



# SHARKS OF THE WORLD

AN ANNOTATED AND ILLUSTRATED CATALOGUE OF  
SHARK SPECIES KNOWN TO DATE

Volume 2. Bullhead, mackerel and carpet sharks  
(Heterodontiformes, Lamniformes and Orectolobiformes)



Food  
and  
Agriculture  
Organization  
of  
the  
United  
Nations



# **SHARKS OF THE WORLD**

**AN ANNOTATED AND ILLUSTRATED CATALOGUE OF SHARK  
SPECIES KNOWN TO DATE**

## **Volume 2**

**Bullhead, mackerel and carpet sharks  
(Heterodontiformes, Lamniformes and Orectolobiformes)**

by

**Leonard J.V. Compagno**  
Shark Research Center  
Iziko-Museums of Cape Town  
South African Museum  
Cape Town  
South Africa

The designations employed and the presentation of material in this publication do not imply the expression of any opinion whatsoever on the part of the Food and Agriculture Organization of the United Nations concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

ISBN 92-5-104543-7

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical, photocopying or otherwise, without the prior permission of the copyright owner. Applications for such permission, with a statement of the purpose and extent of the reproduction, should be addressed to the Director, Information Division, Food and Agriculture Organization of the United Nations, Viale delle Terme di Caracalla, 00100 Rome, Italy.

© FAO 2001

## PREPARATION OF THIS DOCUMENT

This document was prepared in FAO under a special programme made possible thanks to a generous Trust Fund (GCP/INT/643/JPN) from the Government of Japan. The present publication is the second installment of the updated version of the original FAO Catalogue of Sharks of the World (Compagno 1984), and constitutes volume two of the first number in a new series: *FAO Species Catalogue for Fishery Purposes*. Up until now, FAO Species Catalogues had existed as a far too lengthy series of volumes within *FAO Fisheries Synopsis No. 125*. But given the importance and size of that series and the continuing need for this type of publication in the foreseeable future, the species catalogues have grown out as an independent series starting with the present three-volume work. In order to preserve the continuity of the species catalogues, the new series will maintain the trademark orange-coloured cover of the old series as well as most of its format. As the new Catalogue has grown apace with new information and revisions, it is being published as three free-standing volumes, each with separate pagination, introduction, terminology, systematic sections, glossary, list of species by FAO Statistical Areas, and a dedicated bibliography. This will allow readers to independently use each volume without having to consult the other volumes for technical terms and measurements or bibliographic purposes, as was the case in the old catalogue. We hope that this added flexibility will be received as an improvement.

**Programme manager:** Pere Oliver (FAO, Rome).

**Scientific and technical editor:** Ramón Bonfil (Fisheries Centre, UBC, Vancouver).

**Technical assistance:** Jascha Minow (FAO, Rome).

**Editorial assistance:** Michèle Kautenberger and Nicoletta De Angelis (FAO, Rome).

**Scientific illustrators:** Emanuela D'Antoni, Paolo Lastrico, Oliviero Lidonnici, Pier-Luigi Isola and Miloud Sadeir (FAO, Rome), Leonard J.V. Compagno (Shark Research Center, South African Museum, Iziko - Museums of Cape Town), Mary H. Wagner (US Bureau of Commercial Fisheries, Stanford) and Juan Varela (Madrid).

**Cover illustration:** Emanuela D'Antoni (FAO, Rome).

**Page composition and indexing:** Michèle Kautenberger (FAO, Rome).

**Digitization of distribution maps:** Fabio Carocci (FAO, Rome), and Elena V. Orlova.

### Compagno, L.J.V.

Sharks of the world. An annotated and illustrated catalogue of shark species known to date. Volume 2. Bullhead, mackerel and carpet sharks (Heterodontiformes, Lamniformes and Orectolobiformes).

*FAO Species Catalogue for Fishery Purposes*. No. 1, Vol. 2. Rome, FAO. 2001. 269p.

