



DEEP-SEA CARTILAGINOUS FISHES OF THE INDIAN OCEAN



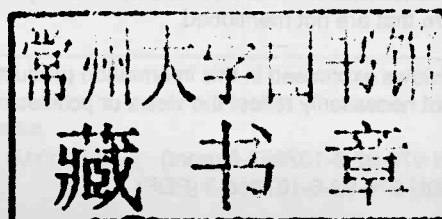
DEEP-SEA CARTILAGINOUS FISHES OF THE INDIAN OCEAN

Volume 1

Sharks

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)
and
Fisheries management and marine conservation within a changing ecosystem
context (GCP/INT/253/JPN)



DEEP-SEA CHONDRODONTIFORMES OF THE INDIAN OCEAN

Volume 1

Sharks

David A. Ebert

FAO Species Stock Research Center

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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 deep-sea identification guides for this group at a regional level.

The present publication is the first of a two-volume set dedicated to the identification of deep-sea cartilaginous fishes known to occur in the Indian Ocean, encompassing FAO Fishing Areas 51 and 57, and that portion of Area 47 off South Africa from about 18°42'E to 30°00'E. It focuses on shark-like species, providing accounts for all orders, families, and genera and for one representative species of each genus. Moreover, fully illustrated keys to all taxa are included.

It is aimed at facilitating the species specific identification of deep-sea shark fishes occurring in the Indian 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 Deep-sea Sharks of the Indian Ocean, encompassing FAO Fishing Areas 51 and 57, and that portion of Area 47 off South Africa from about 18°42'E to 30°00'E. The present volume includes 8 orders, 23 families, 46 genera, and 117 species of shark-like fishes occurring in the Indian Ocean deep-sea. It provides accounts for all orders, families, and genera and all keys to taxa are fully illustrated. A species representative account of each genus is also provided and includes: valid modern names and original citation of the species; synonyms; the English, French, and Spanish FAO names for the species; 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 sections; and literature. The volume is fully indexed and also includes sections on terminology and measurements for sharks including an extensive glossary, and a dedicated bibliography.

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1. INTRODUCTION

The genesis of this Catalogue stems from a workshop on Deep-sea Species Identification held in Rome, Italy, from 2 to 4 December 2009 (FAO, 2011). The workshop objectives were to identify and review key issues for vulnerable deep-sea species, e.g. corals, sponges, and chondrichthyans, that could be addressed when developing identification tools to assist in implementing the FAO Guidelines for the management of deep-sea fisheries and enhance fisheries management tools in general. A global checklist of deep-sea chondrichthyans, that occur in the deep-sea from about 200 m to over 2000 m deep, was compiled in relation to the 19 FAO major fishing areas. Among the recommendations from the workshop was the production of comprehensive regional identification guides to the deep-sea chondrichthyan fauna. The present catalogue covers the deep-sea Indian Ocean, primarily FAO Fishing Areas 51 and 57, and that part of Area 47 that extends from Cape Point, South Africa to the east, e.g. the extreme southwestern Indian Ocean. The catalogue has been divided into two volumes, the first on the sharks (presented below) and a second volume on the batoids and chimaeras. 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 shark-like fishes of the deep-sea Indian 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 in the sea, and the general public.

Biogeography of Region. The Indian Ocean region includes two major FAO Fishing Areas, the western Indian Ocean (Area 51) and the eastern Indian Ocean (Area 57). The western Indian Ocean extends from the southeast coast of India at 77°00'E longitude where the states of Kerala and Tamil Nadu meet at the sea, and extends southward to the equator, then east to 80°00'E longitude and south to 45°00'S latitude where it runs parallel westward to 30°00'E longitude and north to the coast of Africa. Also, included in this region is the extreme southeastern portion of Area 47, extending from Cape Point at about 18°42'E longitude eastwards to the boundary of Area 51 at 30°00'E longitude. The eastern Indian Ocean region extends essentially from the boundary with Area 51 on its western edge, although it extends further south to 55°00'S latitude, where it runs parallel to 150°00'E longitude and then north to about 37°31'S latitude to the southeast coast of Australia. The eastern boundary of Area 57 runs along the coast of southern Australia and around to the boundary of the states of Western Australia and the Northern Territory at 129°00'E longitude. At that boundary it extends northwards to 08°00'S latitude and then west along 113°28'E longitude where it meets the south coast of Java at 08°23'S latitude and extends westwards along the coasts of Java and Sumatra running south in the Strait of Malacca, where it crosses the Strait at 02°30'N latitude to meet the coast of the Malay Peninsula, where it goes in a northerly and westerly direction along the coasts facing the Bay of Bengal to the point of departure. The Indian Ocean encompasses 10 Large Marine Ecosystems, five

