

# BONY FISHES

## GENERAL REMARKS

by K.E. Carpenter

**B**ony fishes constitute the bulk, by far, of both the diversity and total landings of marine organisms encountered in fisheries of the Western Central Pacific. They are found in all macrofaunal marine and estuarine habitats and exhibit a lavish array of adaptations to these environments. This extreme diversity of form and taxa presents an exceptional challenge for identification. There are 30 orders and 269 families of bony fishes presented in this guide, representing all families known from the area. Each order and family presents a unique suite of taxonomic problems and relevant characters. The purpose of this preliminary section on technical terms and guide to orders and families is to serve as an introduction and initial identification guide to this taxonomic diversity. It should also serve as a general reference for those features most commonly used in identification of bony fishes throughout the remaining volumes. Taxonomic details relevant to a specific family are explained under each of the appropriate family sections. A general introduction to the fisheries of bony fishes in this region is given in the introduction to these volumes. More detailed information relevant to understanding the diversity of fishes can be found in general texts such as Bond (1996), Moyle and Cech (1996), and Helfman et al. (1997).

The classification of bony fishes continues to transform as our knowledge of their evolutionary relationships improves. Many changes have been proposed in fish classification since the initiation of this project in 1993. At the time, Eschmeyer's (1990) classification was the most widely accepted in its general form and it served as a basis for planning the taxonomic assignments for these volumes. Since then, Nelson's (1994) third edition of "Fishes of the world" appeared with some changes to Eschmeyer's classification and some reassignments in these volumes were made to adjust for improvements. In addition, some authors made a special case for a deviation from our acceptance of Nelson's classification and these were mostly incorporated. The classification in Eschmeyer's (1998) more recent monumental "Catalog of fishes" largely follows Nelson (1994) and further supports the basis for the classification used here. There have been a number of notable advances in our knowledge of the phylogenetic relationships of bony fishes in recent years. Many of these are found in Johnson and Anderson (1993) and Stiassney et al. (1996). However, much of the comparative morphology with implications to changes in classifications in these volumes needs to be further corroborated before these changes will become commonly used. An alternative classification with modifications to Nelson's (1994) classification, particularly with respect to suborders of perciform fishes, can be found in Paxton and Eschmeyer (1994).

The common English names of orders and families varies widely from place to place. To help standardize common family names, we asked the authors to choose the single most representative name. In cases where there was ambiguity, we tended to choose the one listed in Nelson (1994). This recommended common family name is given in the guide to orders and families section. In separate family accounts, the preferred name is given first and followed by secondary frequent common names listed in parentheses.

## Literature cited

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TECHNICAL TERMS AND MEASUREMENTS

