Trawled Fishes of Southern Indonesia and Northwestern Australia

Thomas Gloerfelt-Tarp
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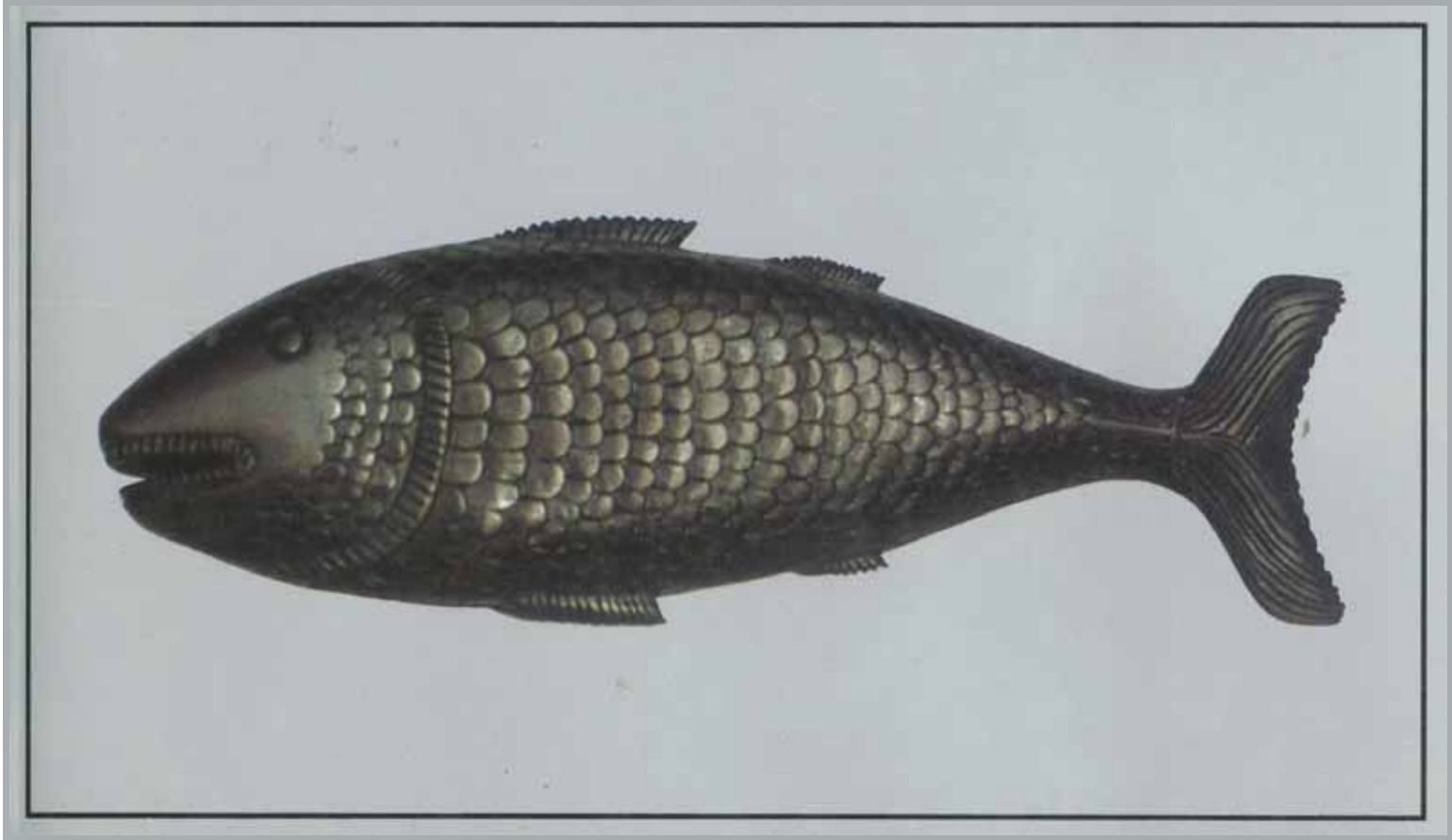

TRAWLED FISHES OF SOUTHERN INDONESIA AND NORTHWESTERN AUSTRALIA

Thomas Gloerfelt-Tarp
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This edition has been prepared for online access by: P.J. Kailola and T. Gloerfelt-Tarp

Original text prepared by P.J. Kailola and T. Gloerfelt-Tarp.
Original photography and art-work by T. Gloerfelt-Tarp and P.J. Kailola.
Edited and prepared for publication by P.J. Kailola and T. Gloerfelt-Tarp.

Updated 2022.

The taxonomic work was finished end of June 2022.

Trawled Fishes of southern Indonesia and northwestern Australia.

Bibliography, checklist, index.

First published in hard-cover 1984 by:

The Australian Development Assistance Bureau (ADAB), Australia
The Directorate General of Fisheries (DGF), Indonesia
The German Agency for Technical Cooperation (GTZ), Federal Republic of Germany

with ISBN 9780642700018

The authors have made every effort to ensure that the information presented in this online version of the original book is correct as of the date of making it available online (June 2022). For any correction or omissions, please contact the authors.

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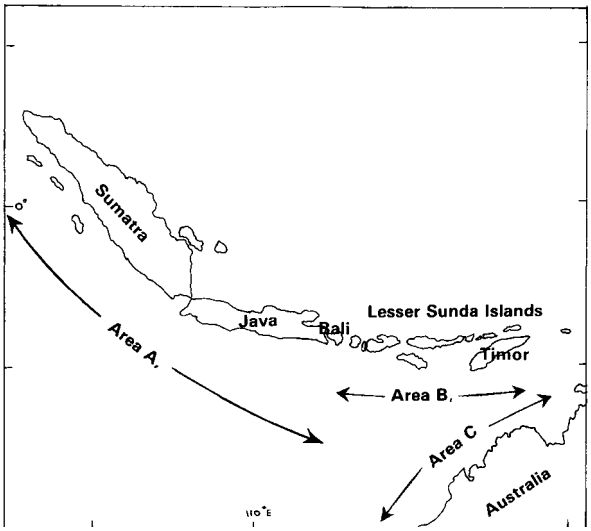
CONTENT

INTRODUCTION

With logistical support from the Food and Agricultural Organization of the United Nations, (FAO) an agreement was signed in 1979 by representatives from the governments of the Republic of Indonesia, the Federal Republic of Germany and Australia.

The purpose of this agreement was to establish a joint fishery project to assess the demersal fish stocks of southern Indonesia and northwestern Australia as a step towards their future utilization. JETINDOFISH was adopted as the acronym for the project - Joint Eastern Tropical Indian Ocean Fishery Survey.

The following agencies provided the necessary staff and research vessels:
The Directorate General of Fisheries (DGF) covered Area B from Bali to Timor
The German Agency for International Cooperation (GIZ) covered Area A from Bali to north Sumatra
The Commonwealth Scientific and Industrial Organisation (CSIRO) covered Area C from the Northwest Cape to the Timor Sea.



Because correct identification of the many species caught was essential to the objective of the project, CSIRO and GIZ respectively recruited taxonomists Dr Patricia Kailola from Australia and Dr Peter Whitehead from the British Museum of Natural History to assist the survey staff. At that time there were very few fish identification guides available for the project area so extensive work went into photographing, collecting, and engaging other international ichthyologists in order to correctly identify the species.

The amount of collected data eventually justified the publication of a field guide covering all of the caught species from the three areas. It was to be a field guide with short descriptions and photographs or drawings showing the fish as they appear when landed on the deck or sold in local markets, and so the illustrations are not the more aesthetically and perfect images of the same species observed when snorkeling or diving. Even so, the final product turned out to be more like a coffee table volume due to its comprehensive content and while it has been used extensively as a valued reference for that region, it is fair to say that the book did not become the hoped-for practical field guide.

As many species were still undescribed at the time of publication in 1984 and quite some were also mis-identified coupled with some recent major taxonomic revisions of many families, we decided to make an update of this book.

The Survey collected a total of 165 different families of bony fishes represented in 1,116 different species, of which 1,047 are figured in the main book and 69 are diagnosed in the Species List. In addition, the Survey also collected 69 different sharks and 52 different rays. Many of the species collected on the Survey were described as new so among the bony fishes, 19 are Holotypes and 32 are Paratypes.

Correct identification of species has never been more important for proper fisheries management and in the project area rapid population growth has placed even more pressure on the fish stocks with corresponding threats to livelihoods.

We hope that by putting this update as an online version field-workers will be able to make better use of this publication by merely printing the relevant pages for their particular tasks.

It is, however, also our wish that the publication will continue to be a cited reference in a region with one of the highest marine biodiversities in the world and where marine products continues to be dominant for food security.

An online version is also easier to correct when mistakes are identified and we shall welcome any inputs from ichthyologists and interested parties where corrections are needed.

Thank you. We trust you will find this online version useful for your different interests.

ACKNOWLEDGEMENTS

We thank in particular:

Dr. William T. White, Senior Curator of the Australian National Fish Collection, CSIRO, for his thorough review of the shark and ray families.

Ms. Emanuela D'Antoni, Scientific Illustrator with the Fisheries Resources Branch of the Food and Agriculture Organization of the United Nations, for her unwavering support in supplying updated and new drawings.

Ms. Rachel Atanacio (Aque) from FishBase for her incredible patience and continued support to our repeated requests for generic family drawings of all the new fish families established since the original publication, as well as providing several better colour images from our original slides.

Dr. Hiroyuki Motomura, Dr. Mizuki Matsunuma and Dr. Hidetoshi Wada provided invaluable assistance with the revision of the Scorpaeniformes.

Dr. Barry Russell, Curator Emeritus, for his thorough review and corrections of the Nemipteridae.

Dr. Seishi Kimura, Professor Emeritus, for his excellent revision of the genus Carangoides and its related genera and the preparation for a diagnostic key to to the species of these genera.

Alastair Graham and John Pogonoski from CSIRO in Hobart were always approachable and provided timely support.

We are very grateful to the following collection managers and associates for providing continued assistance to the completion of this update

Dianne Bray – Victoria Museum, Melbourne
Willem Coetzer – South African Institute for Aquatic Biodiversity (SAIAB) Grahamstown.
Gavin Dally – Northern Territory Museum and Art Gallery, Darwin
Ron Fricke – Staatliches Museum für Naturkunde in Stuttgart
Alastair Graham – Commonwealth Scientific and Industrial Research Organisation (CSIRO), Hobart
Ken Graham – Australian Museum, Sydney
Amanda Hay – Australian Museum, Sydney
Jeff Johnson – Queensland Museum, Brisbane
James Maclaine – British Museum Natural History, London
Mark McGrouther – Australian Museum, Sydney
Glenn Moore – Western Australian Museum, Perth
Kerryn Parkinson – Australian Museum, Sydney
John Pogonoski – Commonwealth Scientific and Industrial Research Organisation (CSIRO), Hobart
Gento Shinohara – National Museum of Nature and Science, Tsukuba
Arnold Suzumoto – Bishop Museum, Hawaii

We are indebted to the following ichthyologists who we repeatedly harassed (but nicely) in our quest for correct identification of particular specimens;

Dr William D. Anderson, Jr – Symphysanodontidae, Callanthiidae
Dianne Bray – Zeniontidae
Dr Rafael Bañón Díaz – Moridae
Dr James J. Dooley – Latilidae, Malacanthidae
Dr Tom Fraser – Apogonidae
Dr Ronald Fricke – Callionymidae, Draconettidae, Uranoscopidae
Dr Anthony Gill – Serranidae, subfamily Anthiinae
Dr Martin F. Gomon – Chlorophthalmidae, Paraulopidae, Trachichthyidae, Triglidae,
Dr Ofer Gon – Apogonidae
Dr Antony S. Harold – Sternoptychidae, Bregmacerotidae
Dr Harutaka Hata – Dussumieriidae, Engraulidae, Clupeidae, Pristigasteridae
Dr Hsuan-Ching Ho – Paralepididae, Bregmacerotidae, Chaunacidae, Ogcocephalidae
Dr Hisashi Imamura – Platycephalidae
Dr Tomio Iwamoto – Macrouridae
Dr Yukio Iwatsuki – Sparidae, Gerreidae, Priacanthidae, Lutjanidae, Lobotidae
Jeff Johnson – Albulidae, Haemulidae, Pinguipedidae
Dr Toshio Kawai – Peristediidae
Dr Seishi Kimura – Leiognathidae, Carangidae
Dr Saki Kishimoto – Plectrogeniidae, Uranoscopidae
Rudie Kuiter – Syngnathidae
Dr Helen K. Larson – Gobiidae
Dr Peter Last – Dasyatidae, Triglidae
Dr Mizuki Matsunuma – Serranidae, subfamily Serraninae, Setarchidae, Scorpaenidae
Dr John McCosker – Muraenidae
Dr Hiroyuki Motomura – Neosebastidae, Scorpaenidae, Sebastidae, Tetrarogidae, Synanceiidae, Engraulidae, Setarchidae, Apogonidae, Sphyraenidae

Dr Yuki Nagano – Hoplichthyidae
Dr Tetsuji Nakabo – Synodontidae
Dr Naohide Nakayama – Macrouridae
Dr Jørgen G. Nielsen – Ophidiidae
Dr Ted W. Pietsch – Antennariidae
Dr Artem M. Prokofiev – Acropomatidae, Uranoscopidae, Synagropidae, Malakichthyidae
Dr John E. Randall – Serranidae, subfamily Epinephelinae
Dr William Richards – Triglidae
Dr Barry C. Russell – Nemipteridae
Dr David G. Smith – Nettastomatidae
Dr Carl Struthers – Moridae, Scorpaenidae
Dr Chi-Ngai Tang – Moridae
Dr Franz Uiblein – Mullidae
Dr Hidetoshi Wada – Serranidae, subfamily Anthiinae, Setarchidae
Dr William White – Chimaeridae, Dasyatidae, Carcharhinidae

Access to the following databases were indispensable for completion of this update:

Fricke, R., Eschmeyer, W. N. & Van der Laan, R. (eds) 2022. ESCHMEYER'S CATALOG OF FISHES: GENERA, SPECIES, REFERENCES. (http://researcharchive.calacademy.org/research/ichthyology/catalog/fishcatmain.asp). Electronic version accessed 29 04 2022.

Froese, R. & D. Pauly. Editors. 2022. FishBase. World Wide Web electronic publication. www.fishbase.org, version (02/2022).

It should be noted, that responsibility for any errors or misleading information presented in this update of the original publication, rests with the authors alone.

LIST OF ILLUSTRATIONS DONATED FOR THE COMPLETION OF THIS BOOK

Dr. William D. Anderson Jr.	Etelis radiosus, Symphysanodon typus.
Dr. Takao Arai	Coelorinchus maculatus, Coelorinchus acutirostris, Coelorinchus sp. 2, Coelorinchus posteromaculatus, Coelorinchus pardus, Coelorinchus thurla, Hymenocephalus heterolepis.
Dr. Julian Badcock	Sigmops elongatus, Phollichthys mauli, Polymetme corythaela.
Dr. Peter Castle	Ariosoma anago, Bathymyrus smithi, Dysomma anguillare, Heteroconger tricia, Nettenchelys gephyra, Macrocephenchelys brevirostris, Uroconger lepturus.
C.S.I.R.O. (listed in family order as in book). These images are the copyright of CSIRO and may not be used in any form without prior consent from CSIRO.	Chimaera ogilbyi, Gymnothorax cribroris, Gymnothorax longinquus, Gymnothorax pseudothyrsoideus, Gymnothorax mccoskeri, Gymnothorax minor, Lumiconger arafura, Saurenchelys sp., Anodontostoma chacunda. Herklotsichthys koningsbergeri, Herklotsichthys lippa, Ilisha lunula, Setipinna tenuifilis, Thryssa hamiltonii, Hime diactithrix, Euristhmus lepturus, Euristhmus nudiceps, Synodus sageneus, Harpadon translucens, Saurida elongata, Batrachomoeus occidentalis, Batrachomoeus trispinosus, Halophryne diemensis, Chlorophthalmus nigromarginatus, Antennarius hispidus, Antennarius striatus, Lophiocharon trisignatus, Tathicarpus butleri, Tetrabrachium ocellatum, Halieutaea sp 1, Bregmaceros pseudolanceolatus, Bregmaceros sp cf atlanticus, Sirembo imberbis, Sirembo amaculata, Encheliophis gracilis, Monocentris japonica, Myripristis botche, Ostichthys kaianus, Sargocentron rubrum, Zeus faber, Apistops caloundra, Dendrochirus brachypterus, Dendrochirus zebra, Minous pictus, Minous roseus, Minous versicolor, Neosebastes pleurostigma, Neomerinthe amplisquamiceps, Liocranium praepositum, Scorpaenodes smithi, Scorpaenopsis neglecta, Lythrichthys dentatus, Richardsonichthys leucogaster, Gargariscus prionocephalus, Lepidotrigla cf japonica, Lepidotrigla sp.1, Lepidotrigla macracaina, Lepidotrigla venusta, Pterygotrigla (Parapterygotrigla) multiocellata, Pterygotrigla (Bovitrigla?) leptacanthus, Satyrichthys welchi, Peristedion liorhynchus, Cymbacephalus nematophthalmus, Cymbacephalus bosschei, Inegocia harrisii, Inegocia japonica, Onigocia sp., Onigocia spinosa, Platycephalus endrachtensis, Ratabulus fulviguttatus, Insidiator macracanthus, Kumococius rodericensis, Cociella hutchinsi, Hoplichthys imamurai, Dactyloptena papilio, Pegasus volitans, Eurypegasus draconis, Centrogenys vaigiensis, Chelidoperca stella, Epinephelus maculatus, Epinephelus epistictus, Epinephelus multinotatus, Epinephelus radiatus, Epinephelus rivulatus (b), Epinephelus sexfasciatus, Epinephelus stictus, Plectropomus maculatus, Selenanthias analis, Diploprion bifasciatus, Glaucosoma buergeri, Glaucosoma magnificum, Pristigenys niphonia, Jaydia carinata, Ostorhinchus hartzfeldii, Ostorhinchus sp 1., Apogonichthyoides timorensis, Jaydia poeciloptera, Ostorhinchus sp. 2, Siphamia roseigaster, Doederleinia berycoides, Sillago robusta, Sillago vittata, Sillago ingenuua, Rachycentron canadum, Ulua aurochs, Carangoides humerosus, Carangoides gymnostethus, Caranx bucculentus, Caranx lugubris, Pantolabus radiatus, Caranx sexfasciatus, Elagatis bipinnulata, Seriola rivoliana, Nuchequula glenysae, Lutjanus gibbus, Nemipterus isacanthus, Pentapodus nagasakiensis, Pentapodus porosus, Pentapodus vitta, Diagramma pictum, Hapalogenys dampieriensis, Lethrinus atkinsoni, Lethrinus nebulosus, Lethrinus laticaudis, Lethrinus miniatus, Lethrinus genivittatus, Lethrinus semicinctus, Lethrinus variegatus, Atrobucca brevis, Johnius (Johnius) laevis, Johnius (Johnieops) borneensis, Parupeneus chrysopleuron, Upeneus australiae, Upeneus sundaicus, Zabidius novemaculeatus, Chaetodon assarius, Chaetodon aureofasciatus, Roa australis, Chelmon marginalis, Chelmon muelleri, Coradion chrysozonus, Heniochus diphreutes, Parachaetodon ocellatus, Chaetodontoplus duboulayi, Chaetodontoplus personifer, Histiopterus typus, Chromis fumea, Abudefduf bengalensis, Sphyraena flavicauda, Polydactylus multiradiatus, Anampses lennardi, Bodianus solatus, Choerodon cephalotes, Choerodon monostigma, Choerodon schoenleinii, Choerodon vitta, Choerodon cauteroma, Choerodon sugillatum, Leptojulis cyanopleura, Iniistius opalus, Iniistius dea, Scarus ghobban, Parapercis alboguttata, Ryukyupercis gushikeni, Parapercis muronis, Parapercis striolata, Parapercis nebulosa, Ichthyscopus fasciatus, Ichthyscopus insperatus, Uranoscopus bicinctus, Uranoscopus cognatus, Uranoscopus sp cf oligolepis, Uranoscopus sp cf japonicus, Uranoscopus kishimotoi, Opistognathus latitabundus, Bembrops platyrhynchus, Bembrops filiferus, Xiphasia setifer, Congrogadoides spinifer, Congrogadus subducens, Bleekeria viridianguilla, Callionymus goodladi, Callionymus grossi, Callionymus australis, Callionymus moretonensis, Synchiropus altivelis, Dactylopus dactylopus, Synchiropus rameus, Acanthurus grammoptilus, Siganus fuscescens, Scomberomorus commerson, Scomberomorus munroi, Scomberomorus queenslandicus, Benthodesmus vityazi, Psenopsis humerosus, Ariomma parini, Brachypleura novaezeelandiae, Arnoglossus waitei, Asterorhombus intermedius, Crossorhombus azureus, Engyprosopon grandisquama, Engyprosopon latifrons, Engyprosopon osculus, Grammatobothus polyophthalmus, Kamoharaia megastoma,

	Laeops parviceps, Parabothus kiensis, Pseudorhombus argus, Pseudorhombus arsius, Pseudorhombus diplospilus, Pseudorhombus elevatus, Pseudorhombus jenynsii, Pseudorhombus quinquocellatus, Pseudorhombus spinosus, Pseudorhombus megalops, Psammodiscus ocellatus, Samaris cristatus, Aesopia cornuta (A) and (B), Dexillus muelleri, Zebrias cancellatus, Brachirus annularis, Zebrias craticulus, Zebrias quagga, Paraplagusia longirostris, Paraplagusia bilineata Tricanthus biaculeatus, Anacanthus barbatus, Chaetodermis penicilligerus, Eubalichthys caeruleoguttatus, Monacanthus chinensis, Pseudomonacanthus peroni, Thamnaconus striatus, Thamnaconus tesselatus, Thamnaconus hypargyreus, Lactoria cornuta, Lactoria diaphana, Arothron manillensis, Tylerius spinosissimus, Feroxodon multistriatus, Canthigaster rivulata, Chelonodontops patoca, Sphoeroides pachygaster, Torquigener pallimaculatus, Triodon macropterus, Cyclichthys hardenbergi, Tragulichthys jaculiferus.
Dr. Roger Cressey	Synodus rubromarmoratus, Synodus usitatus.
Dr. James Dooley	Malacanthus brevirostris.
FishBase	Family drawings of: Apistidae, Ophichthidae, Neosebastidae, Scorpaenidae, Setarchidae, Sebastidae, Synanceiidae, Tetrarogidae, Muraenesocidae, Congridae, Paraulopidae, Peristediidae, Bembridae, Plectrogeniidae, Centrogenyidae, Pseudochromidae, Synagropidae, Malakichthyidae, Acropomatidae.
Food and Agriculture Organization of the United Nations, Original Scientific Illustrations Archive. Reproduced with permission.	All shark drawings and some of the rays (Anoxypristis cuspidata, Narcine baliensis, Dentiraja healdi, Hypnos monopterygium, Mobula mobular, Myliobatis tobijei, Narcinops lasti, Neotrygon annotata, Pateobatis uarnacoides, Plesiobatis daviesi, Pristis clavata, Pteroplatygon violacea, Urogymnus granulatus), and most generic family drawings. Hoplobrotula armata.
Dr Ronald Fricke	Callionymus whiteheadi; all preopercular spines for the Callionymidae.
Dr Robert Gibbs, Jr	Astronesthes chrysophekadion.
Dr Antony S. Harold Reproduced with permission from Bulletin of Marine Science	Polyipnus soelae, Argyripnus pharos.
Dr Barry Hutchins	Chimaera ogilbyi, Chlorophthalmus sp 1 albatrossis, Velifer sp., Erosa erosa, Scorpaenopsis neglecta, Setarches guentheri, Rogadius patriciae, Cephalopolis boenak, Epinephelus amblycephalus, Ozichthys albimaculosus, Apogonichthyoides brevicaudatus, Ostorhinchus septemstriatus, Malakichthys griseus, Synagrops japonicus, Branchiostegus sawakinensis, Echeneis naucrates, Carangoides equula, Pterocaesio chrysozona, Etelis carbunculus, Lutjanus carponotatus, Plectorhinchus gibbosus, Protonibea diacanthus, Neoepinnula orientalis, Cantherhines pardalis, Arotrolepis filicauda, Paramonacanthus oblongus, Pseudomonacanthus elongatus, Thamnaconus modestoides, Xanthichthys lineopunctatus.
Mr Rudie H. Kuiter	Hippocanpus spinosissimus, Hippocampus angustus.
Dr Tony Lewis	Tail patterns of Platycephalus species.
Dr R.J. Mckay	Swim bladders of Sillaginidae.
Mr John Marek	Lutjanus boutton, Selar boops, Upeneus luzonius.
Dr Glenn Moore	Maurolicus javanicus.
Dr Alfred Post	All Paralepididae drawings.
Dr. Jack Randall	Scorpaenodes evides.
Dr Barry Russell	Nemipterus thosaporni, Scolopsis bilineata.
Dr Matthias Stehmann	Tetronarce nobiliana.
Dr David Woodland	Siganus argenteus.
Dr. William White	Aetomylaeus caeruleofasciatus, Aptychotrema timorensis, Aptychotrema vincentiana, Dentiraja falloarga, Irolita westraliensis, Neotrygon australie, Pastinachus ater, Rhinobatos sainsburyi, Rhynchobatus palpebratus, Urolophus westraliensis.

GLOSSARY

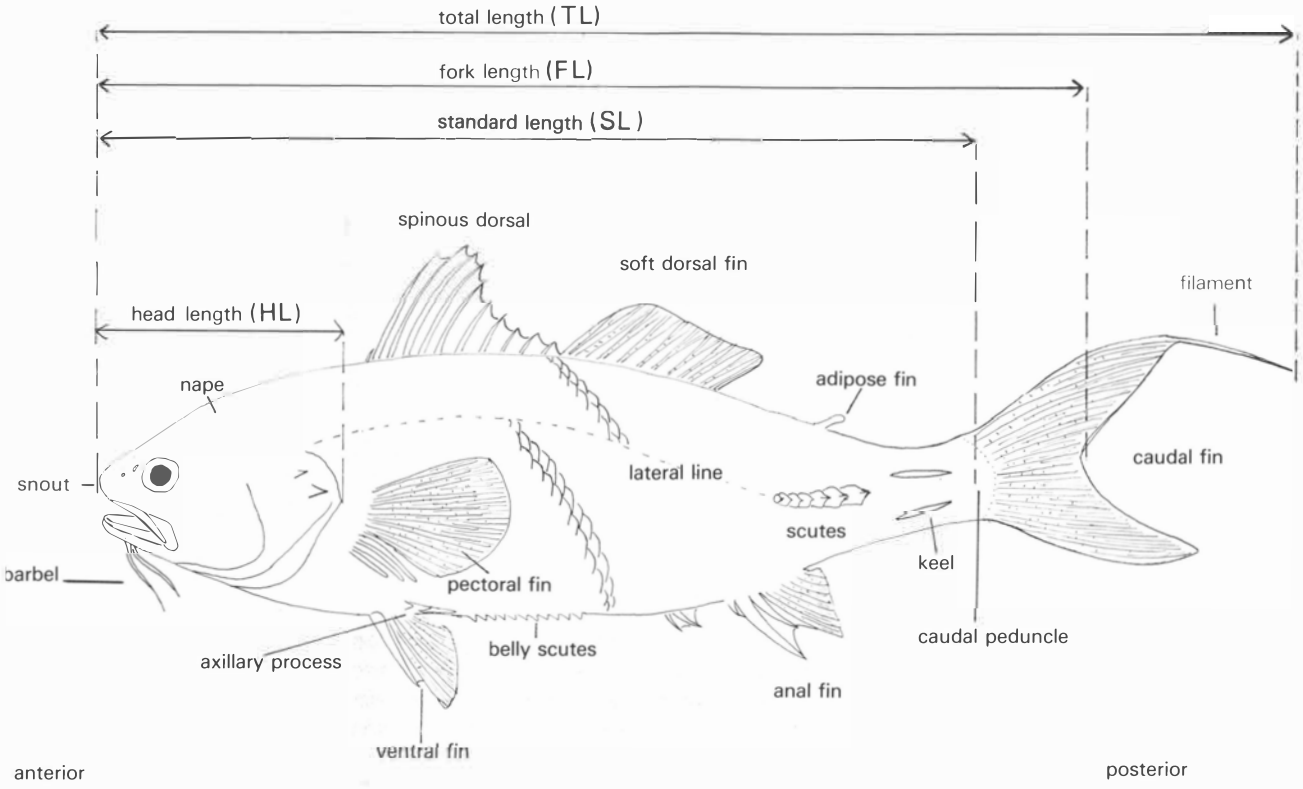
accessory lateral line: additional lateral line.
acute: sharp or pointed.
adipose eyelid (tissue): fatty transparent tissue around eye.
adipose fin: small fleshy fin without supporting spine or ray.
anal fin: fin behind the anus.
angular: not evenly curved; forming a distinct angle.
anterior: the front part.
antrorse: forward pointing.
apex: the tip; pointed end.
axil: innermost part between paired fins and body.
axillary scale: scale in the pectoral or ventral axil.
barbel: elongate fleshy tentacle on chin or front of upper jaw.
branched rays: rays that are forked distally.
branchiostegal rays: structures supporting the gill membrane behind the lower jaws.
bucklers: external bony or horny plates.
canine teeth: strong sharp teeth, like those of dogs (see plate 3).
caudal peduncle: the part of the body behind the dorsal and anal fins and before the caudal fin (usually the least depth of a fish).
caudal pit: a small groove or depression on the caudal peduncle.
chin: the anterior part below the lower jaws.
cirri: small, thin flaps of skin.
claspers: modified portions of the ventral fins in male sharks, rays and chimaeras, used in sperm transfer.
cleithrum: shoulder girdle.
compressed: laterally flattened (see plate 3)
concave: inwardly curved.
conical teeth: teeth shaped like a cone (see plate 3).
conspecific: individuals of populations of the same species.
convex: outwardly curved.
corselet: a band of specialised scales on the pectoral region of tunas.
cusp: main point of a tooth.
ctenoid scale: scale which has the exposed margin with tooth-like projections (see plate 3).
cycloid scale: scale with smooth exposed margin (see plate 3).
dorsal: the back or upper part of the body.
element: a ray or a spine of a fin
elevated: higher.
elongate: long, extended, drawn out.
emarginate: concave, inwardly curved.
embedded: term used when scales are completely covered by skin.
encased: completely surrounded by hard plates.
erectile: capable of being raised or erected.
filament: a thread-like process.
finlet: small rayed fin structure behind dorsal and anal fins.
forked: term to describe the shape of the caudal fin which is inwardly angular (see plate 2).
fossa: opening in a bone.
fusiform: cigar-shaped, rounded, broadest in the middle and tapering at each end.
genus (genera): a group of related species.
gill arch: the bony support for the gill filament and gill rakers (see plate 3).
gill membrane: membrane along the ventral and posterior margin of the operculum; it is supported by the branchiostegal rays.
gill opening: the opening on the head covered by the operculum, through which the water used for respiration is expelled.
gillraker: bony projections on anterior edge of the gill arch (see plate 3).
gular plate: situated behind the lower jaws and behind chin.
humeral: shoulder region.
illicium: the "fishing rod" and "bait" used by certain fishes to attract their prey.
incisiform teeth: flattened teeth with sharp edges, like the front teeth of man (see plate 3).
indented: refers to a structure with a small notch in the middle.
inferior: lower; term often relating to mouth (see plate 3).
interorbital: the region on top of the head between the eyes.
intestine: long tube of the digestive tract behind the stomach.
iridescent: display of brilliant reflecting colours.
isthmus: throat region of a fish situated ventrally from the breast and forward.
jugular: related to the throat.
keel: sharp or strong ridge; on ventral midline (CLUPEIDAE) or on caudal peduncle.
labial furrow: grooves around the lips (sharks).
lanceolate: broad at base, tapering to a point.
lateral line: series of openings to sensory canals along the sides.

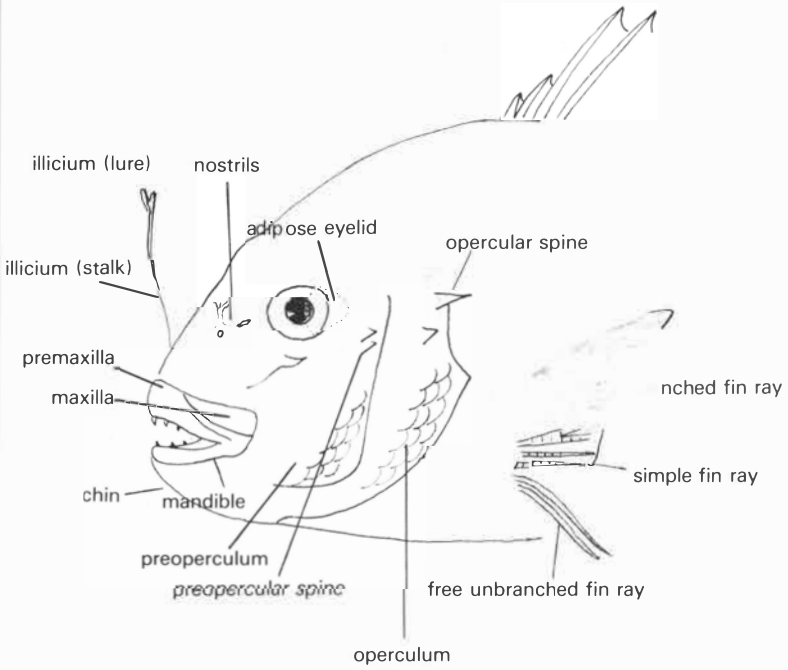
luminous organs: light producing organs.
lunate: term to describe a caudal fin which is deeply emarginate with narrow lobes (see plate 3).
mandible: lower jaw.
maxilla: lateral part of upper jaw.
molar teeth: rounded, low and broad teeth for crushing (see plate 3).
nape: dorsal part immediately behind the head.
nostril: the nasal opening.
notch: refers to structures, especially fins, which have a "dip" in the middle.
nuchal: upper dorsal part of head, nape.
operculum: bony gill cover; consist of four bones: opercle, preopercle, interopercle and subopercle.
orbit: refers to the eye.
palatines: a paired lateral bone in the roof of mouth, with or without teeth (see plate 3).
papilla: a small fleshy extension.
pectoral: the region of the side of the fish behind the gill opening.
pelvic: see ventral.
photophore: specialised light organ.
postorbital: region behind the eye.
posterior: the tail end.
premaxilla: the more anterior bone forming the upper jaw; it is this part which can be protruded by many fishes.
preoperculum: the bone which forms the posterior and lower margins of the cheek region (see plate 1).
procurrent rays: small rays that are divided into halves, but are unbranched and unsegmented.
produced: drawn out to a point; lengthened.
protractile: capable of being extended outwards.
protrusible: having mouth which can be extended forward.
pseudobranchial filaments: situated on the half gill arch which is located inside the operculum.
ray: segmented and usually branched rod that supports the fin membrane.
scaly sheath: scaled area covering part or all of a fin.
scute: an external bony plate or enlarged scale, often with a posteriory pointed spine (see plate 3).
serrate: saw-like.
sexual dimorphism: difference of physical form between male and female.
snout: the region of the head in front of the eyes.
soft rays: segmented rays, flexible and often branched.
spine: an unsegmented bony process consisting of a single element, often sharp and pointed.
spiracle: an opening between the eye and the first gill slit of sharks and rays.
standard length: the length of a fish from front of upper lip to the posterior end of the vertebral column.
supramaxilla: a small additional bone lying along the upper edge of the maxilla.
symphysis: a "link", usually immovable between two bones (e.g. the anterior junction between the lower jaws).
synonym: a term referring to the existence of invalid different scientific names for the same species.
temporal region: area behind and above eye.
truncate: term to describe a caudal fin with a straight vertical hind border (see plate 2).
uniserial: arranged in a single row.
venomous: toxic.
ventral fin: paired fins situated near the ventral midline (absent in some fishes).
villiform teeth: small slender teeth forming a band (see plate 3).
vomer: the unpaired bone at front in the roof of mouth; different-shaped and the anterior part often with teeth (see plate 3).

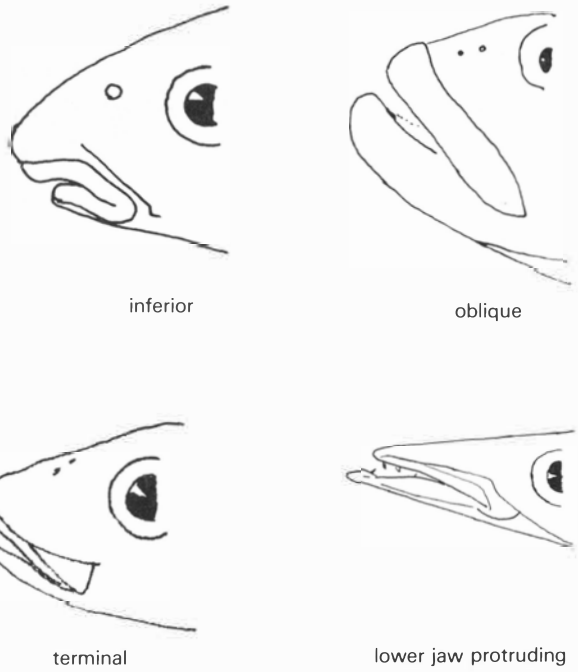
ABBREVIATIONS USED IN TEXT.

A (followed by a number - roman and/or arabic): number of spines and/or rays in the anal fin.
D (followed by a number - roman and/or arabic): number of spines and/or rays in the dorsal fin.
D_1 (followed by a number): number of spines in the first dorsal fin.
D_2 (followed by a number): number of rays in the second dorsal fin.
P: pectoral fin.
V: ventral fin (often called pelvic fin).
SL: standard length
TL: total length
FL: fork length
i: unsegmented rays in the ventral fin.
GR.: gill rakers.
L. lat.: lateral line.
Tr (followed by a number): number of horizontal scale rows between the back and the ventral midline and is usually counted in two parts.
Tr above: number of scales from dorsal mid-line to the lateral line.
Tr below: number of scales from the lateral line to the ventral mid-line.

Plate 1

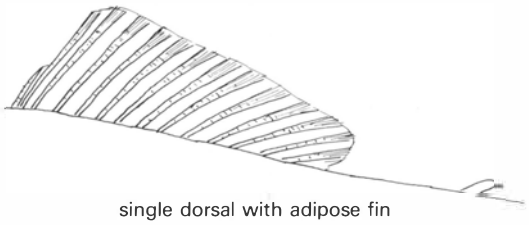






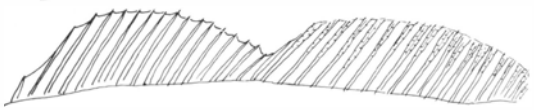
Mouth position

Plate 2

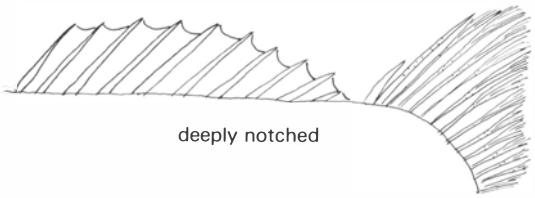


single dorsal with adipose fin

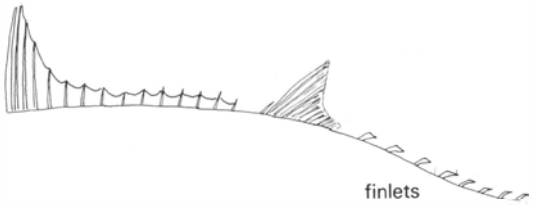
two dorsal



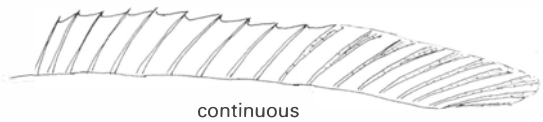
notched



deeply notched

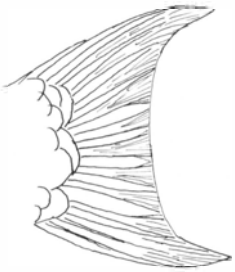


finlets

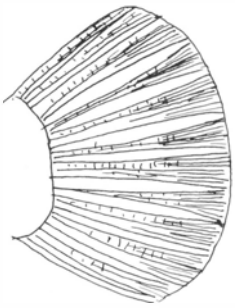


continuous

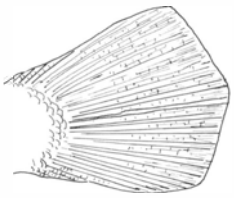
Types of dorsal fins



lunate

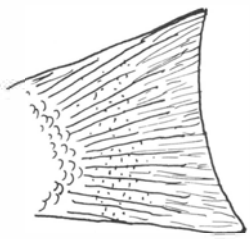


rounded



rhomboid

forked

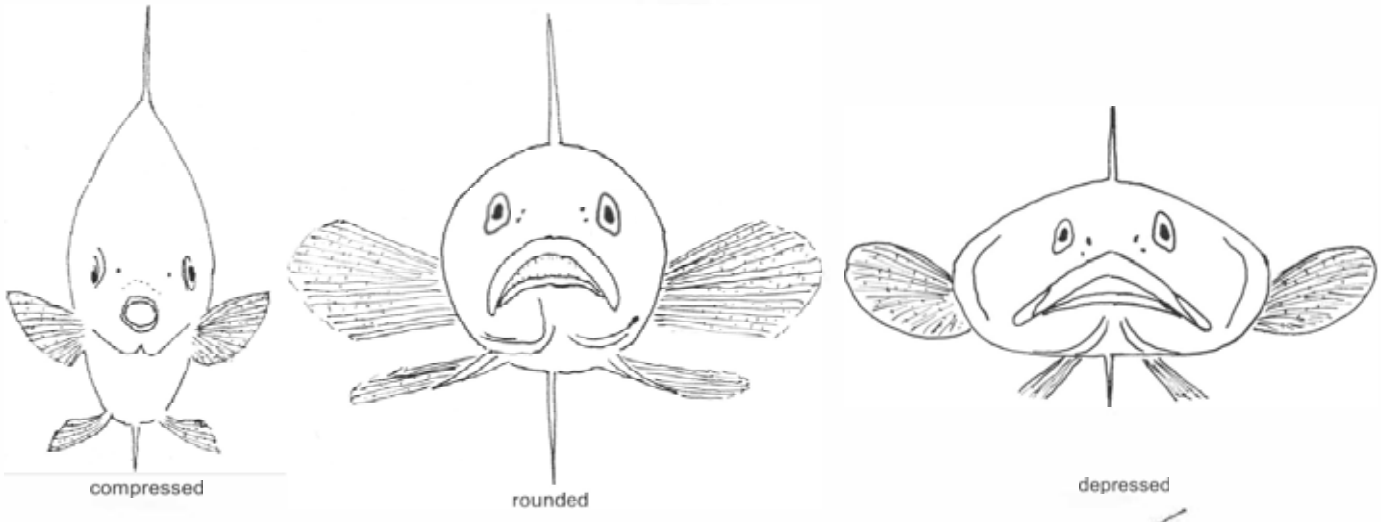


emarginate

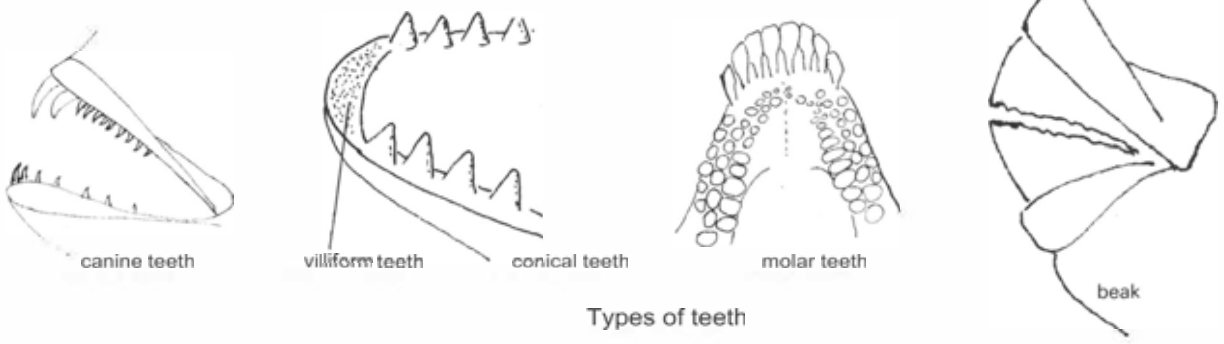
truncate

Types of caudal fins

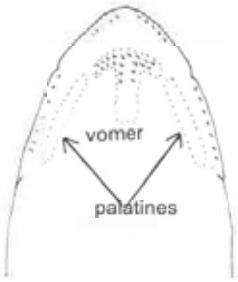
Plate 3

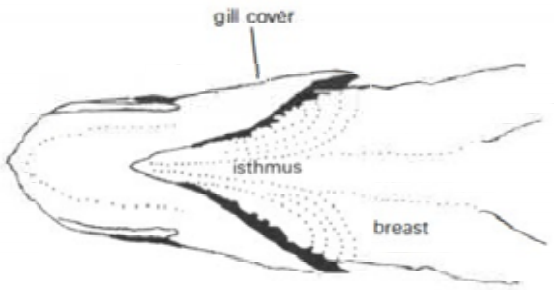


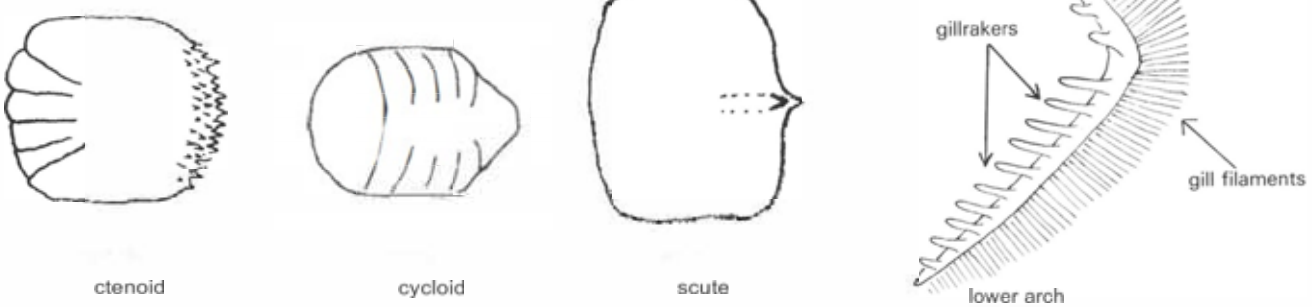
Types of body shapes



Types of teeth







ctenoid cycloid scute

SHARKS

REFERENCES: Last & Stevens, 2009; Last, White, de Carvalho, Séret, Stehmann,& Naylor, (eds.) 2016; White, Last, Stevens, Yearsley, Fahmi & Dharmadi 2006; Ebert, Fowler & Compagno, 2013.

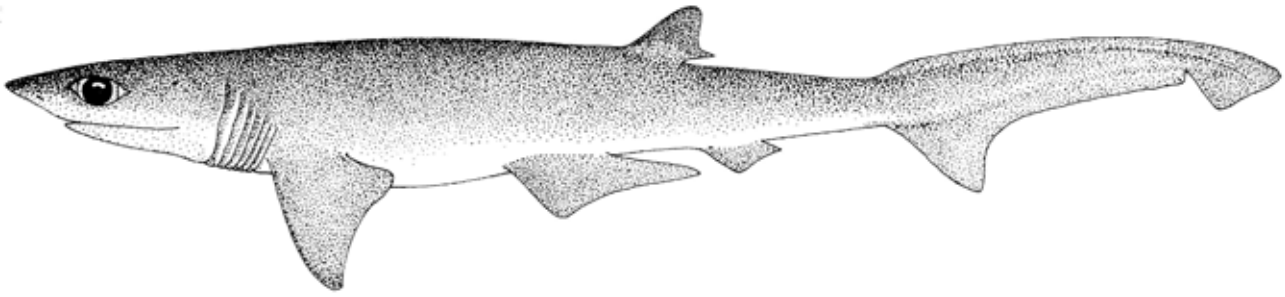
HEXANCHIDAE

Cow Sharks

Small to rather large sharks (mature at 140-480 cm) found in all oceans, mostly in fairly deep water, but also close inshore and near surface. Body cylindrical or fairly slender in some species. Mouth ventral, teeth quite different in the two jaws; those of the upper jaw with a single conical cusp, preceded and/or followed by an increasing number of minor cusps in the teeth around the side of the jaw; teeth lower jaw broad, saw-like or comb-like with a series of about 10 cusps usually decreasing in size. Six or seven gill slits, the lower ends of the first pair not meeting under head. Dorsal fin far back on body; anal fin short, below or just behind dorsal fin; caudal fin with a strong subterminal notch.

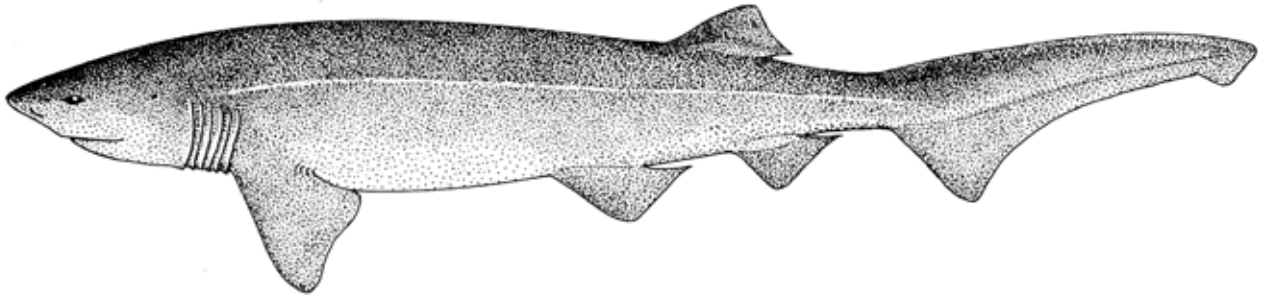
No distinctive colouration. Cow Sharks are oviviparous, i.e. give birth to fully-formed young, which have not been nourished by a placenta.

Three genera (*Hexanchus* with 6 gill slits, and *Heptranchias* and *Notorynchus* with 7 gill slits), with five species recognised, of which three are recorded here.



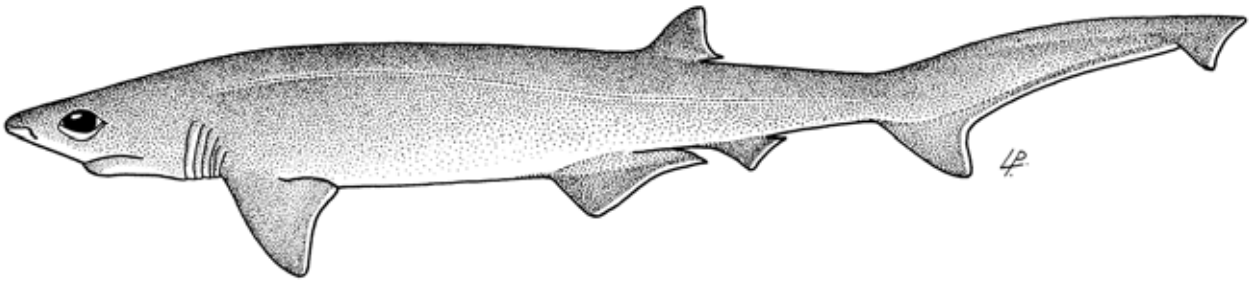
Heptranchias perlo (Bonnaterre, 1788)

Head and snout narrow, pointed; eyes very large; lower jaw with 5 rows of large comb-like teeth on each side, one cusp much large than those that precede or follow it. Dorsal fin much farther from beginning of caudal fin than its own base length. A small species, reaching only 140 cm TL.



Hexanchus griseus (Bonnaterre, 1788)

Snout short, blunt and broad; lower jaw with 6 rows of large comb-like teeth on each side; 6 gill slits. Dorsal fin about as far from beginning of caudal fin as its own base length. A large species, reaching 470 cm TL; mostly found in deep water, but comes to surface.



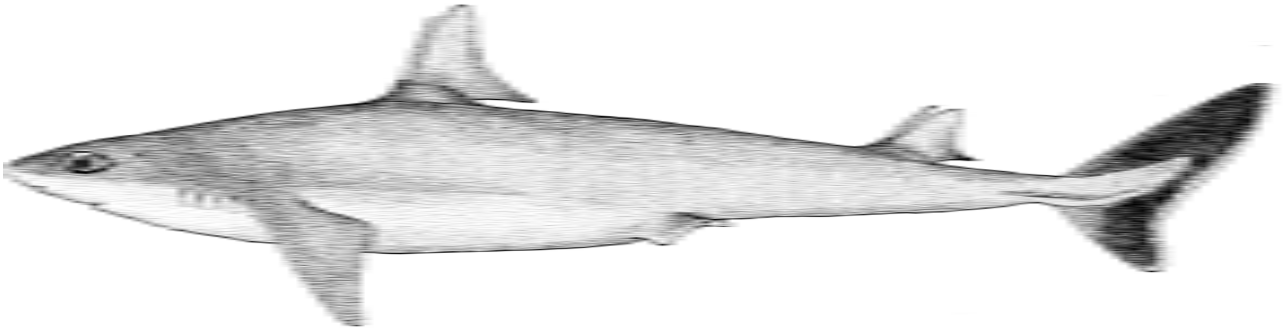
Hexanchus nakamurai Teng, 1962

Snout longer and more pointed; lower jaw with 5 rows of large comb-like teeth on each side; 6 gill slits. Dorsal fin much farther from beginning of caudal fin than its own base length. A small species, reaching only 180 cm TL; found at 90-600 m, but comes to surface.

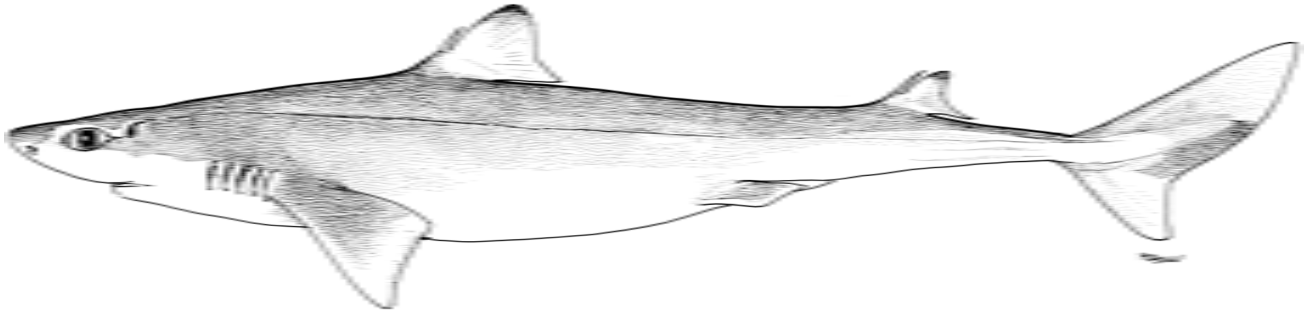
SQUALIDAE

Dogfish sharks

Small moderately large sharks (some to about 200 cm), mostly of deeper waters (50 m or more) in tropical seas. Body somewhat cylindrical with at most inconspicuous ridges between pectoral and ventral fins. Snout variable (short and blunt to long and pointed); mouth ventral, teeth similar or dissimilar in upper and lower jaws, blade-like in most, with a single oblique cusp, but with smaller cusplets on either side of main cusp in some. Five gill slits, none over pectoral fins. Two dorsal fins, some with and some without a spine in front, the first dorsal fin sometimes far back on body and smaller than second; no anal fin; caudal fin variable, form strongly asymmetrical to nearly symmetrical, the lower lobe strong to virtually absent. No distinctive colouration; deep-water species dark grey to black; light organs present in some. Dogfish sharks are viviparous with yolk-sac dependency. 41 species globally.



Squalus altipinnis Last, White & Stevens, 2007
Snout rather pointed. Teeth similar in jaws, small, compressed, with a single oblique cusp. Dorsal fin spines prominent and strong, reaching to apex or above of each fin, without grooves, second dorsal fin a little smaller than first. A low keel on each side of caudal peduncle. Pectoral fins with posterior end nearly straight.

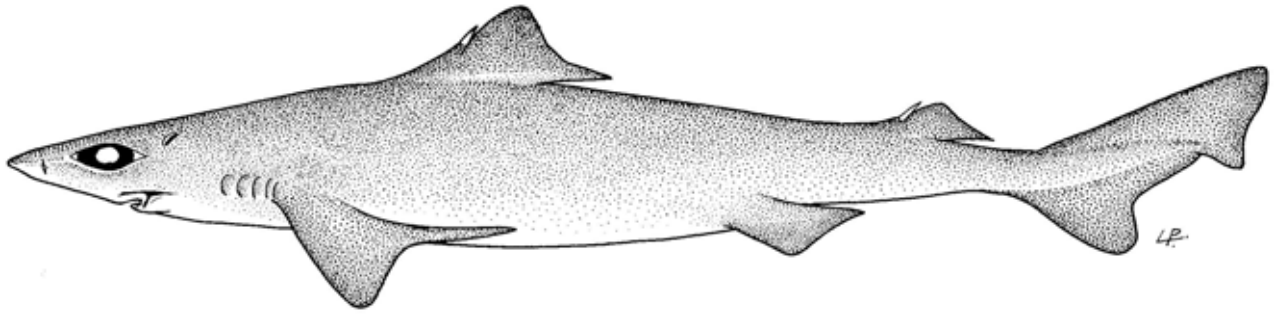


Squalus montalbani Whitley, 1931
Snout pointed and slightly larger than mouth width. Eye large. First dorsal spine does not reach apex. Pectoral fins rather broad, their inner corners usually acutely pointed and their posterior margins deeply concave.

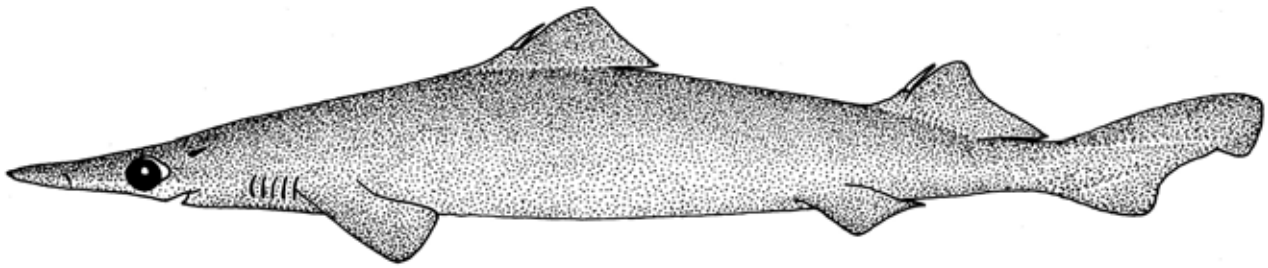
CENTROPHORIDAE

Gulper Sharks -

Gulper sharks comprise two genera and about 17 species of deepwater, bottom-dwelling sharks that are 0.9–1.7 m long at maturity. They are distinguished from related families in being cylindrical in cross-section, having two dorsal fins (the first of which originates well in advance of the ventral fins) that are preceded by grooved spines, and lacking both an anal fin and a saw-like snout. They have large green or yellowish eyes, blade-like teeth (with those in the lower jaw larger than those in the upper jaw), large spiracles, variable denticle sizes and shapes, and have a subterminal notch on the caudal fin. All species are viviparous (aplacental) and are reported to have litters of 1–12.



Centrophorus moluccensis Bleeker, 1860
Snout fairly long and pointed. Teeth in jaws dissimilar, upper teeth relatively broad and low-cusped, lower teeth low and wide. Dorsal fin spines prominent and strong, the first over or just behind inner margin of pectoral fin, the second dorsal fin distinctly smaller than first; inner corners of pectoral fins angular and elongated.

