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REVIEW OF SHARK SPECIMENS OF THE NATIONAL MUSEUM IN PRAGUE

ABSTRACT: In this work, 56 specimens of 20 shark species are described and given their inventory numbers. Tables of proportional measurements, drawings of teeth, micrographs of dermal denticles and other photographs are included.

INTRODUCTION

Five years ago I began to examine specimens of sharks which are kept in the ichthyological depository of the National Museum in Prague. The shark collection of the National Museum is not very large, containing not more than a hundred shark specimens. It has been never reviewed; no specimens have been described yet. Fifty-six of them have been well enough preserved to be measured and described. The others cannot be examined due to various deformities or poor preservation. The majority of the material studied was donated to the museum by the firm "Firma J. Frič" in 1949, some other specimens were collected by Antonín Frič, head of the zoological department of the National Museum from 1854—1913.

The purpose of this paper is to review a collection of sharks which has never before been examined.

MATERIAL

The fifty-six specimens of sharks described herein belong to twenty species, sixteen genera, nine families and five orders of subclass Elasmobranchii, cohort Euselachii.

All specimens are preserved in glass bottles, covered with 70 % ethyl-alcohol; only four are preserved in a formalin solution. The vast majority of specimens were probably captured within the years 1889 and 1909. The others were obtained in 1950's and 1960's either by purchase or exchange.

The examined material comes from the Mediterranean Sea, Black Sea, North Sea, East Indies and Japan. The location of capture is known in the case of only nineteen of the specimens.

TERMINOLOGY AND METHODS

Terminology used in the morphological descriptions of shark specimens follows mainly COMPAGNO [1970, 1973, 1977] and TAYLOR et al. [1983]. Some terms and measurements are adapted from SPRINGER [1964] and GILBERT [1967].

Terminology

Some basic morphological terms are explained on Fig. 1.

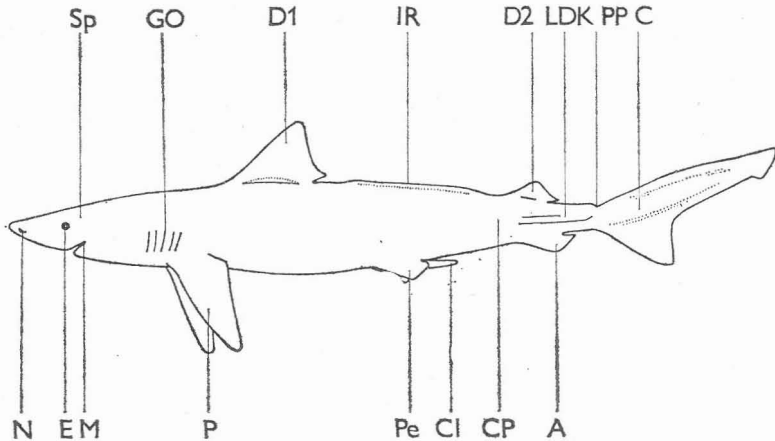


Fig. 1. External anatomy of a shark. Abbreviations: A, anal fin; C, caudal fin; Cl, claspers; CP, caudal peduncle; D 1, first dorsal fin; D 2, second dorsal fin; E, eye; GO, gill openings; IR, interdorsal ridge; LDK, lateral dermal keel; M, mouth; N, nostrils; P, pectoral fin; Pe, pelvic fin; PP, precaudal pit; Sp, spiracle.

Head morphology

Nictitating lower eyelid [NLE] — a movable eyelid which is formed on the lower part of the orbit in carcharhiniform sharks. Four various types of NLE are distinguished: rudimentary, external, internal and transitional (as described by COMPAGNO, 1970).

Subocular pouch — a groove separating the NLE from the secondary lower eyelid.

Spiracle — variably developed external opening formed between the palatoquadrate and the hyomandibula, lying usually behind the posterior eye corner.

Nostrils are located on the underside of the snout, either well separated or connected with the mouth and with each other by nasoral grooves. The anterior margin of the nostril forms the anterior nasal flap which may extend and form the anterior nasal barbel.

Dentition

All terms concerning dentition are thoroughly discussed by COMPAGNO (1970). The tooth is divided into two parts — the root and the crown. The root and the lower part of the crown (crown foot) form the base. The crown has usually a strong primary (median) cusp and several lateral cusplets (Fig. 2). The teeth in each jaw form several series and many rows. According to their position in the jaw they are differentiated as symphyseal, anterior, lateral and posterior teeth (Fig. 3). Two main types of heterodonty can be identified: monognathic heterodonty is defined by the morphological differentiation between teeth of the same jaw series, dignathic heterodonty by the differentiation between opposite teeth of the upper and lower jaws.

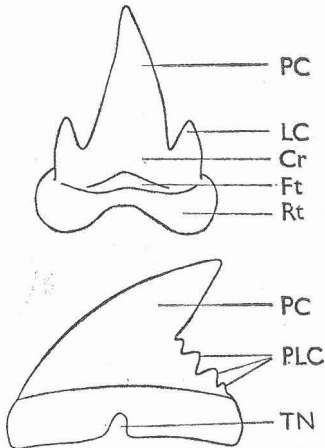


Fig. 2. Tooth morphology. Abbreviations: Cr, crown; Ft, crown foot; LC, lateral cusp; PC, primary cusp; PLC, postlateral cusps; Rt, root; TN, transverse notch.

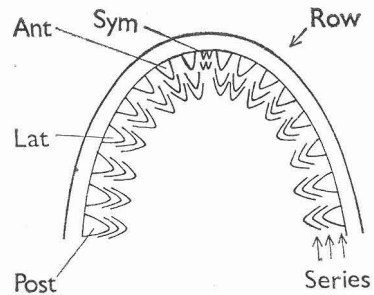


Fig. 3. Monognathic differentiation of teeth. Abbreviations: Ant, anterior teeth; Lat, lateral teeth; Post, posterior teeth; Sym, symphyseal teeth.

Dermal denticles

Crowns of dermal denticles may have a medial cusp and variably developed lateral cusps, a medial ridge and several lateral ridges.

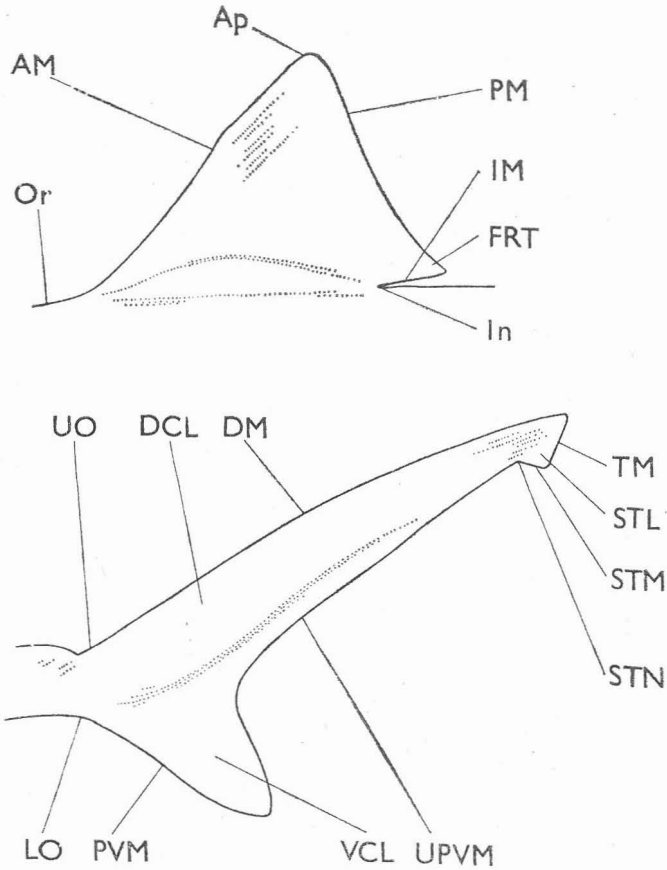


Fig. 4. Shark fin terminology. A. First dorsal fin. B. Caudal fin. Terms on A apply to pectoral, pelvic, dorsal fins and anal fin. Abbreviations: AM, anterior margin; Ap, apex; DCL, dorsal caudal lobe; DM, dorsal margin; FRT, free rear tip; IM, inner margin; In, insertion; LO, lower caudal origin; Or, origin; PM, posterior margin; PVM, pre-ventral margin; STL, subterminal lobe; STM, subterminal margin; STN, subterminal notch; TM, terminal margin; UO, upper caudal origin; UPVM, upper postventral margin; VCL, ventral caudal lobe.

Fins

All terms concerning fin morphology are explained on Fig. 4. Origins of the fins are defined as places where the fin from lateral view (from dorsolateral view in paired fins) rises above the body contour.

Methods

Each specimen was removed from the bottle and immediately measured. Samples of anteroposterior teeth were taken from the upper

and lower jaws. All teeth were measured, described, and some were drawn with the use of the binocular microscope and Abbe's drawing instrument. Skin samples were taken in most of the specimens, usually below the base of the first dorsal fin. Photographs of dermal denticles were taken on the JSM—T 200 scanning electron microscope. Both tooth and skin samples were examined under the binocular microscope. No dissections of bodies or jaws were made.

Finally, each specimen was named and listed under its respective museum number [Nos. 33 748—33 803]. All numbers were labeled on the bottles.

Measurements

Thirty-one basic measurements were taken. "Snout tip to —" measurements were made with the 80 cm long measuring board supplied with the millimeter scale, and the right-angled triangle. Other measurements were taken with the slide ruler (vernier calliper).

Many difficulties were caused by various deformities. In cases where two different values were gained from opposite halves of the body, the average was taken (eye length, gill opening length, etc.).

Total length [TL]: A distance from the snout tip to a vertical line through the tip of the dorsal lobe of the caudal fin. The dorsal caudal lobe is placed into its normal position, i.e. with its axis somewhat raised above the body axis.

Precaudal length: A distance from the snout tip to a vertical line through the origin of the dorsal lobe of the caudal fin (upper caudal origin).

Snout tip to —

— mouth: A distance from the snout tip to the anterior tip of the lower jaw.

— eyes: A line connecting the anterior corners of eyes was drawn on the underside of the head. Then, the distance between the snout tip and the midpoint of this line is measured.

— gill openings: Points of junction with the ventral side of the body were found on both gill openings. A line connecting these points was drawn. Crossing the midpoint of this line, a line vertical to the measuring board was made with the use of the right-angled triangle. The distance between the snout tip and the place where the vertical line intersects the scale is measured.

— pectoral origins: A line connecting the origins of both pectoral fins was drawn on the underside of the body. The midpoint of this line is crossed by the edge of the triangle and the distance is found in the same way as above.

— pelvic origins: This distance is found in a similar way as in the case of pectoral fins.

— first dorsal origin: A distance from the snout tip to a vertical line through the origin of the first dorsal fin.

— second dorsal origin: A distance from the snout tip to a vertical line through the origin of the second dorsal fin.

— anal origin: A distance from the snout tip to a vertical line through the origin of the anal fin.

Eye length: The length of the horizontal diameter of external eye opening, i.e. the distance between the anteriormost and the posteriormost points of the orbital rim.

Spiracles —

— spiracle — eye distance: The distance between the posterior margin of the orbital rim and the anterior margin of the spiracle.

Mouth —

— length: A line was drawn between the corners of the mouth. The distance from the tip of the lower jaw to the midpoint of the line is measured.

— width: The distance between the corners of the mouth.

Gill opening length: The shortest distance between the upper and the lower ends (i.e. points of junction with the body) of the opening.

Trunk height: The height of the trunk at a level of the first dorsal origin is measured.

Caudal peduncle height: The height of the caudal peduncle at a level of the upper caudal origin is measured.

Pectoral, pelvic, dorsal fins, anal fin —

— anterior margin length: The distance between the origin and the tip of the anterior margin (apex) of the fin.

— base length: The distance between the origin and the insertion (axil) of the fin.

Clasper length: The distance between the pelvic insertions and the tips of the claspers.

Caudal fin —

— dorsal margin length: The distance from the upper caudal origin to the tip of the dorsal caudal lobe.

— preventral margin length: The distance from the lower caudal origin to the tip of the ventral caudal lobe.

CLASSIFICATION OF SHARKS

In this account I follow the classification of COMPAGNO (1973). All living elasmobranchs are divided into three superorders of sharks and a single superorder of rays, rays (Batoidea) are placed between squalomorph and squatinomorph sharks. The last superorder, galeomorph sharks, is the most numerous. Leonard J. V. Compagno called his classification as "highly provisional", but he improved it well in his recent works. This classification is widely used in the world nowadays, and I find it very useful and highly progressive, too.

Classification of living elasmobranchs (COMPAGNO, 1973):

- Class Chondrichthyes
- Subclass Elasmobranchii
- Cohort Euselachii
- Superorder Squalomorphii
- Order Hexanchiformes
- Order Squaliformes
- Order Pristiophoriformes

Superorder Batoidea
Order Rajiformes
Order Pristiformes
Order Torpediniformes
Order Myliobatiformes
Superorder Squatinomorphii
Order Squatiniformes
Superorder Galeomorphii
Order Heterodontiformes
Order Orectolobiformes
Order Lamniformes
Order Carcharhiniformes

DESCRIPTIONS

Class Chondrichthyes
Subclass Elasmobranchii
Cohort Euselachii
Superorder Squalomorphii
Order Hexanchiformes
Family Hexanchidae Gray, 1851
Genus *Hexanchus* Rafinesque, 1810

HEXANCHUS GRISEUS (BONNATERRE, 1788), No. 33748
771 mm TL, female. Capture data unavailable. Formerly indentified as *Notidanus griseus*.

Head moderately long, broad, its width at 1st gill openings 13.7 % of total length; head flattened dorsoventrally. Snout blunt, comparatively short, broadly rounded. Eye openings dorso-lateral, not visible from ventral view. Eyes elongate, their height almost 4 times in length, irises circular. Posterior corners of eyes forming short furrows. No nictitating eyelids or subocular ridges. Spiracles slitlike, small, their lengths $\frac{1}{5}$ eye length, located more than eye length behind eyes, above level of dorsal eye margins. Nostrils moderately large, closer to snout tip than to mouth. Anterior nasal flap not very long, narrowly rounded angle. No nasoral grooves. Six pairs of gill openings, running from dorsal to ventral surfaces of head, not connected with each other. Gill openings greatly arched, all in front of pectoral fin bases and at about their level, decreasing in size from 1st to 6th. Length of 6th gill opening $\frac{3}{4}$ length of 1st.

Mouth short and broad, below eyes. Teeth bladelike, smooth, their cusps obliquely directed towards mouth corners (Fig. 7). Upper and lower teeth present in a single functional series, 20 rows of anteroposterior teeth in upper, and 12 rows in lower jaws. 10 symphyseal teeth present in upper jaw — awl-like, about as high as upper anteroposteriors, but narrower basally. A single symphyseal tooth present in lower jaw. Tooth formula 10—10—10/6—1—6. Dignathic heterodonty strong: crowns of upper teeth having a single cusp; lower teeth longer, their crowns 6-cusped. Width of upper anterior teeth bases 0.47 % of TL, lower 1 % of TL. Labial furrows poorly developed. Noticeable groove running from behind upper jaw symphysis almost to 1st gill openings.

Trunk slender, very broad at level of pectoral fin bases, flattened dorsoventrally, tapering rearward from head. Caudal peduncle vertically oval in cross section. No dorsal or lateral ridges on body, no precaudal pits.

Dermal denticles on body closely imbricated, relatively large, length of largest 0.08 % of TL. Crowns about as long as broad, flattened, with a long medial cusp and longitudinal ridge, and a pair of lateral cusps and ridges.

All fins have a generally slender appearance. Pectoral fins relatively large, their apices narrowly rounded, free rear tips broadly rounded. Pectoral fin apices about over pectoral free rear tips when pectoral inner margins are held parallel to body axis.

Origins of pectoral fins posterior to 6th gill openings by only $\frac{1}{3}$ of eye length. Pelvic fins small, their apices broadly rounded, free rear tips pointed. Bases of pelvic fins just in advance of dorsal fin base.

Dorsal fin low, small, its apex broadly rounded, free rear tip pointed, posterior margin concave. Origin of dorsal fin over pelvic insertions, its free rear tip anterior to anal insertion by only $\frac{1}{4}$ of dorsal base length. Anal fin almost as large as dorsal fin, their shapes similar. Origin of anal fin anterior to dorsal fin insertion by more than $\frac{1}{4}$ of dorsal fin base length.

Caudal fin long, heterocercal, with a subterminal notch on dorsal caudal lobe, upper postventral margin very long. Preventral margin length 0.3 times dorsal margin length.

Color: Cinnamon brown to light brown above, paler below. Fins darker than body; tips of dorsal fin, dorsal and ventral caudal lobes dark brown.

Family Heptranchidae Barnard, 1925

Genus *Heptranchias* Rafinesque, 1810

HEPTRANCHIAS PERLO (BONNATERRE, 1788), No. 33749

862 mm TL, female. Locality: Nice, Mediterranean Sea. Formerly identified as *Notidanus cinereus*.

Head narrow, its width at 1st gill openings 9.2% of TL. Snout comparatively short, sharply pointed. Eyes lateral on head, elongate, their apertures' height 3.6 times in length. Posterior corners of eye openings formed into short furrows. No nictitating eyelids or subocular ridges. Spiracles slitlike, very small ($\frac{1}{5}$ eye length), located $\frac{4}{5}$ eye length behind eyes and above dorsal margins of eyes. Nostrils moderately large, slightly closer to snout tip than to mouth, anterior nasal flaps short, rounded.

Seven pairs of laterally situated gill openings. External gill slits growing shorter from 1st to 7th. Length of 1st gill opening 2.3 times eye length, 7th about $\frac{2}{5}$ length of 1st. All gill openings in front and at the level of pectoral fin bases.

Mouth long, narrow, extending far behind eyes. Its width about $\frac{9}{10}$ its length. Teeth large, length of upper teeth bases 1.2% of TL, bases of lower teeth 1.7% of TL (Fig. 7). Teeth present in a single series, other series of teeth lying flatly in jaws. All teeth smooth, obliquely rounded towards mouth angles. Dignathic heterodonty very strong. Upper teeth with a slender curved primary cusp and a small postlateral cusp. Lower teeth with 9 cusps, the second enlarged, others smaller. A low symphyseal tooth present at lower jaw symphysis. Tooth formula 12-12/5-1-15. Labial furrows poorly developed. Noticeable groove running from above upper jaw almost to level of 1st gill openings.

Body slender, trunk tapering rearward from head, vertically oval in cross section. Caudal peduncle not very long, its height 1.6 times its width at upper caudal origin. No dorsal ridges; lateral keels and precaudal pits absent from caudal peduncle.

Dermal denticles not very large, their length about 0.06% of TL, closely imbricated, with a single cusp and high longitudinal ridge (Plate 7A).

Pectoral fins relatively large, their apices and free rear tips narrowly rounded, posterior margins concave. Origins of pectoral fins just behind 7th gill openings. Pelvic fins much smaller than pectoral fins, their apices broadly eyed. Pelvic fin bases in advance of dorsal fin base.

Dorsal fin small, its anterior margin only 8.6% of TL; its apex narrowly rounded, free rear tip little extended. Origin of dorsal fin over pelvic fin insertions. Insertion of dorsal fin posterior to anal origin by only $\frac{1}{6}$ of dorsal base length, free rear tip of dorsal fin about over anal midbase. Anal fin low and long, its apex broadly rounded.

Caudal fin very long, heterocercal, subterminal notch present. Length of preventral margin 0.3 times dorsal margin length.

Color: Dull brown to dark brown above, lighter below. Fins with no markings, having the color of the body.