### ABSTRACT

This is the second volume of an extensively rewritten, revised, and updated version of the original FAO Catalogue of Sharks of the World. The present volume reviews all 15 families 25 genera and 57 species of living bullhead, mackerel and carpet sharks (orders Heterodontiformes, Lamniformes and Orectolobiformes), that is, the non-carcharhinoid galeomorph sharks, including certain well-established but currently undescribed species mainly from Australia. It gives accounts for all orders, families and genera and all keys to taxa are fully illustrated. Information under each species account includes: valid modern names and original citation of the species (or subspecies); 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 section when necessary; and literature. The volume is fully indexed and also includes sections on terminology and measurements including an extensive glossary, a list of species by FAO Statistical Areas, an appendix on shark preservation, and a dedicated bibliography.

### Distribution

Authors  
FAO Fisheries Officers  
Regional Fisheries Councils and Commissions  
Selector SC

## Acknowledgements

It is hard to summarize the large number of people that have helped me over the course of preparing the 1984 shark catalogue and its current revision; several are no longer living, but I salute the memories of the dead as with the living, and make no distinction here. I apologize beforehand if I have forgotten anybody, which will inevitably happen.

I would especially like to thank W.I. (Bill) Follett, of the California Academy of Sciences, San Francisco, California, for encouragement on my initial checklists and interest in shark systematics many, many years ago. Especial thanks go to five of my research colleagues, Shelton P. (Shelly) Applegate (Los Angeles County Museum and Instituto de Geologia, Ciudad Universitaria, Mexico City), J.A.F. (Jack) Garrick (Department of Zoology, Victoria University, Wellington, New Zealand), Stewart (Stew) Springer (National Marine Fisheries Service, USA, and Mote Marine Laboratory, Sarasota, Florida), Warren C. Freihofer (Division of Systematic Biology, Stanford University, California Academy of Sciences and Tiburon Center for Environmental Studies) and Sid F. Cook (Argus-Mariner Consulting Scientists, Portland, Oregon), all of whom were extremely helpful and inspirational over the years. Special thanks for my wife, Martina Roeleveld (South African Museum) for her support.

The 1984 catalogue owed an enormous amount to the untiring and titanic efforts of Dr Walter Fischer, formerly Marine Resources Department, FAO Fisheries Division, who inspired me to make it a far more useful work than would have been my inclination as a professional systematist. This was not entirely a painless process, but I learned an enormous amount while writing it. Special thanks go to Dr Bernard Zahuranec, of the US Office of Naval Research, for providing support for the writing of the catalogue over three years in the form of a research contract to the writer at the Tiburon Center for Environmental Studies, San Francisco State University, Tiburon, California, and for arranging funding for a circumglobal research trip in 1982. Thanks also to Dr Samuel E. Gruber (University of Miami) and the American Elasmobranch Society for support for the publication of the 1984 catalogue in the United States. Dr Cornelia E. Nauen, formerly of the Marine Resources Department, FAO Fisheries Division, was extremely helpful in the organization of the final version of the 1984 catalogue, which went through several changes in format during the past five years. Thanks also to the staff of Dr W. Fischer's Species Identification and Data Programme (SIDP) at FAO for their efforts, particularly for the fine artistic work of Emanuela D'Antoni, Pier Luigi Isola, Paolo Lastrico, and Oliviero Lidonnici in translating often difficult material from the literature as well as the writer's research drawings and maps into the illustrations in this catalogue; and to Giulia Sciarappa-Demuro for typing the final manuscript. Mrs Paula Smith, Ms Barbara Nabors, and Ms Dale White of the Tiburon Center for Environmental Studies helped in the typing and copying of versions of the manuscript and the organization of the bibliography.

The present revised Catalogue was made much easier on the writer's side by powerful personal computers, slide and flatbed scanners, OCR and digital graphics programmes, and electronic communications, which eliminated the need to spend part of the time at Rome to produce the Catalogue. A very large thanks to Dr Ramón Bonfil (Fisheries Centre, University of British Columbia), who served as grand coordinator of production and editor for the Catalogue at SIDP, as well as peer reviewer, user-friendliness tester, and contributor to the work; a massive task, but from this side not thankless! Thanks to Dr Pere Oliver, Dr Kent Carpenter, Mr Jascha Minow, Ms Michèle Kautenberger, Ms Emanuela D'Antoni, Ms Nicoletta De Angelis and Ms Giulia Sciarappa at SIDP, and Mr Fabio Carocci at FAO, for their outstanding work during various stages of the project that helped to make it possible.

