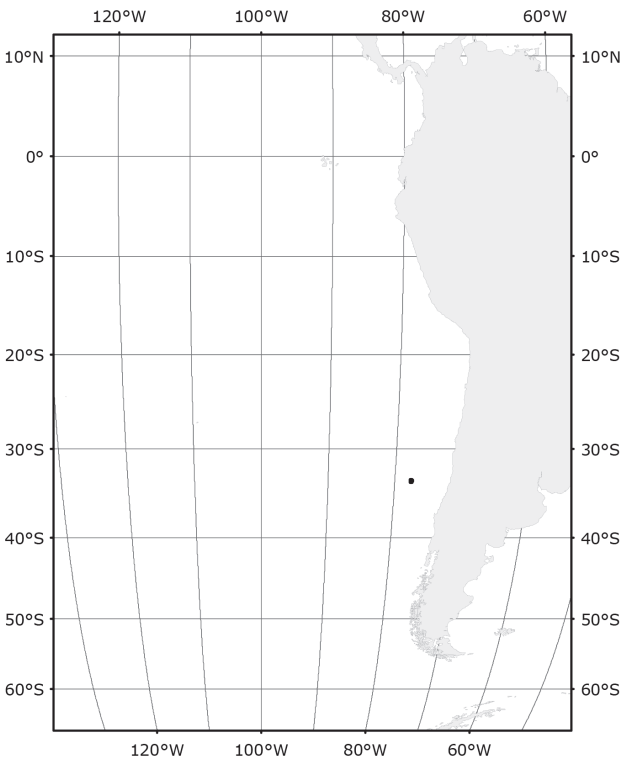


Fig. 239 ***Hydrolagus trolli***

Known distribution

Literature: Didier and Séret (2002); (Andrade & Pequeno, 2006); Bustamante *et al.* (2012); Bustamante, Vargas-Caro, and Bennett (2014); Kemper, Ebert, and Didier (2015a); D.A. Didier, J.M. Kemper (unpubl. data); D.A. Ebert (pers. obs. and unpubl. data).

4.1.2 Family RHINOCHIMAERIDAE

Family: Rhinochimaeridae Garman, 1901, *Proc. New England Zool. Club*, 2: 75–77.

Type genus: ***Rhinochimaera*** Garman, 1901.

Number of Recognized Deep–sea Southeastern Pacific Ocean Genera: 2.

Synonyms: None.

FAO Name: En – Longnose chimaeras.

Field Marks: Medium to large–sized chimaeras with large head, elongated bodies tapering posteriorly to filamentous tail, very long snout, distinctively spear–shaped, and flexible, first dorsal fin preceded by prominent fin spine, and anal fin, depending on the genus, present or absent. Body uniformly pale to dark brown or blackish with fin edges darker in some species.

Diagnostic Features: Body elongate, somewhat compressed, tapering from large head to elongated filamentous tail. Snout fleshy, very elongate, broad, and spear–like, flexible, extending anterior to head and tapering to a blunt point. Eyes large and prominent, bright green in life. Skin smooth, often deciduous, flaking off in patches during and after capture. Gill openings, one on each side covered by a fleshy operculum, and located anterior to pectoral fins. Spiracles absent. Mouth small, ventral on head, connected to nostrils by deep grooves. Teeth non–replaceable, in the form of three paired tooth plates; two pairs on upper jaw, one pair on lower jaw. Tooth plates robust with patches of dense hypermineralized tissue that appears as ridges and bumps on the surface; some lacking robust ridges, with tooth plates that appear smooth. Lateral line canals appear as open grooves on the head and sides of body. Pectoral and pelvic fins somewhat ovoid in shape, broad with delicate external fin webs supported by cartilaginous rays (ceratotrichia). First dorsal fin triangular, erect, preceded by an elongate, smooth or serrated spine. Second dorsal fin separated from first, long, relatively low, with distal margin straight to slightly undulating. Anal fin present or absent. Caudal fin lanceolate, dorsal lobe with or without tubercles along margin; lower lobe without tubercles; whip–like tail filament present or absent. Sexual dimorphism strong, adult males with bulbous, denticulate frontal tenaculum that can retract into pouch atop head and anterior to eyes. Pre–pelvic tenaculum blade–like, retractable into hidden pouch anterior to each pelvic fin; tenaculum medial margin with large denticles. Claspers slender, rod–like with small fleshy

denticulate tip. Size ranging from 65 to 130 cm total length. **Colour:** uniform pale to greyish or brownish, often lighter or white ventrally, fins darker in some species, and without distinct pattern of spots or stripes. Neonates and very small juveniles may be paler in colour, darker around the opercular flap, and with very dark brown or black fins.

Distribution: Rhinochimaerids have a circumglobal distribution with most members being wide–ranging although many species have a patchy or scattered distribution; the other chimaeroid families tend to exhibit a higher degree of endemism.

Habitat: Very little known about the habitat preference of longnose chimaeras. They tend to occur over muddy or soft bottoms, although this may be an artifact of sampling methods, and usually occur in very deepwater from over 1000 m, but with several species occurring to 3000 m.