Order Squaliformes

Family Squalidae Bonaparte, 1834

Genus *Etmopterus* Rafinesque, 1810

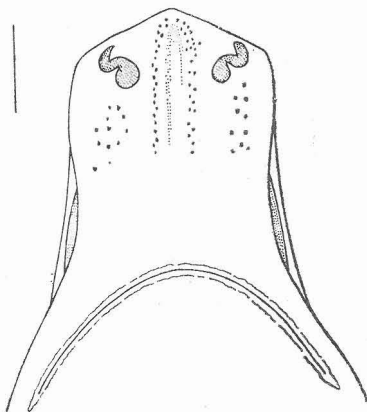
ETMOPTERUS SPINAX (LINNAEUS, 1758)

Specimen No. 33750

365 mm TL, female. Locality: Nice, Mediterranean Sea. Captured in 1898.

Head bell-shaped (Fig. 5), much narrower at eyes than at gill openings. Snout narrow and pointed, forming a short triangle. Eyes lateral on head, clearly visible neither in dorsal, nor in ventral view of head. Eyes elongate, with no nictitating eyelids, height of eye openings 2.7 times in length. Irises of eyes black. Notched anterior orbital rim. Spiracles large, their diameter almost $\frac{1}{2}$ eye length, located dorsally on head, about $\frac{1}{2}$ eye length behind and above eyes. Nostrils closer to snout tip than to eyes, relatively large, well separated. Anterior and posterior nasal flaps short, pointed. Five pairs of short, laterally situated gill openings. All about equal, slightly decreasing in size from 1st to 5th.

Fig. 5. *Etmopterus spinax*, No. 33750. Ventral view of head. Scale line at upper left equals 10 mm.



Mouth subterminal, broad, its width about $\frac{4}{5}$ of width of head at mouth corners. Teeth smooth, moderately large, base width of largest lower anteroposteriors about 0.39 % of TL (Fig. 7). Four functional series of teeth in upper and one in lower jaws. Dignathic heterodonty strong; lower anteroposteriors having broad, oblique and compressed single-cusped crowns with cusps turned aside, so inner margin forms cutting edge. Upper anteroposteriors narrow basally, crowns directed obliquely rearward, having a single median cusp and a pair of lateral cusplets. 28 rows of teeth in lower jaw, and about as many rows in upper jaw. Noticeable hyomandibular pores present. Labial furrows very short.

Body and fins of a slender appearance, trunk not compressed. Caudal peduncle short, vertically oval in cross section. No interdorsal ridges, lateral keels or precaudal pits. A spine in front of each dorsal fin. Spines with two lateral ridges and four lateral grooves (two grooves forming one ridge), second spine much longer than first.

Dermal denticles long, closely imbricated, with a single hairlike medial cusp and no cusplets. Length of largest denticles 0.3 % of TL (Plate 7B).

Pectoral fins small, but larger than first dorsal fin in area. Origins of pectoral fins just behind 5th gill openings, distal tips of appressed pectorals over their free rear tips. Pelvic fins moderately large, set far back. Their bases reach to below second dorsal fin base.

First dorsal fin very small and low, its apex broadly rounded, its base closer to pectoral than to pelvic fin origins. Origin of first dorsal fin posterior to pectoral free rear tips only by about 1st gill opening length.

Second dorsal fin higher and larger than first, its anterior margin 1.4 times first dorsal anterior margin. Origin of second dorsal fin anterior to pelvic insertions by $\frac{1}{4}$ of pelvic bases length. No anal fin.

Caudal fin heterocercal, short, with subterminal notch on dorsal caudal lobe. Pre-ventral caudal margin $\frac{1}{2}$ of dorsal margin length, lower caudal origin anterior to upper origin by $\frac{1}{3}$ of pre-ventral margin length.

Color: Body uniform brown, somewhat darker underneath. Upper eyelids with paler margins.

Specimen No. 33751

295 mm TL, female. Captured in 1889.

Differences from No. 33750 specimen:

Origin of first dorsal fin posterior to pectoral free rear tips by three lengths of 1st gill opening. Second dorsal anterior margin 1.2 times first dorsal anterior margin.

Specimen No. 33752

111 mm TL, male — fetus. Locality: Bergen, North Sea. Captured in 1898. Formerly identified as *Spinax niger*.

Head broad, flattened ventrally, its length about 22 % of TL. Snout very short, broad and bluntly tipped. Eyes lateral on head, visible in ventral as well as in dorsal view of head. Eye openings large, oval, irises of eyes black. Eyes with notched orbital rims and weak subocular ridges. No nictitating eyelids. Spiracles small, situated behind dorsal margins of eyes. Nostrils relatively large, separated, without nasaoral grooves, about 5 times closer to snout tip than to mouth. Anterior nasal flap well developed.

Five pairs of short gill openings, lying in front of pectoral fin origin, their lengths about equal. Mouth lying on ventral side of head, broadly arched. Teeth small, not developed. Upper and lower labial furrows present.

Trunk triangular in section at first dorsal origin, about as high as wide. Caudal peduncle short, vertically oval in cross section. Three dermal ridges along the back, a pair of weak lateral keels in space between pectoral and pelvic fins. No precaudal pits. Dorsal fins with spines doubly grooved laterally, second spine longer than first. Yolk sac still present. Dermal denticles poorly developed and not very numerous.

Pectoral fins large and rounded, originating just behind gill openings. Pelvic fins slightly smaller than second dorsal fin, but larger than first dorsal fin. Apices broadly rounded, free rear tips extended. Pelvic origins midway between pectoral origins and upper caudal origin. Juvenile claspers, not reaching pelvic rear tips.

First dorsal fin origin slightly anterior to pectoral free rear tips, but posterior to pectoral insertions. Second dorsal fin similar to first, slightly larger, originating above last third of pelvic fin bases. No anal fin.

Caudal fin short, with shallow subterminal notch and pre-ventral margin length nearly $\frac{1}{2}$ of dorsal caudal margin length.

Color: Grayish black above, black below. All fins somewhat lighter than body.

Genus *Centrophorus* Müller and Henle, 1837

CENROPHORUS GRANULOSUS (BLOCH AND SCHNEIDER, 1801)

Specimen No. 33753

812 mm TL, male. Formerly identified as *Centrophorus granulosus*.

Head broad, depressed, and moderately long, its length about 20 % of TL. Outline of head in ventral view bell-shaped. Snout triangular, its tip narrowly rounded. Eyes lateral on head, eye openings very large, orbital rim doubly notched. Supraorbital ridges long, but not very high. Nictitating lower eyelids absent. Spiracles moderately large (about $\frac{1}{6}$ eye length), located dorsally, about $\frac{3}{10}$ eye length behind eyes, opposite dorsal margins of eyes.

Nostrils about 2.3 times closer to mouth than to snout tip, slightly in advance anterior corners of eyes. Nostrils relatively large, well separated, without nasoral grooves. Anterior nasal flap short, triangular. Gill openings shorter, their lengths about equal, first $\frac{1}{4}$ of eye length.

Mouth broadly arched, its length 7 times in width. Teeth large, bladelike, with a single pointed cusp and no serrations (Fig. 7). Teeth in a single jaw not differentiated, symphyseal teeth absent. Dignathic heterodonty strong, with lower teeth (bases 0.5 to 0.6 % of TL) larger than upper (bases not larger than 0.25 % of TL). Teeth in lower jaw oblique, their cusps directed towards mouth angles. 38 rows of teeth in upper, 29 rows in lower jaws. Deep labial furrows present, upper about twice lower in length. Noticeable hyomandibular pores between mouth and snout tip.

Body slender, elongate. Trunk cylindrical, vertically oval in section at first dorsal origin. Caudal peduncle short, its height about twice its width at upper caudal origin. Lateral dermal keels and precaudal pits absent. A short, low interdorsal ridge behind first dorsal fin. Both dorsal fins have strong spines in front of them. Heights of both spines about equal, first stronger than second. Second dorsal spine with a pair of deep lateral grooves, those on first dorsal spine definitely shallower.

Dermal denticles closely imbricated, pavement-like, and relatively large — crown width of lateral trunk denticles about 0.1 % of TL (Plate 8A). Crowns flattened, leaf-shaped, with 6 ridges and no cusps. Irregular areas with enlarged denticles present on several places of body.

Pectoral fins relatively large, much larger than dorsal fins. Apices of pectoral fins narrowly rounded, free rear tips produced, reaching to below first dorsal midbase when fins are appressed to body. Origins of pectoral fins just behind fifth gill openings.

Pelvic fins with broadly rounded apices, relatively small, their anterior margins slightly more than half as long as pectoral anterior margins. Pelvic fin bases in front of second dorsal base. Claspers slender, intermediately developed, rear tips of claspers reaching beyond level of second dorsal midbase. Small clasper hooks present.

First dorsal fin small, low, its free rear tip little extended. Apex broadly rounded. First dorsal origin about over pectoral apices when pectoral inner margin is held parallel to body axis, and posterior to pectoral insertions by a distance greater than length of 1st gill opening. First dorsal free rear tip much anterior to pelvic origins.

Second dorsal fin with narrowly rounded apex, free rear tip little extended. Second dorsal anterior margin $\frac{3}{4}$ length of first dorsal anterior margin. Second dorsal origin posterior to pelvic insertions by about $\frac{2}{5}$ of second dorsal base length, its free rear tip over lower caudal origin. No anal fin.

Caudal fin heterocercal, lower caudal origin anterior to upper origin by about 1st gill opening length. Preventral margin nearly 0.6 times dorsal margin. Terminal margin long, its length about 0.4 times dorsal margin length.

Color: Brown above, paler below. Dorsal fins darker than body.

Specimen No. 33754

719 mm TL, male. Capture data unavailable. Formerly identified as *Centrophorus granulosus* Less.

Differences from No. 33753 specimen:

Length of spiracles $\frac{1}{4}$ eye length, length of 1st gill opening $\frac{2}{5}$ eye length. Mouth length 6 times in width. Upper anterior teeth bases reaching 0.2 to 0.3 % of TL; 40 rows of teeth in upper jaw, 28 rows in lower jaw. Interdorsal ridge absent. Dermal denticles smaller, crown width of lateral trunk denticles 0.08 % of TL, denticles 4- to 5-ridged. Some denticles are white. Claspers juvenile, not reaching pelvic free rear tips. Terminal margin of caudal fin 0.3 times dorsal margin. Upper surfaces of body cinnamon brown, darker than those of 33753 specimen, sparsely sprinkled with little white dots.

Genus *Squalus* Linnaeus, 1758

SQUALUS ACANTHIAS LINNAEUS, 1758

Specimen No. 33755

370 mm TL, female. Locality: Black Sea. Captured in 1959. Preserved in a formalin solution.

Head long and pointed, slightly flattened dorsoventrally. Snout long, acute. Eyes lateral on head, in dorsal as well as in ventral view touching head rim. Eye openings about twice as long as high, without nictitating eyelids. Irises of eyes dark, posterior

orbital rim notched at midlevel. Spiracles large, length about $\frac{1}{3}$ eye length, located $\frac{2}{7}$ eye length behind posterior eye notches, above dorsal margins of eyes. Nostrils large, closer to snout tip than to mouth, well separated, without any nasoral grooves. Anterior and posterior nasal flaps small, pointed. Five pairs of moderately long gill openings, 1st about 3 in eye length, the longest (5th) about 1.5 times length of first.

Mouth situated on ventral side of head, short, not very broad. Teeth present in a single series along jaw sides, similar in both jaws. All teeth low, compressed, smooth, unicuspid, with their cusps obliquely turned aside and inner cutting margin nearly parallel to jaw edge. Upper teeth slightly smaller than lower, largest bases of lower anteroposterior teeth 0.3 % of TL. Labial furrows present, upper longer than lower.

Body unflattened, trunk vertically oval in section at first dorsal base. Caudal peduncle moderately long, circular in cross section, with strong lateral dermal keels. Low interdorsal ridge and upper precaudal pit present. Spines in front of dorsal fins, doubly grooved laterally, second larger than first. Dermal denticles not developed, small, length of largest lateral trunk denticles about 0.05 % of TL.

Pectoral fins large, their free rear tips sharply rounded. Pectoral fin origins just behind fifth gill openings, distal tips of appressed pectorals anterior to their free rear tips by $\frac{3}{4}$ of pectoral bases length. Pelvic fins about as large as second dorsal fin in area, pelvic fin bases definitely closer to second dorsal fin than to first.

First dorsal fin with rounded apex, free rear tip little extended, insertion just below apex. Origin of first dorsal fin over pectoral free rear tips, its free rear tip anterior to pelvic origins by more than pelvic bases length. Second dorsal fin smaller than first, its anterior margin 0.81 times first dorsal anterior margin. Second dorsal free rear tip extended, insertion slightly anterior to level of dorsal apex. Origin of second dorsal over pelvic free rear tips. No anal fin.

Caudal fin large, heterocercal, subterminal notch absent. Length of preventral caudal margin $\frac{1}{2}$ of dorsal margin length.

Color: Gray above, light below. Many small white dots set along the back, some of them forming rows on flanks, near lateral line. A pair of white dots in front of and behind each dorsal fin. First dorsal fin and dorsal caudal lobe black-tipped, posterior margins of paired fins paler.

Specimen No. 33756

286 mm TL, male. Locality: Black Sea. Captured in 1959. Preserved in a formalin solution.

Differences from No. 33755 specimen:

Anterior margin of second dorsal fin 0.85 times first dorsal anterior margin.

Specimen No. 33757

217 mm TL, female — fetus. Locality: Mamaia, Constanta — Black Sea. Captured in 1959.

Head narrow and comparatively long, about 23 % of total length. Head in dorsal view narrowly, in lateral view sharply rounded, flattened ventrally. Snout long, acute. Eyes lateral on head, not visible in dorsal view. Eyes elongate, without nictitating eyelids. Posterior orbital rim notched. Spiracles large, located about $\frac{1}{3}$ eye length behind and above posterior eye notch. Nostrils moderately large, about 1.5 times farther from mouth than from snout tip, with anterior nasal flaps. Five pairs of short gill openings, their length about equal.

Mouth situated on ventral side of head, short, with upper and lower labial furrows. Teeth not developed.

Body slender, slightly compressed dorsoventrally. Trunk triangular in section at first dorsal origin. Caudal peduncle circular in cross section, without lateral keels. Low interdorsal ridge present. Shallow precaudal pit in front of upper caudal origin. Each dorsal fin with a spine, second spine longer than first. Yolk sac still present. Dermal denticles large (0.15 % of TL), oval, poorly developed.

Pectoral fins large, with narrowly rounded apices, free rear tips right-angled. Origins of pectoral fins just behind 5th gill openings. Pelvic fins as large as first dorsal fin, their bases between first and second dorsal fin bases, somewhat closer to the second.

First dorsal fin small, broadly rounded. Its origin opposite to pectoral fin apices, its midbase closer to pelvic origins than to pectoral insertions. Second dorsal fin lower than first, anterior margin of 2nd dorsal fin about as long as first dorsal anterior margin. Second dorsal origin about over pelvic inner margins. No anal fin.

Caudal fin heterocercal, with no subterminal notch and preventral caudal margin nearly $\frac{1}{2}$ of dorsal margin length.

Color: Slate gray above, lighter below. Small white spots on the back. Ventral surfaces of paired fins pale, those of pectoral fins with anterior margins gray. Tips of dorsal fins and posterior margin of caudal fin blackish.

SQUALUS MEGALOPS (MACLEAY, 1881), No. 33758

437 mm TL, male. Capture data unavailable. Preserved in a formalin solution.

Head moderately broad, flattened dorsoventrally, its length about 19% of total length. Outline of head in dorsal view parabolic in shape. Snout short, rounded in dorsal view, acute in lateral view. Eyes situated dorso-laterally on head, not visible in ventral view of head, in dorsal view touching head rim. Eye openings oval, nearly twice as long as high, without nictitating eyelids or subocular pouches. Irises of eyes black. Posterior rim of orbit with a prominent notch at midlevel (Plate 4B). Relatively large spiracles present, located about $\frac{1}{4}$ eye length behind eyes, about opposite dorsal margins of eyes, nearly touching posterior eye notch.

Nostrils about twice as far from mouth as from snout tip, relatively large, without nasoral grooves, and with moderately large, double-winged nasal flaps. Five pairs of laterally situated gill openings. External gill slits relatively short, lengths nearly equal, the longest (5th) about 1.2 times length of first.

Mouth situated on ventral side of head, short, moderately broad. Teeth small, similar in upper and lower jaws, in three functional series in upper jaw and two series in lower jaw. Anterior teeth with an oblique primary cusp and no cusplets, nonserrated. Upper labial furrows well developed.

Trunk vertically oval in section at first dorsal origin, circular at second dorsal origin. Low interdorsal ridge present. Caudal peduncle flattened dorsoventrally, with a pair of lateral keels. Both precaudal pits present, lower shallower than upper. Spine in front of 1st dorsal fin smaller than spine in front of 2nd dorsal fin. Spines triangular in cross section, with no lateral grooves.

Dermal denticles leaf-shaped, very small, length of largest 0.04% of TL. Denticles on body with a median keel and posterior cusp, and a pair of winglike lateral expansions.

Pectoral fins relatively large, their origins behind fifth gill openings. Free rear tips not rounded, but forming an angle. Distal tips of appressed pectoral fins reaching below level of first dorsal origin, free rear tips reaching below midpoint of first dorsal base. Pelvic fins about equal to second dorsal fin in area. Pelvic bases lying between first dorsal and second dorsal fin bases. Completely formed claspers, their rear tips reaching slightly behind second dorsal origin.

First dorsal fin base much closer to pectoral fin than to pelvic fin bases, origin of 1st dorsal fin posterior to pectoral fin insertions by 5th gill opening length. Second dorsal fin lower than first, its anterior margin nearly as long as first dorsal anterior margin. Second dorsal origin posterior to pelvic insertions by about second dorsal base length. No anal fin.

Caudal fin heterocercal, moderately long. Preventral caudal margin about $\frac{1}{2}$ of dorsal margin length. Dorsal caudal lobe with narrowly rounded tip and no subterminal notch.

Color: Gray brown above, white below. No spots on body. Fins dark, posterior margins of all fins lighter. Pectoral fins dark below, dorsal fins and dorsal caudal lobe black-tipped. A thin brown transverse stripe present approximately at one half of each dorsal spine.

Genus *Oxynotus* Rafinesque, 1810

OXYNOTUS CENTRINA (LINNAEUS, 1758), No. 33759

435 mm TL, female. Capture data unavailable. Formerly identified as *Centrina salviani*.

Head small, depressed, its length from snout tip to 1st gill openings about 16 % of TL. Snout short, bluntly tipped in lateral view. Eyes lateral on head, elongate, with no nictitating eyelids. Low supraorbital ridges present. Spiracles large (about $\frac{2}{5}$ eye length), located about their own length behind eyes and slightly above posterior eye notches. Nostrils very large, about as far from mouth as from snout tip, well separated, but close together. Anterior and posterior nasal flaps well developed, forming triangular lobes. Gill openings narrow, lengths of all five pairs nearly equal. Last two gill openings closer together than others, all lying at level and in front of pectoral origin.

Mouth subterminal, transverse and very small — its width 4.4 % of TL. Teeth unicuspid, different in both jaws, showing strong gradient dignathic heterodonty. Teeth in upper jaw small, slender, in four irregular functional series. Teeth in lower jaw much larger, reaching 1 % of TL, triangular, formed into a single compact series. Lips and deep labial furrows present on both jaws.

Body stout, trunk very high, slightly compressed laterally, subtriangular in cross section. Caudal peduncle short, having more slender appearance than trunk, with no lateral keels or precaudal pits. Prominent ridge along back. Two dorsal spines originating approximately in the middle of each dorsal base, first spine directed forward.