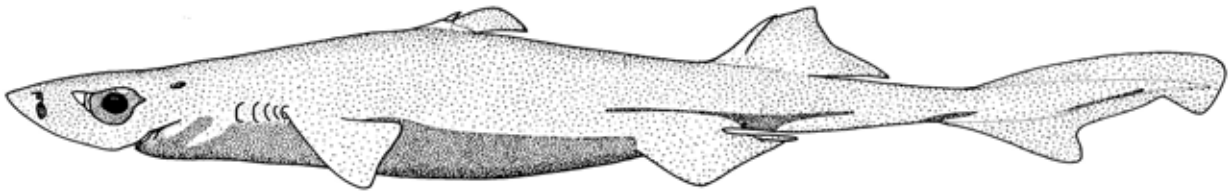


Deania quadrispinosa (McCulloch, 1915)
Snout long and pointed. Teeth in jaws dissimilar, upper teeth erect, without cusplets on either side of main cusp, lower teeth larger, broader, with an oblique blade-like cusp. Dorsal fin spines prominent, second dorsal fin about same size as first; inner corners of pectoral fin rounded; a low keel behind ventral fins along lower part of caudal peduncle.

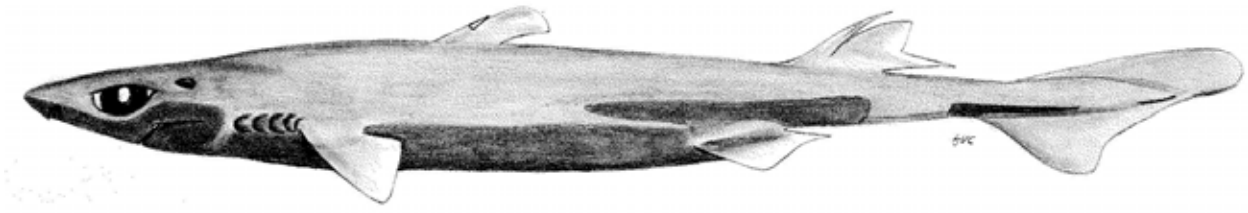
ETMOPTERIDAE

Lantern sharks -

Lantern sharks are very small to moderate-sized sharks (0.2–1 m long at maturity) that include the smallest known species of sharks. They are distinguished from related families in being cylindrical in cross-section, lacking both an anal fin and a saw-like snout, and having light organs and two dorsal fins (the first of which originates in advance of the pelvic fins), preceded by spines. They have single or multicuspid teeth of varied shapes that may be the same or different in each jaw, large spiracles, variable denticle sizes and shapes, and they have a sub-terminal notch on the caudal fin. There are five genera and more than 40 species worldwide. All are viviparous (aplacental) and are reported to have litters of 3–20.



Etmopterus lucifer Jordan & Snyder, 1902
Snout rather rounded. Teeth in jaws dissimilar, upper teeth erect, with one or more cusplets on either side of main cusp, lower teeth larger, broader, with oblique blade-like cusp. Dorsal fin spines prominent, second dorsal fin noticably larger than first. Denticles on sides of body with cusps.



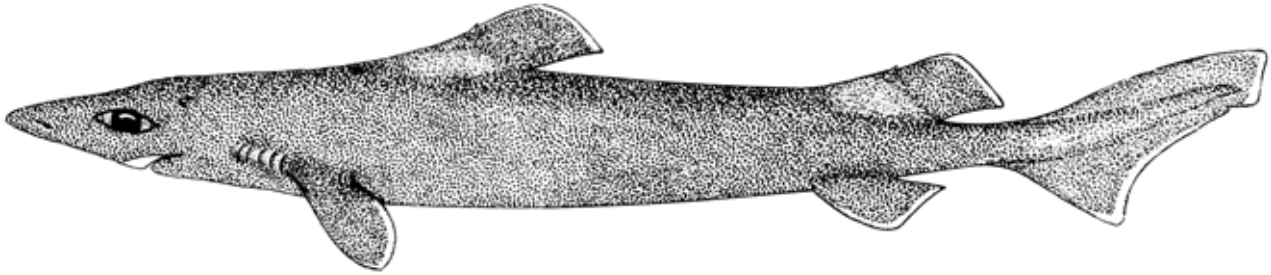
Etmopterus pusillus (Lowe, 1839)
Similar to *E. lucifer*, but denticles on sides of body without cusps.

SOMNIOSIDAE

Sleeper Sharks

Sleeper sharks are small to very large sharks (0.7–6 m in adult length). They are distinguished from related families in being cylindrical in cross-section, lacking an anal fin and a saw-like snout, and having two dorsal fins (the first of which originates in advance of the pelvic fins), usually preceded by small spines. They have small dagger-like unicuspid upper teeth, larger blade-like lower teeth, large spiracles, denticles of variable size and shape, and have a subterminal notch on the caudal fin. The labial furrows, which vary from short to long (and almost connected), can be useful in distinguishing between species.

There are seven genera and 18 species. All are viviparous (aplacental) and are reported to have litters of 4–59 young.



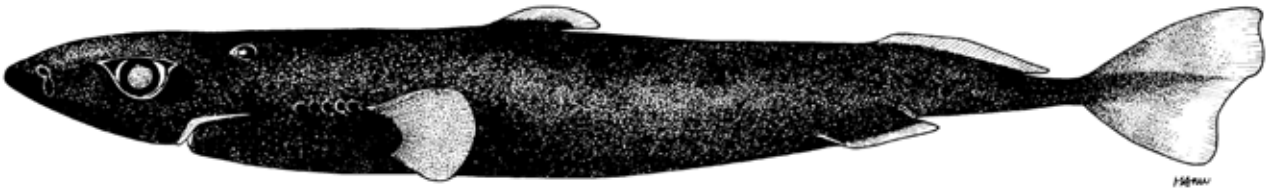
Centroselachus crepidater (Berbosa du Bocage & de Brito Capello, 1864)
Snout long and rather pointed. Teeth in jaws dissimilar, upper teeth erect, with single cusp, lower teeth larger, broader, with an oblique blade-like cusp. Dorsal fin spines very small, the first over pectoral fin tips, the second dorsal fin about same size as first; inner corners of pectoral fins rounded.

DALATIIDAE

Kitefin sharks -

Kitefin sharks are very small to medium-sized (0.2–1.6 m long as adults) deepwater sharks. They are distinguished from related families in being cylindrical in cross-section, lacking an anal fin and a saw-like snout, and having two spineless (except *Squaliolus*) dorsal fins (the first of which originates in advance of the pelvic fins). They have conical-shaped heads, small, dagger-like upper teeth and large, blade-like lower teeth, large spiracles, variable denticle sizes and shapes, and a subterminal notch on the caudal fin.
Viviparous (aplacental) with up to 16 pups in a litter; some species are ectoparasitic on large fishes and cetaceans.

About seven genera and 10 species occur worldwide.

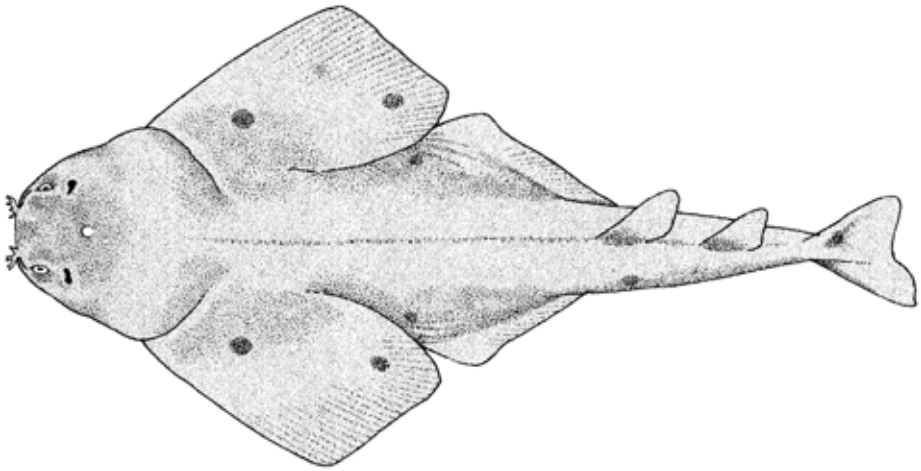


Squaliolus aliae Teng, 1959
Snout pointed but only moderately elongate. First dorsal fin with small spine, nearer to pectoral than to ventral fin base, no spine in second, the first dorsal fin smaller than second; pectoral fins small and rounded; caudal fin nearly symmetrical.

SQUATINIDAE

Angel sharks

Ray-like sharks of moderate size found in all oceans from shallow inshore waters down to the upper continental slope. Body greatly depressed, flattened. Head flattened, with distinct 'neck' at pectoral fin base; eyes on upper side of head; mouth terminal, teeth in upper and lower jaws the same, small, with a single needle-like cusp, but no cusplets. Five gill slits, not visible from above. Two dorsal fins, without spines; no anal fin; pectoral fins wing-like, not joining smoothly to head in front, but with distinct lobes that cover gill slits; ventral fins large; caudal fin almost symmetrical (lower lobe slightly larger). Colouration may include darker markings or light ocelli. Angel sharks are viviparous, i.e. give birth to fully-formed young which have not been nourished from a placenta. A single genus (*Squatina*) with about five species, of which one is recorded here.

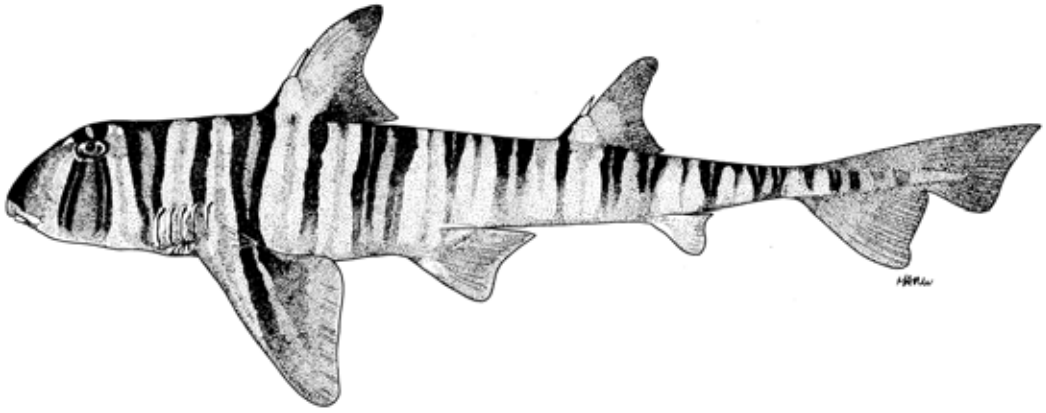


Squatina pseudocellata Last & White, 2008
Body and head greatly depressed, thus resembling a species of ray, but front edge of pectoral fins not smoothly joined to head. Snout short, rounded; eyes on top of head. Two dorsal fins, without spines; no anal fin; pectoral fins wing-like, angular. Body brown with occelate markings on pectoral fins.

HETERODONTIDAE

Bull head Sharks

Moderate-sized sharks found in the Indo-Pacific, also Eastern Pacific, often in shallow-water. Body tapering from rather bulky head. Snout blunt and rounded, eyes fairly high on head; mouth well in front of eyes, teeth in upper and lower jaws the same, small and with cusps in front, enlarged and molar-like behind. Five gill slits, the last 3 above pectoral fins. Two dorsal fins, each with a stout spine; anal fin below or just behind base of second dorsal fin. Various distinctive colour patterns of bands, bars or spots. Bullhead sharks are oviparous, laying eggs in characteristic spiral-shaped egg cases. A single genus (*Heterodontus*) with six species, of which one is recorded here.



Heterodontus zebra (Gray, 1831)
Snout blunt and broad; jaws with small cusped teeth in front, broad molar-like teeth behind; 5 gill slits. Two dorsal fins, each preceded by a spine; anal fin present. Body light brown, with distinctive dark transverse bands. A small species, reaching 85 cm.

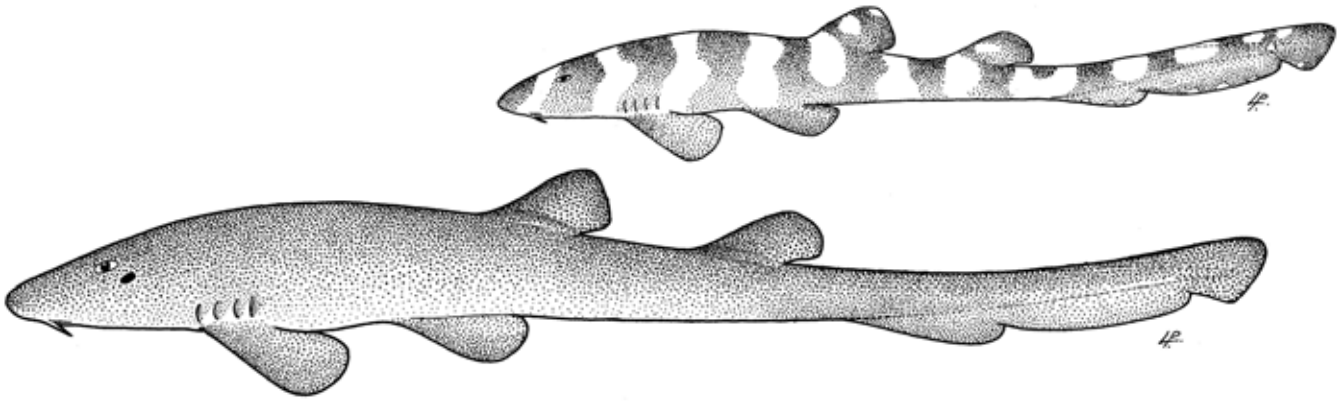
HEMISCYLLIIDAE

Longtailed Carpet Sharks - Cutcut sembilang; Cutcut toke

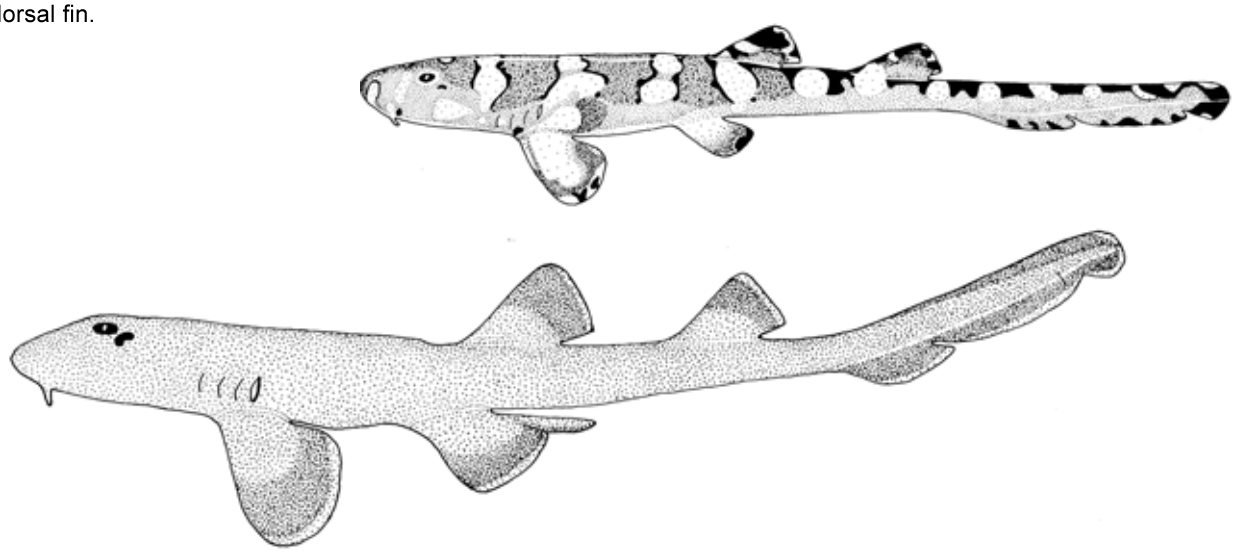
Small slender sharks (to less than 100 cm) found inshore water of the tropical Indo-Pacific. Body cylindrical or slightly depressed, with or without ridges on sides. Snout broadly rounded or a little pointed; eyes fairly high on head; mouth ventral and nearly transverse, teeth on upper and lower jaws more or less similar, with a main cusp and in some species small cusplets on either side. Five gill slits, the fifth overlapping the fourth. Two dorsal fins, without spines and about equal in size; anal fin present, a little smaller than second dorsal fin, separated by a notch from lower lobe of caudal fin; upper part of caudal fin almost in line with body axis. Various colour patterns, including dark saddles and dark or light spots. Longtailed Carpet Sharks are oviparous (egg-layers). Two genera, with about five species, of which three are recorded here.

Two genera which can be separated as follows:

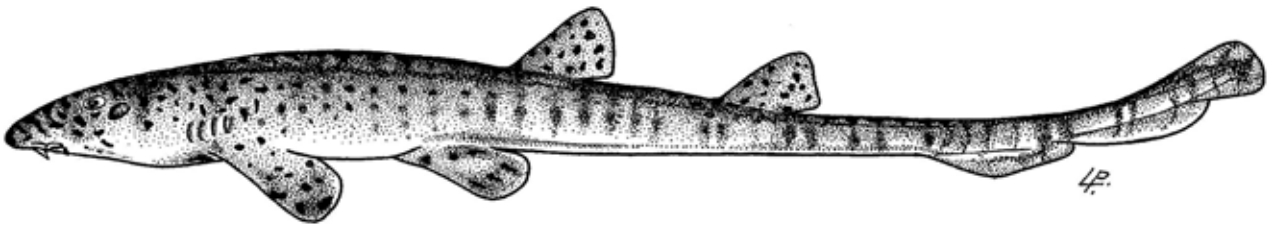
A. Distance from nose tip to mouth goes more than 5 times in head length . . . . . **Hemiscyllium**
B. Distance from nose tip to mouth goes less than 5 times in head length. . . . . **Chiloscyllium**



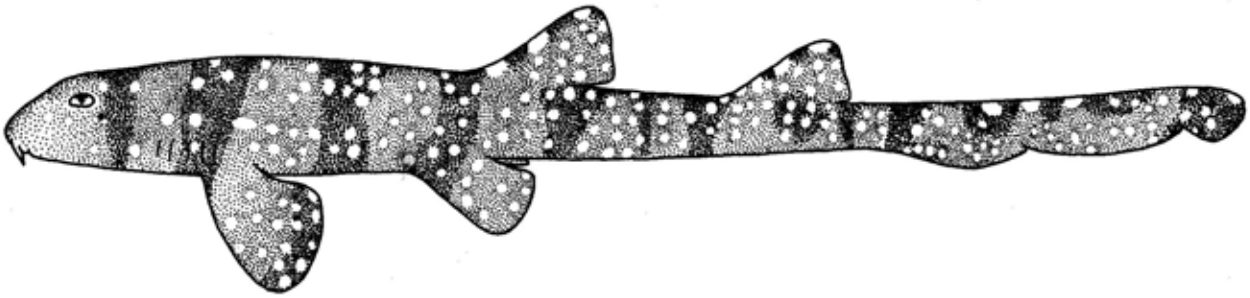
Chiloscyllium griseum Muller & Henle, 1838
Juveniles with light grey-brown and dark grey-brown bands; adults become uniformly tan to light brown; belly cream to light tan. First dorsal fin base longer than that of second. A mid-dorsal ridge present; origin of anal fin only a little behind second dorsal fin.



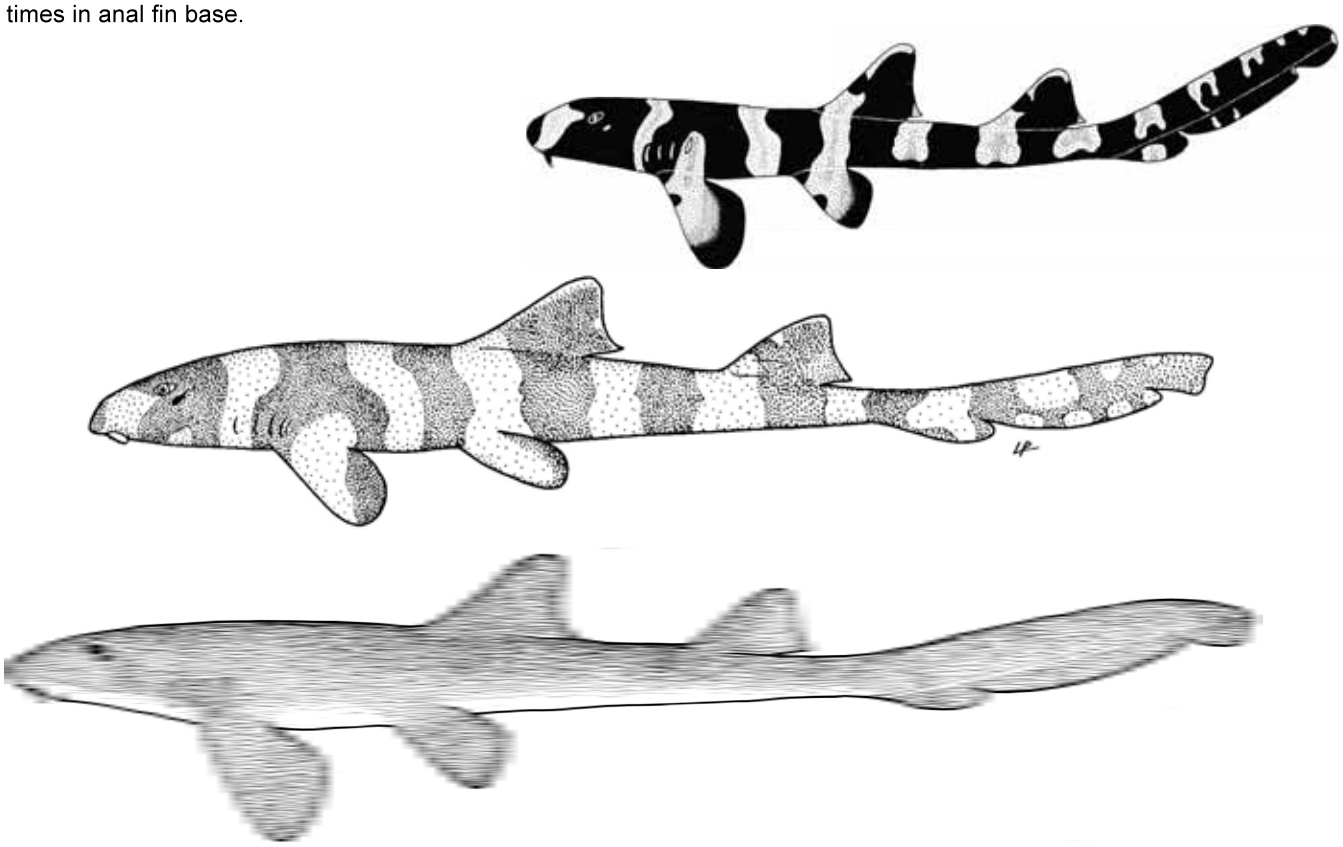
Chiloscyllium hasseltii Bleeker, 1852
Juveniles with black-edged bands of grey-brown or dark-brown colour. These bands disappear with age although traces of the black edges often can give the specimen the appearance of being spotted. First dorsal fin base longer than that of second. Nearly identical to *C. griseum* but can be separated by: second dorsal fin height usually less than 5.8% of TL; first dorsal fin height usually less than 6.6% of TL; distance from first dorsal to second dorsal usually less than 9.3% of TL. These figures are usually higher for *C. griseum.*



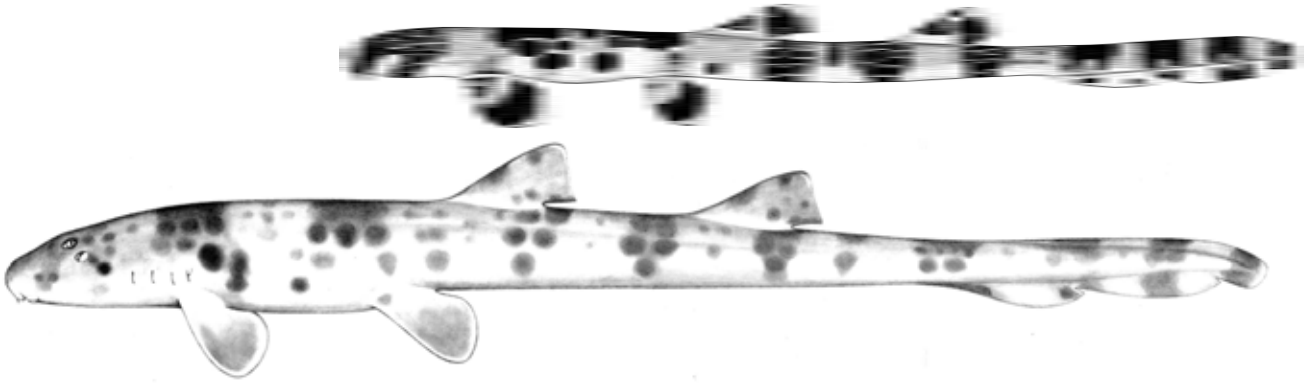
Chiloscyllium indicum (Gmelin, 1789)
The bands in the juveniles become less distinct in adults. The bands are medium to dark brown with scattered darker spots; background colour is cream or light brown. Lateral dermal ridge present. Anal fin origin well behind second dorsal fin; anal fin height goes more than six times in anal fin base.



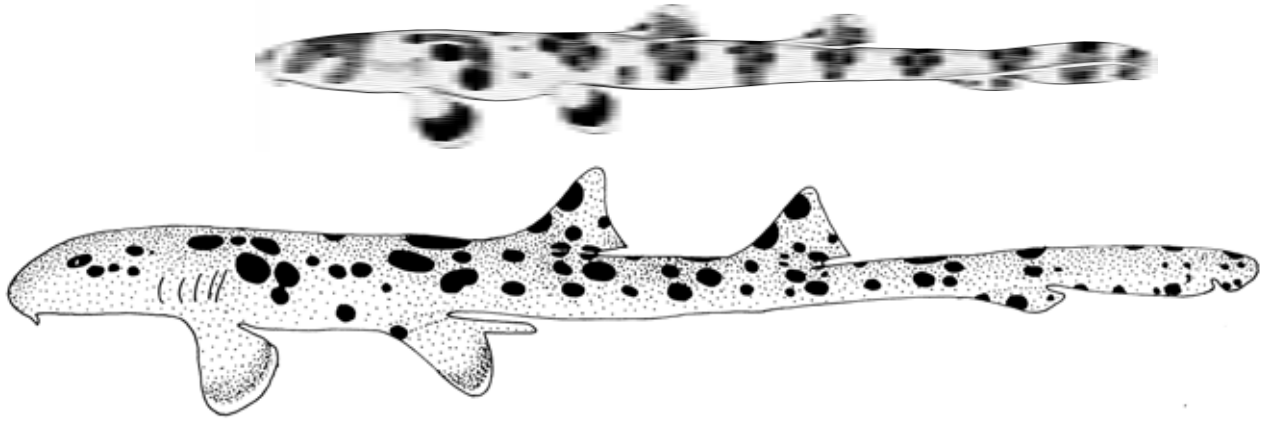
Chiloscyllium plagiosum (Bennett, 1830)
Juveniles and adults are both banded and patterned, the juveniles being very dark; the adults with fainter margins. Light grey on belly. Distinct lateral ridges present. Anal fin origin well behind second dorsal; anal fin height goes less than six times in anal fin base.



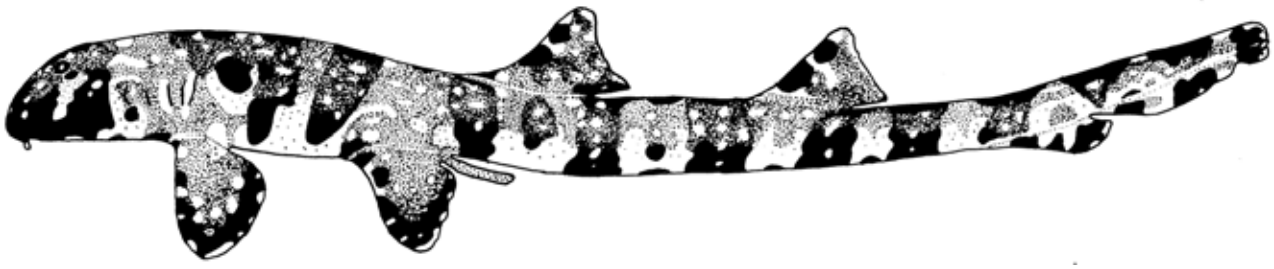
Chiloscyllium punctatum Müller & Henle, 1838
Juveniles are strongly banded in alternating black and white bands. With age these bands fade and a more uniform colour appear with small black spots over body. At maturity the body colour is uniformly light brown. Anal fin origin below end of second dorsal fin.



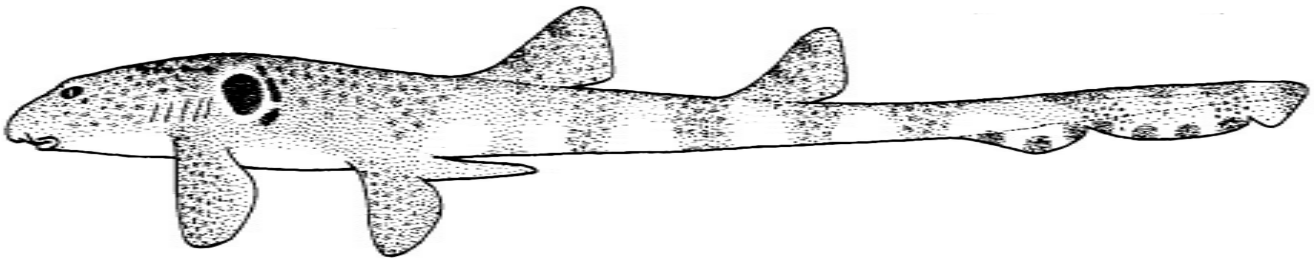
Hemiscyllium freycineti (Quoy & Gaimard, 1824)
Juveniles with dark brown and tan bands; the dark bands break up into spots and more spots appear in the light bands, reaching the adult colour pattern which appears as red-brown spots on a cream to light tan background; belly white or cream. Spots on head in front of eye of equal size to eye.



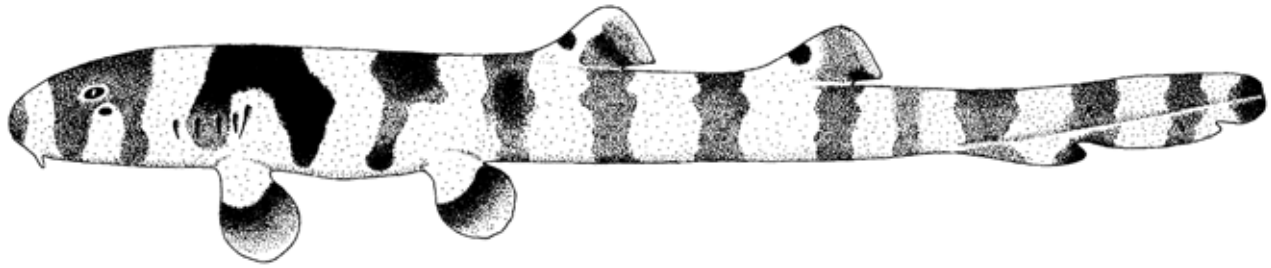
Hemiscyllium hallstromii Whitley, 1967
Adults have dark brown to black spots most of which are subequal or larger to the very dark brown "shoulder" spot. The background colour is tan to light brown. Juveniles with dark bands which break up into spots and with age more spots appears and with more intense colour.



Hemiscyllium strahani Whitley, 1967
This species has dark bands and spots on throat; tip of barbels white; back and sides have light spots on the dark grey to black background. The "shoulder" spot not easily seen against the dark background. Belly white to cream.



Hemiscyllium trispeculare Richardson, 1843
Head anterior to eyes covered with small spots, less than half the diameter of the eye; "shoulder" spot broken up into at least two and usually three separate spots. Body colour tan to light brown with many dark brown spots somewhat with a greenish tinge. Belly cream or white.

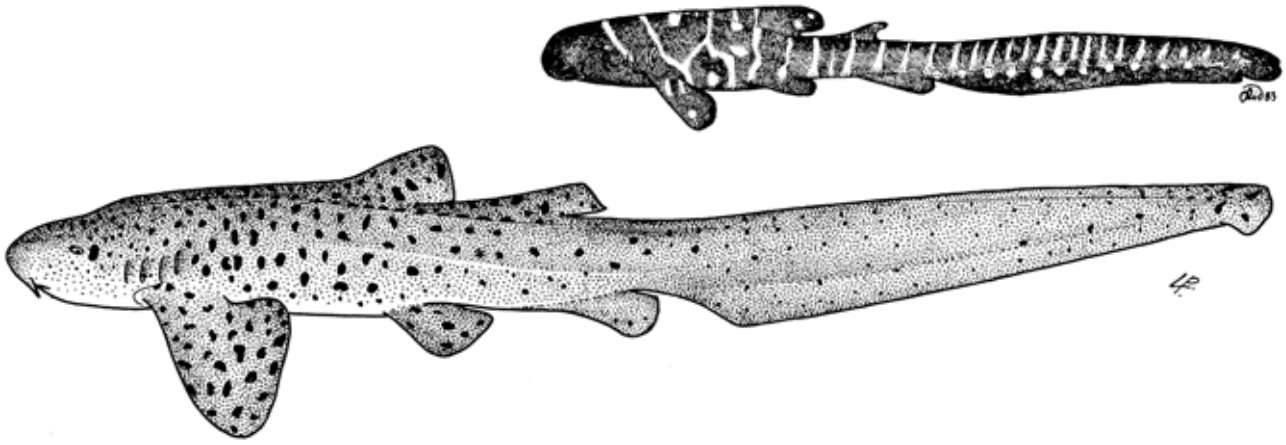


Hemiscyllium henryi Allen & Erdmann, 2008
Body covered with white and black bands, no spots. The picture shown is from the only juvenile caught.

STEGOSTOMATIDAE

Zebra Shark - Cutcut tekeh

Small to moderate-sized sharks of the warmer parts of the Indo-Pacific. Body cylindrical, with prominent ridges on sides. Snout broad and very slightly rounded; eyes on side of head; mouth almost terminal, teeth about the same in both jaws, with a central cusp and small cusplets on either side. Five gill slits, small, the fourth overlapped by the fifth. Two dorsal fins, the first larger than second; anal fin present, larger than second dorsal fin, its base broad, separated from lower part of caudal fin by narrow notch or small space; upper part of caudal fin forming low angle with body, long, about half length of entire fish. Body with dark saddles in young, changing to spots in adults. Zebra sharks are oviparous laying purplish egg cases. One species is recorded here.

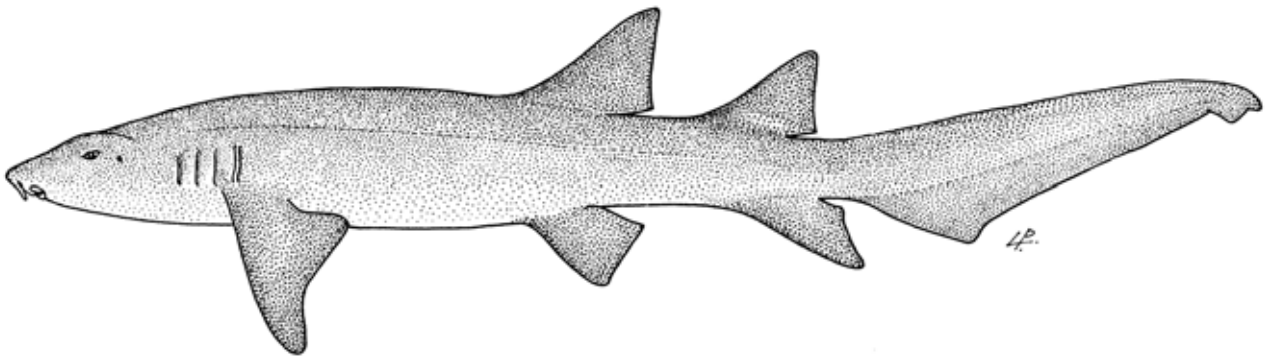


Stegostoma triginum (Foster, 1781)
Description as for family. Juveniles with dark brown saddle - shaped bands on upper part of body, gradually changing to spots or blotches in adults.

GINGLYMOSTOMATIDAE

Nurse sharks - Cutcut buta

Small to large nocturnal sharks (some to 100 cm, others to about 300 cm), found in all tropical and subtropical seas in shallow waters down to at least 70 m. Body cylindrical or moderately depressed, without ridges on sides. Mouth subterminal, teeth about the same in both jaws, with a main cusp and small lateral cusplets. Five gill slits, the fourth almost overlapped by the fifth. Two dorsal fins, about equal or the first somewhat larger, the first dorsal origin over or just before ventral fin base; anal fin present, about as large as second dorsal fin, separated by small space from lower lobe of caudal fin; upper lobe of caudal fin at low angle to body and less than a third length of entire fish. Caudal peduncle without lateral keels. Nurse sharks are perhaps mostly ovoviviparous (give birth to fully-formed young), but at least *Nebrius ferrugineus* is aplacentally viviparous (embryos nourished from yolk sac). There are 2 genera of which one is recorded here.

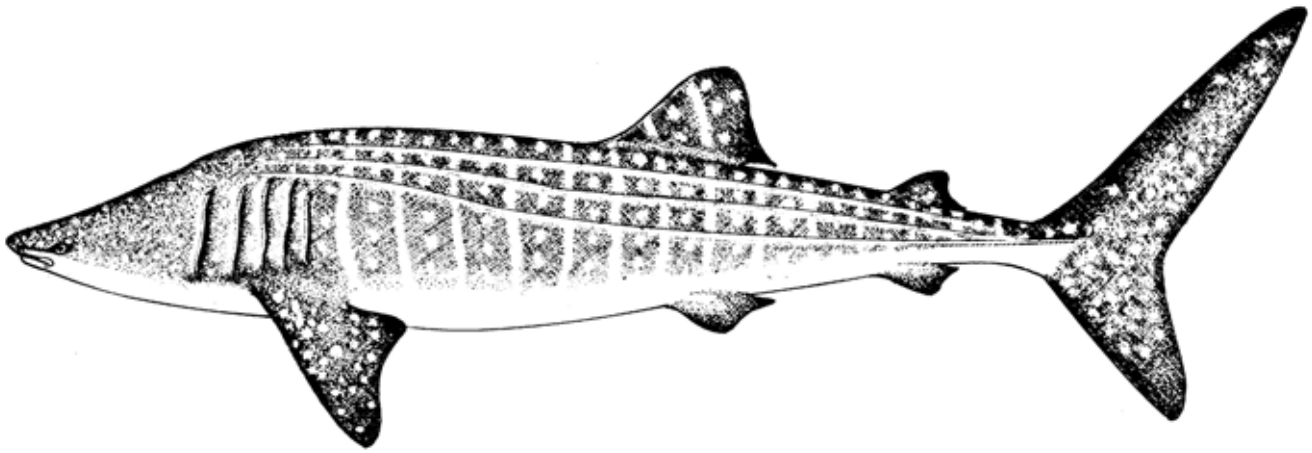


Nebrius ferrugineus (Lesson, 1830)
Teeth more or less compressed at sides of jaw, imbricated (overlapping). Dorsal, anal and pectoral fins pointed at tips, pectoral fins narrow and falcate.

RHINCODONTIDAE

Whale Sharks -

Very large sharks (perhaps to about 2000 cm), found in all tropical seas. Body, bulky, but tapering evenly to tail, Snout short and blunt; mouth almost terminal, teeth very small and numerous, with hooked cusps; no gill rakers, but filter grids. Five gill slits, last 3 over pectoral fins. Two dorsal fins, second half size of first; anal fin present; caudal fin asymmetrical, but with strong lower lobe. Caudal peduncle depressed with a strong keel on each side. Whale sharks are viviparous (retain egg-cases in uterus where they hatch and then born); feed on pelagic crustaceans, small fishes and squids. A single genus and species.

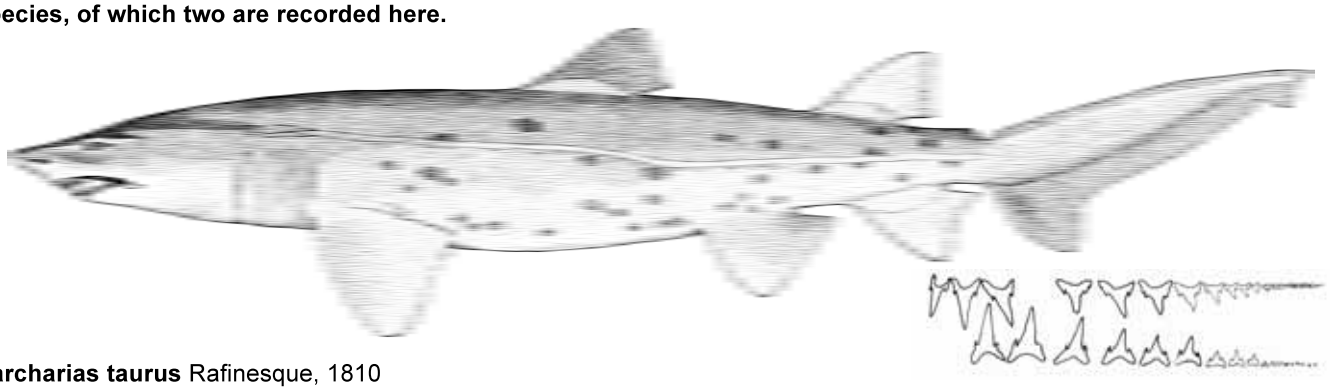


Rhincodon typus Smith, 1828
Description as for family. Body dark grey, reddish or greenish grey above, with white or yellow spots and transverse stripes.

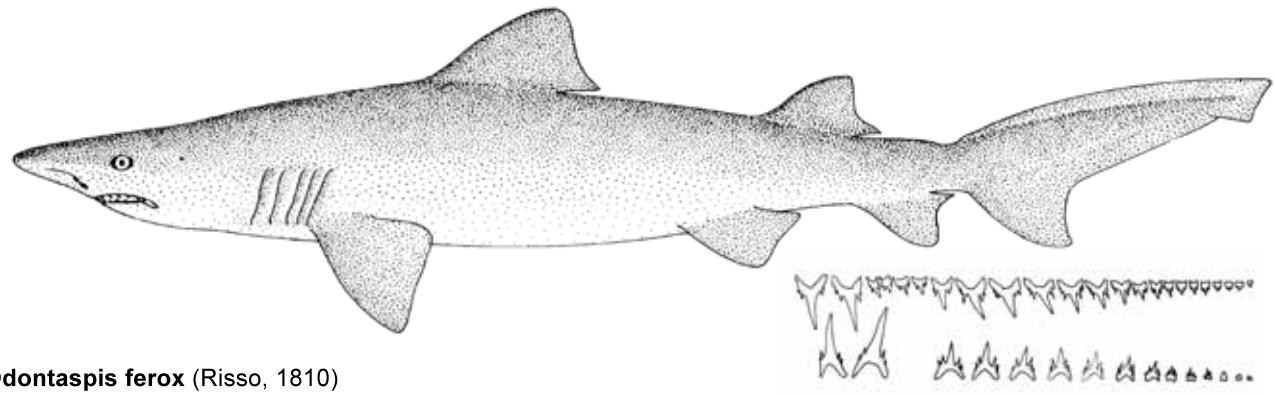
ODONTASPIDIDAE

Sand Tiger Sharks -

Large sharks (some to 360 cm or more) of tropical to cool temperate waters down to moderate depths. Body fairly bulky. Snout more or less pointed; mouth ventral, teeth with a large slender cusp and one or more small cusplets on either side, teeth at front enlarged and separated from lateral teeth by a gap and/or tiny intermediate teeth. Five gill slits, all in front of pectoral fin. Two dorsal fins, the first well in front of ventral fins; anal fin present; caudal fin asymmetrical, but lower lobe well developed. Caudal peduncle without keels on sides. Sand Tiger Sharks are ovoviviparous (have fully formed young which have not been nourished by a placenta). Two genera, with about six species, of which two are recorded here.



Carcharias taurus Rafinesque, 1810
Snout very short, moderately flattened; eyes small. Enlarged teeth at front of upper jaw in 3 rows on either side. First dorsal fin only a little before ventral fins, not larger than second dorsal fin. *Carcharias taurus* is adelphophagous, where embryos eat other eggs in their egg case then hatch into uterus and prey on other embryos in utero until only one left in each uterus

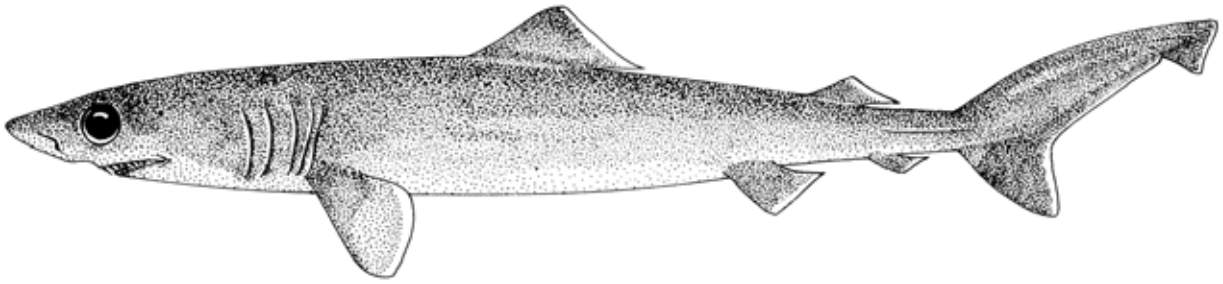


Odontaspis ferox (Risso, 1810)
Snout moderately elongate, bulbously conical; eyes fairly large. Enlarged teeth at front of upper jaw in 2 rows on either side. First dorsal fin well before ventral fins, larger than second dorsal fin.

PSEUDOCARCHARIIDAE

Crocodile Sharks -

Small to moderate-sized sharks (to about 100 cm), oceanic and found in all tropical seas. Body slender, elongate. Snout rather pointed; eyes large on side of head; mouth ventral, reaching well behind eyes, teeth with long slender cusps, without lateral cusplets, anterior teeth enlarged in both jaws and a little hooked. Five gill slits, none over pectoral fins. Two low dorsal fins, the first larger than the second and more or less equidistant between pectoral and ventral fin bases; anal fin present, smaller than second dorsal fin; caudal fin strongly asymmetrical, lower lobe short. Caudal peduncle depressed, with a low keel on each side. No distinctive colouration. Crocodile-sharks are ovoviviparous (give birth to fully-formed young which have not been nourished by a placenta). A single genus.



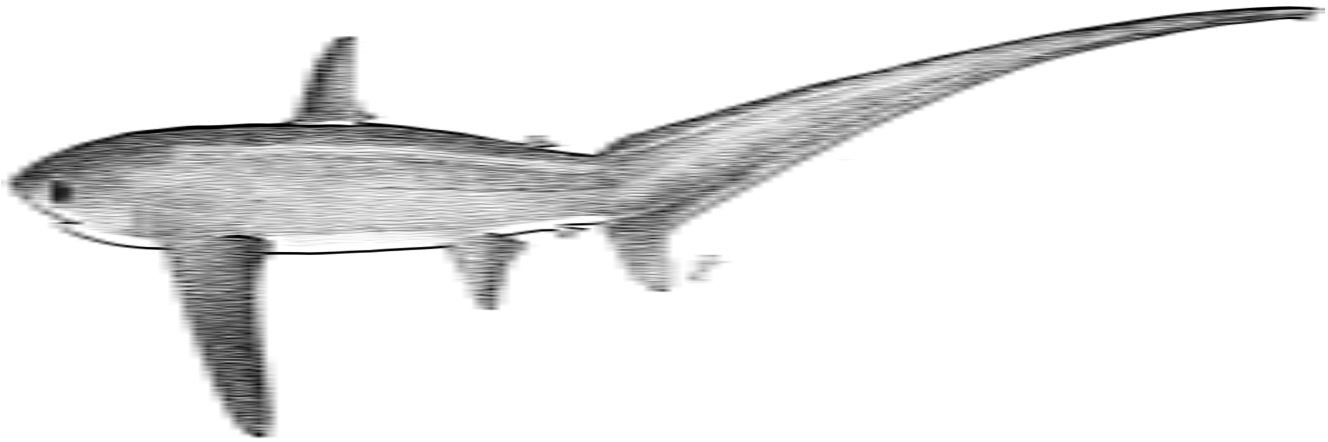
Pseudocarcharias kamoharai (Matsubara, 1936)
Description as for family. Body greyish above, lighter below, sometimes with small white spots and a white blotch between the mouth and gill slits; fins white-edge

ALOPIIDAE

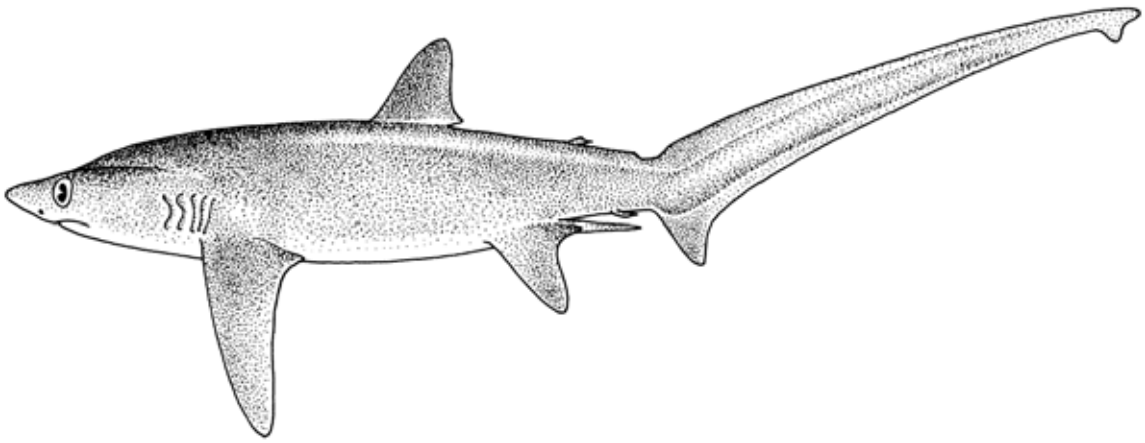
Thresher sharks -

Large pelagic sharks (to about 500 cm), mostly of shallow to moderate depths, but one deeper-water species, found in all oceans. Body cylindrical, moderately stout. Snout moderately long, conical and pointed, mouth ventral, teeth small or moderate, compressed, blade-like, with less than 60 rows in each jaw. Five gill slits, last two over pectoral fins. First dorsal fin at about midpoint of body or a little behind, high and erect, second dorsal fin minute; anal fin minute, behind second dorsal fin base; pectoral fins long and narrow; ventral fins as large as first dorsal fin and set well behind it; caudal fin with upper lobe about as long as body. No distinctive colouration. Thresher sharks are they are oophagous - embryos feed on eggs continually ovulated by the mother and give birth to fully-formed young.

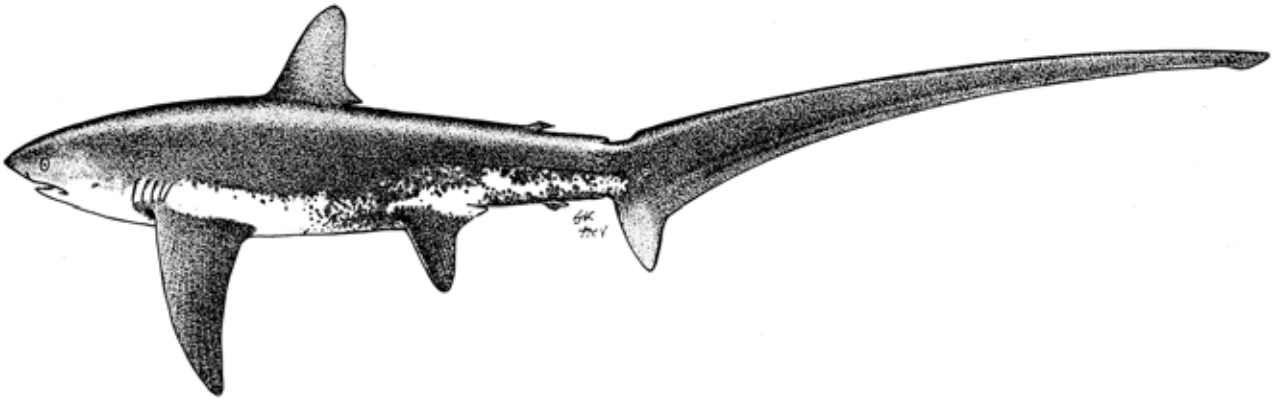
A single genus (*Alopias*) with three species, all of which are recorded here.



Alopias pelagicus Nakamura, 1935
Weak horizontal groove on each side of nape, forehead not indented over eyes, which are small. Teeth small, more than 29 rows in each jaw. First dorsal fin about equidistant between pectoral and ventral fin bases; pectoral fins long, narrow, the tips rounded. White of belly not expanded over pectoral fin bases.



Alopias superciliosus (Lowe, 1841)
Deep horizontal groove on each side of nape, forehead distinctly indented over eyes, which are large and expanded onto top of head. Teeth large, less than 25 rows in each jaw. First dorsal fin much closer to ventral fin base; pectoral fin long, narrow, the tips rounded. White of belly not expanded over pectoral fin bases.

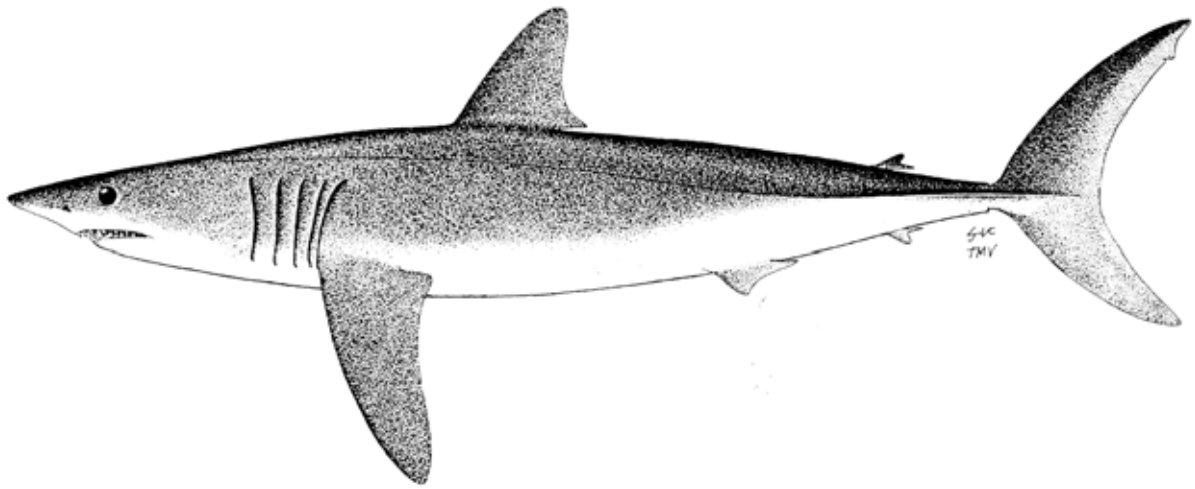


Alopias vulpinus (Bonnaterre, 1788)
No horizontal grooves at nape, forehead not indented over eyes, which are small. Teeth small, usually more than 29 rows in each jaw. First dorsal fin about equidistant between pectoral and ventral fin bases; pectoral fins long and falcate, with pointed tips in adults. White of belly expanded over pectoral fin bases.

LAMNIDAE

Mackerel Sharks -

Large sharks (to at least 300 cm, but *Carcharodon* to 640 cm). found in all tropical and temperate waters. Body fusiform, sometimes stout. Snout moderately long, more or less pointed; mouth ventral, teeth large, but variable, slender and awl-like to broad or blade-like. Five gill slits, all in front of pectoral fin. Two dorsal fins, the first short-based and well in advance of ventral fins, the second much smaller; anal fin present, as small as second dorsal fin; caudal fin lunate. Caudal peduncle depressed, with a prominent keel on each side extending back onto base of caudal fin. No distinctive colour patterns. Mackerel sharks are oophagous - embryos feed on eggs continually ovulated by the mother and give birth to fully-formed young. Three genera, with about seven species, of which one is recorded here.

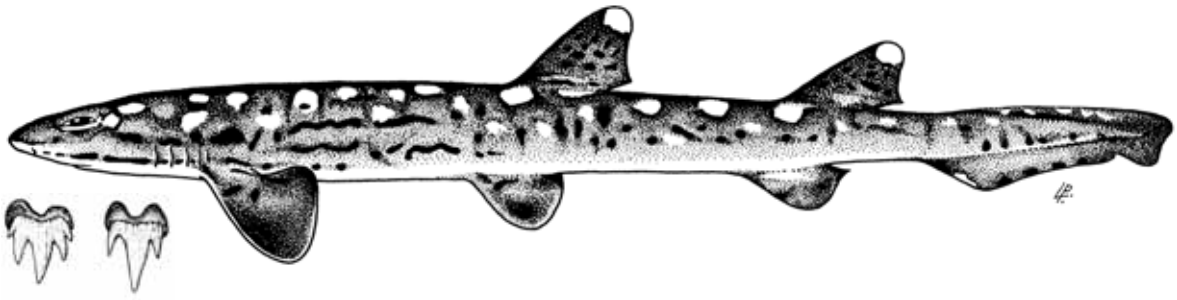


Isurus oxyrinchus Rafinesque, 1810
Snout acutely pointed. Teeth moderately slender, without cusplets at side, edges smooth. First dorsal fin origin just behind inner corner of pectoral fin; pectoral fin falcate, shorter than head, tip pointed in adults. Underside of snout and around mouth pale.

SCYLIORHINIDAE

Cat sharks - Cutcut kembang

Mostly small sharks (to less than 100 cm), found in all oceans, usually in shallow to moderate depths. Body more or less round, fairly slender. Snout often somewhat depressed; eyes oval or slit-like; nostrils connected to mouth by a groove in some species; mouth ventral, teeth small, with acute narrow cusps and often small cusplets on either side. Two dorsal fins, the first over or behind ventral fin base, its origin near midpoint of body in some species, but well behind in others; anal fin present; ventral fin origin before base of first dorsal fin; lower caudal fin lobe small, sometimes absent, upper lobe not rising steeply from line of body and sometimes almost horizontal. Variegated colour patterns in some species. Cat sharks are mostly oviparous (egg-layers), but some species are ovoviviparous (give birth to fully-formed young which have not been nourished from a placental) seven genera, with 49 species, of which one is recorded here.

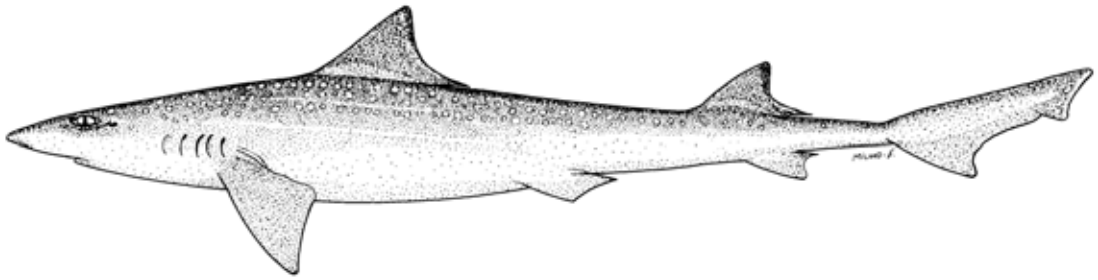


Atelomycterus marmoratus (Bennett, 1830)
Body moderately slender, not tadpole-shaped, firm and thick-skinned. Snout short, bluntly round; space between nostrils less than half nostril width; eyes on upper part of head, with a narrow ridge below. Two dorsal fins, the second a little smaller than first. Upper parts of body with dark spots and marbling, interspersed with white blotches; white blotches at tips of dorsal fins.

TRIAKIDAE

Hound-sharks -

Small to moderate-sized sharks (to about 150 cm) widely distributed in tropical and warm temperate seas, from shallow waters to moderate depths (300 m or more). Body elongate to stout. Eyes elongate or oval; mouth ventral, teeth either large, blade-like with small cusplets but no serrations, or numerous, small, without cusps and arranged in a pavement. Two dorsal fins, the first before ventral fins, the second somewhat smaller than first; anal fin present, not larger than second dorsal fin; caudal fin asymmetrical, upper edge not rippled, lower lobe variable (strong in some, almost absent in others). Body sometimes with pale or dark spots, otherwise no distinctive markings. Hound-sharks are ovoviviparous (give birth to fully-formed young which are not nourished from a placenta) or viviparous (yolk sac forms a 'placenta' before birth).