Biology: Virtually nothing known about their reproductive biology or life history. Maturity is attained by about 40 cm body length in some species. Females lay egg cases in pairs; egg cases are tadpole–like, with broad, fan–like lateral flanges with numerous transverse ridges. Their diet is little known, but they appear to feed on small benthic invertebrates and fishes.

Interest to Fisheries and Human Impact: Longnose chimaeras are of minimal fishery interest and are mostly taken as bycatch in bottom trawl fisheries and may be utilized for fishmeal or other fish products.

The conservation status of most longnose chimaeras is Data Deficient or Least Concern due to their patchy distribution, deepwater habitat, and lack of commercial fisheries. However, more information is needed on the abundance, life history, and population trends of this poorly known group.

Local Names: No information.

Remarks: The above family account is modified, and updated, after Didier (1995, 2002, 2004), Didier, Kemper and Ebert (2012), and Kemper and Ebert (In press) and recognizes three genera and at least eight described species; two genera and three species occur in the southeastern Pacific Ocean.

Literature: Garman (1901); Bigelow and Schroeder (1953, 1954b); Krefft in Hureau and Monod (1973b); Stehmann and Bürkel in Whitehead *et al.* (1984); Didier (2002, 2004); Nelson (2006); Last and Stevens (2009); Ebert and Winton (2010); Didier, Kemper and Ebert (2012); Ebert and Stehmann (2013); Ebert (2014); Kemper, Ebert, and Didier (2015b); D.A. Didier and D.A. Ebert (unpubl. data).

List of Species Occurring in the Area:

Harriotta raleighana Goode and Bean, 1895
Rhinochimaera africana Compagno, Stehmann and Ebert, 1990
Rhinochimaera pacifica (Mitsukuri, 1895)

Key to Deep–sea Southeastern Pacific Ocean Genera:

1a. Lateral head profile convex; mouth located slightly in front of or just below eyes; tooth plates with raised hypermineralized tritors on the surface; margin of upper caudal–fin lobe without tubercles (Fig. 240) . . . . . ***Harriotta***

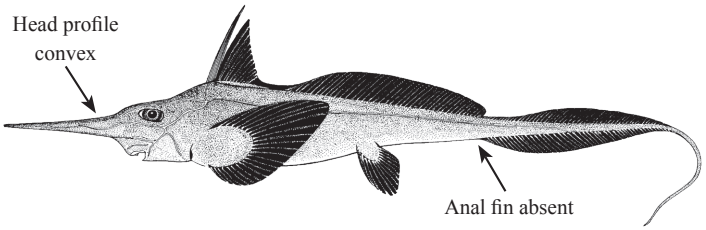


Fig. 240 ***Harriotta***

1b. Lateral head profile straight; mouth located well in front of eyes; tooth plates smooth, lacking raised hypermineralized tritors on the surface; margin of upper caudal–fin lobe with tubercles (Fig. 241) . . . . . ***Rhinochimaera***

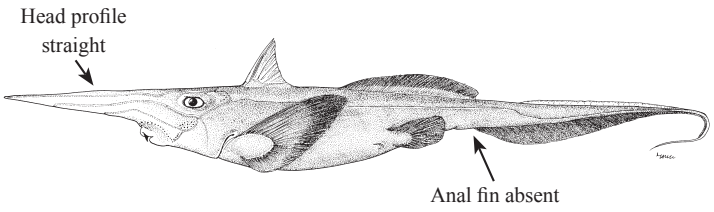


Fig. 241 ***Rhinochimaera***

Harriotta Goode and Bean, 1895

Genus: ***Harriotta*** Goode and Bean, 1895, *Spec. Bull. U.S. Natl. Mus. Washington, D.C.*, 17: 471. ***Harriotta*** Goode and Bean, 1886, *Proc. Biol. Soc. Wash.*, 3: 104 (*nomen nudum*), "a long–rostrated chimaeroid fish" without further description and without species named.

Type species: ***Harriotta raleighana*** Goode and Bean, 1895, by monotypy.

Number of Recognized Deep–sea Southeastern Pacific Ocean Species: 1.

Synonyms: None.

FAO Name: En – Narrownose chimaeras.

Field Marks: Elongated snout, fleshy at base, and tapering to a fine point at the tip, distal tip of snout curved upwards, more so in adult males which also have a series of small rounded knobs dorsally, caudal fin rounded with elongate filament, upper and lower lobes almost equal in height with the upper lobe slightly taller, upper–lobe margin without tubercles, and no anal fin present.

