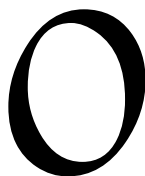


OSTEOLOGY AND RELATIONSHIPS
OF CERATIOID ANGLERFISHES OF THE
FAMILY ONEIRODIDAE, WITH A REVIEW
OF THE GENUS ONEIRODES LÜTKEN



NATURAL HISTORY MUSEUM
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OSTEOLOGY AND RELATIONSHIPS OF CERATIOID ANGLERFISHES
OF THE FAMILY ONEIRODIDAE, WITH A REVIEW OF THE
GENUS *ONEIRODES* LÜTKEN

By THEODORE W. PIETSCH²

ABSTRACT: A detailed osteological description of *Oneirodes acanthias* is presented as a basis for a comparative osteological study of nine of the 13 genera of the ceratioid family Oneirodidae. The family and the genus *Oneirodes* are diagnosed and described, and keys to the genera and species of *Oneirodes* are provided. The genus *Oneirodes* is reviewed on the basis of personal examination of all known material. Twenty-three species are recognized, seven of which are described as new. Eighteen nominal forms previously placed in the *O. eschrichti*-group are considered synonyms of *O. eschrichtii*. The remaining species of the *O. eschrichti*-group, *O. bulbosus*, *O. anisacan thus*, *O. heteronema*, and *O. theodoritissieri* are considered valid species of *Oneirodes*. *Oneirodes inimicus* is a synonym of *O. carlsbergi*, and *O. thysanophorus* is a synonym of *O. flagellifer*. The *O. eschrichti*-group and *O. flagellifer*-group are not recognized. The *O. schmidti*-group, however, is retained to include a number of morphologically similar forms which are clearly differentiated from other species of *Oneirodes*: *O. mirus*, *O. schmidti*, *O. basili*, *O. theodoritissieri*, and additional unidentifiable material designated as *Oneirodes* sp. of *O. schmidti*-group. Larvae, metamorphosing and unidentifiable females, and males of all stages of development are listed as *Oneirodes* sp. Complete annotated synonymies are provided for each species followed by a diagnosis, description, and if known, comments on size at maturity, geographic variation and ontogenetic change.

Patterns of phenetic similarity and phyletic relationship among the nine oneirodid genera examined are deduced on the basis of 30 characters chosen for their intrageneric stability and intergeneric variability. Morphological trends found within and between these genera, and which characterize the evolution of the Oneirodidae, include an elongation and depression of the bones of the jaws, palatine arch, and cranium, accompanied by a shortening of the hyoid arch, a widening and deepening of the illicial trough, and an anterior displacement and flattening of the frontal bones. Lying near the base of these evolutionary trends, *Oneirodes* is considered to be the least derived member of the group, being most like the ancestral form which gave rise to the Oneirodidae. *Danaphryne* and *Microlophichthys* are phylogenetically closely related to *Oneirodes*. *Leptacanthichthys* appears to be intermediate between *Microlophichthys* and *Dolopichthys*. *Bertella* and especially *Dolopichthys* represent the extreme condition in the trends toward elongation and depression of the cranium, facial bones and jaws, and toward the anterior displacement and flattening of the frontal bones. *Chaenophryne*, *Pentherichthys*, and *Lophodolos* are each unique in their own way and show little phylogenetic relationship to each other or to any other oneirodid.

Within the genus *Oneirodes*, *O. luetkeni*, *O. carlsbergi*, and *O. rosenblatti* are considered the least derived members of the group. Species included in the *O. schmidti*-group are considered the most derived. The remaining 16 species appear intermediate in specialization and constitute an assemblage of morphologically very similar forms, the inter-relationships of which are difficult to assess.

Oneirodes is distributed in the more productive waters of all three major oceans of the world, between approximately 60° N and 65° S. The members of the genus occupy a wide vertical range between 300 and 3000 meters, but are commonly found between 800 and 1500 meters. Contrary to previous thought, the species are not cosmopolitan, but for the most part restricted

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geographically into discrete areas within each ocean, areas which are definable on the basis of their physico-chemical and biological parameters. The distributional patterns exhibited by species of *Oneirodes* are similar to those of many other groups of midwater organisms, thus conforming to recognized zoogeographic regions. The ontogenetic vertical migration of ceratioids in conjunction with movements of water masses and current gyres is considered an essential factor in the formation and maintenance of restricted distributions of these and other midwater organisms.

The esca is part of a luring apparatus, unique to the Ceratioidei. This organ is capable of: 1) attracting other organisms through its bioluminescence and external embellishment of appendages and filaments, 2) detecting the close presence of other organisms through its nerve supply, and 3) a wide range of movement by the muscles which insert on the bones of the illicial apparatus. The external morphology of the escae of most ceratioids is highly species-specific. Within *Oneirodes*, and probably other ceratioid genera, the maintenance of a certain degree of morphological difference between escae seems essential, especially for the coexistence of sympatric forms. The esca appears to have at least two functions, the attraction of prey, and the attraction of a species-specific male. Experiments conducted on shallow water anglerfishes show that lost parts and even complete escae are replaced by tissue regeneration. Further, regenerated escae are morphologically similar to the original non-regenerated esca. It is assumed that deep-sea anglerfishes, like their shallow water relatives, also have the ability to regenerate their escae, and thus maintain the species-specific lure which is presumably of prime importance to their survival.