by K.E. Carpenter

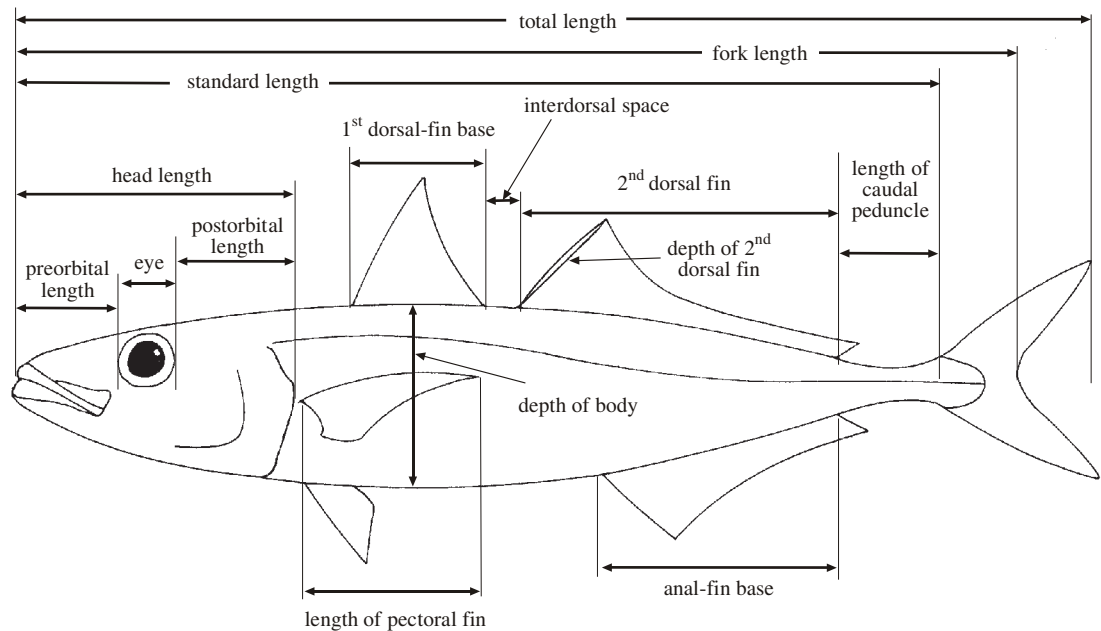


Fig. 1 common external measurements

NOTE: although all measurements are shown vertical and horizontal, all distances are measured as the straight line, shortest distance between the 2 points