in the western Indian Ocean and six in the eastern Indian Ocean; one of the large marine ecosystems crosses the boundary of both areas off India. This includes the Agulhas Current, Somali Coastal Current, Arabian Sea, Red Sea, and a portion of the Bay of Bengal large marine ecosystems in the western Indian Ocean (Area 51), and in the eastern Indian Ocean (Area 57) this includes most of the Bay of Bengal, North Australia, Northwest Australia, West-Central Australia, Southwest Australia, and Southeast Australia large marine ecosystems (Figure 1 – Map of the Indian Ocean FAO Areas 51 and 57).

The Indian Ocean is the warmest ocean with a minimum surface temperature north of 20°S of 22 °C, but often exceeding 28 °C. Two major circular ocean currents, a clockwise flowing current in the northern hemisphere and a counterclockwise flowing current south of the equator, dominate the flow patterns. However, during the winter monsoon season, which heavily influences these currents, the northern current reverses flow. The continental shelves surrounding the Indian Ocean are generally narrow, averaging 200 km in width, except off the western coast of Australia where the shelf exceeds 1,000 km. The average depth is 3,890 m with a maximum depth of 8,047 m in the Diamantina Trench. The Indian Ocean topography is quite dynamic as three crustal plates, African, Indian and Antarctic, converge with their junctures forming an inverted "Y" with the stem originating from the edge of the continental shelf off Mumbai, India and extending to the southern Indian Ocean where all three plates meet at a geologic feature called Rodrigues Triple Point, named after the island of Rodrigues that is located nearby. This geologic feature subdivides the Indian Ocean into three basins, eastern, western and southern. Geologically the region, as the youngest of the major oceans, has active spreading ridges with several distinct subsurface features including the Ninety East Ridge that runs north-south at the 90°E meridian, which bisects the Indian Ocean into its eastern and western halves.

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, Squaliformes, Squatiniformes, and Pristiophoriformes, while the superorder Galeomorphii includes the Heterodontiformes, Orectolobiformes, Lamniformes, and Carcharhiniformes. The cohort Batoidea recognizes four orders, Torpediniformes, Pristiformes, Rajiformes, and Myliobatiformes. The ordinal classification of the shark-like fishes largely follows the arrangement of Compagno (2001, 2005), Ebert and Compagno (In press), and Ebert (In preparation) with some modifications in recognizing eight orders and 34 families. The higher classification and the taxonomic arrangement of the batoid fishes and the chimaeras will be discussed in volume 2 of this catalogue.

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 (cow and frilled sharks)*
 - Order Squaliformes (dogfish sharks)*
 - Order Squatiniformes (angel sharks)*
 - Order Pristiophoriformes (sawsharks)*
 - Superorder Galeomorphii (galeomorph sharks)
 - Order Heterodontiformes (bullhead sharks)*
 - Order Lamniformes (mackerel sharks)*
 - Order Orectolobiformes (carpet sharks)*
 - Order Carcharhiniformes (ground sharks)*
 - Cohort Batoidea (batoids)
 - Order Torpediniformes (electric rays)
 - Order Pristiformes (sawfishes)
 - Order Rajiformes (skates and guitarfishes)
 - Order Myliobatiformes (stingrays)

Indian Ocean Deep-sea Biodiversity. Sharks are among one the most successful groups of fishes having penetrated most marine ecosystems, including continental and insular shelf waters from the intertidal out to, and into, the deep-sea as well as occupying oceanic and pelagic habitats; some species have even penetrated into and occupy estuarine and freshwater river ecosystems. Recent reviews on the biodiversity and distribution of sharks in various ecosystems has shown that tropical marine ecosystems have the highest diversity, followed by deep-sea and temperate ecosystems, and with the epipelagic and freshwater ecosystems having a lower diversity of species (Ebert and Winton, 2010; Kyne and Simpfendorfer, 2010; Rosa, Charvet-Almeida and Quijada, 2010; Stevens, 2010; White and Sommerville, 2010). Worldwide there are more than 500 known living and valid species of sharks comprising 8 orders, 34 families, and 107 genera, with additional species requiring description (Nelson, 2006; Ebert and Winton, 2010; D.A. Ebert, pers. database, 1 March 2013). Globally, of these totals, all eight orders, 23 families, 58 genera, and 265 sharks species are considered to primarily inhabit the deep-sea (FAO, 2011; D.A. Ebert, pers. database, 1 March 2013).