Dermal denticles large (0.2 to 0.3 % of TL), making skin rough. Crowns with a single pointed medial cusp and longitudinal ridge, two lateral ridges and three smaller cusps.

Pectoral fins slender, moderately large, their apices sharply pointed. Pectoral fin origins just behind fifth gill openings. Pelvic fins rounded, their anterior margins more than $\frac{1}{2}$ length of pectoral anterior margins. Pelvic bases and second dorsal base about opposite.

First dorsal fin large, its base very long. Apex and free rear tip sharply pointed, posterior margin concave. Origin of first dorsal fin far forward, anterior to 1st gill openings by 1st gill opening length. Midpoint of first dorsal base about over pectoral insertions. Second dorsal fin similar to first in shape. Its anterior margin nearly 0.6 times first dorsal anterior margin length, its height $\frac{3}{4}$ of first dorsal height. Origin of second dorsal fin anterior to pelvic origins by only $\frac{1}{5}$ of 2nd dorsal base length. No anal fin.

Caudal fin heterocercal; ventral lobe large, its tip broadly rounded. Subterminal notch weak. Terminal margin short, preterminal margin almost $\frac{1}{3}$ of dorsal margin length.

Color: Rusty brown above, brown below. Fins have the color of body.

Genus *Dalatias* Rafinesque, 1810

DALATIAS LICHA (BONNATERRE, 1788), No. 33760

163 mm TL, male — fetus. Captured in 1889.

Head comparatively long (24 % of TL), subconical, narrowly rounded in dorsal view, sharply pointed in lateral view. Snout moderately long, flattened. Eyes lateral on head, eye openings about circular, not very large. Eye irises gray. No nictitating eyelids, notches or subocular ridges. Spiracles small, situated dorsally, far behind and above eyes. Nostrils much closer to snout tip than to eyes and mouth, with anterior and posterior nasal flaps, but no nasoral grooves.

Gill openings short, situated laterally. First gill openings smallest, their length about 0.6 times 5th gill openings length. Mouth subterminal, teeth not developed. Both labial furrows present, upper furrow forming noticeable fold. Hoymandibular pores present.

Trunk triangular in section at first dorsal origin, comparatively high. Predorsal ridge high, strong. Caudal peduncle short, vertically oval in cross section. No lateral keels or precaudal pits. Dorsal fins spineless. Yolk sac still present.

Dermal denticles poorly developed, present in front of first dorsal fin and on caudal peduncle only. Denticles from back with square or circular crowns and no cusps, their length about 0.2 % of TL. Caudal peduncle denticles longer (0.3 % of TL), with a single medial cusp and broad ridge. Lateral cusps small, rounded.

Pectoral fins small, tips rounded. Pectoral fin origins just behind 5th gill openings. Pelvic fins larger than second dorsal fin, their bases lying in front of second dorsal base. Claspers juvenile, very short.

First dorsal fin small, its apex broadly rounded. First dorsal origin posterior to appressed pectoral apices by only 1st gill opening length. Second dorsal fin similar in

shape to first one, its anterior margin 0.6 times first dorsal anterior margin length. Origin of second dorsal fin about over last fourth of pelvic bases. No anal fin.

Caudal fin comparatively large, subterminal notch shallow, preventral caudal margin nearly $\frac{3}{4}$ of dorsal margin length.

Color: Uniform pale brown, dorsal fins and caudal fin darker than body.

Superorder Galeomorphii
Order Heterodontiformes
Family Heterodontidae Gray, 1851
Genus *Heterodontus* Blainville, 1816

HETERODONTUS JAPONICUS (MACLAY AND MACLEAY, 1884)

Specimen No. 33761

650 mm TL, male. Locality: Sagami Bay (Japan) — North Pacific Ocean. Captured in May 1909. Formerly identified as *Heterodontus japonicus*.

Head large, broad, its length more than 20 % of total length. Snout very short, bluntly tipped. Eyes dorso-lateral, relatively small. Eye apertures oval, about twice as long as high, with no nictitating eyelids. Prominent supraorbital ridges present, running from snout tip to behind eyes, joining head silhouette about one eye length behind eyes (in front of 1st gill openings). Spiracles small, their length $\frac{1}{6}$ eye length, $\frac{1}{2}$ eye length from eyes — below ventral margins of eyes and behind level of posterior eye margins. Nostrils moderately large, not far from mouth. Deep nasal grooves between nostrils and mouth forming a large flap. Anterior nasal grooves almost reaching snout tip. Gill openings relatively long, gradually smaller from 1st to 5th, first gill opening length about twice eye length, fifth less than $\frac{1}{2}$ of first. Upper and lower edges of all gill slits slightly rounded rearward.

Mouth terminal, short. Anterior teeth moderately large, bladelike multicuspidate. Posterior teeth of crushing molariform type. Lower anterior teeth erect, serrated basally, largest bases about 0.4 % of TL. Crowns about as broad as high, with a strong primary cusp, and a pair of smaller, variably developed lateral cusps. Dignathic heterodonty weak — upper anterior teeth somewhat larger than lower, all teeth similar in shape. Prominent upper and lower labial furrows present.

Body stout, massive. Trunk compressed ventrally, tapering rearward from head, trihedral in section at first dorsal origin, vertically oval or nearly circular in section at second dorsal origin. Caudal peduncle shorter, circular in cross section. No interdorsal ridge, lateral keels or precaudal pits. A pair of strong, smooth spines in front of dorsal fins, their lengths about equal. Length of first dorsal spine $\frac{1}{3}$ of first dorsal anterior margin length, second dorsal spine $\frac{2}{5}$ of 2nd dorsal anterior margin length.

Dermal denticles of heterodontoid type, flattened, crowns having stronger medial cusp and longitudinal ridge, and a pair of lateral cusps. Lateral cusps originating in midpoint of medial ridge, giving denticles their cruciform shape when viewed from above. Width of lateral trunk denticles about 0.1 % of TL. Denticles from ventral sides of pectoral and pelvic fins flattened, with circular crowns.

Pectoral fins large, their anterior margins longer than head. Apices of pectoral fins narrowly rounded, free rear tips broadly rounded. Pectoral fin origins just behind and below first gill openings. Pectoral fin apices reach behind insertion of first dorsal fin, and pectoral free rear tips are anterior to pelvic origins by only $\frac{1}{2}$ of pectoral fin base length when pectoral inner margins are held parallel to body axis. Noticeable pores present on ventral sides of pectoral fins, near their anterior margins. Pelvic fins moderately large, pelvic bases closer to second dorsal than to first dorsal fin bases. Claspers completely formed, clasper hooks present. Rear tips of claspers reaching to below free rear tip of second dorsal fin.

First dorsal fin large, its apex narrowly rounded, free rear tip pointed, slightly anterior to level of first dorsal apex. Origin of first dorsal fin anterior to pectoral insertions by only $\frac{1}{7}$ of 1st dorsal base length. Second dorsal fin similar in shape to first, its anterior margin $\frac{3}{4}$ of first dorsal anterior margin length. Origin of second dorsal fin about over pelvic fin insertions, 2nd dorsal free rear tip over second half of anal base.

Anal fin comparatively large and high, almost as large as second dorsal fin in area. Anal origin slightly posterior to second dorsal fin insertion.

Caudal fin moderately large, heterocercal. Subterminal notch deep, terminal margin long, about $\frac{1}{2}$ of dorsal caudal margin length. Preventral margin length 0.68 times dorsal margin length.

Color: Brown to russet brown above, with several transverse, dark brown bands on head, back and tail. Yellowish below. Fins darker than body.

Specimen No. 33762

670 mm TL, male. Locality: Sagami Bay (Japan) — North Pacific Ocean. Captured in May 1909. Formerly identified as *Cestracion (Heterodontus) japonicus*.

Differences from No. 33761 specimen:

Some teeth are higher than broad, lateral cusps always well developed. Lower anterior teeth bases 0.35 % of TL. Predorsal spines longer, length of first spine more than $\frac{2}{5}$ of 1st dorsal anterior margin length, second spine $\frac{1}{2}$ of 2nd dorsal anterior margin length. Clasper hooks absent, clasper rear tips reaching behind 2nd dorsal insertion only. Second dorsal origin posterior to pelvic insertions by $\frac{1}{4}$ of 2nd dorsal base length, about over pelvic free rear tips. Preventral caudal margin 0.62 times dorsal margin.

HETERODONTUS ZEBRA (GRAY, 1831)

Specimen No. 33763

279 mm TL, male. Capture data unavailable. Formerly identified as *Cestracion philippi*.

Head broad, oblong, ventral surface slightly flattened. Snout short, blunt. Eyes dorso-lateral, not visible in ventral view of head, in dorsal view hidden under strong supraorbital ridges. Eye openings oval or nearly circular, their height about 1.5 times in length. No nictitating eyelids present. Irises of eyes black, pupils pale, elongated, running in direction from anterior ventral to posterior dorsal eye margins. Strong subocular ridges present. Supraorbital ridges high, joining head silhouette above 1st gill openings. Spiracles very small, porelike, $\frac{1}{3}$ eye length from eye, at level of posterior eye margin vertically, and below ventral eye margin horizontally (Plate 5A).

Nostrils small, closer to mouth than to snout tip. Prominent nasoral grooves, connecting nostrils with mouth and forming a large flap. Grooves extend to the exterior as far as to snout tip. Five pairs of large, laterally situated gill openings. External gill slits decreasing in size from 1st to 5th, first longer than eye, fifth about $\frac{1}{2}$ of first. Upper and lower edges of all gill slits (except 5th) rounded rearward.

Mouth terminal, very short and narrow. Monognathic heterodonty strong, anterior teeth bladeliike multicuspidate, posterior teeth of crushing molariform type. Lower anterior teeth large (largest bases width 0.7 % of TL), smooth, erect. Crowns with seven small pointed cusps, central cusp largest. Upper teeth similar in shape and size to lower teeth, their cusps not so sharply pointed, lateralmost pair of cusplets variably developed (Fig. 7). Deep upper and lower labial furrows present.

Body stout, robust, trihedral in section at first dorsal origin, vertically oval in section at second dorsal origin. Caudal peduncle moderately long, its width at upper caudal origin $\frac{3}{4}$ its height there. No interdorsal ridge, lateral keels or precaudal pits. Dorsal fins with strong, smooth spines; spines about equal, triangular in cross section, grooved posteriorly.

Dermal denticles on body with a single low cusp directed rearward, and 4 to 5 radial roots (cruciform or asteriform from above). Width of bases about 0.35 % of TL. Denticles from ventral sides of paired fins with flattened, oval or nearly circular crowns, their width 0.2 % of TL.

Pectoral fins large and long, much longer than head. Their apices narrowly rounded, free rear tips broadly rounded. Pectoral fin origins below first gill openings, distal tips of appressed pectoral fins posterior to pectoral free rear tips by about $\frac{2}{3}$ of pectoral base length, and reaching to below first dorsal insertion when pectoral inner margins are held parallel to body axis. Pelvic fins moderately large, pelvic bases

slightly closer to first dorsal than to second dorsal fin bases. Juvenile claspers, not reaching pelvic free rear tips.

First dorsal fin extremely high and long, but not very broad basally. Origin of first dorsal fin anterior to pectoral insertions by length of 5th gill opening. Second dorsal fin similar in shape to first, but smaller. Its anterior margin about 0.7 times first dorsal anterior margin length. Origin of second dorsal fin posterior by $\frac{3}{4}$ of 2nd dorsal base length to pelvic insertions, and about over pelvic free rear tips.

Anal fin small, low, its origin posterior to second dorsal insertion by $\frac{1}{3}$ of 2nd dorsal base length. Anal base less than twice its length from lower caudal origin.

Caudal fin moderately large, heterocercal. Prominent subterminal notch, terminal margin long. Ventral caudal lobe well developed, preventral caudal margin 0.62 times dorsal margin.

Color: Dark brown above, with several blackish-brown bands across body. Yellowish below. All fins, including ventral sides of paired fins, darker distally.

Specimen No. 33764

243 mm TL, male. Capture data unavailable. Formerly identified as *Cestracion philippi*.

Differences from No. 33763 specimen:

Crowns of lower anterior teeth having mostly 5 cusps. Preventral caudal margin 0.54 times dorsal margin.

Specimen No. 33765

232 mm TL, male. Capture data unavailable. Formerly identified as *Cestracion philippi*.

Differences from No. 33763 specimen:

Spiracles $\frac{2}{5}$ eye length from eyes. Some lower anterior teeth having only 5 or 6 cusps. Origin of first dorsal fin about over pectoral insertions. Origin of second dorsal fin posterior to pelvic insertions by 2nd dorsal base length. Preventral caudal margin 0.51 times dorsal margin. Generally lighter coloration — yellowish brown above with transverse brown bands.

Specimen No. 33766

226 mm TL, female. Capture data unavailable. Formerly identified as *Cestracion philippi*.

Differences from No. 33763 specimen:

Spiracles $\frac{1}{2}$ eye length from eyes. Crowns of all anterior teeth having 5 cusps. No claspers. Anal origin and second dorsal insertion opposite. Preventral caudal margin 0.51 times dorsal margin.

Specimen No. 33767

220 mm TL, female. Capture data unavailable. Formerly identified as *Cestracion philippi*.

Differences from No. 33763 specimen:

Crowns of all anterior teeth having 5 cusps. No claspers. Preventral caudal margin 0.55 times dorsal margin.

Specimen No. 33768

212 mm TL, male. Capture data unavailable. Formerly identified as *Cestracion philippi*.

Differences from No. 33763 specimen:

Spiracles $\frac{1}{4}$ eye length from eyes. Crowns of all anterior teeth having 5 cusps. Pre-ventral caudal margin 0.54 times dorsal margin.

Specimen No. 33769

208 mm TL, female. Capture data unavailable. Formerly identified as *Cestracion philippi*.

Differences from No. 33763 specimen:

Crowns of all anterior teeth having 5 cusps. No claspers. Preventral caudal margin 0.54 times dorsal margin.

DESCRIPTIVE NOTES

All seven specimens of *Heterodontus zebra* are kept in one bottle and were probably captured at the same time and place. The former bright coloration has disappeared due to alcohol preservation and only several indistinct dark bands on the back can be recognized now. All *Heterodontus zebra* specimens are immature, claspers of males reach only 2.4 to 3.3 percent of the total length; some of the young may be only several weeks old.

Extremely long dorsal fins are not uncommon among heterodontoid sharks and get smaller (relative to body length) with age. Length of first dorsal anterior margins of the examined material ranges between 22.1 and 27.4 percent of the total length, length of second dorsal anterior margins between 14.8 and 19.4 percent of the TL. Smaller specimens have longer dorsal fins than larger specimens relative to total length. The largest shark (No. 33763) has the relatively shortest dorsal fins, while the fins of the smallest (No. 33769) are very long — see Table 1.

In one specimen (No. 33763) anterior teeth with 7 cusps are well developed. Many smaller examined specimens have 5-cusped teeth only. See Fig. 7 E.

No essential signs of sexual dimorphism have been recorded. Average total length of four males is 241.5 mm, average length of three females is 218 mm. This fact may suggest that among males and females of approximately the same age males are longer. Average proportional lengths of anterior margins and bases of dorsal fins, and preventral and dorsal margins of caudal fins are greater in females. This difference may be also explained by a generally lesser size of females, but when the respective dimensions of a male and female of about the same size are compared (Nos. 33765 and 33766, 33768 and 33769), the values of the female are always higher.

Some characteristics of the male No. 33765 distinguish it from other specimens. Positions of both dorsal fins as well as lighter coloration suggest that No. 44765 may be placed into a different subspecies.

Order Orectolobiformes

Family Hemiscylliidae Gill, 1862

Genus *Chiloscyllium* Müller and Henle, 1837

CHILOSCYLLIUM PUNCTATUM MÜLLER AND HENLE, 1838, No. 33770
512 mm TL, female. Locality: Borneo. Formerly identified as *Chiloscyllium indicum* op. Gm. var. *obscura* Gnth.

Head short and broad, flattened ventrally. Its greatest width 12.6% of TL at level

of 1st gill openings. Snout moderately long, obtuse. Eyes high on sides of head, not visible in ventral view of head, in dorsal view far from head rim. Eyes small, oval, their apertures over twice as long as high. Eyes without any notches or nictitating eyelids. Spiracles large, having a slight ridge on their posterior edges. Their length $\frac{9}{10}$ eye length, located $\frac{2}{5}$ eye length below eyes, at level of posterior margins of eyes.

Nostrils moderately large, closer to mouth than to snout tip. Nasoral grooves deep, connecting nostrils with mouth. Anterior nasal flap formed into a pointed barbel (its length 2.4% of TL) which reaches mouth. Posterior nasal flap well developed. Five pairs of laterally situated gill openings. External gill slits short, increasing in size from 1st to 5th, first less than eye length, fifth 1.2 times eye length. Last two openings very close together, other much farther apart.

Mouth subterminal, transverse, small and short. Teeth similar in upper and lower jaws, small, present in several functional series. All teeth smooth, erect, their crowns triangular, possessing a strong primary cusp and a pair of poorly developed lateral cusps (Fig. 7). Length of largest upper anterior teeth bases almost 0.2% of TL. Upper and lower labial furrows present, with continuous, nearly straight fold across chin.

Body elongate, trunk compressed. Caudal peduncle long, its height at upper caudal origin 1.4 times its width there. Low interdorsal ridge running from behind eyes to above origin of anal fin. No lateral keels or precaudal pits. Dorsal fins spineless. Dermal denticles very small, flattened, closely imbricated, with a single cusp and short ridge. Length of largest lateral trunk denticles 0.1% of TL.

Pectoral fins with rounded apices, free rear tips broadly rounded. Origins of pectoral fins slightly behind and below 1st gill openings, distal tips of appressed pectorals about over their free rear tips. Pelvic fins moderately large, about equal to first dorsal fin in area. Apices broadly rounded, free rear tips narrowly rounded. Origins of pelvic fins 2.1 times closer to pectoral origins than to anal origin.

First dorsal fin small, low, its apex and free rear tip narrowly rounded. Origin of first dorsal fin above midpoints of pelvic fin bases. Midpoint of first dorsal base about over pelvic apices. Second dorsal fin similar in shape to first one, its anterior margin 0.87 times first dorsal anterior margin length. Origin of second dorsal fin posterior to 1st dorsal free rear tip by less than $\frac{1}{2}$ of 2nd dorsal base length.

Anal fin very low and long, close to caudal fin — insertion of anal fin and origin of ventral caudal lobe are identical. Origin of anal fin posterior to second dorsal free rear tip by only $\frac{1}{5}$ of 2nd dorsal base length, and anterior to upper caudal origin by $\frac{1}{2}$ of 2nd dorsal base length.

Caudal fin heterocercal, with ventral lobe very low, broadly rounded. Preventral margin less than $\frac{1}{4}$ of dorsal margin length.

Color: Light brown above, with ten darker transverse bands across head, body and tail. Yellowish below. Tips of dorsal fins and dorsal caudal lobe slightly darker than body.

CHILOSCYLLIUM PLAGIOSUM (BENNETT, 1830), No. 33771

452 mm TL, female. Locality: Borneo. Captured in 1897. Formerly identified as *Chiloscyllium indicum* L. Gmel. var. *plagiosa*.

Head short, slightly flattened ventrally. Its width at level of 1st gill openings 8.2% of TL. Snout short, obtuse, bluntly tipped. Eyes high on sides of head, not visible in ventral view of head. Eyes small, oval, height of eye apertures about 2.5 times in length. Eyes without anterior or posterior notches, nictitating lower eyelids absent. Low supraorbital ridges present. Spiracles large, with short ridges on their posterior edges. Spiracles located $\frac{1}{3}$ eye length below eyes, at level of posterior eye margins, their length $\frac{4}{5}$ eye length.