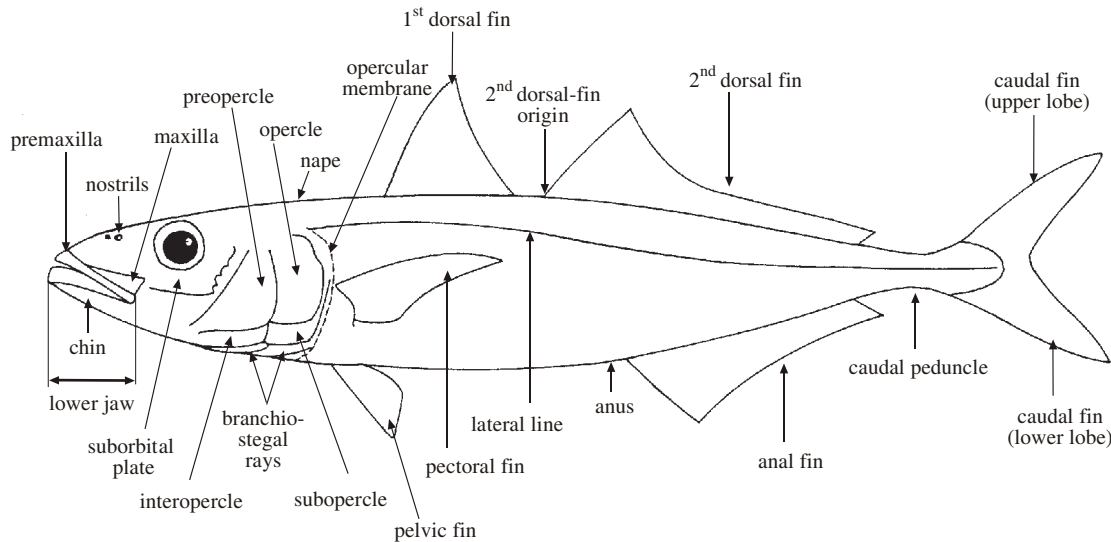


Fig. 2 common external features

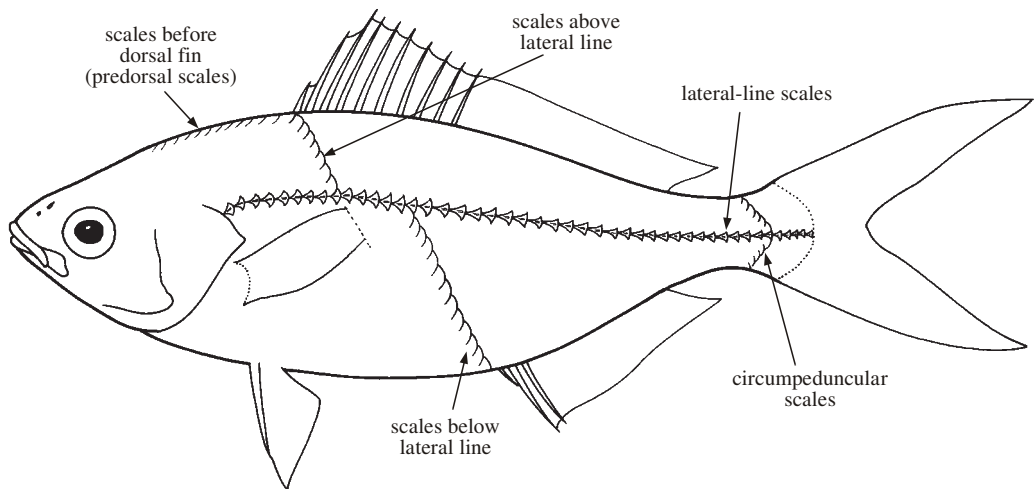


Fig. 3 common scale counts

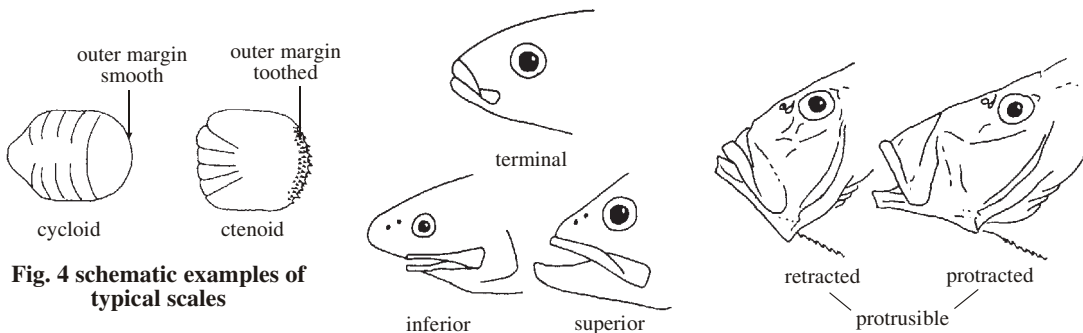


Fig. 4 schematic examples of typical scales

Fig. 5 mouth position and protrusibility

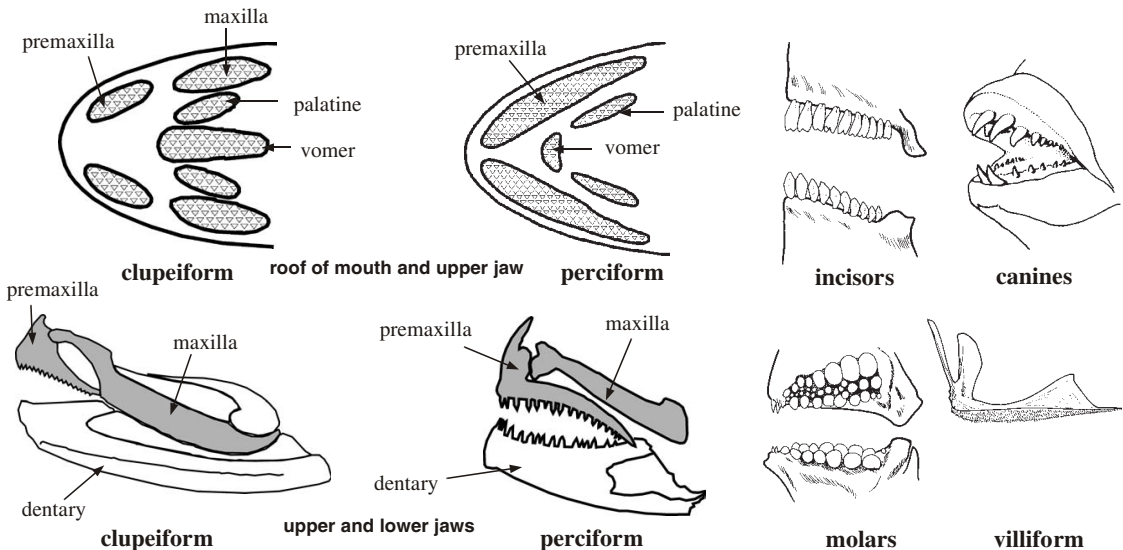
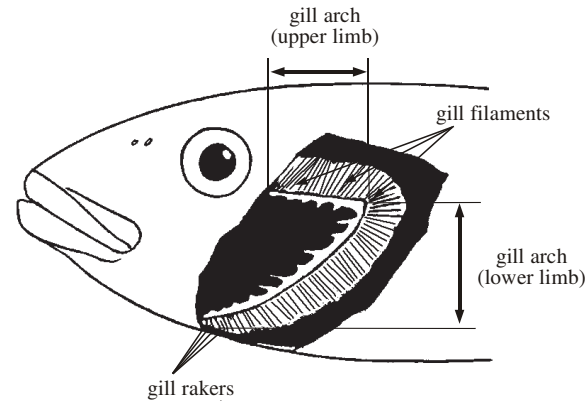
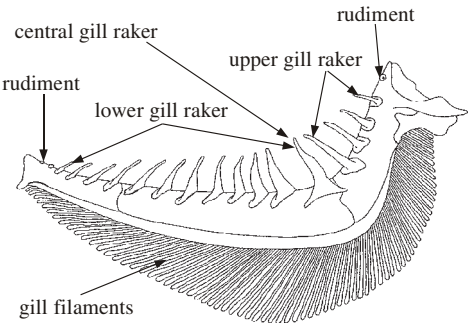