INTRODUCTION

Of the 11 families of the lophiiform suborder Ceratioidei (Pietsch, 1972a:18), the family Oneirodidae is the largest and most diverse, consisting of 13 genera and nearly 50 species, more than half of all described ceratioids. The systematic history of the Oneirodidae begins with **Lütken's** (1871, 1872) description of a deep-sea anglerfish, collected from the west coast of Greenland, which he called *Oneirodes eschrichtii*. Since that time, and despite **Lütken's** detailed and accurate original description, the systematics of the genus has been confusing. Part of this confusion can be traced to an early failure to distinguish between *Oneirodes* and *Dolopichthys* Garman, 1899. While maintaining *Oneirodes* as a monotypic genus, Regan and Trewavas (1932) provisionally recognized 43 species of *Dolopichthys*, 28 of which were described as new. These were distributed among five subgenera: *Dermatias*, *Microlophichthys*, *Dolopichthys*, *Leptacanthichthys* and *Pentherichthys*. Within their subgenus *Dermatias*, Regan and Trewavas (1932) included 29 species, 18 of which were represented by only one or two adolescent female specimens less than 30 mm in standard length. Bertelsen (1951) amended this situation by placing the subgenus *Dermatias* in synonymy with *Oneirodes* and elevating the remaining four subgenera to generic status. Within the newly defined genus *Oneirodes*, Bertelsen (1951) listed 33 species, 28 of which were divided among three species groups. Within each of these groups

"the separation of species is based on small details in the number, form and relative size of the esca appendages. These differences are almost of the same dimensions as the individual and ontogenetic variation we find within well-defined species. Only 4 of the 28 species I place in these 3 groups are based on more than 1 specimen and none on more than 4. The esca of the few specimens referred to the same species show differences, which do not seem essentially smaller than those used in the separation of the remaining species within the same group. As it is possible that each of the 3 groups embraces some few species, they may be designated, until closer examination of a larger material has been made, as respectively: the *Oneirodes eschrichti*-, *flagellifer*- and *schmidti*-groups." (Bertelsen, 1951:77.)

Since the publication of Bertelsen's (1951) monograph on the Ceratioidei the number of known female specimens of the genus *Oneirodes* has increased more than six-fold. This increase in material has made possible the following detailed revision of the group based on personal examination of the approximately 450 known metamorphosed male and female specimens of *Oneirodes*, including all type material. The work attempts to attain the following objectives: 1) to describe and compare osteological variation within the genus *Oneirodes* and the family Oneirodidae, and to thus broaden and establish definitions for the taxa; 2) to determine how many forms comprise the genus *Onei-*

rodes; 3) to determine how the many morphologically similar species of the genus may be best differentiated; 4) to describe geographical variation and ontogenetic change within the species; 5) to determine phenetic similarities and phylogenetic relationships among oneirodid genera and *Oneirodes* species; 6) to examine the geographic distribution of *Oneirodes* species relative to physico-chemically defined oceanic water masses; and 7) to consider the structure and function of the ceratioid esca.

In spite of the increase in material, the systematics of *Oneirodes* is by no means complete. The separation of species is based on few characters, the most important being the morphology of the esca. Specimens with damaged or lost escae are particularly difficult and sometimes impossible to identify. Characters that allow specific identification of males have not been found, thus species definitions are based solely on females. Even as here restricted, *Oneirodes* is by far the largest of the 33 ceratioid genera, including a quarter of all known ceratioid species; yet, new forms remain to be described when adequate material becomes available and the discovery of numerous additional species is predicted.

METHODS AND MATERIALS

Standard lengths (SL) were used throughout, unless otherwise indicated. Measurements were taken from the left side whenever possible and rounded to the nearest 0.5 mm in specimens greater than 20 mm, and to the nearest 0.1 mm in specimens less than 20 mm. The range of variation for measurements was expressed in percent of SL within parentheses preceded by the mean. To insure accurate fin-ray counts, skin was removed from the pectoral fins and incisions were made in the skin to reveal the rays of the dorsal and anal fins. Sockets, indicating missing teeth in the jaws and on the vomer, were included in total tooth counts. Jaw-tooth counts are the sum of both left and right sides. Head length is the distance from the anterior tip of the upper jaw to the posteriormost margin of the preoperculum. Head width is the distance between the tips of the sphenotic spines. Head depth is the distance from the tip of the sphenotic spine to the base of the quadrate spine. Lower-jaw length is the distance from the symphyseal spine to the posteriormost margin of the articular. Illicium length is the distance from the articulation of the pterygiophore of the illicium and the illicial bone to the dorsal surface of the esca bulb, not including esca appendages. The ratio of the lengths of

the upper and lower forks of the operculum is obtained by dividing the length of the lower fork of the bone by the length of the upper fork. Terminology used in describing the various appendages and filaments of the esca are given in the generic description, p. 35. Terminology used in describing the various parts of the angling apparatus follows Bradbury (1967). Definitions of terms used for the different stages of development follow Bertelsen (1951). Computation of statistics describing regressions was performed at the Natural History Museum of Los Angeles County on a General Electric time-share terminal on General Electric Mark II computer services. Drawings are by the author unless otherwise indicated, and were made with the aid of a Wild M-5 Camera Lucida except where noted.