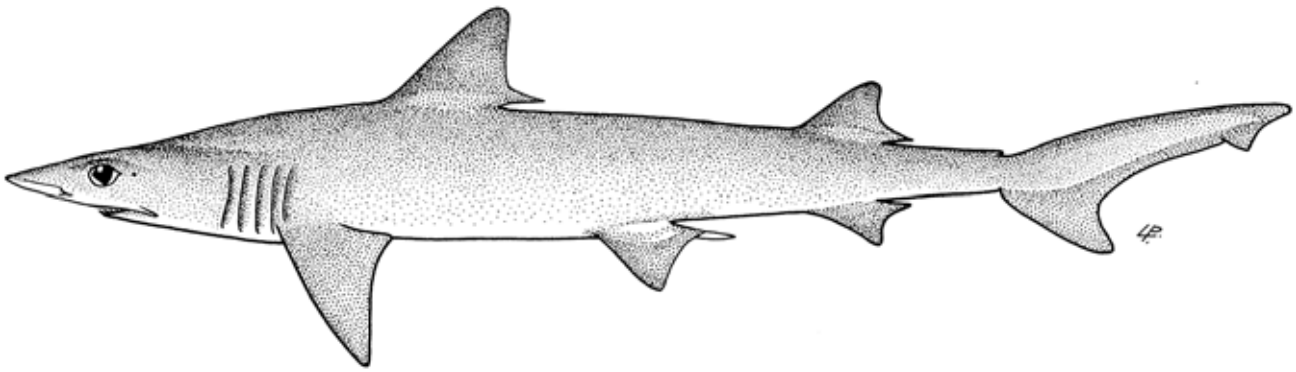


Mustelus stevensi White & Last, 2008
Relatively large species with moderately tall dorsal fins, posterior margin mostly upright distally, about 72/75 teeth rows; dorsal color light yellowish grey with numerous small, diffuse-edged white spots in staggered, irregular rows on postspiracular head and body; the light and dark tonal coloration are not well demarcated.

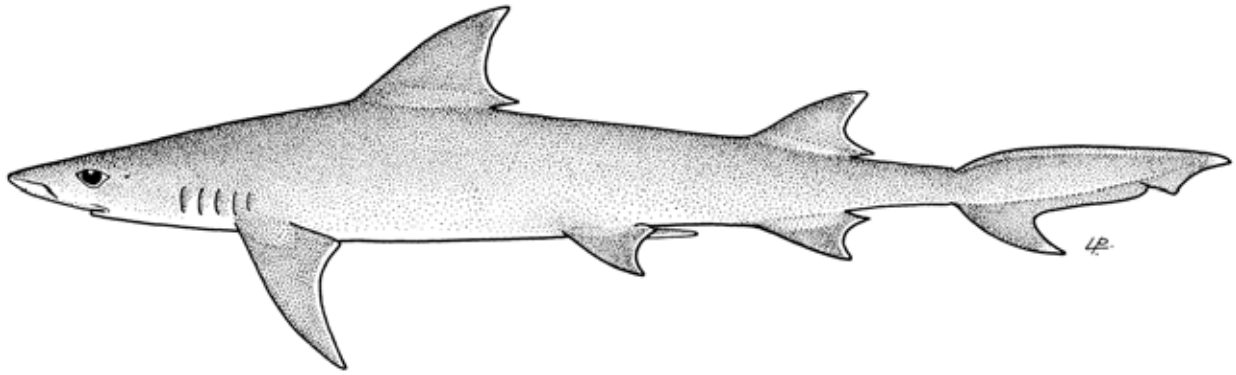
HEMIGALEIDAE

Weasel sharks -

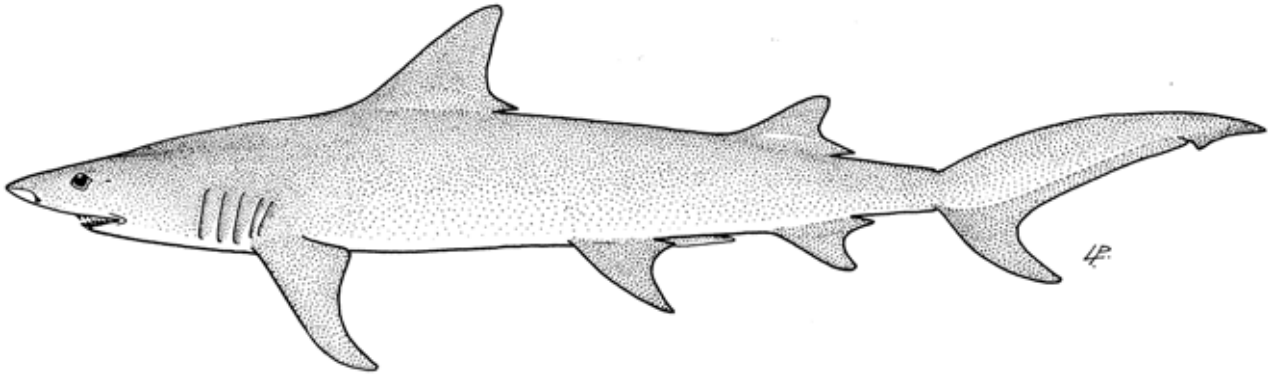
Small to moderate-sized sharks (to about 150 cm) of the Indo-Pacific and one species in the Atlantic. Body cylindrical. Head and snout somewhat depressed; eyes oval; mouth ventral, teeth small to large, blade-like, with a single cusp, also cusplets or serrations on upper teeth, cusplets sometimes present on lower teeth, anterior teeth of upper jaw not larger than lateral teeth. Five gill slits, the last 2-3 over pectoral fin. Two dorsal fins, without spines, the first between pectoral and pelvic fin bases, the second about ⅔ size of first; anal fin present; caudal fin strongly asymmetrical, its upper edge rippled or undulated. No distinctive colouration. Weasel sharks are viviparous (give birth to fully-formed young which have been nourished by a 'placenta' formed from the yolk sac). Four genera, with about 8-10 species, of which three are recorded from Survey



Chaenogaleus macrostoma (Bleeker, 1852)
Snout obtusely wedge-shaped when seen from above. Gill slits large, over twice length of eye. Front teeth of lower jaw with long strongly hooked cusps that protrude when mouth closed; edges of upper teeth smooth. Fins not falcate, hind edges of pectoral and pelvic fins straight or only slightly concave.



Hemigaleus microstoma Bleeker, 1852
Gill slits small, less than twice eye length. Front teeth of lower jaw short, without strongly hooked cusps, not protruding when mouth closed; no cusplets on lower teeth. Fins falcate, including lower caudal lobe. (any specimens caught in Australia would be *Hemigaleus australiensis* White, Last & Compagno, 2005.)

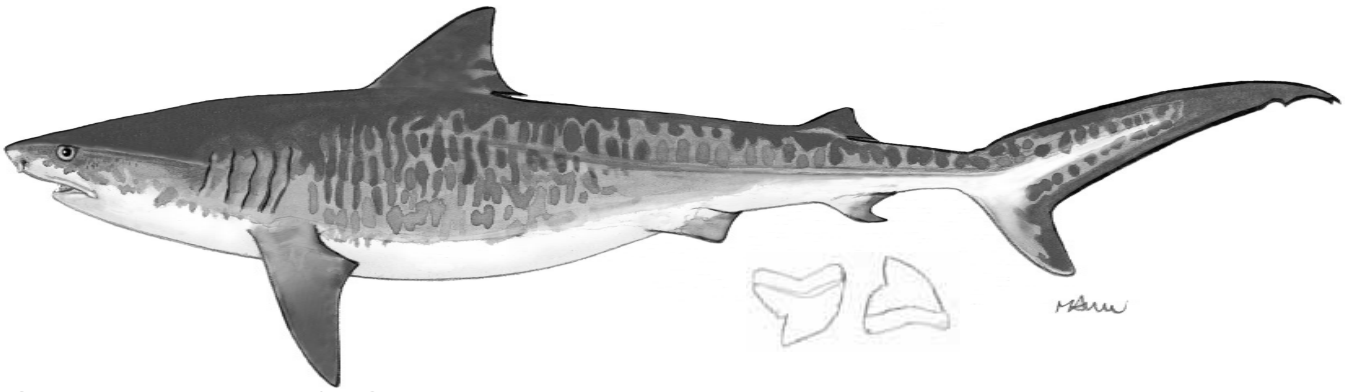


Hemipristis elongata (Klunzinger, 1871)
Snout bluntly rounded when seen from above. Gill slits large, over twice length of eye. Front teeth on either side of lower jaw symphysis with long, strongly hooked cusps that protrude when mouth closed; edges of upper teeth serrated in fishes over 60 cm. Fins strongly falcate, hind edges of pectoral and pelvic fins deeply concave.

GALEOCERDIDAE

Tiger shark - Hiu Macan

Tiger sharks are large, mostly nocturnal predators with the widest food spectrum of all sharks. Specimens are recorded longer than 5 m. This family was previously included in the CARCHARHINIDAE but differs on the following characteristics: spiracle present, small and slit-like; caudal peduncle with low, rounded, lateral keel; upper labial furrows very long, subequal to preoral length; snout broad, very short and bluntly rounded (viewed from underneath). Tiger sharks are aplacentally viviparous (eggs develop and hatch inside the body without a placenta); teeth are unique with very sharp, pronounced serrations and an unmistakable sideways-pointing tip. A single species.



Galeocerdo cuvier (Peron & LeSueur, 1822)
Dorsal surfaces grey with dark, vertical reticulations in newborns, forming vertical bars in sharks up to 300 cm TL, faint or absent in large adults. Fins without markings. Ventral surfaces white.

CARCHARHINIDAE

Requiem sharks - Cucut

Small to large sharks (some to 100-150 cm, others to 300 cm or more), found in all seas. Body cylindrical, without lateral ridges; head conical to moderately depressed. Snout prominent; eyes round, with a well-developed nictitating lower eyelid. Mouth ventral, teeth small to large, blade-like, with a single large cusp (often serrated) and smaller lateral cusplets in some. Five gill slits, the last 1-3 over pectoral fin. Two dorsal fins, the first usually much longer than second, its base about equidistant between pectoral and ventral fins; anal fin present; caudal fin strongly asymmetrical, upper edge rippled or undulated, lower lobe well-defined. Caudal peduncle strongly depressed, weak keels on sides only in two genera; precaudal pits well developed. Requiem sharks are vivoparous (give birth to fully formed young which have been nourished from a placenta). One of the largest shark families; there are numerous genera and species, of which nine genera and 28 species are recorded here. The information given here is taken from W. White, 2019.

SYNOPSIS OF GENERA

Triaenodon : teeth with high cusplets on either side of main cusp.

Negaprion : second dorsal fin almost as big as first; upper teeth with slender smooth cusps.

Lamiopsis : second dorsal fin almost as big as first; upper teeth with triangular serrated cusps, lower teeth with narrow smooth cusps.

Scoliodon : snout strongly depressed, trowel-shaped; pectoral fin broad.

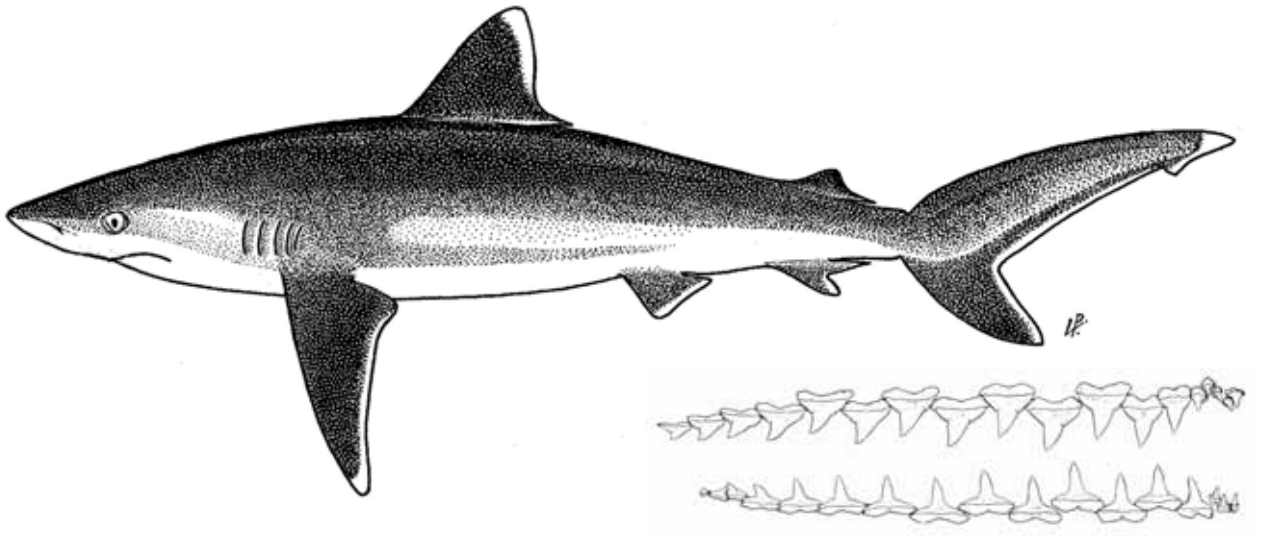
Loxodon : eye with posterior notch

Rhizoprionodon : long paired ridges before anal fin; anal fin origin distinctly before origin of second dorsal fin.

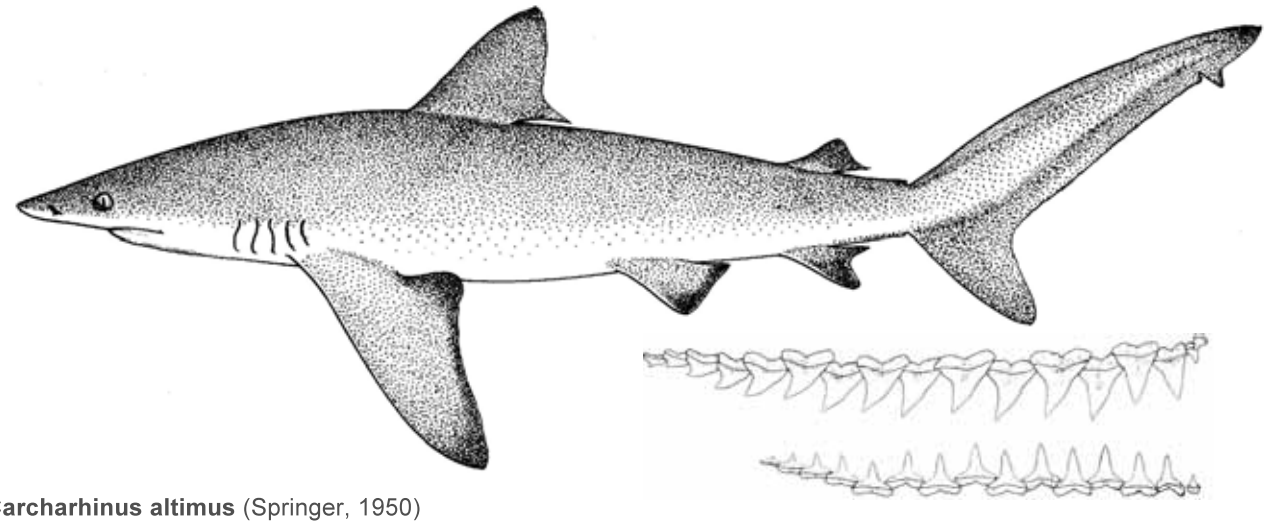
Prionacae : papilla-like gill rakers; weak keels on side of caudal peduncle back brilliant blue.

Glyphis : lower teeth long, hooked, protruding when mouth closed.

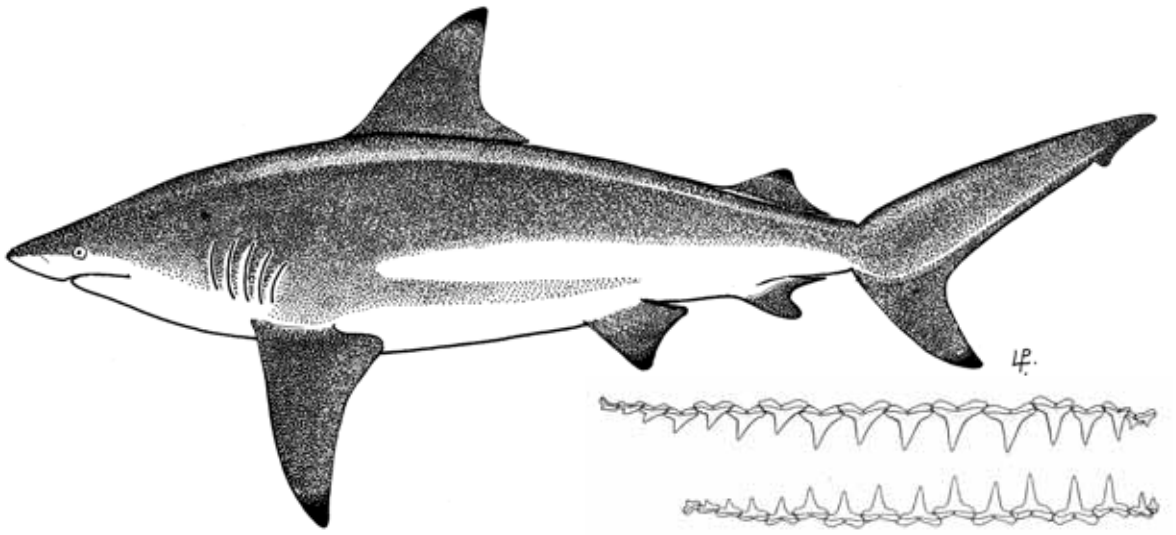
Carcharhinus : anal fin origin at most only a little before origin of second dorsal fin; no papilla-like gill rakers; lower teeth not protruding when mouth closed.



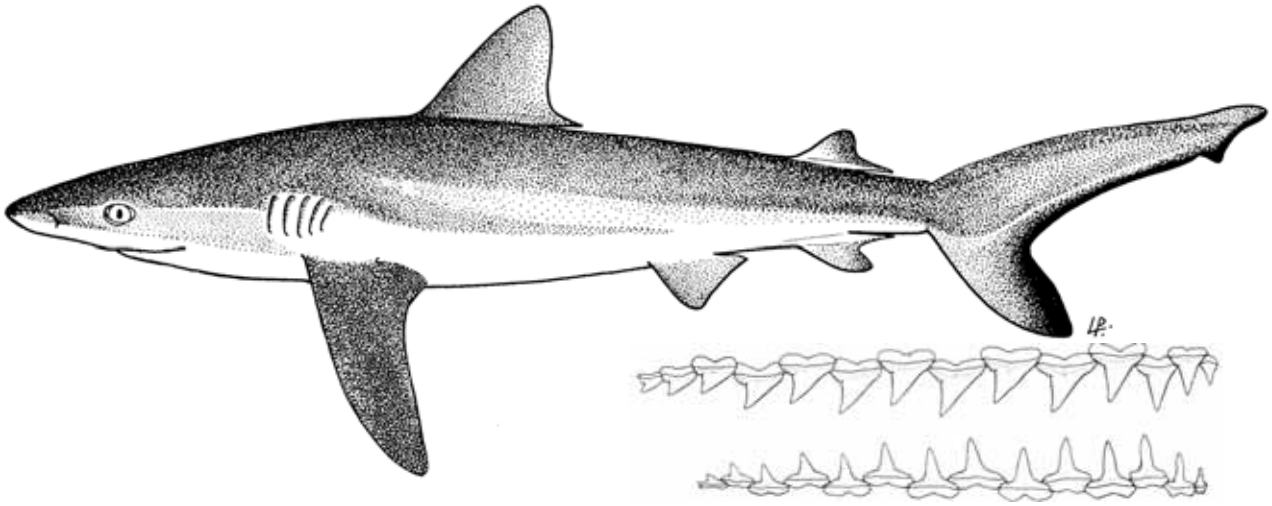
Carcharhinus albimarginatus (Rüppell, 1837)
Snout moderately long and parabolic. Upper teeth broadly triangular and erect at front of mouth. Second dorsal fin moderately high; dermal ridge between dorsal fins. All fins have white tips and white hind margins.



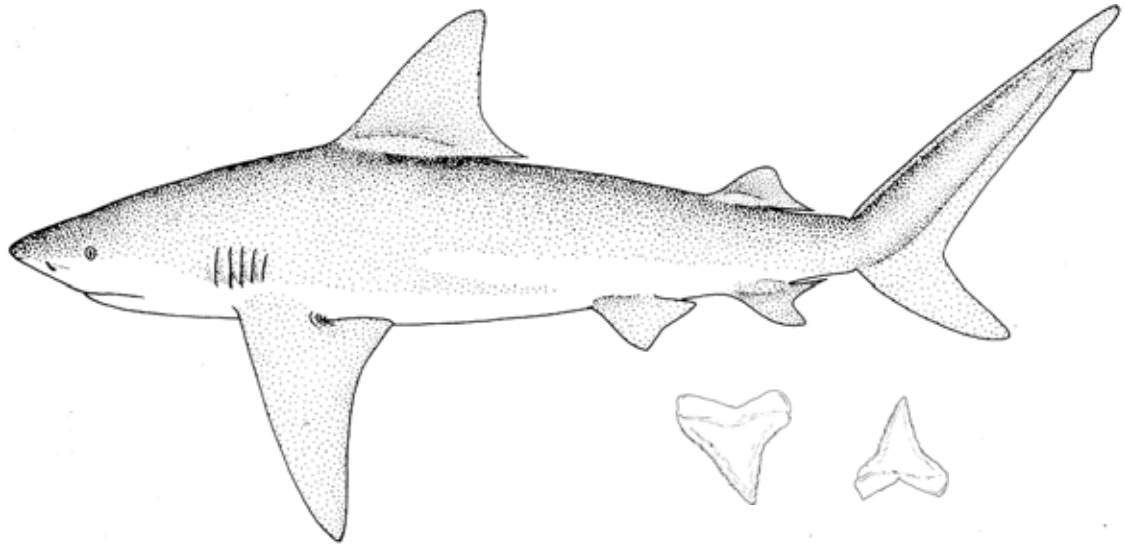
Carcharhinus altimus (Springer, 1950)
Snout rounded and rather long. Upper teeth broadly triangular and erect at front of mouth. First dorsal fin moderately high, with a narrowly rounded apex, its origin over inner margins of pectoral fins; pectoral fins long and not strongly falcate; high dermal ridge between dorsal fins.



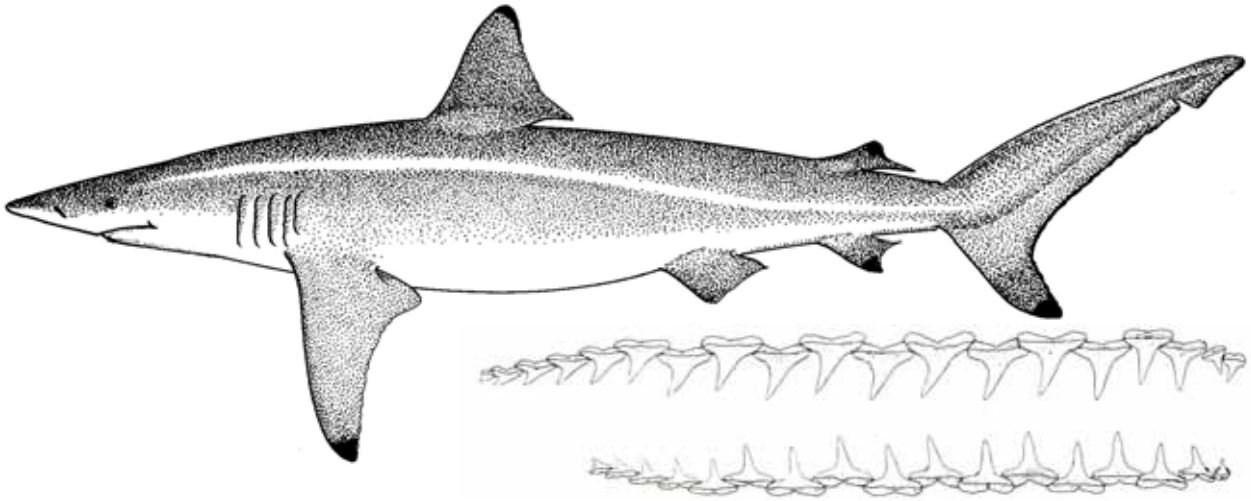
Carcharhinus amblyrhynchoides (Whitley, 1934)
Snout short but pointed, less than mouth width. Upper teeth with a narrow cusp, no prominent cusplet. First dorsal fin moderately high. No dermal ridge between dorsal fins.



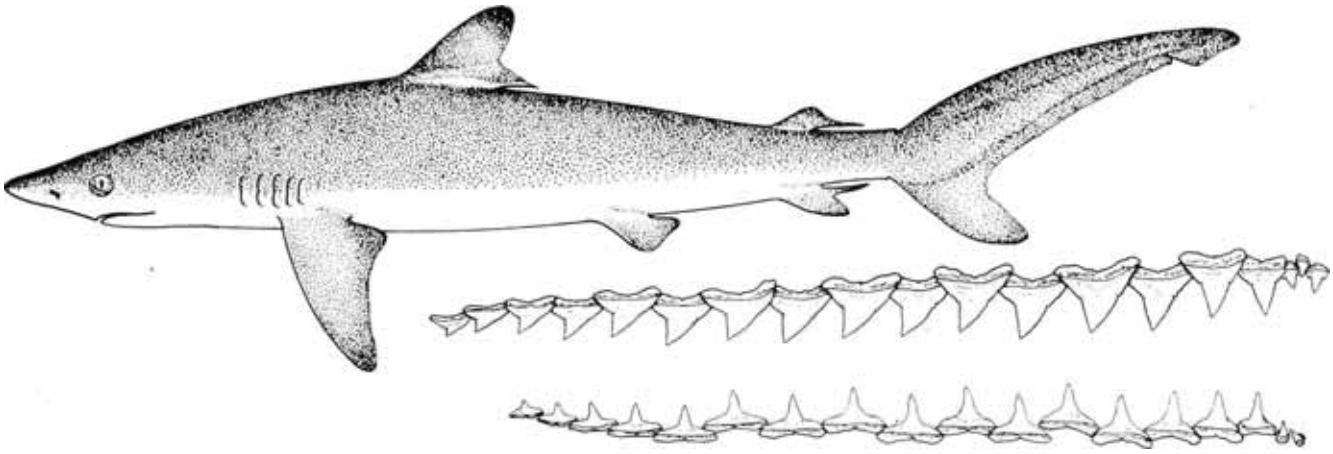
Carcharhinus amblyrhynchos (Bleeker, 1856)
Snout broadly rounded, less than mouth width. Upper teeth narrowly triangular, high, erect at front but becoming oblique further back. Dermal ridge between dorsal fins weak or absent. Posterior margin of caudal fin distinctly blackish.



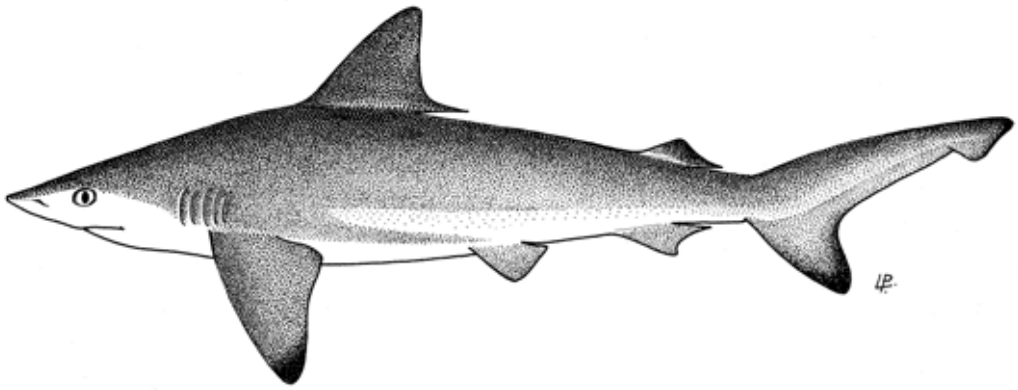
Carcharhinus amboinensis (Müller & Henle, 1839)
Body rather stout, snout short. Upper teeth triangular, with a broad, heavy, serrated cusp. First dorsal fin very high, second dorsal fin low. No dermal ridge between dorsal fins.



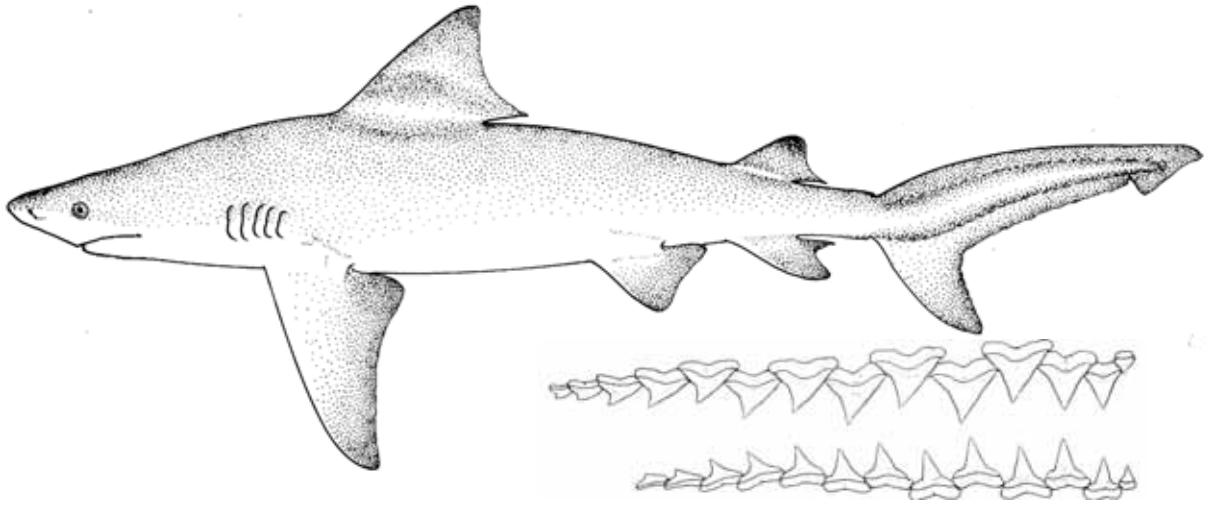
Carcharhinus brevipinna (Müller & Henle, 1839)
Snout pointed and long. Upper and lower teeth nearly symmetrical and very similar, cusps narrow, serrated in upper jaw, smooth in lower. Gill slits relatively long. Origin of first dorsal fin above or slightly behind free hind tips of pectoral fins. Pectoral fins short, 13.5-16% TL. No dermal ridge between dorsal fins.



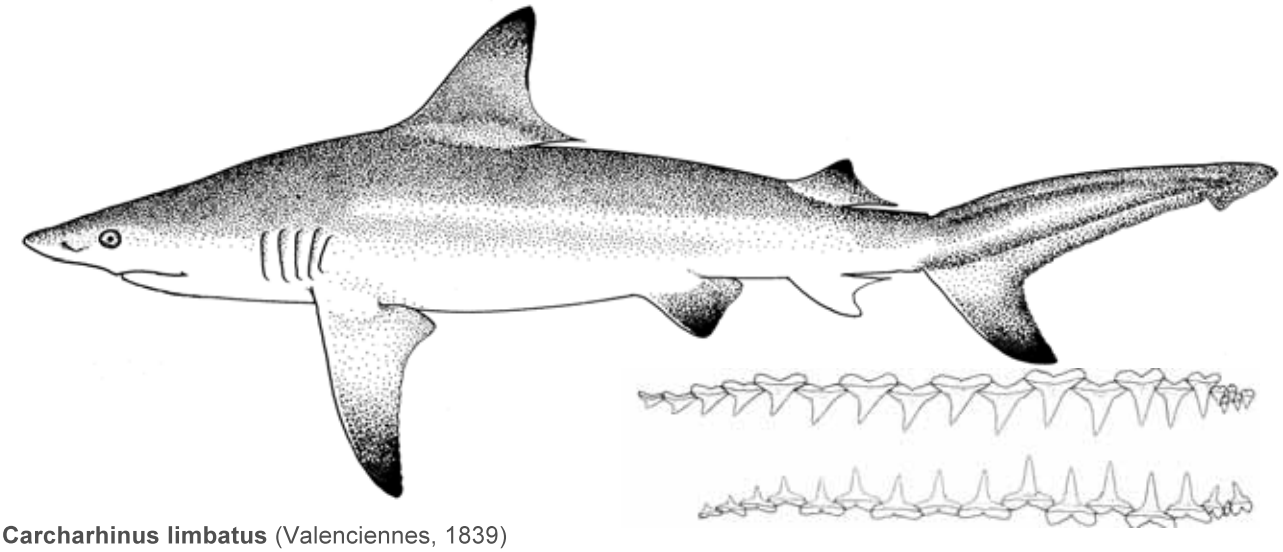
Carcharhinus falciformis (Bibron, 1839)
Body rather slender. Snout moderately long, narrowly rounded. Upper teeth with a narrow serrated cusp, well delimited from broad and serrated base. Origin of first dorsal fin a little behind free hind tips of pectoral fin; inner margin of second dorsal fin twice the length of the fin. A dermal ridge between dorsal fin.



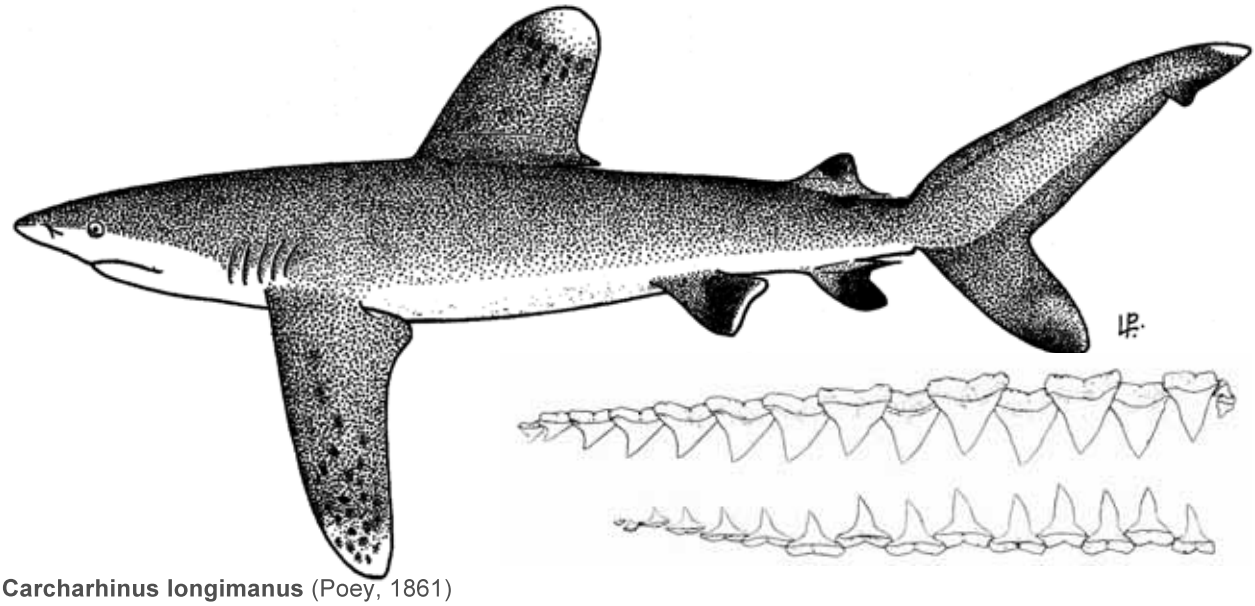
Carcharhinus hemiodon (Valenciennes, 1839)
Snout moderately pointed and parabolic. Upper teeth with a more or less oblique, narrow, smooth or weakly serrated cusp and strong cusplets. Inner margin of second dorsal fin elongated, but less than twice length of fin. A dermal ridge between dorsal fins.
Note: *C. hemiodon* is a very small and extremely rare shark. Specimen was not kept, so this is an uncertain record.



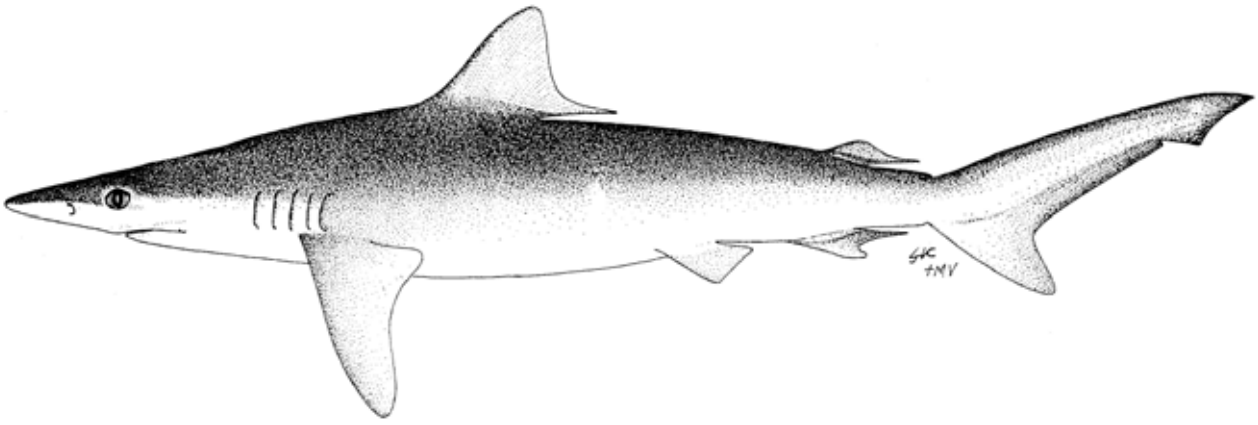
Carcharhinus leucas (Valenciennes, 1839)
Snout extremely short and broadly rounded. Upper teeth triangular, with a broad, heavy, serrated cusp. First dorsal fin high and broad with a slightly rounded apex, its origin over base of pectoral fins; pectoral fins broad, with narrow pointed tips. No dermal ridge between dorsal fins.



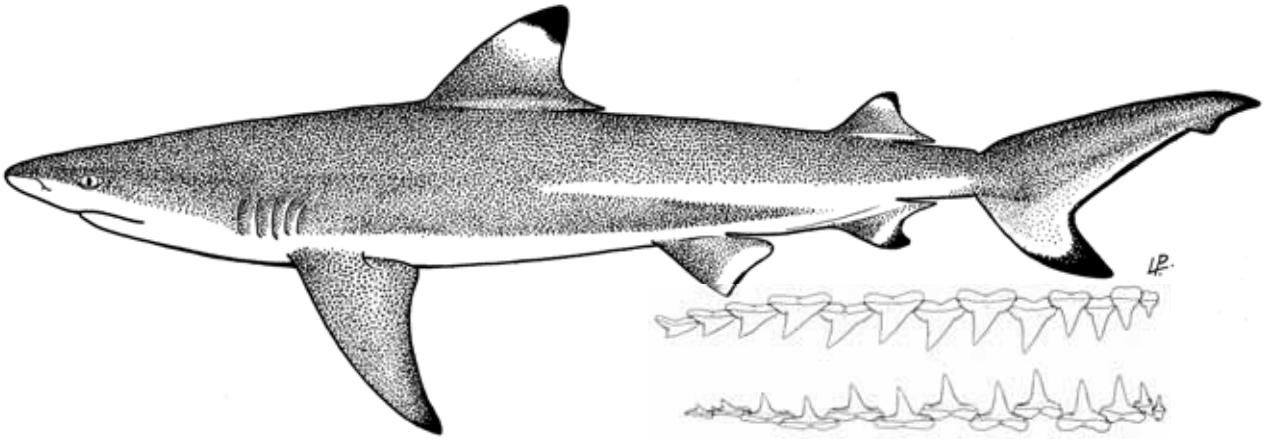
Carcharhinus limbatus (Valenciennes, 1839)
Snout long. Upper and lower teeth nearly symmetrical, with erect, narrow and serrated cusps. First dorsal fin more or less pointed, its origin above or just behind pectoral fin base. No dermal ridge between dorsal fins. Dark band along flank to about ventral fins, tips of latter consistently black. (Species may include *C. tilstoni.* White pers comm. 2019).



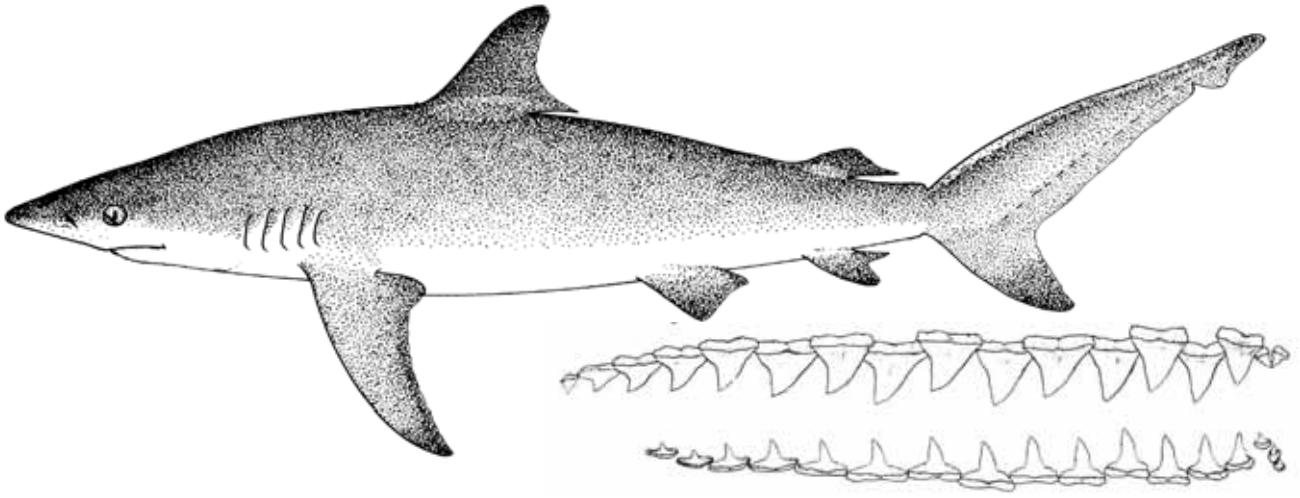
Carcharhinus longimanus (Poey, 1861)
Snout short and broadly rounded. Upper teeth triangular, with a broad heavy, serrated, mostly erect cusp. First dorsal fin noticeably large, with a broadly rounded apex; pectoral fins very long, tips broadly rounded. A dermal ridge between dorsal fins.



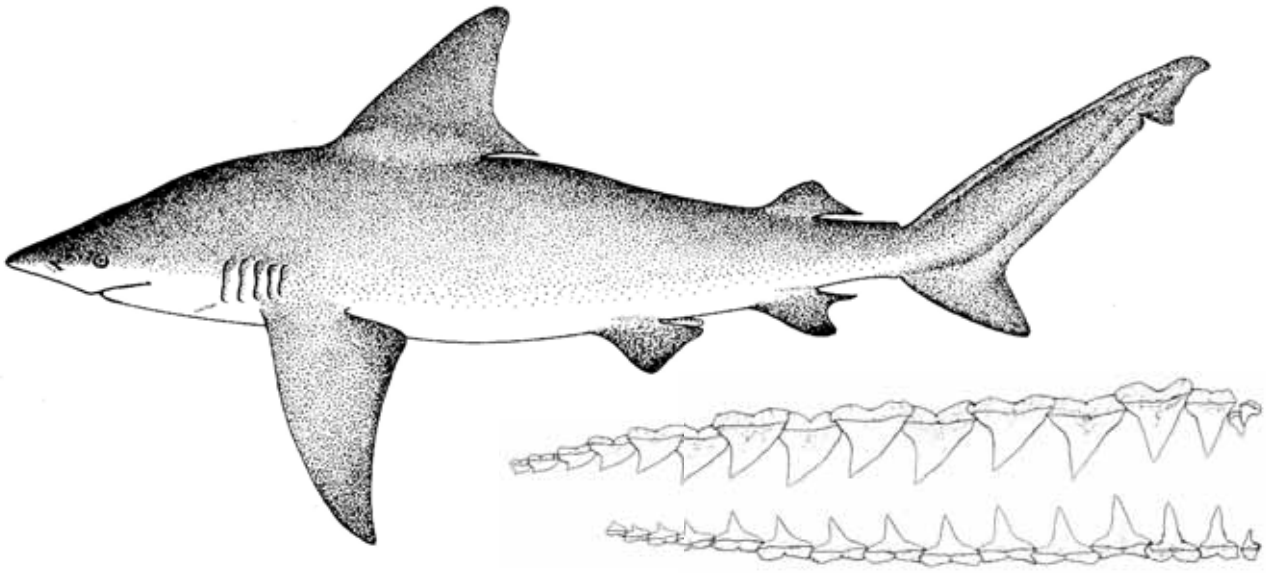
Carcharhinus macloti (Müller & Henle, 1839)
Snout very long and narrowly rounded or pointed. Teeth with smooth edges, those in upper jaw with an oblique or nearly erect cusp flanked by strong cusplets. Lower tip of first dorsal fin very elongated; second dorsal fin very low, inner margin more than twice fin length. No dermal ridge between dorsal fins.



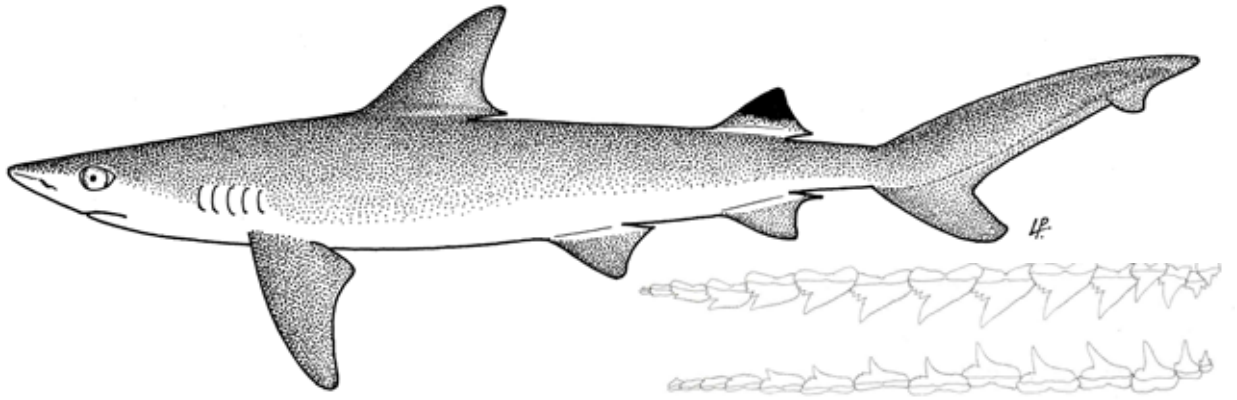
Carcharhinus melanopterus (Quoy & Gaimard, 1824)
Snout very short and broadly rounded, its length less than mouth width. Upper teeth more or less oblique, with a narrow cusp and low basal cusplets. Second dorsal fin fairly high. No dermal ridge between dorsal fins. Back yellow-brown; all fins with black tips, that of first dorsal fin with a whitish band below.



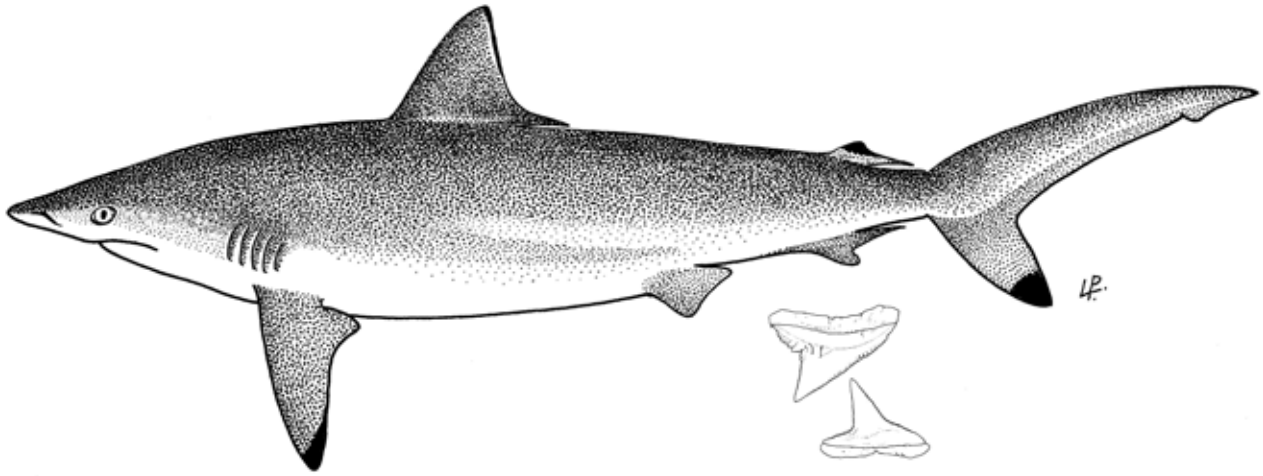
Carcharhinus obscurus (Lesueur, 1818)
Snout short and rounded, its length less than mouth width. Upper teeth broadly triangular. First dorsal fin relatively small, its front margin arched; second dorsal fin low. A low dermal ridge between dorsal fins.



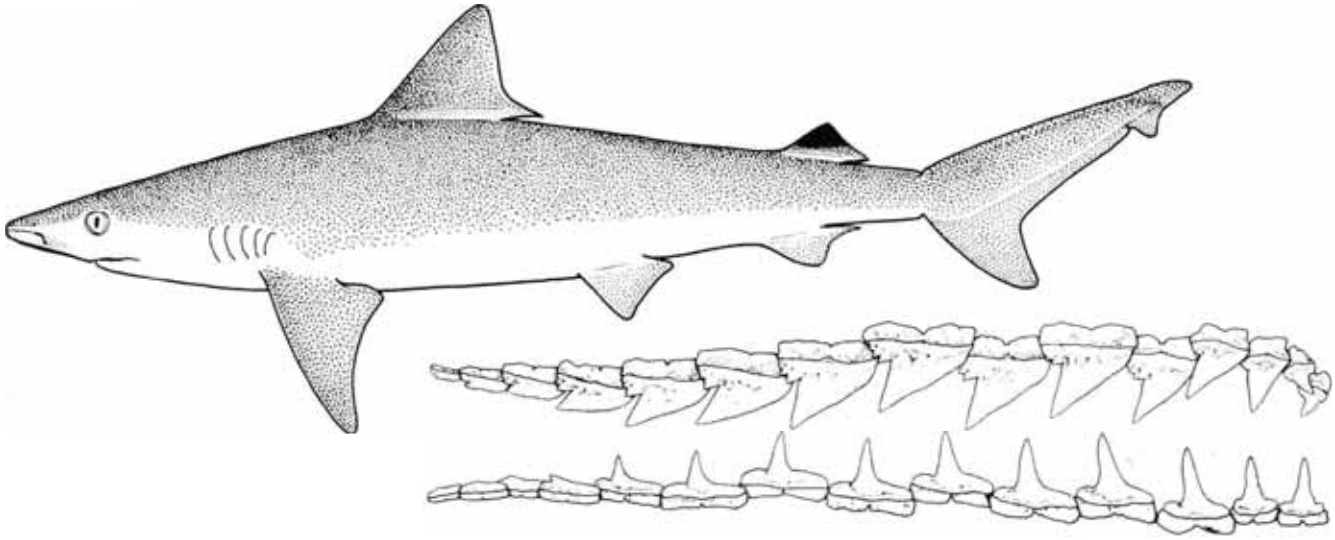
Carcharhinus plumbeus (Nardo, 1827)
Snout short and broadly rounded, its length less than mouth width. Teeth with finely serrated edges, those in upper jaw broadly triangular. First dorsal fin very high and triangular, its origin over base of pectoral fins. A dermal ridge between dorsal fins.



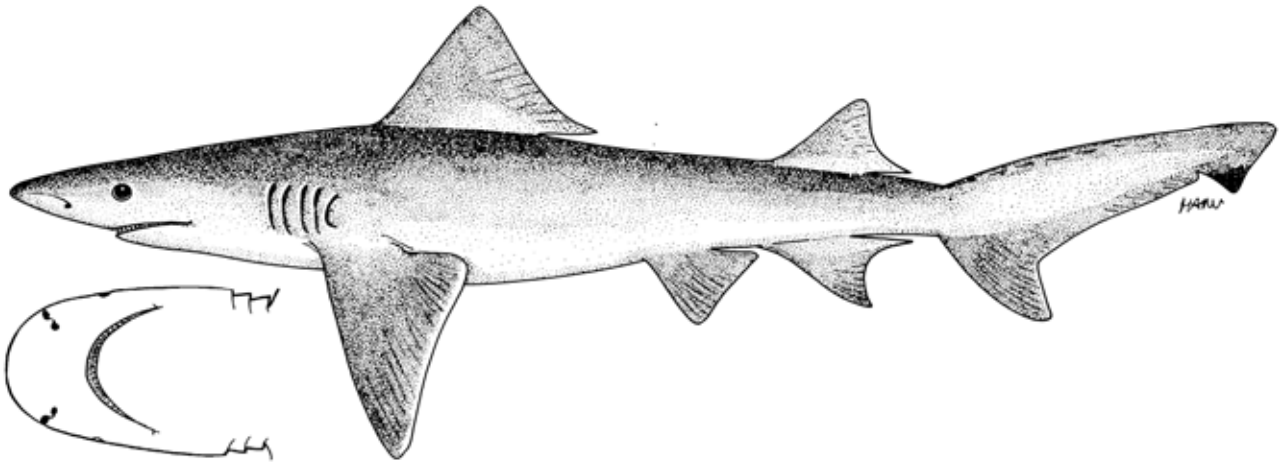
Carcharhinus sealei (Pietschmann, 1913)
Snout rather long and narrow parabolic or wedge-shaped. Teeth with serrated edges, those of upper jaw with a narrow based, strongly oblique cusp and strong, smooth cusplets. First dorsal fin moderate, second dorsal fin high. A dermal ridge between dorsal fins. Top of second dorsal fin with black spot. (Australian species now *C. coatesi* - previously called *C. dussumieri*. W. White pers. comm. 2009)



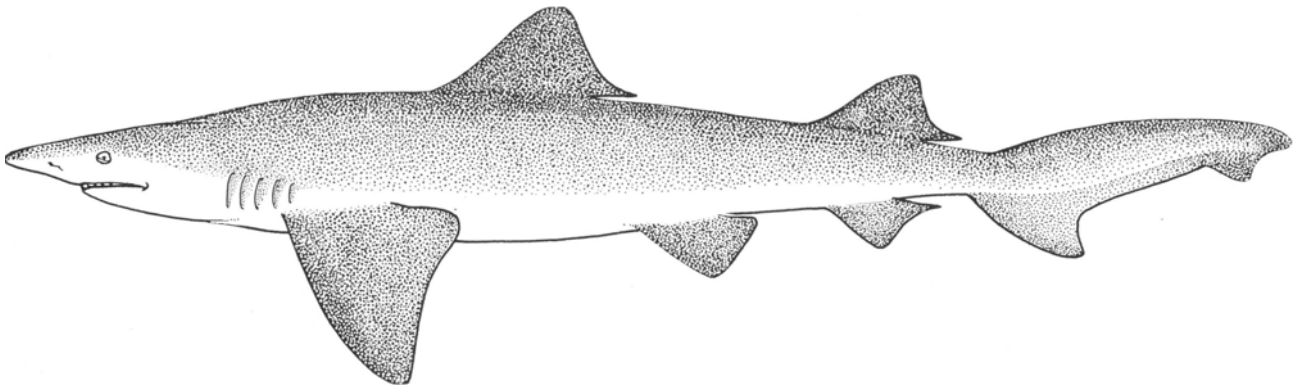
Carcharhinus sorrah (Valenciennes, 1839)
Snout moderately pointed, parabolic and long. Upper teeth with a more or less oblique, narrow, serrated cusp and strong cusplets. Second dorsal fin low, with elongate lower tip over twice fin height. A dermal ridge between dorsal fins. Pectoral, second dorsal and lower caudal fin lobe black.



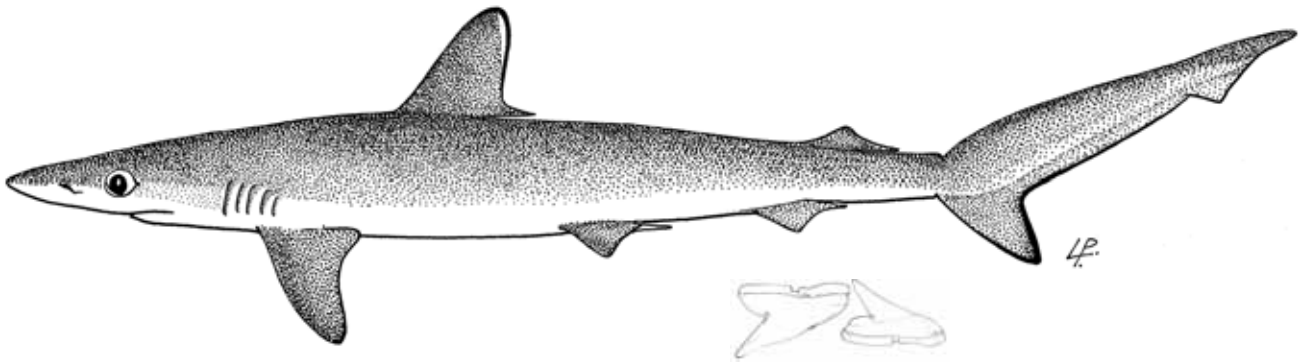
Carcharhinus tjutjot (Bleeker, 1852)
Snout moderately long and broadly parabolic or wedge-shaped. Upper teeth with a narrow-based strongly oblique cusp and strong, serrated cusplets. First dorsal fin not falcate. A dermal ridge between dorsal fins (occasionally absent). Black spot on second dorsal fin.



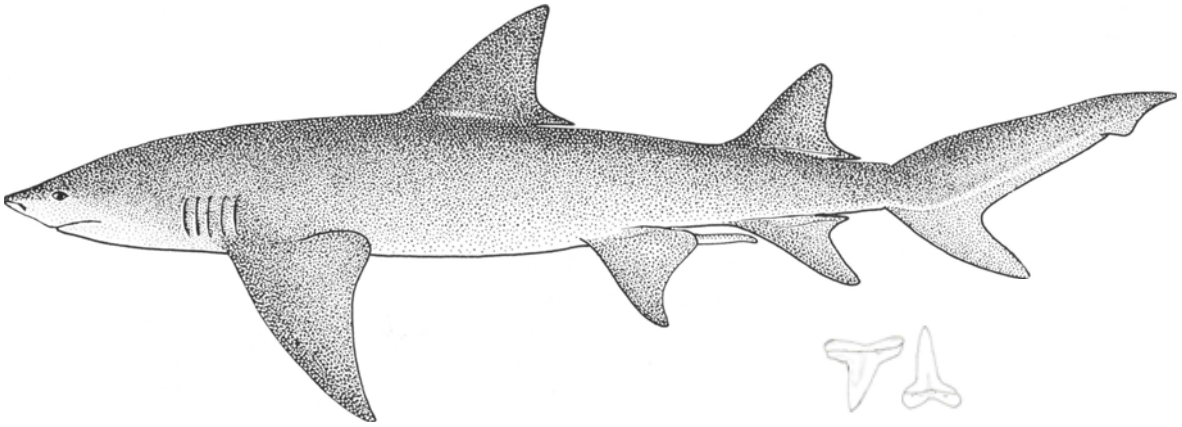
Glyphis garricki Compagno, White & Last, 2008 or ***G. glyphis*** (Müller & Henle, 1839)
Snout short, rounded, less than mouth width; eyes very small. Upper teeth triangular, with a broad, high, serrated cusp; lower teeth long, hooked, protruding when mouth closed. Origin of first dorsal fin over pectoral fin base. No dermal ridge between dorsal fins.