Nostrils large, far apart, closer to mouth than to snout tip. Deep nasoral grooves from nostrils to mouth. Anterior nasal flap a pointed barbel, extending posteriorly to mouth (its length 2.1% of TL). Posterior nasal flap broad, rounded. Gill openings short, increasing in size from 1st to 5th. Length of first $\frac{4}{5}$ eye length, fifth 1.3 times first. Last two gill openings close together.

Mouth subterminal, transverse. Teeth very small, present in several functional series. Teeth in both jaws similar, lower erect, upper slightly oblique. Crowns of all teeth smooth, having a strong pointed primary cusp and a pair of variably developed lateral

cusps. Upper and lower labial furrows present, lower furrow forming a fold across chin which is continuous and irregularly crooked.

Body elongate, slender, trunk compressed ventrally. Caudal peduncle long, its height at upper caudal origin 1.5 times its width there. Interdorsal ridge low, running from above 3rd gill openings to above anal origin. Lateral keels and precaudal pits absent from caudal peduncle. Dorsal fins spineless. Lateral trunk dermal denticles flattened, closely imbricated, with a single cusp and 3 or 5 longitudinal ridges. Length of largest crowns 0.12 % of TL (Plate 8B).

Apices of pectoral fins narrowly rounded, free rear tips broadly rounded. Origins of pectoral fins slightly posterior to 1st gill openings, distal tips of appressed pectoral fins over their free rear tips. Pelvic fins with broadly rounded apices, free rear tips of pelvic fins form a short, broadly rounded lobe. Origins of pelvic fins 2.5 times closer to pectoral origins than to anal origin.

First dorsal fin small, low, about as large as pelvic fins in area. Apex of first dorsal fin narrowly rounded, its free rear tip pointed, but not extended. Origin of first dorsal fin slightly posterior to midpoints of pelvic fin bases. Midpoint of first dorsal base about over pelvic apices. Second dorsal fin similar in shape to first, its anterior margin 0.86 times first dorsal anterior margin length. Origin of second dorsal fin posterior to 1st dorsal free rear tip by second dorsal base length.

Anal fin low and comparatively long, its insertion is identical with lower caudal origin. Origin of anal fin posterior to 2nd dorsal free rear tip by slightly more than $\frac{1}{2}$ of 2nd dorsal base length, and anterior to upper caudal origin by $\frac{2}{5}$ of 2nd dorsal base length.

Caudal fin heterocercal, its ventral lobe very low, broadly rounded. Length of pre-ventral margin $\frac{1}{5}$ of dorsal caudal margin length.

Color: Light brown above, with numerous small, dark brown spots on head and trunk. Ten broad, deep brown crossbars on back, each with several light brown spots. A dark brown spot lying between each two bars on the back. Paler below.

Order Carcharhiniformes
Family Scyliorhinidae Gill, 1862
Genus *Atelomycterus* Garman, 1913

ATELOMYCTERUS MARMORATUS (BENNETT, 1830)

Specimen No. 33772

425 mm TL, male. Locality: Celebes. Preserved in a formalin solution.

Head moderately narrow, flattened dorsoventrally, its length about 17 % of TL. Head outline parabolic in dorsal view. Snout short, narrowly rounded in lateral view. Eye openings dorso-lateral, not visible in ventral view, with strong subocular ridges separating eyes from head rim in dorsal view. Eye apertures elongate, their height about 4 times in length, orbital rims doubly notched. Nictitating lower eyelid of rudimentary type, subocular pouch shallow. Spiracles small, close behind eyes and about opposite ventral margins of eyes (Plate 5B). Nostrils smaller, far apart, about half way from snout tip to mouth. Anterior nasal flap a large rounded lobe reaching mouth, rudimentary groove to mouth present. Five pairs of laterally situated gill openings. All shorter than eye, the longest (2nd and 3rd) about 1.1 times length of first, the shortest (5th) $\frac{2}{3}$ length of 1st.

Mouth moderately small, situated on the underside of head. Teeth small, in several functional series, teeth in upper jaw obliquely directed rearward. Teeth in upper and lower jaws are generally similar, with a strong pointed primary cusp and a pair of lateral cusplets. Strong serrations present on crowns. Anterior and symphyseal teeth smaller than laterals, upper teeth slightly smaller than lower. Long and deep labial furrows present, upper furrow shorter than lower, extending anteriorly beyond level of anterior eye notch. Noticeable hyomandibular pores.

Slender body, trunk compressed ventrally, vertically oval in cross section. No interdorsal ridge. Caudal peduncle slender, comparatively long, with no lateral keels or precaudal pits. Dorsal fins spineless. Dermal denticles large, their length about 0.1 % of TL. Denticles on back imbricate, pointed rearward, crowns with strong medial cusp

and high longitudinal ridge, lateral cusps short rounded lobes. Denticles on fins smaller, those on ventral sides of pectoral fins nearly circular, less pointed.

Pectoral fins relatively small, apices narrowly, free rear tips broadly rounded. Origins of pectoral fins slightly in advance of 4th gill openings. Tips of appressed pectoral fins about over their free rear tips. Pelvic fins smaller than dorsal fins, much closer to first dorsal than to pectoral fin bases. Juvenile claspers, not reaching pelvic free rear tips.

First dorsal fin with narrowly rounded apex, its insertion much anterior to level of dorsal apex. Free rear tip little extended. Origin of first dorsal fin over last third of pelvic fin bases, its apex far behind pelvics. Second dorsal fin similar to first in shape, almost as large, but definitely lower. Lengths of anterior margins and bases of dorsal fins about equal. Origin of second dorsal fin over first third of anal fin base, its insertion slightly posterior to anal free rear tip, apex almost reaching level of upper caudal origin. Anal fin low, much smaller than second dorsal fin.

Caudal fin short, ventral caudal lobe without projected tip. Subterminal notch present, preventral margin about $\frac{1}{3}$ of dorsal margin length.

Color: Dorsal surfaces of body with brown-white coloration. Several rows of white and brown spots running along body form irregular pattern. Noticeable white stripe running from below eye to above pectoral insertion on each side. White below. Paired fins with posterior margins pale, each of pectoral and pelvic fins having irregular dark spot. Tips of dorsal fins whitish, anal fin with dark longitudinal stripe.

Specimen No. 33773

522 mm TL, female. Locality: Borneo. Formerly identified as *Scyllium marmoratum* Benn.

Differences from No. 33772 specimen:

1st, 2nd and 3rd gill openings are longest. No claspers. Origin of first dorsal fin over midpoint of pelvic fin bases. First and second dorsal fins about equal in area. Pre-ventral margin of caudal fin $\frac{2}{5}$ of dorsal caudal margin. Color: Yellowish below.

Specimen No. 33774

486 mm TL, male. Locality: Borneo. Formerly identified as *Scyllium marmoratum* Benn.

Differences from No. 33772 specimen:

1st, 2nd and 3rd gill openings are longest. Claspers well developed, slender and long, with no clasper hooks. First and second dorsal fins about equal in area. Pre-ventral caudal margin $\frac{2}{5}$ of dorsal margin. Color: Yellowish below, with a distinct brown spot on the underside of snout.

DESCRIPTIVE NOTES

Clasper lengths of two examined males of *Atelomycterus marmoratus* (Nos. 33772 and 33774) suggest that males of this species mature at about 450 mm of total length.

Genus *Galeus* Rafinesque, 1810

GALEUS MELASTOMUS RAFINESQUE, 1810

Specimen No. 33775

318 mm TL, male. Locality: Napoli, Mediterranean Sea. Captured in 1901. Formerly identified as *Pristiurus melanostomus*.

Head about 20 % of TL, narrowly rounded, nearly pointed in dorsal view, flattened dorsoventrally. Snout elongate, depressed. Eyes lateral on head, visible in dorsal as well as in ventral view of head. Eye openings elongate, large, irises of eyes black. Nictitating lower eyelids of rudimentary type, subocular pouches deep. Spiracles small,

about $\frac{1}{5}$ eye length behind eyes and at their midlevel. Nostrils large, their anterior margins as far from mouth as from snout tip. Anterior nasal flaps large, without cirri, posterior flaps smaller. Nostrils well separated, with no grooves to mouth. Gill openings situated latero-ventrally, length of 1st about $\frac{1}{3}$ eye length. Gill openings graduated smaller from 1st to 5th. length of 5th 0.6 times length of 1st.

Mouth lying on ventral side of head, approximately below eyes. Mouth opening large, narrowly rounded, about twice as wide as long. Teeth in several functional series, similar in both jaws. Base length of largest anteroposteriors about 0.2 % of TL. Teeth serrated on crowns and roots, with an oblique primary cusp and two pairs of lateral cusplets; the lateralmost pair variably developed. Upper and lower labial furrows short, but well defined. Large, noticeable hyomandibular pores present.

Body slender, not compressed, vertically oval in section at first dorsal origin. Caudal peduncle short, stout, its height at upper caudal origin 1.9 times its width there. No interdorsal ridge, lateral keels or precaudal pits.

Dermal denticles moderately large, length of largest lateral trunk denticles 0.1 % of TL. Crowns closely imbricated and greatly flattened, with a central cusp and longitudinal ridge, and a pair of smaller lateral cusplets. Lateral cusps almost as long as central cusp, possessing short keels. Low walls of dentine forming mosaiclike hexagonal pattern on surface of lateral trunk denticles — see Plate 9 [denticles of 33776 spec.]. Upper caudal edge with scaly armature — two series of small flat spines with denticles like those on body between them.

Pectoral fins large, much larger than dorsal fins. Pectoral fin origins below fourth gill openings. Distal tips of appressed pectorals anterior to their free rear tips by $\frac{1}{2}$ of pectoral base length. Pelvic fins moderately large, with broadly rounded apices and extended free rear tips. Juvenile claspers, not reaching pelvic free rear tips.

First dorsal fin small and low, its origin over $\frac{2}{3}$ of pelvic fin bases, its free rear tip opposite to anal origin. Second dorsal fin similar in shape and size to first, its origin about over $\frac{4}{7}$ of anal fin base. Second dorsal insertion about over anal insertion. Anal fin very large, apex below $\frac{2}{5}$ of base.

Caudal fin moderately long, heterocercal, subterminal notch present. Preventral caudal margin about $\frac{2}{5}$ of dorsal margin length.

Color: Light brown to yellowish brown above, pale below. Rows of elongated brown specks along the back. These specks of various size are edged to white on flanks.

Specimen No. 33776

467 mm TL, male. Locality: Nice, Mediterranean Sea. Captured in 1898. Formerly identified as *Pristiurus melanostomus*.

Differences from No. 33775 specimen:

Eyes not visible in ventral view of head. 1st gill opening length about $\frac{1}{2}$ eye length. Caudal peduncle height at upper caudal origin 2.3 times its width there. Claspers slender, completely formed, rear tips sharply pointed, reaching anal fin base; clasper hooks present. Color: Elongated specks on back are not in great contrast with brown color underneath.

Specimen No. 33777

327 mm TL, male. Capture data unavailable. Formerly identified as *Pristiurus melanostomus*.

Differences from No. 33775 specimen:

Caudal peduncle height at upper caudal origin 1.7 times its width there. Origin of second dorsal fin over $\frac{2}{3}$ of anal fin base. Apex of anal fin below $\frac{1}{2}$ of anal base.

Genus *Scyliorhinus* Blainville, 1816

SCYLIORHINUS CANICULA (LINNAEUS, 1758)

Specimen No. 33778

391 mm TL, female. Capture data unavailable. Formerly identified as *Scyllium canicula* Cuv.

Head broad, flattened ventrally, its length about 15 % of TL. Snout short, depressed, broadly rounded in dorsal view, narrowly rounded in lateral view. Eyes high on sides of head, visible in dorsal view only. Eye openings about twice as long as high. Doubly notched orbital rim, anterior notch more distinct than posterior. Nictitating lower eyelid of rudimentary type, subocular pouch well defined, but shallow. Strong subocular ridges present. Spiracles slitlike, their length about $\frac{1}{3}$ eye length, located only $\frac{1}{4}$ eye length behind eyes, opposite ventral margins of eyes. Nostrils relatively large, closer to mouth than to snout tip, not connected with mouth by nasoral grooves. Anterior nasal flaps well developed, reaching mouth in large lobes. Both lobes separated in front of upper jaw symphysis. Gill openings short, 1st gill opening length nearly $\frac{2}{3}$ eye length. The shortest (5th) about $\frac{1}{2}$ length of longest (1st). Last two gill openings lying above pectoral fin bases.

Mouth subterminal, moderately small, broadly arched, length about twice in width. Teeth similar in both jaws, bladelike, serrated, present in several functional series. All teeth having a central pointed cusp and two smaller cusps on each side. Median cusps of upper teeth slightly oblique and stronger serrated. Teeth small, as high as broad, largest bases of lower anterior teeth about 0.25 % of TL, teeth from upper jaw are even smaller. Teeth growing smaller towards mouth corners, teeth in 1st series smaller than teeth in other series. Only lower labial furrows present, extending half-way to lower jaw tip.

Slender body, trunk compressed ventrally, vertically oval in section at first dorsal base. Caudal peduncle slender, with no lateral keels or precaudal pits, its height at upper caudal origin about 1.4 times its width there. No interdorsal ridge on back, dorsal fins spineless. Dermal denticles large (0.1—0.25 % of TL), closely imbricated. Crowns with a strong medial ridge and pointed posterior cusp, lateral cusps and ridges variably developed.

Pectoral fins much larger than dorsal fins in area, with narrowly rounded apices. Distal tips of appressed pectoral fins over their free rear tips and posterior margins perpendicular to body axis when pectoral inner margins are held parallel to body axis. Pectoral fin origins below 3rd gill openings. Pelvic fins with broadly rounded apices, smaller than pectoral fins — their anterior margins 0.4 times length of pectoral anterior margins. Pelvic fin bases closely anterior to first dorsal fin base.

Dorsal fins small, set far back, with narrowly rounded apices. Their insertions much anterior to levels of dorsal apices. Origin of first dorsal fin posterior to pelvic insertions by only $\frac{1}{7}$ of first dorsal base length and by same distance anterior to pelvic free rear tips. First dorsal free rear tip about over anal origin. Second dorsal fin nearly as large as first, its anterior margin 0.85 times 1st dorsal anterior margin length. Origin of second dorsal fin about over last tenth of anal fin base, second dorsal free rear tip almost reaching lower caudal origin. Anal fin low, its height about 3 times in base length.

Caudal fin relatively short, heterocercal, with subterminal notch. Lower caudal origin slightly anterior to upper origin, preventral caudal margin over $\frac{1}{2}$ of dorsal margin length.

Color: Above and on flanks brown, with numerous paler and darker spots of various sizes (approximately as large as spiracles). Yellowish below. Upper surfaces of pectoral and pelvic fins, dorsal fins and caudal fin have color of the back. No distinct markings on fins.

Specimen No. 33779

412 mm TL, female. Capture data unavailable. Formerly identified as *Scyllium canicula*.

Differences from No. 33778 specimen:

Length of spiracles $\frac{1}{4}$ eye length, spiracles located $\frac{1}{3}$ eye length behind eyes. Length of 1st gill openings $\frac{3}{4}$ eye length. Mouth length nearly 2.5 times in width. Largest bases of lower anterior teeth 0.3 % of TL. About 4 rows of symphyseal teeth present in lower jaw; symphyseal teeth similar to anterior teeth in shape, but about half as large. Anterior margins of pelvic fins 0.45 times length of pectoral anterior margins. Origin of first dorsal fin about opposite to pelvic fin insertions, first dorsal midbase opposite to pelvic free rear tips. First dorsal insertion about over anal origin. Second

dorsal anterior margin 0.95 times first dorsal anterior margin length. Second dorsal origin anterior to anal insertion by $\frac{1}{7}$ of anal base length. Preventral caudal margin less than $\frac{1}{2}$ of dorsal margin length. Color: Dark brown above with many paler spots usually larger than spiracles.

Specimen No. 33780

386 mm TL, male. Capture data unavailable. Formerly identified as *Scyllium canicula*.

Differences from No. 33778 specimen:

Length of spiracles $\frac{1}{4}$ eye length, spiracles located $\frac{1}{3}$ eye length behind eyes. Mouth length about 1.7 times in width. Bases of largest lower anterior teeth reaching more than 0.3 % of TL. Lower symphyseal teeth present in about 3 rows, about half as large as lower anterior teeth; no upper symphyseal teeth present. Some lower anterior teeth much higher than broad. Dermal denticles on tips of claspers flattened, longer and broader than others, single-cusped; their cusps sharp, directed anteriorly. Pelvic fin anterior margins 0.5 times length of pectoral anterior margins. Claspers juvenile, almost reaching pelvic free rear tips. Pelvic inner margins joined together. Origin of 1st dorsal fin about opposite to pelvic insertions, first dorsal midbase opposite to pelvic free rear tips. First dorsal insertion anterior to anal origin by $\frac{1}{5}$ of 1st dorsal base length.

Specimen No. 33781

381 mm TL, female. Capture data unavailable. Formerly identified as *Scyllium canicula*.

Differences from No. 33778 specimen:

Spiracles located $\frac{1}{3}$ eye length behind eyes. Mouth length 2.3 times in width. Pelvic fin anterior margins 0.5 times length of pectoral anterior margins. Dorsal fins relatively high, their insertions closely anterior to levels of dorsal apices. Origin of 1st dorsal fin about over pelvic insertions and anterior to pelvic free rear tips by $\frac{1}{4}$ of 1st dorsal base length. First dorsal insertion anterior to anal origin by $\frac{1}{5}$ of 1st dorsal base length. Second dorsal anterior margin 0.9 times first dorsal anterior margin length.

Specimen No. 33782

375 mm TL, male. Capture data unavailable. Formerly identified as *Scyllium canicula*.

Differences from No. 33778 specimen:

Eye openings 4 times as long as high. Length of spiracle $\frac{1}{4}$ eye length, spiracles located $\frac{1}{3}$ eye length behind eyes. Length of 1st gill opening more than $\frac{1}{2}$ eye length. Anterior margins of pelvic fins 0.5 times length of pectoral anterior margins. Claspers juvenile, not reaching pelvic free rear tips. Pelvic inner margins joined together. First dorsal origin over pelvic insertions, first dorsal midbase over pelvic free rear tips, and midpoint of 1st dorsal inner margin over anal origin. Second dorsal anterior margin 0.9 times first dorsal anterior margin length. Second dorsal origin over last sixth of anal base. Anal fin height 5 times in base length.

Specimen No. 33783

370 mm TL, female. Capture data unavailable. Formerly identified as *Scyllium canicula*.

Differences from No. 33778 specimen:

Eye openings 5 times as long as high. Length of spiracle $\frac{1}{4}$ eye length, spiracles located $\frac{1}{2}$ eye length behind eyes. Length of 1st gill opening more than $\frac{4}{5}$ eye length. Anterior margins of pelvic fins 0.55 times length of pectoral anterior margins. First dorsal origin posterior to pelvic insertions by only $\frac{1}{5}$ of 1st dorsal base length, and anterior to pelvic free rear tips by $\frac{2}{5}$ of 1st dorsal base length. Second dorsal anterior

margin 0.9 times first dorsal anterior margin length. Anal fin height 4 times in base length. Preventral caudal margin less than $\frac{1}{2}$ of dorsal margin length.

Specimen No. 33784

366 mm TL, female. Capture data unavailable. Formerly identified as *Scyllium canicula*.