Fig. 6 teeth-bearing bones in the roof of the mouth and upper jaw, and alternative positions of premaxilla and maxilla in ancestral (clupeiform) versus derived (perciform) fishes

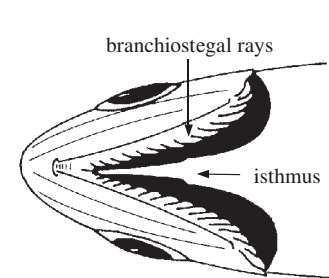
Fig. 7 common types of teeth



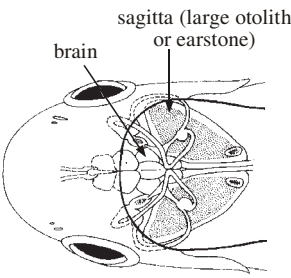
**Fig. 8** position of 1<sup>st</sup> left gill arch with gill cover removed



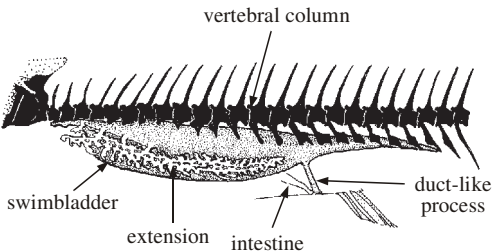
**Fig. 9** structures of 1<sup>st</sup> left gill arch



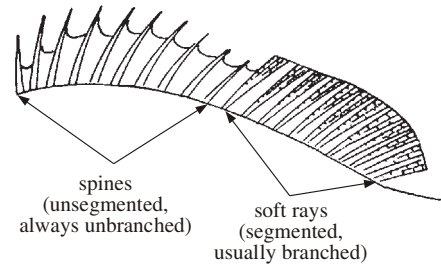
**Fig. 10** structures on ventral side of head



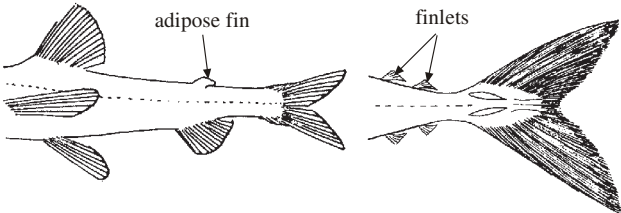
**Fig. 11** position of sagittal otolith inside head (dorsal view)



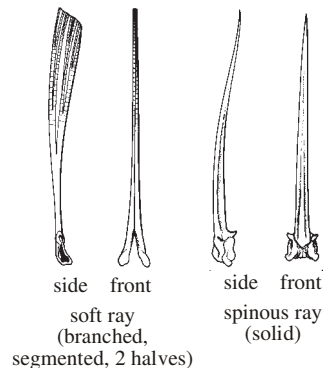
**Fig. 12** position of swimbladder inside body cavity



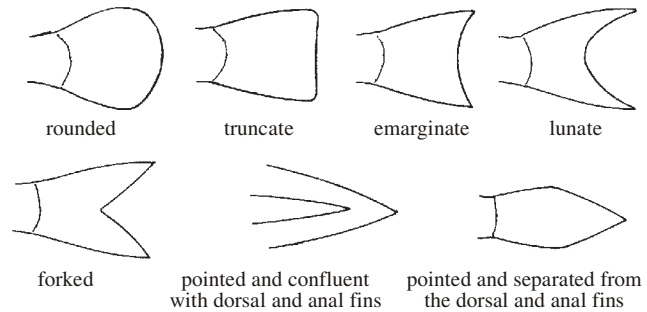
**Fig. 13** example of a continuous dorsal fin of a spiny-rayed fish