The deep-sea Indian Ocean has a very diverse shark fauna with 8 orders, 23 families, 46 genera, and at least 117 species being represented (Table 1); while this catalogue was in preparation a new genus and species of deep-sea Pseudotriakidae from the northern Indian Ocean was described, *Planonassus parini* Weigmann, Stehmann, and Thiel, 2013, and is included here. The most speciose group of sharks in the deep-sea Indian Ocean are the Squaliformes that have at least 58 species represented, most of which are in the families Etmopteridae ($n = 15$) and the Centrophoridae and Squalidae with 13 species in each family. The Carcharhiniformes have 41 species representatives, with the vast majority in the family Scyliorhinidae ($n = 32$). All of the other shark orders only have six or fewer species representatives. Of these totals, the diversity is remarkably similar in terms of numbers of families, genera, and species between the eastern and western Indian Ocean deep-sea

(Table 1). The only families not represented in the eastern Indian Ocean are the Pristiophoridae and Heterodontidae, while in the western Indian Ocean only the Parascylliidae is not represented. The number of genera occurring in the western Indian Ocean ($n = 42$) is slightly higher than in the eastern Indian Ocean ($n = 38$), as well as the number of species ($n = 78$ and 77 , respectively). A total of 38 species occurs in both regions, with the remaining numbers of species being unique to each region.

Indian Ocean (Tot.)	Sharks	Batoids	Chimaeras	Tot.
Orders	8	3	1	12
Families	23	8	2	33
Genera	46	23	5	74
Species	117	61	17	195
Indian Ocean (Area 51)				
Orders	7	3	1	11
Families	22	5	2	29
Genera	42	14	5	61
Species	78	30	9	117
Indian Ocean (Area 57)				
Orders	6	3	1	10
Families	21	8	2	31
Genera	38	17	4	59
Species	77	34	11	122

Table 1 – The families, genera, and species represented within the Deep-sea Indian Ocean (total for Areas 51 and 57), western Indian Ocean (Area 51), and eastern Indian Ocean (Area 57).

1.1 Plan of the Catalogue

The format for this catalogue follows that of the FAO Catalogue of Sharks of the World (Compagno, 2001; Ebert and Compagno, In press; Ebert, In preparation), with orders as the highest taxonomic group dealt with here, followed by family, genus, and species accounts. A key to the families and genera, where appropriate is also included. A difference in the present catalogue is that not all species accounts are dealt with in the same comprehensive detail. A list of all deep-sea species known to occur in the Indian Ocean is presented for each family, with a representative species of each genus presented in detail and indicated by the presence of a shark icon beside its scientific name. For those genera where more than a single member of the genus has species that are possibly subjected to intense fishing pressures or are considered especially vulnerable (e.g. *Centrophorus*, *Squalus*), more than one species is presented in detail. In total, 51 of 117 shark species are presented in detail here.

The species specific information on the biology, conservation status, distribution, habitat, fisheries, and systematics of Indian Ocean sharks was compiled from primary literature sources including, but not limited to, Compagno (2001), Compagno, Ebert and Smale (1989), Last, White and Pogonosky (2007), Last, Motomura and White (2008), Last Séret and White (2008), Last and Stevens (2009), Ebert and