Under the description of new species and in Appendix A, locality data are presented for all specimens examined. Complete data for DANA stations are given for type material only. For non-type material the reader is referred to Schmidt (1929) and Carlsberg Foundation (1934). Coordinates for the starting position only of each trawl are included. Most collections were made with a 10-foot Isaacs-Kidd midwater trawl (IKMT). Material deposited at the Institut für Seefischerei, Hamburg, was collected with a Combined Midwater Bottom Trawl, having a rectangular mouth and a 1600 mesh circumference (CMBT-1600). This and similar gear are described more fully by Schärfe (1966, 1969). Material from the National Institute of Oceanography, Surrey, England, was collected with a Rectangular Midwater Trawl, mouth area eight square meters, mesh size five millimeters (RMT 8/5), equipped with an opening and closing device (Clarke, 1969).

Since nearly all the available collections of *Oneirodes* were made with nonclosing nets the actual depth of capture is unknown. For those species represented by sufficient material, vertical distributions were analyzed by a procedure similar to that used by William H. Krueger (unpublished manuscript) for determining depths of capture of *Idiacanthus*, and outlined by Gibbs (1969). Data were used from expeditions from which all specimens of any species were examined, and only those stations within the known geographical range of a species were used. No separation of daytime and night tows was made. Station data were taken from Schmidt (1929), Carlsberg Foundation (1934), and unpublished data for VELERO IV cruises of the University of Southern California. For each trawl, the number of hours at depth was multiplied by the area of the mouth of the net. The number

of meter-hours for each depth interval, and the number of specimens caught at each depth interval were tabulated and expressed as a percentage of total for comparison. When the percentage of specimens caught at any depth is considerably greater than the percentage of meter-hours at that depth, it may be assumed that this represents a region of concentration. The reverse indicates that specimens recorded for that depth probably were caught while the net was being lowered or raised.

Vertical distributions of poorly represented species, for which an analytic treatment of the non-closing-net data was impossible, are based on the maximum depths reached by fishing gear for each capture.

Material used for the comparative osteological investigation was cleared and stained with alizarin red S following the trypsin digestion technique (Taylor, W., 1967). In many cases dissections were made of uncleared specimens to confirm observations made on cleared and stained specimens and to determine ontogenetic changes. All osteological material examined is listed by family in Appendix B with the exception of lophiiform material previously listed by Pietsch (1972a). The formal classification follows that of Greenwood et al. (1966). Bone terminology follows Pietsch (1972a) and Nybelin (1963). In osteological drawings cartilage is stippled, and where necessary for clarity, open spaces are rendered in solid black.

The generic diagnosis and description of *Oneirodes* were based on 419 metamorphosed female specimens, ranging in size from 10.0 to 213.0 mm, and 35 metamorphosed males, 7.5 to 16.5 mm. Material examined is deposited in the following museums and institutions:

BOC:	Bingham Oceanographic Collections, Peabody Museum of Natural History, Yale University.
BMNH:	British Museum (Natural History), London.
CAS:	California Academy of Sciences, San Francisco.
IFAN:	Institut Francais d'Afrique Noire, Senegal.
IOM:	Institute of Oceanography, Academy of Sciences of the USSR, Moscow.
ISH:	Institut für Seefischerei, Hamburg.
LACM:	Natural History Museum of Los Angeles County.
MCZ:	Museum of Comparative Zoology, Harvard University.
MHLR:	Musee d'Histoire Naturelle de La Rochelle.
MMF:	Museu Municipal do Funchal, Madeira.
NIO:	National Institute of Oceanography, Surrey, England.
NMFS:	National Marine Fisheries Service, Fishery-Oceanography Center, La Jolla.
NMI:	National Museum of Ireland, Dublin.

NYZS:	New York Zoological Society.
OSUO:	Oregon State University, Department of Oceanography.
ROM:	Royal Ontario Museum, Toronto.
SIO:	Scripps Institution of Oceanography, La Jolla.
UBC:	University of British Columbia, Institute of Fisheries, Vancouver.
UMML:	University of Miami Marine Laboratory.
USNM:	United States National Museum, Washington.
ZIL:	Zoological Institute, Academy of Sciences of the USSR, Leningrad.
ZMUC:	Zoological Museum, University of Copenhagen.

OSTEOLOGY

Osteology of *Oneirodes acanthias*

Cranium

Figs. 1-7

Ethmoid cartilage (Figs. 1-4): The ethmoid cartilage of *O. acanthias* consists of a thick plate which broadly covers the dorsal surface of the vomer and the anterior tip of the parasphenoid. Anteromedially, the concave, dorsal surface of the cartilage forms a shelf upon which rides the **symphysial** cartilage (rostral cartilage of Gregory, 1933) of the upper jaw. The lateral faces of the posterior half of the ethmoid cartilage are concave and form the articular facets for the palatines. Immediately posterior to these articular facets the cartilage is covered by the anterolateral tips of the frontals. Posteriorly, the ethmoid cartilage trifurcates, remaining continuous laterally with the anterior ends of the lateral ethmoids and medially with the supraethmoid to form the nasal septum. Posteromedially, the space formed by the supraethmoid, the ventromedial margins of the frontals, the prootics, and the dorsal surface of the parasphenoid is free of cartilage, except for a narrow, dorsally-directed, posteromedial extension of the ethmoid cartilage which meets with **ventromedial** extensions of the frontals, and the posterior margin of the supraethmoid.