**Fig. 14** accessory dorsal and anal fins: adipose fin and finlets



**Fig. 15** construction of fin rays



**Fig. 16** most common types of caudal fins

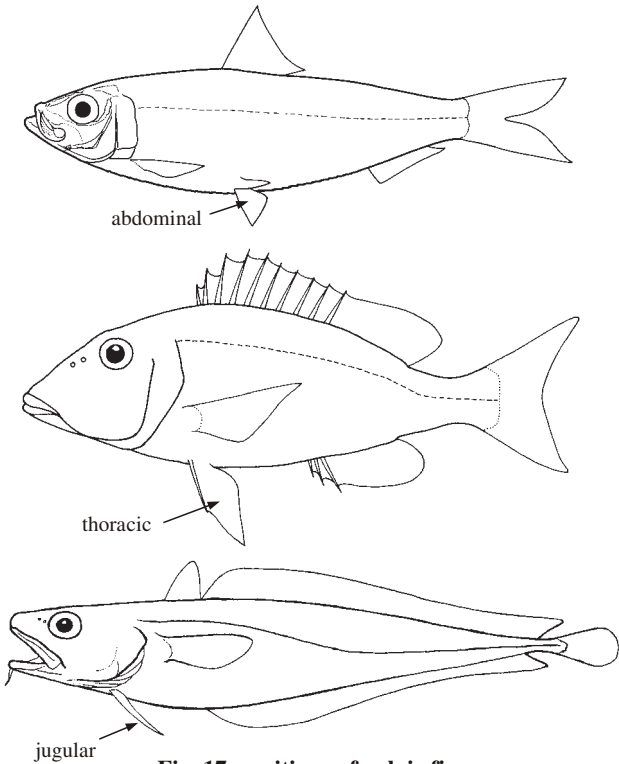


Fig. 17 positions of pelvic fins

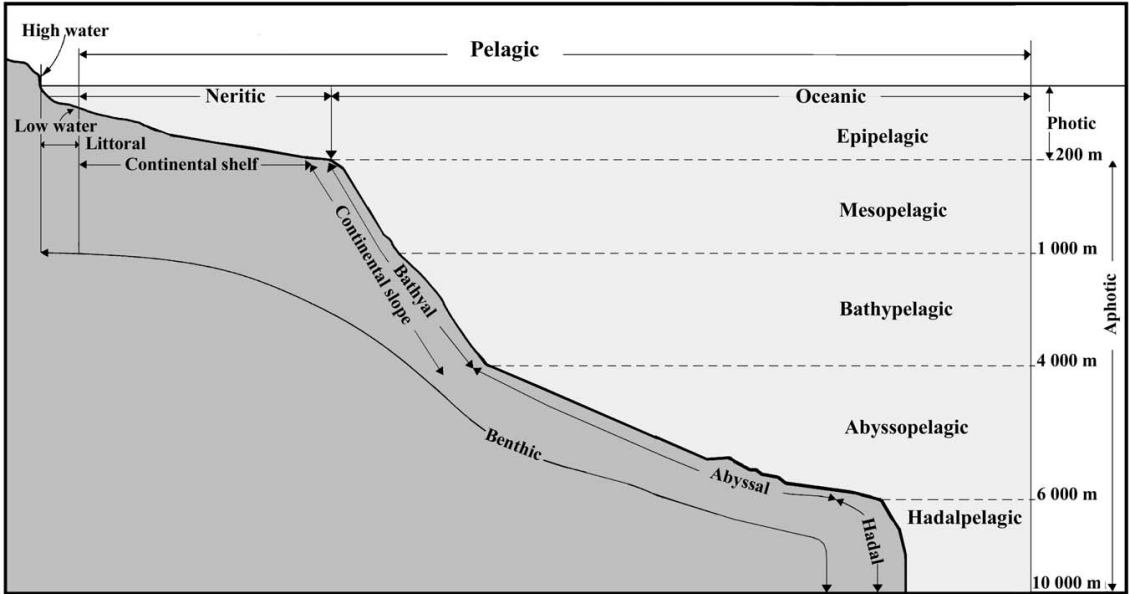


Fig. 18 marine habitat divisions  
(after Nybakken, 1997)