Winton (2010), Kyne and Simpfendorfer (2010), FAO (2011), and Ebert and Compagno (In press). Electronic sources were also of invaluable help, these included, but were not limited to, the California Academy of Sciences Catalogue of Fishes (<http://www.calacademy.org/research/ichthyology/catalog/fishcatsearch.html>) and IUCN Shark Specialist Group (<http://www.iucnredlist.org>). 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 Indian Ocean deep-sea; common order Synonyms mainly from the Indian Ocean deep-sea region with the name, author, year, and pagination; the FAO order Vernacular Names in English, French and Spanish; 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 systematic comments; and a Key to Deep-sea Indian Ocean 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 Indian Ocean genera in the family; family Synonyms with names mostly associated with the Indian Ocean region and with the name, author, year, and pagination; the FAO family Vernacular Names in English, French and Spanish; 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 systematic comments; a Literature section covering references to the entire family; and a Key to Deep-sea Indian Ocean 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 Indian Ocean 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 where available; a Key to Deep-sea Indian Ocean 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; 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 Indian Ocean 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 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 of the Western Indian Ocean (Compagno, 1984c), Namibia (Bianchi *et al.*, 1999), Western Central Pacific (Compagno, 1998), Red Sea and Gulf of Aden (Bonfil and Abdallah, 2004), and North Atlantic (Ebert and Stehmann, 2013), 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 Areas 51 and 57, or within the scope of the present Catalogue and does 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 orders with one family (such as Squatiniformes), monotypic families with one genus (Mitsukurinidae) or monotypic genera with one species (*Pseudotriakis*) all have the Diagnostic Features section present only in the highest taxon covered.

Distribution. Geographic distributions for nearly all species of sharks are given by listing the countries or oceanographic features, e.g. seamounts and troughs, off the coasts of which the sharks occur, and, in some instances with large countries (Australia), more detailed data are given when available. In compiling distributional data and preparing maps it was noted that the distributions of many wide-ranging coastal and deep-sea species are very patchily known as present. In many cases gaps in distribution may not indicate absence of a given species but absence of knowledge. Continental slope shark faunas are poorly known for much of the world, and a number of deepwater 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 patchy, but possibly more accurate.

Habitat. Habitat covers information on physical conditions where various sharks 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 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 shark workers 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 are presented when available. Other aspects of human interaction is 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 deep-sea species have no vernacular names whatsoever or are lumped under catchall names, while some species such as the basking sharks have dozens of names. Wherever possible common local names are presented, especially for important wide-ranging sharks. The broadening interest in sharks 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 Areas 51 and 57.

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.

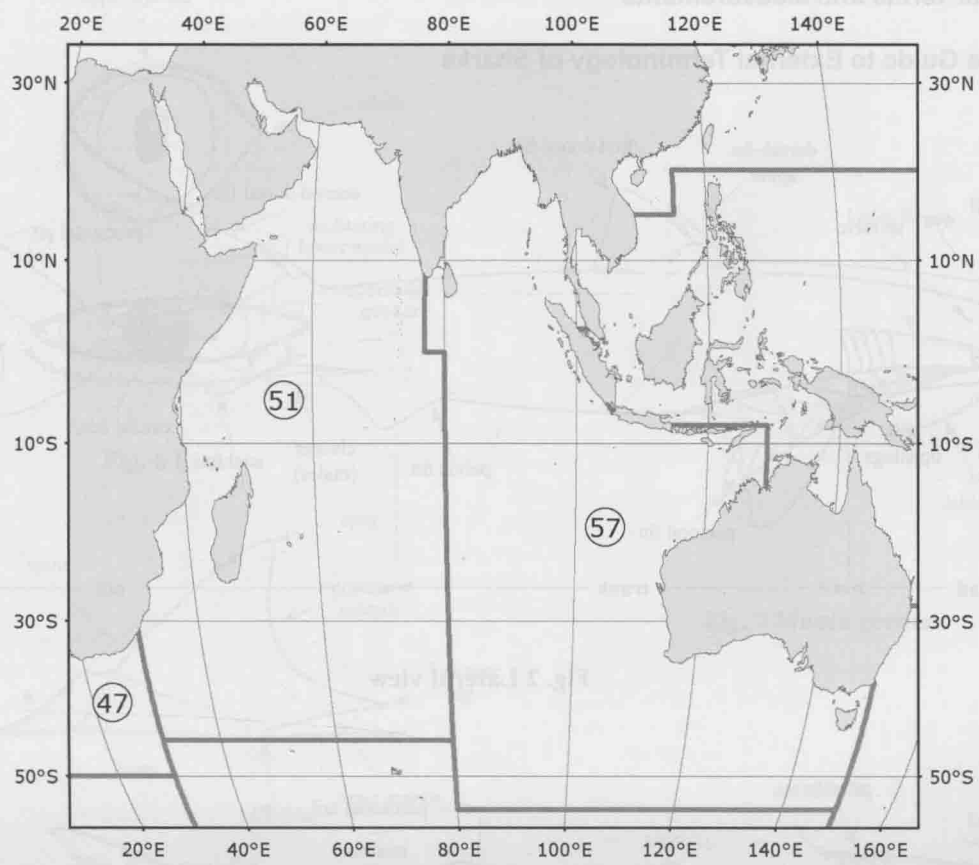


Fig. 1 Map of FAO Area 51 (Western Indian Ocean), Area 57 (Eastern Indian Ocean) and the southeastern portion of Area 47 (Southeastern Atlantic Ocean)