Supraethmoid and lateral ethmoids (Figs. 1-4, 6): Anteriorly, the ventromedial process of the T-shaped supraethmoid, together with the lateral ethmoids and concave, dorsal surface of the ethmoid cartilage, form large, nearly circular nasal foramina. The semicircular, posterior margin of the supraethmoid is bordered on each side by the anterior ventromedial extensions of the frontals (see below, p. 6).

A strong ethmomaxillary ligament originates on each anterolateral corner of the supraethmoid and inserts on the dorsal process of the respective maxillary bone.

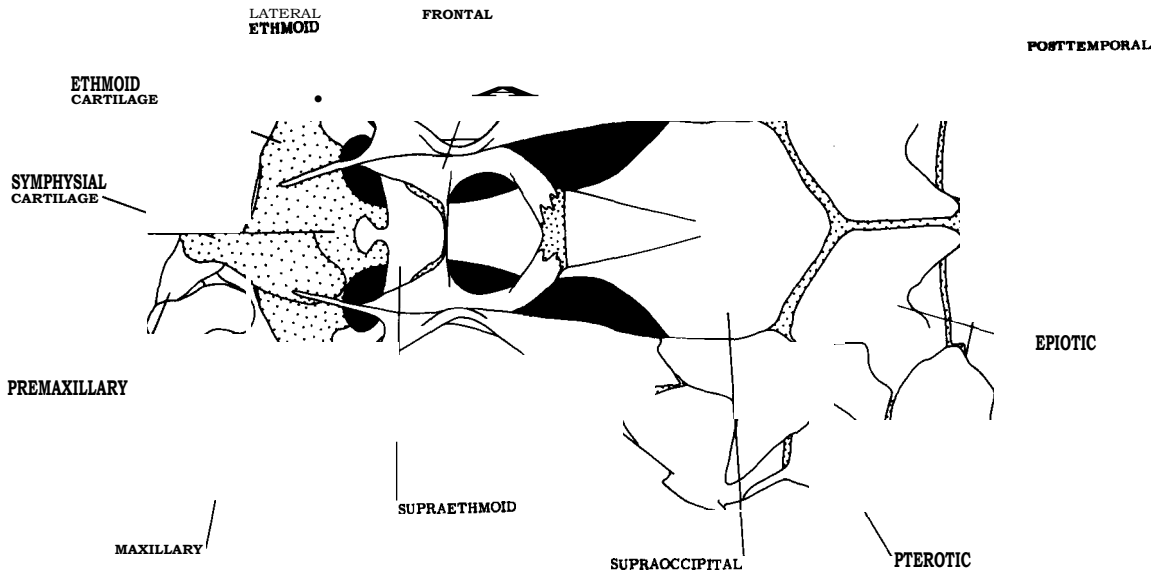


FIGURE 1. Dorsal view of cranium of *Oneirodes acanthias* with anterior portions of premaxillary and maxillary bones of left side in place.

Vomer (Figs. 2-4) : The vomer consists of a broad, anterior head which lies ventral to the ethmoid cartilage and a posteromedial shaft which lies ventral to the anterior tip of the parasphenoid. Anteriorly, the vomer becomes thickened and forms an ascending process which cups the eth-

moid cartilage. The ventral surface of the vomer of osteological preparations of *O. acanthias* examined bear as many as four, recurved and depressible teeth arranged in a transverse row on each side.

Frontals (Figs. 1-4, 6) : The frontals are sepa-

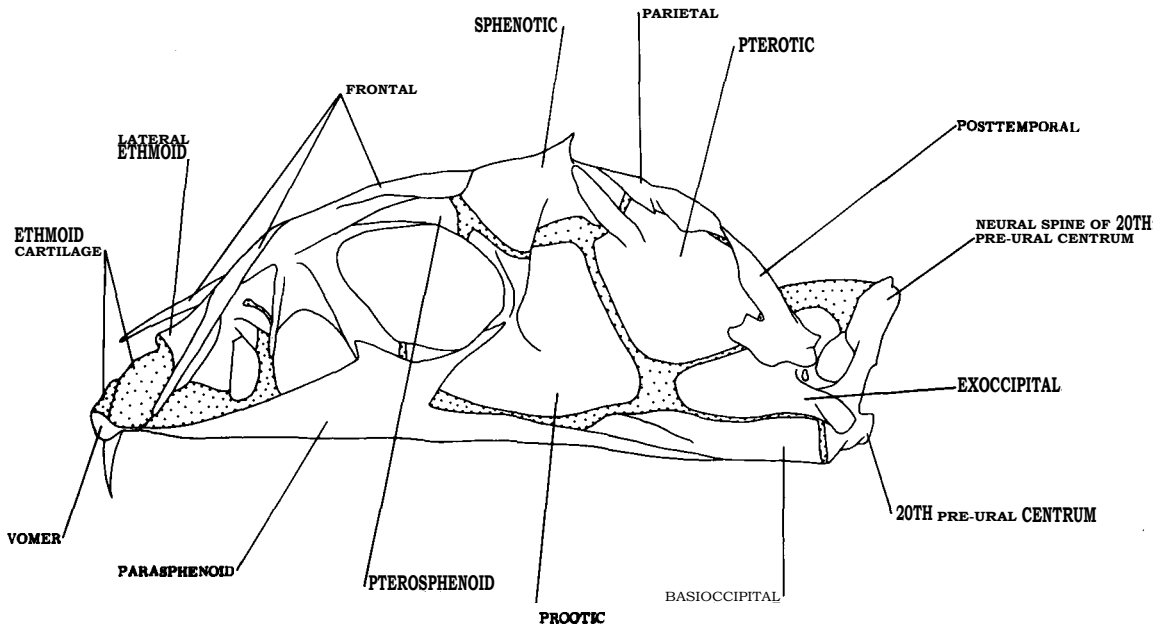


FIGURE 2. Lateral view of cranium of *Oneirodes acanthias*.