## GLOSSARY OF TECHNICAL TERMS USED FOR BONY FISHES

by K.E. Carpenter

**Abdomen** - the belly; ventral area between breast and anus.

**Abyssal** - region of the ocean floor between the depths of 4 000 and 6 000 m (Fig. 18).

**Abyssopelagic** - pelagic zone between the depths of 4 000 and 6 000 m (Fig. 18).

**Acute** - pointed or sharp.

**Adipose eyelid** - transparent fleshy tissue covering part or all of the eye in some fishes.

**Adipose fin** - small, fleshy fin without rays or spines on the dorsal midline between the dorsal and caudal fins of some fishes (Fig. 14).

**Airbladder** - see **swimbladder**.

**Anadromous** - living mostly in sea water and migrating to fresh water to spawn.

**Anal fin** - unpaired median fin supported by rays on the tail behind the anus (Fig. 2).

**Anterior** - pertaining to the front portion.

**Antorse** - turned forward.

**Anus** - posterior opening of the intestine through which wastes are excreted; vent (Fig. 1).

**Attenuate** - elongate; extended or drawn out.

**Axil** - angular area between pectoral fin and body, equivalent to arm-pit.

**Axillary scale** - an elongate or modified scale at the insertion of the pelvic or pectoral fins in some fishes.

**Band** - usually refers to an oblique or irregular marking.

**Bar** - elongate nearly straight vertical marking.

**Barbel** - elongate fleshy tentacle-like sensory projection, usually about the mouth or head.

**Base of fin** - part of the fin that attaches to the body (Fig. 1).

**Bathyl zone** - region of the ocean floor from the edge of the continental shelf (at around 200 m) down to a depth of about 4 000 m (Fig. 18).

**Bathypelagic** - pelagic zone between the depths of about 1 000 and 4 000 m (Fig. 18).

**Benthic** - referring to the ocean bottom; benthic species are closely associated with and often attached to the ocean bottom (Fig. 18).

**Benthopelagic** - inhabiting waters above but near the bottom or, spending part of the time on the bottom and part of the time further up in the pelagic zone.

**Branchiostegal membranes** - membranes on the ventral interior surface of the gill cover supported by branchiostegal rays.

**Branchiostegal rays, branchiostegals** - bony rays supporting the membranes inside the lower part of the gill cover (Fig. 10).

**Breast** - ventral surface of body between the isthmus and pectoral or pelvic fins.

**Canine** - slender conical tooth, often enlarged and elongate (Fig. 7).

**Carapace** - a hardened encasing covering all or part of the body.

**Cardiform** - small short conical outgrowths in a close-set patch or band; usually refers to a band of close-set small conical teeth.

**Catadromous** - living in fresh water and migrating to the sea to spawn.

**Caudal fin** - the tail fin (Fig. 1).

**Caudal peduncle** - posterior part of body between the rear parts of the dorsal and anal fins, and the caudal fin (Fig. 1).

**Cheek** - side of head below and slightly behind the eye.

**Cirrus** - small, fleshy protuberance.

**Compressed** - flattened laterally; a body shape much deeper than wide.

**Continental rise** - the gentle slope at the base of the continental slope.

**Continental shelf** - the flattened edge of the continental land mass between the coast and the continental slope (generally, the continental subtidal zone down to a depth of about 200 m).

**Continental slope** - the sloping edge of the continental land mass, generally beginning at a depth of around 200 m.

**Crenulate** - scalloped or wavy edge.

**Ctenoid scale** - scale with a spiny posterior margin (Fig. 4).

**Cycloid scale** - scales with smooth posterior margin, without spines on posterior margin (Fig. 4).

**Deciduous** - easily shed or rubbed off; refers to scales.

**Demersal** - free living close to the sea bottom.

**Denticle** - small tooth-like structures.

**Depressed** - flattened from top to bottom; body shape much wider than deep.

**Distal** - near outer edge; far end from point of attachment or centre of body.

**Dorsal** - back or upper body.

**Dorsal fin** - median fin supported by spines and/or rays; sometimes separated into 2 or more fins with the anteriormost fin designated the first (Fig. 2).