Diagnostic Features: Body large, elongate, tapering posteriorly to a whip–like filamentous tail; head relatively large, snout very long, fleshy, wide at base, tapering anteriorly to a pointed tip; snout may or may not curve upwards (depending on species) and with or without knobby protuberances at distal end. Eyes oval, small to moderately large. Nostrils moderate, slightly longer than wide. Mouth relatively small, located below eyes. Tooth plates thick, hypermineralized with transverse ridges and rounded tritors (except in small juveniles), anterior edge of tooth plates form sharp nipping blades. Canals on head relatively widely spaced; nasal canal on ventral surface of either not expanded or expanded, and may or may not join rostral canal; lateral line canals on trunk straight, not wavy. Pectoral fins broad, large, with tips extending, or not, to pelvic–fin origin (depending on species). Pelvic fins broadly rounded. First dorsal fin small, short–based, its height not much greater than second dorsal fin; fin spine relatively short, height less than or slightly greater than fin height; spine may be recurved or straight. Interdorsal space small when first dorsal fin laid back, fin spine either reaching origin of second dorsal fin or not. Second dorsal fin relatively even or slightly convex in height, base short. Anal fin absent. Caudal–fin upper and lower lobes similar, or slightly different, in length and height; upper dorsal–fin margin without tubercles. Tail short and filamentous. **Colour:** uniform light to dark brown above, may be darker below and along fin edges; fin spine light to whitish.

Local names: No information.

Remarks: This genus has two wide–ranging, but patchily distributed species. These are very poorly known chimaeras and if encountered should be retained for detailed examination. One species, ***Harriotta raleighana***, is known to occur in the area, but the other species (***Harriotta haeckeli*** Karrer, 1972) has been reported from the Gulf of California, but not been confirmed from this region. However, given its spotty distribution and very deep–sea habitat ***H. haeckeli*** may eventually be found to occur within this area.

Harriotta raleighana Goode and Bean, 1895

Harriotta raleighana Goode and Bean, 1895, *Proc. U.S. Nat. Mus.*, 17(1014): 472, pl. 19, figs 1–2. Lectotype (Syntype): USNM 35520, Albatross station 2210, female, 100 mm TL. Type Locality: Northwest Atlantic, Gulf Stream, New Jersey, USA, (39° 37'N, 71° 18'W), 1812 m. Collected 21 August 1884. Goode and Bean (1895) based their description on four specimens, but without designating a holotype, therefore making them syntypes. However, according to Eschmeyer (2012) a lectotype was established in Jordan and Evermann (1900) from the caption to plate 19, p. 3234, "*Fishes of North and Middle America*".

Synonyms: ***Harriotta curtissjamesi*** Townsend and Nichols, 1925: 6, fig. 2.

Other Combinations: ***Harriotta chaetirhamphus***.

FAO Names: En – Narrownose chimaera; **Fr** – Chimère de Raleigh; **Sp** – Quimera de Raleigh.

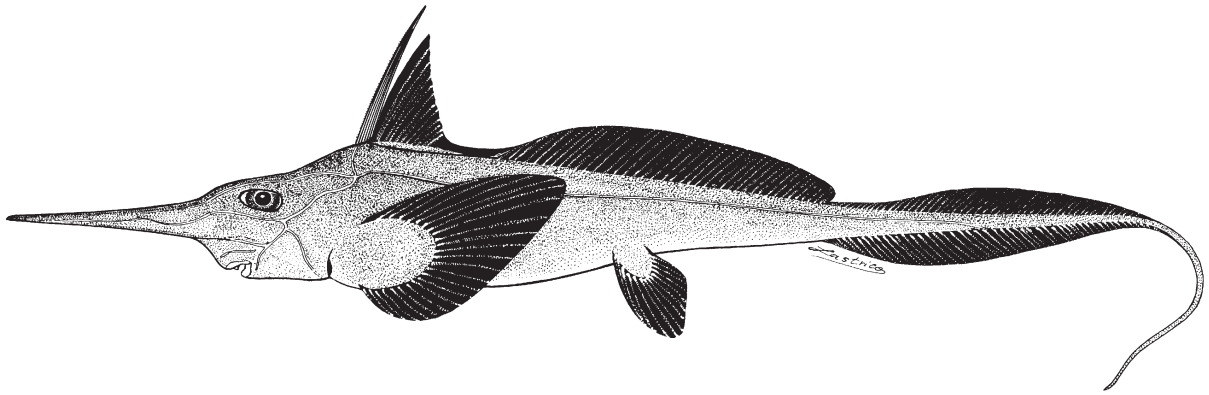


Fig. 242 ***Harriotta raleighana***

Field Marks: A relatively small–bodied rhinochimaerid with a moderately long, spear–like snout, broader at base and tapering to a narrow tip, eyes moderate–sized, pectoral fins short and broad, and a caudal fin with no tubercles on upper edge, and a long terminal tail filament. Colour is a uniform dark brown.

Diagnostic Features: Snout wide at base, moderately long, slightly flattened, tapering to a fine point with knobby protuberances at distal end; snout tip curves upwards. Eyes moderately large, ovoid. Head canals separated by a relatively wide space; trunk lateral–line canal straight, not wavy; nasal canal on ventral side of trunk expanded laterally at its distal end and joins rostral canal. Pectoral fins large, reaching past origin of second dorsal fin to near origin of pelvic fin (about 4/5 distance). Pelvic fins rounded in shape. Frontal tenaculum is small and slender with a pronounced curve and distal bulb bearing numerous spiny denticles. Prepelvic tenaculum with six stout spines along medial edge. Pelvic claspers in mature males rod–like with a small fleshy denticulate tip. First dorsal fin relatively small, with a small spine about equal in length to height of first dorsal fin, keeled and weakly serrate along distal one–half. Interdorsal space small, first dorsal and fin spine reach origin of second dorsal fin when laid back. Second dorsal fin gently slopes anteriorly and posteriorly but relatively even in height. Caudal fin with short filament. Maximum total length about 120 cm. **Colour:** uniform dark brown; fin edges much darker, pelvic fins blackish.