Differences from No. 33778 specimen:

Eye openings 5 times as long as high. Length of spiracles $\frac{1}{4}$ eye length, spiracles located $\frac{1}{3}$ eye length behind eyes. Length of 1st gill opening $\frac{3}{4}$ eye length. Anterior margins of pelvic fins 0.55 times length of pectoral anterior margins. Origin of first dorsal fin over pelvic insertions, first dorsal insertion over anal origin, first dorsal free rear tip over first fifth of anal base. Second dorsal anterior margin 0.8 times 1st dorsal anterior margin length. Anal fin height 4 times in base length. Color: Dark brown and pale spots usually larger than spiracles.

Specimen No. 33785

363 mm TL, male. Capture data unavailable. Formerly identified as *Scyllium canicula*.

Differences from No. 33778 specimen:

Eye openings 5 times as long as high. Spiracles located $\frac{1}{3}$ eye length behind eyes. Length of 1st gill opening $\frac{4}{5}$ eye length. Anterior margins of pelvic fins 0.55 times length of pectoral anterior margins. Claspers covered with denticles, almost reaching pelvic free rear tips. Pelvic inner margins jointed together. Origin of first dorsal fin over pelvic insertions, first dorsal insertion over pelvic free rear tips, and its free rear tip posterior to anal origin by $\frac{1}{5}$ of 1st dorsal base length. Second dorsal anterior margin 0.8 times 1st dorsal anterior margin length. Second dorsal origin over anal insertion, 2nd dorsal free rear tip over lower caudal origin. Anal fin height 5 times in base length.

Specimen No. 33786

355 mm TL, female. Capture data unavailable. Formerly identified as *Scyllium canicula*.

Differences from No. 33778 specimen:

Eye openings about 5 times as long as high. Length of spiracle $\frac{1}{4}$ eye length, spiracles located $\frac{1}{2}$ eye length behind eyes. 1st gill opening nearly equals eye in length. Anterior margins of pelvic fins 0.55 times length of pectoral anterior margins. First dorsal origin anterior to pelvic free rear tips by $\frac{1}{8}$ of 1st dorsal base length. Anal fin height 4 times in base length. Preventral caudal margin less than $\frac{1}{2}$ of dorsal margin length. Color: A large brown spot behind left base of pectoral fin, its diameter about equals eye length.

Specimen No. 33787

354 mm TL, female. Capture data unavailable. Formerly identified as *Scyllium canicula*.

Differences from No. 33778 specimen:

Eye openings 4 times as long as high. Length of spiracle $\frac{1}{4}$ eye length, located $\frac{1}{3}$ eye length behind eyes. Length of 1st gill opening nearly $\frac{4}{5}$ eye length. Anterior margins of pelvic fins 0.45 times length of pectoral anterior margins. First dorsal origin posterior to pelvic insertions by only $\frac{1}{5}$ of 1st dorsal base length, and anterior to pelvic free rear tips by $\frac{1}{4}$ of 1st dorsal base length. First dorsal insertion and anal origin about opposite. Anal fin height 4 times in base length. Preventral caudal margin less than $\frac{1}{2}$ of dorsal margin length.

Specimen No. 33788

348 mm TL, male. Capture data unavailable. Formerly identified as *Scyllium canicula*.

Differences from No. 33778 specimen:

Eye openings 5 times as long as high. Spiracles located $\frac{1}{5}$ eye length behind eyes. Length of 1st gill opening $\frac{4}{5}$ eye length. Mouth length 1.5 times in width. Anterior margins of pelvic fins 0.5 times length of pectoral anterior margins. Juvenile claspers, not reaching pelvic free rear tips. Pelvic inner margins joined together. First dorsal origin posterior to pelvic insertions by only $\frac{1}{5}$ of 1st dorsal base length, midpoint of first dorsal base over pelvic free rear tips. Second dorsal anterior margin 0.8 times 1st dorsal anterior margin length. Anal fin height 5 times in base length.

Specimen No. 33789

336 mm TL, female. Capture data unavailable. Formerly identified as *Scyllium canicula*.

Differences from No. 33778 specimen:

Eye openings 5 times as long as high. Spiracles located $\frac{1}{5}$ eye length behind eyes. Length of 1st gill opening more than $\frac{2}{3}$ eye length. Anterior margins of pelvic fins 0.5 times length of pectoral anterior margins. First dorsal origin over pelvic insertions, midpoint of first dorsal base over pelvic free rear tips. Second dorsal anterior margin 0.8 times 1st dorsal anterior margin length. Second dorsal origin about over anal insertion, its free rear tip over lower caudal origin. Anal fin height 4 times in base length. Preventral caudal margin less than $\frac{1}{2}$ of dorsal margin length.

Specimen No. 33790

336 mm TL, male. Capture data unavailable. Formerly identified as *Scyllium canicula*.

Differences from No. 33778 specimen:

Eye openings 5 times as long as high. Spiracles located $\frac{1}{5}$ eye length behind eyes. Anterior margins of pelvic fins 0.55 times length of pectoral anterior margins. Claspers juvenile, not reaching pelvic free rear tips. Pelvic inner margins joined together. First dorsal origin over pelvic insertions, first dorsal midbase over pelvic free rear tips, and midpoint of 1st dorsal inner margin over anal origin. Second dorsal anterior margin 0.75 times 1st dorsal anterior margin length. Preventral caudal margin less than $\frac{1}{2}$ dorsal margin length.

Specimen No. 33791

327 mm TL, female. Capture data unavailable. Formerly identified as *Scyllium canicula*.

Differences from No. 33778 specimen:

Eye openings 5 times as long as high. Spiracles located $\frac{1}{5}$ eye length behind eyes. Length of 1st gill opening more than $\frac{2}{3}$ eye length. Anterior margins of pelvic fins 0.55 times length of pectoral anterior margins. First dorsal origin over pelvic insertions, first dorsal midbase over pelvic free rear tips, and midpoint of 1st dorsal inner margin over anal origin. Preventral caudal margin less than $\frac{1}{2}$ of dorsal margin length.

Specimen No. 33792

322 mm TL, male. Capture data unavailable. Formerly identified as *Scyllium canicula*.

Differences from No. 33778 specimen:

Eye openings 5 times as long as high. Spiracles located $\frac{1}{5}$ eye length behind eyes. Length of 1st gill opening $\frac{3}{4}$ eye length. Anterior margins of pelvic fins 0.5 times

length of pectoral anterior margins. Claspers juvenile, very short, not reaching pelvic free rear tips. Pelvic inner margins joined together. First dorsal origin anterior to pelvic free rear tips by $\frac{1}{3}$ of 1st dorsal base length. Second dorsal anterior margin 0.9 times 1st dorsal anterior margin length. Anal fin height 4 times in base length. Pre-ventral caudal margin less than $\frac{1}{2}$ of dorsal margin length.

DESCRIPTIVE NOTES

Fifteen specimens of *Scyliorhinus canicula* were examined, six males and nine females. Specimens No. 33779—81 and 33782—92 are kept in separate bottles. Three sharks from the first bottle and eleven sharks from the second bottle were probably captured in different places. The latter mentioned sharks are smaller, with paler coloration.

All specimens are immature, clasper length of the largest male is 4.1 % of the total length and on the average 2.8 % of the TL. Position of the first dorsal origin varies from being above pelvic insertions to being posterior to pelvic insertions by $\frac{1}{5}$ of the 1st dorsal base length. Position of the second dorsal origin varies from being anterior to the anal insertion by $\frac{1}{6}$ of the anal base length to being over the anal insertion.

No essential signs of sexual dimorphism have been recorded. Males are slightly smaller than females; the average length of males is 355 mm, the average length of females 366 mm. Pelvic inner margins of all males are joined together; this was not observed in any female. Upper symphyseal teeth always absent. Only two specimens (Nos. 33779 and 33780) have lower symphyseal teeth which are not developed in smaller specimens.

SCYLIORHINUS STELLARIS (LINNAEUS, 1758), No. 33793
463 mm TL, male. Locality: Yugoslavia, Adriatic Sea — Mediterranean Sea. Captured in 1965.

Head broad, its length nearly 20 % of total length. Head outline parabolic in dorsal view. Snout short, narrowly rounded in lateral view. Eye openings dorso-lateral, not visible in ventral view and not touching head rim in dorsal view. Eye apertures elongate, orbital rim doubly notched. Nictitating lower eyelid of rudimentary type, strongly differentiated secondary lower eyelid. Spiracles moderate, posterior to eyes by almost $\frac{1}{2}$ of eye length, located slightly below posterior eye notches. Strong subocular ridges present. Nostrils large, closer to upper jaw symphysis than to snout tip. Anterior nasal flaps well developed, with no cirri. Five pairs of short gill openings, length of longest (1st) about $\frac{3}{4}$ eye length, 5th $\frac{1}{2}$ length of first.

Mouth subterminal, large. Teeth small, but well developed, present in three functional series in both jaws. 47 rows of teeth in upper jaw, about 40 rows in lower jaw. Teeth in upper and lower jaws similar, awl-like, in upper jaw directed rearward. Crowns with large basal serration, strong pointed median cusp and a pair of smaller lateral cusps (Fig. 8). Symphyseal teeth about half as large as anteroposterior teeth. Prominent lower labial furrows present.

Body slender, trunk vertically oval in cross section, with no interdorsal ridge. Caudal peduncle height at second dorsal fin origin about twice its width there. Lateral dermal keels absent, no precaudal pits.

Dermal denticles vary in size and shape very much. Lateral trunk denticles with long, teardrop crowns, having a long pointed medial cusp with strong longitudinal ridge, and a pair of smaller lateral cusps and ridges (Plate 10B). Crowns of lateral trunk denticles 0.1—0.4 % of TL. Ventral denticles generally smaller.

Pectoral fins large, much larger than first dorsal fin in area. Apices narrowly and free rear tips broadly rounded. Pectoral fin origins below fourth gill openings. Pelvic

fins moderately large, their bases under first dorsal origin. Juvenile claspers, not reaching pelvic free rear tips.

First dorsal fin with narrowly rounded apex, insertion much anterior to level of dorsal apex. Origin of first dorsal fin far back, above last third of pelvic fin bases, its posterior tip over anal fin origin. Second dorsal fin similar to first and nearly as large. Origin of second dorsal fin over midpoint of anal base, its posterior tip over ventral caudal origin. Anal fin with broadly rounded apex, larger than second dorsal fin. Anal origin posterior to first dorsal insertion by about $\frac{1}{2}$ of 1st dorsal base length.

Caudal fin heterocercal, dorsal caudal margin twice as long as preventral margin. Prominent subterminal notch present.

Color: Light brown above, with numerous dark brown spots, increasing in size from head to tail and from back to flanks. Yellowish below. Dorsal fins, caudal fin and upper surfaces of paired fins have color of the back. Ventral surfaces of pectoral and pelvic fins with a single brown spot on anterior margins. Anal fin yellowish, with dark vertical stripe at midlevel.

Family Triakidae Gray, 1851
Genus *Mustelus* Linck, 1790

MUSTELUS MUSTELUS (LINNAEUS, 1758)

Specimen No. 33794

417 mm TL, male. Capture data unavailable. Formerly identified as *Mustelus vulgaris*.

Head moderately long, flattened ventrally, head outline in dorsal view parabolic in shape. Snout long, narrowly rounded in dorsal view, sharply pointed in lateral view. Eyes situated dorso-laterally, eye openings elliptic, about 3 times as long as high. Eye irises gray, pupils yellowish, oval. Subocular ridges covering eyes in ventral view, and separating eyes from head rim in dorsal view. Supraorbital ridges arched, extending not high above head profile. Nictitating lower eyelids of external type, subocular pouch very deep. Spiracles not large, length about $\frac{2}{9}$ eye length, located close behind eyes and slightly below posterior eye corners (Plate 4A).

Nostrils closer to mouth than to snout tip, wide, anterior nasal flaps well developed, rather extended rounded lobes. No nasoral grooves. Five pairs of laterally situated gill openings, relatively small, length of 1st about $\frac{1}{2}$ eye length. Gill openings increasing in size from 1st to 4th, length of 5th (smallest) about $\frac{9}{10}$ length of 1st.

Mouth subterminal, triangular, relatively long. Teeth flat, pavementlike, alike in both jaws, in several functional series. Crowns smooth, oval, having no cusps, width of largest upper anteroposteriors 0.21% of TL. Labial furrows deep, upper longer than lower.

Trunk slightly compressed ventrally, ventically oval in section at pelvic origins. Caudal peduncle long, slender, with no precaudal pits. Lateral keels present. Low interdorsal ridge along the back. Dermal denticles not very large, largest crowns of lateral trunk denticles about 0.09% of TL. Crowns wide, teardrop, with a single cusp and 2 to 4 lateral ridges (Plate 11A). Axes of denticles slightly inclined in relation to body axis. Denticles from back more narrow, with longer cusps.

Pectoral fins larger than first dorsal fin in area. Apices of pectoral fins narrowly rounded, free rear tips angular. Pectoral fin origins slightly anterior to fourth gill openings. Pectoral fin bases short, inner margins long. Pelvic fins smaller than second dorsal fin, pelvic bases approximately equidistant between first dorsal insertion and second dorsal origin. Claspers juvenile, not reaching pelvic free rear tips.

First dorsal fin with narrowly rounded apex, free rear tip extended. Origin of first dorsal fin posterior to pectoral insertions by only 1st gill opening length, midpoint of 1st dorsal base closer to pectoral insertions than to pelvic origins. Second dorsal fin similar to first in shape, large, its anterior margin 0.77 times 1st dorsal anterior margin length. Second dorsal origin anterior to anal origin by length of anal base. Anal fin low and small, much smaller than second dorsal fin. Anal origin opposite to midpoint of 2nd dorsal base.

Caudal fin heterocercal, subterminal notch on dorsal caudal lobe. Preventral caudal margin $\frac{2}{5}$ of dorsal caudal margin length.

Color: Grayish brown, with many white dots above, paler below. No markings on fins.

Specimen No. 33795

403 mm TL, female. Capture data unavailable. Formerly identified as *Mustelus vulgaris*.

Differences from No. 33794 specimen:

Width of largest upper anteroposteriors 0.17 % of TL. No claspers. Second dorsal anterior margin 0.84 times 1st dorsal anterior margin length. Second dorsal origin anterior to anal origin by $\frac{2}{3}$ of anal fin base length. Color: No white dots on the back.

Family Carcharhinidae Jordan and Evermann, 1896

Genus *Scoliodon* Müller and Henle, 1837

SCOLIODON LATICAUDUS MÜLLER AND HENLE, 1838

Specimen No. 33796

360 mm TL, female. Capture data unavailable. Formerly identified as *Carcharias laticaudatus*.

Head narrow and comparatively long. Snout long, spadelike, greatly depressed. Eyes lateral on head, visible better in dorsal than in ventral view. Eye apertures relatively short, about circular. Orbital rims without notches. Nictitating lower eyelid of internal type, subocular pouch deep. Spiracles absent, replaced by several minute pores behind each eye. Nostrils relatively large, $\frac{2}{3}$ eye length, close to lateral head rim, about 3.5 times closer to mouth than to snout tip. Nostrils far apart, distance between their inner corners 5.9 % of TL. Short anterior nasal flaps present. Gill openings moderately large, longer than eye, increasing in size from 1st to 3rd, 5th slightly longer than 1st. The longest (3rd) 1.1 times shortest (1st).

Mouth narrow but long, its length 1.25 times in width. Teeth large, unicuspid, smooth and oblique, present in a single functional series (other series lying flatly in jaws). Cusps of all teeth directed towards mouth corners. 22 rows of teeth in upper jaw as well as in lower jaw. A pair of smaller erect symphyseal teeth in each jaw. Tooth formula 11—2—11/11—2—11. Dignathic heterodonty weak, upper anteroposterior teeth slightly higher, with broader crowns. Bases of largest lower anteroposteriors 0.75 % of TL. Short upper and lower labial furrows present. Length of upper furrow 0.4 % of TL, lower 1.1 % of TL.

Trunk compressed laterally, vertically oval in section at first dorsal origin. Caudal peduncle short, its height at upper caudal origin 1.5 times its width there. There are no interdorsal ridges or lateral dermal keels. Both precaudal pits present, lower shallower than upper. Dermal denticles very small, length of lateral trunk denticles 0.04—0.09 % of TL, flattened and closely imbricated. Crowns about as long as broad, with 3 longitudinal ridges and 3 to 5 posterior cusps, central cusp largest (Plate 11B).

Pectoral fins moderately small, their apices sharply pointed, free rear tips narrowly rounded. Origins of pectoral fins slightly in advance 5th gill openings. Apex of pectoral fin slightly anterior to pectoral free rear tip when fin is appressed to body. Pelvic fins small, with broadly rounded apices. Pelvic fin bases situated close behind level of first dorsal base, posterior to first dorsal insertion by only 1st gill opening length.

First dorsal fin not very large, its apex and free rear tip pointed, free rear tip little extended rearwards. Origin of first dorsal fin posterior to free rear tips of appressed pectoral fins by $\frac{1}{6}$ of 1st dorsal base length. Free rear tip of first dorsal fin over first third of pelvic fin bases. Second dorsal fin very small and low, its anterior margin 0.3 times 1st dorsal anterior margin length. Origin of second dorsal fin above last fourth of anal base. Second dorsal midbase opposite to anal insertion. Anal fin low and long, much larger than 2nd dorsal fin in area. Origin of anal fin anterior to 2nd dorsal origin by about anal anterior margin length.

Caudal fin heterocercal, preventral margin about $\frac{2}{5}$ of dorsal margin length. Subterminal notch deep, terminal margin $\frac{1}{2}$ of preventral margin length.

Color: Gray-brown above. Area below level of pectoral origins and 2nd dorsal insertion paler.

Specimen No. 33797

342 mm TL, female. Capture data unavailable. Formerly identified as *Carcharias laticaudatus*.

Differences from No. 33796 specimen:

Distance between inner corners of nostrils 5.6 % of TL. Mouth length 1.4 times in width. Tooth formula 12—1—12/11—2—11. Length of upper labial furrow 0.3 % of TL, lower furrow 0.7 % of TL. Origin of first dorsal fin about over free rear tips of appressed pectoral fins. Free rear tip of first dorsal fin over first fourth of pelvic fin bases. Anterior margin of second dorsal fin $\frac{1}{4}$ of 1st dorsal anterior margin length.

Genus *Prionace* Cantor, 1849

PRIONACE GLAUCA (LINNAEUS, 1758)

Specimen No. 33798

508 mm TL, male. Locality: Nice, Mediterranean Sea. Captured in August 1904. Formerly identified as *Squalus glaucus*.

Head about 20 % of TL, depressed, narrowly rounded. Snout elongate, markedly pointed. Eyes lateral on head, eye openings oval, their height about 1.5 times in length. Eye irises circular, dark blue. Nictitating lower eyelid internal, not connected with upper eyelid. Subocular pouch very deep. Spiracles absent. Nostrils as far from mouth as from snout tip, well separated, without nasoral grooves. Anterior nasal flap short triangular lobe. Gill openings relatively small, lengths of all five pairs nearly equal (2nd longest, 5th shortest). First gill opening length about $\frac{3}{5}$ eye length. Last two openings closer together.

Mouth inferior, greatly arched, extending far behind eyes. Teeth bladelike, curved, large, broadest bases of upper anterior teeth nearly 0.6 % of TL. Teeth with broad bases and edges serrate, transverse notches present. Upper symphyseal teeth absent, lower erect, about half as long as largest lower anteroposteriors. All teeth present in a single series only. Dignathic heterodonty strong — upper teeth oblique, directed rearward, crowns broad, with a strong pointed primary cusp and four postlateral cusplets. Lower teeth smaller, more erect, crowns narrow, with a pointed primary cusp and a single postlateral cusplet. Labial furrows short, hardly visible.