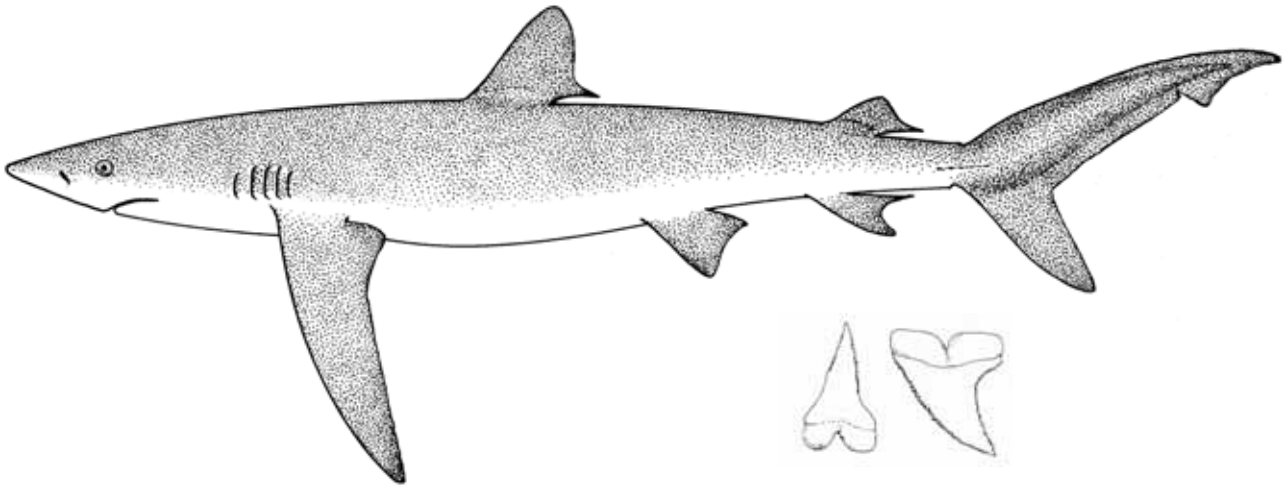
Lamiopsis tephrodes (Fowler, 1905)
Snout moderately long, parabolic in shape. Upper teeth broadly triangular, erect or semi-oblique, serrated, no cusplets; lower teeth slender, erect, hooked, smooth, no cusplets. Second dorsal fin almost as large as first. No dermal ridge between dorsal fins.



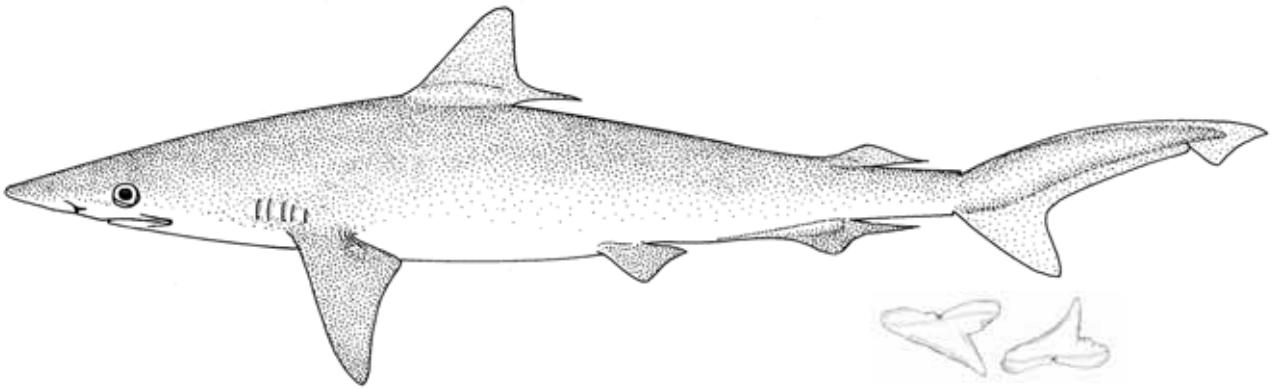
Loxodon macrorhinus (Müller & Henle, 1839)
Small, slender species (usually to about 70-80 cm TL.). Snout very long, parabolic in shape; hind edge of eye with distinct notch. Teeth low, cusp narrow, oblique, smooth, no cusplets. First dorsal fin small, second dorsal fin beginning just behind anal fin base. Usually no dermal ridge between dorsal fins.



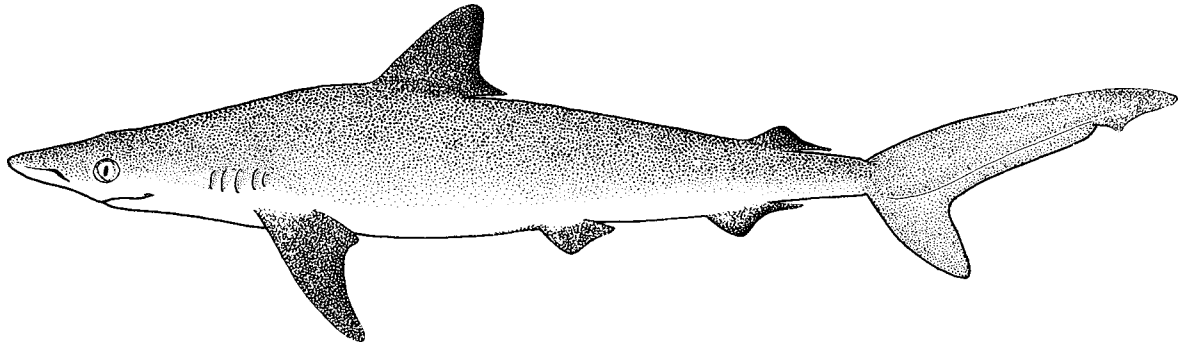
Negaprion acutidens (Rüppell, 1837)
Snout short, broadly rounded. Teeth narrow, erect at front of jaws, becoming oblique, cusps smooth-edged, no cusplets. Second dorsal fin almost as large as first. No dermal ridge between dorsal fins.



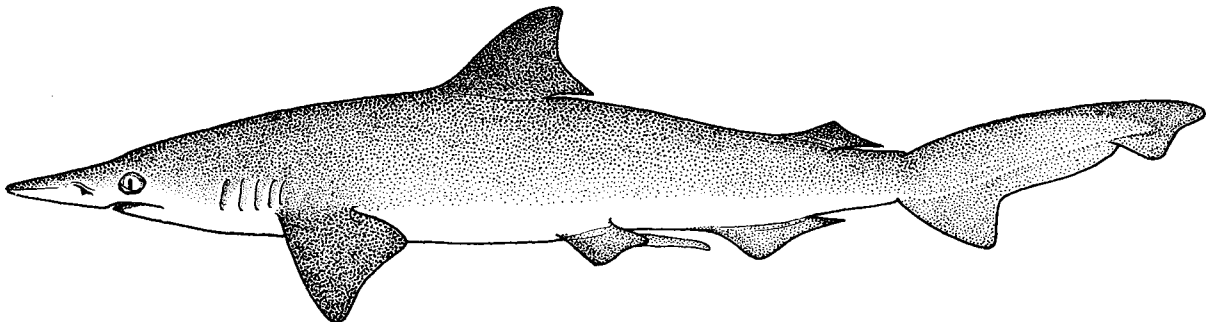
Prionace glauca (Linnaeus, 1758)
Body very slender; snout long and narrow rounded. Upper teeth broadly triangular, curved, serrated. Inner gill arches with gillraker papillae (visible through open mouth). Pectoral fins very long, narrow, somewhat falcate. A weak keel on either side of caudal peduncle. Back dark blue, sides bright blue.



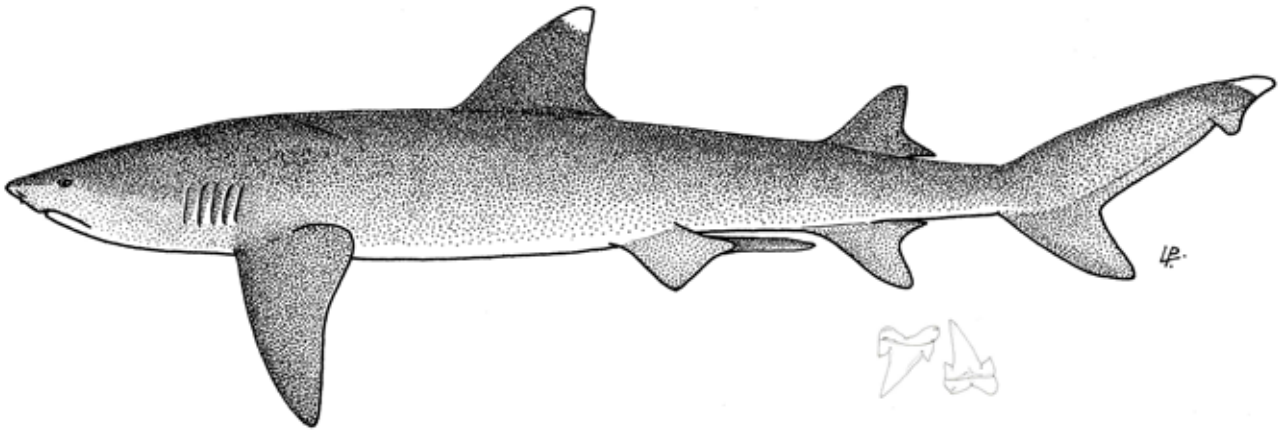
Rhizoprionodon acutus (Rüppell, 1837)
Small slender species (usually to about 60-70 cm TL.). Teeth low-crowned, oblique, narrow-cusped, outer edges deeply notched, no cusplets. Second dorsal fin smaller than anal fin, origin of latter distinctly before former; long paired ridges before anal fin.



Rhizoprionodon cf taylori (Ogilby, 1915)
Snout long with a narrowly-rounded tip, small labial furrows confined to the corners of the mouth, and 7-11 pores on either side of the mouth; eye relatively large; interdorsal ridge occasionally present; origin of second dorsal fin behind origin of anal fin. Jaw teeth deeply notched, oblique and narrowly triangular with smooth edges.



Scoliodon macrorhynchos (Bleeker, 1852)
Snout long and extremely flattened; slender body and tail; smooth-edged teeth with slender, strongly oblique, blade-like cusps and no cusplets; anterior teeth strongly sexually dimorphic, for adult males greatly elongate and flexuous; total tooth row counts 25-28/23-28 rows or 48-56 total rows; second dorsal fin origin well posterior of anal fin origin, about opposite posterior third of anal-fin base;



Triaenodon obesus (Rüppell, 1837)
Snout very short, broadly rounded, less than mouth width. Teeth with a high, narrow, smooth-edged cusp and strong cusplets on each side, no serrations. Second dorsal fin large, more than half height of first. No dermal ridge between dorsal fins. Tips of first dorsal fin and upper caudal fin lobe white.

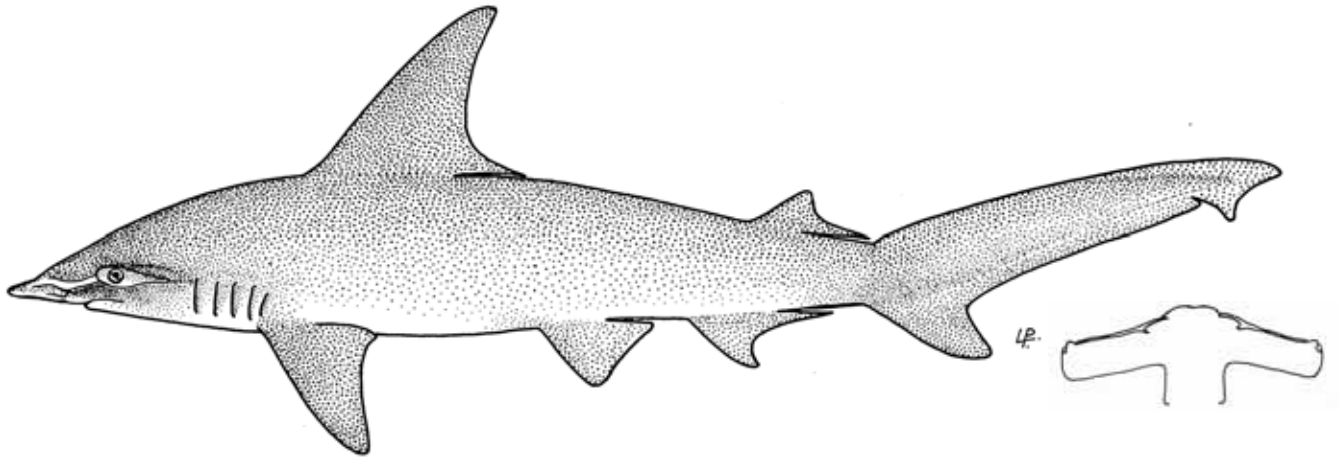
SPHYRNIDAE

Hammerhead sharks - Cucut martil

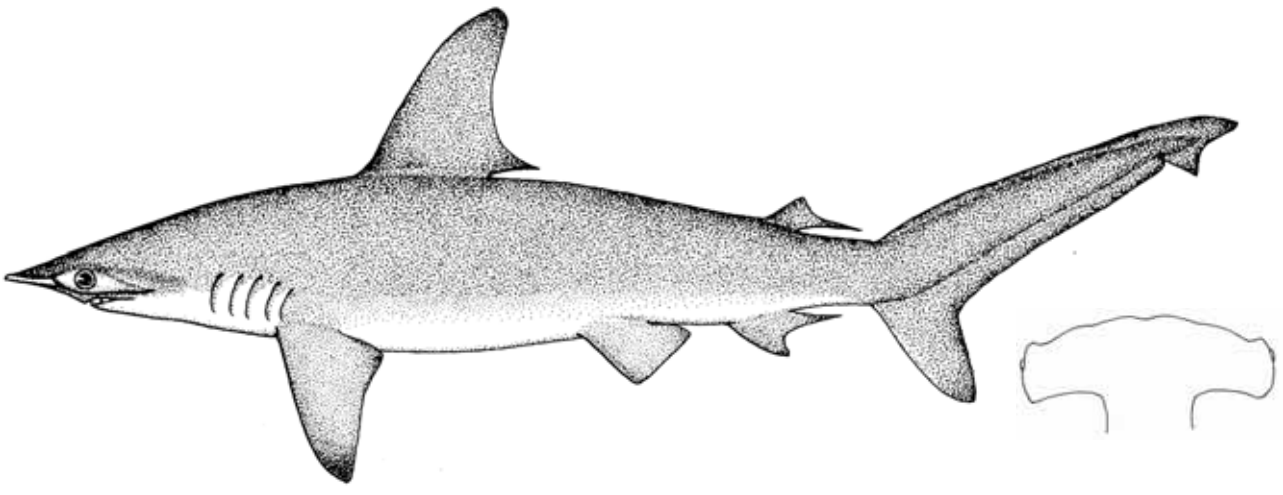
Medium to large sharks (to 600 cm, possibly more), found in all warm seas. Body elongate and moderately slender. Front of head greatly flattened and expanded into 'hammer' or 'spade' shape, the eyes at outer edges. Mouth ventral, crescentic, teeth blade-like, with a single cusp. Five gill slits, the last over pectoral fins. Two dorsal fins, the first short-based, high and well before ventral fins, the second much smaller, anal fin present, a little larger than second dorsal fin; caudal fin strongly asymmetrical, but lower lobe well defined. Hammerhead sharks are viviparous (give birth to fully-formed young which have been nourished by a 'placenta' formed from the yolk sac). Species often placed in a single genus, *Sphyrna*, but recent work suggests two genera in the present area.

Eusphyra : expanded lateral blades of head very narrow and wing-like, with distinct bumps along front edge.

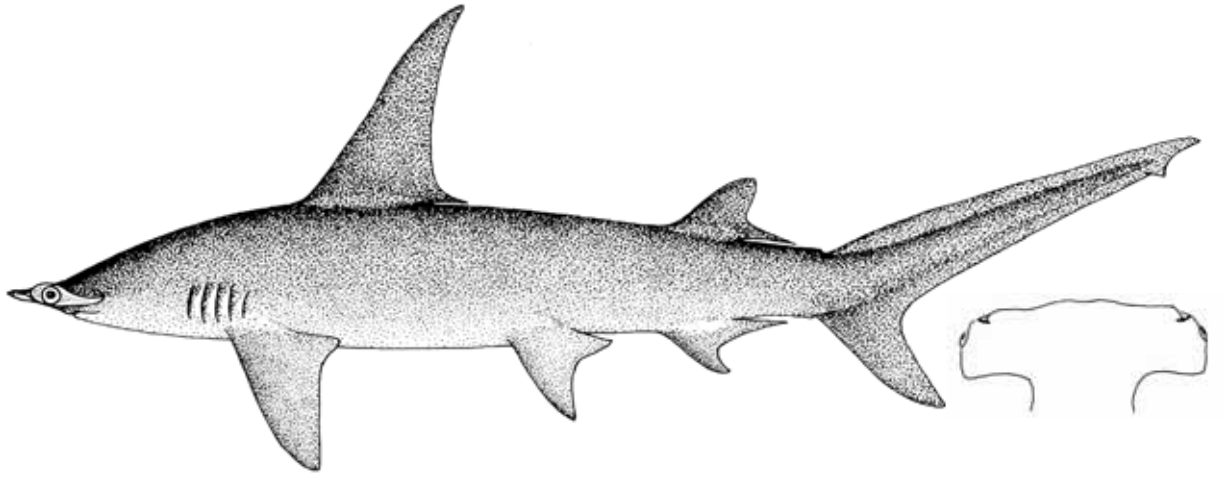
Sphyrna : expanded lateral blades of head relatively broad, not wing-like, without anterior bumps.



Eusphyra blochii (Cuvier, 1816)
Lateral expansion of head wing-like, somewhat resembling an aeroplane when seen from above or below, the wings long and narrow; front edge of expansion with distinct bumps; nostrils greatly elongated, wider than mouth. First dorsal fin high and falcate.



Sphyrna lewini (Griffith & Smith, 1834)
Lateral expansion of head more or less arched in front, with a shallow but distinct indentation at centre. Ventral fins with nearly straight hind margin; anal fin base distinctly longer than second dorsal fin base.



Sphyrna mokarran (Rüppell, 1837)
Lateral expansion of head more or less straight in front, with a shallow but distinct indentation at centre. First dorsal fin strongly falcate; ventral fins with deeply concave hind margin.

RAYS (BATOIDEA)

The batoid fishes are distinct from the sharks by having the pectoral fin attached to the side of the head, no free upper eyelid, the 5 (rarely 6) gill openings ventrally placed and well-developed spiracles. Most batoids have a very depressed body with the pectoral fins expanded sideways, giving a disc-like shape, and the tail marked off from the rest of the body. Eyes and spiracles are on the dorsal surface, mouth on the ventral surface. The sawfishes (PRISTIDAE) and less so the other four families (RHINIDAE to TRYGONORRHINIDAE) have a shark-like body but the position of the gill openings and pectoral fins indicate their affinity with the remaining batoid fishes. Within the group, there is no anal fin, a caudal and dorsal fin(s) are present or absent, the ventrals are expanded sideways; the cloaca is separate from the ventral fins and the skin is naked, prickly or with tubercles or thorns.

Representatives of 18 of the 26 families of batoid fishes were obtained during the JETINDOFISH Survey. Initial identification of this material was more than difficult, for a number of reasons. There were problems encountered during the Survey itself (larger specimens were photographed only on the dorsal surface and then often discarded because of insufficient storage facilities; many specimens were also mutilated after capture); and many specimens could not be identified within the project time-frame.

Dr. William White, Dr. Peter Last, and Mr. John Pogonoski all provided exceptional assistance with identification for this update.

REFERENCES: Last, 2004; Last, White, de Carvalho, Seret, Stehmann & Naylor, 2016; Last, White & Fahmai, 2006; Last, White & Pogonoski, 2008; Last & Gomon, 1987; Notarbartolo-di-sciona, 1987; Last, 1987; Finucci, White, Kemper & Naylor, 2018.

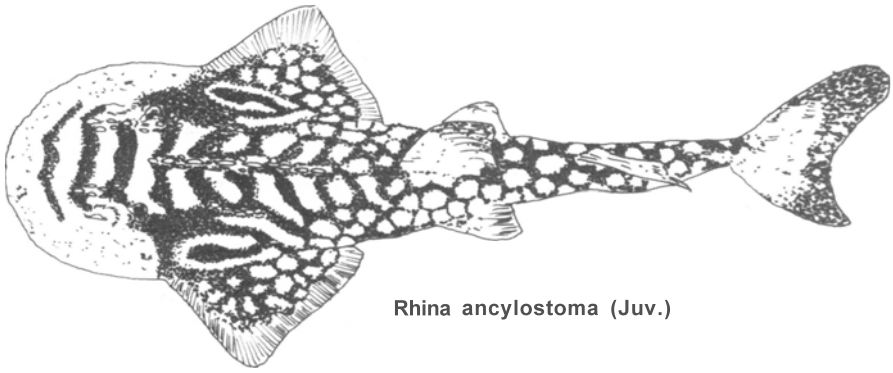
RHINIDAE

Wedgefishes - Napeh, Kekeh

These rays have moderately depressed body and thick powerful tail which is slightly longer than the rest of the body. The snout is narrow and pointed and moderately large. The pectoral fins are angled out from the head and are well separated from anterior margin of pelvic fins. The first of two well-developed, triangular dorsal fins begins above or just before the ventral fin bases. Two distinct pointed lobes form the caudal fin which has a concave posterior margin. There are 2 low vertical ridges or skin folds along the hind border of the spiracles, mouth is small and horizontal. A process at the middle of the lower jaw fits into an opposing notch on the upper jaw when the mouth is closed.

The family comprises three genera and 10 species. Two genera, three species found in the survey area.

Size: attains nearly 3 m in length.



Rhina ancylostoma (Juv.)

Rhina ancylostoma Bloch & Schneider, 1801

Eye slightly smaller than spiracle; nostril large and oblique; row of enlarged, coarse tubercles along midline of back, additional rows along shoulder and above eye. Adults plain brown, sometimes with few white spots and dark lines; juveniles grey-blue with bold pattern of white and blue lines and spots, black shoulder spot and rosy caudal fin. Material: TGT1379 (from 08° 46'S., 115° 02'E.); drawing of juvenile specimen from Area C (not kept); CSIRO CA2983; determined by P. Last & CSIRO. Areas A, B, C.

Rhynchobatus australiae Whitley, 1939

Large eyes placed just before smaller spiracles; nostrils large and oblique; many tubercles in a row along midline of back and tail, patches of tubercles on each shoulder. Dorsal surface yellowish to dark brown, large dark brown or black spot on each shoulder, white spots along disc margin and side of tail.
Material: TGT3184 (from 08° 58'S., 116° 31'E.) and TGT2567 (from 01° 57'S., 99° 26'E.), det by M. Stehmann, P. Last & CSIRO on photo. Areas A, B, C.

Rhynchobatus palpebratus (juv)

Rhynchobatus palpebratus Compagno & Last, 2008

It is distinguished by its broader snout and usually a ring of 4 white spots around the black shoulder spot. Dorsal surface dark yellowish or greyish. Thorns very small and partly embedded along midline.
Material: CSIRO CA2373. (13ºS, 136ºE, det by L. Compagno & P. Last. Area C.

RHINOBATIDAE

Guitarfishes; Shovelnose rays - Kekeh

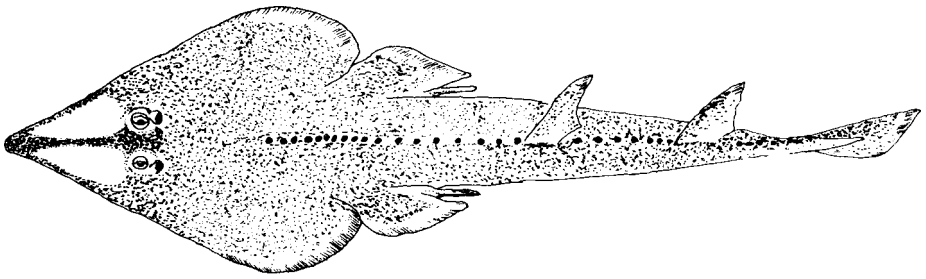
These rays are similar to the RHINIDAE in possessing a long, thick and powerful tail and 2 well-developed dorsal fins, however, the trunk is strongly depressed. They can be distinguished by the pectoral fin extending backwards as far as or farther than the pelvic fin origin, the first dorsal fin originating noticeably behind the posterior tip of the ventral fin and the well-developed caudal fin without a distinct lower lobe. The snout is wedge-shaped, either obtuse or prolonged; mouth and upper lip almost straight. Large nostrils not greatly elongated, length usually only just exceeding inter-nasal distance; anterior nasal opening circular or oval.

Size: 1.2m -2m in length.

A large family of three genera and 35 species. We obtained a poor sample of rhinobatid fishes but from the photographs and few specimens examined, it appears that only *Rhinobatus* is represented in the Survey material:

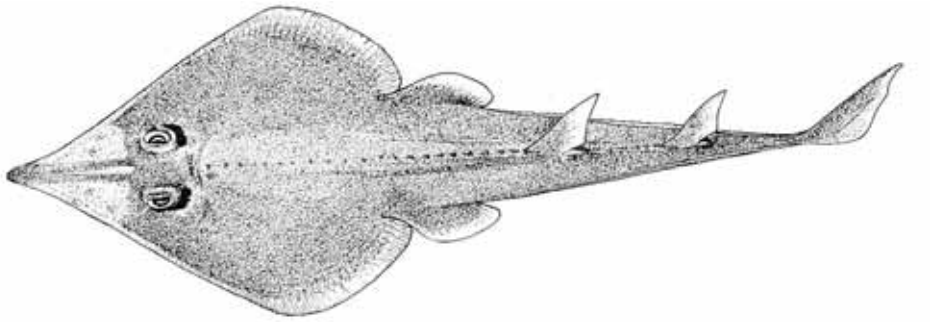
Rhinobatos sainsburyi Last, 2004

Body pale yellowish brown dorsally, with dense cover of faint dusky blotches (blotches sometimes absent or more golden); somewhat paler near hind margin of pectoral fin; paler yellowish to white on lateral snout, anterior edge of orbit, lateral cutaneous fold of tail, and between ridges of rostral cartilage; nasal capsules not sharply demarcated from lateral snout; snout tip and fins plain. Ventral surface uniformly white; no dark tip on snout apex.
Material: CSIRO CA2863 (from 18° 20'S., 118° 27'E.). CSIRO CA1257 (from 19° 50'S., 115° 59'E.). TGT (PJPW) 803. det W. White. Area A, C.



Rhinobatos sp. cf jimbaranensis Last, White & Fahmi, 2005

Dorsal surface brown, speckled dark and light; front nostril valve not extending inwards much past level of inner nostril edge; snout long; rostral ridges close together for most of their length; mouth width 3.5 in snout length. Indonesian only, not occurring in Australia (W. White pers. comm. 2019). det. P. Last



Rhinobatos sp.1

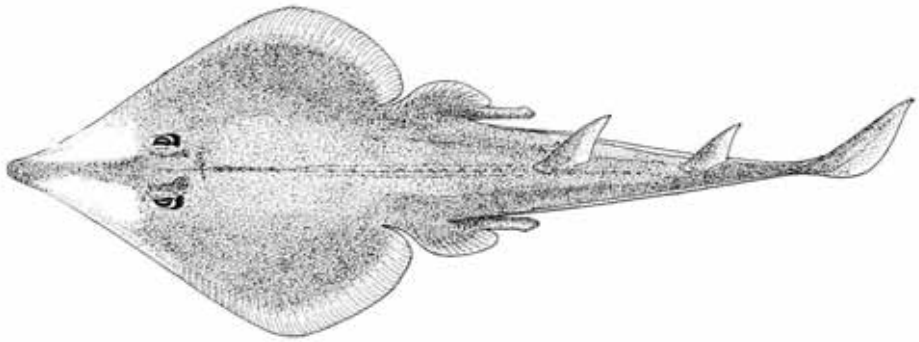
Plain brown dorsal surface, fins light brown. It is possible that this specimen is a female of *R. jimbaranensis.* Material: TGT2606 (from 08° 33'S., 114° 31'E. Area A, B. (det PK on drawing.

GLAUCOSTEGIDAE

Giant Guitarfishes -

Large rays with a flattened, spade-like to wedge-shaped disc with a robust, depressed shark-like trunk. Mouth and upper lip almost straight. Nostrils relatively oblique; long and narrow, length greatly exceeding internasal distance; anterior nasal opening retangular. Skin covered with fine denticles with small thorns along mid-line of body and on patches near eyes and shoulder. The small caudal fin lacks a ventral lobe. Colour is plain brownish or greyish with anterior craniun and rostral cartilage sharply demarcated from a much paler translucent snout. No stripes, spots or blotches.

Size: 2m to more that 3m
A single genus



Glaucostegus typus (Bennett, 1830)

Dorsal surface brown, side of snout and tail fins grey or fawn; front nostril valve extends well onto space between nostrils which is about equal to nostril length; snout very long, narrow, rostral ridges close together for most of their length; mouth width 2.6-3.3 in snout length.
Material: TGT 1659 (from 08° 57' S., 116° 57'E.). det. P. Last. Area B.

TRYGONORRHINIDAE

Banjo rays -

Small to large guitarfishes (with adults reaching 1.5 m TL) with a broad suboval or wedge-shaped disc and depressed trunk; snout very long and pointed or broadly rounded; spiracle with one well developed fold (*Trygonorrhina*) or single fold weak or absent (*Aptychotrema, Zapteryx*); nostrils is almost horizontal; mouth and upper lip distinctly curved; skin with medium-sized to very large thorns in row along midline of body; tail with well-developed lateral skin folds extending along its ventrolateral margin; ventral fins are short- to long-based; two dorsal fins well separated, first well to slightly behind rear tips of pelvic fins; small caudal fin, lacking an extended ventral lobe.

Aptychotrema vincentiana (Haacke, 1885)

Dorsal surface brown, hind spiracle margin smooth, without folds or ridges; nostrils transverse, lobes from their anterior margins well-separated. Nostrils slightly oblique, 2 spiracular folds feebly developed.
Material: CSIRO CA1259 (from 19° 38'S., 117° 44'E.). det. P. Last.

Aptychotrema timorensis Last, 2004

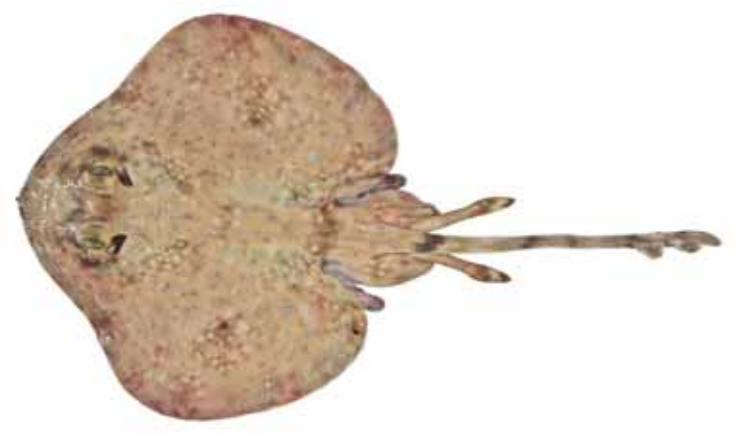
Characterised by narrow snout apex, disk width 48% TL, eye diameter = interorbital width, first dorsal fin 6% TL, caudal fin 12% TL; dorsal aspect of body with scattered white spots over brown dorsal surface, spines in rows and patches on disc, tail strong and compressed.
Material: CSIRO CA1258 (from 10° 14'S., 130° 03'E.). det. P. Last; BMNH unregistered - PJPW 103 (08° 45'S, 114°, 17'E). Area B, C. Holotype.

ARHYNCHOBATIDAE

Softnose skates -

Small to large rays with heart-shaped or rhomboid disc, pectoral fins broadly rounded to pointed, and a variably angular and flexible snout, sometimes with a prominent lobe at tip. Tail very slender, with lateral folds, usually 2 reduced dorsal fins and a reduces caudal fin. Electric organs weak, developed from caudal muscles. Skin prickly in most species, the prickles often in a row along midline of dorsal. Thorns usually present on tail.

REFERENCE: Last, Mallick & Yearsley, 2008:



Irolita westraliensis Last & Gledhill, 2008

Small skate with a smooth subcircular disc, rather long tail usually lacking orbital thorns, dense coverage of greyish pores ventrally and widely spaced bluish spots dorsally on brown skin. Snout very short, broad, flexible, lacking a firm rostral cartilage with a minute fleshy lobe at tip.
Material: CSIRO CA2800 from 19° 44'S., 117° 58'E., det. P. Last. Area C

RAJIDAE

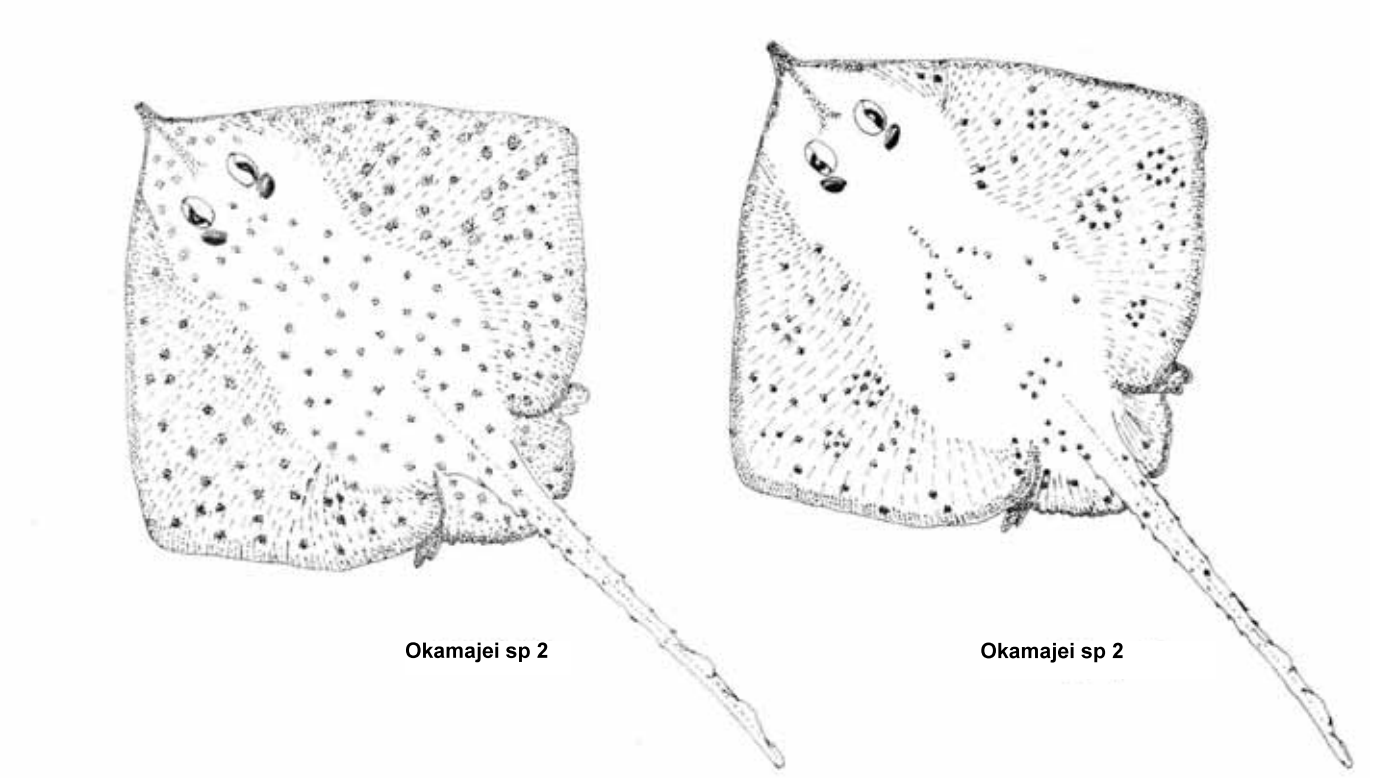
Skates, Hardnose Skates -

Members of the skate family have a rhomboid, sometimes almost circular disc and a narrow, often short tail. The 2 dorsal fins are small and placed near the blunt tail tip which lacks a caudal fin, or the caudal is represented by a low fold mostly on the dorsal tail surface. The large ventral fins are formed into 2 lobes. There is a definite snout supported by a strong rostral cartilage and not easily bendable. The nasal curtain from the small nostrils is large and joined to the median isthmus before the mouth. Rows of small spines and granules often cover the surface of the tail and mature males (with prominent claspers) have patches of sharp spines on the disc edge anteriorly. This is a widespread family with about 17 genera but several unnamed genera and species are known to exists.

Although the Survey specimens of RAJIDAE are distinctive in their colouration. Most cannot easily be assigned to species because of insufficient comparative material.
Size: up to 1.7m in length.

Okamejei sp. 1

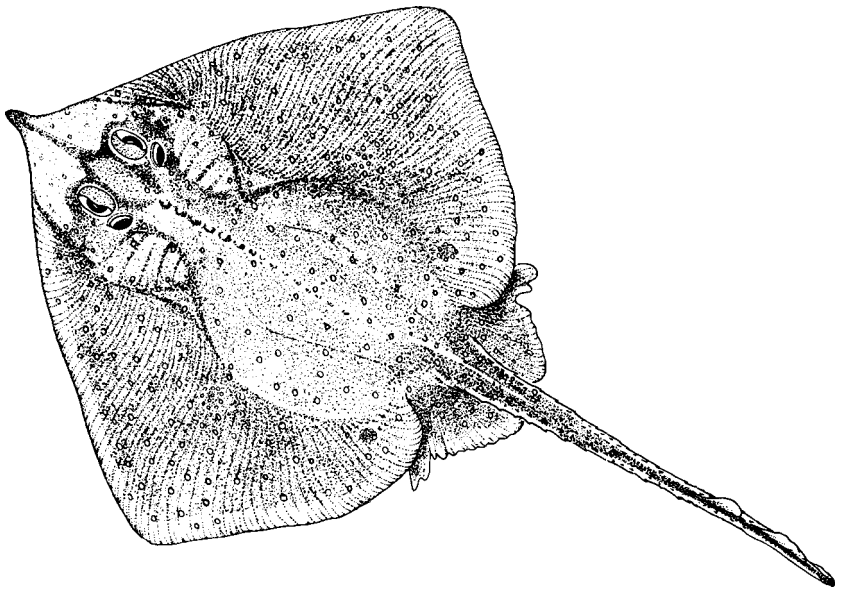
Dorsal surface brown with pattern of many fawn or grey spots and cream circular blotches; small circular cream ocellus edged black and surrounded by many white spots on inner part of each pectoral fin. No thorns on body behind shoulder. About 70 tooth rows in upper jaw.
Material: TGT3221 (from 09° 01'S., 116° 18'E., det. and diagnosed M. Stehmann, ZMH 120386). Area A.



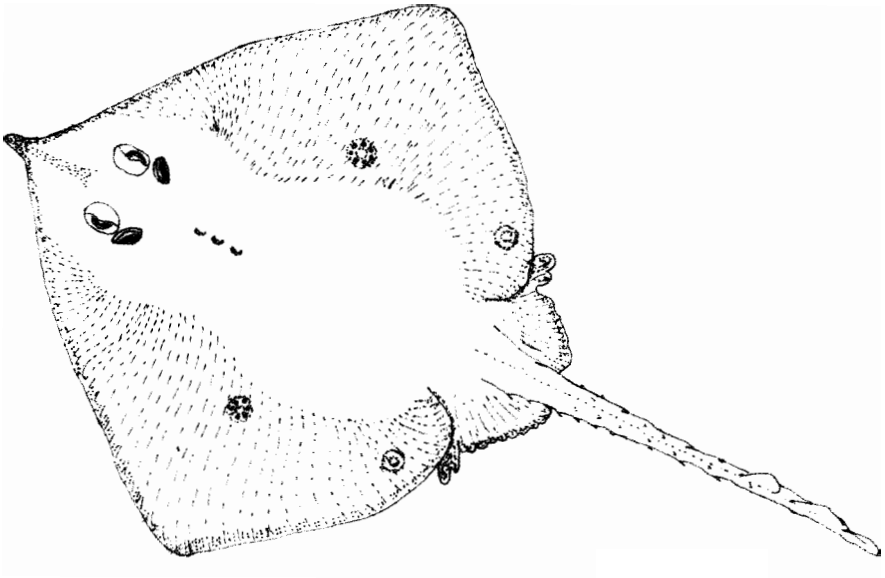
Okamajei sp 2

Okamajei sp 2

• **Okamejei sp. 2**
Dorsal surface dark grey to dark brown with many dusky yellow spots and circular blotches evenly scattered over disc, ventral fins and tail sometimes forming clusters on pectoral fin. Lower surface white with grey patches. Median row of thorns from nape to first dorsal, parallel thorn rows on tail anteriorly. About 56-61 tooth rows in upper jaw.
Material: TGT(PJPW)768 (from 98° 37'S., 115° 59'E., NTM S.10766-002) (Fig 2); TGT(PJPW)769 (same data, NTM S.10766-002). both det. and diagnosed M. Stehmann. Area B.



• **Raja (Okamejei?) sp. 1**
Material: TGT2604 (from 08° 33'S., 114° 31 'E., det. M. Stehmann on photo)

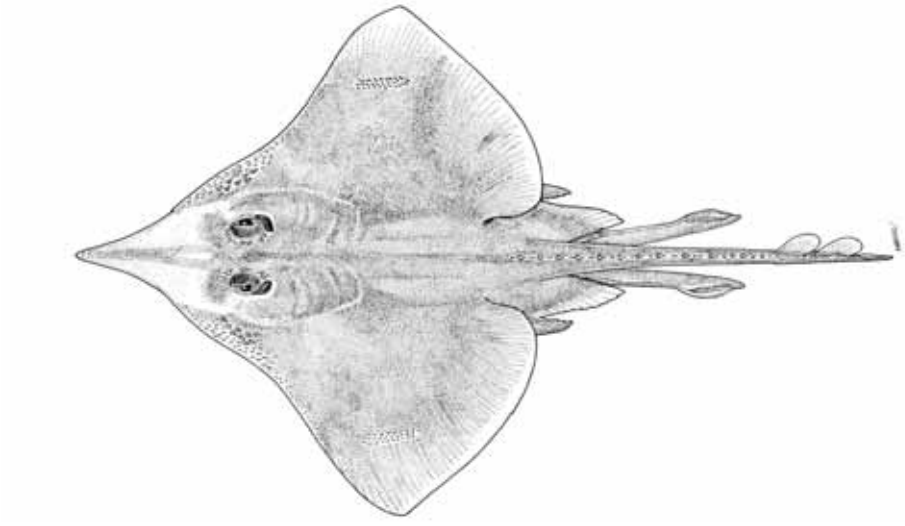


***Okamejei sp. 3**

Dorsal surface dark brown with pattern of many black dots, a pale ocellus margined with black dots on each inner pectoral fin and small circular patch of black spots at each pectoral axil. Lower surface grey-brown, blotched lighter; inner side of nasal curtain dark brown; each mucus pore marked black. About 47 tooth rows in upper jaw. Additional specimens from Area C.
Material: TGT(PJPW)767 (from 08° 37'S, 115° 59'E, Lombok Strait), det. M. Stehmann, NTM S.10766-001. Area B, C.

Dentiraja falloarga (Last, 2008)

Pale yellowish grey to brownish with 2 white ocellate markings on each inner pectoral fin. Tooth row in lower jaw 34-41. Material: CSIRO CA2857 (from 18° 21'S., 118° 26'E.). det. P. Last. Area C.



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• **Dentiraja healdi** (Last, White & Pogonoski, 2008)

Uniformly pale yellowish brown, darkest near eyes, at mid-disc and along tail. paler around disc margin. Dorsal fins dusky in adults, black in juveniles. Disc anterior margin deeply concave and its apex angular.
Material: CSIRO CA2830 (from 17° 49'S., 118° 29'E. det. P. Last. Area C.

PRISTIDAE

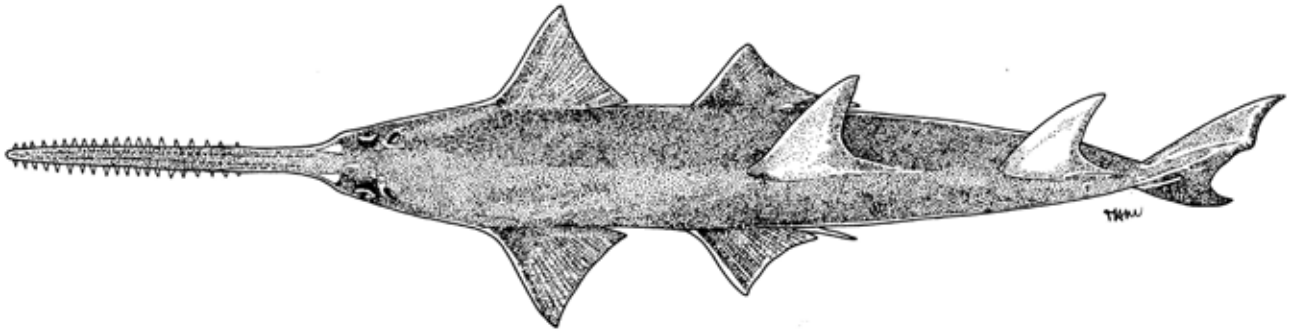
Sawfishes - Cucut gargaji; Cucut pedang; Hiyu parang

Sawfishes are very distinctive as they possess a hard, flat blade (saw or rostrum) as an extension of the snout and which has a row of stout 'teeth' along each edge. The body is thick and robust, tapering to a well-developed caudal fin which may have a lower lobe (subcaudal lobe). The pectoral fins are moderate-sized and end well before the ventral fins and there are 2 large, widely separated dorsal fins. The nostrils are placed well before the mouth. Size: attains length of 7m-8 m.

Dr. G. Dingerkus has provided us with information on this family. There are two genera and five valid species, all occurring in the Survey area.

A. Rostral teeth large and triangular, no grove on posterior margin . . . . . Anoxypristis

B. Rostral teeth long and thin, grove on the posterior margin . . . . . .Pristis



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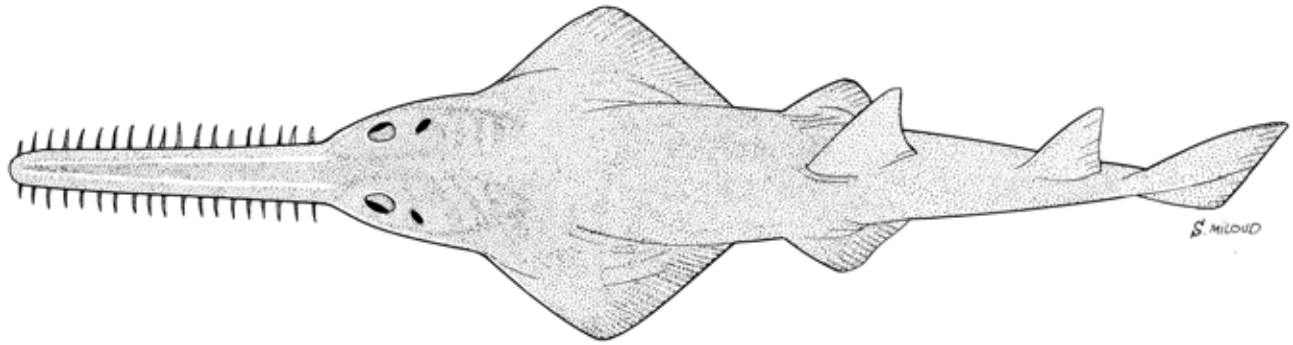
Anoxypristis cuspidata (Latham, 1794)

Body greyish when alive. The skin is virtually naked of dermal denticles. First dorsal fin originates behind the ventral fin; subcaudal lobe extremely large. The rostral teeth are large and triangular, with no groove on their posterior margin. Strictly marine species and is only found in the Indo-Pacific region.



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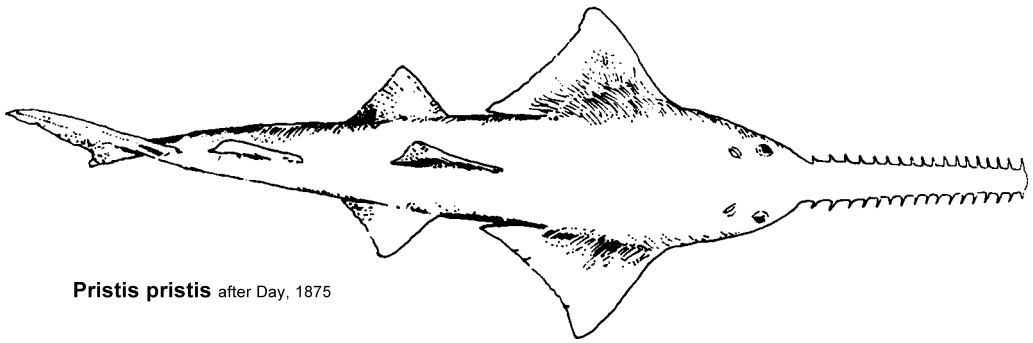
Pristis clavata Garman, 1906

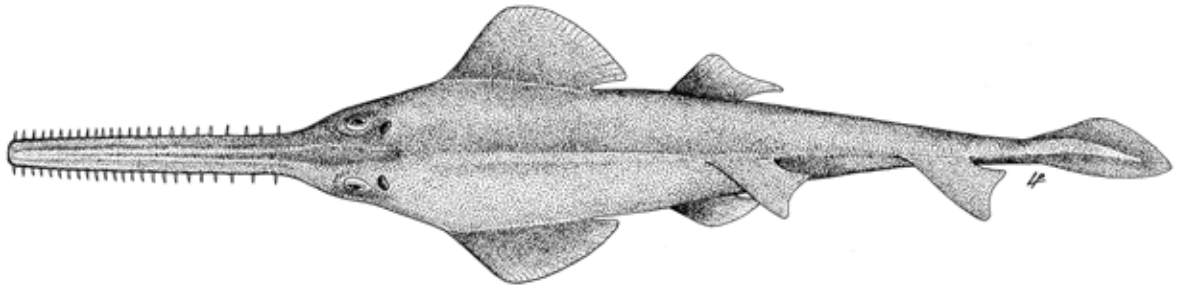
Colour greyish brown. First dorsal fin originates above the origin of the ventral fins; no subcaudal lobe present. The distance between the rostral teeth is uniform, or gradually increasing from the first to last rostral teeth. The species is marine, rarely entering rivers.



Pristis pristis after Day, 1875

Pristis pristis (Linnaeus, 1758)

Colour greyish brown. First dorsal fin originates anterior to the origin of the ventral fin; subcaudal lobe only small but distinct. Less than 22 pairs of rostral teeth, with grooves on their posterior margin. Mainly found in fresh water rivers and has a worldwide distribution.



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Pristis zijsron (Bleeker, 1851)
Colour greyish brown. First dorsal fin originates about half way above the ventral fin. The last 2 or 3 pairs of rostral teeth are separated by a much larger distance than all of the preceding ones. The species is mainly marine; rarely entering rivers and is only found in the Indo-Pacific region. *P. zysron* is an older spelling.

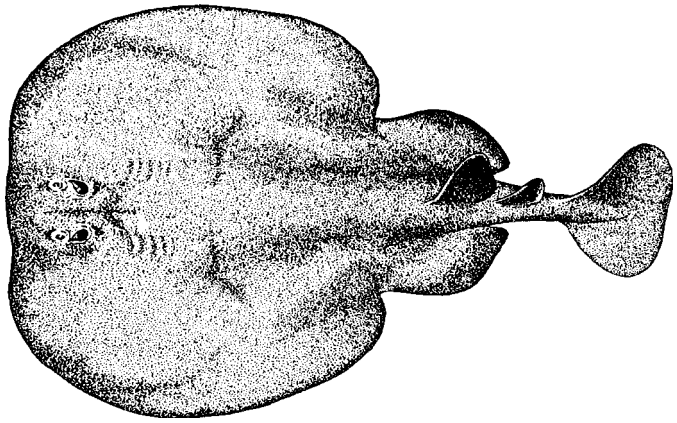
ELECTRIC RAYS

The Survey recorded specimens from 3 of the 4 families in this group of specialised fishes - TORPEDINIDAE, HYPNIDAE, and NARCINIDAE. In these, the skin is soft and all body surfaces are typically naked, the disc is thick and fleshy towards its margin, the eyes and spiracles are small and a caudal fin is present. All members of this group possess powerful electric organs which are paired and situated on each side of the anterior part of the disc.

TORPEDINIDAE

Torpedo Rays -

Disc circular, longer than tail; 2 dorsal fins, 1st dorsal origin at least partly over ventral fin base; ventrals not united anteriorly below pectoral fin; skin folds present on tail; well-developed caudal fin rounded, truncate or emarginate. Teeth with one cusp.
Size: to 2 m in length.
Species collected:



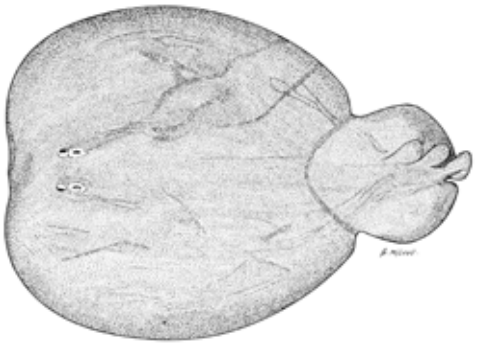
Tetronarce nobiliana (Bonaparte, 1835)

Dorsal surface uniform tan or dark grey; half base of first dorsal fin above ventral bases; caudal lobes rounded, hind margin emarginate; margins of spiracle smooth.
Material: TGT (PJPW)541 (from 07º 52'S., 109° 04' E. det. M. Stehmann on photo, BMNH 1984.4.11.3). Area A.

HYPNIDAE

Coffin Ray -

Pear-shaped, the large disc joined posteriorly with the large rounded ventral fins which unite to form a smaller disc; 2 dorsal fins placed above ventrals; tail very short, caudal small and rounded. Teeth with 2 or 3 cusps and spiracle margin fringed (see also TORPEDINIDAE and NARCINIDAE).
Size: to 0.7 m in length.
This family contains a single species



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Hypnos monopterygium (Shaw, 1795)

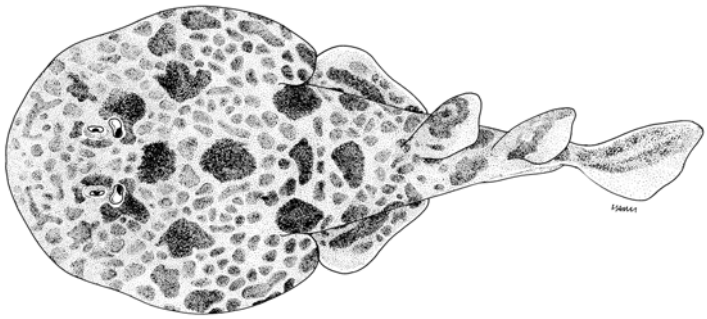
Dark brown or reddish above, white or yellowish beneath.
Material: CSIRO CA3993 (from 19° 00'S., 117° 48' E.). det. W.White. Area C.

NARCINIDAE

Numbfishes -

Disc circular or oval, slightly longer or shorter than tail; ventral fins distinct, not united; 2 dorsal fins, both situated on tail, origin of 1st above or just behind ventral bases; well-developed skin folds on side of tail; caudal fin ovate or truncate. Margins of spiracle smooth, corrugated or fringed (see also HYPNIDAE and TORPEDINIDAE).

Our material belongs to the genera ***Narcine*** and ***Narcinops*** (teeth well exposed when mouth closed; nasal curtain as broad or broader than deep).



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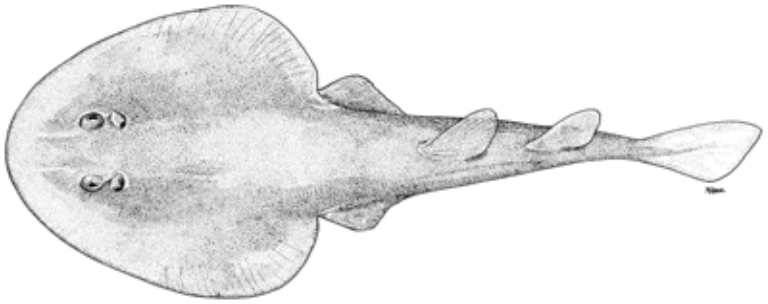
Narcine baliensis Carvalho & White, 2016

Dorsal surface pale brown, covered with symmetrical pattern of dark brown blotches and smaller spots; markings largely circular or oval. Dorsal fin blackish anteriorly, hind margin pale; caudal fin blotchy above and ventral lobe pale. Material: TGT (PJPW)766 (from 08° 37'S., 115° 59'E.). BMNH 1984.4.11.2. det. Carvalho. Area A. Holotype.

Narcinops ornata (Calvalho, 2008)

Fawn dorsal surface with elaborate patterns of dark brown spots or bands, tail banded dark brown; spiracle adjacent to and equal to eye length, margins smooth.
Material: CSIRO CA2273 (from 10° 48'S., 139° 55'E., det. Carvalho. Area C.



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• **Narcinops lasti** (Carvalho & Seret, 2002)

Dorsal surface uniformly pale yellowish, somewhat lighter over pelvic fin margins and lateral bases of tail; dorsal and caudal fins translucent. Nostrils circular with elevated rims, not divided into 2 separate openings.
Material: CSIRO CA2873 (from 18° 31'5., 118° 09'E.) det. Carvalho. Area C.

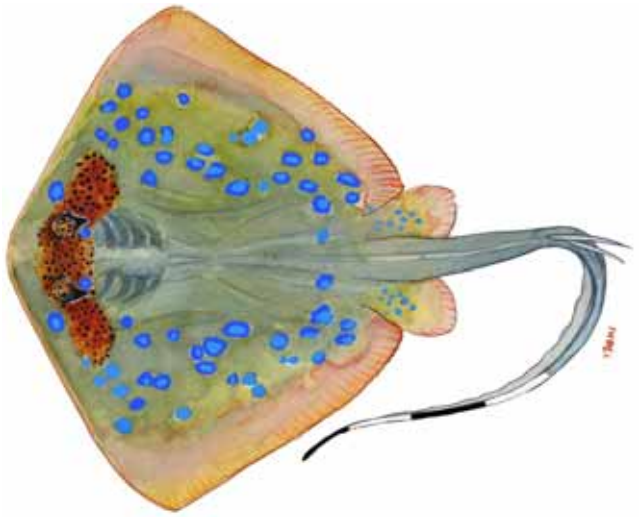
DASYATIDAE

Stingrays - Pari; Pari kembang; Pari macan

The dasyatids lack both dorsal and caudal fins and the disc is either diamond-shaped (rhombic), oval or nearly circular, not more than 1.3 times wider than long. The pectoral fin is fused to the head along its entire length, the nasal curtail is fringed and there are fleshy papillae on the floor of the mouth. The tail is slender and whip-like, much longer than the disc (when undamaged) and bears one or more long, serrated venomous spines near its base. In some species, there is a skin fold or ridge along the tail on the upper and/or lower surfaces.

Size: attains 2.5m - 3m breath of disc. These fishes were very common in Survey area.

The generic classification in the family is complex but presently contains 19 genera and at least 89 species.



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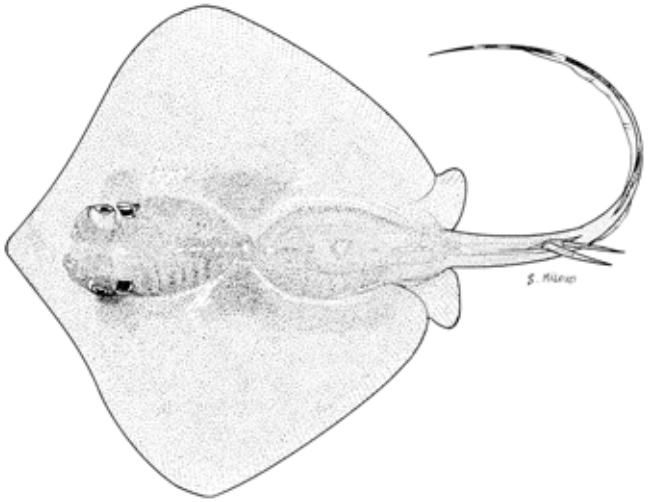
- **Neotrygon sp cf. kuhlii** (Müller & Henle, 1841)

  Disc diamond-shaped, broader than long; few or many low tubercles on midline of back; tail 1-2 times disc length. Dorsal surface colouration: brown or olive to pale pink with large blue and small black spots, or with reddish brown reticulations and grey patches, or with numerous black or reddish spots and pale reticulations. Posterior tail markings: always alternating white and blackish blue bands.
  Material: TGT2327 (from 03° 24'S., 100° 33'E.). det TGT; TGT2326 (same data); TGT1092 (from 08° 56'S., 115° 10'E.). det. Stehmann, ZMH 120534. Area A, B, C.
  Note. *Neotrygon kuhlii* is endemic to the Solomon Islands but there are several species in the 'kuhlii complex'. W. White pers comm. 2020.