Distribution: Southeastern Pacific Ocean: Peru, but with scattered records from the eastern Pacific from Costa Rica, Mexico, and southern California, USA. Elsewhere circumglobal, but patchily distributed, most commonly found in the North Atlantic and around New Zealand.

Habitat: Poorly known deepwater longnose chimaera with a depth range of 380 to 2600 m, although an unconfirmed Indian Ocean record was from only 100 m depth. It has been observed at depth by remote operated vehicles over soft mud and gravelly bottom substrates and on occasion in association with other deepwater chimaeras (***Hydrolagus* spp.**). There appears to be an ontogenetic shift between 300 and 1000 m depth with large individuals occurring deeper than smaller individuals.

Biology: Oviparous, but little else known of its reproductive biology. Egg cases small, about 16 cm in length, strongly convex, more so on one side than the other, lateral flanges thin, with narrow transverse ridges numbering more than 50 rows on each side; capsule dark in colour, but lighter on flanges. Diet little known, but includes a variety of polychaetes, molluscs, and other small benthic invertebrates and teleosts. Smaller ***Harriotta raleighana*** feed mainly on polychaetes, gastropods, and small crustaceans, but the diet of larger individuals shifts more to crustaceans.

Size: Maximum total length about 120 cm (70 cm precaudal length); males mature at about 25 to 30 cm body length and females at about 30 cm body length. Size at birth about 10 to 13 cm precaudal length.

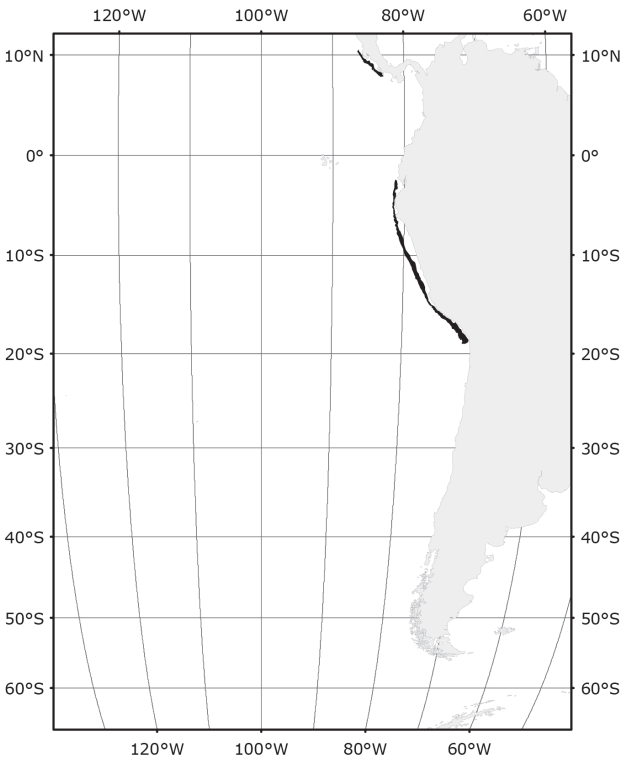


Fig. 243 *Harriotta raleighana*

Known distribution

Interest to Fisheries and Human Impact: There is no targeted fishery for this species, but it is likely taken as bycatch on occasion.

The conservation status is Least Concern since it appears to be one of the few chimaeroids with a wide geographic distribution and occurs at depths below where most fisheries occur.

Local Names: No information.

Remarks: This wide–ranging longnose chimaera is occasionally mistaken with ***Harriotta haeckeli***, another wide–ranging member of this genus characterized by a relatively small eye and dorsal–fin spine significantly shorter than height of first dorsal fin.

Literature: Goode and Bean (1895); Compagno, Stehmann and Ebert (1990); Ebert (2003); González *et al.* (2007); James *et al.* (2009); Last and Stevens (2009); Nakaya *et al.* (2009); Dunn *et al.* (2010); Ebert and Winton (2010); Didier, Kemper and Ebert (2012); Ebert and Stehmann (2013); Angulo *et al.* (2014); Ebert (2014, 2015); Cornejo *et al.* (2015); Kemper, Ebert, and Didier (2015b); D.A. Ebert (unpubl. data).

Rhinochimaera Garman, 1901

Genus: ***Rhinochimaera*** Garman, 1901, by original designation, *Proc. New Engl. Zool. Club*, 2: 75–76.

Type species: ***Harriotta*** [sic] ***pacifica*** Mitsukuri, 1895, Kurikama, near Misaki, Sagami, by original designation.

Number of Recognized Deep–sea Southeastern Pacific Ocean Species: 2.

Synonyms: None.

FAO Names: En – Knife–nosed chimaeras; **Fr** – Chimères–couteau; **Sp** – Quimeras–navaja.