Trunk elongate, slender, vertically oval in section at first dorsal origin. Caudal peduncle slender, prominent upper and lower precaudal pits present. No interdorsal ridge. Dermal denticles (Plate 12A) moderately large, length of lateral trunk denticles 0.06—0.1 % of TL. Crowns nearly as wide as long, with three longitudinal ridges and a single posterior cusp.

Pectoral fins narrow, very long. Pectoral fin origins below fourth gill openings. Pelvic fins relatively small, their anterior margins shorter than $\frac{1}{3}$ length of pectoral anterior margins. Pelvic bases slightly closer to first dorsal than to second dorsal fin bases. Claspers juvenile, almost reaching pelvic free rear tips.

First dorsal fin not very large, apex narrowly rounded, above first dorsal insertion. Free rear tip little extended. First dorsal origin posterior to free rear tips of appressed pectoral fins by the distance between 1st and 5th gill openings. Midpoint of first dorsal base definitely closer to pelvic origins than to pectoral insertions. Second dorsal fin much lower and smaller than first, its anterior margin less than $\frac{1}{2}$ of first dorsal anterior margin length. Free rear tip little extended. Second dorsal origin above first fifth of anal base. Anal fin quite small, but larger than 2nd dorsal fin in area. Free rear tip extended. Anal and second dorsal bases about opposite.

Caudal fin narrow, long, with subterminal notch. Length of preventral margin $\frac{2}{5}$ of dorsal caudal margin length.

Color: Deep blue above, yellowish below. Nictitating lower eyelid margins, ventral margins of eyes, tips of anal fin and ventral caudal lobe dark blue.

Specimen No. 33799

740 mm TL, female. Capture data unavailable.

Differences from No. 33798 specimen:

2nd and 3rd gill openings are longest. Length of 1st gill opening $\frac{4}{5}$ eye length. Broadest bases of upper anterior teeth 0.5 % of TL. Two upper symphyseal teeth present — erect, with stronger central cusp and 4 to 6 smaller lateral cusps, their height about $\frac{3}{4}$ height of longest anteriors. No lower symphyseal teeth. Length of dermal denticles about 0.03 % of TL. No claspers. Second dorsal anterior margin nearly 0.6 times first dorsal anterior margin length. Second dorsal and anal fin origins opposite. Preventral caudal margin less than $\frac{2}{5}$ of dorsal caudal margin length. Color: Nictitating lower eyelids without blue margins.

Specimen No. 33800

660 mm TL, male. Locality: Nice, Mediterranean Sea. Captured in August 1904. Formerly identified as *Squalus glaucus*.

Differences from No. 33798 specimen:

Upper symphyseal teeth present — small but broad, erect. Preventral caudal margin less than $\frac{2}{5}$ of dorsal margin length.

Specimen No. 33801

536 mm TL, male. Capture data unavailable. Formerly identified as *Squalus glaucus*.

Differences from No. 33798 specimen:

Length of 1st gill opening $\frac{2}{3}$ eye length. One upper symphyseal tooth present, having a strong central cusp and 4 lateral cusplets on each side. Length of dermal denticles nearly 0.04 % of TL. Origin of first dorsal fin posterior to free rear tips of appressed pectoral fins by more than distance between 1st and 5th gill openings. Second dorsal anterior margin nearly 0.6 times first dorsal anterior margin length. Second dorsal and anal fin origins opposite.

Family Sphyrnidae Gill, 1872
Genus *Sphyrna* Rafinesque, 1810

SPHYRNA ZYGAENA (LINNAEUS, 1758)

Specimen No. 33802

734 mm TL, female. Locality: Nice, Mediterranean Sea. Captured in August 1904. Formerly identified as *Zygaena malleus*.

Head broad, depressed, expanded laterally, its width 27.1 % of TL. Oculonarial expansions length 0.3 times head width, their width 0.25 times head width. Median indentation [scallop] absent from anterior margin of head. Lateral indentations shallow, slightly closer to snout tip than to nostrils. Outer narial groove absent, inner narial groove deep, extending to lateral indentations [Fig. 6]. Eyes located on ends of lateral expansions, much closer to their anterior than to posterior margins. Eye openings circular, nictitating lower eyelids of internal type, subocular pouches very deep. Spiracles absent.

Nostrils large, their length $\frac{3}{4}$ eye length, slitlike, located near ends of anterior head margins. Their shortest distance from eyes about equals eye length. Nostrils far apart, not connected with mouth, anterior nasal flaps pointed. Gill openings moderately large, situated laterally. First gill opening about as long as eye. The smallest gill openings (1st and 5th) about 0.7 times length of longest (4th). Fourth and fifth gill openings closer together, lying above pectoral base.

Mouth on the underside of head, large, its width 6.5 % of TL. Mouth length more than $\frac{1}{2}$ its width. Teeth large, bladelike, present in a single series in both jaws. Crowns smooth, compressed, oblique, outer edges deeply notched, transverse notches present on roots. Symphyseal teeth absent. Dignathic heterodonty weak, lower teeth

slightly more compressed, base width of all anterior teeth 0.45 % of TL. About 28 rows of teeth in each jaw. Very short labial furrows on lower jaw. Comparatively large and noticeable hyomandibular pores (Fig. 6). Anterior-median pores formed into triangle, anterior-lateral and preoral pores well developed. Subocular pores present near eyes. Similar pore formations present on dorsal surface of head.

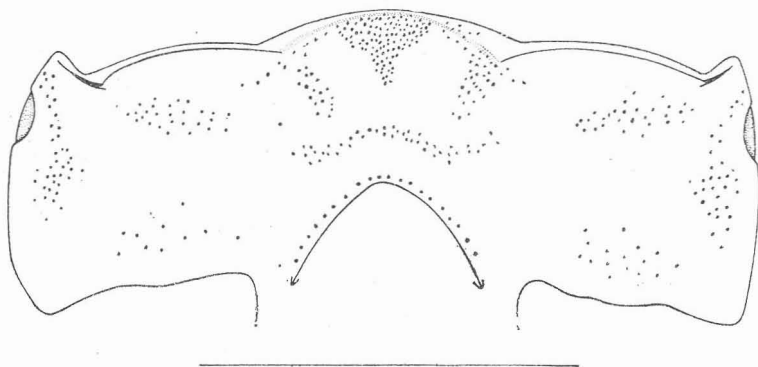


Fig. 6. *Sphyrna zygaena*, No. 33802. Ventral view of head. Scale line equals 10 cm.

Trunk cylindrical, vertically oval in section at first dorsal origin. Caudal peduncle short, stout. There is no interdorsal ridge, lateral dermal keels absent. Both precaudal pits are present, lower shallower than upper. Dermal denticles imbricate, very small and flattened. Crowns about as long as wide, having 3 longitudinal ridges and 3 to 5 posterior cusps, central cusp enlarged. Length of largest lateral trunk denticles 0.03 % of TL (Plate 12B).

Pectoral fins relatively large, their tips narrowly rounded. Pectoral fin origins in advance of fourth gill openings. Posterior margins slightly curved, distal tips of appressed pectorals about over their free rear tips. Pelvic fins moderately large, their posterior margins nearly straight. Anterior margins of pelvic fins about $\frac{1}{3}$ length of pectoral anterior margins. Pelvic bases somewhat closer to first dorsal base than to second dorsal base.

First dorsal fin large and high, with narrowly rounded apex, posterior margin perpendicular to body axis, free rear tip extended. Origin of first dorsal fin over pectoral insertions, its free rear tip far in advance of pelvic origins. Second dorsal fin very low, its anterior margin $\frac{1}{4}$ of first dorsal anterior margin length. Apex of second dorsal fin broadly rounded, its free rear tip much extended, almost reaching upper precaudal pit. Origin of second dorsal fin posterior to anal origin only by $\frac{1}{3}$ of 2nd dorsal base length, its insertion slightly posterior to anal insertion, and its free rear tip posterior to anal free rear tip.

Anal fin larger than second dorsal fin in area, but definitely smaller than pelvic fins. Its apex sharply pointed posteriorly, posterior margin deeply notched. Anal free rear tip extended.

Caudal fin heterocercal, dorsal caudal lobe much larger than ventral, subterminal notch present. Preventral margin length about 0.4 times dorsal margin length.

Color: Gray-brown above, yellowish below.

Specimen No. 33803

667 mm TL, male. Capture data unavailable. Formerly identified as *Zygaena maleus*.

Differences from No. 33802 specimen:

Head width 26.7 % of TL. Oculonarial expansions length 0.27 times head width, their

width 0.28 times head width. A pair of small symphyseal teeth present in each jaw. About 32 rows of teeth (Fig. 8) in upper jaw, 35 rows in lower jaw. Juvenile claspers, not reaching pelvic free rear tips. Midpoint of second dorsal base over anal insertion.

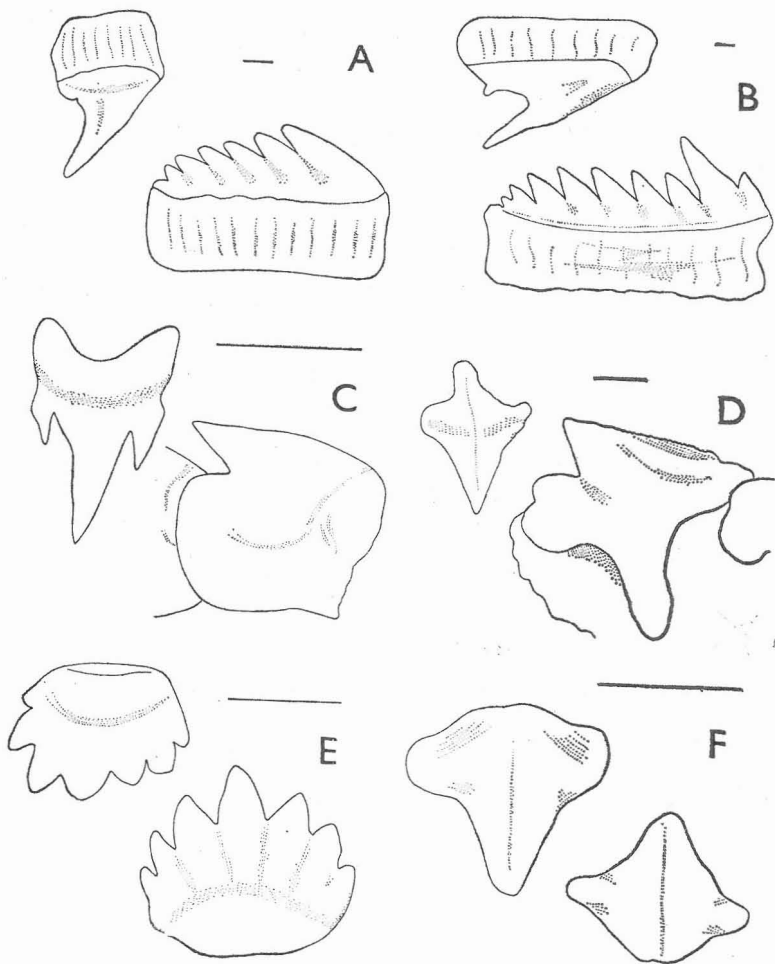


Fig. 7. Anteroposterior teeth of examined specimens. Scale lines equal 1 mm. A. *Hexanchus griseus* (33748), 2nd right upper and 1st right lower teeth. B. *Hepranchias perlo* (33749), 5th right upper and 2nd right lower teeth. C. *Etmopterus spinax* (33750), left upper and lower teeth [buccal surface of lower tooth]. D. *Centrophorus granulosus* (33753), right upper and lower teeth. E. *Heterodontus zebra* (33763), upper and lower anterior teeth. F. *Chiloscylium punctatum* (33770), left upper and lower teeth.

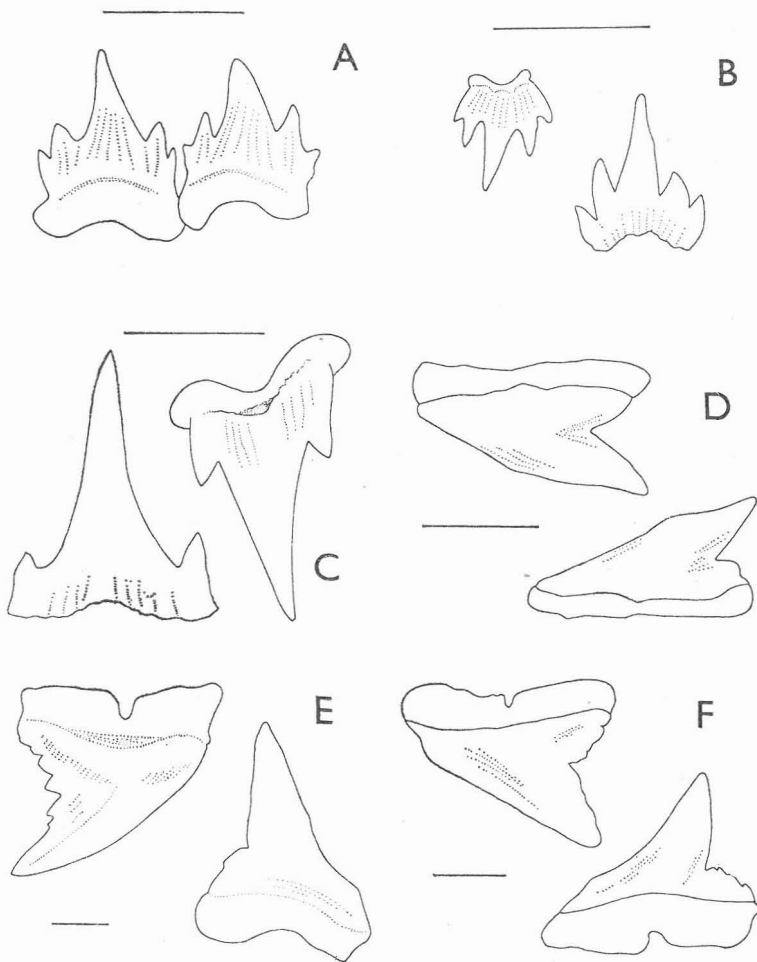


Fig. 8. Anteroposterior teeth of examined specimens II. Scale lines equal 1 mm. A. *Galeus melastomus* [33776], upper teeth. B. *Scyliorhinus canicula* [33786], upper and lower teeth. C. *Scyliorhinus stellaris* [33793], upper and lower teeth. D. *Scoliodon laticaudus* [33797], left upper and lower teeth. E. *Prionace glauca* [33800], right upper and lower teeth. F. *Sphyrna zygaena* [33803], left upper and right lower teeth.

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PŘEHLED STUDOVANÝCH ŽRALOKŮ ZE SBÍREK NÁRODNÍHO MUZEA V PRAZE

Autor zpracoval 56 kusů tekutinových preparátů žraloků, uložených v depozitáři Národního muzea v Praze. Všechny exempláře byly detailně proměřeny, popsány a zařazeny k příslušnému druhu. Dále byly opatřeny inventárními čísly (33748 až 33803) a označeny.

Sbírký Národního muzea obsahují přes sto exponátů žraloků, pro práci byly použity ty nejjachovější z nich. Exponáty jsou uloženy ve skleněných válcích a fixovány v roztoku lihu či formaldehydu. Pouze u 21 žraloků jsou známy některé bližší údaje o jejich chycení. Většina úlovků je z let 1889—1909, menší část byla získána teprve nedávno. Zdá se, že všichni žraloci pocházejí z evropské a indopacifické oblasti, přesná lokalita je známa v 19 případech.

Identifikováno bylo celkem 20 druhů žraloků, patřících k nadřádům Squalomorphii a Galeomorphii podtřídy příčnoústých (Elasmobranchii), použit byl systém Compagnův (1973).

Šestižábřý *Hexanchus griseus* (žralok šedý) a sedmižábřý *Hepranchias perlo* (žralok sivý), patřící do řádu Hexanchiformes (šedouni), vykazují četné primitivní znaky. Žraloci řádu Squaliformes (ostrouni) nemají řitní ploutev a jsou blízcí příbuzní prvně zmíněné skupiny. Ve sbírkách Národního muzea jsou zastoupeni především hlubinnými druhy *Etmopterus spinax* (ostroun černý) a *Centrophorus granulosus*, dále také nejhojnějším evropským žalokem *Squalus acanthias* (ostroun obecný).

Zástupci řádu Heterodontiformes se u Evropy nevyskytují; všechny exempláře obou popsaných druhů tohoto řádu, *Heterodontus japonicus* a *H. zebra*, byly pravděpodobně chyceny v západním Pacifiku. Řád Orectolobiformes je ve sbírkách reprezentován pouze jedním rodem se dvěma druhy — *Chiloscyllium punctatum* (máčka hnědoskvrnná) a *C. plagiosum*.

Více než polovina žraloků popsaných v této práci je řazena k řádu Carcharhiniformes. Alespoň dvěma exempláři jsou ve sbírkách zastoupeny druhy *Atelomycterus marmoratus*, *Galeus melastomus* (žralok černohubý), *Scyliorhinus canicula* (máčka skvrnitá), *Mustelus mustelus* (hladkou obecný), *Scoliodon laticaudus*, *Prionace glauca* (žralok modravý) a *Sphyrna zygaena* (žralok kladivoun).

U druhů *Heterodontus zebra* (Heterodontiformes, Galeomorphii) a *Scyliorhinus canicula* (Carcharhiniformes, Galeomorphii) umožňuje větší počet popsaných exemplářů vyvození obecnějších závěrů, které se týkají jejich morfologie. Všichni žraloci druhu *Heterodontus zebra* jsou mláďata, někteří jsou možná jen několik týdnů staří. Hřbetní ploutve jsou v poměru k celkové délce těla značně dlouhé, tato jejich relativní délka však rychle klesá u větších exemplářů. Samci mají celkovou délku těla větší než samice. Hřbetní ploutve a ocasní ploutev jsou u samic delší než u samců.

Všechny popsané máčky *Scyliorhinus canicula* jsou nedospělé, průměrná délka těla je u samců poněkud menší než u samic. Vnitřní okraje břišních ploutví jsou u každého samce srostlé, což nebylo zaznamenáno u žádné ze samic. Menší zuby ve středu čelisti jsou vyvinuty jen u dolních čelistí větších exemplářů.

Práce obsahuje 32 obrázků — 8 kreseb a 24 fotografií. Na obr. 7 a 8 jsou zuby některých zkoumaných exemplářů žraloků, celkové záběry těla a detaily hlavy některých žraloků jsou na tab. 1 až 6. Snímky z elektronového mikroskopu (tab. 7 až 12) zachycují plakoidní šupiny na kůži žraloků. Všechna provedená měření byla sestavena do tabulky, která je uvedena na konci práce.