**Edentulous** - without teeth.

**Emarginate** - margin slightly concave; pertains to a caudal-fin shape (Fig. 16).

**Entire** - smooth or straight margin.

**Estuary** - partly enclosed body of sea water that is measurably diluted with fresh water.

**Falcate** - sickle-shaped.

**Finlets** - small separate dorsal and anal fins (Fig. 14).

**Forked** - branched; caudal fin shape with distinct upper and lower lobes and the posterior margin of each lobe relatively straight or gently curved (Fig. 16).

**Furcate** - forked.

**Fusiform** - spindle-shaped; body shape that is cylindrical and tapering at both ends.

**Gasbladder** - see **swimbladder**.

**Gill** - organ for exchange of dissolved gasses between water and the blood stream; gill tissues are supported by a gill arch in fishes (Figs 8 and 9).

**Gill arch** - bony angular skeleton that supports the gill filaments and gill rakers (Figs 8 and 9).

**Gill filaments** - principal site of gas exchange in the gill (Fig. 9).

**Gill membrane** - membranes along the posterior and ventral margin of the gill cove.

**Gill rakers** - bony projections along the front edge of the gill arch that help prevent food from escaping through the gill opening (Figs 8 and 9).

**Gular plate** - bony plate covering the underside of the head as exemplified in elopiform fishes.

**Hadal zone** - region of the ocean floor between the depths of 6 000 and 10 300 m (Fig. 18).

**Herbivore** - feeding on plants.

**Illicium** - modified isolated first ray of the dorsal fin that forms the "fishing gear" (rod and lure) in anglerfishes.

**Incisor** - flattened chisel-shaped tooth (Fig. 7).

**Inferior** - mouth position on underside of head with snout projecting in front of mouth (Fig. 5).

**Insertion** - the anterior or posterior point of attachment of a fin to the body.

**Interdorsal** - the space on the back between the bases of the first and second dorsal fins (Fig. 1).

**Interopercle** - the lower anterior bone of the gill cover (Fig. 2).

**Interorbital** - the space on top of the head between the eyes.

**Intertidal** - the area of the shore covered at high tide and exposed at low tide.

**Isthmus** - the part of the underside of the head separating the gill openings (Fig. 10).

**Jugular** - pertaining to the throat region; pelvic fins are jugular when positioned on the underside of the head in front of the pectoral fins (Fig. 17).

**Lanceolate** - spear- or lance-shaped.

**Lateral** - the side or toward the side.

**Lateral line** - a vibration sensory canal along the side of the body with a series of pores that communicate to the outside of the body, often through specialized pored lateral-line scales (Figs 2 and 3).

**Littoral** - the intertidal area of the shore.

**Lunate** - crescent-shaped; caudal-fin shape that is deeply emarginate with narrow lobes (Fig. 16).

**Mandible** - lower jaw.

**Maxilla** - the bone in the upper jaw behind the premaxilla. In ancestral fishes the maxilla is the principal bone of the upper jaw that bears teeth; in derived fishes it generally does not bear teeth and serves more to support the premaxilla (Fig. 6).

**Median** - the middle or toward the midline.

**Median fins** - fins that lie on the midline; the dorsal, anal, and caudal fins.

**Melanophore** - cell carrying black or greyish pigments.

**Mesopelagic** - pelagic zone between the depths of about 200 and 1 000 m (Fig. 18).

**Molar** - a low, blunt, rounded tooth for crushing and grinding (Fig. 7).

**Nape** - the dorsal part of the body just behind the occiput or hard dorsal region of the skull (Fig. 2).

**Neritic** - nearshore; the zone of water above the continental shelves.

**Occiput** - upper back part of the head or skull.

**Ocellus** - a round eye-like spot or marking with a marginal ring.

**Opercle** - the large posterior upper bone of the gill cover (Fig. 2).

**Operculum** - the gill cover composed of the preopercle, opercle, interopercle, and subopercle.

**Orbital** - referring to the eye, particularly the bones surrounding the eye.

**Origin** - the anterior point of attachment of fins to the body (anterior insertion) (Fig. 2).

**Otolith** - a small bone or earstone in the inner ear of fishes (Fig. 11).

**Paired fin** - fins found on both sides of the body; the pectoral and pelvic fins (Fig. 2).

**Palate** - roof of the mouth.

**Palatine** - paired bones on each side of the roof of mouth, behind and lateral to the vomer, often bearing teeth (Fig. 6).