Field Marks: Snout elongated, fleshy, tapering to a fine blunt point, distal tip straight, without a series of small rounded knobs on adult males, caudal–fin lower lobe at least three times height of upper lobe, margin of upper caudal–fin lobe with row of tubercles, and no anal fin present.

Diagnostic Features: Body bulky, elongated, tapering posterior to pectoral fins, ending in a filamentous tail. Snout very elongate, straight, broad at base, fleshy from base to mid–length, distal tip of snout not fleshy, tip bluntly pointed, not upturn. Adult males with short frontal tenaculum, flat, not deeply curved, and with a distal fleshy bulb with numerous small denticles. Eyes relatively small. Mouth in front of eyes. Tooth plates thin, smooth, blade–like cutting edges, not formed as crushing plates, lacking hypermineralized tritors on surface. Pectoral fins elongate, oval to narrow, rounded apex and along distal edge near base. Pelvic fins broad or elongated, rounded at apex. Pre–pelvic tenaculum spatulate with denticles along the medial edge. Pelvic claspers simple, rod–like structures with a small, fleshy bulbous tip in which there are small pointed denticles. First dorsal fin short–based, low and relatively small, preceded by a serrated spine that extends beyond first dorsal fin height; spine tip does not reach second dorsal fin when depressed. Second dorsal fin low and elongate, separated from first dorsal and caudal fins by distinct gap; dorsal margin convex. Anal fin absent. Caudal–fin dorsal margin narrow or sickle–shaped, with series of 19 to 68 tubercles along upper margin in adults; lower caudal fin lobe similar in height to second dorsal fin, its origin anterior to upper caudal–fin origin. Tail short to very elongated ending in whip–like filament, which is often broken. **Colour:** uniform dark to pale brown, greyish–brown or white, with no distinctive markings on body or fins.

Local names: No information.

Remarks: Following Didier, Kemper and Ebert (2012) three wide–ranging species are recognized within this genus. ***Rhinochimaera atlantica*** is primarily found in the Atlantic Ocean, while ***R. pacifica*** is found in the Pacific Ocean. The wide–ranging ***R. africana*** overlaps both these species and in fact the holotype was collected off the west coast of South Africa, off Doring Bay.

Key to Deep–sea Southeastern Pacific Ocean Species:

1a. Body colour an even dark brown; snout broad and paddle–shaped; eye is small; junction of supraorbital and infraorbital canals on ventral side of snout closer to the tip of the snout than to the nasal canal (Fig. 244) . . . . . ***Rhinochimaera africana***

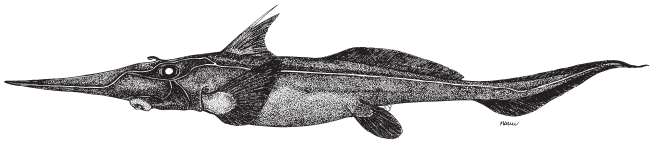


Fig. 244 ***Rhinochimaera africana***

1b. Body colour a pale brown or brownish grey with dark fins; snout narrow and conical-shaped; junction of supraorbital and infraorbital canals on ventral side of snout nearly equidistant between the tip of the snout and the nasal canal (Fig. 245) . . . . . ***Rhinochimaera pacifica***

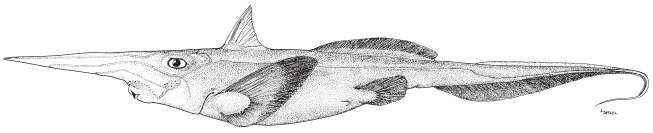


Fig. 245 ***Rhinochimaera pacifica***

Rhinochimaera africana Compagno, Stehmann and Ebert, 1990

Rhinochimaera africana Compagno, Stehmann and Ebert, 1990, *S. Afr. J. Mar. Sci.*, 9: 206, figs. 2–5. Holotype: SAIAB [formerly RUSI] 27744, immature female, 1119 mm total length, 901 mm precaudal length. Type locality: west of Doring Bay, Western Cape, South Africa (31° 59.8'S, 15° 56.2'E), by RV *Africana*, station A4361 046 E12, 850 m, 17 July 1986.

Synonyms: None.

Other Combinations: None.

FAO Name: En – Paddlenose chimaera.

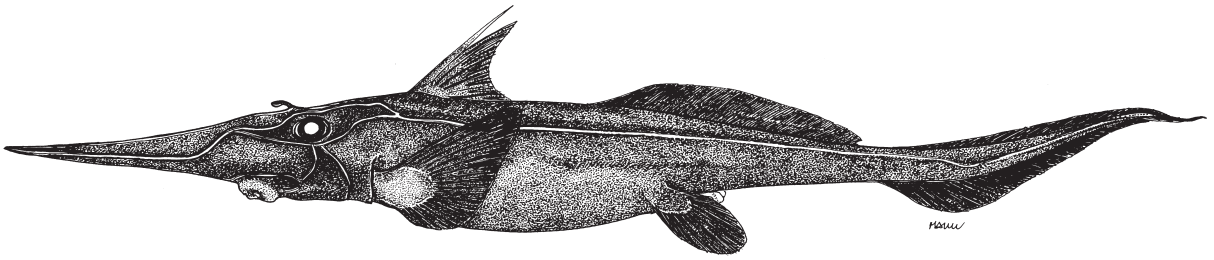


Fig. 246 ***Rhinochimaera africana***

Field Marks: A ***Rhinochimaera*** with an extremely long, broad, paddle–shaped, bluntly pointed snout, a low, relatively small first dorsal fin and short spine, and a short caudal fin with a minute filament. Colour is a uniform blackish–brown.