Special thanks also to the following: Bobb Schaeffer, Donn Rosen, Gareth Nelson, John Maisey, Gavin Naylor, Guido Dingerkus and Marcelo de Carvalho (American Museum of Natural History, New York); John R. Paxton and Doug Hoese (Australian Museum, Sydney); John E. Randall, Arnold Susumoto, J. Culp and Richard Pyle (Bernice P. Bishop Museum, Honolulu); Robert Lea (California Department of Fish and Game); F. R. Harden Jones, John Stevens, Peter Last, A.J. Rees, T. Carter, Maria Bresic' and Justine O'Regan (Division of Fisheries, CSIRO Marine Laboratories, Hobart, Tasmania); Alwynne Wheeler, Peter Whitehead, and Oliver Crimmen (British Museum [Natural History], London, now the Natural History Museum); David Ward (University of London); William D. Eschmeyer, Frank H. Talbot, John McCosker, Tyson R. Roberts, Lillian J. Dempster, Robert P. Dempster, Tomio Iwamoto, Pearl Sonoda, and David Catania (California Academy of Sciences, San Francisco); E.G. Silas, K.K. Appukuttan, and M.E. Rajapandian (Central Marine Fisheries Research Institute, Cochin, India); L.W. Filewood (Department of Agriculture, Stock and Fisheries, Konedobu, Papua-New Guinea); Gregg Brett (East London Museum, South Africa); Rob Heijman (Expert Center for Taxonomic Identifications, Amsterdam); Ian Fergusson (European Shark Research Bureau and Shark Trust, UK); Hideki Nakano (National Research Institute of Far Seas Fisheries, Shimizu); Kazunori Yano (Seikai National Fisheries Research Institute, Ishigaki Tropical Station, Fisheries Agency of Japan); Rainer Zangerl (Department of Geology, Field Museum of Natural History, Chicago); Kazuhiro Nakaya (Hokkaido University); Manfred Fischer (Infotek, Cape Town); E. MacPherson (Instituto del Mar, Barcelona); Dario J. Guitart (Instituto de Oceanologia, Academia de Ciencias de Cuba, Havana); Gordon Hubbell (JAWS International, Miami); M. Stehmann (Institut für Seefischerei, Hamburg); J.L.B. Smith, Margaret Smith, Michael Bruton, Tom Hecht, Phillip C. Heemstra, Elaine Heemstra, Paul Skelton, M. Eric Anderson, Dave Voorfelt, Paul Cowley, Billy Ranchod, Margaret Crampton, Robin Stobbs, Edward Matama, S. Matama, H. Tomlinson, Alexandra Macras and K. Liley (J.L.B. Smith Institute of Ichthyology, Shark Research Center of JLBSII, and Rhodes University, Grahamstown, South Africa); Supap Monkolprasit and Prachit Wongrat (Faculty of Fisheries, Kasetsart University, Bangkok); Martha J. Mitchill (Kent Cambridge Scientific Inc., Palo Alto, California, and Stanford University); Robert J. Lavenberg, Camm Swift and Jeffery A. Seigel (Los Angeles County Museum of Natural History); Myvanwy M. Dick (Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts); Louis Garibaldi and Don Reed (Marine World, Redwood City, California); G. Victor Morejohn, Gregor Cailliet, and Dan Varoujean (Moss Landing Marine Laboratories); Dave Ebert (Moss Landing Marine Laboratories, Shark Research Center in Grahamstown and Cape Town, and US Abalone); Ken Goldman (Virginia Institute of Marine Science,