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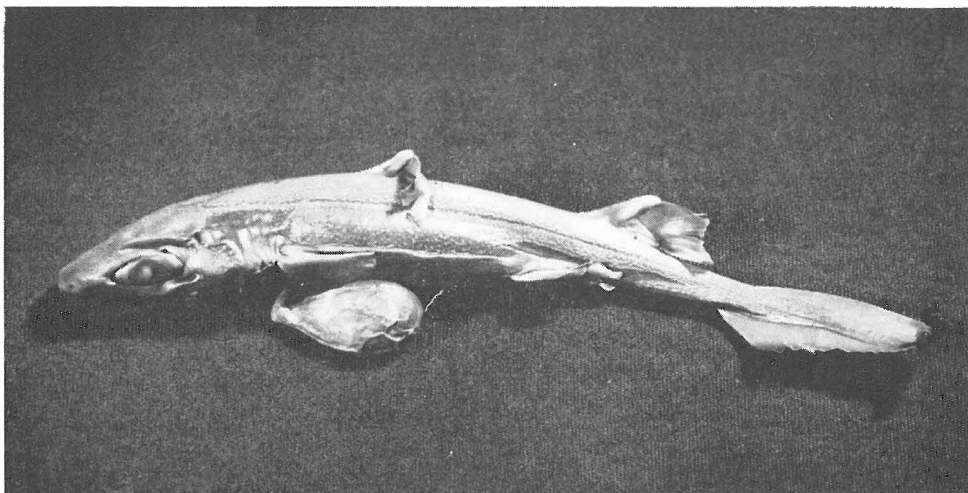
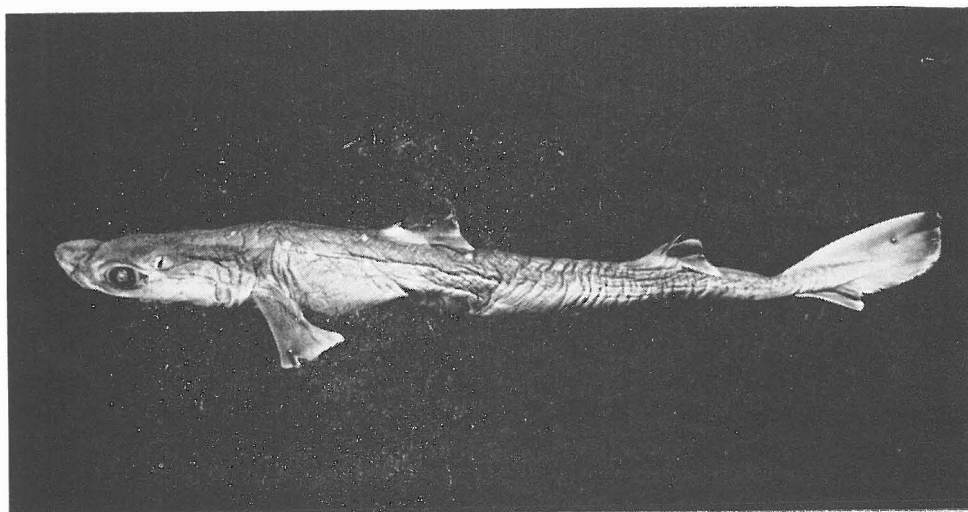


Photo A. *Etmopterus spinax* 33752. 111 mm TL fetus from Norway.

Photo B. *Squalus acanthias* 33756. 286 mm TL male. Black Sea.

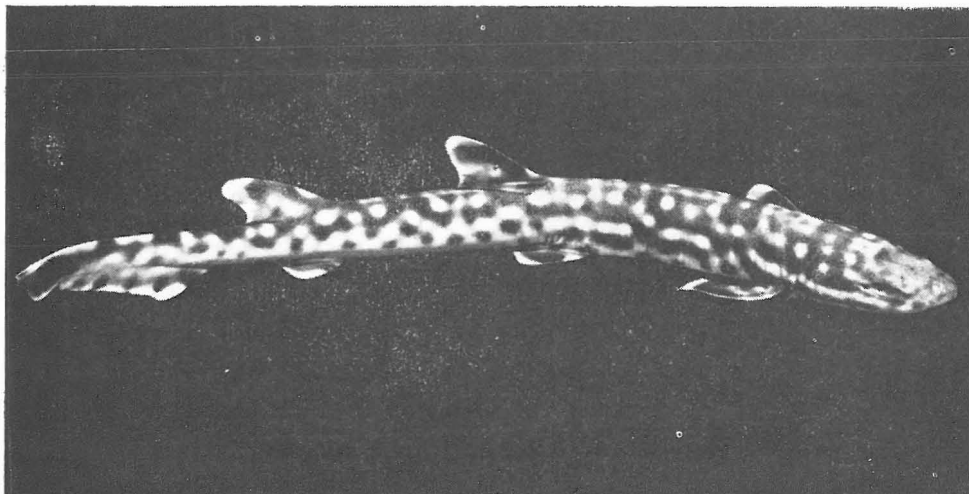


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Photo A. *Heterodontus zebra* 33765. 232 mm TL male.

Photo B. *Atelomycterus marmoratus* 33772. 425 mm TL male from Celebes.



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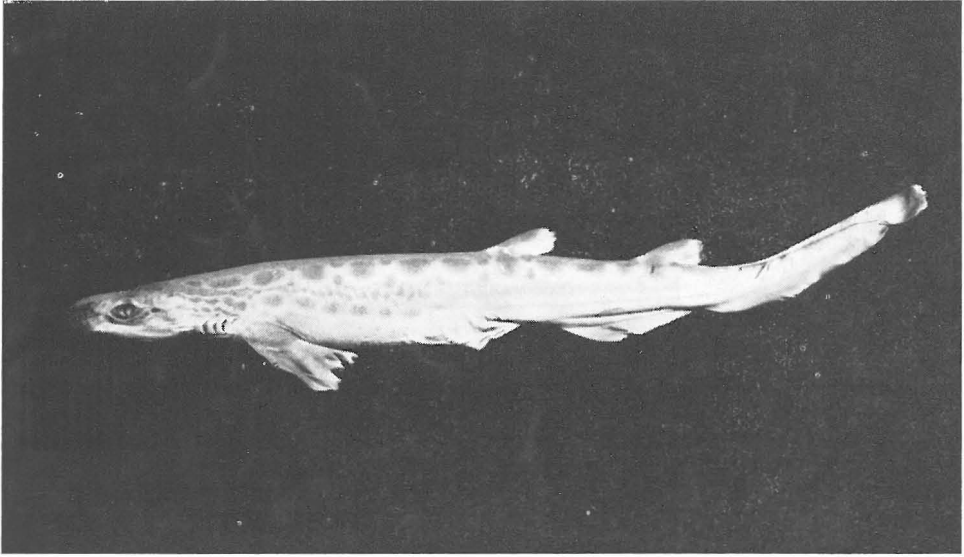
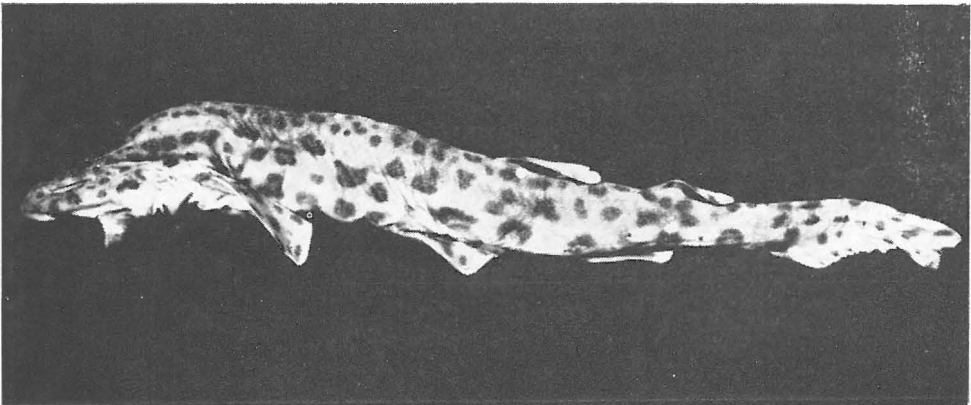


Photo A. *Galeus melastomus* 33777. 327 mm TL male.

Photo B. *Scyliorhinus stellaris* 33793. 463 mm TL male. Adriatic Sea.



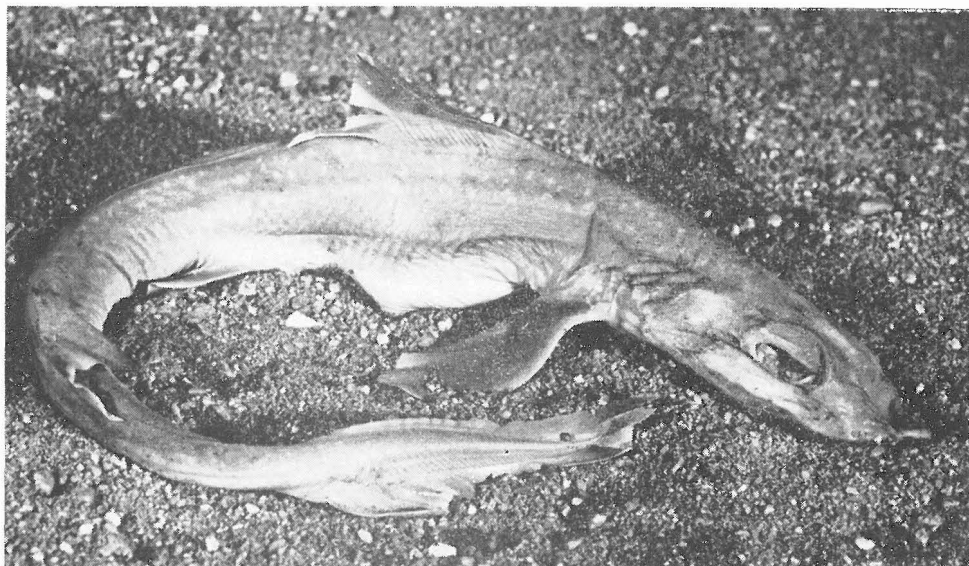
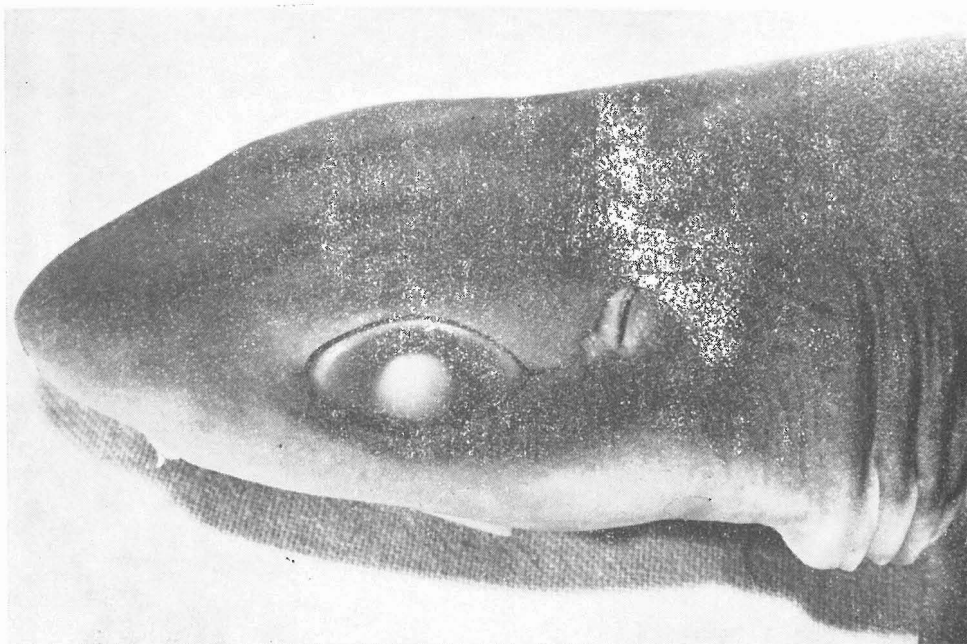


Photo A. *Mustelus mustelus* 33794. 417 mm TL male.

Photo B. Lateral view of the head of a 437 mm TL male *Squalus megalops* [33758].



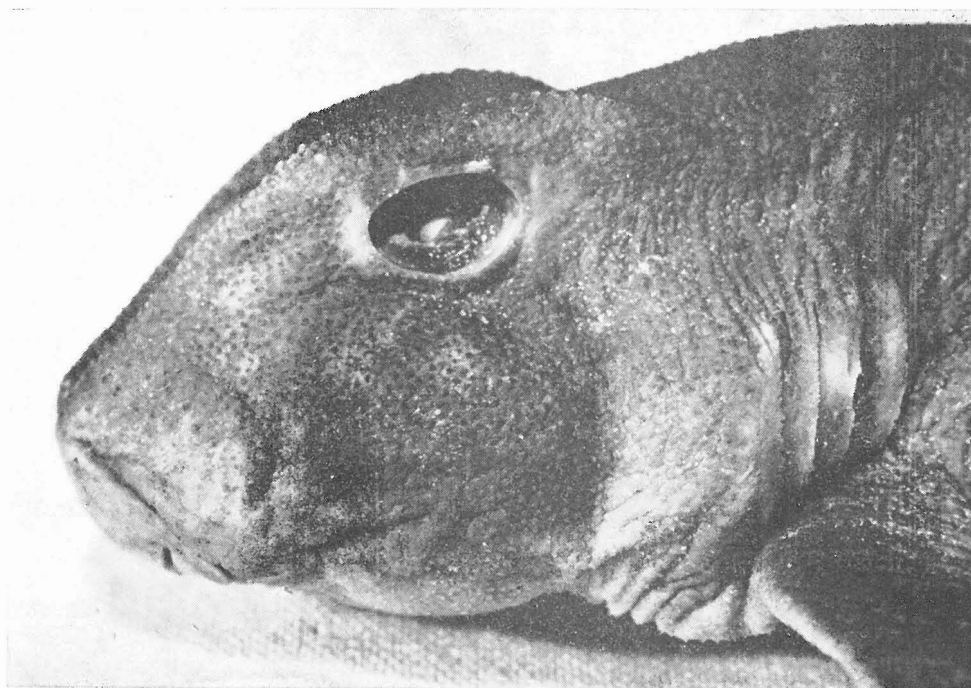
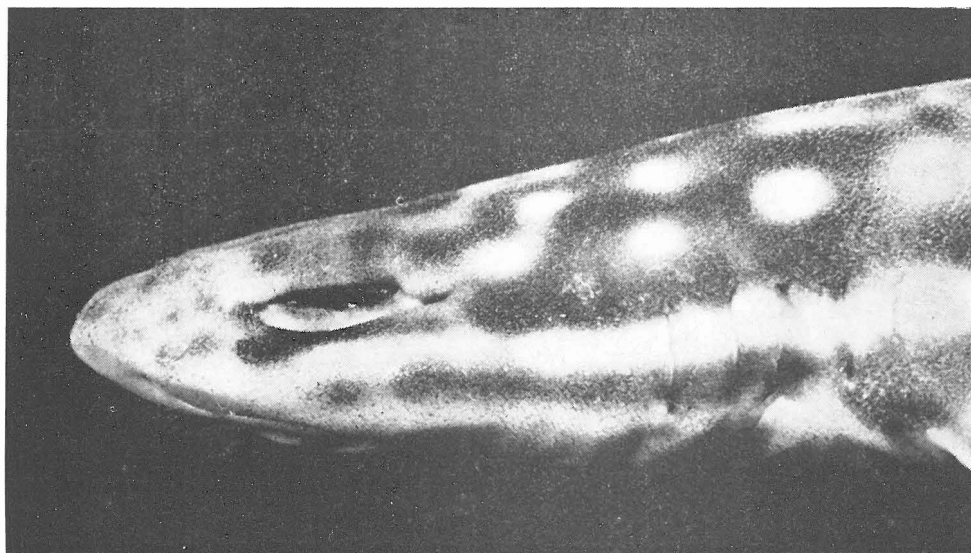


Photo A. Lateral view of the head of a 279 mm TL male *Heterodontus zebra* (33763).

Photo B. Lateral view of the head of a 425 mm TL male *Atelomycterus marmoratus* (33772).

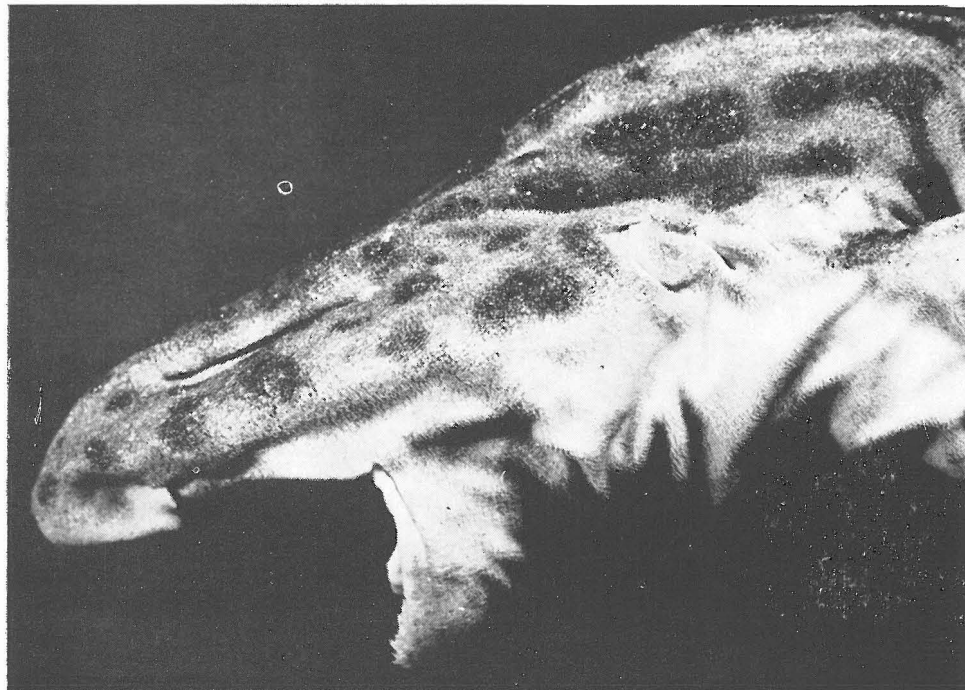


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Photo A. Ventral view of the head of a 327 mm TL male *Galeus melastomus* (33777). The enlarged hyomandibular pores can be seen.

Photo B. Lateral view of the head of a 463 mm TL male *Scyliorhinus stellaris* (33793). Mouth widely open.