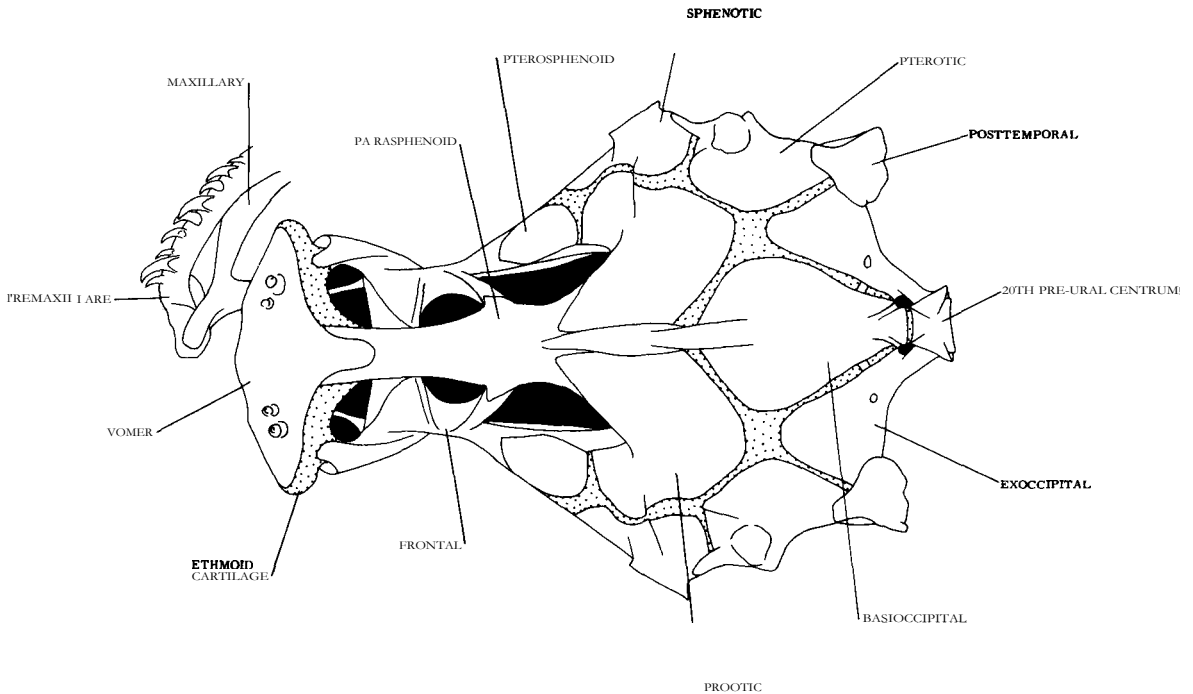


FIGURE 3. Ventral view of cranium of *Oneirodes acanthias* with anterior portions of premaxillary and maxillary bones of left side in place.

rated, approaching each other only at their ventromedial extensions. Each frontal has an anterior, ventromedial extension which meets the postero-dorsal process of the ethmoid cartilage, and a posterior ventromedial extension which is in contact with the parasphenoid anteriorly, and separated by cartilage from an anterior projection of the supraoccipital bone posteriorly.

Each frontal is deeply notched anteriorly forming a lateral fork which overlaps the lateral ethmoid and ethmoid cartilage, and a much narrower medial fork which extends nearly to the anterior limits of the ethmoid cartilage.

Parietals (Figs. 1-2) : The thin, weakly ossified parietals make up a considerable portion of the dorsal surface of the cranium. Their medial margins dip slightly, overlap the supraoccipital and epiotic, and contribute to the relatively shallow posterior half of the trough in which lies the pterygophore of the illicium. The posterolateral corner of each parietal is sharply bent downward where it overlaps the pterotic laterally and borders on the posttemporal posteriorly. A narrow anterior process of each parietal overlaps the posterior one-third of the frontal, and a shorter, lateral extension overlaps the sphenotic.

Pterosphenoids (Figs. 1-3, 6) : The pterosphenoids of *O. acanthias* are semicircular in shape

and lie ventral to the posterior ends of the frontals. The curved, lateral margin of each pterosphenoid is separated by cartilage posteriorly from the respective sphenotic and prootic.

Orbitosphenoid and basisphenoid: The orbitosphenoid and basisphenoid are absent in all Lophiiformes.

Parasphenoid (Figs. 2-3) : The parasphenoid underlies the vomer and ethmoid cartilage anteriorly and the anterior one-half of the basioccipital posteriorly. Medially, each stout, posteriorly directed, dorsolateral wing of the parasphenoid is in contact laterally with the posterior, ventromedial

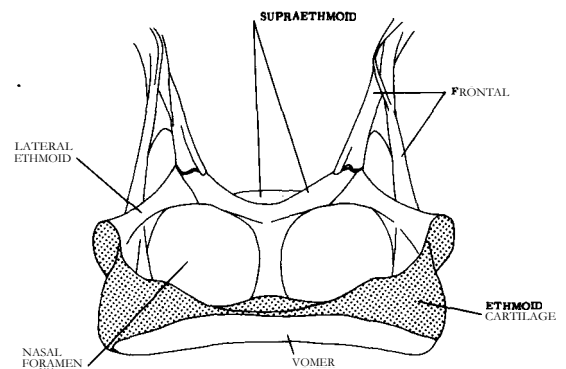


FIGURE 4. Anterior view of anterior half of cranium of *Oneirodes acanthias*.