Diagnostic Features: Snout elongate, broad, fleshy, paddle–shaped and bluntly pointed at tip; snout slightly depressed at base, more so distally, tip not upturn; preorbital snout about 1.1 to 1.7 times in body length. Eyes small, diameter about 4 times in distance between eye and dorsal–fin spine; mouth located forward of eye. Supraorbital and infraorbital canals junction is closer to the tip of the snout than to the nasal canal. Tooth plates thin, smooth, with sharp blade–like cutting edges, not formed as crushing plates. Pectoral fins moderately long and narrow, rounded apex and along distal edge near base; apices when laid back do not reach pelvic–fin insertions. Pelvic fins broad, paddle–shaped, and short, with convex anterior margin, rounded apex, and moderately convex posterior margin. First dorsal fin low and small, preceded by a serrated spine; spine tip does not reach second dorsal fin when depressed; first dorsal–fin apex below tip of dorsal–fin spine; spine free from anterior margin of dorsal fin for about the distal 1/3 of length; relatively long interdorsal space. Second dorsal fin low, moderately long, distal margin convex. Caudal fin relatively short and broad, sickle–shaped, not greatly elongated; dorsal caudal–fin margin broadly convex; ventral caudal–fin origin anterior to dorsal lobe origin; ventral lobe margin deeper than upper lobe; dorsal lobe with 27 to 46 tubercles from along upper edge in adults; caudal fin ends in a very short vestigial filament. Maximum total length 112 cm (65 cm body length). **Colour:** uniform dark brown to black, with no distinctive markings on body or fins.

Distribution: Southeastern Pacific Ocean: from off Costa Rica and Peru. Also known from the western and eastern Indian, western Pacific and southeastern Atlantic oceans.

Habitat: A little known longnose chimaera that occurs from about 500 to at least 1500 m. It appears to occur mostly on soft–bottom habitats on deep–sea slopes and around seamounts.

Biology: Oviparous, but nothing else known of its reproductive biology or feeding habits. Unlike the other two ***Rhinochimaera*** species ***R. africana*** does not appear to aggregate in large numbers, since it is usually caught singly or in small numbers.

Size: Maximum total length about 112 cm (body length about 65 cm). Males adult at 40 to 50 cm body length; females are adult at about 50 cm body length. Size at birth is unknown.

Interest to Fisheries and Human Impact: Of no commercial value, this species is taken occasionally as bycatch in bottom trawl fisheries.

The conservation status is Data Deficient due to its widespread biogeography, deepwater habitat, and lack of directed commercial fisheries.

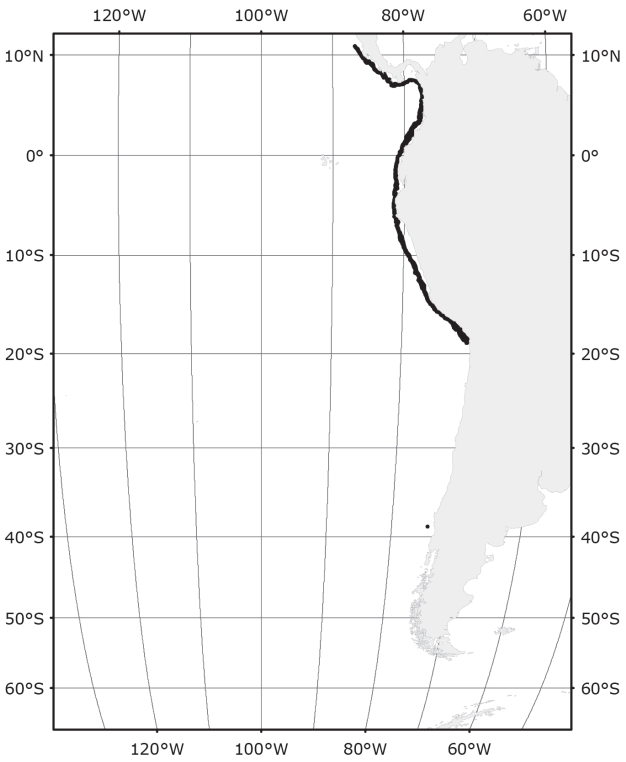


Fig. 247 ***Rhinochimaera africana***

Local names: No information.

Remarks: ***Rhinochimaera africana*** was first recognized as being distinct from other ***Rhinochimaera*** species when it was caught in a trawl along with several ***R. atlantica*** off Doring Bay, South Africa. Prior to its recognition as being distinct, it was long misidentified with the other two more common ***Rhinochimaera*** species, ***R. atlantica*** and ***R. pacifica***, and therefore the geographic distribution of this species may eventually prove to be more wide–ranging than currently known.