1.2 Technical Terms and Measurements

1.2.1 Picture Guide to External Terminology of Sharks

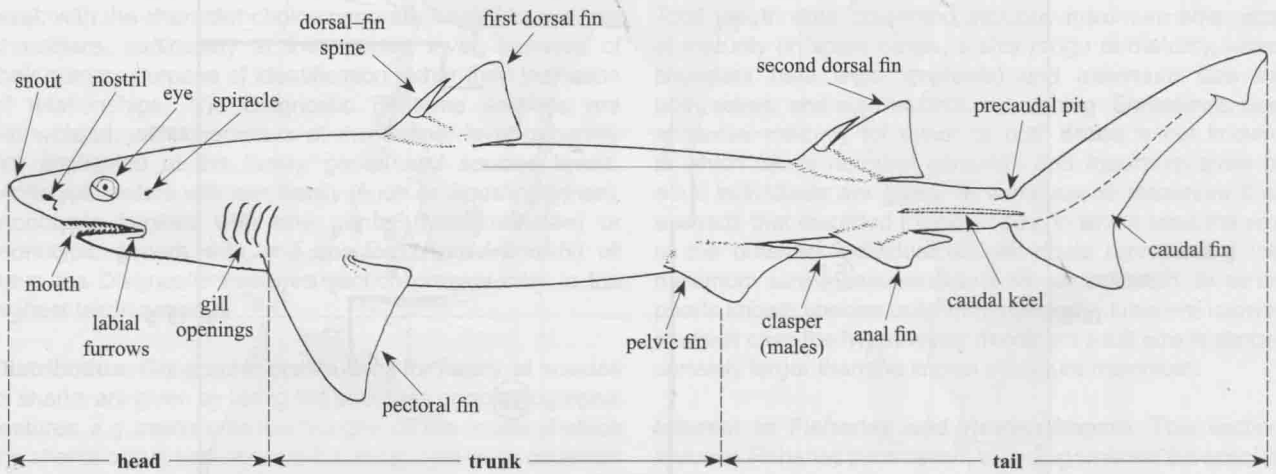


Fig. 2 Lateral view

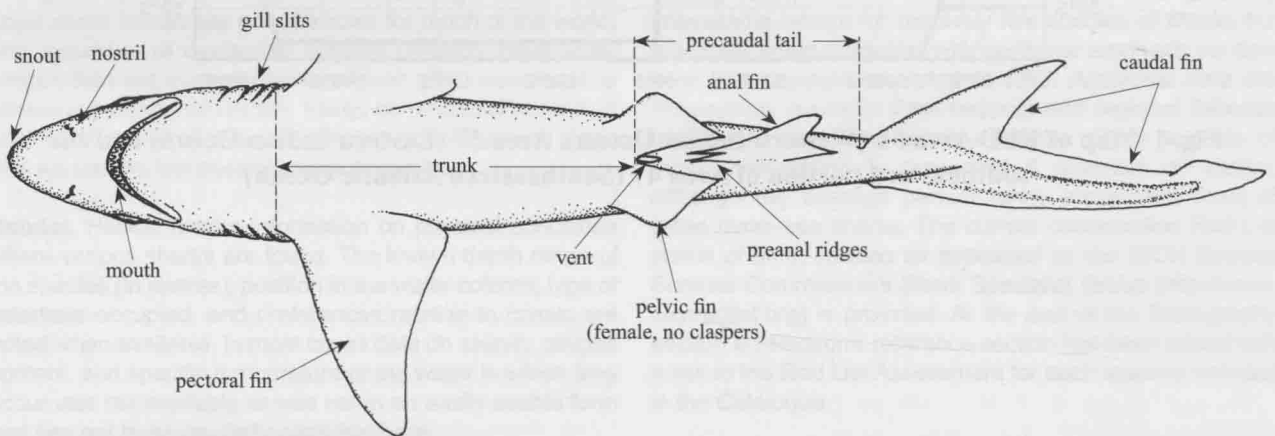


Fig. 3 Ventral view

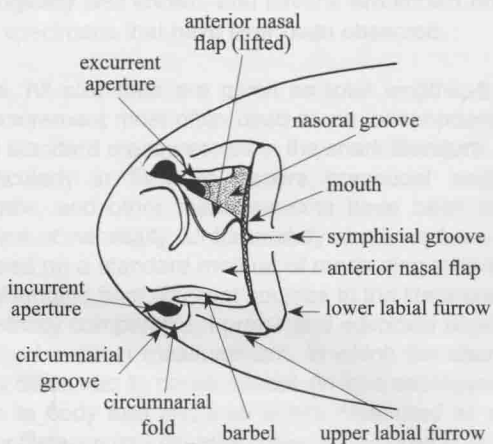


Fig. 4 Head of an orectoloboid shark
(ventral view)