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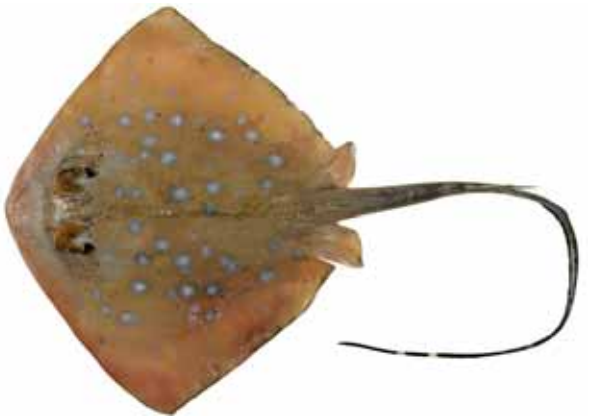
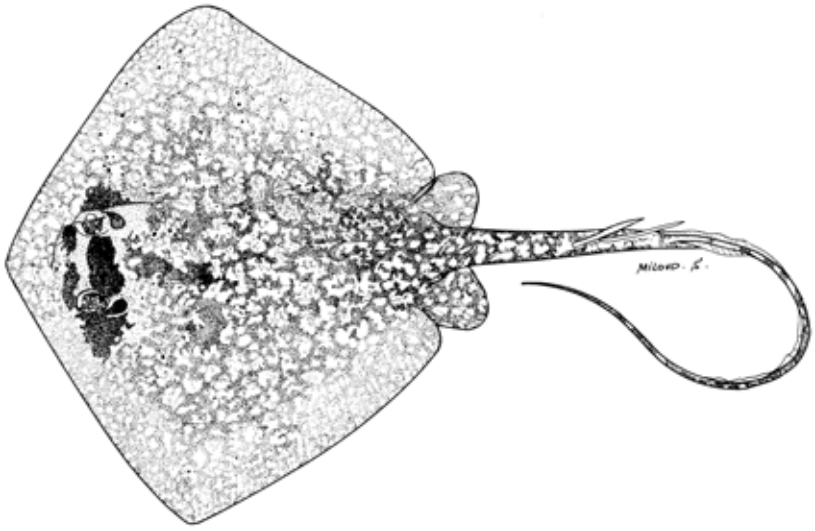
- **Neotrygon annotata** (Last, 1987)

  Dorsal surface uniform brown to greyish green; mask-like markings moderately well developed, pair dark blotches on mid-disc. Faint alternating dark and light bands posteriorly on tail. Snout angular. 4-13 small, seed-shaped thorns along mid-line of disc, 0-4 on anterior tail before caudal sting.
  Material: CSIRO CA 1248 (from 13° 41'S., 126° 31'E.). det. P. Last. Area C



Neotrygon australiae Last, White & Seret, 2016

Upper surface pale yellowish brown with large blue spots; spots usually ocellate (bluish white with thick darker grey-blue ring); mask-like markings distinct; dark speckles concentrated on mask, comparatively sparse elsewhere. Tail with black and white bands near tip; dorsal and ventral folds blackish.
Material. CSIRO CA1241 (from 12º 88'S., 125º 60'E.). det. P. Last. Area C.



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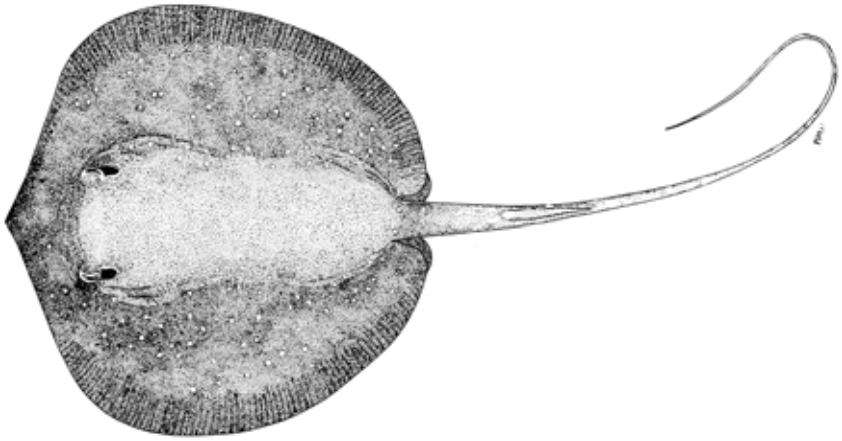
Neotrygon leylandi (Last 1987)

Small stingray uniformly pale brownish to yellowish above, covered with elaborate network of darker reticulations and flecks; mask-like markings well defined, blotches on mid-disc usually faint. Tail bands strong, ventral fold pale with dark markings. Small thorns usually confined to central disc.
Material. CSIRO CA1273 (from 19º 73'S., 117º 21'E.). det W. White. Area C.



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• **Urogymnus granulatus** (Macleay, 1883)

Large ray with an oval disc, rough skin, well-developed band of denticles on central disc. Tail whip-like without folds. Dorsal surface geyish or yellowish brown, covered with small white flecks and often with dark mucus; tail white behind sting. dark margin on ventral surface; disc oval; snout broadly triangular.
Material: CSIRO CA1255 (from 12º 05'S., 130º 00'E.). det. P. Last. Area C.

Fig.1

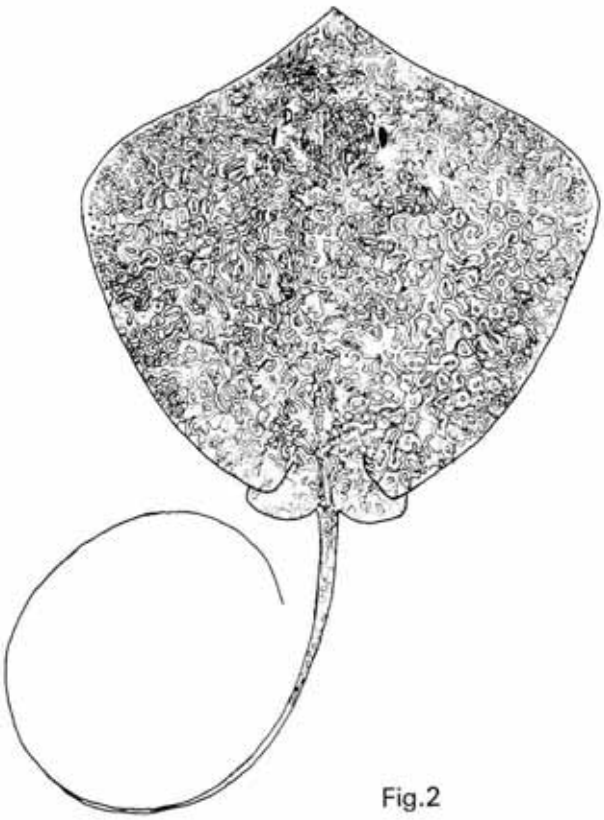
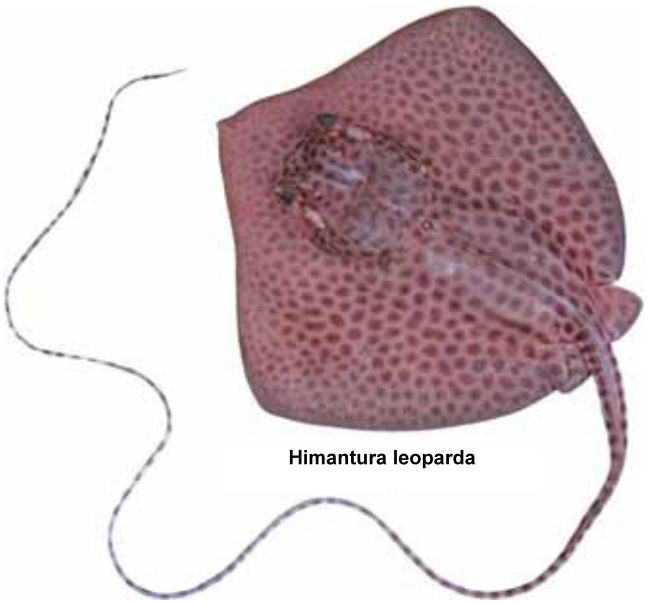


Fig.2

• **Maculabatis astra** (Last, Manjaji-Matsumoto & Pogonoski, 2008)

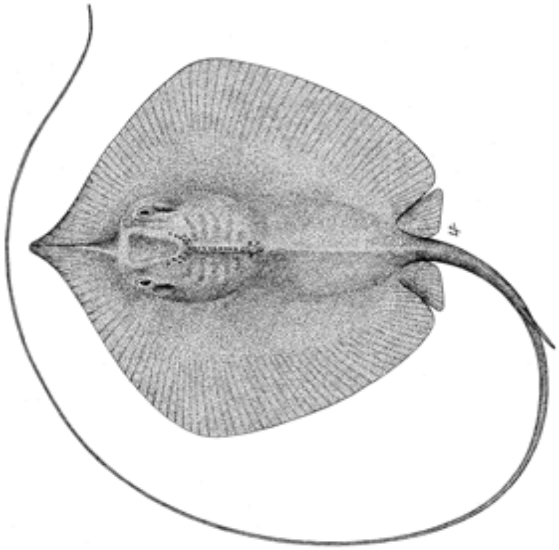
Dorsal surface greyish brown with dense pattern of black spots; black spots small, diffuse-edged, usually surrounded by slightly smaller whitish spots or rings. Tail with many alternating black and white bands beyond caudal sting in juveniles.
(Fig 1) Material: CSIRO CA1245 (from 18º 53'S., 120º 49'E.). det. P. Last. Area C.
(Fig 2) Material: Unnumbered specimens from Areas B, C. det. P. Last.



Himantura leoparda

Himantura leoparda Manjaji-Matsumoto & Last 2008

Dorsal surface yellowish brown with densely reticulated patters of dull yellow or white lines encircling brownish violet spots over entire disc; tail banded. Disc diamond-shaped; pearl-like nuchal thorn (rounded tubercle) on middle of back; 2 large and 2 small papillae on mouth.
Material: TGT 1409 (from 08º 03'S., 110º 05'E., Paratype as NTM S. 10765-002). det. Manjaji-Matsumoto. Area A.



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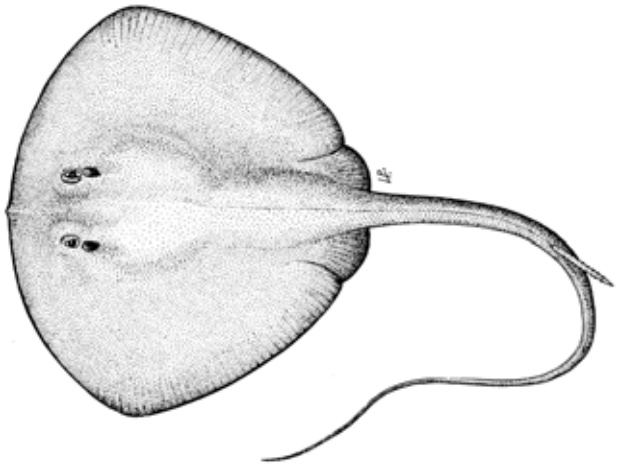
• **Pateobatis uarnacoides** (Bleeker, 1852

Dorsal surface plain brown with partial mottling on posterior part of disc; pairs of light spots along tail; broad dark margin on ventral surface of disc. Slightly oval or diamond-shaped disc; snout triangular and pointed; 2 tail spines; 2 large and 2 small papillae in mouth.
Material: TGT1426 (from 08° 56'S., 116° 24'E., det. W.White. NTM S. 10765-004). Area A.



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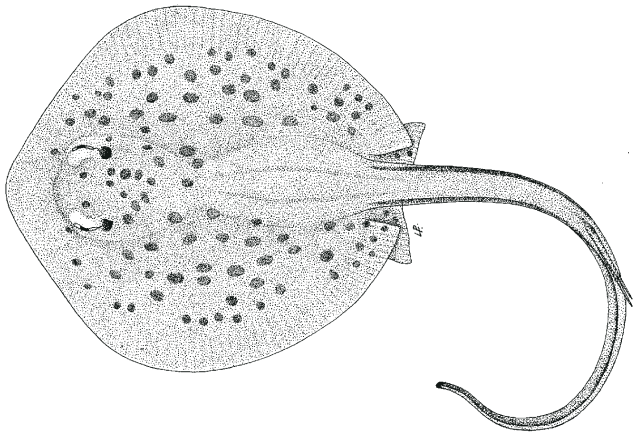
• **Pteroplatytrogon violacea** (Bonaparte, 1832)

Upper surface, tail folds and whip-like portion of tail uniformly black. Ventral surface of disc and tail dark brownish or black. Cloaca, thorns and sting mostly pale.
Material: unnumbered specimen (from 09º 30'S., 116º 45'E.). det P. Last. ZMH 120489. Area B.

• **Pastinachus ater** (Macleay, 1883)

Dorsal surface uniformly greyish brown, grey or blackish, tail tip and skin fold black; disc rhombic, dorsal surface prickly in larger specimens, one or few tubercles in midline of disc; 4 papillae in mouth; 1-2 tail spines.
Material: PJPW101 (from 08° 45'S., 114° 17'E., det. M. Stehmann on photo, BMNH 1984.4.11.1); CSIRO CA1247 (from 12º 38'S., 129º 50'E.). det. P. Last. Areas A, C.



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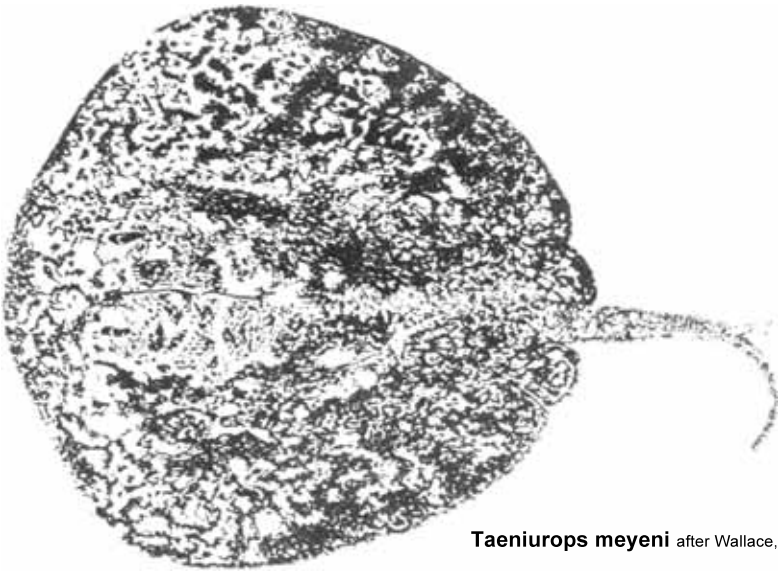
• **Taeniura lymma** (Forsskål, 1775)

Dorsal surface greyish or tan, scattered with bright blue spots, blue stripe along each side of tail; disc ovoid, longer than wide; eyes prominent; skin smooth except for low tubercles along midline of disc; 1-2 tail spines.

Material: TGT1552 (from 08° 22'S., 117° 15'E., specimen lost); TGT1164 (from 08° 28'S., 119° 08'E., specimen lost), both det. M. Stehmann on photo; unnumbered specimen (from 08° 45'S., 115° 05'E., det. M. Stehmann. ZMH 120535); CSIRO CA1246 (from 20° 40'S., 116° 43'E.) det. P. Last. Areas B, C.



Taeniurops meyeni after Wallace, 1967b

• **Taeniurops meyeni** (Müller & Henle, 1841)

Dorsal surface bluish grey, mottled or "splattered" with dark or charcoal spots and blotches, tail skin fold black; disc almost circular, slightly wider than long; eyes prominent; dorsal surface covered with spinules, few tubercles on midline of disc; 1-2 tail spines; 4 papillae in mouth.

Material: unnumbered specimen ("47-77-31" from Area A, specimen lost, det. M. Stehmann on photo); unnumbered specimen (from Area C, specimen lost, det. P. Last on photo).

UROLOPHIDAE

Stingarees -

This family is characterised by its moderately short, stout tail which ends in a well-developed oval or "leaf"-shaped caudal fin. The tail bears a long serrated stinging spine sometimes preceded by a short dorsal fin. Other features, shared with the DASYATIDAE, are: a rhombic or slightly circular disc, the head not free from the pectoral fins along its length, there are fleshy papillae on the floor of the mouth and the nasal curtain is fringed.
Size: to 90 cm in total length.

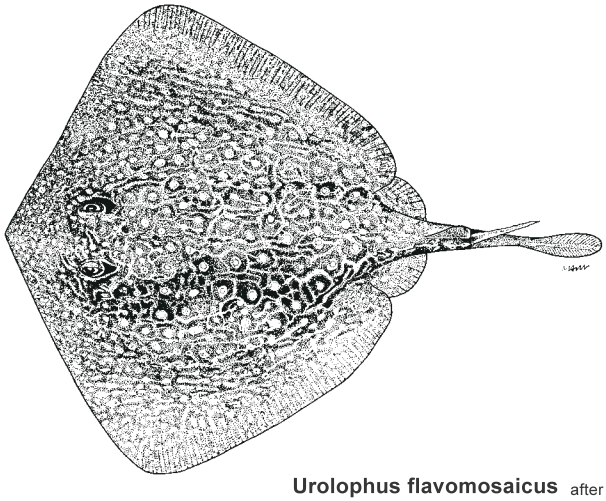
There are 3 genera in this family, differing slightly on external characteristics, 2 of which occur in Australian waters. Colour is often an important character for identifying fresh specimens to the species level.

Trygonoptera – a broad and flattened fleshy lobe along lateral margin of nostril.
Urolophus – no enlarged fleshy lobe along lateral margin of nostril.
Spinilophus – fine denticles on dorsal disc. (found only in PNG).

• **Urolophus cf mitosis** Last & Gomon, 1987
Dorsal surface greenish brown with pattern of dark dots forming confluent oval blotches and transverse and longitudinal bands; disc slightly broader than long; 4 widely-spaced oral papillae.
Material: TGT1652 (from 08° 57'S., 116° 17'E., det. S. Weigmann. ZMH 120361). Area B.

Urolophus mitosis

• **Urolophus mitosis** Last & Gomon, 1987
Dorsal surface reddish brown or grey-green with few pale, elongate or round blotches, each containing small blue spots, blotches either oblique or transversely arranged; snout tip pointed.
Material: CSIRO CA2874 (from 18° 39'S., 117° 53'E., det. P. Last). Area C.



Urolophus flavomosaicus after Last and Stevens, 1994

• **Urolophus flavomosaicus** Last & Gomon, 1987
Dorsal surface yellowish, central disc covered with pale spots surrounded by narrow yellowish rings and reticulations; spots rather regularly spaced, less obvious near disc margins. Caudal and dorsal fins usually pale yellowish.
Material: CSIRO CA2866 (from 18° 20'S., 118° 27'E.). det. P. Last. Area C.

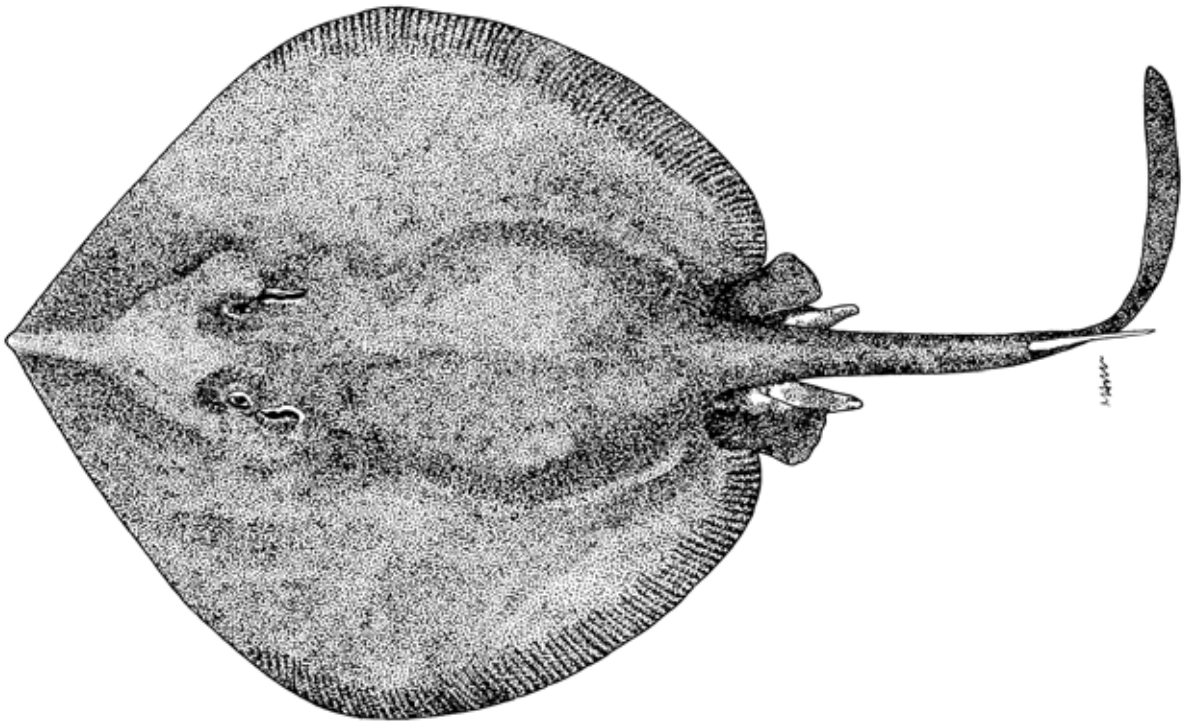
Urolophus westraliensis Last & Gomon, 1987

Uniformly yellowish to pale brown, lacking spots but often with 3 indistinct dusky crossbars (across eyes, middle of gills and mid-disc); young pale yellowish; caudal fin yellow with black margins. Ventral surface white.
Material: CSIRO CA2870 CA2802 (from 18° 34'S., 118° 46'E.). det. P. Last. Area C

PLESIOBATIDAE

Giant stingarees -

Characterised by nasal curtain incompletely united, not reaching the mouth. Caudal fin present; sting present on tail; 5 pairs of gill openings. Their pectoral disc is rounded and confluent with a broadly angular, pointed snout. The disc is slightly longer than it is wide, is grayish brown to black, and is covered with small denticles.
Maximum length 2.7 m.
Family comprises one genus, one species.



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Plesiobatis daviesi (Wallace, 1967)

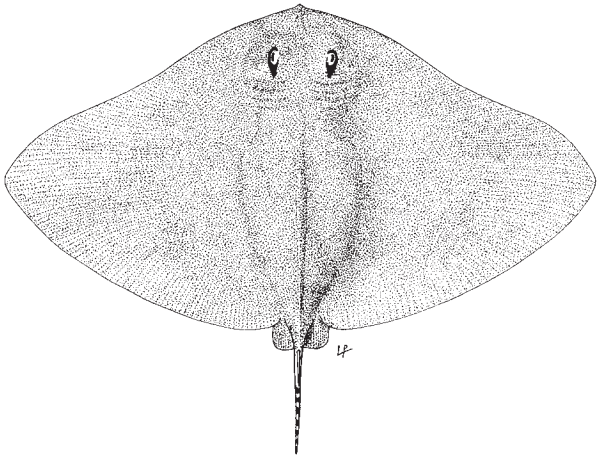
Dorsal surface uniform reddish brown or grey; disc anteriorly wedge-shaped, snout pointed; fine prickles above on disc, tail and centrally on ventrals; 38 tooth rows in upper jaw; ventral fins narrowly elongate.
Material: TGT1422 (from 08° 03'S., 100° 06'E.). det W. White. (NTM S. 10765-001) Area A.

GYMNURIDAE

Butterfly rays; Rat-tailed rays - Pari lempur; Pareh

The butterfly rays are easily recognised by their wide disc - at least 1.5 times broader than long - and their short thin tail - even shorter than the disc length. The pectorals are completely fused to the whole length of the head. The tail has one or more long, serrated spine(s) (barbs); a small dorsal fin maybe present but never a caudal fin, and low skin folds lie along one or more surfaces. The nasal curtain is usually smooth-edged and there are no papillae on the mouth floor.

Size: attain a disc width of 2 m.
The family comprises one genus and 10 named species.



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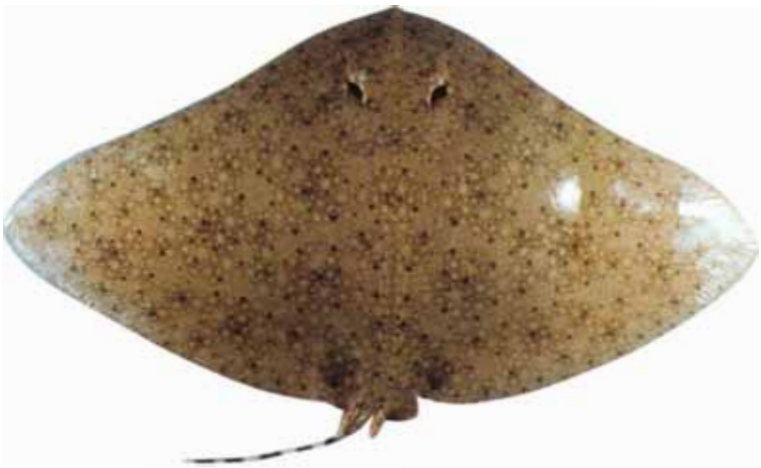
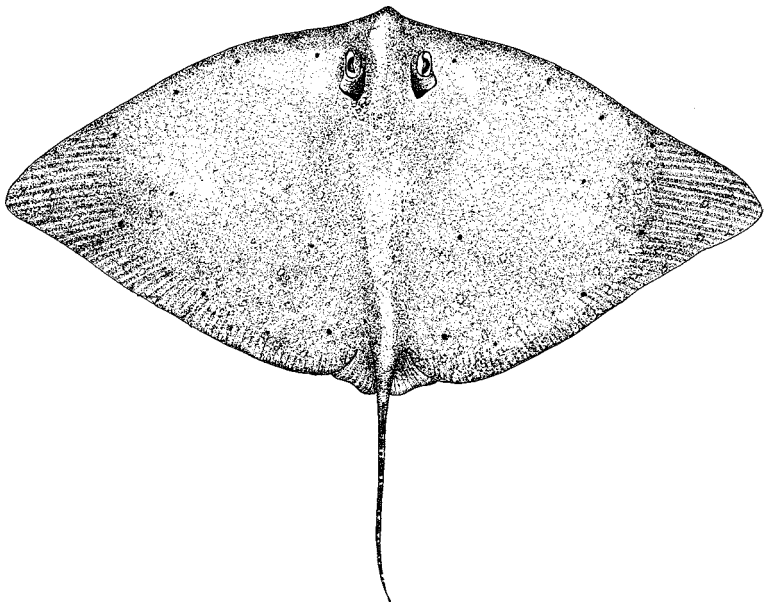
• **Gymnura poecilura** (Shaw, 1804)

Dorsal surface uniformly light to dark brown; sometimes with black dots or with weak round whitish spots. Ventral surface whitish or brownish. Tail banded; dark spot frequently between each black band. A small dorsal fin originates at posterior ventral fin margin.
Material: PJPW148 (from 08º 45'S., 114º 17'E. NTM S. 10767-001). det. M. Stehmann. Area A.



• **Gymnura australis** (Ramsay & Ogilby, 1886)

Dorsal surface olive grey to brown, speckled light and dark with black spots, lower surface white with darker markings; tail alternately banded white and black on sides, the bands of equal width.
Material: CSIRO CA2883 (from 19° 32'S., 116° 43'E.). det. P. Last. Area C.



• **Gymnura cf zonura** (Bleeker, 1852)
Dorsal surface olive-grey to brown, speckled yellow, regularly spaced black spots along outer disc margin, another pair on midline on disc; tail banded white and black, the black bands alternately broad and narrow; snout extremely short.
Material: TGT2215 (from 06° 13'S., 105° 44'E.) and unnumbered specimen at the BMNH from Area A. Both det. P. Last & M. Stehmann on photos. Area A.

MYLIOBATIDAE

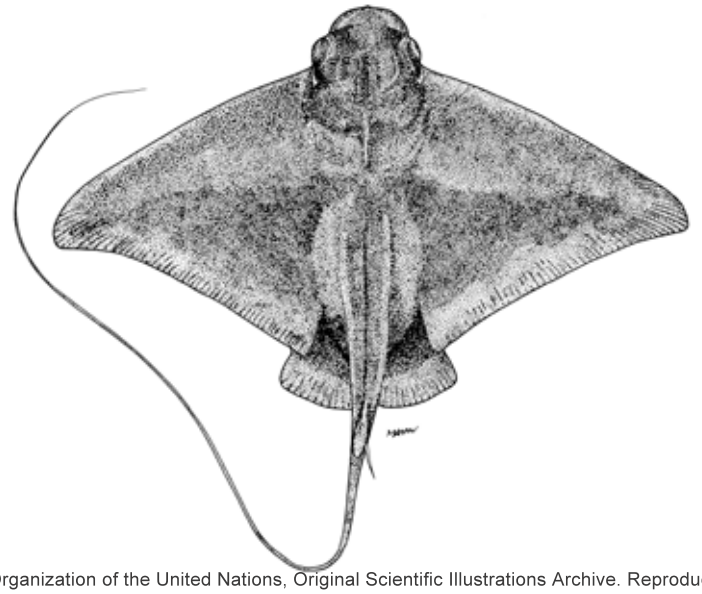
Eagle rays - Penmanuk; Pari burung

This family and the RHINOPTERIDAE can be distinguished from other rays by the large angular, "wing"-like pectoral fins which form the disc, being distinct from the raised, anterior part of the head. The eyes and the large spiracles are thus situated on the side of the head and the anterior parts of the pectoral fins form an undivided, fleshy lobe low on the snout (subrostral lobe. The tail is longer than the disc and whip-like, lacking a caudal fin but having a small dorsal fin on its base not far behind the ventral fin. One or more long, serrate venomous spines are sometimes present behind the dorsal. There are several fleshy papillae on the floor of the mouth.
Size: 2.5-3 m in breadth.
We collected specimens belonging to:
Aetomylaeus - usually 7 rows of teeth in each jaw; no spine on tail; subrostral lobe separate from main pectoral fin.
Myliobatis - usually 7 rows of teeth in each jaw; subrostral lobe continuous with main pectoral fin.

Aetomylaeus nichofii (Bloch & Schneider, 1801)

Dorsal surface dark greenish-brown with 3-5 transverse grey or blue bands, fading with age; dorsal fin origin opposite end of ventral fin base; tail 2-4 times length of disc. Faint banding present on tail.
Material: TGT2242 (from 06° 25'S., 105° 34E.), det. M. Stehmann on photo. Area A.

• **Aetomylaeus caeruleofasciatus** White, Last & Baje, 2015
A greenish to yellowish brown ray with 5-8 broad blueish (sometimes dark-edged) bands across the disc. Faint banding on tail. Ventral surface white.
Material: CSIRO CA1254. (from 13° 18'S., 128° 21'E.). det. P. Last. Area C.



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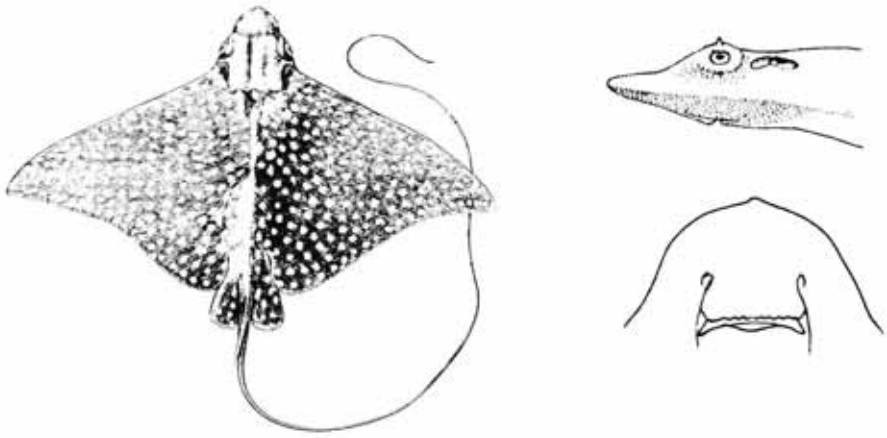
• **Myliobatis tobijei** Bleeker, 1857
Dorsal surface yellowish brown to olive brown, sometimes with irregular shaped, darker brownish spots and blotches of various sizes. Ventral surface mostly white; pectoral tips and posterior margins of disc usually dark brown. Disc entirely smooth, without denticles or thorns. Tail whip-like 1.5 times dorsal width.
Material: TGT1421 (from 08° 03'S., 110° 05'E.), det. P. Last and M. Stehmann. NTM S.10765-003. Area A.

AETOBATIDAE

Pelagic eagle rays -

This family is distinguished from MYLIOBATIDAE by a deeply-notched nasal curtain and only a single row of teeth plate.



• **Aetobatus ocellatus** (Kuhl, 1823)
Dorsal surface brown or blue grey with many small white or cream spots; snout projecting; tail up to 4 times length of disc.
Material: 2 photographs of unkept specimens and PJPW167 (from 08° 45'S., 114° 17'E., specimen lost), all det. M. Stehmann on photos. Areas A, C.

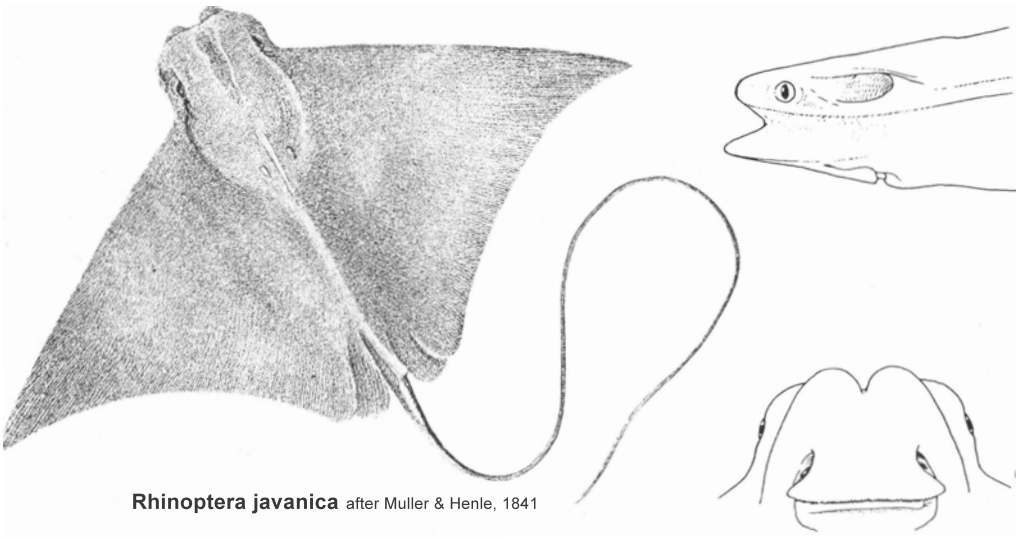
RHINOPTERIDAE

Cownose Rays - Pareh burung

The cownose rays differ from the previous two families mainly in the size and shape of the fleshy subrostral lobe on the head which does not extend as far forward and is deeply indented in the midline, appearing as 2 distinct lobes. In addition, there are 5-20 rows of teeth in the bony dental plate and there are no fleshy papillae on the floor of the mouth.

Size: to about 2.5 m breath.

The family contains a single genus, ***Rhinoptera*** with 8 species.



Rhinoptera javanica after Muller & Henle, 1841

underside of head

• **Rhinoptera javanica** Müller & Henle, 1841

Dorsal surface uniform reddish-brown; skin smooth; tail 2-3 times disc length; teeth in 7-9 rows in both jaws. Material: TGT (PJPW) 804 (from 08º 43'S., 114º 15'E.). det. P Last on photo, BMNH specimen. Area A.

• **Rhinoptera cf javanica**

Dorsal surface uniform greenish brown; skin roughened with small prickles along mid-body and tail to dorsal fin; tail 2-3 times disc length; teeth in 9 rows in upper jaw, 7-9 rows in lower jaw.

Material: TGT2126 (from 08º 45'S., 114º 17'E.). det S. Weigmann. ZMH 120119. Area B.

MOBULIDAE

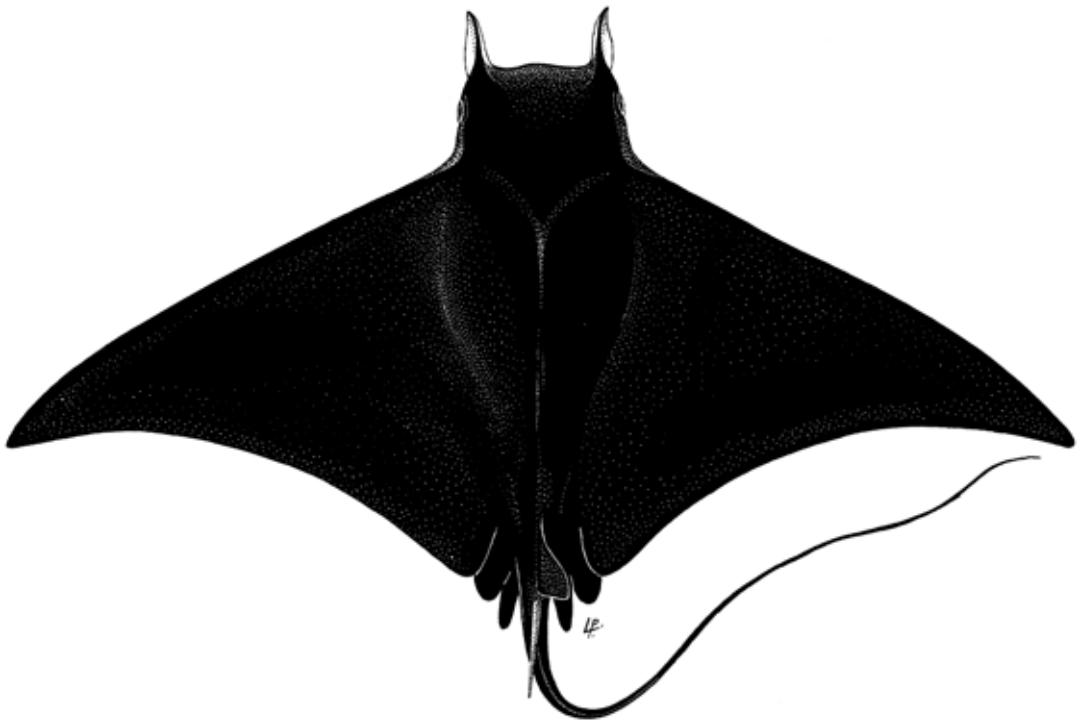
Devil rays; Manta rays - Pareh

This family includes the largest rays in the world, with "wing span" (breadth of disc) of up to 7 m. The head is partly marked off from the rhombic disc, giving them a similarity of form to the previous three families. The head however, is not elevated, although the eye and spiracle are laterally placed, and it has 2 long, forward projections (cephalic fins). The minute teeth are arranged in bands in the jaws, and the gill openings are well-developed. There is no caudal fin, and the small dorsal is placed on the base of the whip-like tail.

The manta and devil rays are pelagic and migrate over long distances. They swim near the surface by flapping their "wing"-like pectoral fins.

Two species were previously assigned to the genus *Manta*, which differs from *Mobula* is having a terminal versus subterminal mouth; however, based on evidence from DNA analyses they should not be considered separate genera.

• **Mobula kuhlii** (Müller & Henle, 1841)
Mouth terminal, extending across front of head. Dorsal surface dark blue to black. Dorsal fin plain or with white tip.



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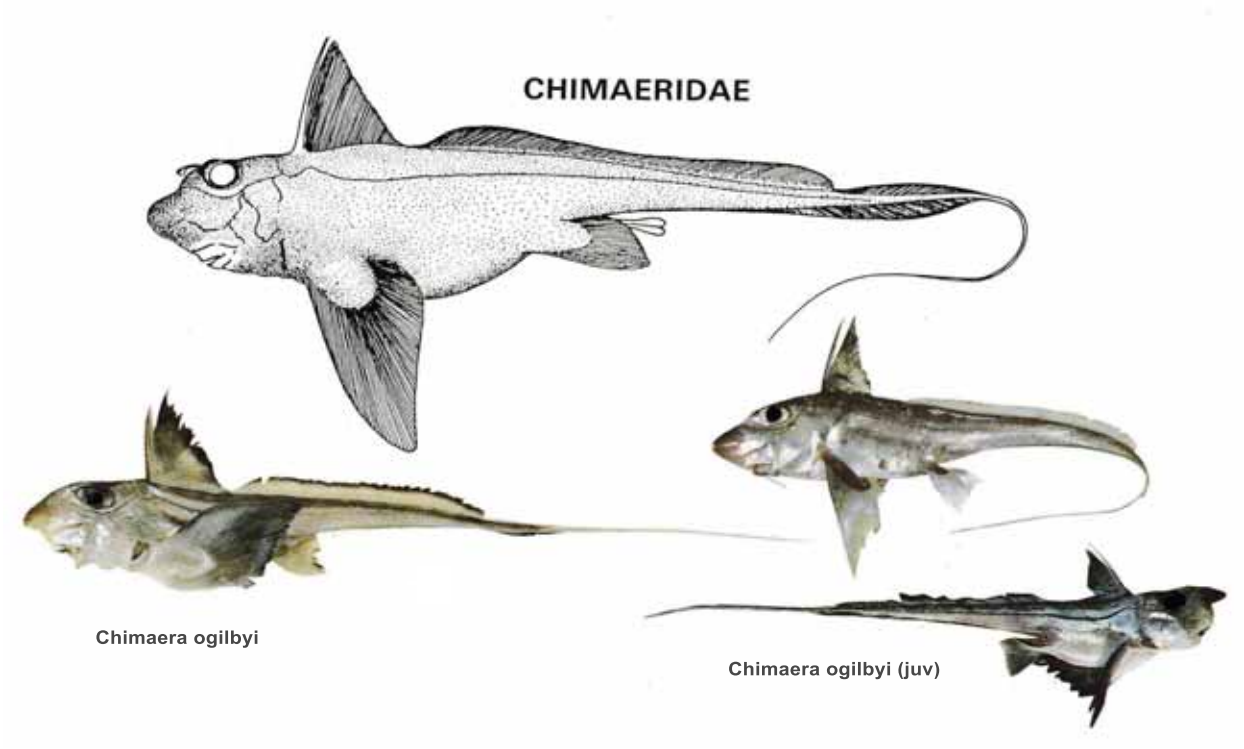
Mobula mobular (Bonnaterre, 1788)
Mouth on lower surface of head. There are additional species occurring in the survey area: *M. birostris* (Walbaum, 1792); *M. tarapacana* (Philippi, 1892); *M. thurstoni* (Lloyd, 1908) and *M. alfredi* (Kreft, 1868) . W. White pers. comm. 2019.

TELEOSTEI

Ray-finned fishes

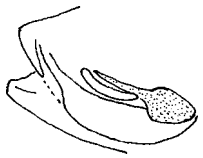
CHIMAERIDAE



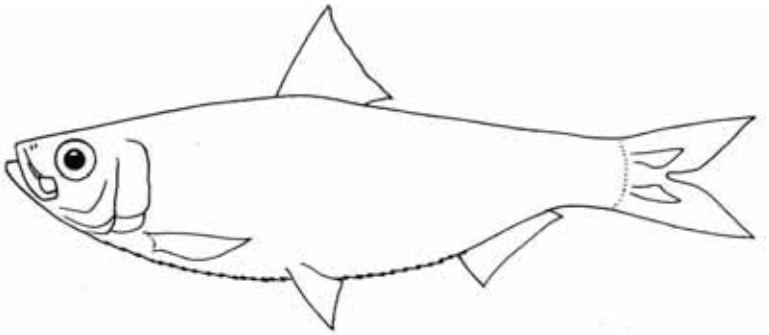
Chimaera ogilbyi

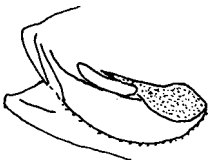
Chimaera ogilbyi (juv)

CLUPEIDAE



Herklotsichthys





Sardinella

Amblygaster leiogaster

Amblygaster sirm

Anodontostoma chacunda

Escualosa thoracata

Herklotsichthys koningsbergeri

Herklotsichthys lippa

CHIMAERIDAE

Ghost sharks –

Body robust anteriorly, tapering to a point at tail. Head large, snout short and rounded; mouth inferior, separated narrowly from nostrils. No spiracle. Skin naked or slightly prickly. Lateral line distinct, much branched over head and shoulder. Dorsal fin in two parts; first dorsal short-based, high, and with a very strong spine; second dorsal fin low and long-based. Anal fin usually absent. Pectoral fins very large, low on sides. Mature males with claspers near ventral fins. Caudal fin long, narrow and tapering, vertebral column continuing to its tip.

Two genera in the family, and many species.

REFERENCE: Finucci, White, Kemper & Naylor 2018.

Chimaera ogilbyi

No anal fin. Snout narrow and long; skin thick. Eye large, about 3-4 in HL; preopercular and oral lateral line canals usually not sharing a common branch; lateral line with tight waves; dorsal spine long, usually longer than first dorsal fin height; height of second dorsal the same along its whole length. Head and body silvery grey, darker above; dusky or black border to both dorsal fins.
(voucher: 370 mm TL)

CLUPEIDAE

Herrings, Sprats, Shads; - Tembang; Lemuru; Cincin

Small, mostly silvery fishes, variously round-bodied to compressed. Scutes often present along belly. Scales cycloid, often easily shed; no lateral line. No spiny rays in fins; single, short dorsal fin, usually near midpoint of body; anal fin short; ventral fin about equidistant between pectoral fin base and anal origin; caudal fin deeply forked. Distinctive colours include dark marks on fin tips or margins, or spots on flanks.

About 50 genera worldwide, and representatives of six were obtained on the Survey.

REFERENCES: Munroe, Wongratana & Nizinski 1999b; Stern, Douek, Goren & Rinkevich, 2017; Whitehead, 1985.

Ambkygaster leiogaster

Body rather slender (less than 4 in SL) and a little compressed, belly rounded; scutes not forming a sharp keel. Back blue-green above; no dark spots along upper flanks.
Lower GR 31-35.

Amblygaster sirm

Body rather slender (less than 3.3 in SL) and little compressed, belly rounded; scutes not forming a sharp keel. A series of small black spots along upper flanks (gold in life).
Vi, 7. Lower GR usually 33-42.
(voucher: 165 mm SL)

Anodontostoma chacunda

Body deep (1.5-3.3 in SL) and strongly compressed. Mouth inferior, snout projecting. Head gold above, large black spot behind gill cover.
Lower GR 54-96.
(voucher: ? mm SL)

Escualosa thoracata

Body compressed and deep, depth 2.7-3.3 in SL. Belly with keel of scutes. Body silvery-brown with bright silvery mid-lateral band about equal to eye diameter from head to tail base. Caudal fin lobes tipped black.
V i, 6. Lower GR 27-40. Scutes 18-19 + 9-12.
(voucher: 75 mm SL)

Herklotsichthys koningsbergeri

Body fairly deep, usually more than 3.3 in SL; belly with strong keel of scutes. Distinct wing-shaped scales hidden beneath normal predorsal scales; scales on flanks not strongly toothed. Up to 14 oval black spots along flanks from head, sometimes a second shorter row of spots below.
Lower GR usually 28-32. Scutes 17-18 + 11-13
(voucher: ? mm SL)

Herklotsichthys lippa

Body moderately slender, usually not more than 3.3 in SL. Belly with strong keel of scutes. Distinct wing-shaped scales hidden beneath normal predorsal scales; scales on flanks toothed. About 8-12 small round black spots in a row along upper flanks behind black shoulder blotch.
Lower GR about 28-34. Scutes 17-18 + 11-13.

Herklotsichthys quadrimaculatus

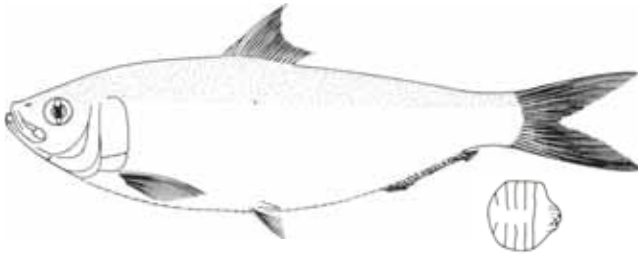
Hilsa kelee

Sardinella brachysoma

scale

Sardinella gibbosa

scale

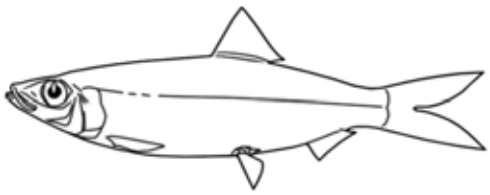


Sardinella fimbriata

Scale

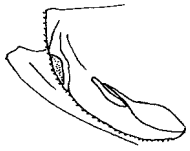
Sardinella lemuru / Sardinelle aurita

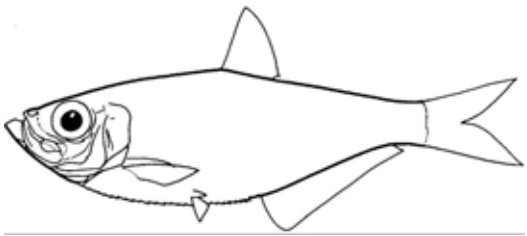
DUSSUMIERIIDAE



Dussumieria elopsoides

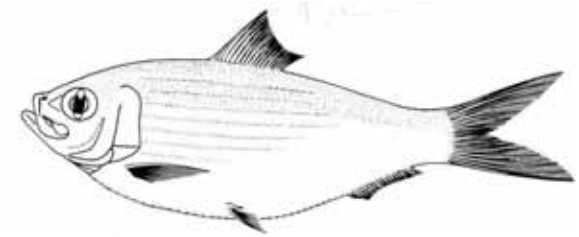
PRISTIGASTERIDAE



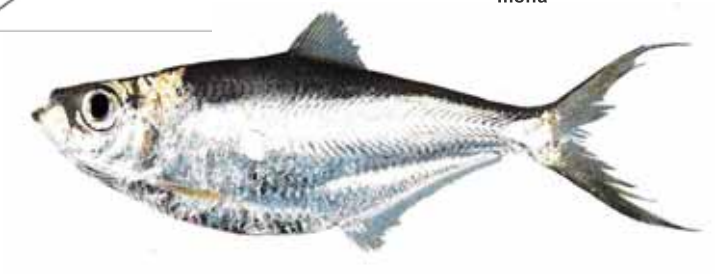


Pellona

Ilisha



Ilisha melastoma



Ilisha lunula

Opisthopterus tardoore

Pellona ditchela

Herklotsichthys quadrimaculatus

Body slender, depth 3.3-5.5 in SL; belly with strong keel of scutes. Distinct wing-shaped scales hidden beneath normal predorsal scales; scales on flanks usually toothed on hind edge. On capture, two gold spots visible behind gill opening and a blue midlateral stripe; dorsal fin pale yellow or grey.
Lower GR usually 30-36. Scutes 17-18 + 12-14.
(voucher: 89 mm SL)

Sardinella brachysoma

Body deep (2.5-3.3 in SL), compressed; belly with sharp keel of scutes (usually 18 + 13 or total of 30-31). Scale margin very crinkled, striae continuous and overlapping at scale centre. A black spot at dorsal fin origin.
V i, 7. Lower GR 48-67. Scutes 18 + 13 (total 29).
(voucher: 115 mm SL)

Sardinella fimbriata

Body moderately compressed and deep (2.9-4 in SL); belly with sharp keel of scutes. Scale margin at centre crinkled and with small holes, striae straight and not joining, separated by wide gap at scale centre. Number of gill rakers increasing with body length. Plain blue-green back without spots or stripes.
Vi, 7. Lower GR 54-82. Scutes 8 + 13 (total 30-32).
(voucher: ? mm SL)

Hilsa kelee

Body deep (2.5-3.3 in SL). Belly keeled. Gill rakers numerous, curved, number increasing with body length. . Distinct notch in midline of upper jaw when wiewed from front. Dark blotch behind gill opening and usually a row of 7-8 smaller blotches behind it along upper sides. Dorsal fin plain dusky yellow.
A 20-22. Lower GR 75-175. Scutes 16 + 13 (total 29).
(voucher: 123 mm SL)

Sardinella gibbosa

Body moderately compressed and deep (usually 3.3-4 in SL); belly with a strong keel of scutes. All of hind scale margin crinkled; striae straight and not joining, separated by wide gap at scale centre. Number of gill rakers increasing with body length. On capture, a gold line along flanks.
V i,7. Lower GR 45-50--60. Scutes 18 + 15 (total 32-34)
(voucher: 131 mm SL)

Sardinella lemuru / Sardinella aurita

Body slender (less than 3.3 in SL) and slightly compressed; belly rounded and scutes not sharp. Gill rakers many, long and slender, curled on 2nd, 3rd and 4th arches, number increasing with body length.
V i, 8 (all other *Sardinella* in area have V i, 7). Lower GR 100-200. Scutes 19 +15 (total 33-34).
(voucher: 152 mm SL)

DUSSUMIERIIDAE

Round herrings -

Differs from CLUPEIDAE in having numerous (11-18) branchiostegal rays, abdomen lacking hard scutes except for a W-shaped pelvic scute supporting ventral fin, and premaxilla rectangular. Two genera worldwide, one obtained on the Survey.

REFERENCES: Lavoué et al., 2017; Hata, Lavoue & Motomura, 2020; Munroe, Wongratana & Nizinski 1999b.

Dussumieria elopsoides

Body slender, depth 4.5-6.3 in SL; no keel of scutes along belly. Small pointed mouth. On capture, body iridescent blue-green with a bronce or gold mid-lateral stripe.
Lower GR 21-32. A 15-16.
(voucher: 154 mm SL)

PRISTIGASTERIDAE

Longfin herrings -

The species belonging in this sardine family can be recognised by their long anal fin comprising 30 or more rays. In most species the ventral fin is situated well forward such that the pectoral fin tip reaches or extends beyond a vertical through the base of the ventral fin.

The family comprises nine genera which were formerly placed in the family CLUPEIDAE; representatives of three genera caught on the Survey.

REFERENCES: Kailola, 1986; Munroe, Wongratana & Nizinski 1999a; Whitehead, 1985.

Ilisha melastoma

Lower jaw projecting. Body deep (2.4 -3 in SL), strongly compressed. Vertical striae overlap and continuous across scale centre. Two tubular extensions of swim bladder posteriorly. Caudal fin forked. Back blue-green; fins pale, stippled dusky.
A 35-48. Lower GR 21-25. Scutes 18-20 + 8-9 (total 27-29).
(voucher: ? mm SL)

Opisthopterus tardoore

Lower jaw prominent, mouth upturned. Body slender (3-3.7 in SL) and strongly compressed; belly keeled. No ventral fin. Anal fin long; pectoral fin longer than HL, 3.5-3.8 in SL. Body silvery, dark spot behind gill opening.
A 51-63. Lower GR 25-28. Scutes usually 29-35 (total).
(voucher: 215 mm SL)

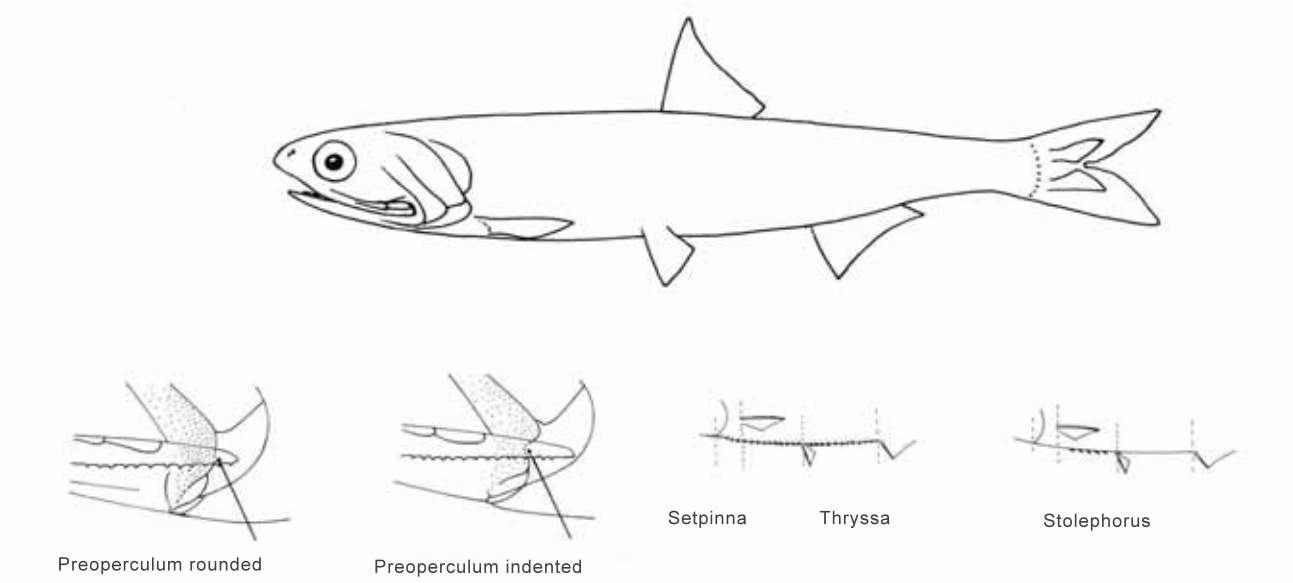
Ilisha lunula

Lower jaw projecting. Body deep (2.4-2.8 in SL), strongly compressed; belly keeled. Vertical striae overlap but do not join at scale centre. Two tubular extensions of swim bladder posteriorly. Caudal fin lunate, lobes produced to nearly twice head length. Back dark olive-yellow; fins pale yellow, margins dark brown.
A 36-48. Lower GR 18-20. Scutes 28-29 (total).
(voucher: ? mm SL)

Pellona ditchela

Lower jaw projecting, entire lower edge of upper jaw toothed, hypomaxilla present. Body deep (2.7-3.1 in SL), strongly compressed; belly keeled. Vertical scale striae overlap at centre of scale. Hind caudal fin margin dusky.
A 34-42. Lower GR 22-27. Scutes 19+8-9 (total 27-28).
(voucher: 130 mm SL)

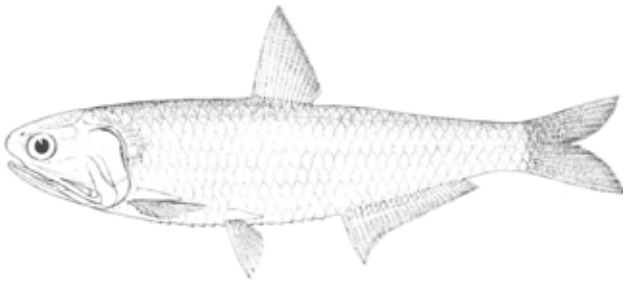
ENGRAULIDAE



Setipinna tenuifilis

Stolephorus balinensis

Encrasicholina heteroloba



Thryssa baelama

Stolephorus baweanensis

Thryssa encrasicholoides

Thryssa hamiltonii

Thryssa mystax

Thryssa setirostris

ENGRAULIDAE

Anchovies - Kenaren; Teri; Bangkok

Small, mostly silvery fishes, variously round-bodied to compressed (body tapering to point in *Coilia*). Scutes usually present along belly (except in *Engraulis*). Snout usually "pig"-like and projecting, lower jaw characteristically "underslung"; hind tip of upper jaw (maxilla) extending well beyond eye. Scales cycloid, often easily shed; no lateral line. No spiny rays in fins; a single short dorsal fin, usually near midpoint of body; anal fin long or short; ventral fin about midway between pectoral fin base and anal fin origin; caudal fin usually forked. Distinctive colours include dark marks on fin tips and margins.

Eight genera in the Indo-Pacific, of which four were obtained on the Survey.