Literature: Compagno, Ebert and Smale (1989); Compagno, Stehmann and Ebert (1990); Compagno, Ebert and Cowley (1991); Dagit (2006c); Didier, Kemper and Ebert (2012); Angulo *et al.* (2014); Ebert (2014; 2015); Kemper, Ebert, and Didier (2015b); D.A. Ebert (unpubl. data).

Rhinochimaera pacifica (Mitsukuri, 1895)

Harriotta pacifica (Mitsukuri, 1895), *Dobutsugaku Zasshi = Zool. Mag. Tokyo* v. 7 (no. 80): 97 [1], Pl. 16. On p. 1 of separate. Holotype (unique): ZUMT ?1453 (lost). Type locality: Tokyo fish market, originally from Kurihama, near Misaki, Sagami Sea, Japan. Didier and Nakaya, 1999, *Ichth. Res,*, v. 46 (no. 2): 141 (figs. 2, 3), designated a Neotype: CBM-ZF 6140, adult female 126.7 cm total length, 53.9 cm body length, off Hota, Tokyo Bay, 250 m, 13 June 1995, collector M. Miya.

Synonyms: ***Harriotta pacifica*** Mitsukuri, 1895: 97 [1], Pl. 16.

FAO Name: En – Pacific spookfish.

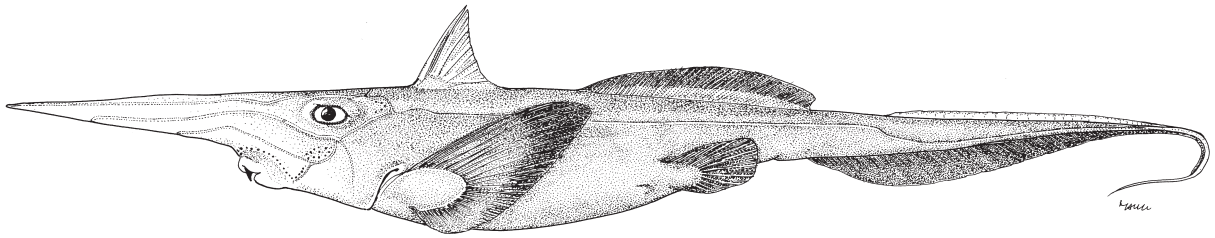


Fig. 248 ***Rhinochimaera pacifica***

Field Marks: A ***Rhinochimaera*** species with a very long, narrow, conical snout that is subtriangular and fleshy at the base, tapering to a narrow distal tip, eye of moderate size, its diameter 5 to 10% body length, dorsal caudal–fin lobe narrow and with a series of 31 to 68 denticulations along distal margin, and caudal fin with a distal filament. Body colour brown or greyish-brown with darker fins, ventral side of snout and oronasal region white.

Diagnostic Features: Snout very long, straight, conical, subtriangular at base; snout base to mid–length fleshy, tapering to a narrow, bluntly pointed tip; distal tip of snout not fleshy; snout length 50 to 87% body length (50 to 66% in adults, 54 to 87% in juveniles). Oronasal region with prominent antero–ventral protuberance at snout base, with complex series of labial cartilages that lie within labial folds. Mouth anterior to eye. Tooth plates thin, smooth and sharp, without ridges, colour dark grey to blackish with thin, blade–like cutting edges, not formed as crushing plates. Eyes moderate in size, 5 to 10% body length (5 to 8% in adults, 5 to 10% in juveniles); eyes smaller than other rhinochimaerids, except appearing distinctly larger than the eyes of ***Rhinochimaera africana***. Preopercular and oral lateral–line canals branches separated from the infraorbital canal below the eye. Pectoral fins ovoid and elongate, more narrow and long rather than triangular and broad shaped. Pelvic fins ovoid, sometimes squared along the distal edge, with anterior and posterior edges somewhat rounded. Adult males with short frontal tenaculum, flat, not deeply curved, and with a distal fleshy bulb with numerous small denticles. Claspers simple, rod–like structures with small, fleshy bulbous tip with small pointed denticles; pelvic claspers just reach the distal edge of the pelvic fin. Prepelvic tenaculum spatulate with five strong denticles along the medial edge. First dorsal fin triangular in shape, posterior margin concave and with a long fleshy base extending beyond the fin tip when depressed, but not connecting to second dorsal fin. Dorsal–fin spine, preceding first dorsal fin, extends slightly beyond first dorsal–fin height; fin spine connected to first dorsal fin along its posterior edge and when depressed together they form a deep groove; spine when depressed reaches one–half way to the origin of the second dorsal fin; spine keeled anteriorly with small serrations on distal one–third of the posterior edge; large adult specimens posterior serrations may become reduced or worn away. Second dorsal fin elongate, separated by a space from both first dorsal fin and dorsal lobe of caudal fin; maximum fin height at center, edges broadly rounded, with anterior and posterior ends sloping; second dorsal–fin height ranges from 3 to 7% body length, and 7 to 16% second dorsal– fin base. Anal fin absent. Dorsal caudal fin narrow, with a series of tubercles along distal margin of dorsal caudal–fin lobe and numbering from 31 to 68. Ventral caudal–fin lobe tallest anteriorly, tapering posteriorly. Tail elongate ending in a firm, short, whip–like caudal filament, sometimes broken, but if intact length can range from 4 to 32% body length. Maximum total length about 130 cm. **Colour:** uniform pale brown or greyish–brown, darker dorsally, lighter ventrally; fins dark, appearing dark brown or purplish after preservation; ventral side of snout and oronasal region white; juveniles usually paler, with dark fins and dark coloration on distal half of snout.