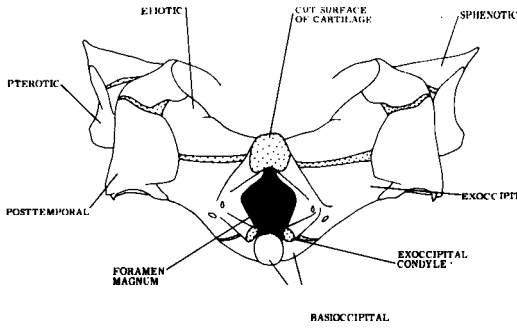


FIGURE 5. Posterior view of cranium of *Oneirodes acanthias*.

extension of the respective frontal, an anterior process of the supraoccipital, and the respective prootic.

Sphenotics (Figs. 1-3, 6) : Each sphenotic is a posterodorsally directed, cone-shaped element, the apex of which forms a well-developed spine. Posterolaterally, the sphenotic is overlapped by a large, anterodorsal process of the respective pterotic,

dorsally, by a lateral extension of the respective parietal, and anterolaterally by the posterior end of the respective frontal.

Pterotics (Figs. 1-3, 6) : A large, anterodorsally directed extension of the pterotic overlaps the posterolateral surface of the sphenotic, reaching nearly to the base of the sphenotic spine. Posteriorly, the pterotic is overlapped to a considerable extent by the respective posttemporal. A facet for the articulation of the posterior head of the double-headed hyomandibular bone is located on the **ventrolateral** surface of each pterotic.

Epiotics (Figs. 1-2, 5) : The epiotics lie completely within the broad, shallow, posterior end of the illicial trough, and are not visible in lateral view. Each epiotic is overlapped anterolaterally by the parietal and posterolaterally by the posttemporal.

Intercalar: An intercalar (opisthotic) is absent in all Lophiiformes.

Prootics (figs. 2-3) : The prootics of *O. acanthias* are separated anteriorly by the anteroventral

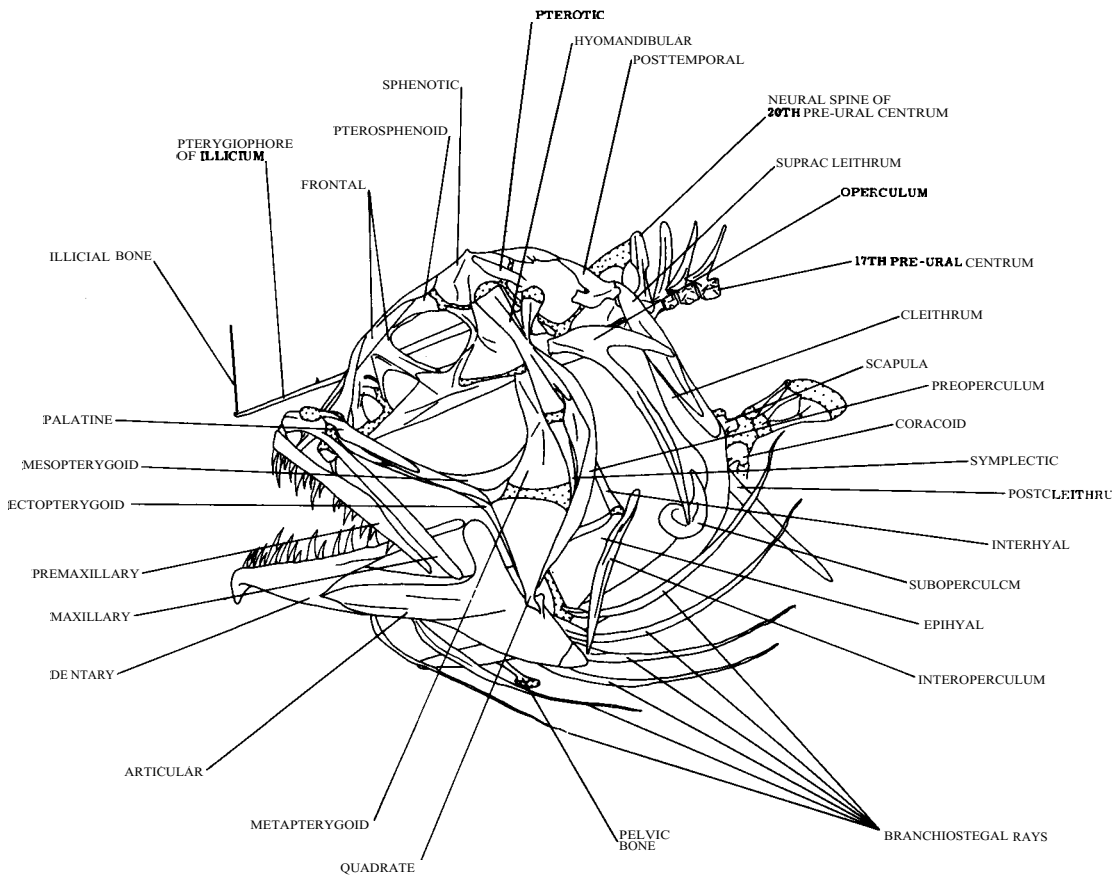


FIGURE 6. Lateral view of skull of *Oneirodes acanthias* with part of pectoral girdle, pelvic bone, hyoid apparatus and first four vertebrae in place.

process of the supraoccipital. The ventral margins of the prootics pass dorsal to the parasphenoid where they are narrowly separated by cartilage. Each prootic meets the respective dorsolateral wing of the parasphenoid anteriorly, the pterosphe-noid and sphenotic dorsally, and the pterotic and basioccipital posteriorly. The posteriormost margin of each prootic is widely separated from the exoccipital by cartilage.