**Papilla** - a small fleshy projection.

**Pectoral fins** - paired fins on the sides behind the gill cover (Fig. 2).

**Pelagic** - the division of the marine environment composed of all the ocean's water; living in the open seas or oceans (Fig. 18).

**Pelvic fins** - paired fins in front of the anus (Fig. 2), sometimes called the ventral fins. Ancestral fishes generally have the pelvic fins in the abdominal position while derived fishes generally have the pelvic fins in the thoracic or jugular position (Fig. 17).

**Pharyngeal teeth** - teeth on the elements of the last gill arch or pharyngeal arch.

**Photophore** - light-emitting organ or luminous spot.

**Posterior** - pertaining to the rear portion.

**Premaxilla** - anterior bone in the upper jaw (see **maxilla**) (Fig. 6).

**Preopercle** - the upper anterior bone of the gill cover (Fig. 2).

**Preorbital** - referring to the region before the eye; a suborbital bone in front and below the eye.

**Principal caudal-fin ray** - the branched and unbranched caudal-fin rays that reach the rear margin of the fin.

**Procurent caudal-fin ray** - small ray at the insertions of the fin that do not reach the rear margin.

**Proximal** - part nearest the centre of the body.

**Pseudobranchium** - a small patch of gill-like filaments on the upper inner surface of the gill cover.

**Ray** - supporting element of fins (Fig. 15). Ray is sometimes used as a collective term to designate both soft rays (see below) and spines (see below). It is also sometimes used to designate exclusively, soft rays.

**Rounded** - a caudal-fin shape with the terminal border smoothly convex (Fig. 16).

**Rudiment** - a poorly developed structure, usually small and minimally functional at best. These include small unbranched soft rays and small gill rakers at the ends of a gill arch.

**Scute** - a modified scale that can be enlarged, hardened, ridged, keeled, or spiny.

**Serrate** - with saw-like teeth along a margin.

**Setae** - bristles or hardened hair-like projections.

**Soft dorsal fin** - the portion of the dorsal fin supported by soft rays (Fig. 13).

**Soft ray** - a fin support element that is composed of 2 halves (paired laterally), segmented, and usually

flexible and branched (Fig. 15). Rarely, soft rays can be pointed and stiff and appear to be a spine.

**Spine** - a fin support element that is unpaired laterally, unsegmented, unbranched and usually stiff and pointed (Fig. 15); also refers to slender sharply pointed bony processes not associated with fins.

**Spinous dorsal fin** - the anterior portion of the dorsal fin that is supported by spines (Fig. 13).

**Spinule** - a small spine.

**Standard length** - the distance from the anteriormost point on the fish to the posterior end of the vertebral column that is generally equivalent to the end of the hypural plates (and recognized externally by the crease between the tail and caudal fin when the caudal fin is bent laterally); sometimes abbreviated as SL (Fig. 1).

**Stripe** - generally refers to a horizontal nearly straight side marking.

**Subopercle** - the lower rear bone in the gill cover (Fig. 2).

**Subtidal** - the ocean floor below the low tide mark.

**Superior** - above or on the upper surface; a mouth position with the snout behind the anterior opening of the mouth (Fig. 5).

**Swimbladder** - a gas-filled sac lying under the backbone in the abdominal cavity, used in buoyancy; also referred to as airbladder or gasbladder (Fig. 12).

**Symphysis** - the articulation between 2 bones; often refers to the anterior juncture between the 2 halves of either jaw.

**Terminal** - pertaining to at the end, or situated at the end; a mouth position with the opening of the mouth even with the tip of the snout (Fig. 5).

**Thoracic** - referring to the breast region; pelvic fins are thoracic in position when directly below the pectoral fins (Fig. 17).

**Truncate** - terminating abruptly in a square end; a caudal-fin shape with a vertically straight terminal border (Fig. 16).

**Vent** - see **anus**.

**Ventral** - the bottom, lower surface, or abdominal part of the body.

**Ventral fins** - see **pelvic fins**.

**Vertical fins** - the median fins; the dorsal, caudal, and anal fins.

**Vestige** - small or underdeveloped structure, as in a rudiment.

**Villiform** - many small slender outgrowths, usually in a close-set patch or carpet; often refers to slender teeth forming velvety bands (Fig. 7).

**Vomer** - an unpaired median bone on the roof of the mouth (Fig. 6).