REFERENCES: Hata & Motomura, 2017; Hata, Lavoué & Motomura, 2019; Hata, Lavoué & Motomura 2021; Wongratana, Munroe & Nizinski 1999; Kottelat, 2013.

Setipinna tenuifilis

Body strongly compressed, depth 3-3.7 in SL; dorsal profile rising evenly, back gently convex. Belly keeled. Maxilla not reaching gill opening. First ray of pectoral fin filamentous, reaching to 9-21st anal fin ray. Ventral fin not reaching to anus.
A 49-59. Lower GR 13-17. Scutes 18-20 + 7-8.
(voucher: ? mm SL)

Encrasicholina heteroloba

Body slender, almost cylindrical; sharp needle-like scutes before ventral fins, none behind. Maxilla tip pointed, reaching to or beyond posterior border of preoperculum. A small diamond-shaped bony plate between front of isthmus and hind border of branchiostegal membrane. Hind border of preoperculum round (convex). HL 25%-29% in SL; 3 unbranched dorsal and anal fin rays. A dark fish with silvery mid-lateral band on flanks.
Lower GR 21-26. Scutes 3-6.
(voucher: 70 mm SL)

Stolephorus baweanensis

Body slightly compressed; sharp needle-like scutes before ventral fins, none behind. Maxilla tip pointed, reaching past gill opening. Isthmus reaching to hind border of branchiostegal membrane. Ventral fin tip does not reach a vertical line from dorsal fin origin. A pale fish with small black spots on underside of snout, under eye and on lower jaw.
Lower GR 19-22. Scutes 4-7. 3 unbranched dorsal and anal fin rays.
(voucher: 75 mm SL)

Thryssa encrasicholoides

Belly rounded; predorsal scutes before level of pectoral fins sometimes lost, then preventral scutes, then post-ventral scutes. Maxilla with very blunt tip, not reaching hind border of preoperculum.
A 27-35. Lower GR 20-22. Scutes 1-2 + 6-7 + 8-10.
(voucher: 81 mm SL)

Thryssa mystax

Body compressed, slender, depth 3.5-4 in SL. Belly keeled. Maxilla reaching just past gill opening. Tip of snout at about level of eye centre. Black venulose area behind gill cover, dorsal fin tip black as also upper, lower and hind borders of caudal fin.
A 34-40. Lower GR usually 13-16. Scutes 17-19 + 8-12.
(voucher: 106 mm SL)

Stolephorus balinensis

No predorsal scutes; posterior border of preopercle convex, rounded; Ventral fin short, its posterior tip not reaching the vertical through dorsal fin origin; ventral fin short. Short maxilla, posterior tip just reaching or slightly beyond anterior border of preopercle, 14.3–17.2% SL. A pale fish with a silver mid-lateral ban on its flanks. two pairs of dark patches on upper back in head; no black spots below eye and lower-jaw tip.
D iii, 11-14. A iii, 14-19. P. 13-16. GR (first arch) 35-42.
2-6 pre-pelvic scutes, without spines. Total scutes 37-41.
(voucher: 133 mm SL)

Thryssa baelama

Belly rounded; no scutes before level of pectoral fins, pre-ventral and post-ventral scutes present. Maxilla tip very blunt, not or barely reaching hind border of preoperculum. Olive above, silvery below; head golden, dark patch on shoulder.
A 27-32. Lower GR 20-26. Scutes 7-8 + 8-10.
(voucher: ? mm SL)

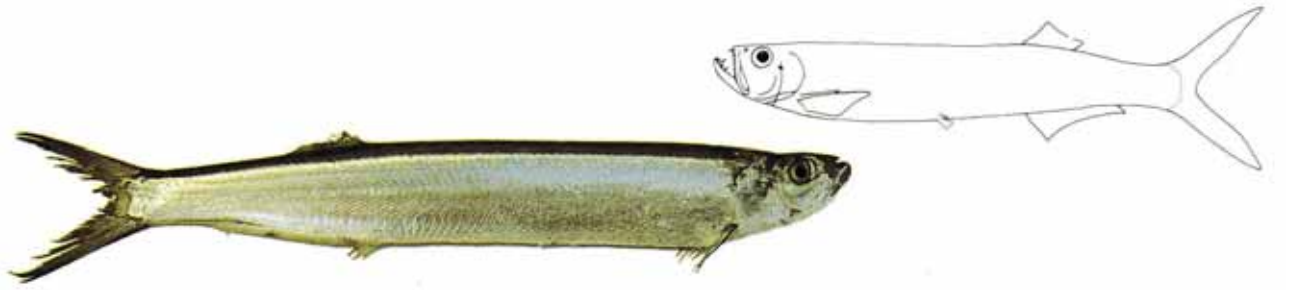
Thryssa hamiltonii

Body compressed and deep, depth 3.1-3.4 in SL. Belly keeled. Maxilla just to gill opening or slightly beyond. Tip of snout above level of eye centre. Black venulose area behind gill cover; midline of back with dark bands or lines.
A 38-43. Lower GR 11-15. Scutes 17-18 + 10-11.
(voucher: ? mm SL)

Thryssa setirostris

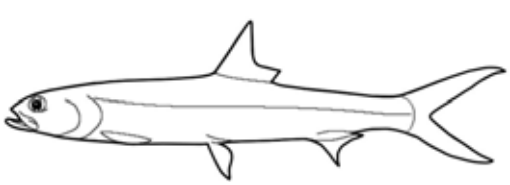
Body compressed; belly keeled. Maxilla very long, reaching to base of ventral fin and beyond. Tip of snout below level of eye centre. Black venulose area behind gill opening; orange in gill cavity. Head bronze, fins yellow, hind caudal fin margin brown.
A 33-38. Lower GR 10-12. Scutes 16-18 + 9-10.
(voucher: 142 mm SL)

CHIROCENTRIDAE



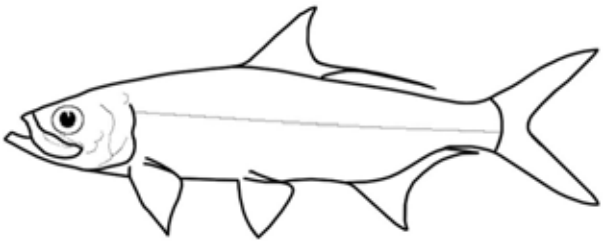
Chirocentrus dorab

ELOPIDAE



Elops machnata

MEGALOPIDAE



Megalops cyprinoides

ALBULIDAE

Albula argentea

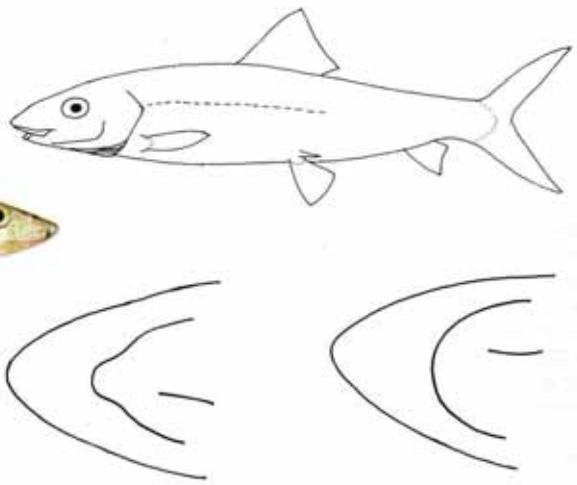


Fig. 1

Fig. 2

CHIROCENTRIDAE

Wolf-herrings - Parang-parang; Golok-golok

Very elongate and compressed, "strap - like" fishes. Mouth large and oblique. large fang-like teeth in both jaws: eye small. Cycloid scales very small. thin and easily shed; no lateral line; no scutes along belly (as in CLUPEIDAE). Fins without spines; single dorsal fin placed well back on body, opposite anal fin; pectoral fin low on body; small ventral fin about halfway between pectoral and anal fins; caudal fin deeply forked.

One genus in the family, and two species.

REFERENCES: Kottelat, 2013; Munroe, Wongratana & Nizinski, 1999.

Chirocentrus dorab

Body strongly compressed, depth 7-7.5 in SL; belly sharp. Pectoral fin 7.6-9 in SL, head depth 9-12.5 in SL. Back bright blue green, flanks brilliant silvery; upper part of dorsal fin black, caudal fin yellow.
D 16-18. A 32-32.
(voucher: 396 mm SL)

ELOPIDAE

Tenpounder - Bondeng lelaki

Body fusiform, slightly compressed. Eyes big and partially covered with adipose eyelid. Mouth terminal, upper jaw extending to posterior border of eye. Bony plate (gular plate) covering anterior part of throat. 20-25 rays in dorsal fin, pelvic with 12-16 rays. Dorsal and anal fins with base in scaly sheath.

One genus in the family and seven species; only one found on the Survey.

REFERENCES: Fricke, 2008; Smith, 1999a, www.fishbase.ca/summary/Elops-machnata.html.

Elops machnata

Body slender, depth 5-6 in SL, belly rounded. Scales very small; lateral line tubules unbranched. Maxilla reaches well behind eye. Back olive or dull green-blue, flanks silvery.
D 23-27. A 15-18. L. lat. about 100. Branchiostegal rays 25-35.
(voucher: 122 mm SL)

MEGALOPIDAE

Tarpon - Bulan-bulan

Large, silvery fish having a fusiform, compressed body. Lower jaw prominent, gular plate ventral between two branches of lower jaw. Branchiostegal rays 23-27. Dorsal fin without a spine, with 13-21 rays, the last one extended as a long filament. Pectorals very low on body; anal fin 22-29; ventral fin 10-11. Branched tubes radiate over lateral line scales. Can attain more than 2 m in length. Larval stage consists of translucid leptocephali.

One genus in the family, two species, of which the single Indo-Pacific member was caught on the Survey.

REFERENCE: Smith, 1999b.

Megalops cyprinoides

Body oblong, depth 3.5-5 in SL, belly slightly rounded. Scales large, lateral line tubules branched. Last dorsal fin ray produced into strong filament reaching tail base. Back blue-green, flanks silvery white; fins yellowish.
D 17-20. A 24-31. L. lat. 36-42. Branchiostegal rays 26-27.

ALBULIDAE

Bonefishes - Bandeng cecurut

Moderate-sized silvery fishes found in all warm waters, associated with shallow sandy bottoms. Body elongate with a rather flat belly without scutes. Snout conical. projecting, small inferior mouth; a bony gular plate between lower jaw; branchiostegal rays 12-14. A single short dorsal fin; anal fin short. far back on body; ventral fins about mid-way between pectoral and anal fins. More than 60 scales in lateral line.

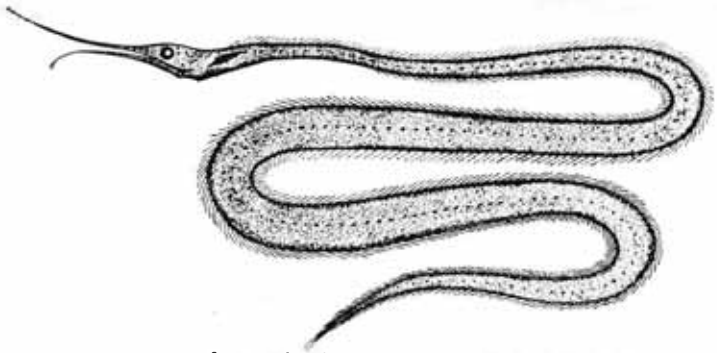
A single genus, with about 4-5 species.

REFERENCES: Hidaka, Iwatsuki & Randall, 2008; Kottelat, 2013; Randall, & Bauchot. 1999.

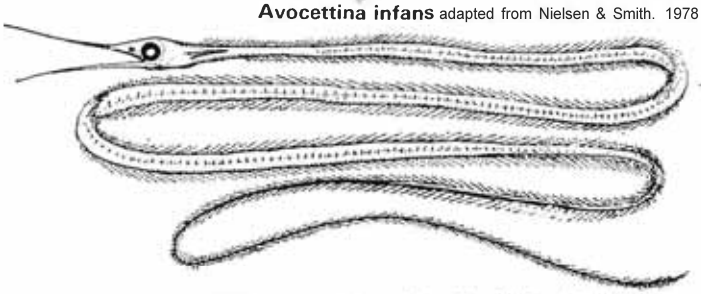
Albula argentea

Body fusiform; belly rather flat without scutes. Lower jaw pointed (Fig. 1). Body scales small. Body plain silvery, yellow-blue on back. Tooth plate on tongue rather elongate.
GR 10-12. L. lat. 63-69.
(voucher: ? mm SL)

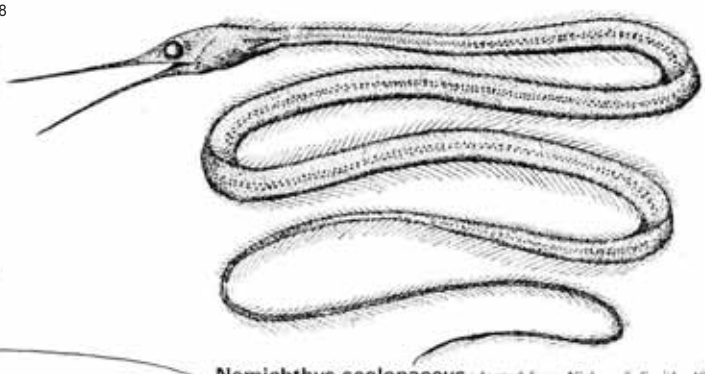
NEMICHTHYIDAE



Avocettina infans adapted from Nielsen & Smith. 1978



Nemichthys curvirostris adapted from Nielsen & Smith, 1978



Nemichthys scolopaceus adapted from Nielsen & Smith, 1978

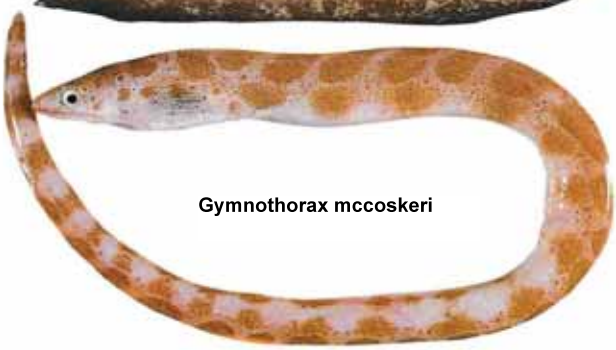
MURAENIDAE

Gymnothorax cribroris

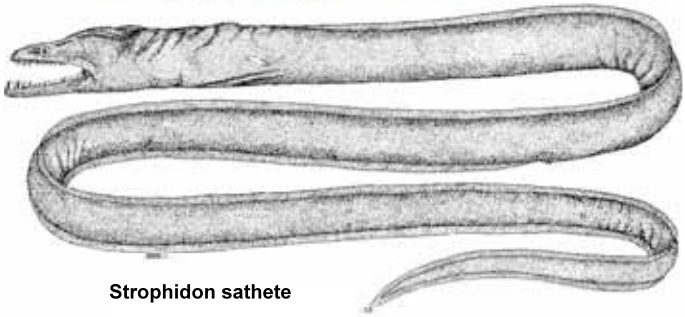
Gymnothorax minor

Gymnothorax longinquus

Gymnothorax pseudothyrsoideus



Gymnothorax mccoskeri



Strophidon sathete

NEMICHTHYIDAE

Snipe Eels -

Very long, tapering eels with jaws diverging and produced into a long beak; jaws with many small teeth each bearing a cusp. Eyes very large; pectoral fins present, dorsal, caudal and anal fins united as one, origin near pectoral fin base; lateral line complete. Tongue not free from floor of mouth. Anus situated from just under middle of pectoral fin to about a head length behind pectoral fin base (*Avocettina*).
The family comprises three genera and nine species; three species were collected on the Survey.

REFERENCES: Smith, 1999e; Nielsen & Smith, 1978.

Avocettina infans

Eye 2-4 times in postorbital distance. Elongate sensory ridges on head behind eyes; upper jaw much longer than lower jaw. Lateral line comprising a single row of pores. Dorsal fin begins behind pectoral fin base; anus well behind pectoral fin; caudal fin without a filament. Body finely mottled black brown.
P 14-18. L. lat. 181-201.
(voucher: ? mm TL)

Nemichthys curvirostris

Teeth large; upper jaw slightly longer than lower jaw. No ridges on head. Three lateral lines, close together along mid-line of body. Dorsal fin begins before pectoral fin base; anus under pectoral fin; body ends as a short filament. Body pale with scattered black stippling on lower half of body especially around belly; vertical dark bars along body. Fins edged black posteriorly. 5-14 pores behind eye; 2-6 pores along preopercular rim. Mature males lack the long jaws.
P 8-12.
(voucher: ? mm TL)

Nemichthys scolopaceus

Teeth small; upper jaw slightly longer than lower jaw. No ridges on head. Three lateral lines, close together along mid-line of body. Dorsal fin begins before pectoral fin base; anus under pectoral fin; body ends as a short filament. Body brown or dark grey, darker ventrally. 3-20 pores behind eye; 2-18 pores along preopercular rim. Mature males lack the long jaws.
P 10-14.
(5 specimen seen))

MURAENIDAE

Moray eels - Kerondong

Body thick and scaleless. Jaws strong, about equal in length; teeth strong, sharp, often depressible. Tongue fixed. Anterior nostril a tube near snout tip; posterior nostrils as rounded openings on top of head near eye. Gill openings as small slits or rounded opening on side of body. Fins usually covered with thick skin; dorsal, anal and caudal fins present; no pectoral fins.

Seven species in two genera were collected on the Survey.

REFERENCES: Bohlke, McCosker & Smith, 1999d; Bohlke, 2000; Bohlke & McCosker, 2001; Castle & Randall, 1999; Chen, Shao, & Chen, 1994; Li, Zang, Feng, Loh, Zheng & Li, 2018; Smith & Bohlke, 1997.

Gymnothorax cribroris

Body and head dull olive-yellow or grey overlain with fine brown reticulations, darker on tail giving appearance of large pale spots. Two-3 rows of dark spots behind eye. 8-10 long canines on vomer, jaw teeth usually in one row.
(voucher: 413 mm TL)

Gymnothorax longinquus

Body and head dark brown to blackish, with irregular large grey or cream patches; fins dark with black margin; gill opening white; inside mouth dark brown. Slender eel, 10-12 vomerine teeth in one row; single row of smooth-edged jaw teeth.
(voucher: 510 mm TL)

Gymnothorax mccoskeri

25-27 oblique interrupted broad brown bands over body from head to tail, extending onto dorsal and anal fins in tail region and broken into patches of spots on belly. Many teeth in single rows in jaws, their edges finely serrated. 16 vomerine teeth.
(voucher: 365 mm TL)

Gymnothorax minor

Fourteen-20 almost vertical continuous broad brown bands across body from head to tail, especially noticeable on lower sides, brown spots on head and upper sides. Jaw teeth in one row, their edges serrated; 7-12 vomerine teeth.
(voucher: 340 mm TL)

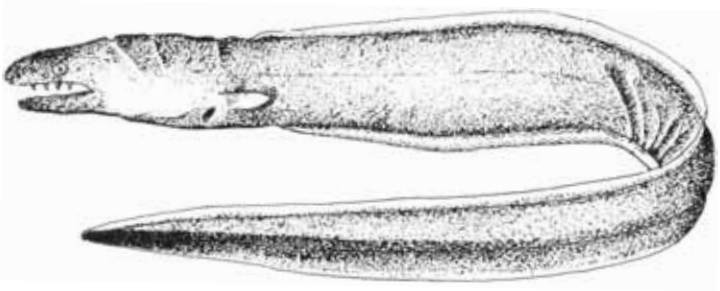
Gymnothorax pseudothyrsoideus

Head cream anteriorly, remainder and body finely marbled cream over dark brown; 3-4 rows of faint dark blotches along body. Robust eel; 8-12 vomerine teeth in one row, jaw teeth smooth-edged, sometimes in two rows anteriorly. Dorsal fin origin well before gill opening.
(voucher: 416 mm TL)

Strophidon sathete

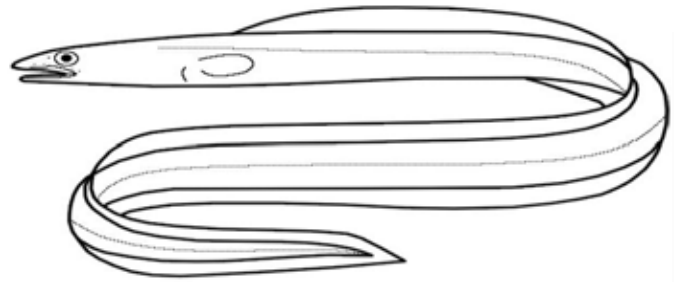
Extremely long and slender, tail 1.5 to twice length of rest of body. Anterior nostrils simple tubes, body cylindrical. Body and fins uniform grey or brown, fins darker.
(voucher: 1280 mm TL)

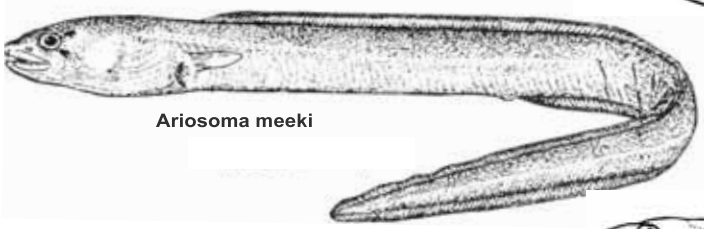
SYNAPHOBRANCHIDAE



Dysomma anguillare after Castle, 1986a

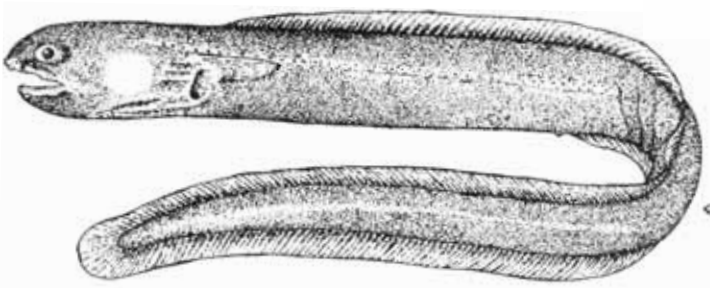
CONGRIDAE





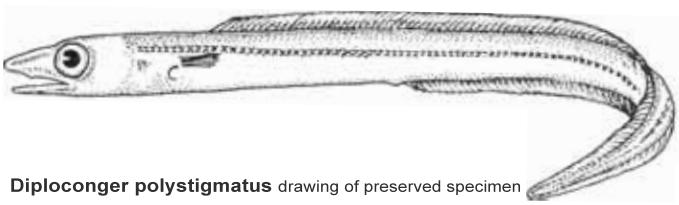
Ariosoma meeki

Ariosoma mauritianum after Castle, 1968

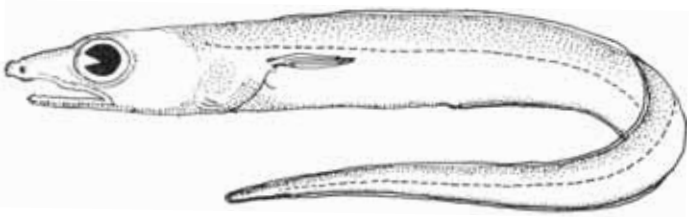


Bathymyrus smithi after Castle, 1986a

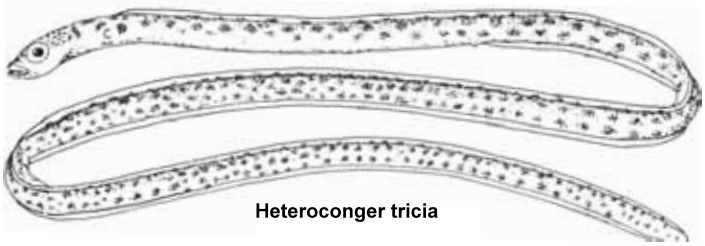
Blachea xenobranchialis after Karrer & Smith, 1980



Diploconger polystigmatus drawing of preserved specimen



Gnathophis nasutus drawing of preserved specimen



Heteroconger tricia

SYNAPHOBRANCHIDAE

Cutthroat Eels -

Compressed eels with plump. robust body. Body naked or scaled in various ways. Eyes covered by skin; snout short, mouth gape wide reaching well past eye. Tongue not free from floor of mouth. Pectoral fin present or absent. Teeth sharp and small. Gill openings ventral, before or under pectoral fin bases. separated. or united into a single slit under throat. Anus not far from gill opening or placed ⅓ along body length. One species (in subfamily Dysommatinae) collected.

REFERENCES: Castle, 1986c; Smith, 1999c; Ho, Smith & Tighe, 2015; Prokofiev, 2019a.

Dysomma anguillare

Body depth 20-23 in TL; head 6.5-7.5 in TL. Snout flattened, 4.5-5 in HL; eye very small, 19-21 in HL. Upper jaw overhangs lower jaw; gape large; skin covers eye; corner of mouth extends far behind eye; short papillae on snout. Jaw teeth fine and in bands in upper jaw; 4 or 5 enlarged double canines on vomer, bases of teeth surrounded by fleshy tissue. Gill opening ventral, just before small pectoral fin. Anus just behind pectoral fin tip. Dorsal fin begins before pectoral fin. Dorsal and anal fins low anteriorly. Body black or dark brown, fins slightly paler. (voucher: ? mm TL)

CONGRIDAE

Conger Eels - Belut laut

Body robust, sometimes slender. Pectoral fins usually well-developed (small or absent in subfamily Heterocongrinae). Rays of dorsal, anal and caudal fins usually clearly visible. Snout not produced; posterior nostril simple, close to front of eye margin. Jaws strong; small and sharp teeth in 1-2 rows along jaws; usually few vomerine teeth. Tongue conspicuous and free from floor of mouth. Gill opening before and below pectoral fin. Anus usually before middle of body length.

Thirty genera in the family and many species; 11 genera were represented in the Survey.

REFERENCES: Castle, 1986a; Castle & Paxton, 1984; Castle & Randall, 1999; Chen & Weng, 1967; Ho, Smith & Shao, 2015; Karmovskaya, 1993; Karmovskaya, 2018; Karmovskaya & Paxton, 2000; Karrer & Smith, 1980; Lin, Shao & Smith, 2018;Mao, Aoyama, Miller, Minegishi, Inoue & Tsukamoto, 2008; Smith, Ho, Huang & Chang, 2018; Smith & Ho, 2018; Shen, 1998; Smith, 1999g;

Ariosoma meeki

Fin rays unsegmented; caudal fin short. Premaxillary teeth in a rounded patch, partly extending outside of mouth. Posterior nostril a simple opening before eye. Dorsal fin origin behind head. Eye very large, 4-5.4 in HL. Head and body yellow. Two conspicuous triangular brown marks at upper and lower corners of eye posteriorly, brown mark at corner of mouth; dark spots on head and throat. Dorsal, anal and caudal fins edged black. Lateral line pores before level of anus 54-58.

Ariosoma mauritianum

Fin rays unsegmented; anus near middle of body length; caudal fin short. Premaxillary teeth forming an oval patch, partly extending outside mouth. Posterior nostril a simple opening before eye. Eye large and prominent, 4.5-5 in HL. Upper lip with well-developed upturned flange. Head dusky, body plain fawn or pinkish, dark edge to unpaired fins; pectoral fin pale. Lateral line pores before anus 50-56; dorsal fin rays before level of anus 60-65.

Bathymyrus smithi

Premaxillary teeth wholly outside of mouth and curving up on front of snout. Posterior nostril a slit below lower front eye border. Head 6.5-7.3 in TL; body depth 13.5-16.5 in TL. Fin rays unsegmented; caudal fin short. Grey-brown body tinged violet-pink, paler below; tips of dorsal, caudal and anal fins black, caudal fin base cream. Dorsal fin rays before level of anus 50-65; lateral line pores before level of anus 43-47.

Blachea xenobranchialis

Fin rays unsegmented, long and filamentous in dorsal fin, about 60 dorsal fin rays before anus; tail slender and tip flexible. Two or 3 branchiostegal rays protrude from gill membrane on sides and lie free. Lateral line broad and canal-like with 2 rows of pores (one row on dorsal edge of line, one row on ventral edge), clusters of curved bony processes supporting canal space between pores. Snout acute; teeth small, sharp, in single rows on jaws and premaxilla. Body dusky above, yellow below and stippled black. Mouth and gill cavity black, peritoneum dark brown, gut black; fins yellow with black edges.
(voucher: ? mm TL)

Diploconger polystigmatus

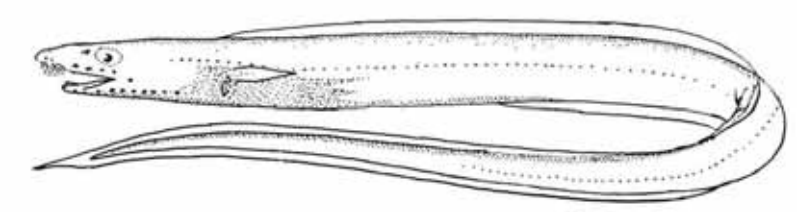
Fin rays unsegmented; anus about ⅓ along body length. Snout prominent, anterior nostril rim high, entire, not slit; lips well-developed. Jaw teeth sharp and slender, in bands; premaxillary tooth patch partly outside mouth. Dorsal fin rays before anus 28-35; lateral line pores in double row, 26-30 before level of anus. Tail tip stiff, caudal fin reduced. Body coppery-fawn, dusky band from head along top of lateral line to tail base, a transverse bar across nape joining band on each side; dark band along snout; fin rays streaked dark brown, tail tip charcoal.
(voucher: ? mm TL)

Gnathophis nasutus

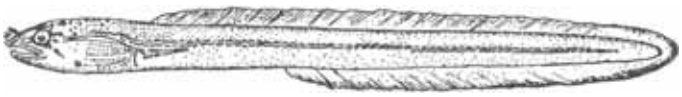
Second, and 6th to 13th lateral line pores raised above level of lateral line. Fin rays segmented; anus about ⅓ along body length. Caudal fin rather long, tail tip stiff. Several rows of teeth in jaws; 3 postorbital pores; a slit in rim of anterior nostril. Eye large, 4.1-4.7 in HL; lips well-developed. Body fawn or pinkish, top of head charcoal, operculum silver, abdomen iridescent pink. Swim bladder and intestine silver, stomach black. Dark margin on dorsal, anal and pectoral fins. Dorsal fin rays before level of anus 28-32; lateral line pores before level of anus 27-29.
(voucher: ? mm TL)

Heteroconger tricia

Body very long and 'worm'-like, slender and cylindrical. Mouth very small, oblique, not reaching level of eye. Teeth numerous, in many rows on jaws and palate; lip continuous across front midline of upper jaw, anterior nostril opening through lip anteriorly. Dorsal fin origin above middle of small, rounded pectoral fin. Body pale, head freckled with brown spots above; 2 rows of large brown blotches along upper ⅔ of body, lower ⅓ of body plain cream. Lateral line pores before level of anus 64-68.
(voucher: ? mm TL)

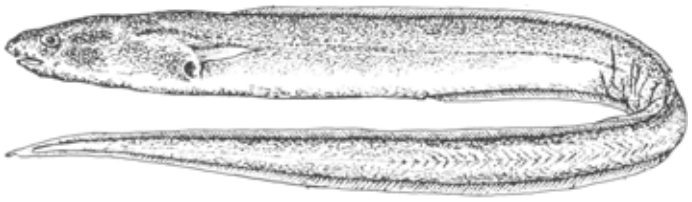


Lumiconger arafura after Castle & Paxton, 1984

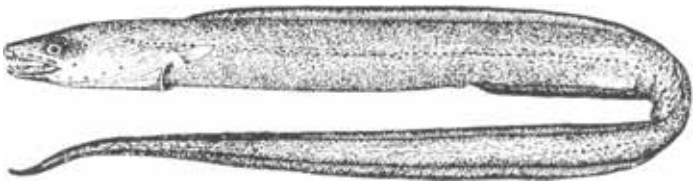


Parabathymyrus macrophthalmus after Chen & Weng. 1967

Bathycongrus guttulatus after Castle. 1968



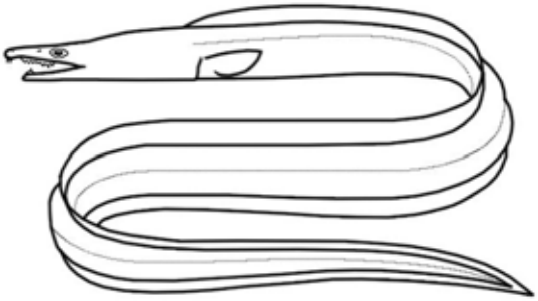
Macrocephenchelys brevirostris

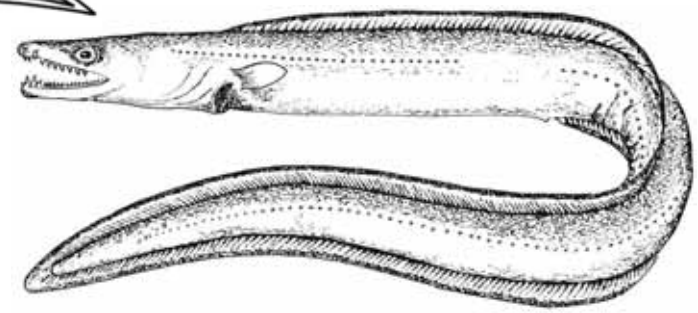


Uroconger lepturus after Castle, 1986a

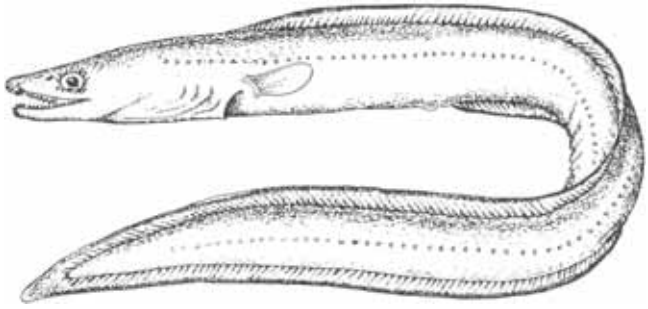
Gavialiceps javanicus

MURAENESOCIDAE

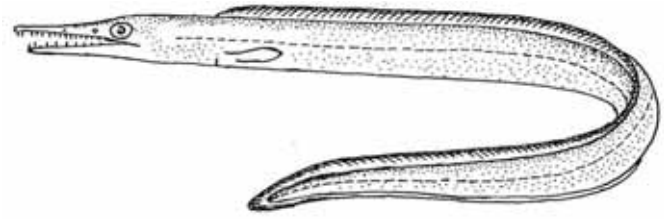




Muraenesox bagio after Castle, 1986b



Muraenesox cinereus



Oxyconger leptognathus after Chen & Weng, 1967

Lumiconger arafura

Fin rays segmented, tail tip soft, fin rays segmented. Snout pointed, 3-4 in HL. Elongate patch of granular premaxillary teeth exposed; vomer teeth in short band; lower gill opening attachment at mid-base of pectoral fin. Head, throat, belly and anal fin black and iridescent, rest of body fawn; 2 brown lines along body; fin edges black. Dorsal fin rays before level of anus 56; lateral line pores before level of anus 32-33.
(voucher: ? mm TL)

Bathycongrus guttulatus

Fin rays segmented; anus ⅓ along body length; tail noticeably long, its tip soft and flexible. Snout projecting, twice eye diameter. Teeth sharp, large, in 2 rows on jaws and in small patch anteriorly on vomer; lips well-developed; gill opening small. Dorsal fin begins behind pectoral fin base; tail noticeably long, tip soft and flexible. Body brownish or dusky yellow, fins grey or black, peritoneum black. Dorsal fin rays before level of anus 59-72; lateral line pores before level of anus 36-39.
(voucher: ? mm TL)

Uroconger lepturus

Fin rays segmented; anus about ⅓ along body length; tail tip soft and flexible. Teeth sharp, large, in 2 rows on jaws and in one row of 10-20 teeth on vomer, extending well back on roof of mouth; most of premaxillary band exposed. Snout 1.5 times eye diameter; eye 5.5-6.5 in HL. Body blue-grey or tan, fins edged black, peritoneum pale. Dorsal fin rays before level of anus 46-62; lateral line pores before level of anus 42-44.

Parabathymyrus macrophthalmus

Fin rays unsegmented; caudal fin short and tail tip stiff. Premaxillary teeth forming an oval patch, not extending outside mouth; posterior nostril a slit, low on cheek below front eye border and covered by a flap; eye 5.5-7 in HL. Body fawn or yellowish, pectoral and caudal fins plain yellow or cream, dorsal and anal fins yellow edged brown. Dorsal fin rays before level of anus about 86; lateral line pores before level of anus 36-44.
(voucher: ? mm TL)

Macrocephenchelys brevirostris

Fin rays segmented; anus about ⅓ along body length, tail rather long, its tip flexible. Snout blunt, 5-6 in HL; posterior nostril an opening above front margin of eye; small papillae on chin and head above. Mouth inferior, teeth fine, in bands on jaws, premaxillary and vomer teeth in broad connected band. Dorsal fin origin above or just behind pectoral fin; gill opening small, below pectoral fin base. Body pale fawn below, snout brown; gill opening, lips and inside mouth black; fins mostly pale, tail tip black. Dorsal fin rays before level of anus 41-43; lateral line pores before level of anus 28-31.

Gavialiceps javanicus

Body very long, soft and sticky, its depth 34-38 in TL. Dorsal and anal fins high, rays segmented; anus about ⅓ along body length; tail tip soft and flexible. Lips reduced; jaws very long, slender, notched behind tip; head flattened above. Teeth small and pointed, inner row of premaxillary teeth separated from outer rows by longitudinal toothless groove; vomer with 9-10 large canines each interspersed with 2-3 small ones. Posterior nostril located far forward on snout; supraorbital pores enlarged and slit-like. Pectoral fin absent; gill opening ventral. Body grey, dark brown or black on top of head and on back; gill opening and end of tail black.
(voucher: ? mm TL)

MURAENESOCIDAE

Pike Eels - Pucuk; Remang

Robust eels, cylindrical anteriorly, tail compressed. Mouth large, upper jaw extending well behind eye; teeth large and powerful, several rows of conical teeth on side of jaws; large canines on vomer and in front of lower jaw. Tongue not free from floor of mouth; anterior nostril tubular; posterior nostril opposite middle of large eye. Gill openings large or small. Anus before midpoint of body. Dorsal and anal fins well-developed; pectoral fin present.

The family has 6 genera and 15 species; representatives of four species in three genera were collected on the Survey.

REFERENCE: Castle, 1986b; Smith, 1999d.

Muraenesox cinereus

Jaws projecting. Canine teeth in jaws in 3 rows, compressed, those in middle row largest; long canines in front of jaws. Teeth on vomer in 3 rows, those in middle row large, compressed and sharp, each with sharp edges and cusps at base. Eye 2-2.8 in snout length; interorbital 7.2-9 in HL. Dorsal rays from origin to a vertical line through anus 65-78; number of lateral line pores before anus 40-47. Head and body dark grey or brown, lower sides grey. Dorsal, anal and caudal fins dark grey with broad black margins. Pectoral fin black.
(voucher: ? mm TL)

Muraenesox bagio

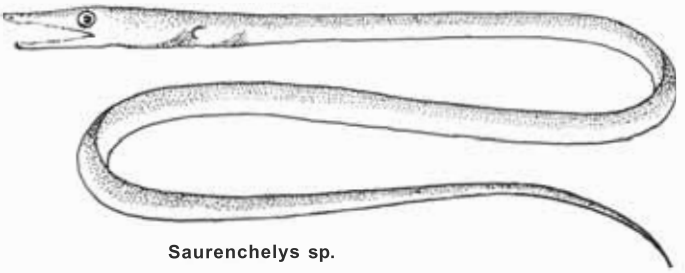
Jaws projecting; canine teeth in jaws compressed and in 3 rows, those in middle row largest; very large in front of jaws. Teeth on vomer in 3 rows, those in middle row large, compressed and sharp, each with sharp edges and cusps at base. Eye 2.9-3 in snout length; interorbital 9.0-10.7 in HL. Number of dorsal rays from origin of fin to a vertical line through anus 47-59; number of lateral line pores before anus 33-40. Head and body grey, lower sides white. Dorsal, anal and caudal fins grey with brown edge. Pectoral fin pale.

Oxyconger leptognathus

Jaws projecting and sharp. Three rows of teeth in jaws, middle row of simple canines, conspicuously long and well-spaced. A short row of simple small canine teeth in front of vomer. Eye large and circular, 3-3.5 in snout length. Body depth 20-21 in TL. Upper head and body tan or coppery; operculum and sides iridescent mauve; peritoneum black, swim bladder silver. Dorsal, caudal and hind part of anal fin edged brown.

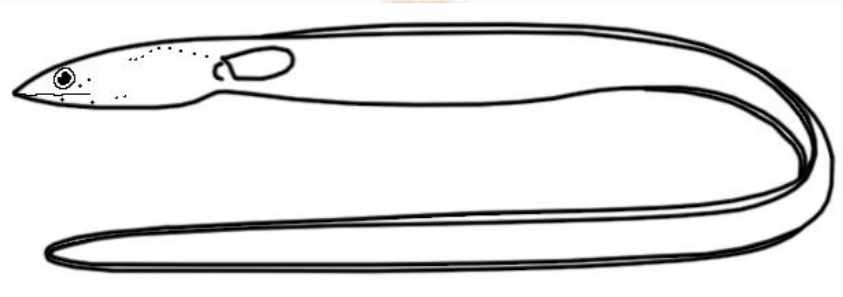
NETTASTOMATIDAE

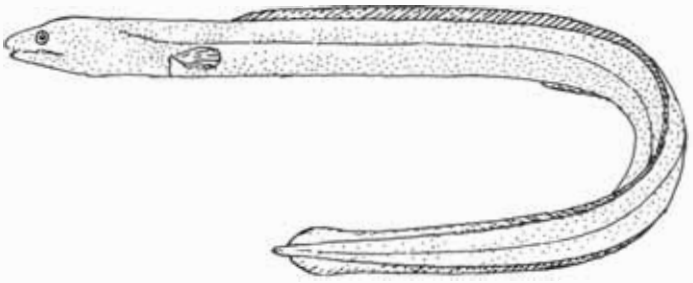
Nettenchelys gephyra



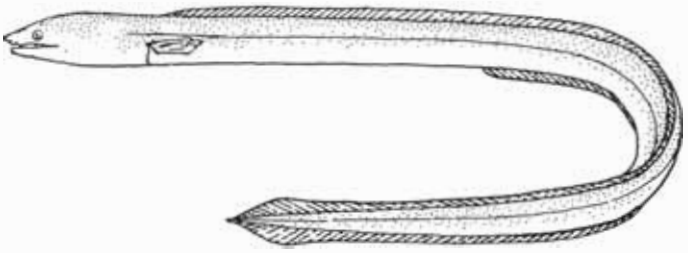
Saurenchelys sp.

OPHICHTHIDAE



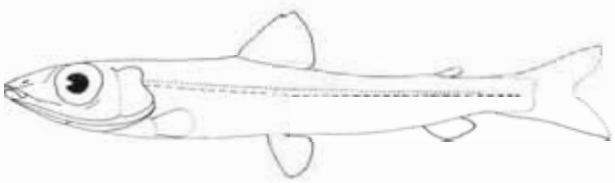


Ophichthus urolophus after Chen & Weng. 1967



Pisodonophis cancrivorus afler Chen & Weng. 1967

ARGENTINIDAE



Glossanodon australis

NETTASTOMATIDAE

Witch Eels, Duckbill Eels -

Body slender, compressed and elongate. Snout long and pointed, strong; teeth in jaws and on vomer numerous and close together. Tongue fixed to floor of mouth. Gill openings small and slit-like. Anus before midpoint of body though far behind gill opening. Pectoral fins usually absent. Tail long and tapering, ending in a slender tip or filament.

There are six genera in the family; members of two species collected during the Survey.

REFERENCES: Smith,1999f; Smith, Lin, Chen & Pogonoski, 1915; Karmovskaya, 2004.; Lin, Smith, Shao & Chen, 2015.

Nettenchelys gephyra

Snout sharp and beak-like, its length about 2.8 in HL; posterior nostril on top of head slightly behind eye; 8-10 pores along upper jaw. Jaw teeth in bands, inner series distinctly larger; long patch of vomerine teeth, 3 enlarged teeth in a separate part anteriorly. Body deepest in middle and tapers towards both ends; its depth about 28 in TL. Dark brown above, grey or cream below.
(voucher: ? mm TL)

Saurenchelys sp

Jaws strong and projecting. Posterior nostril just in front of eye. Many rows of sharp fine teeth in jaws; 3 rows of teeth on vomer, sharp and larger in the median row; teeth on pterygoids. Body depth 37 in TL. Body pale yellow or grey, top of head and end of tail brown; eye green, operculum and belly brilliantly silver.
(voucher: ? mm TL)

OPHICHTHIDAE

Snake Eels -

Elongate or cylindrical robust eels. Tongue not free from mouth; snout projects beyond lower jaw. Posterior nostril usually a slit in border of upper lip, pointing downward; anterior nostril a tube on or under front border of snout or upper lip. Teeth sharp, conical or granular. Anus at or behind midpoint of body. Tip of tail finless and muscular, pointed. Pectoral fin present or absent.

The family comprises 62 genera and numerous species, just two species were collected during the Survey.

REFERENCES: Chen & Weng, 1967; McCosker, 2010; Smith & McCosker, 1999; McCosker & Randall, 2001.

Ophichthus urolophus

Body depth 24-27 in TL; head 8-9 in TL; snout 5.5-6.5 in HL; eye 8-10 in HL. Snout short, tip rounded; anterior nostril a simple tube. Teeth pointed, mostly in single rows. Pectoral fin present, longer than eye diameter, its base narrow and opposite upper half of gill opening. Dorsal fin begins behind pectoral fin, posterior parts of dorsal and anal fins elevated. Anus about ⅓ along body length. Body plain fawn or tan, paler below; pectoral fin dusky anteriorly.

Pisodonophis cancrivorus

Body depth 22-34 in TL; head 8.5-10 in TL; eye 9-12 in HL. Teeth low and granular, in bands of several rows. Pectoral fin well developed, its base broad, twice or less in fin length. Dorsal fin begins above middle of pectoral fin; anus in anterior ⅓ of body length. Body tan or coppery brown, unpaired fins with dark margins.
(voucher: ? mm TL)

ARGENTINIDAE

Herring Smelts -

(Subfamily *Argentininae* Moderately elongate, silvery fishes. Mouth small, teeth absent on upper jaw, present on palate and lower jaw; eye large 'looking' outwards. Scales cycloid, easily lost; lateral line present. No spines on fins, single dorsal midway along body, begins before ventral fin; adipose fin present, above anal fin; pectoral fin low on sides of body, base close to head; caudal fin forked.
(Subfamily *Microstomatinae* has tubular eyes 'looking forward', no adipose fin, dorsal fin behind ventral fin, pectoral fin well up on sides).

REFERENCES: Kobyliansky, 1998; Parin & Belyanina 2007; Paxton & Cohen, 1999a.

Glossanodon australis

Silvery yellow, dark blotches above lateral line, dark lines along dorsal profile and to anus along ventral profile; gill rakers pale or streaked charcoal. Anus just before anal fin base, teeth along all of lower jaw; body width 2.5-2.9 in HL, snout 2.8-3.2 in HL, maxillary expansion 7.4-10.3 in HL.
D 10-14. A 9-12. P 20-25. L. lat. 50-54. Lower GR 19-22.
(voucher: 168.4 mm SL)

* BATHYLAGIDAE

(See Species list)

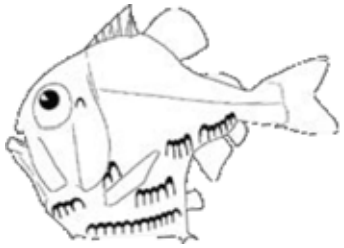
STERNOPTYCHIDAE

Hatchetfishes -

Small and mainly deep-water fishes found in all oceans from the surface to a depth of over 3000 m but most commonly around 1000-1800 m. Formerly only the very characteristic Hatchetfishes - with the short and extremely compressed body, well developed dorsal blade and post abdominal spine - were included in this family, but based on the arrangement of photophores, presence of gill rakers, pseudobranch and a gas-filled swim bladder, several genera previously in the GONOSTOMATIDAE have been included here, making a total number of 10 genera. The dorsal blade of the Hatchetfishes represents the highly specialised dorsal pterygiophores and they are seen either as a thin plate, a small pair of bony keels or as a single spine. The family is characterised by the arrangement of photophores in compound clusters. An adipose fin may be present or absent.

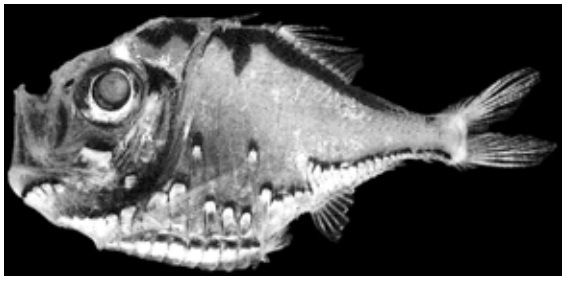
Four species in three genera were collected in the Survey.

REFERENCES: Harold, 1994. Harold, 1999a; Harold, Kemp & Shore, 2016; Harold & Lancaster, 2003; Parin & Kobyliansky, 1996..

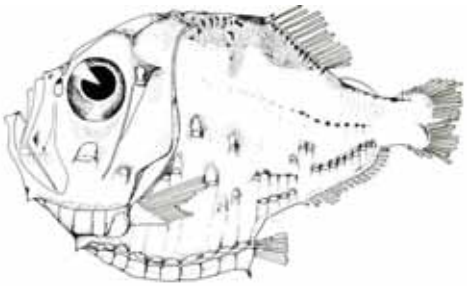


Argyripnus pharos (photo of preserved specimen) from Proc. Biol. Soc. Wash, Dec 2003

Maurolicus javanicus



Polyipnus soelae after Harold, 1994



Polyipnus triphanos after Schultz, 1938

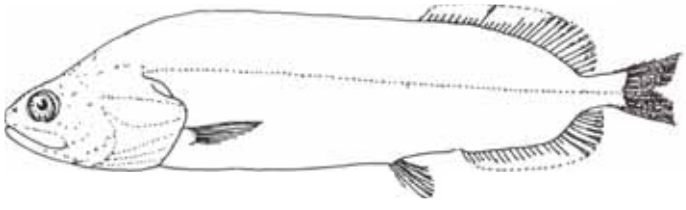
ALEPOCEPHALIDAE

Slickheads -

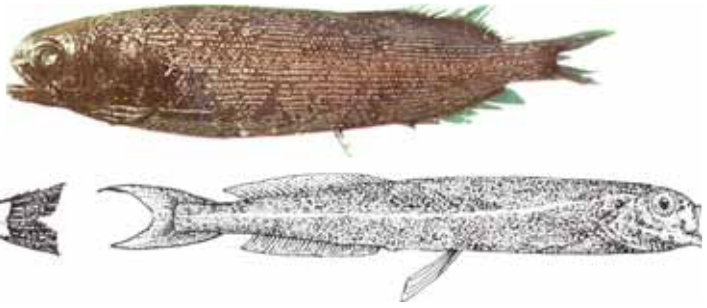
Deep-sea fishes with variable habitats from usually benthic to midwater. They are most numerous below 1000 m and are found in all oceans. The fishes are predominantly brown or black, although the members of one genus are bright blue. The body shape is highly variable, from moderately deep to elongate and eel-like. All but one species lacks scales on the head and if present on the body, the scales are always cycloid (smooth to touch) though easily lost. A lateral line, when present, is composed of either pored scales, a pored tube supported by ring-like scales, or papillae. The dentition of the jaws and roof of the mouth is variable, but teeth are usually present on the premaxilla and mandible. The gill rakers are moderate to long and have small tooth-like structures. The single dorsal fin may be continuous with the caudal and anal fins. There are no adipose fins. Light organs are present in four genera.

Only two species in the 20 known genera were collected in the Survey.

REFERENCE: Sazonov & Markle, 1999.



Microphotolepis schmidti after Sazonov & Parin. 1977



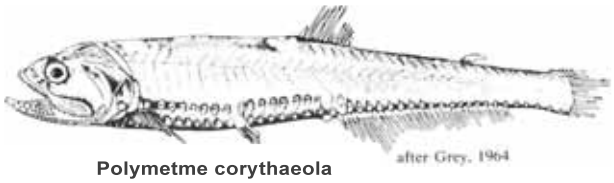
Xenodermichthys copei after Günther. 1887

PHOSICHTHYIDAE
Lighthousefishes-

Small to moderate-sized fishes. They are generally oceanic but some are benthopelagic, mostly found between 200 and 300 m at day time. A pattern of vertical migration often takes place during the night for some species. Dorsal and adipose fins are present; the dorsal fin placed above the anal fin. These fish lack a chin barbel. Gill rakers are well-developed. Photophores are present on the isthmus and in two rows on the lower flanks (except *Varella*) up to the anal fin origin. A single row of photophores follows behind the anal fin onto the caudal peduncle.
Seven genera in the family; two species obtained on the Survey.

REFERENCE: Harold, 1999c.

Pollichthys mauli after Grey, 1964



Polymetme corythaeola

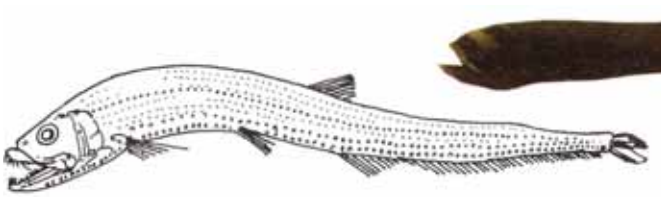
GONOSTOMATIDAE
Lightfishes -

Small to moderate sized fishes rarely exceeding 25 cm in length and found in all oceans at depths between 200 and 3000 m during day time; pre-metamorphic post-larvae are found near the surface but during metamorphosis they sink down to a preferred depth. Many species perform vertical migration during the night to feed on zooplankton in the upper water layers.

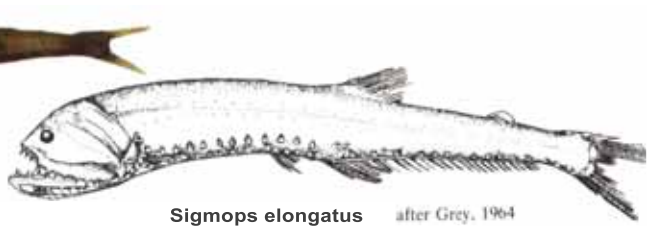
The body is usually elongated and compressed, the head is without barbels, eyes small and the large mouth has teeth in both jaws. The gill opening is wide. Contrary to other stomioid fishes, the GONOSTOMATIDAE often have true gill rakers. Positions of the dorsal and ventral fins are variable, an adipose fin is often present and the pectoral fin is placed low on the body. The cycloid scales, if present, are large, thin and easily lost. Photophores (light-organs are present on all species except *Cyclothone obscura* and are arranged as one or more on the head, always one series on the branchiostegal membranes and one or more rows on the body. Additional patches of luminous tissue may be present on the head and/or on the body. The body is either uniformly dark brown or black, often with silvery iridescence on the body and cheeks; or the fish is translucent white with scattered black chromatophores.

These are very common fishes. The family GONOSTOMATIDAE contains eight genera and 32 species, two of which were obtained on the Survey.

REFERENCES: Harold, 1999a; Miya & Nishida, 2000.



Manducus greyae after Johnson, 1970



Sigmops elongatus

STOMIIDAE

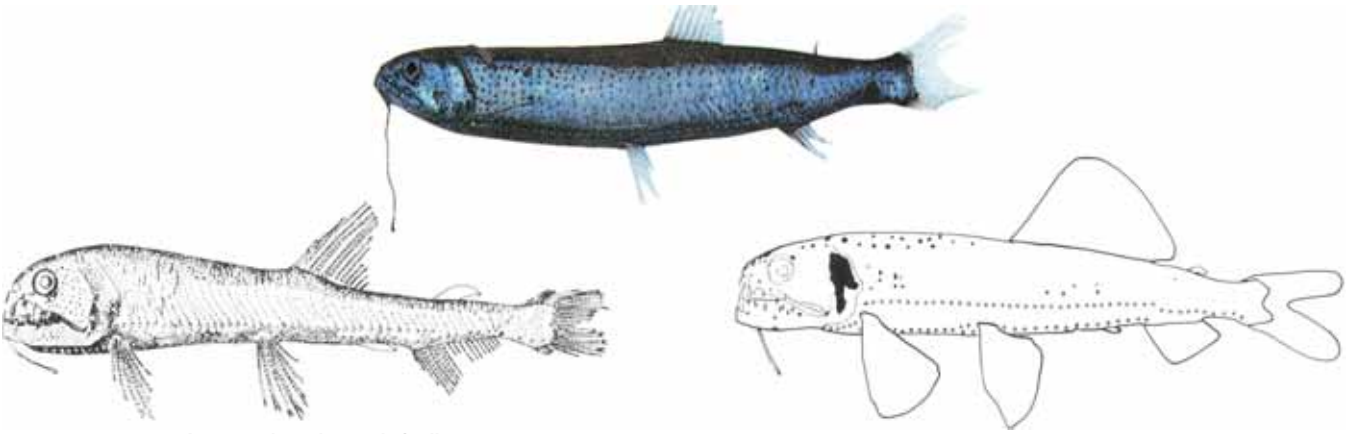
No true gill rakers in adults; one infraorbital bone; one or no supramaxillary; mesopterygoid reduced in size or absent; photophores without ducts or lumen; usually a chin barbel in most, associated with hyoid apparatus; pectoral fin rays absent in *Tactostoma*, *Idiacanthus*, and *Photostomias*; most are darkish in colour.

Subfamily Astronesthinae
Stareaters, Snaggletooth -

Small-sized fishes rarely exceeding 15 cm in length, found in all oceans – from 200m (small species) to 2000m. The body is black. Small photophores are present over most of the body, becoming abundant ventrally. Two rows of photophores on the lower flanks are usually divided into discrete sections; two mid-ventral rows of photophores between the major series are often developed. In front of the eye is a small luminous organ and behind the eye a larger light organ, which is sometimes divided into a small anterior and a large posterior part. A row of photophores lies along the maxilla. The dorsal fin origin is well in front of the anal fin and over or behind the ventral fins. A dorsal adipose fin is usually present. The head and mouth are large; fangs are present on the premaxilla and anterior lower jaw, while slender or comb-like teeth are on the maxilla. The gill arch possesses gill 'teeth' instead of true gill rakers. A barbel is present on the chin; during sampling, care should be taken not to damage it as it is important in identification. The Atlantic species *Astronesthes niger* has been reported to flash violet-blue light over the fins, along the barbel and on the anterior part of the body. Very little is known about the life history or food habits of these fishes.

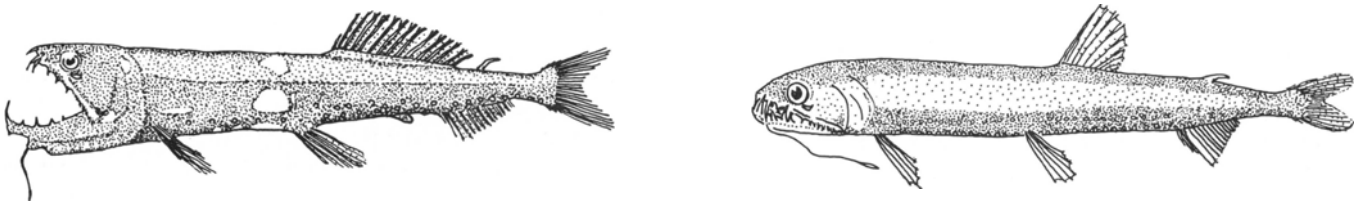
Six genera and 59 species in this subfamily, of which five were collected on the Survey.

REFERENCES: Liao, Chen & Shao, 2006; Parin & Borodulina, 2003; Harold, 1999d.