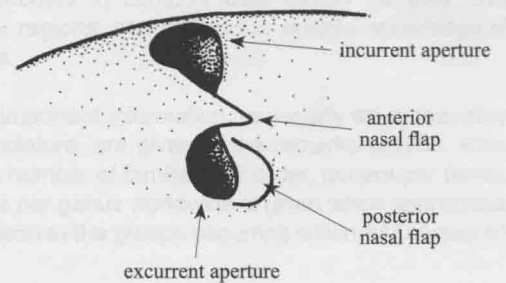


Fig. 5 Nostril

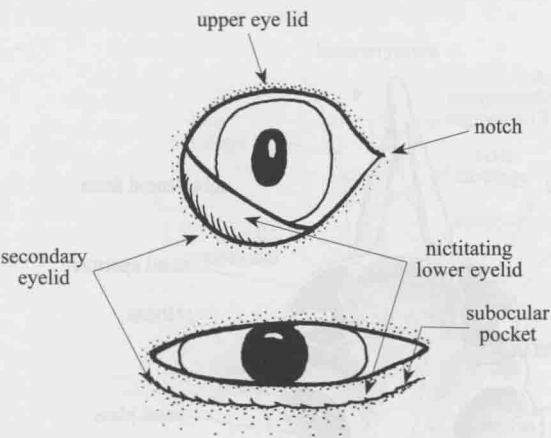


Fig. 6 Eyes

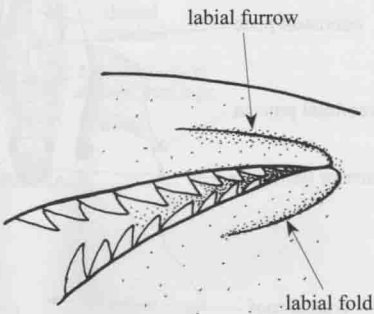


Fig. 7 Mouth corner

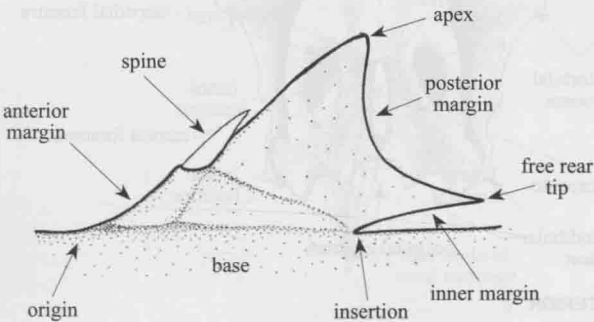