Supraoccipital (Figs. 1-2) : The supraoccipital of *O. acanthias* is large, roughly hexagonal and makes up a considerable portion of the roof of the cranium and the floor of the illicial trough. Its anterior margin dips ventrally, separating the prootics from each other, and meets the posteriorly-directed, dorsolateral wings of the parasphenoid. An anteriorly-directed extension of the supraoccipital is narrowly separated by cartilage from the ends of the posterior, ventromedial extensions of the frontals. Laterally, the supraoccipital is slightly overlapped by each parietal.

Exoccipitals (Figs. 2-3, 5) : The modified neural arch and spine of the last pre-ural centrum of *O. acanthias* is suturally united to both exoccipitals along the posterior midline. With the basioccipital, a ventromedial extension of each exoccipital shares in the articulation with the centrum of the anteriormost vertebra. The posteromedial margins of the exoccipitals form a large, nearly circular foramen magnum.

Basioccipital (Figs. 2-3, 5) : The anterior one-half of the ventral surface of the basioccipital is covered by the posterior end of the paraphenoid. A dorsolateral flange projecting from each side of the basioccipital meets the prootic anteriorly and the exoccipital posteriorly. A short, posterolaterally-directed strut of bone, originating on the internal surface of each dorsolateral flange of the basioccipital, is suturally united to the internal surface of the medial margin of the respective exoccipital.

Mandibular Arch Upper Jaw

Premaxillaries and symphyseal cartilage (Figs. 1, 3, 6-7) : Each premaxillary consists of a curved, elongate portion, the posterodorsal margin of which is slightly expanded at midlength, and an anterior portion which bears a short ascending process and a slightly longer articular process. The anterior tips of the premaxillaries are securely attached to each other by fibrous connective tissue and by a broad ligament which passes ventral to the anterior end of a large, triangular, posteriorly notched symphyseal cartilage (Fig. 7). This **car-**

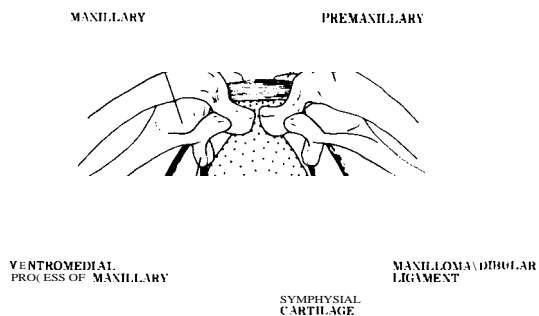


FIGURE 7. Ventral view of symphysis of upper jaw of *Oneirodes acanthias* showing symphyseal cartilage and associated ligaments. Teeth not shown.

tilage provides support for the upper jaw and part of the mechanism for the protrusion of the upper jaw. Movement of the symphyseal cartilage upon the slightly concave, dorsal surface of the ethmoid cartilage, is restricted to a horizontal plane by the narrow, medial forks of the frontal bones which extend nearly to the anterior limits of the ethmoid cartilage. The symphyseal cartilage is securely fastened to the upper jaw by a short ligament that originates on the mid-dorsal surface of the cartilage and bifurcates anteriorly, sending a branch to the base of the ascending process of each premaxillary. A second ligament originates on the lateral margin of each posterior lobe of the symphyseal cartilage and inserts on the ventromedial process of the respective maxillary bone. Forward movement of the upper jaw is limited by a series of ligaments: a palatopremaxillary ligament originating on the head of each palatine bone and inserting on the short ascending process of the premaxillary bone of the opposite side; two ligaments inserting on the dorsal process of each maxillary, an ethmomaxillary ligament which originates on each anterolateral corner of the supraethmoid, and a palatomaxillary ligament which originates on the head of the respective palatine bone; a **maxillo-mandibular** ligament, originating at the base of the dorsal process of each maxillary bone, passes **ventrally**, forming a tendinous association with the adductor mandibulae muscle, and inserts on the medial side of the respective articular bone.

Posteromedially, the notched symphyseal cartilage butts against the supraethmoid, its posterior lobes fitting into the large nasal foramina formed by the supraethmoid, ethmoid cartilage, and lateral ethmoids (Fig. 4). Force exerted on the **premaxillaries** is thus cushioned and transferred by the symphyseal cartilage to the supraethmoid and then back through the frontal bones and parasphenoid to the posterior part of the cranium.