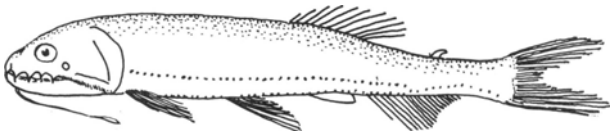
Astronesthes chrysophekadion

Astronesthes cyaneus after Goodyear & Gibbs, 1970



Astronesthes indicus after Regan & Trewavas. 1929

Astronesthes martensii after Lutken. 1892



Astronesthes splendidus after Brauer 1906

Subfamily Chauliodontinae

Viperfishes -

These are small to medium sized fishes growing to about 30 cm in length, occurring in all oceans but apparently less abundant in the Central Pacific. They are found from 20-2800 m, the larger species generally occurring in the deepest waters. The body is slender and compressed, tapering at its end. The large, rather heavy scales that cover the body, though easily lost, form five longitudinal rows. Under each scale is a hexagonally-patterned pigmented area, the pigment being absent over each small light organ which thus shines through the transparent scale. Luminous organs are present immediately before and behind the eye. A row of large light organs lies on each side of the body from the gill opening to above and near the end of the anal fin; another row below these begins at the isthmus and ends at the caudal fin base. A wavy row of smaller organs runs between these rows and small groups are also present on the mid-ventral line. The entire body is covered by a gelatinous membrane which is usually lost on preserved material. The dorsal fin is well in advance of the anal fin and adipose dorsal and adipose anal fins are present. The first dorsal fin ray is filamentous and tipped with a light organ which presumably is used as a lure. Large fang-like teeth arm the mouth which can open 90° and thus accommodate large prey. A barbel is present on the chin.

The subfamily comprises one genus and nine species, of which one was obtained on the Survey.

REFERENCE: Harold, 1999e.

Chauliodus sloani after Regan & Trewavas. 1929

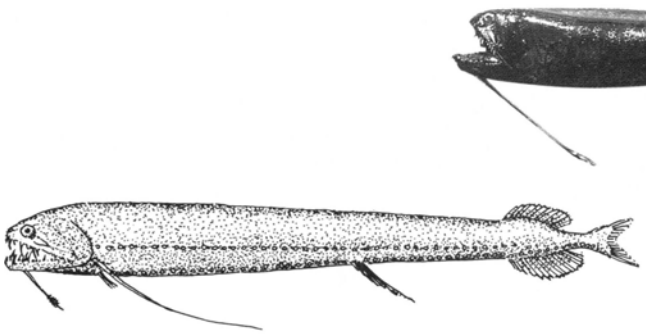
Subfamily Melanostomiinae

Scaleless black Dragonfishes -

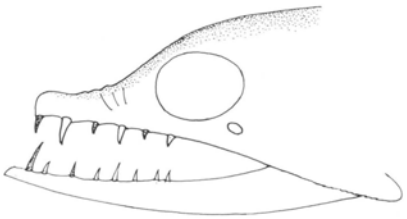
Small deep-water fishes found in all oceans from the surface down to 4500 m, although the majority is found in layers shallower than 1000 m. The body is long and slender and slightly compressed (except for one species). The head is rather short, the nostrils small. The jaws are large, nearly as long as the head. Teeth on the premaxilla, maxilla and mandible are erect anteriorly but only as small denticles posteriorly. A chin barbel is present and variously developed, showing sexual dimorphism in some groups. The dorsal and anal fins are placed far back on the body: confined to the caudal peduncle. Except for *Chirostomias*, a dorsal adipose fin is present. A pectoral fin may be present also. The skin is usually naked, covered with more or less numerous minute light organs. These are scattered over the head and the body, arranged especially into vertical rows. A postorbital photophore is usually present but it may be absent in females. Two rows of light organs are present on the lower flanks of the body up to the anal fin, followed by a single row on the caudal peduncle which is often separated from the two anterior rows by a space.

This family comprises 15-16 genera and 195 species, of which seven were obtained on the Survey.

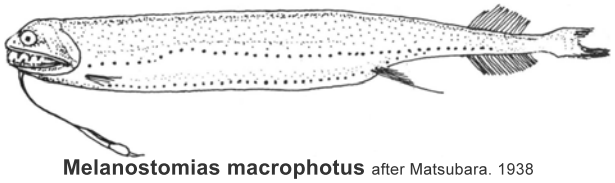
REFERENCES: Harold, 1999f; Prokofiev & Klepadlo, 2019; Prokofiev, 2019b; Koeda & Ho, 2019.



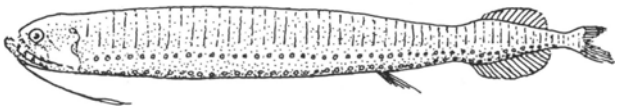
Echiostoma barbatum after Regan & Trewavas. 1930



Eustomias bifilis after Gibbs. 1960



Melanostomias macrophotus after Matsubara. 1938



Photonectes albipennis after Imai. 1957

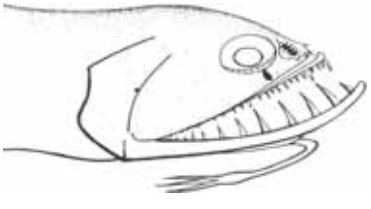
Subfamily Stominae

Scaly Dragonfishes

Small fishes found in all oceans except for Arctic and Antarctic regions, from the surface to as deep as 2000 m, with the majority appearing between 300-500 m. The body is long, slender and compressed, covered by a thin, gelatinous, transparent membrane. Beneath this membrane are the scales, which are very thin, completely transparent and easily lost as no apparent scale pockets exist. The scales form 5 or 6 longitudinal rows and beneath each scale a pigmented hexagonally-patterned area is visible, its centre a luminous organ. A light organ lies below and behind the eye; other small light organs are scattered over the head and body. A row of larger light organs lies on each side of the body from the gill opening to the origin of the anal fin; another row of light organs below these begins on the isthmus and ends near the caudal fin base. Small photophores are also present on the branchiostegal membranes. The dorsal and anal fins are on the posterior part of the body, the ventral fins at or just behind the midlength of the body. No adipose fins are present. The teeth on the premaxilla and mandible are rigid and fang-like and there are numerous fine teeth on the posterior part of the maxilla. The vomer has a pair of teeth and there are one to three teeth on each side of the palatines. There are no true gill rakers but gill 'teeth'. These fishes possess a chin barbel which is either long or short and has a light organ at its end, sometimes with a filament as well.

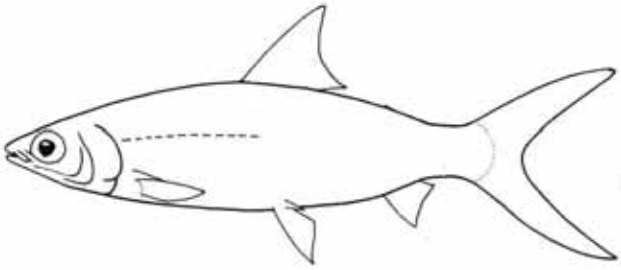
The family comprises one genus and eleven species, of which one was obtained on the Survey.

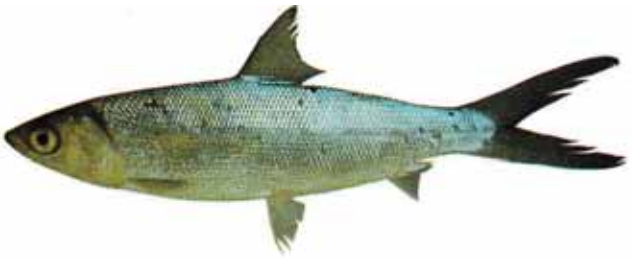
REFERENCE: Harold, 1999.



Stomias nebulosus after Brauer, 1906

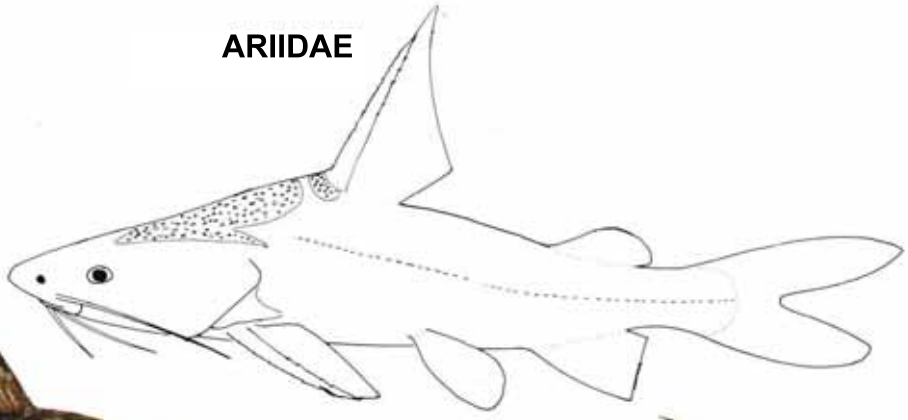
CHANIDAE





Chanos chanos

ARIIDAE



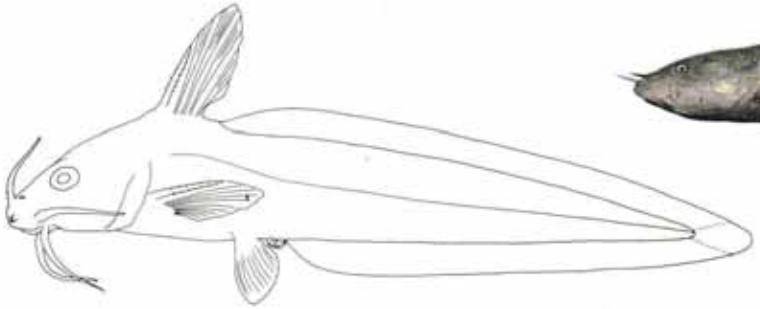
Plicofolis tonggol

Arius maculatus

Netuma thalassina

Netuma bilineata

PLOTOSIDAE



Euristhmus lepturus

CHANIDAE

Milkfishes - Bandeng

Body oblong, moderately elongate. Head naked. Gill membranes united but free from throat. Four branchiostegal rays. Mouth small, toothless; knob on symphysis of lower jaw; adipose tissue over eye. No gular plate. No belly scutes. Scales small; lateral line present. Dorsal and anal fins with basal sheath of scales; pectoral and caudal fin deeply forked. Eleven to 12 rays in ventral fin.

Chanos chanos

Olive-green back, silvery-yellow below. Dorsal, anal and caudal fins edged black. Maxilla does not reach eye. Dorsal fin in middle of dorsal profile.
D 13- 17. A 9-11.
(voucher: 179 mm SL)

REFERENCES: https://www.fishbase.ca/summary/Chanos-chanos.html; Bagarinao, 1994.

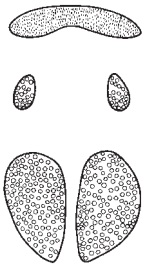
ARIIDAE

Fork-tailed catfishes - Manyong; Jahan

Oblong, robust, heavy-bodied fishes with naked body. Head moderately depressed with strong bony shield on top extending almost to dorsal fin origin ('occipital process'); mouth moderate to wide; bands of fine or conical teeth in jaws; patches of fine or granular teeth often present on palate; 1, 2 or 3 pairs of barbels around mouth the maxillary barbels usually longest; nostrils close together. Gill opening wide, or restricted, lateral line distinct. Dorsal fin short-based, of a strong serrated spine, and 7 rays. Adipose fin behind dorsal fin, short-based. Anal fin which has 15-30 rays; pectoral fin low on sides, with a strong, serrated spine; caudal fin forked. Inner ventral fin rays in mature females often develop a thick pad or blunt hook.

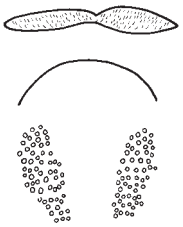
REFERENCES: Kailola, 1999; Kailola, 2004; Kottelat, 2013.

Plicofollis tonggol



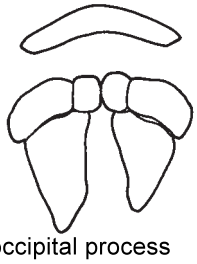
Teeth on palate granular, in 4 patches, the 2 anterior patches small but always visible, posterior patches broadly oval, running obliquely along palate. Head shield rugose, striate posteriorly. Sides of occipital process slightly convex, keel moderate. Snout conical, head length 30-31% SL. No rakers on back of first gill arch. Body bluish grey above, white below, often a black patch on adipose fin, unpaired fins dark or dark-margined.
A 18-20. GR total 9-12.
(voucher: 275 mm SL)

Arius maculatus



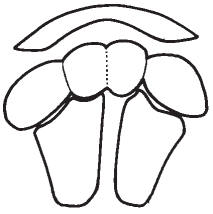
Teeth on palate granular, in 2 patches (Fig); patches semi-oval and placed far back on palate. Teeth on upper jaw in narrow band. Occipital process keeled and rough with strong granules and low ridges; sides straight. HL 3.6-4 in SL; base of adipose fin 4-6 in its distance from dorsal. Body silvery blue, cream below, conspicuous black spot over outer half of adipose fin.
A 19-22. Lower GR 13-15.
(voucher: 177 mm SL)

Netuma thalassina



Teeth on palate fine and slender, in 2 large triangular patches, each of 3 smaller patches (Fig). Snout prominent and 'shark-like' (especially in large fish), exposing maxillary tooth band, distance from snout to tip of dorsal origin 2.4-2.7 in SL; triangular occipital process rough to smooth, keel low, sides straight and converging posteriorly. Body blue-green, sometimes dusky above, cream below, usually with coppery-golden sheen, especially over head.
A 14-17. Lower GR 8-9.
(voucher: 390 mm SL)

Netuma bilineata



Teeth on palate fine and slender, in 2 large triangular patches, each of 3 smaller patches (Fig.). Snout bluntly rounded, never very prominent, none or half of maxillary tooth band exposed, distance from snout tip to dorsal fin origin 2.6-2.9 in SL; oblong or slightly triangular occipital process rough, keel moderate, sides almost parallel. Body dusky blue-brown above, paler below, usually with bronze sheen, especially over head.
A16-20. Lower GR 9-10.
(voucher: 283 mm SL)

PLOTOSIDAE

Eeltailed catfish - Sembilang karang

Body elongate and robust, tail tapering. Scales absent. Four pair of barbels around mouth. A serrated spine in front of dorsal fin and one in front of each pectoral fin. Thickened caudo-dorsal fin continuous with long-based anal fin. The three species collected during the Survey have a much-branched dendritic organ before anal fin origin (absent in many representatives of the family).

Ten genera and 42 species in this family, most of them inhabiting fresh waters.

REFERENCES: Ferraris, 1999; Murdy & Ferraris, Jr., 2006.

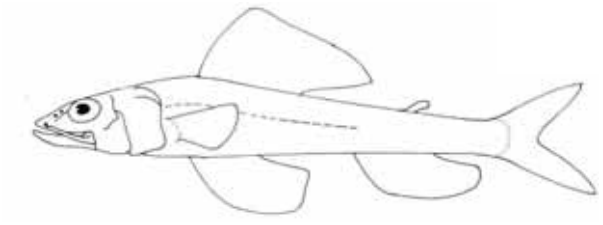
Euristhmus lepturus

Gill membranes not joined, separated by broad isthmus. Body depth less than 8 in SL. More than two rows of teeth on vomer. Body grey-brown.
(voucher: 366 mm SL)

Euristhmus nudiceps

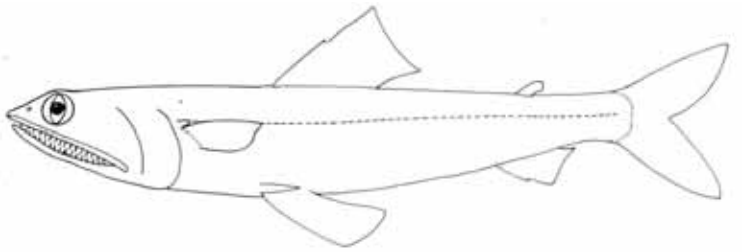
Plotosus lineatus

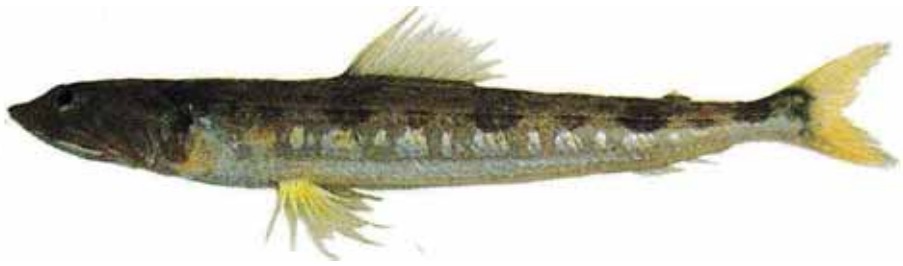
AULOPIDAE



Hime diactithrix

SYNODONTIDAE
Subfamily Synodontinae





Synodus hoshinonis

Synodus indicus

Synodus jaculum

Euristhmus nudiceps

Gill membranes not joined, separated by broad isthmus. Body depth more than 10 in SL. Two rows of teeth on vomer. Body dark brown.
(voucher: 152 mm SL)

Plotosus lineatus

Gill membranes free from isthmus and joined across it. Nasal barbels do not reach past eye. Body tan or with 2 or 3 or white stripes along body.
(voucher: 87 mm SL)

AULOPIDAE

Flagfins -

Body elongate and cylindrical. Head large; mouth oblique, maxilla broad posteriorly, with two supramaxillary bones; teeth small and sharp. Scales ctenoid or cycloid, those on cheeks and operculum enlarged. No spines in fins. Dorsal fin long and high with 14-21 rays. Adipose fin present. Nine rays in large ventral fins; 9-13 anal fin rays. Caudal fin deeply forked. Sexes differently coloured.

REFERENCES: Lee & Chao, 1994; Prokofiev, 2008; Gomon & Struthers, 2015; Gomon, Struthers & Stewart, 2013.

Hime diactithrix

Snout equal to eye diameter. Dorsal fin elevated anteriorly. Second to fourth rays elongated in males; fin long-based. Red-brown above, silvery-white below. Three to 4 oblique blotched brown bands across back. Three series of orange spots along dorsal fin; orange band along anal fin; ventral fin rays red basally.
D 14-17. A 8-10. L. lat. 39-45. Lower GR 11-13.
(voucher: 185 mm SL)

SYNODONTIDAE

Lizardfishes; Grinners - Beloso; Kepala busok

Small to medium-sized cylindrical fishes with spineless fins and large mouth full of slender sharp teeth, even on tongue. Voracious predators of small fishes.

REFERENCES: Cressey, 1981; Russell, 1999; Ganga, Thomas & Sukumaran, 2015; Inoue & Nakabo 2006; Polanco, Acero & Betancour-R, 2016.

Subfamily Synodontinae

Body elongate and cylindrical. Head depressed, 'lizard-like'; mouth very large with rows of small, sharp, slender teeth. Usually an adipose dorsal fin present. Always scales on body, few or none on caudal fin rays. Dorsal and anal fins short-based and single; pectoral fin well developed; caudal fin forked; 8 rays in ventral fin, inner rays much longer than the outer ones.

Two genera and 59 species in the sub-family; we collected 13 species on the Survey.

REFERENCES: Cressey, 1981; Russell, 1999; Polanco, Acero & Betancour-R, 2016.

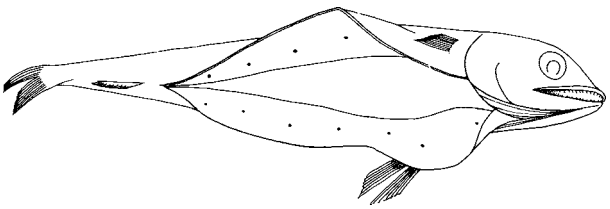
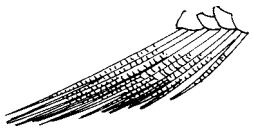


Diagram showing peritoneal spots



Ventral fin

Synodus indicus

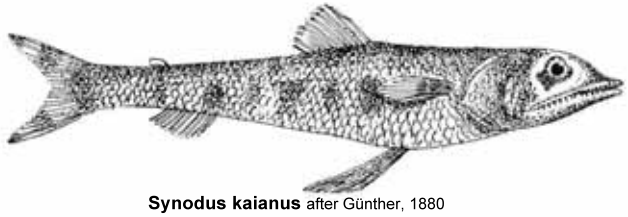
All teeth on palatine band the same length. Pectoral fin does not reach a line drawn between origin of ventral and dorsal fins. Two small black marks on upper corner of operculum; blue spots and wavy short longitudinal bands on back and sides. Pale peritoneum with 9-11 black spots.
D 11-13. A 9-11. L. lat. 52-58. Tr above 3½.
(voucher: 120 mm SL)

Synodus hoshinonis

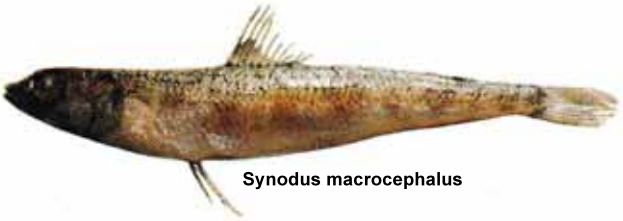
Anterior teeth of palatine band longer than posterior ones. Pale peritoneum with 12-13 black spots. Prominent black area on upper corner of operculum split above into 3 or 4 branches. Brown bars across back.
D 12-14. A 8-10. L. lat. 55-57. Tr above 3½-4½.
(voucher: 150 mm SL)

Synodus jaculum

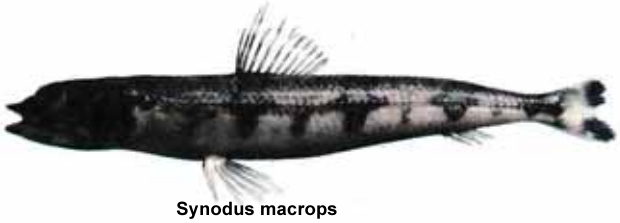
Anterior teeth of palatine band longer than posterior ones; no scales on cheek behind corner of mouth; 11-13 black spots on pale peritoneum. Conspicuous large black spot on side of caudal peduncle at base of caudal fin.
D 11-13. A 8-10. L. lat. 59-62. Tr above 5½-6½.
(voucher: 93 mm SL)



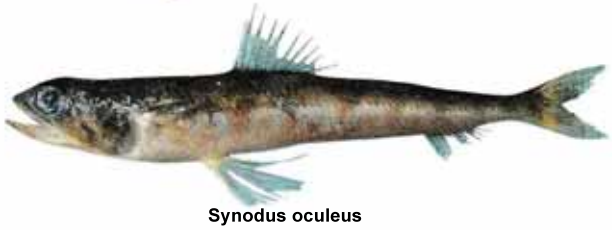
Synodus kaianus after Günther, 1880



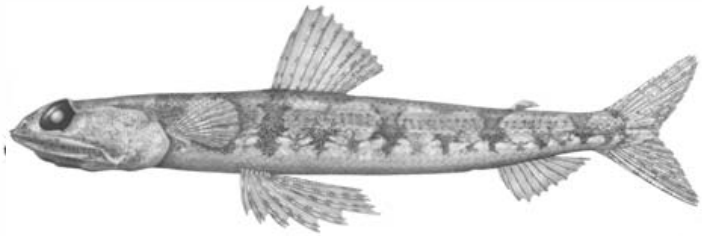
Synodus macrocephalus



Synodus macrops



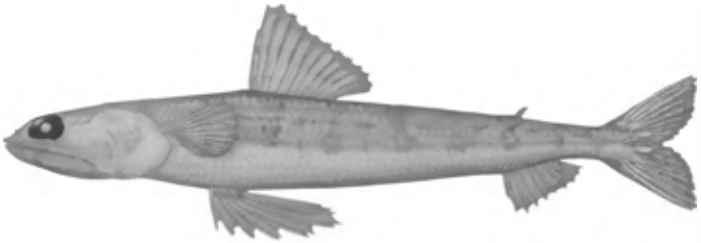
Synodus oculeus



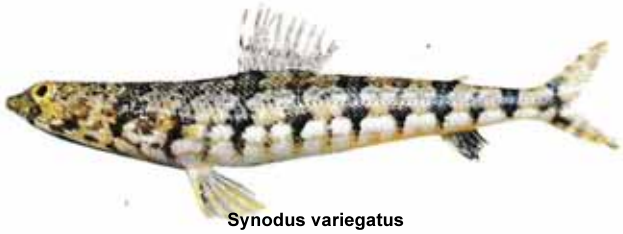
Synodus rubromarmoratus from Cressey, 1981

Synodus segeneus

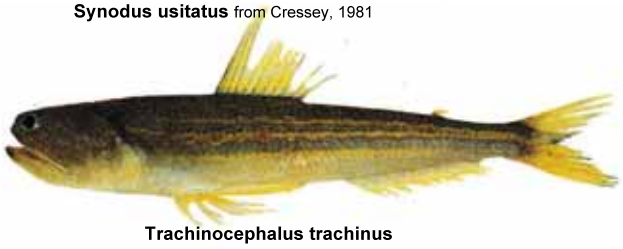
Synodus tectus



Synodus usitatus from Cressey, 1981

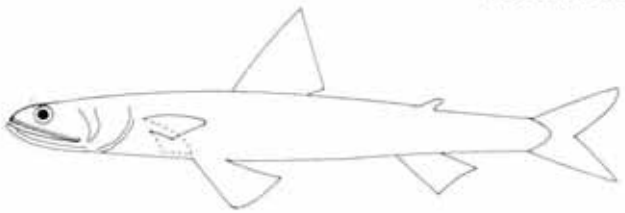


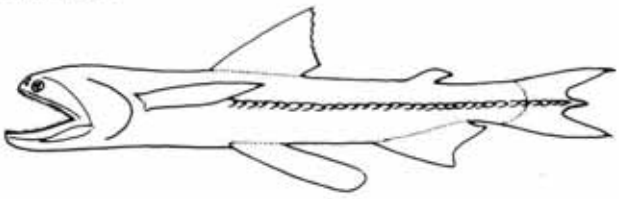
Synodus variegatus



Trachinocephalus trachinus

Subfamily Harpadontinae





Hapradon microchir

Harpadon nehereus

Synodus kaianus

All teeth on palatine band same length; fleshy tip on both jaws. Pectoral fin reaches beyond a line drawn between origin of dorsal and ventral fins. Three broad dark brown patches below lateral line and narrower patches in interspaces; dark bar across each lobe of caudal fin; basal half of pectoral fin dark brown. Peritoneum dark brown, nearly black.
D 10-13. A 10-11. L. lat. 59-63. Tr above 7½-8½.
(voucher: ? mm SL)

Synodus macrops

Three or 4 conspicuous dark grey "X" -shaped markings spaced along side of body; peritoneum dark brown with 6-7 black spots. Palatine teeth of equal length; tip of lower jaw fleshy.
D 11-12. A 10-11. L. lat. 51-55. Tr above 3½.
(voucher: 135 mm SL)

Synodus rubromarmoratus

Pectoral fin does not reach a line drawn between origin of dorsal and ventral fins; all teeth in palatine band of equal length. Body and fins mottled red, 8 dark markings along back and sides, conspicuous below lateral line; 12-13 black spots on pale peritoneum
D 10-12. A 9. L. lat. 54-55.
(voucher: ? mm SL)

Synodus tectus

Prominent black patch on upper corner of operculum. Anterior teeth of palatine band longer than posterior ones. Pale peritoneum with 10-11 black spots. Bars across body indistinct.
D 13-14. A 9-10. L. lat. 55-57. Tr above 3½.
(voucher: 120 mm SL)

Synodus variegatus

Usually six dark spots at snout tip. Two longitudinal series of about 9 irregular diamond-shaped blackish blotches (which may have pale centres) on upper half of body, each blotch narrowly joined with the one in vertical alignment, the intervening zone often appearing as a pale bluish stripe; a second fainter bluish stripe sometimes apparent. Anterior teeth of palatine band longer than posterior ones; usually no scales on cheek behind corner of mouth. Pale peritoneum with 10-12 black spots.
D 10-13. A 8-10. L. lat. 56-61. Tr above 5½-6½.
(voucher: 60 mm SL)

Synodus macrocephalus

Snout pointed when viewed from above; all teeth on palatine band the same length; pectoral fin reaches beyond a line drawn between origin of dorsal and ventral fins. Two or 3 dark bars over dorsal fin. 7 black spots on pale peritoneum.
D 11-13. A 9-11. L. lat. 55-56. Tr above 3½.
(voucher: 78 mm SL)

Synodus oculeus

Dorsal fin high, longest ray 5.3-6.3 in SL. All teeth on palatine band of equal length; snout rounded when viewed from above. Body and fins plain, without distinct markings. Seven or 8 black spots on pale peritoneum.
D 12-13. A 9-10. L. lat. 54-57.
(voucher: 106 mm SL)

Synodus sageneus

Anal fin base longer than dorsal fin base; snout longer than eye diameter and sharply pointed; adipose fin very small or absent, especially in large individuals. Faint yellow-mauve band from pectoral fin base to caudal fin; small brown spot on operculum above pectoral fin base. Fins and remainder of body without distinct markings.
D 12-13. A 12-15. L. lat. 50-55.
(voucher: 143 mm SL)

Synodus usitatus

Pectoral fin reaches well beyond a line drawn between ventral and dorsal fin origins; 14-17 black spots on pale peritoneum; all teeth in palatine band the same length. Five dark bands across back; 2 or 3 faint bands on dorsal fin.
D 12. A 8-9. L. lat. 58-60.
(voucher: ? mm SL)

Trachinocephalus trachinus

Snout blunt, shorter than eye diameter, 9-15% HL. Anal fin base longer than dorsal fin base. Body with alternating narrow light blue and dark-edged yellow stripes, shading to whitish ventrally; a large diagonally elongate black blotch behind upper end of gill opening.
A 14-16. P 11-13.
(voucher: 115 mm SL)

Subfamily Harpadontinae

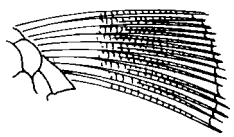
Bombay ducks; Saurys; - Luli; Buntut kerbo; Lumpah

Body elongate and cylindrical (*Saurida)* or compressed *(Harpadon)*. Mouth very large, either with bands of many sharp, slender teeth or with rows of larger, sharp and curved teeth. Head thick, depressed or somewhat rounded; eye moderate to small. An adipose dorsal fin is usually present; ventral fin with 9 rays and noticeably large; caudal fin forked or trilobate (3-lobed). Scales present or absent from body, always on caudal fin rays.

Representatives of the two genera were collected during the Survey.

REFERENCES: Inoue & Nakabo, 2006; Ganga, Thomas & Sukamaran, 2015; Russell, 1999.

Saurida: scales on body present; body robust; caudal fin forked.
Harpadon: scales few and weakly attached on flabby body; caudal fin 3-lobed.



Ventral fin

Harpadon microchir

Body slender; pectoral fin short, reaching much less than half-way to dorsal fin origin. Lateral line tubules long and narrow; scales over basal half of adipose fin and in caudal region. Body silvery blue; dorsal, caudal and anal fins dusky over outer two-thirds, pectoral fin brown; mouth and gill cavities.
D 13-15.
(voucher: ? mm SL

Harpadon nehereus

Body deep, depth 5-8 in SL; pectoral fin long, reaching past dorsal fin origin. Body dusky yellow, stippled black over lower sides; fins pale, dorsal and caudal fins tipped brown; operculum charcoal.
D 12-13. A 13-15. L. lat. 40. Scales on trunk and caudal region.
(voucher: ? mm SL)

Harpadon translucens

Harpadon mortenseni

Harpadon sp cf nehereus

Saurida gracilis

Saurida longimanus

Saurida micropectoralis

Saurida nebulosa

Saurida tumbil

Saurida macrolepis

Saurida wanieso

Saurida elongata

Harpadon translucens

Body deep, depth 4.8-6.6 in SL; pectoral fin moderately short, reaching about half-way to dorsal fin origin. Body translucent, greyish-green, darker above and finely stippled black; fins darker along margins.
D 14-15. A 15. L. lat. 55. Body scales on trunk and caudal region.
(voucher: ? mm SL)

Harpadon sp. cf nehereus

Body deep, depth about 3.5 in SL; pectoral fin long, reaching past dorsal fin origin. Body bluish violet, darker above; head brown, iridescent over operculum; fins brown to black, ventral fin barred black, pectoral fin completely black.

Saurida longimanus

Pectoral fin long, reaching well past ventral fin origin, less than 5 in SL, its axillary scale long and pointed. Both palatine tooth bands narrow, outer with 2-3 rows of teeth. Body greenish to charcoal above, lower sides and dins grey; pectoral fin dark brown or black.
L. lat. 49-52.
(voucher: 215 mm SL)

Saurida nebulosa

Axillary scale of pectoral fin short and broad; pectoral fin length 8.5-10 in SL and ending opposite 4th to 6th scale before dorsal fin origin. Upper jaw length 6.3-7.1 in SL. Body dusky green above, silvery below, sides mottled and blotched brown; brown checks on lips; dark bands and spots on fins.
D 10-11. P 11-13.
L. lat. 48-52. Peritoneum dark on upper half.
(voucher: 74 mm SL)

Saurida macrolepis

Head 23-27% SL, pectoral fin 14-18% SL, reaching line between ventral and dorsal fins; hind margin of pectoral fin moderately concave. Body dusky olive above, silvery white below, a row of dark blotches on lateral line may be present. Pectoral fin dark brown, its inner side dusky; two brown streaks on preoperculum; brown checks along leading edges of dorsal and caudal fins sometimes present, upper lobe of caudal yellow, fin hind margin black.
P. 13-15. L. lat. 46-49.
(voucher: 210 mm SL)

Saurida elongata

Scale in axil of pectoral fin long and pointed; pectoral fin short, not reaching base of ventral fin; anterior rays of dorsal fin elongate in larger individuals. Outer bands of palatine teeth in 3 or more rows anteriorly. Grey or pale brown above, silvery white below, about 8 distinct white spots along upper sides but no dark cross bands on back; front edges of dorsal and caudal fins dark brown.
L. lat. 62-66.
(voucher: 210 mm SL)

Harpadon mortenseni

Body slender, depth about 7-8 in SL; pectoral fin short, reaching about one-third distance to dorsal fin origin. Body dark grey; inside mouth and gill cavity dark; fins pale, outer half of each caudal lobe dark brown.
D 60-70. D 13-14. Body scales on lateral line and caudal region.
(voucher: ? mm SL)

Saurida gracilis

Axillary scale of pectoral fin short and broad; pectoral fin length 7.6-8.5 in SL and ending opposite 2nd to 3rd scale before dorsal fin origin. Upper jaw length 5.1-6 in SL. Body yellowish brown above, creamy silver below; brown blotches and spots over sides; fins banded and spotted brown; lips checked brown. Peritoneum mostly pale.
D 11-12. P 12-14. L. lat. 48-52.
(voucher: 128 mm SL)

Saurida micropectoralis

Pectoral fin short, less than 8.7 in SL and never reaching ventral fin origin when laid towards it. Three or more rows of teeth in anterior part of outer palatine band. Body fawn above, white below, with traces of dark blotches across back; brown spot at base of adipose fin; upper half of inner pectoral fin dusky and black bar across ventral fin.
L. lat. 56-58.
(voucher: 215 mm SL)

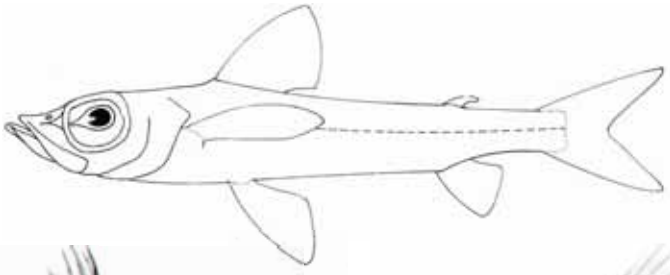
Saurida tumbil

Pectoral fin only just reaches ventral fin origin when laid towards it, length 8 in SL. More than 3 rows of teeth in anterior part of palatine tooth band. Back dusky green to brown, with faint crossbars, more distinct along lateral line; inner ventral fin charcoal, margin white; lower caudal fin lobe charcoal, upper lobe fawn.
L. lat. 50-53.
(voucher: 325 mm SL)

Saurida wanieso

Pectoral fin 5.6-7.1 in SL; reaching ventral fin origin when laid towards it; upper caudal fin lobe longer than lower; 2nd (sometimes 3rd and 4th) dorsal fin ray elongate and filamentous in larger fish. Two rows of teeth in anterior part of outer palatine tooth band. Back greenish brown, dark blotches apparent along lateral line; pectoral fin and lower caudal fin lobe charcoal.
L. lat. 54-58.
(voucher: 180 mm SL)

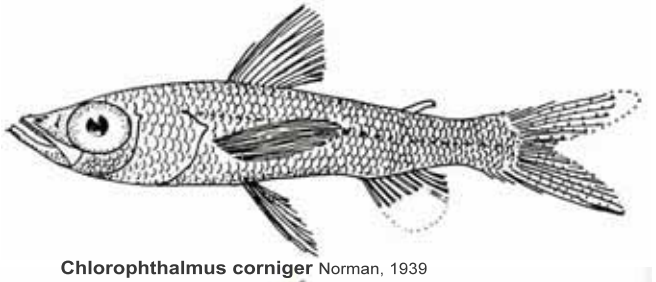
CHLOROPHTHALMIDAE



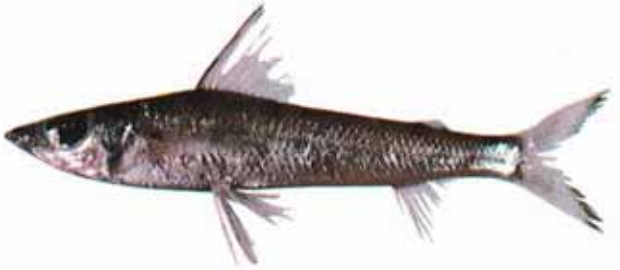
Chlorophthalmus acutifrons

Chlorophthalmus sp 1 cf albatrossis

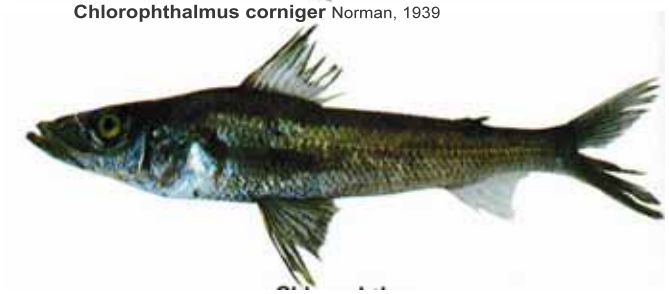
Chlorophthalmus sp 2 cf albatrossis



Chlorophthalmus corniger Norman, 1939

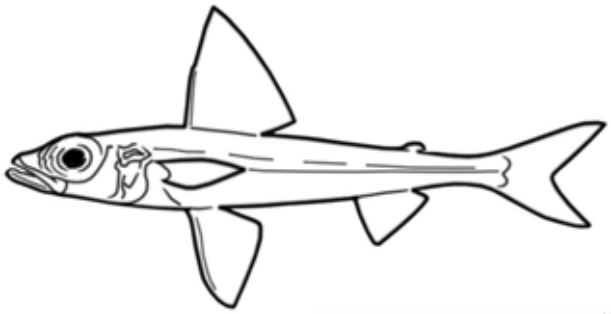


Chlorophthalmus migromarginatus



Chlorophthalmus vityazi

PARAULOPIDAE



Paraulopus brevirostris

Paraulopus oblongus

CHLOROPHTHALMIDAE

Greeneyes -

Body small to moderate, compressed posteriorly. Head moderately large; eye large. Scales ctenoid or cycloid, absent from top of head. No spines in fins: dorsal fin single, before middle of body, with 9-13 rays; adipose dorsal fin present; seven to 11 rays in anal fin. Pectoral fin large or moderate with 15-17 rays. Caudal fin forked. Anus either near ventral fin bases or just before anal fin origin. Mouth slightly superior, lower jaw protruding noticeably in advance of upper jaw, anterior tip clearly visible in dorsal aspect; jaw teeth in few rows, overlapping little, if at all, onto lateral surfaces of premaxilla or dentary; oblique rows of scales on sides often indicated by narrow dark lines near their posterior margins, especially anterodorsally.

The family comprises two genera and 17 species; six species were obtained on the Survey.

REFERENCES: Bineesh, Akhilesh, Gomon, Abdussamad, Pillai & Gopalakrishnan, 2014; Kobyliansky, 2013; Kamohara, 1953.

Chlorophthalmus acutifrons

Body compressed, head width 2.4-2.6 in HL. Snout more than eye diameter, 2.9-3.2 in HL; eye 3.5-3.8 in HL, 1.1-1.3 in snout. Body yellow with one or 2 longitudinal rows of large blotches, most conspicuous at mid-sides; operculum black and silver, gill cavity black; fins fawn, leading edge and margin of dorsal fin charcoal.
D 11. A 9-10. P 15. GR 2-3 + 14-17. Tr above 6-7. L. lat. 53-57.
(voucher: 106 mm SL)

Chlorophthalmus sp 2 cf albatrossis

Body square or rounded in cross-section; head width 1.8-2 in HL. Very large eye, interorbital narrow. Eye 2.5-2.7 in HL, 1.4-1.5 longer than snout which is 3.1-3.9 in HL. Pectoral fin long, subequal to HL, ventral fin much shorter. Body dusky with faint or large oblique blotches along sides; operculum silver-black, gill cavity dark; anus black; leading edge of dorsal fin black, bases of adipose fin and caudal fin black, inner rays of ventral fin black.
D 10-12. A 8-9. P 14-15. GR 3-4 + 17-19. Tr above 7-8. L. lat. 53-56.
(voucher: 112 mm SL)

Chlorophthalmus nigromarginatus

Body square in cross-section; head width 2-2.6 in HL. Snout tip slightly upturned, subequal to eye and 2.8-3.4 in HL. Eye 2.8-3.2 in HL. Body dusky yellow, 2 series of dark blotches along back and sides; operculum dusky, gill cavity dark; black stripping on belly, anus black; leading edge and margin of dorsal fin black, pectoral fin axil black, hind caudal fin margin black.
(voucher: 108 mm SL)

Chlorophthalmus sp 1 cf albatrossis

Body slightly compressed, head width 2-2.2 in HL Snout less than eye diameter, 2.5-3.2 in HL and 1.2-1.4 in eye; eye 1.9-2.6 in HL. Body yellow-fawn, sides crossed by large oblique irregular brown patches; operculum silver-black, gill cavity black, anus black and belly stippled black; caudal fin base and inner ventral fin rays black.
D 10-11, A 8-10. P 15-17. GR 2 + 19-22. Tr above 5. L. lat. 50-58.
(voucher: 91 mm SL)

Chlorophthalmus corniger

Body sub-cylindrical and compressed. Lower jaw ending in two strong, tooth-like projections. Head large, 2.6-3 in SL; eye 2.5-3 in HL. Pectoral fin long, extending past dorsal fin base. Body silvery-grey finely stippled black, traces of broad darker bars across sides; base and inner rays of ventral fin black.; dorsal fins edged black, caudal fin black.
D 10-11. A 9-10. Total GR 22-26. L. lat. 47-48. Tr 3-4.
(voucher: ? mm SL)

Chlorophthalmus vityazi

Body compressed; head width 2-2.3 in HL. Snout slightly depressed, about equal to eye diameter, 3.1-3.4 in HL, 1.1-0.9 in eye. Eye 2.8-3.4 in H L. Body dusky green, silvery below, 2 series of brown blotches along back and sides; operculum silver-black, gill cavity black; anus dark; fins dusky, leading edge and margin of dorsal fin black, hind caudal fin margin dark, black band across ventral fin. On larger specimens, blotches and fin markings become obscure.
D 10-11. A 9-10. P 15-16. GR 3-4 + 1517. Tr above 5-6. L. lat. 51-53.
(vouchers: 142 and 189 mm SL)

PARAULOPIDAE

Cucumber fish -

Benthic fishes. Dorsal fin rays 10-11, anal fin rays 8-11, pectoral fin rays 13-20; pored lateral line scales 40-52. Was previously included in CHLOROPHTHALMIDAE. Mouth terminal, lower jaw protruding little, if at all, in advance of upper jaw, seen as thin edge, if visible at all, around anterior profile of upper jaw in dorsal aspect; jaw teeth in broad bands, overlapping onto lateral surfaces of premaxilla and dentary (as in *Saurida*); dentary rather shallow posteriorly, only posterior half covered laterally by narrow triangular membrane; second infraorbital uniformly broad, third broad anteriorly, tapering posteriorly, second and third infraorbitals cupping eye ventrally; individual body scales sometimes with narrow dark marginal line but not forming narrow dark oblique lines on body.

Two species in this monogeneric family were obtained on the Survey.

REFERENCES: Sato & Nakabo, 2002; Sato & Nakabo, 2003.

Paraulopus brevirostris

Body rounded/square in cross-section; head width 2.1 in HL. Snout short, 3.9-4.1 in HL, 1.2-1.3 in eye diameter. Eye 3-3.1 in HL. Pectoral fin short, 1.5-1.8 in HL, ventral fin very long, equal to or more than HL; anus well behind ventral fin base. Body iridescent pale green with 1 or 2 rows of large yellow blotches along back and sides and 3-4 dusky blotches on lower sides; operculum dusky; gill cavity fawn; breast pale; dorsal and caudal fins tipped brown.
D 11. A 11. P 14. GR 4-5 + 12. Tr. above 3-4. L. lat. 46-48.
(voucher: 126 mm SL)

Paraulopus oblongus

Body rounded in cross-section; head width 1.8-1.9 in HL. Snout short, 3.9-4.1 in HL, 1.3-1.5 in eye diameter. Eye 2.8-2.9 in HL. Body dusky yellow, 2 or 3 rows of dark blotches along back and sides; operculum dark, gill cavity black; breast charcoal; anus pale; black margin to dorsal fin, black tips to ventral fins, b!ack streak along each caudal fin lobe.
D 10. A 8-9. P 18-20. GR 4-5 + 17-19. Tr above 2-3. L. lat. 40-45.
(vouchers: 54 mm and 84 mm SL)

MYCTOPHIDAE

Lanternfishes -

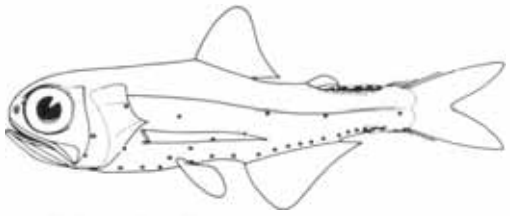
The myctophids are deep-sea pelagic fishes which are extremely abundant in all oceans and perform vertical migration to upper water levels at night.

Lanternfishes have a compressed head and body. The eyes are well-developed and moderately large. The mouth is large, terminal or subterminal with the jaws extending to or well beyond the posterior margin of the eye. Dentition is highly variable but there are no fang-like teeth.

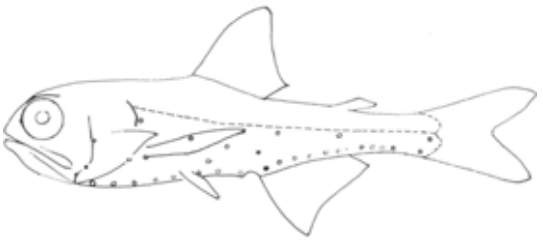
A single dorsal fin is placed well in front of the anal fin origin and a dorsal adipose fin is present. A rudimentary spine is often present at the bases of the first dorsal, first anal, outer-most ventral and upper pectoral fin rays. All but one species have distinct groups of photophores on the head and body, and other luminous organs are present on the head and/or caudal peduncle. The arrangement of the photophores and luminous organs has been shown to be species specific and thus it is one of the most important characters in identification. Of the luminous organ present, the most conspicuous is the supracaudal gland which is also called the "stern chaser". It is thought that this organ may be used as a defensive mechanism, being activated to emit light just as a predator attacks, then extinguished to enable the fish to speed away before the attack is completed.

The name photophore should only be applied to a specific structure which is formed from two modified scales: one consists of a "cup" with a thin, flattened stack of cells, the other forming a biconvex lens on top of the "cup!'. The bluish light emitted by the photophores comes from a chemical reaction in the cells; it lies within the region of maximum absorption of visual pigment in deep-sea fishes.

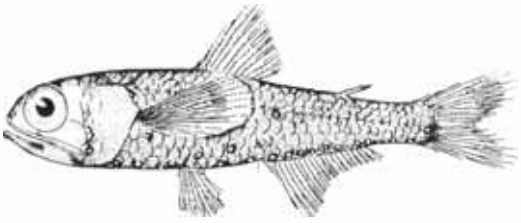
REFERENCES: Paxton & Hulley 1999; https://www.fishbase.ca/Nomenclature/NominalSpeciesList.php?Family=Myctophidae



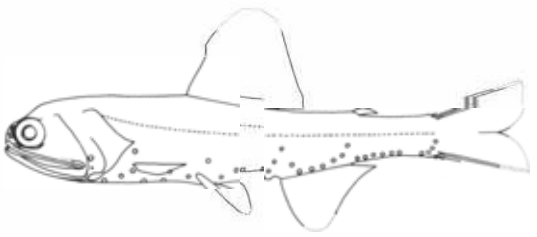
Benthosema fibulatum after Nafpaktitis & Nafpaktitis. 1969



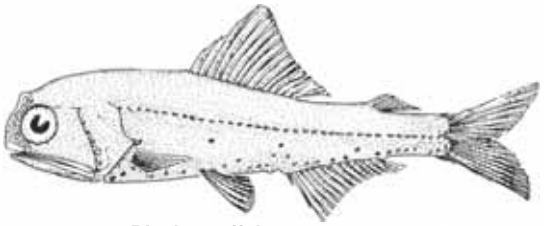
Benthosema pterotum after Evermann & Seale. 1907



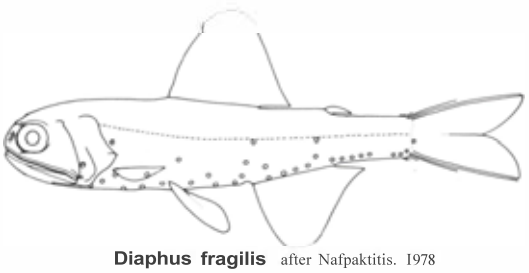
Diaphus chrysorhynchus after Gilbert & Cramer. 1897



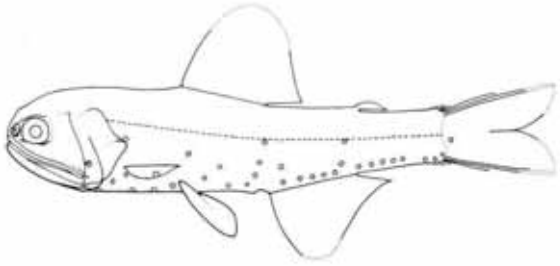
Diaphus coeruleus after Nafpaktitis. 1978



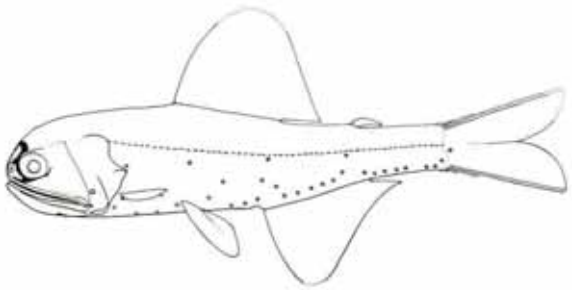
Diaphus effulgens after Goode & Bean. 1896



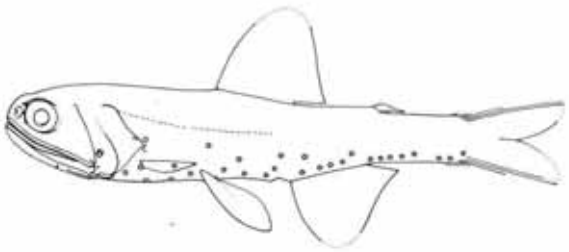
Diaphus fragilis after Nafpaktitis. 1978



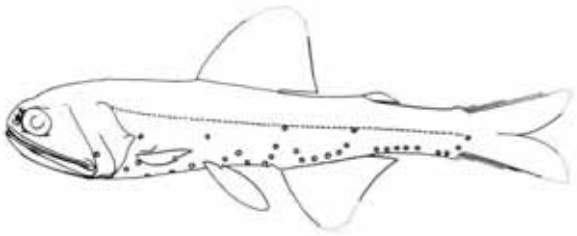
Diaphus garmani after Nafpaktitis. 1978



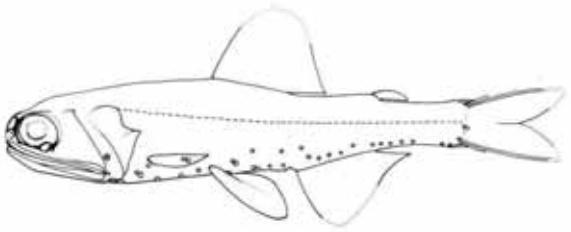
Diaphus lucidus after Nafpaktitis, 1978



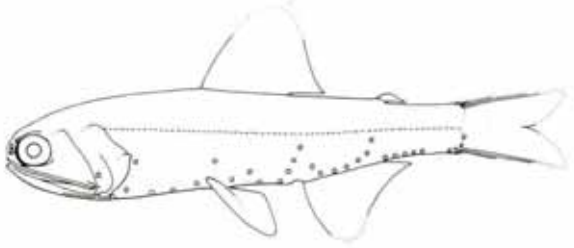
Diaphus signatus after Nafpaktitis. 1978



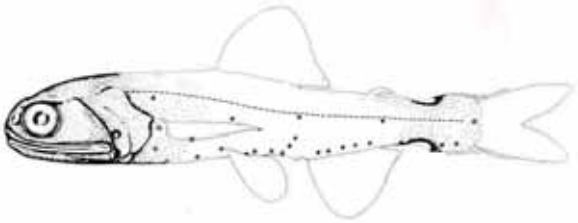
Diaphus splendidus after Nafpaktitis, 1978



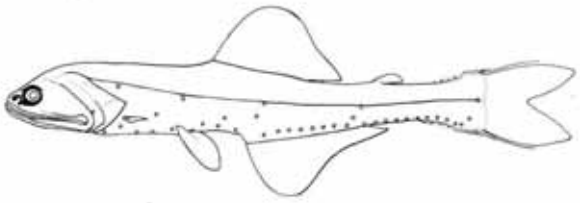
Diaphus suborbitalis after Nafpaktitis. 1978



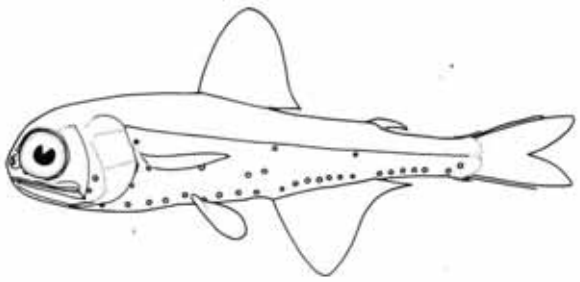
Diaphus watasei after Nafpaktitis. 1978



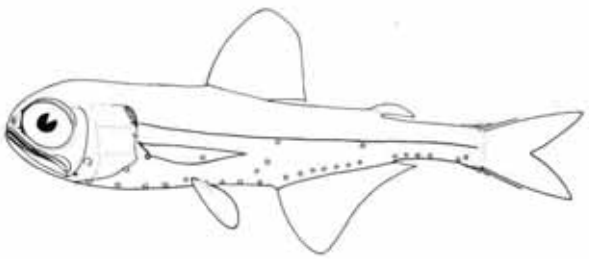
Lampadena luminosa after Nafpaktitis & Nafpaktitis. 1969



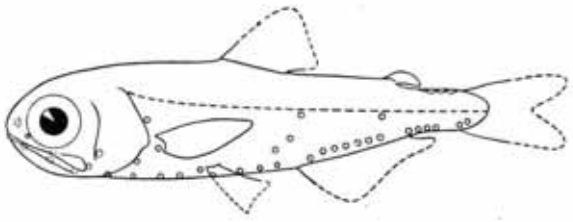
Lampanyctus lineatus after Nafpaktitis & Nafpaktitis. 1969



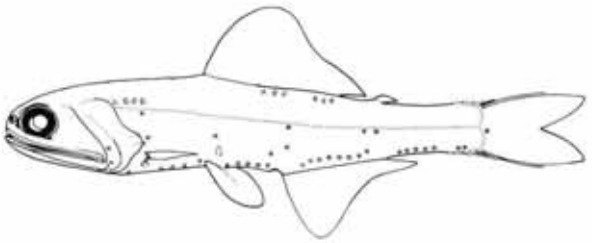
Dasyscopelus asper after Nafpaktitis & Nafpaktitis, 1969



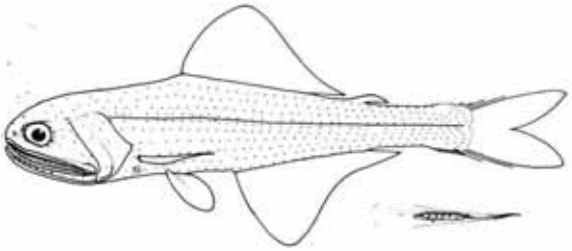
Dasyscopelus brachygnathum after Nafpaktitis & Nafpaktitis. 1969



Myctophum fissunovi after Becker & Borodulina. 1971

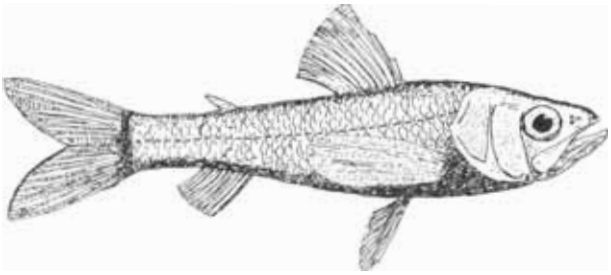


Notoscopelus resplendens after Nafpaktitis & Nafpaktitis. 1969



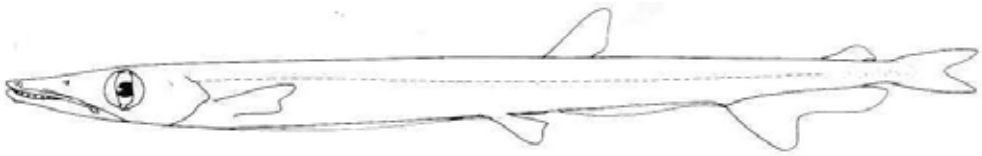
Scopelopsis multipunctatus after Nafpaktitis & Nafpaktitis. 1969

NEOSCOPELIDAE



Neoscopelus microchir

PARALEPIDIDAE



Lestrolepis japonica

Lestidium longilucifer

Lestidiops mirabilis after Rofen, 1966

Lestidium sp cf prolixum

Stemonosudis retrodorsalis

NEOSCOPELIDAE

New lanternfishes -

Tropical and subtropical fishes of small to medium size. The family consists of three very different genera: *Scopelengys*, which inhabits deep oceanic midwaters, has small eyes, flabby musculature and a fragile skeleton; *Neoscopelus* which occurs relatively close to land and is benthopelagic, has large eyes, a silvery fusiform body and a strong skeleton; and the monotypic *Solivomer* which is benthopelagic in the Philippine area. Entirely compressed. Supramaxilla long and slender, trilobate rostral cartilage. No subocular shelf. Anal fin origin far posterior to dorsal fin. Some with photophores. Scales cycloid; ctenoid scales present in *Solivomer*. Swim bladder present in all but *Scopelengys*. The last mentioned genus seems to form an intermediate between the other 2. The head and body are compressed; the mouth is large with closely-set villiform teeth in the jaws, the vomer and palatines. The gill rakers are well developed. The dorsal fin lies well forward of the anal fin and a dorsal adipose fin is present. The lateral line is only weakly developed. *Solivomer* has ctenoid scales, the other two genera have large cycloid scales which are easily lost. Only the genus *Neoscopelus* possesses luminous organs and they are arranged linearly along the lower flanks of the body and from the isthmus along the belly to the caudal peduncle. Another row of photophores lies along the periphery of the tongue. The photophores are somewhat oval in shape with their anteroventral margins often indistinct, fading into the surrounding tissue.

One species obtained on the Survey.

REFERENCE: Paxton & Hulley 1999.