Gloucester Pt, Virginia); Lee B. Hulbert (National Marine Fisheries Service, Juneau, Alaska); Marie-Louise Bauchot and Bernard Seret (Museum National d'Histoire Naturelle, Paris); Merry Camhi (Ocean Wildlife Campaign, National Audubon Society, USA, and IUCN Shark Specialist Group); Beulah Davis, Graeme Charter, Jeremy Cliff, Sheldon Dudley, B. Wilson and P. Mthembu (Natal Sharks Board, Umhlanga Rocks); John Moreland and Andrew Stewart (National Museum of New Zealand, Wellington); Sarah Fowler (Nature Conservation Bureau, UK, and IUCN Shark Specialist Group); Ernst Mikschi (Naturhistorisches Museum, Vienna); Keiichi Matsuura (National Science Museum, Tokyo); Che-Tsung Chen (National Taiwan Ocean University); Peter Ng and Kelvin Lim (Zoological Reference Collection, Department of Zoology, National University of Singapore); Nadaraj (Nat) Kistnasamy, John Bass, Alan Bowmaker, Elinor Bullen, Rudy van der Elst, John Wallace and Lynnath Beckley (Oceanographic Research Institute, Durban, South Africa); S. Uchida and Katherine M. Muzik (Okinawa Expo Aquarium); Fritz J. Pfeil (Pfeil Verlag, Munich); Malcolm J. Smale, Graham Ross, Colin Buxton, J. Clarke, M. du Plessis, and W. Mahola (Port Elizabeth Museum and Oceanarium: Bayworld); Mabel Manjaji and Alvin Wong (Sabah Fisheries, Sabah, Malaysia); Anna Wong (Sabah Museum, Sabah); C.G. Alexander, Robert I. Bowman, Margaret G. Bradbury, Erwin Seibel, and Michael Jocelyn (San Francisco State University); Carl L. Hubbs and Richard H. Rosenblatt (Scripps Institution of Oceanography, La Jolla, California); A.I.L. (Andy) Payne, L. Botha, A. Robertson, A. Badenhorst, C. Augustyn, Marek Lipinski, Jeremy David, Herman Oosthuizen, Marc Griffiths, Andrew Penny, R. Cooper, Robin Leslie, Roy Melville-Smith, Rob Tilney, H. Crous, Peter Sims, Captain Derek Krige, and the officers and crew of RV *AFRICANA*, RV *ALGOA*, RV *BENGUELA*, and RV *SARDINOPS* (Sea Fisheries Research Institute/Marine and Coastal Management, Cape Town); Barrie Rose, Graham Brill and the captains, officers and crew of the Irvin and Johnson deepwater bottom trawling fleet (Sea Fisheries Research Institute and Irvin and Johnson, Cape Town); Steve Campana (Bedford Institute of Oceanography, Dartmouth, Nova Scotia); Leslie W. Knapp (Smithsonian Oceanographic Sorting Center, Washington, DC); Martina A.C. Roeleveld, P.A. (Butch) Hulley, Graham Avery, Sydney Kannemeyer, Rachel Alexander, Mark Marks, Andrea Bertolini, Michelle van der Merwe, Liz Hoenson, Cedric Goliath, Mike Bougaardt, Ricardo Adams, Mike Boon, and Pete White (Iziko: Museums of Cape Town, South African Museum and Shark Research Center); George S. Myers, Norman K. Wessells, Paul R. Ehrlich, Donald Kennedy, Robert T. Schimke, Evelyn Shaw, John H. Thomas, and Margaret A. Sharp (Department of Biological Sciences, Stanford University); Carlos J. Villavicencio-Garayzar (Universidad Autónoma de Baja California Sur, La Paz, Mexico); John D. McEachran (Texas A and M University); Takashi Okutani and Hajime Ishihara (Tokyo University of Fisheries); Stanley H. Weitzman and Victor G. Springer (Division of Fishes, US National Museum of Natural History); John G. Casey, and Harold L. Pratt, Jr. (US National Marine Fisheries Service, Narragansett Laboratory); Bruce B. Collette, Susumu Kato, Joseph Russo, Susan Smith and Mary H. Wagner (US National Marine Fisheries Service); Hans-J. Paepke (Museum für Naturkunde, Universität Humboldt, Berlin); C. Richard Robins and Arthur Myrberg (Institute of Marine Sciences, University of Miami); Reeve M. Bailey (University of Michigan Museum of Zoology, Ann Arbor); Bruce Welton (University of California, Berkeley, Los Angeles County Museum of Natural History, and Chevron Oil Field Research Company); Dave Freer, Richard Brooke, Tim Crowe, Charles Griffiths and J. Jarvis (University of Cape Town); Fernando Márquez (Instituto Nacional de la Pesca, Mexico); Steve Kajiura (University of Hawaii, Honolulu); Tom Thorson (University of Nebraska); Toru Taniuchi (University of Tokyo, Department of Fisheries); Alvaro E. Tresierra Aguilar (Universidad Nacional de Trujillo, Peru); Wolf-Ernst Reif (Institut und Museum für Geologie und Paläontologie der Universität Tübingen, Germany); Fabio H. V. Hazin (Universidade Federal Rural de Pernambuco, Recife, Brazil); George Zorzi (Sacramento State University and US Air Force); R.J. McKay, Gerald Allen, J. Barry Hutchins and Nick Haigh (Western Australian Museum, Perth, Australia); Leighton R. Taylor, Jr. (Waikiki Aquarium, Honolulu, Hawaii); John C. Cordell (Woods Hole Oceanographic Institute, Massachusetts); John W. Shipman (Zoological Data Processing, Socorro, New Mexico); P.K. Talwar (Zoological Survey of India, Calcutta).