Fig. 8 Dorsal fin

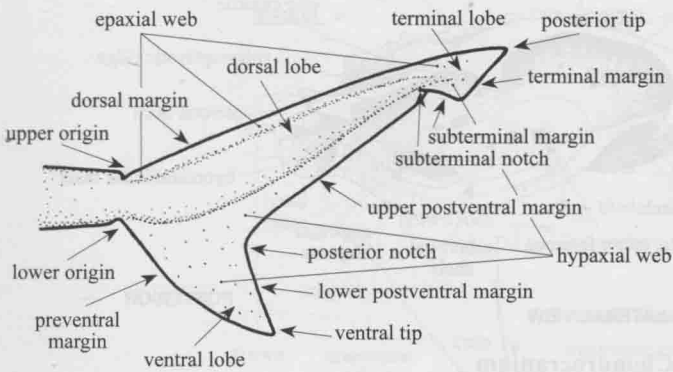


Fig. 9 Caudal fin

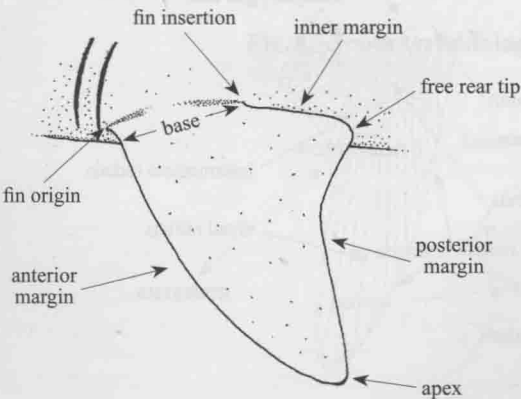


Fig. 10 Pectoral fin

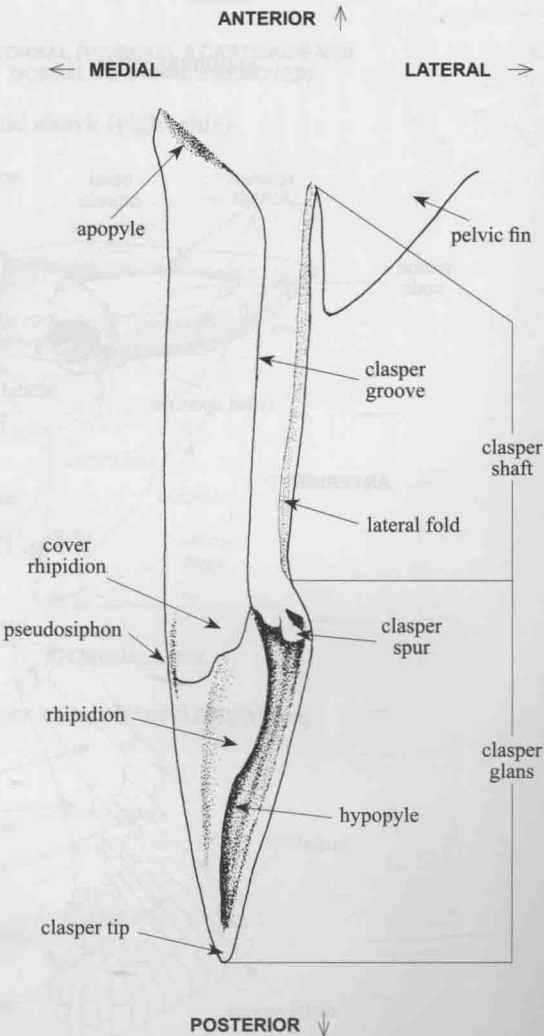


Fig. 11 Dorsal view of clasper (lamnid shark)