Neoscopelus microchir

An adipose dorsal fin present. Scales deciduous. Mid ventral and bilateral rows of photophores on body. Head and side of body dark red, silver-white below.
D_2 12-13. A 11-13.
(voucher: ? mm SL)

PARALEPIDIDAE

Barracudinas -

Moderately to very elongate fishes, slightly compressed. Snout long, jaws pointed ('beak'-like), lower sometimes projecting; mouth large, most teeth small in upper jaw, many long and fang-like in lower jaw; eye moderately large; opercular bones thin; gill rakers reduced to groups of small spines. Body naked or with large and easily lost cycloid scales. No spines in fins; dorsal adipose fin close to base of forked caudal fin; ventral fin midway along body: sometimes adipose fin present before posteriorly-placed anal fin, which is long and concave with 20-50 rays.

Four genera (of the family's eight) and five species were obtained on the Survey.

REFERENCES: Ho & Golani, 2019; Ho, Tsai & Li, 2019; Ho, Russell, Graham & Psomadakis, 2019; Ho, Graham & Russell, 2020.

Lestrolepis japonica

Distance between dorsal and caudal fin origins less than 3 in SL. Snout to anus distance 1.6-1.9 in SL, distance between verticals from dorsal and ventral fins 9.2-12.7 in SL. Body silvery grey or cream, silvery or dark over opercles, tail and belly; 2 close black bands of luminous tissue along belly from isthmus to ventral fin; prominent black spot just before eye.
A 36-41.
(voucher: 174.4 mm SL)

Lestidiops mirabilis

Distance between dorsal and caudal fin origins less than 3 in SL; from snout to anus 1.4-1.5 in SL; ventral fin begins just behind dorsal origin. HL 4-4.2 in SL; body depth 9.5 in SL. Low adipose fin before anal fin. Body very dark, back and top of head with densely-packed black dots, lateral line sections very dark.
A 26-32.
(voucher: ? mm SL)

Lestidium sp. cf prolixum

Ventral fin origin well before dorsal origin and ventral adipose fin present. Distance between snout and anus 1.6-1.7 in SL; predorsal length 1.6 in SL; snout to anal origin 1.3 in SL; HL 5 or more in SL. Body translucent grey-blue, silver over opercles and tail; 3 spots on back before dorsal fin.
A 35-38.
(voucher: 145 mm SL)

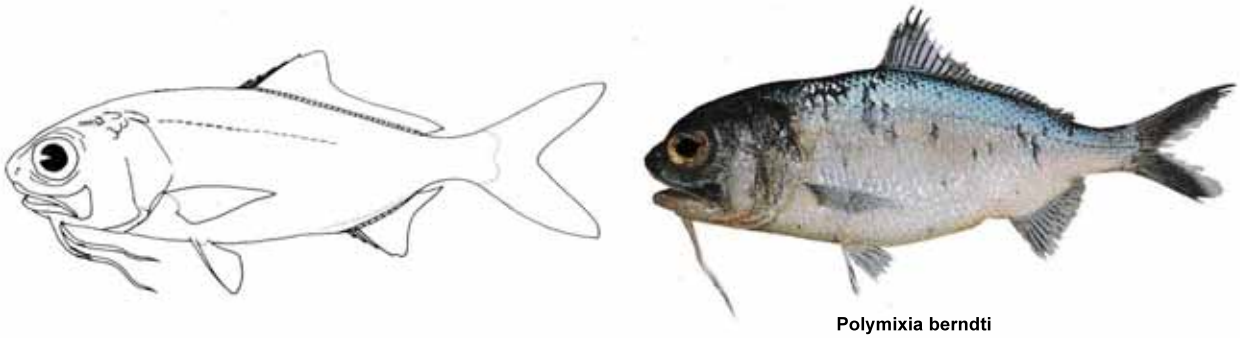
Lestidium longilucifer

Distance between dorsal and caudal fin origins less than 3 in SL; from snout to anus 1.6-1.7 in HL; ventral fin begins under or just behind dorsal origin. HL 4.4 in SL; body depth 12.5 in SL. Translucent grey-blue, silvery or dark over opercles and tail; single black band of luminous tissue along belly from isthmus to ventral fin.
A 26-32.
(voucher: 247 mm SL)

Stemonosudis retrodorsalis

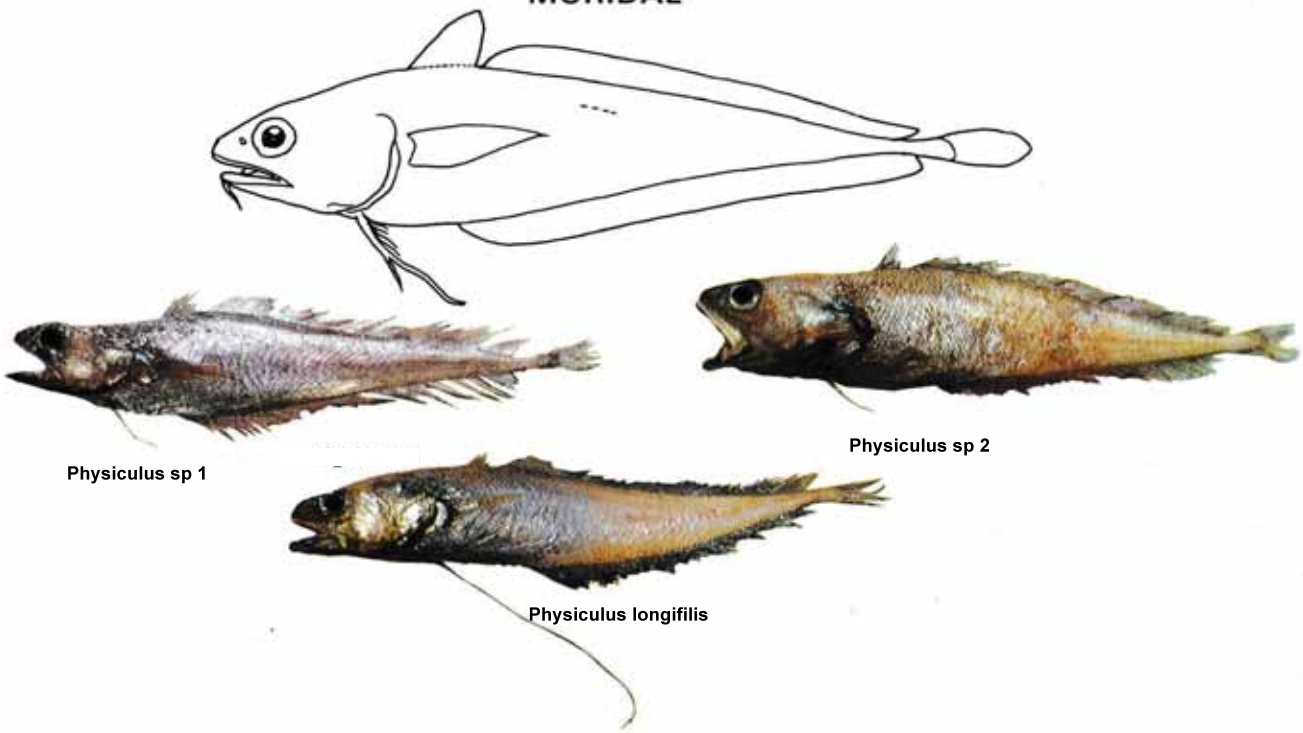
Ventral fin origin well before dorsal fin origin. Ventral adipose fin present. Distance between snout and anus 1.5 in SL; predorsal length 1.3 in SL; snout to anal origin 1.3 in SL; HL 5.3 in SL. Translucent yellow body with 9 saddle-like dark blotches along back, 8 along lower sides before ventral fin.
A 33.
(voucher: 146 mm SL)

POLYMIXIIDAE



Polymixia berndti

MORIDAE

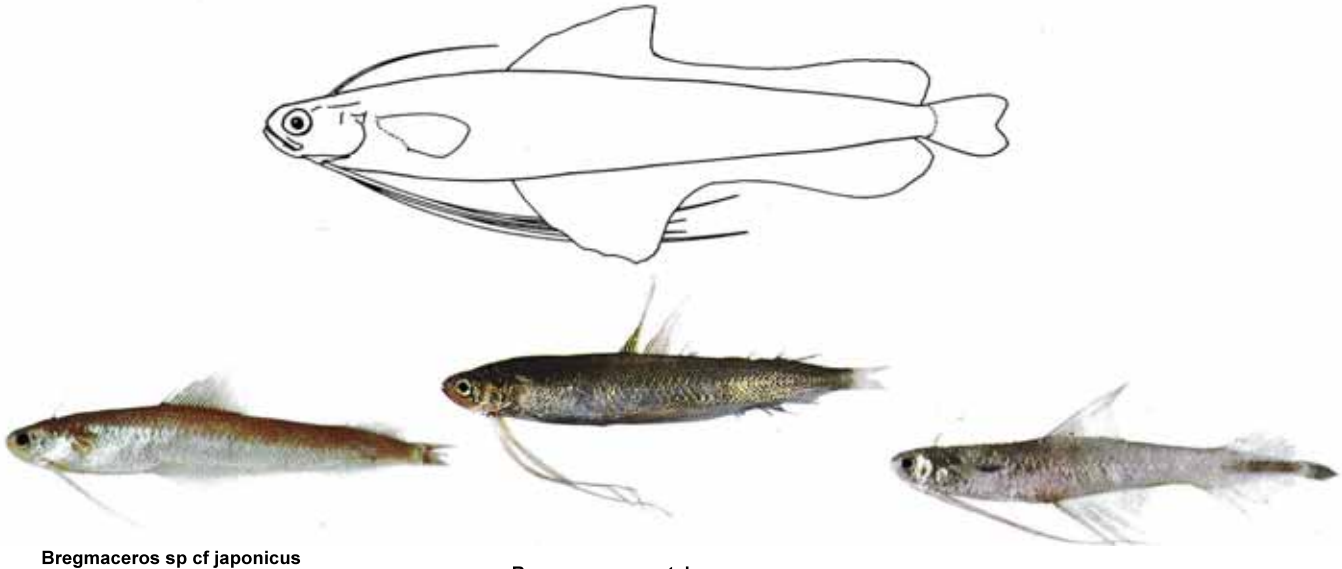


Physiculus sp 1

Physiculus sp 2

Physiculus longifilis

BREGMACEROTIDAE



Bregmaceros sp cf japonicus

Bregmaceros nectabanus

Bregmaceros pseudolanceolatus

POLYMIXIIDAE

Beardfishes -

Body moderately elongate and compressed. Eye large; teeth fine. A pair of fleshy chin barbels present. nearly as long as head. Large strongly ctenoid, firmly-attached scales. Dorsal fin single, continuous, with 4-6 spines and 26-38 rays. Anal fin long-based. Ventral fin with one spine, 6 rays. Caudal fin forked.
One species obtained on the Survey.

REFERENCES: Nakaya et al, 1980; Paxton, 1999a.

Polymixia berndti

Outer ⅓ of soft dorsal fin dusky (never black), edges of dorsal and anal fins white. Dorsal and anal fins high anteriorly. Iridescent violet and white.
D V-VI, 28-30. A IV, 14. L. lat. 32-36. Tr 10-11 + 13-14.
(voucher: 131 mm SL)

MORIDAE

Morid cods -

Body elongate, only a little compressed. Mouth terminal or ventral; head of vomer toothless or with very small teeth; chin barbel may be present; gill openings wide. Scales small and cycloid, easily lost. No spines in fins; one or 2 (rarely 3 dorsal fins; anal fin often in two parts; ventral fin far forward. below head, of one to several rays, some filamentous; caudal fin free from dorsal and anal fins.

About 17 genera in the family of which two were obtained in the Survey area.

REFERENCES: Iwamoto, 1999b; Paulin, 1989; https://www.fishbase.ca/Nomenclature/ScientificNameSearchList.php? – Physiculus; Vinu et al., 2017; Yu & Ho, 2012.

Physiculus sp 1

Head, including gular part, scaled except for area around nostrils. Chin barbel short. Eye 4.2 in HL; interorbital 4.3 in HL. Anus ⅓ distance from anal fin origin to ventral fin base. Ventral fin with 6 rays, outer 3 produced, longest one subequal to HL. Ventral light organ with 2 black dermal windows. All fins pale, some with dusky edges.
D 9; 59. A 65. P 23. Total GR 16.
(voucher: 166 mm SL)

Physiculus longifilis

Head covered with scales except naked gular part. Chin barbel long and slender. Eye 5 in HL; interorbital 4.2 in HL. Anus ¼ distance from anal fin origin to ventral fin base. Ventral fin with 3 rays, outer 2 filamentous, about twice HL. Ventral light organ with 2 black dermal windows. All fins charcoal or black.
D 7; 59. A 61. P 21. Total GR 11.
(voucher: 145 mm SL)

Physiculus sp 2

Snout, suborbital area and gular part naked. Chin barbel slender. Eye 3.7-4 in HL; interorbital 3.3-3.8 in HL. Anus ⅓ distance from anal fin origin to ventral fin base. Ventral fin with 4 or 5 rays, 2nd ray longest, shorter than postorbital head length. Ventral light organ with a round black dermal window. Dorsal and anal fins with dark margins; pectoral and ventral fins dark near base.
D 7-8; 55-57. A 58-61. P 24-26. Total GR 10-12. Tr above 7-9.
(voucher: 120 mm SL)

BREGMACEROTIDAE

Unicorn cods -

Elongate, moderately compressed small fishes up to about 12 cm long. Head with spongy skin; snout short; head of vomer toothed. Gill openings wide. Scales cycloid and easily lost. Two widely separated dorsal fins: first is on nape and consists of one elongate ray; second is long-based, with an extensive depression in its middle; anal fin similar to second dorsal fin. Ventral fin inserted under rear of head and comprising thick rays which extend well past anal fin origin. Caudal fin present.

REFERENCES: Torii, Ozawa & Harold, 2003; Ho, Endo, Lee & Chu. 2020; Torii, Javonillo & Ozawa, 2004; Ho, Choo & Teng, 2011.

Bregmaceros sp cf japonicus

Dorsal fin begins just behind anal fin. Caudal fin emarginate. Body depth 7.6-8 in SL; eye 3.5-4 in HL. Back olive, densely stippled black; lower half of body silvery-white. Dorsal, anal and caudal fin bases stippled black, black spots extending over most of anterior dorsal fin rays; pectoral fin pale.
D 48-57. A 43-50. P 18-20. Scales in row from head to tail about 65. Tr 11-13.
(voucher: 73.5 mm SL)

Bregmaceros pseudolanceolatus

Dorsal fin origin slightly before anal fin. Caudal fin lanceolate (pointed). Back olive, sparsely stippled brown; brown band mid-laterally on caudal peduncle. Base of anterior dorsal fin rays stippled black; outer pectoral fin and all of caudal fin intense black.
(voucher: 67 mm SL)

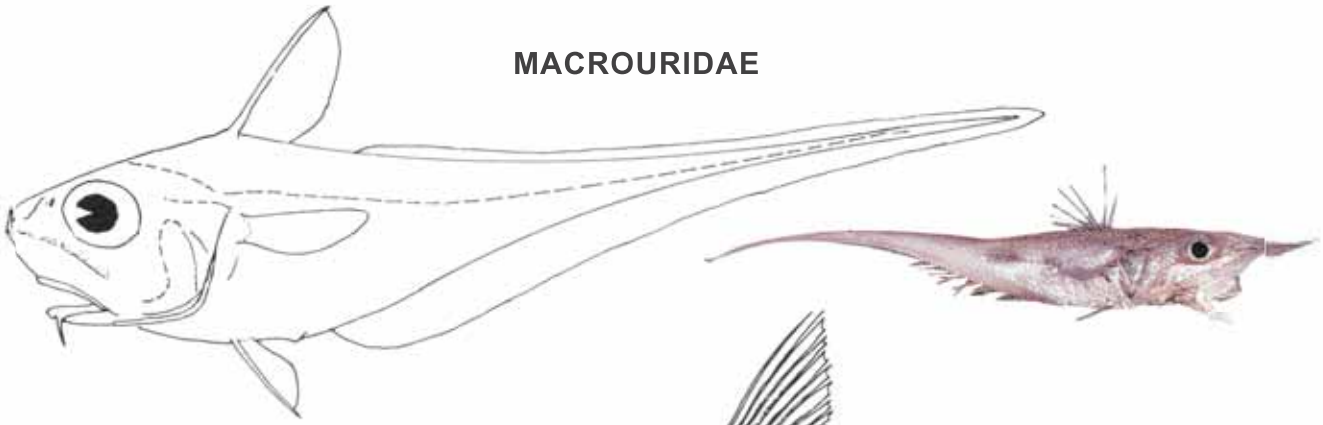
Bregmaceros nectabanus

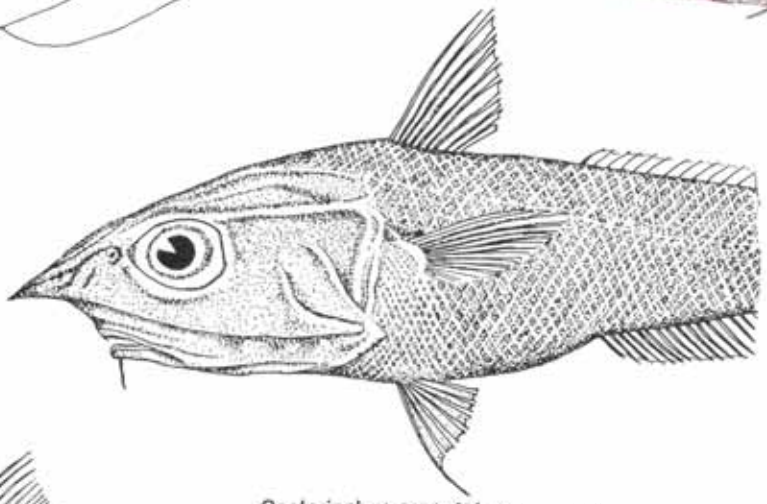
Dorsal fin begins just behind anal fin; caudal fin emarginate. Body depth 8.7-9 in SL. Eye less than snout length, 3.8-5 in HL; snout 3.3-3.6 in SL. Back dark grey or black, sides sparsely stippled dark brown. Pectoral fin pale; base of dorsal, anal and caudal fins brown.
D 56-63. A 52-58. P 16-21. Scales in row from head to tail 69-75. Tr 13-14.
(voucher: 73 mm SL)

Bregmaceros mcclellandi

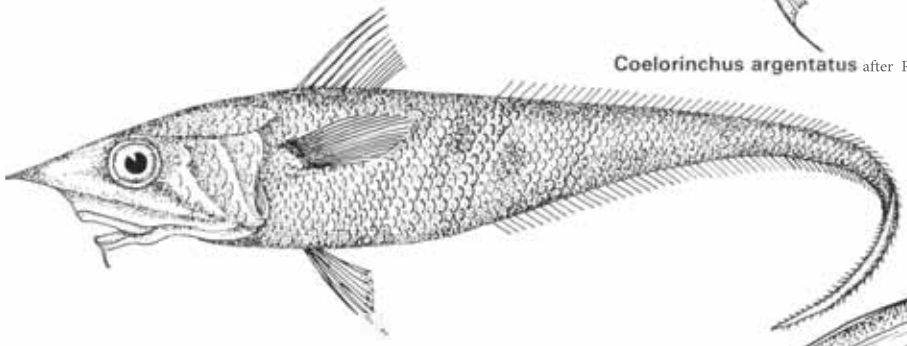
Bregmaceros anchovia

MACROURIDAE

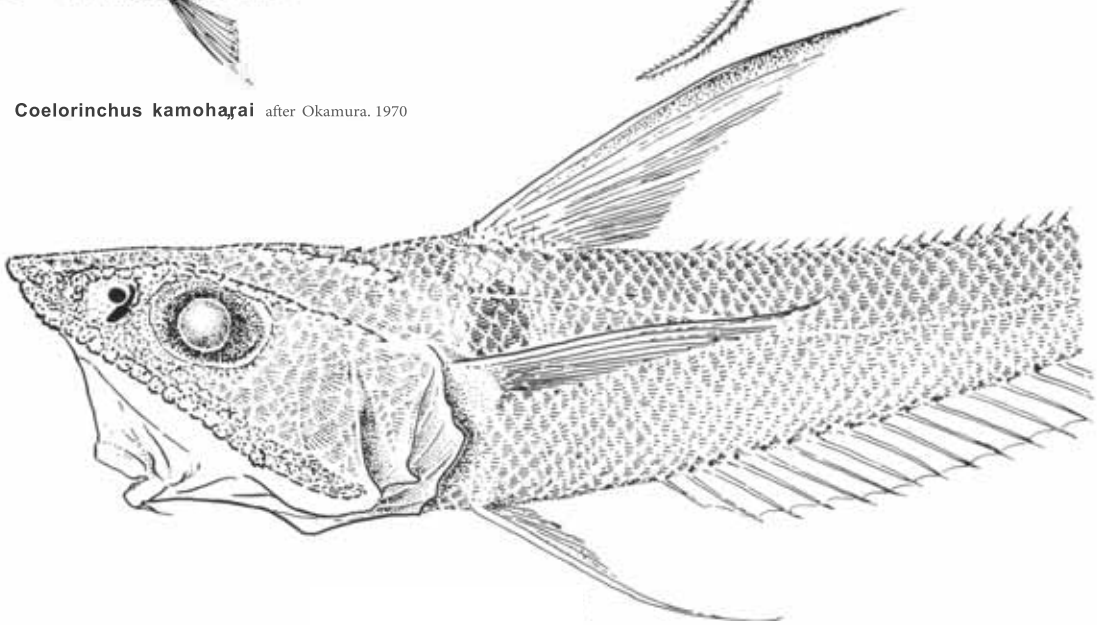




Coelorinchus argentatus after Radcliffe. 1912



Coelorinchus kamoharai after Okamura. 1970



Coelorhinchus maculatus original drawing by T. Arai

Bregmaceros mcclellandi

Dorsal fin begins slightly before anal fin; caudal fin rounded. Body depth 5.6-7.1 in SL. Scales on upper half of body edged black. Anterior dorsal rays, all of pectoral fin and all of caudal fin intensely black.
D 41-57. A 48-68. Scale rows 54-71 between head and tail. Tr 13-16.
(voucher: 77 mm SL)

Bregmaceros anchovia

Caudal fin emarginate; dorsal fin begins just before anal fin. Body depth 6.3-6.7 in SL; eye 3.6-3.8 in HL; snout 3.7-4.8 in HL. Body olive, paler below; brown band along back. Fins dusky basally, anterior dorsal fin rays black; pectoral fin pale.
D 40-55. A 42-55. P 15-18. Scale rows 70-74 between head and tail. Tr 17-18.
(voucher: 67 mm SL)

MACROURIDAE

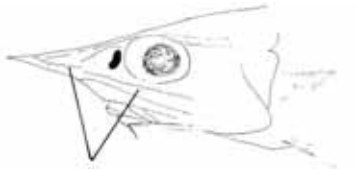
Rattails; Grenadiers -

Head large, trunk short and compressed; tail long and strap-like, tapering to a fine point. Often two dorsal fins: first short and high, second long, continuous to tail tip; anal fin similar to second dorsal fin; ventral fin with 5-17 rays usually present on breast or throat, outer ray often produced; caudal fin usually absent. Snout produced, blunt or pointed, stout and often armed with spiny scutes. Mouth terminal to inferior; teeth fine; chin barbel often present; eyes usually large. Scales usually armed, covered with small spines. Ventral light organ on belly in some species (Fig 2).

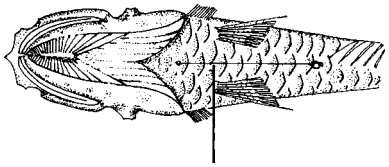
Ten species in two genera (*Coelorinchus* and *Hymenocephalus*) were obtained on our Survey.

Macrourid descriptions prepared by T. Arai and partly supplemented by PK.

REFERENCES: Iwamoto, 1999a: Iwamoto & Williams, 1999; Iwamoto, Nakayama, Shao & Ho, 2015; Nakayama, Prokofiev & Kawai, 2020.;Schwarzhans, 2014.; Nakayama & Endo, 2017; Nakayama, 2020.



Anterolateral snout margin



Ventral light organ

Coelorinchus argentatus

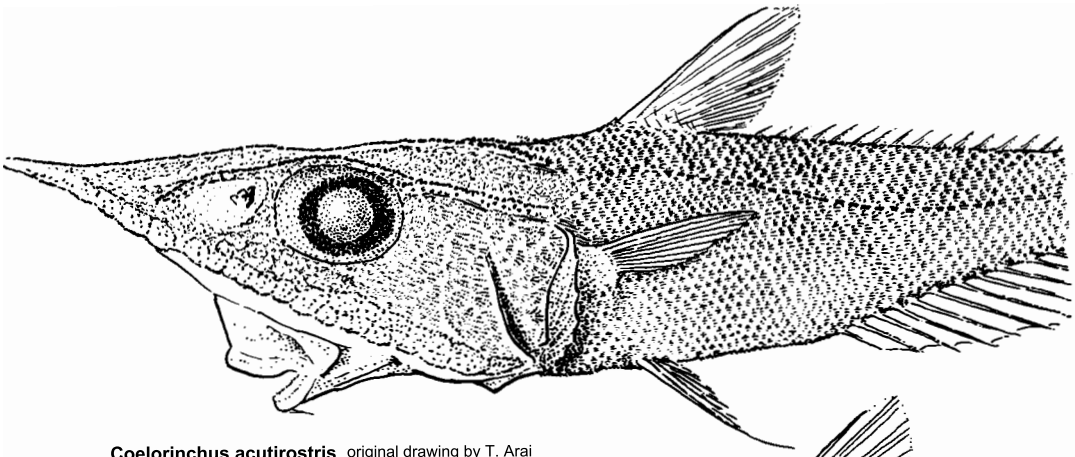
Distinct black stripe along middle of snout; head transparent; 3-4 diffuse dark blotches on lateral line below 1st dorsal fin and before 2nd dorsal fin origin; thin brown band on body below 2nd dorsal fin; thin cross bars on tail. First dorsal fin blackish anteriorly. Snout long, sharply-pointed, 2.2-2.4 in HL. Head with scattered short brown cirri and mostly naked below but for scales along anterolateral snout margins. Broad naked areas dorsally near front of unsupported snout margins. Eye (orbit) 3.7-4 in HL; interorbital 3.2-3.6 in HL; upper jaw length 3.1-3.3 in HL. Close-set teeth on upper jaw in band and on lower jaw in two rows. Anus just before anal fin origin; ventral light organ very long, scaled, from anus to near isthmus, both ends enlarged, its length 1.5-1.8 in HL. Body scale spinules in about 5 diverging rows anteriorly and in quincunx order posteriorly; 1st dorsal fin rays not produced.
D_1 II, 8-10. P 14-17. V 7. Tr above 6-7. Branchiostegal rays 6.
(voucher: 184 mm TL)

Coelorinchus kamoharai

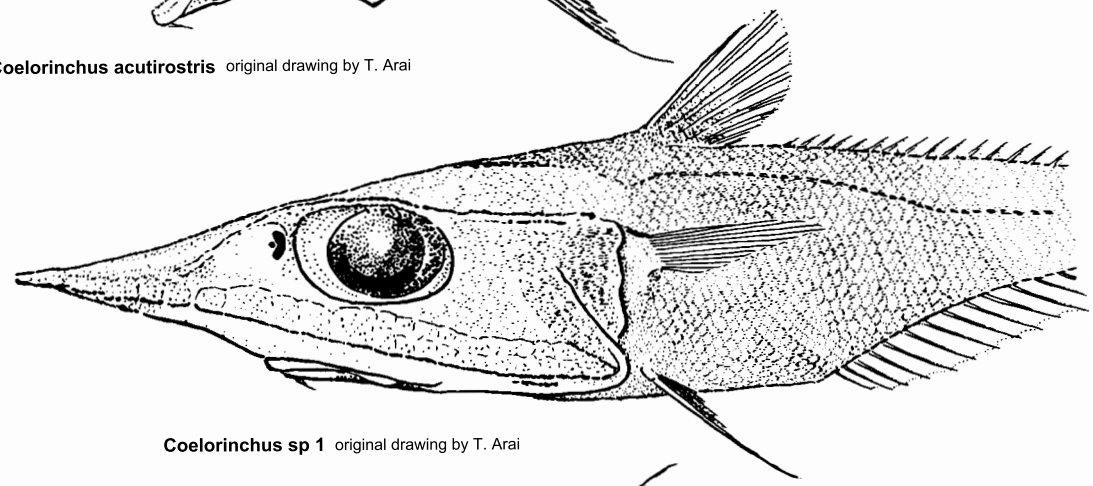
Grey with irregular darker blotches on back below 1st dorsal fin; fins dusky. Snout long, sharply pointed, 2.4-2.7 in HL. Head mostly naked below except for scales along anterolateral margins of snout and with scattered short brown cirri. Broad naked areas dorsally near front of snout margin which are not supported by bone. Eye (orbit) 3.4-4.2 in HL; upper jaw longer than orbit diameter, its length 2.9-3.6 in HL. Body scale spinules few and in quincunx order. Anus immediately before anal fin origin; ventral light organ very long, from anus to near isthmus, slightly enlarged at each end, its length 1.3-1.8 in H L; 1st dorsal fin rays not produced.
D_1 II, 8-10. P 16-20. V 7. Tr above 3-4.
(voucher: 182 mm TL)

Coelorinchus maculatus

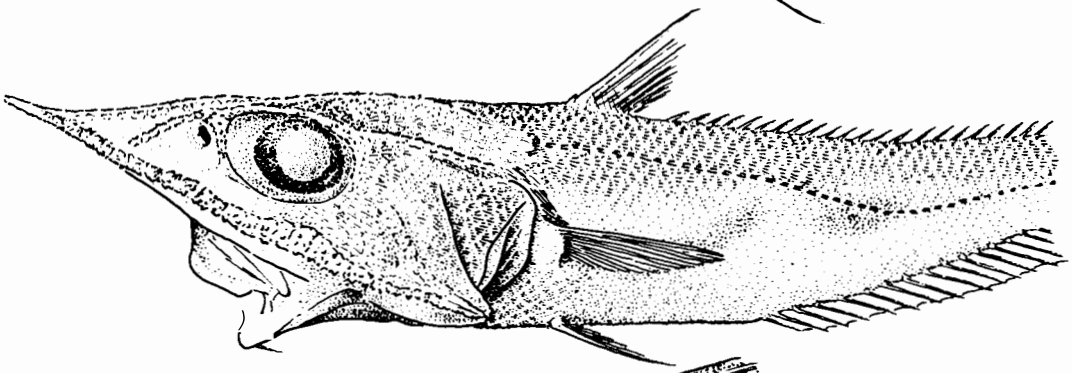
Pale body, distinct large black spot over pectoral fin axil, without saddle marks. Snout broad, short, bluntly pointed, tip a three-cornered 'bump', its length 2.3-2.8 in HL. Head naked below; front snout margins rough and scalloped, supported by narrow bone; naked areas dorsally near front snout margins, small in adults but large in young. Predorsal profile slightly convex. Eye (orbit) 3.4-3.9 in HL, upper jaw length 3.1 - 4.2 in HL. Spinules on body scales arranged in 5 or fewer slightly diverging rows. Anus separated from anal fin origin by 2-3 scale rows; ventral light organ naked, extending from anus to between ventral fin bases, widening anteriorly, its length 2.7-3.6 in HL. Second spine on 1st dorsal fin rounded and produced into a filament.
D_1 II, 8-9. P 14-15. V 7. Branchiostegal rays 6.
(7 specimens, 141-185 mm TL)



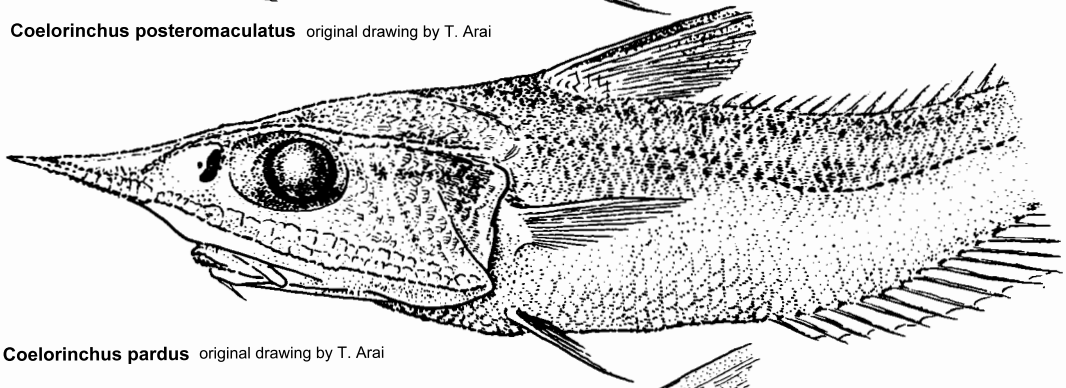
Coelorinchus acutirostris original drawing by T. Arai



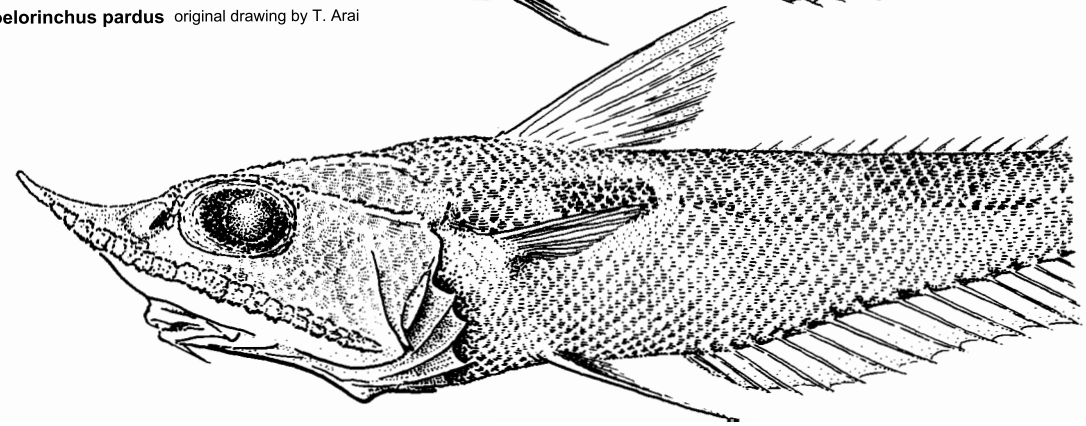
Coelorinchus sp 1 original drawing by T. Arai



Coelorinchus posteromaculatus original drawing by T. Arai



Coelorinchus pardus original drawing by T. Arai



Coelorinchus thurla original drawing by T. Arai

Coelorinchus acutirostris

Body plain light brown. Snout long and sharp, 1.8-2 in HL, its anterolateral margins supported by bone. Head completely naked below; snout scaled above but for 2 naked strips anteriorly. Eye (orbit) 4.3-4.8 in HL; upper jaw length 4.5-7 in HL. Teeth on upper jaw in villiform band and on lower jaw in two rows on sides. Angle of suboperculum acute and without a flap. Body scale spinules arranged in 5-8 diverging rows and without enlarged median keel. Anus just before anal fin origin; ventral light organ long, scaled, extending from isthmus to anus, both ends enlarged, its length about 2.1 in HL. D_1 fin height less than HL without snout.
D_1 II, 8-9. P 16-20. V 7. Tr above 5-6. Branchiostegal rays 6.
(3 specimens, 123-181 mm HL)

Coelorinchus sp 1

Body plain fawn or dusky; distinct black stripe along middle of snout. Head naked below except for scales along anterior snout margins and below preopercular angle. Snout long, slender, pointed, 2.1 in HL; its edges not supported by bone and scaled above except for narrow naked strips anteriorly. Eye 4 in HL; upper jaw long, 3.9 in HL. Teeth on both jaws in villiform bands. Suboperculum with a short acute flap posteroventrally. Body scale spinules arranged in diverging rows. Anus immediately before anal fin origin; ventral light organ very long, scaled, without fossa - visible only as black streak, from anus to isthmus, its length 1.8 in HL. 1st dorsal fin rays not produced.
D_1 II, 9. P 17. V 7. Tr above 5-6. Branchostegal rays 6.
(voucher: 65 mm HL)

Coelorinchus posteromaculatus

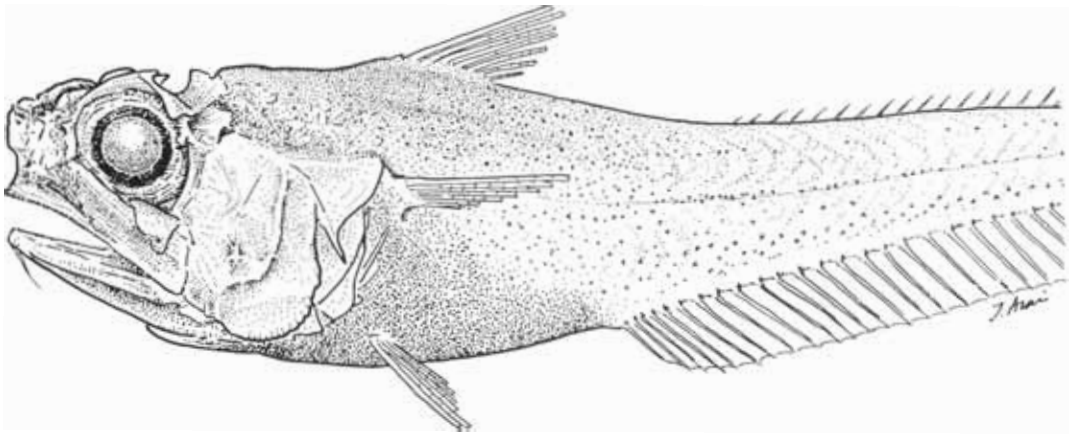
Three distinct dark blotches on body; on lateral line below 1st dorsal, between lateral line and anus, and above front part of anal fin. Snout long, slender, with sharp tip, 2.1 in HL. Head mostly naked below; broad naked areas around nostrils and dorsally near front of unsupported snout margins. Eye (orbit) 4.2-4.3 in HL; upper jaw length 4-4.3 in HL. Body scale spinules arranged in diverging rows. Anus just before anal fin origin; ventral light organ very long, from anus to throat, its ends enlarged, length 1.8-2 in HL; 1st dorsal fin rays not produced.
D_1 II, 10. P 18-19. V 7. Tr above 4.
(voucher: 211 mm TL)

Coelorinchus pardus

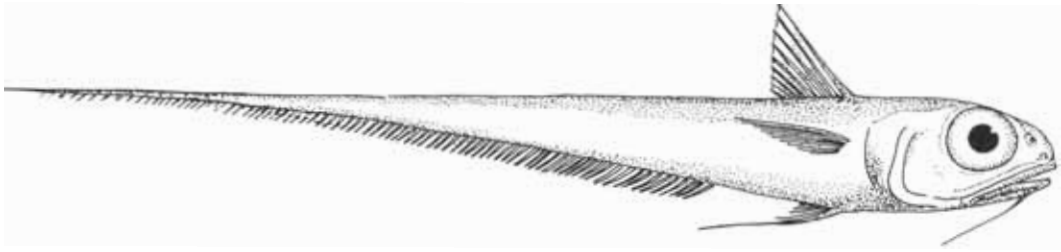
Olive-grey, upper sides with irregular brown blotches, arranged roughly into 2 rows; upper row along dorsal body profile to tail and 3rd blotch in second row slanted forward to below pectoral fin; 1st dorsal fin with brown markings. Snout long and sharply pointed, 2.1-2.3 in HL. Head mostly naked below except for scales along anterolateral snout margins which are not supported by bone. Broad naked areas dorsally near front snout margins. Eye (orbit) 4-4.3 in HL; upper jaw length 3.8-4 in HL. Body scale spinules arranged in parallel rows. Anus just before anal fin origin; ventral light organ very long, scaled, from anus to throat, longer than half HL; 1st dorsal fin rays not produced.
D_1 II, 8-9. P 15-16. V 7. Tr above 5-7.
(3 specimens, 417-185 mm TL)

Coelorinchus thurla

Large oval black blotch surrounded by pale ring on lateral line below 1st dorsal fin, followed by 1 or 2 oblique dark bars on tail; fin edges dark brown. Snout broad and sharply pointed, 2.3-2.4 in HL, its edge supported by bone. Head completely naked below; snout almost completely scaled above but for very narrow naked strips anteriorly. Eye (orbit) 3.8-4 in HL; upper jaw length 4.1-4.3 in HL. Spinules on body scales arranged in 6-10 parallel rows. Anus separate from anal fin origin by 3 or 4 scale rows; ventral light organ long, extending from ventral fin bases almost to anus. No rays of 1st dorsal fin produced.
D_1 II, 7-8. P 16-17. V 7. Tr above 4-5. Branchiostegal rays 6.
(2 specimens, 196-204 mm TL)

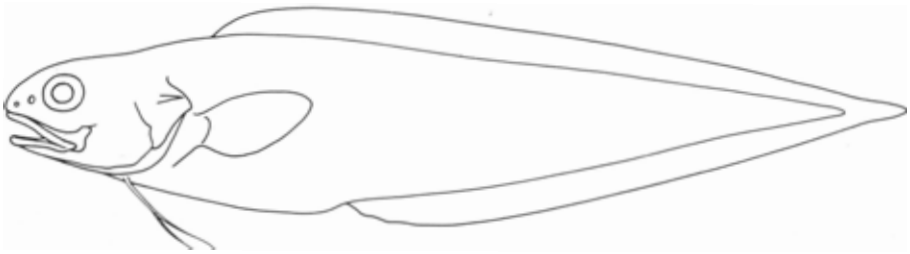


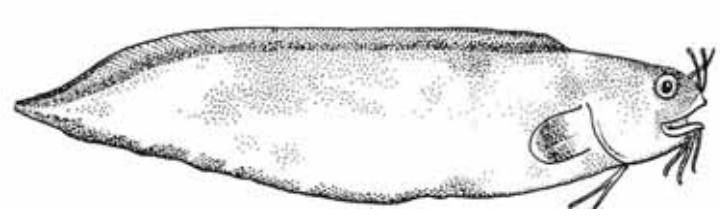
Hymenocephalus heterolepis original drawing by T. Arai



Hymenocephalus longibarbis after Günther. 1887

OPHIDIIDAE





Brotula multibarbata redrawn after Smith, 1965

Glytophidium macropus

Glyptophidium oceanium

Hoplobrotula armata

Source: Food and Agriculture Organization of the United Nations, Original Scientific Illustrations Archive. Reproduced with permission

Hymenocephalus heterolepis

Plain fawn to brown, covered with tiny black spots; black striations on isthmus and belly. Head covering thin and ‘papery’, with crests. Chin barbel very short, not reaching vertical through anterior rim of orbit, 9 in HL (5-10%). Snout protrudes slightly beyond mouth, its lower profile almost straight, 3.7-4 in HL (17-20%); eye (orbit) 2.9 in HL (28-33%); interorbital width 3.3 in HL (5-17%). Ventral light organ long, from throat to anus, both ends enlarged like a lens; anus immediately before anal fin. Second dorsal spine smooth; ventral fin not elongate, about twice in HL. interorbital about 3.3 in HL.
P.11-13 V 10-11. GR 22-25

Hymenocephalus longibarbis

Plain fawn, black striations on isthmus and belly, brown stripe along lateral line distinct in adults. Head covering thin and "papery", head crest high and well-developed. Chin barbel very long, 1.7 in HL; eye (orbit) 2.8-3 in HL; interorbital 3.7-4.2 in HL; upper jaw 1.6-1.9 in HL. Gill rakers present on both sides of first gill arch, 3-4 + 16-19 on inner side. Ventral light organ long, from anus to throat, both ends enlarged with lens-like organ, total length 1.2-1.5 in HL; anus immediately before anal fin origin. Second dorsal spine smooth; interdorsal space very wide, 1.1-1.5 in HL; ventral fin produced as a filament, 1.1-1.2 in HL.
D_1 II, 8-10. P 11-16. V 8. Branchiostegal rays 7.
(11 specimens, 89-122 mm TL)

OPHIDIIDAE

Brotulas; Cusk-eels -

Robust and short or elongate and compressed fishes, to about 100 cm length. Supramaxilla present; small, granular teeth; gill openings wide; usually more than seven long gill rakers on first arch; nostrils paired, both well above upper lip; often a sharp spine on upper angle of operculum. Scales present. No spines in fins, dorsal and anal fins long-based, united with caudal fin, fin rays in dorsal fin equal to or longer than anal fin rays; none-2 rays in ventral fin, bases usually close together and placed under gill opening or further forward.

About 50 known genera, of which 7 were obtained on the Survey.

REFERENCES: Nielsen, 1999; Uiblein & Nielsen. 2018; Nielsen, Schwarzhans & Uiblein. 2014.

Brotula multibarbata

Barbels on chin and snout; scales cycloid, small and overlapping; ventral fin base well behind eye. Body and fins reddish brown, paler below, lips and barbels reddish; dorsal, anal and pectoral fin margins black, edged white.
P 22. V 2. GR (long) 4.
(voucher: ? mm SL)

Glyptophidium oceanium

Head large, 4.8 in SL; eye larger than snout; head bones thin; spine on operculum slender, flat and weak. Ventral fin bases below dorsal fin origin, inner ray about twice in HL. Body dusky yellow, silvery and paler below; fins dotted black, margin of dorsal fin dark.
D about 130. A about 100. P 23. V 2. GR (long) 36.
Pseudobranchial filaments 10-12.
(voucher: 174 mm SL)

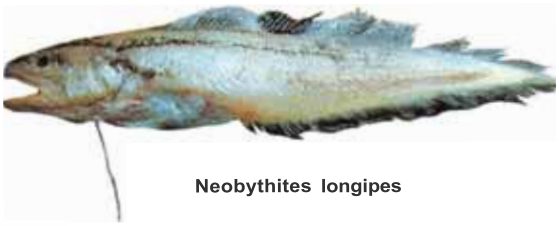
Glytophidium macropus

Head large, equal to trunk length and 4 in SL; eye larger than snout; head bones thin; spine on operculum broad, flat and weak. Ventral fin bases below preoperculum, inner ray as long as HL. Head and body dusky yellow, silvery below and finely dotted black ventrally; dorsal and anal fin margins black, pectoral fin dusky.
D 110-120. A about 100. P 23-24. V2. GR (long) 38-40.
Pseudobranchial filaments 5-10.
(voucher: ? mm SL)

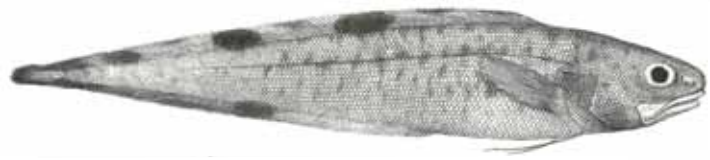
Hoplobrotula armata

Short strong spine on operculum, 3 strong spines on angle and lower edge of preoperculum, sometimes a spine on snout; cycloid scales on body; ventral fin rays unequal in length, fin bases below eye; eye large, 4.7-5.1 in HL. Plain yellow or dusky, paler below, mouth black inside, black dots over breast and throat; dorsal and anal fins black or dark grey posteriorly.
D 90-92. A 78. P 20-21. V 2. GR (long) 5.
Pseudobranchial filaments 14-17.
(voucher: ? mm SL)

Hypopleuron caninum



Neobythites longipes



Neobythites macrops after Günther, 1887

Neobythites malayanus

Neobythites purus after Radcliffe. 1913

Neobythites lombokensis

Ophidion muraenolepis

Sirembo imberbis

Sirembo jerdoni

Sirembo amaculata

Hypopleuron canium

Jaws equal with some enlarged curved teeth, pair of canines at front of upper jaw; no spines on preoperculum and operculum; HL 5.1-5.4 in SL. Scales small, cycloid, lateral line of larger scales overlaid with smaller scales; ventral fin bases below posterior margin of operculum. Dark brown or fawn, posterior half of body sometimes darker with 10-15 dark cross bands; black dots over pale belly and paired fins, black margin of dorsal and anal fins widening posteriorly.
P 26. V 1. GR (long) 3.
(voucher: 235 mm SL)

Neobythites macrops

Snout equal to eye; opercular spine strong; lateral line distinct; ventral fin bases below preoperculum, inner ray longer. Dusky yellow, many dark crossbars on sides broken into series of dashes; dorsal and anal fins pale, 3-4 large black blotches on dorsal fin, 1-2 on anal, alternating with dark semicircular spots on dark fin margins.
D 102. A 92. P 27. V 2. GR (long) 12. Pseudobranchial filaments 6-7.
(voucher: ? mm SL)

Neobythites purus

Snout longer than eye; operculum spine strong and sharp, one to 3 small spines on preopercular angle; lateral line distinct; ventral fin bases below preoperculum, inner ray longer. Fawn above, paler below, belly and lower sides of head dotted black; fins grey, pectoral and ventral fins pearly-grey, dotted black.
D 87. A 70. P 27. V 2. GR (long) 13-16. Pseudobranchial filaments 5-7.
(voucher: ? mm SL)

Ophidion muraenolepis

Head naked, snout without a spine; body scales elongate, arranged at oblique angles to each other. Ventral fin base below eye, fin rays unequal in length, outer ray much longer. Head and body pale yellow or pinkish cream, sides of head iridescent; dorsal, caudal and sometimes anal fin margins black.
P 23. V 2. GR (long) 4.
(voucher: 155 mm SL)

Sirembo jerdoni

Short spine on operculum, no spine on preoperculum; small cycloid scales cover head and body; ventral fin base below posterior half of eye. Six or 7 oblique scale rows between lateral line and dorsal fin. Head and body yellowish grey crossed by 4 or 5 oblique dark brown bands anteriorly, each connecting with its partner over head and nape; dorsal fin with 3 or 4 dark brown blotches anteriorly followed by dark band, anal fin white with dark band.
A 64-68. P 22-24. V 1. GR (long) 4-5. Pseudobranchial filaments 18-20.
(voucher: 125 mm SL)

Neobythites longiceps

Snout slightly longer than eye; opercular spine strong; lateral line distinct; ventral fin bases below preoperculum, inner ray longer - more than twice HL. Dusky yellow, brown band from snout through eye to below posterior ⅓ of dorsal fin, second band sometimes present from head to mid-sides; large pale-ringed black blotch covering 10-12 rays in mid-length of dorsal fin, dorsal and caudal fins dark brown posteriorly.
D 95. P 26. V 2. GR (long) 10.
Pseudobranchial filaments 7-8.
(voucher: 100 mm SL)

Neobythites malayanus

Snout subequal to eye; opercular spine strong, sometimes weak spine at preoperculum angle. Lateral line distinct; ventral fin bases below preoperculum, inner ray longer-equal to postorbital HL. Tan or dark brown body and fins; black ocellus covering 4-6 fin rays in mid-length of dorsal, followed by broken brown bands along fin; anal and caudal fins dark brown, anal fin with white edge; pectoral fin black.
D 87-95. P 27. V 2. GR (long) 10. Pseudobranchial filaments 3.
(voucher: 175 mm SL)

Neobythites lombokensis

Head and body golden-fawn, silvery over lower head and belly, 2 faint brown bands from snout along body; large pale-ringed, oval black blotch covering about 14 fin rays in mid-length of dorsal fin; anal fin plain brown.
D 91. A 77. P 28. GR (long) 7. Pseudobranchial filaments 2.
(voucher: 95 mm SL)

Sirembo imberbis

Short spine on operculum, no spine on preoperculum; small cycloid scales cover head and body; ventral fin base below hind half of eye. Six to 8 oblique scale rows between lateral line and dorsal fin. Head and body olive-golden above, creamy-silver below, 2 or 3 tan or golden bands along sides, broken into spots and dashes; several large dark blotches on outer half of pale dorsal fin, dark brown band along white anal fin.
A 67-73. P 21-25. V 1.
(voucher: ? mm SL)

Sirembo amaculata

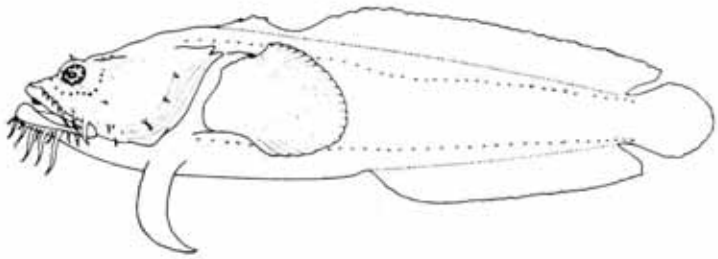
Strong pointed spine on operculum, no spine on free edge of operculum; ventral fin bases below operculum, fleshy rays subequal to HL. Pectoral fin entire, on mid-sides, small flap of skin above it; body depth 4.8-5.6 in SL. Head and body fawn, silvery below, with 2 or 3 brown bands from head along upper sides; dorsal and anal fins edged white, smaller individuals with broad brown band along fin bases.
D 94-96. A 71-73. P 25-26. V 2. GR (long) 3-4.
Pseudobranchial filaments 25.
(voucher: 250 mm SL)

CARAPIDAE

Encheliophis gracilis

BATRACHOIDIDAE

Fig. 1.



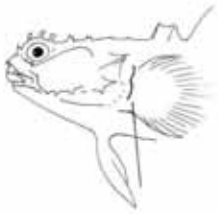


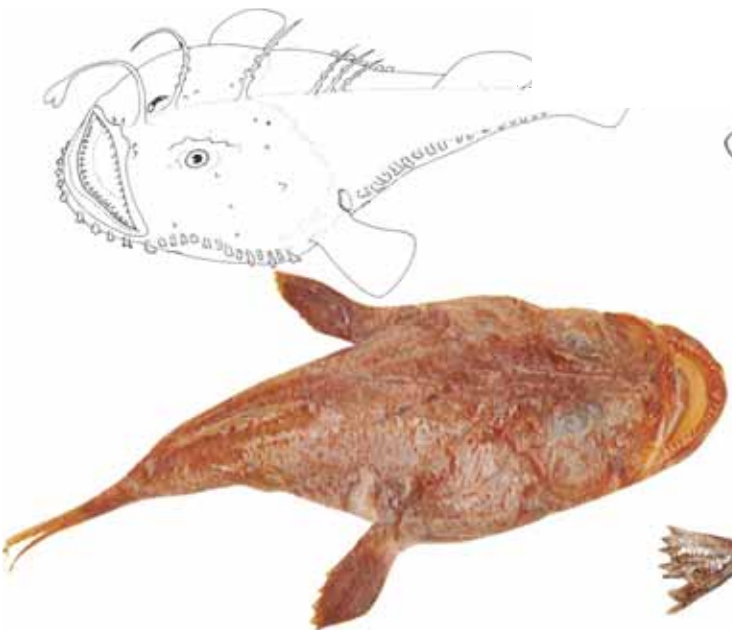
Fig 2

Batrachomoeus occidentalis

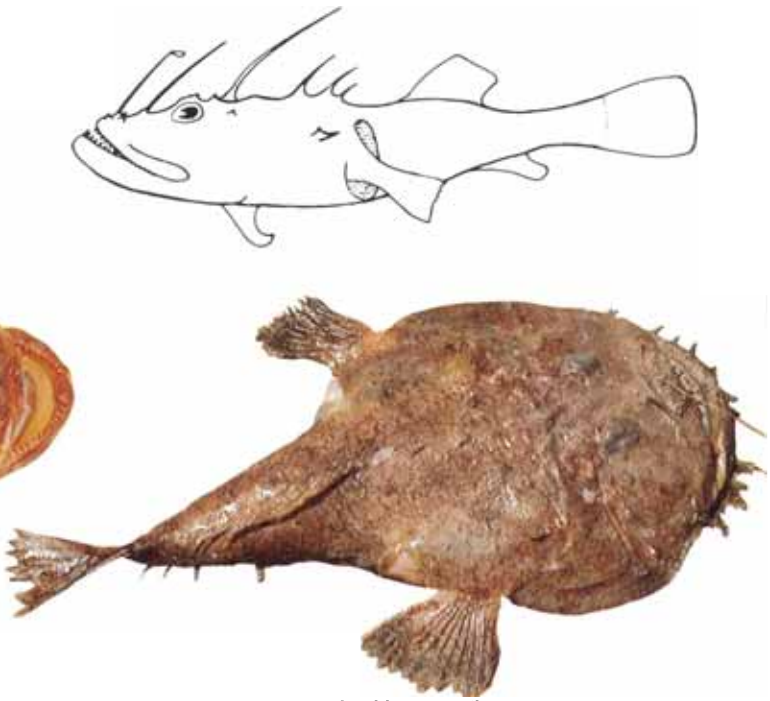
Batrachomoeus trispinosus

Halophryne diemensis

LOPHIIDAE



Lophiodes gracilimanus



Lophiomus setigerus

CARAPIDAE
Pearlfishes -

Body very elongate and slender, tapering posteriorly. Eye large; mouth large and oblique; teeth fine; gill openings wide. No scales, but lateral line present. Dorsal and anal fins very long (anal longer than dorsal); no caudal fin and no ventral fin. Anus close to head. These fishes often live inside sea cucumbers, starfish and the mantle cavity of molluscs.

The Family has eight genera and many species.

REFERENCES: Nielsen et al., 1999; Markle & Olney, 1990.

Encheliophis gracilis

Maxilla hidden by skin and only one row of teeth in jaws, palatines, and vomer. Pectoral fin well developed. Brown, yellowish greenish, spotted black.
(voucher: 172 mm SL)

BATRACHOIDIDAE
Toadfishes - Kokok

Body robust, covered with thick mucus. Head broad and flattened; eyes on top. Mouth large, horizontal, bordered by barbels and skin flaps; teeth strong. Gill opening restricted to side of body; strong spines present on gill cover. First dorsal fin with 2 or 3 solid spines, second dorsal and anal fins long-based and without spines; pectoral fins large, broad-based; ventral fin with one spine and 3-5 soft rays, base well before that of pectoral fins.

Twenty-five genera globally of which two were obtained in the Survey area.

REFERENCES: Hutchins, 1976; Greenfield, 1999; Greenfield, Winterbottom & Collette, 2008.

Batrachomoeus occidentalis

Maxilla extends at least to posterior eye border; gill opening wide (Fig 1); pore present in pectoral fin axil. Anal fin base 1.1-1.3 in HL; head 2.1-2.4 in SL. Dark brown to olive-brown bands across body and head, those on body arranged as 3 or 4 double bands; soft dorsal and anal fin bands oblique and continuous with body bands; 7-8 staggered or checked brown bands across pectoral and caudal fins.
D III, 19-20. A 15-16.
(voucher: 200 mm SL)

Batrachomoeus trispinosus

Maxilla extends at least to posterior eye border; gill opening wide (Fig 1); pore present in pectoral fin axil. Anal fin base 0.9-1 in HL. Irregular dark brown bars, marbling and blotches across head and body; dark brown bands across soft dorsal and anal fins continuous with body bars. Four or 5 distinct brown bars across caudal fin.
D III, 21-33. A 17-20.
(voucher: 65 mm SL)

Halophryne diemensis

Middle orbital tentacle longer than others; gill opening narrow (Fig 2). First dorsal fin spine 1.4-2 in eye diameter. Five to 8 brown bands across body (last 2 joined at mid-sides) and scattered black spots over head and back; fins plain, spotted or barred.
D III, 19-21. A 16-18.
(voucher: ? mm SL)

LOPHIIDAE
Goosefishes -

Head and anterior part of body very depressed and broad, posterior part of body tapered. Mouth very large and wide; teeth long, sharp, depressible; sharp spines on head. Gill opening large, in axil of pectoral fin. No scales but fleshy flaps on smooth, loose skin. Two dorsal fins: the first with up to 3 long individual spines on head and 3 on nape; second with rays, opposite rayed anal fin. First dorsal fin spine in form of an illicium. Pectoral fin strong and broad; ventral fin base before pectoral fin base.

Four genera with 28 species in the family. Members of two genera were obtained on the Survey.

REFERENCE: Caruso, 1999a.

Lophiodes gracilimanus

Second dorsal fin spine very long, reaching 4th or 5th dorsal fin spine when depressed. Gill opening large and extending behind, below and in front of pectoral fin base. Brown above and below; inside of mouth orange-brown. Peritoneum pale.
D_1 3+3 (all well developed); D_2 8. P 14-16. A 6.
(voucher: 187 mm SL)

Lophiomus setigerus

Three to 4 rows of teeth in jaw. Gill opening just to below and behind pectoral fin "elbow". Dusky lilac above, white below; inside of mouth white, tongue and floor of mouth with network of black lines.
D_1 3+3 (only last 2 or 3 connected by membrane);
D_2 8-9. A 6-7. P 21-25.