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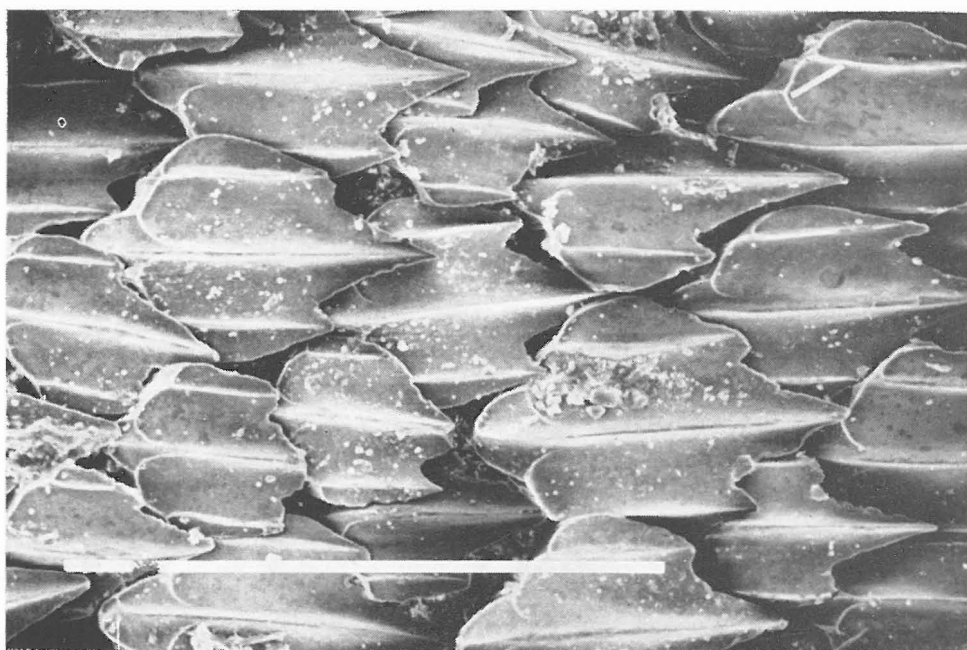
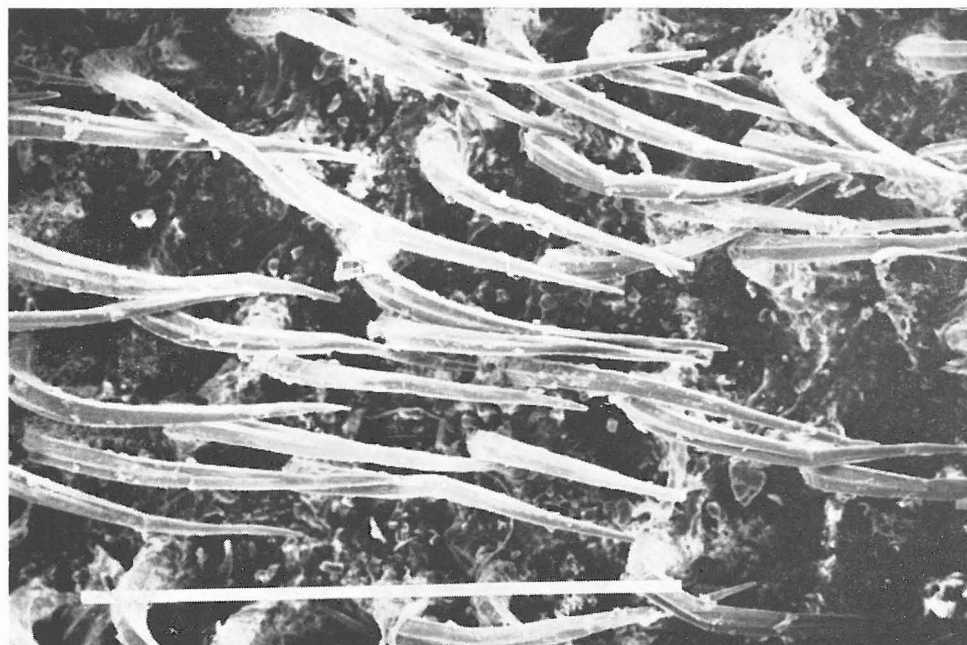


Photo A. Lateral trunk dermal denticles of *Hepranchias perlo*, No. 33749. Scanning electron micrograph. Scale line equals 1 mm.

Photo B. Lateral trunk dermal denticles of *Etmopterus spinax*, No. 33750. Scanning electron micrograph. Scale line equals 1 mm.



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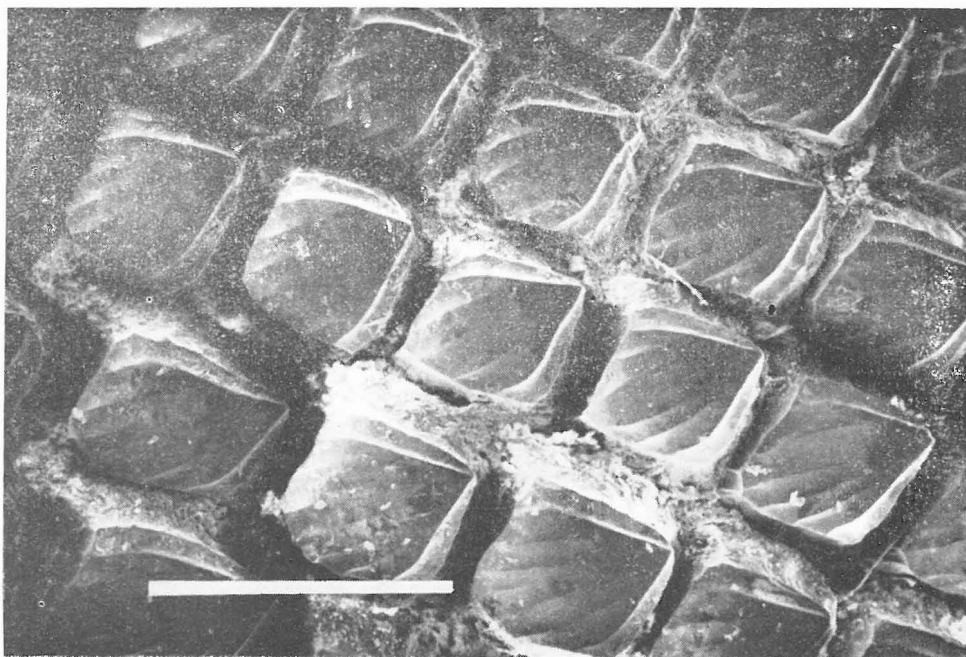
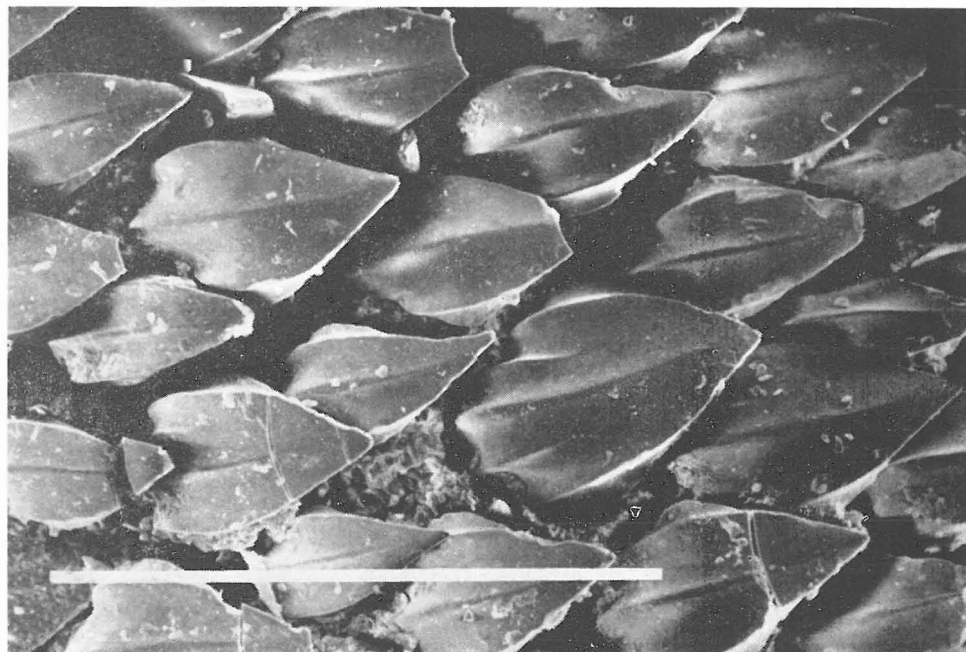


Photo A. Lateral trunk dermal denticles of *Centrophorus granulosus*, No. 33753. Scanning electron micrograph. Scale line equals 1 mm.

Photo B. Lateral trunk dermal denticles of *Chiloscyllium plagiosum*, No. 33771. Scanning electron micrograph. Scale line equals 1 mm.



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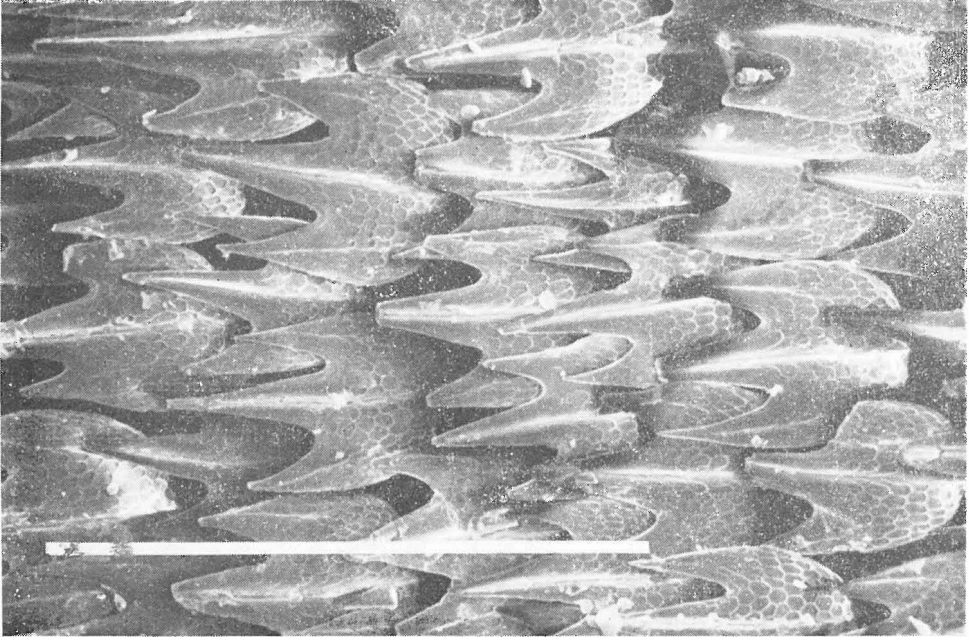
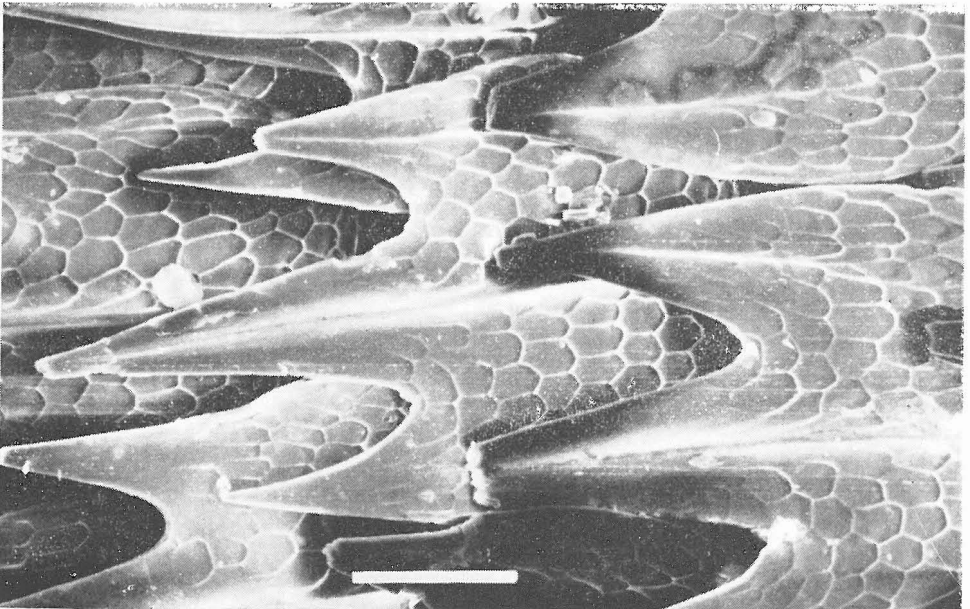


Photo A. Lateral trunk dermal denticles of *Galeus melastomus*, No. 33776. Scanning electron micrograph. Scale line equals 1 mm.

Photo B. Lateral trunk dermal denticles of *Galeus melastomus*, No. 33776 (detail). Scanning electron micrograph. Scale line equals 0.1 mm.



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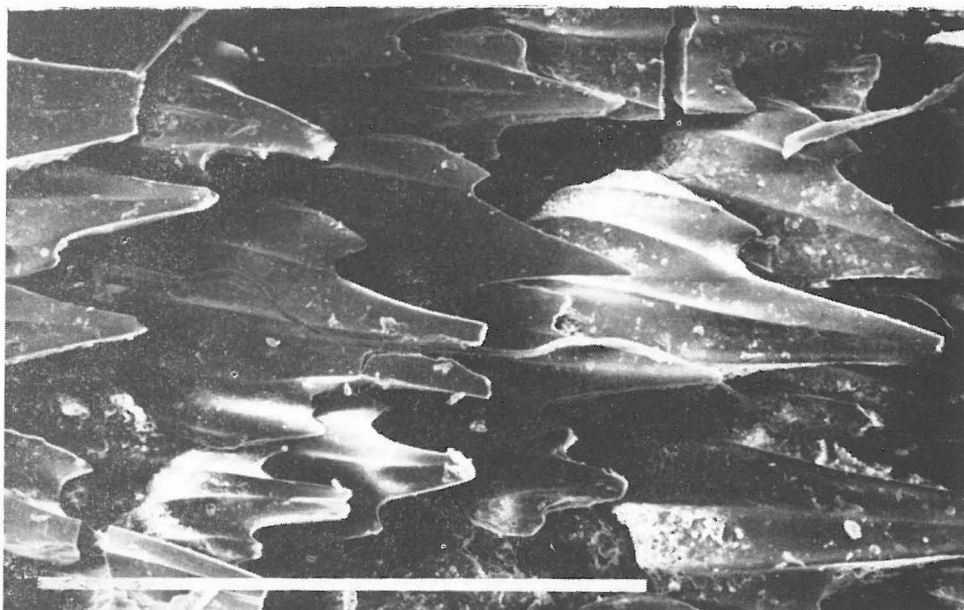


Photo A. Lateral trunk dermal denticles of *Scyliorhinus canicula*, No. 33786. Scanning electron micrograph. Scale line equals 1 mm.

Photo B. Lateral trunk dermal denticles of *Scyliorhinus stellaris*, No. 33793. Scanning electron micrograph. Scale line equals 1 mm.



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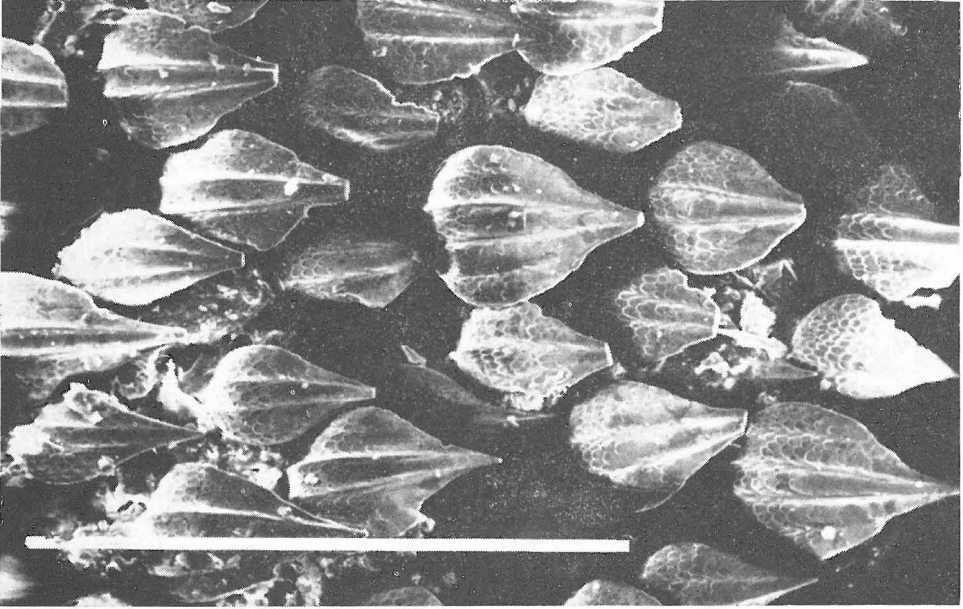
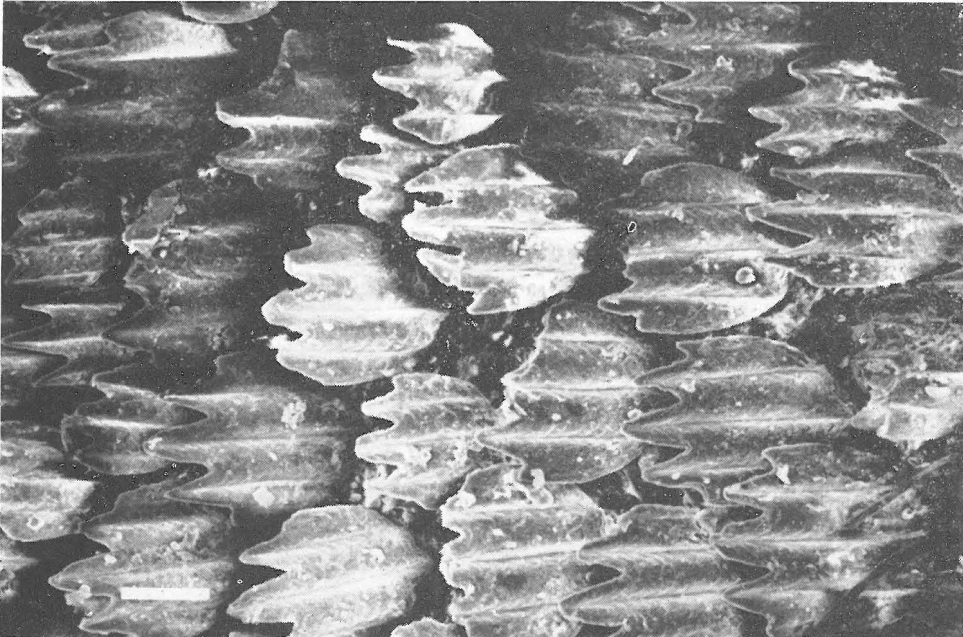


Photo A. Lateral trunk dermal denticles of *Mustelus mustelus*, No. 33794. Scanning electron micrograph. Scale line equals 1 mm. Axes of dermal denticles inclined to body axis by an angle of about 27° , anterior is to upper left.

Photo B. Lateral trunk dermal denticles of *Scoliodon laticaudus*, No. 33796. Scanning electron micrograph. Scale line equals 0.1 mm.



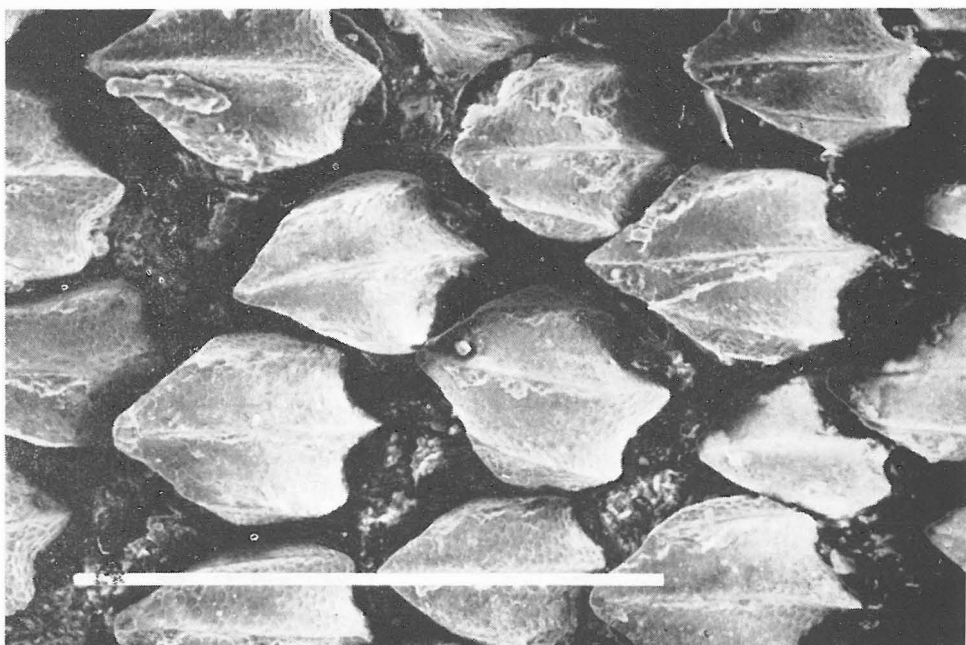


Photo A. Lateral trunk dermal denticles of *Prionace glauca*, No. 33798. Scanning electron micrograph. Scale line equals 1 mm.

Photo B. Lateral trunk dermal denticles of *Sphyrna zygaena*, No. 33802. Scanning electron micrograph. Scale line equals 0.1 mm.