1.2.2 Picture Guide to Skeletal Terminology of Sharks

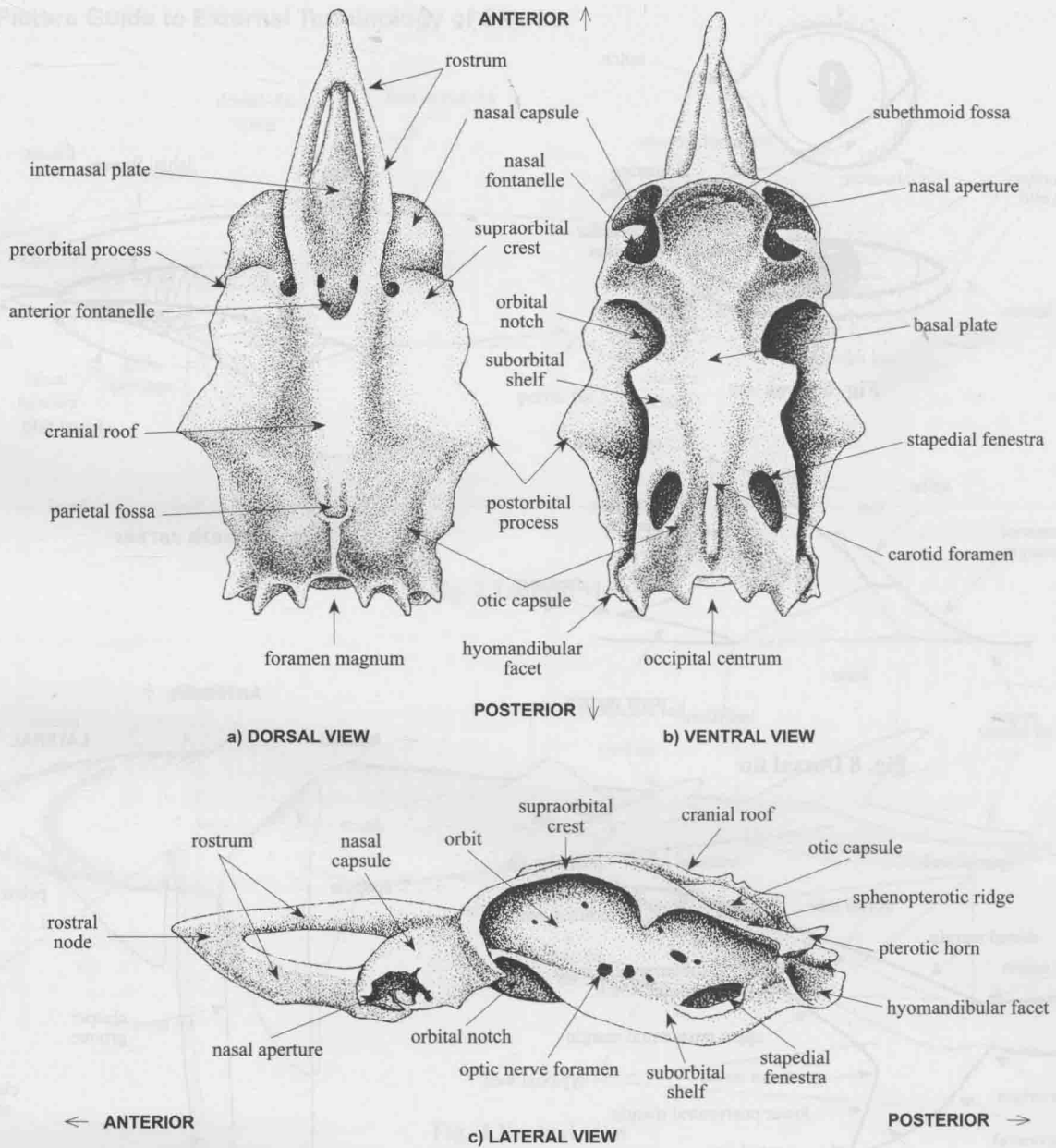


Fig. 12 Chondrocranium

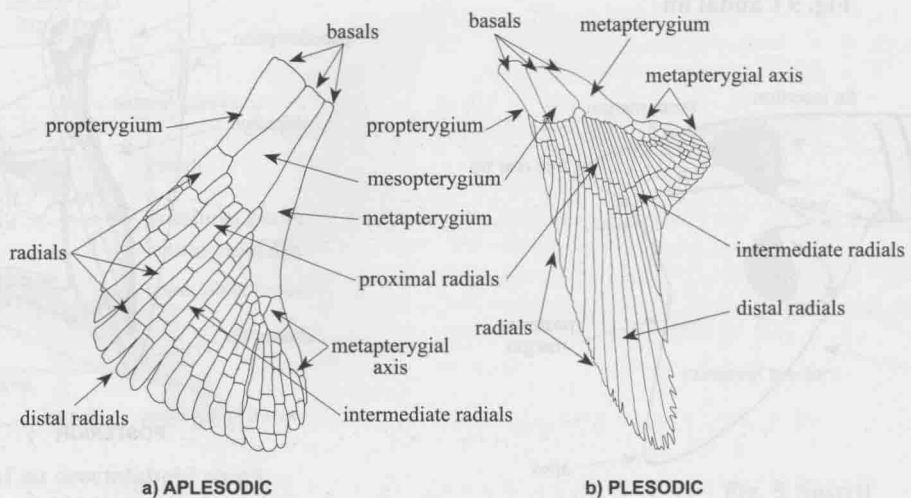


Fig. 13 Aplesodic and plesodic pectoral fins