The writer's work on both versions of the Catalogue was aided by funding and other support from the Department of Fisheries of FAO and the Fisheries Agency of Japan; the US Office of Naval Research, National Science Foundation (NSF), and National Marine Fisheries Service; the UK Darwin Initiative; Argus-Mariner Consulting Scientists; the South African National Research Foundation (formerly Foundation for Research Development); the J.L.B. Smith Institute of Ichthyology, Iziko: Museums of Cape Town, South African Museum); Tiburon Center for Environmental Studies, San Francisco State University; CIAC (Cephalopod International Advisory Council); and the Australian Division of Fisheries, Commonwealth Scientific and Industrial Research Organization (CSIRO).

## Table of Contents

	Page
<b>1. INTRODUCTION</b> .....	1
1.1 Plan of the Catalogue .....	2
1.2 Technical Terms and Measurements .....	7
1.2.1 Picture Guide to External Terminology of Sharks .....	7
1.2.2 Picture Guide to Skeletal Terminology of Sharks .....	9
1.2.3 Measurements Used for Sharks .....	11
1.2.4 Glossary of Technical Terms .....	15
<b>2. SYSTEMATIC CATALOGUE</b> .....	31
2.1 Order HETERODONTIFORMES - Bullhead sharks .....	31
2.1.1 Family HETERODONTIDAE .....	33
<i>Heterodontus</i> .....	34
<i>Heterodontus francisci</i> .....	36
<i>Heterodontus galeatus</i> .....	38
<i>Heterodontus japonicus</i> .....	39
<i>Heterodontus mexicanus</i> .....	41
<i>Heterodontus portusjacksoni</i> .....	42
<i>Heterodontus quoyi</i> .....	45
<i>Heterodontus ramalheira</i> .....	46
<i>Heterodontus zebra</i> .....	48
<i>Heterodontus sp. A</i> .....	49
2.2 Order LAMNIFORMES - Mackerel sharks .....	51
2.2.1 Family ODONTASPIDIDAE .....	55
<i>Carcharias</i> .....	57
<i>Carcharias taurus</i> .....	58
<i>Odontaspis</i> .....	63
<i>Odontaspis ferox</i> .....	64
<i>Odontaspis noronhai</i> .....	66
2.2.2 Family MITSUKURINIDAE .....	68
<i>Mitsukurina</i> .....	69
<i>Mitsukurina owstoni</i> .....	69
2.2.3 Family PSEUDOCARCHARIIDAE .....	71
<i>Pseudocarcharias</i> .....	72
<i>Pseudocarcharias kamoharai</i> .....	72
2.2.4 Family MEGACHASMIDAE .....	74
<i>Megachasma</i> .....	75
<i>Megachasma pelagios</i> .....	75
2.2.5 Family ALOPIIDAE .....	78
<i>Alopias</i> .....	80
<i>Alopias pelagicus</i> .....	81
<i>Alopias superciliosus</i> .....	83
<i>Alopias vulpinus</i> .....	86
2.2.6 Family CETORHINIDAE .....	88
<i>Cetorhinus</i> .....	90
<i>Cetorhinus maximus</i> .....	91