Distribution: Southeastern Pacific Ocean: Peru, this species may be confused with ***Rhinochimaera africana***, also known from this region. Elsewhere, spottily distributed in the western Pacific, and eastern Indian oceans.

Habitat: Appears to inhabit deep-sea canyons, troughs, and plateaus at depths of 191 to 1290 m, but most common at depths greater than 700 m.

Biology: Virtually unknown, except for oviparous reproductive mode. This species appears to aggregate in large schools of similar size and sex like its sister species, ***Rhinochimaera atlantica***, rather than ***R. africana*** that appears to occur solitarily or in small groups.

Size: Maximum total length about 130 cm, slightly longer if short filamentous tail intact; males mature at about 100 cm total length, with females maturing at a slightly larger length.

Interest to Fisheries and Human Impact: None, it is occasionally taken as bycatch in deep-sea fisheries, but little utilized. In the southeastern Pacific it is only known from very few records off Peru.

The conservation status is Least Concern since it appears to have a wide geographic distribution and occurs at depths below where most fisheries occur.

Local names: No information.

Remarks: The differences between this species and ***Rhinochimaera atlantica*** is based exclusively on the number of caudal tubercles; a character that overlaps these two species. Molecular studies however appear to confirm the distinction between the two species.

Literature: Mitsukuri (1895); Dean (1904); Garman (1904, 1911); Inada and Garrick (1979); Compagno, Stehmann, and Ebert (1990); Didier and Nakaya (1999); Last and Stevens (2009); Didier, Kemper, and Ebert (2012); Bustamante, Vargas-Caro, and Bennett (2014); Ebert *et al.* (2013); Cornejo *et al.* (2015); Dagit and Kyne (2015); Kemper, Ebert, and Didier (2015b); D.A. Ebert and J.M. Kemper (unpubl. data).

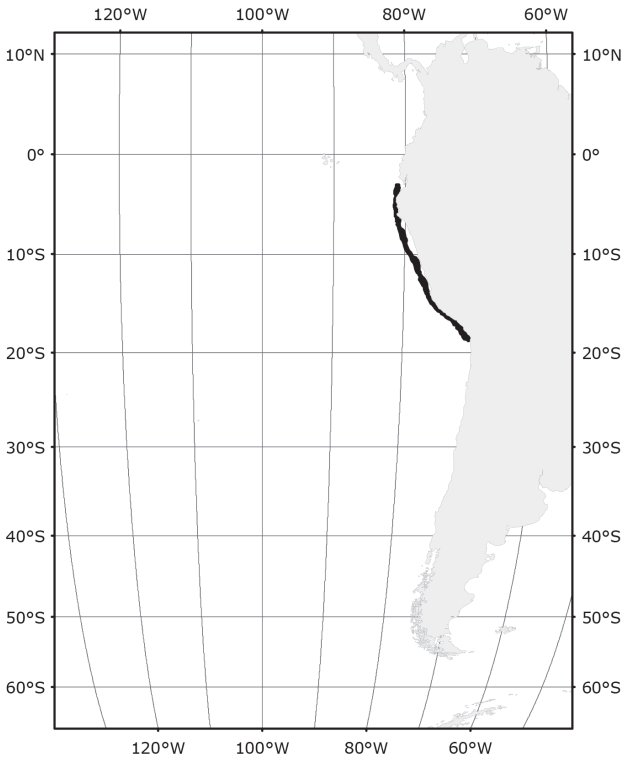


Fig. 249 ***Rhinochimaera pacifica***

Known distribution

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6. INDEX OF SCIENTIFIC AND VERNACULAR NAMES

Explanation of the System

Italics : Valid scientific names (double entry by genera and species)
Italics : Synonyms and misidentifications (double entry by genera and species)
ROMAN : Family names
ROMAN : Names of classes, subclasses, cohorts, superorders and orders.
Roman : Suborders, subfamilies, tribes, and FAO and local names

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This volume is a comprehensive, fully illustrated Catalogue of the Sharks, Batoid Fishes, and Chimaeras of the southeastern Pacific Ocean, encompassing FAO Fishing Area 87. The present volume includes 8 orders, 17 families, 39 genera, and 68 species of cartilaginous fishes occurring in the southeastern Pacific Ocean. It provides accounts for all orders, families, genera and species, and all keys to taxa are fully illustrated. Accounts of each species include: valid modern names and original citation of the species; synonyms; the English, French, and Spanish FAO names for the species (when available); a lateral view and often other useful illustrations; field marks; diagnostic features; distribution, including a GIS map; habitat; biology; size; interest to fisheries and human impact; local names (when available); a remarks section; and literature. The volume is fully indexed and also includes sections on terminology and measurements, an extensive glossary, and a dedicated bibliography.

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