	Page
2.2.7 Family LAMNIDAE .....	96
<i>Carcharodon</i> .....	98
<i>Carcharodon carcharias</i> .....	100
<i>Isurus</i> .....	108
<i>Isurus oxyrinchus</i> .....	109
<i>Isurus paucus</i> .....	115
<i>Lamna</i> .....	117
<i>Lamna ditropis</i> .....	119
<i>Lamna nasus</i> .....	121
2.3 Order ORECTOLOBIFORMES - Carpet sharks .....	126
2.3.1 Family PARASCYLLIIDAE .....	130
<i>Cirrhoscyllium</i> .....	132
<i>Cirrhoscyllium exolitum</i> .....	133
<i>Cirrhoscyllium formosanum</i> .....	134
<i>Cirrhoscyllium japonicum</i> .....	135
<i>Parascyllum</i> .....	136
<i>Parascyllum collare</i> .....	137
<i>Parascyllum ferrugineum</i> .....	138
<i>Parascyllum variolatum</i> .....	140
<i>Parascyllum sp. A</i> .....	141
2.3.2 Family BRACHAELURIDAE .....	142
<i>Brachaelurus</i> .....	144
<i>Brachaelurus waddi</i> .....	145
<i>Heteroscyllium</i> .....	146
<i>Heteroscyllium colcloughi</i> .....	147
2.3.3 Family ORECTOLOBIDAE .....	148
<i>Eucrossorhinus</i> .....	150
<i>Eucrossorhinus dasypogon</i> .....	151
<i>Orectolobus</i> .....	152
<i>Orectolobus japonicus</i> .....	154
<i>Orectolobus maculatus</i> .....	155
<i>Orectolobus ornatus</i> .....	158
<i>Orectolobus wardi</i> .....	159
<i>Orectolobus sp. A</i> .....	161
<i>Sutorectus</i> .....	162
<i>Sutorectus tentaculatus</i> .....	162
2.3.4 Family HEMISCYLLIIDAE .....	164
<i>Chiloscyllium</i> .....	165
<i>Chiloscyllium arabicum</i> .....	167
<i>Chiloscyllium burmensis</i> .....	168
<i>Chiloscyllium griseum</i> .....	169
<i>Chiloscyllium hasselti</i> .....	171
<i>Chiloscyllium indicum</i> .....	172
<i>Chiloscyllium plagiosum</i> .....	173
<i>Chiloscyllium punctatum</i> .....	175
<i>Hemiscyllium</i> .....	177
<i>Hemiscyllium freycineti</i> .....	179
<i>Hemiscyllium hallstromi</i> .....	180
<i>Hemiscyllium ocellatum</i> .....	181
<i>Hemiscyllium strahani</i> .....	182
<i>Hemiscyllium trispeculare</i> .....	183



	<b>Page</b>
2.3.5 Family STEGOSTOMATIDAE .....	184
<i>Stegostoma</i> .....	185
<i>Stegostoma fasciatum</i> .....	186
2.3.6 Family GINGLYMOSTOMATIDAE .....	188
<i>Ginglymostoma</i> .....	191
<i>Ginglymostoma cirratum</i> .....	192
<i>Nebrius</i> .....	195
<i>Nebrius ferrugineus</i> .....	196
<i>Pseudoginglymostoma</i> .....	199
<i>Pseudoginglymostoma brevicaudatum</i> .....	200
2.3.7 Family RHINCODONTIDAE .....	201
<i>Rhincodon</i> .....	202
<i>Rhincodon typus</i> .....	203
<b>3. LIST OF SPECIES BY MAJOR FISHING AREAS</b> .....	<b>210</b>
<b>4. APPENDIX</b> .....	<b>211</b>
4.1 Keeping Sharks for Scientific Study .....	211
4.1.1 Generalities About Shark Collections .....	211
4.1.2 Practical Advice for Creating Shark Collections .....	212
<b>5. BIBLIOGRAPHY</b> .....	<b>215</b>
<b>6. INDEX OF SCIENTIFIC AND VERNACULAR NAMES</b> .....	<b>249</b>