On each side, the posterior ends of the premaxil-

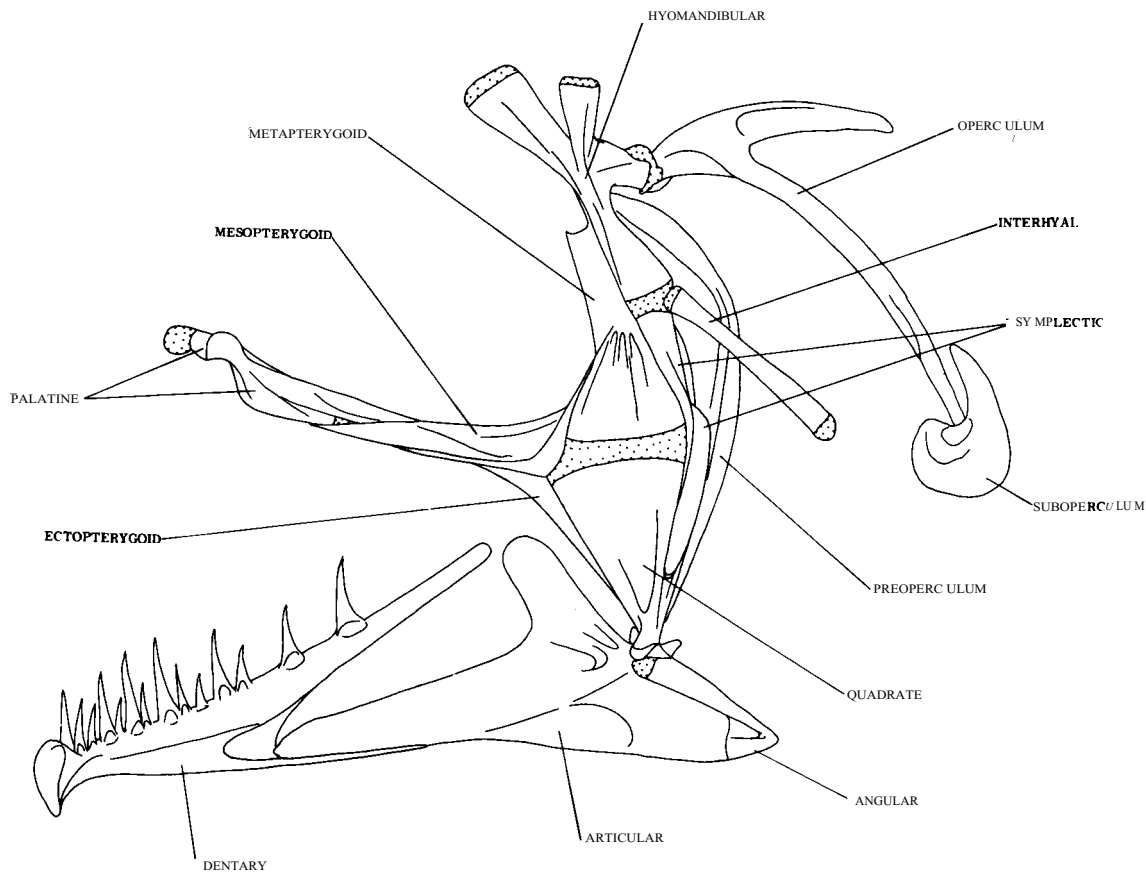


FIGURE 8. Medial view of right side of lower jaw and suspensorium of *Oneirodes acanthias* with part of opercular apparatus in place.

lary and maxillary bones are united by a strong ligament that passes anteriorly to attach to the labial cartilage of the dentary (Pietsch, 1972a:31). The elongate portion of each premaxillary bone may bear up to 28 recurved, depressible teeth of mixed sizes with no recognizable pattern in their placement.

Maxillaries (Figs. 1, 3, 6-7) : The expanded anterior end of each maxillary bone consists of two parts: a dorsal process which overlaps the respective premaxillary and on which two ligaments insert (an ethmomaxillary ligament originating on the anterolateral corner of the supraethmoid, and a palatomaxillary ligament originating on the head of the palatine bone), and a ventromedial process which is loosely attached by a short ligament to the articular process of the respective premaxillary.

Lower Jaw

Dentaries, articulars, and angulars (Figs. 6, 8) : The dentaries are thick, toothed bones, each consisting of a dorsal and ventral fork between which

fits the anterior process of the articular. Anteriorly, the dentaries curve to meet on the midline where they form a strong symphyseal spine. The labial cartilage of the dentary (Pietsch, 1972a:31) is well developed. The anterior two-thirds of each dentary bears 14 to 17 depressible, recurved teeth of mixed sizes with no obvious pattern in their placement. At its articulation with the quadrate, the articular forms a small, posteriorly and **ventrolaterally** directed spine which is connected by a ligament to the ventral tip of the preoperculum. The angular articulates within a shallow recess on the medial surface of the articular just below the articular-quadrate joint. A strong ligament extends from the posteriormost tip of each angular to the ventral tip of the respective interoperculum.

Palatine Arch

Metapterygoids (Figs. 6, 8) : Anteriorly, the upper half of each metapterygoid forms a thin, weakly ossified flange, the concave dorsal margin of which is attached to the anterodorsal margin of

the hyomandibular by a sheet of connective tissue. The posterior margin of the metapterygoid is ankylosed to the ventral half of the hyomandibular dorsally, and the dorsal two-thirds of the symplectic ventrally. Although Rosen and Patterson (1969: 439) state that the metapterygoid is fused with the hyomandibular in Lophiiformes, I have not found this to be the case in any **lophiiform** examined (see Appendix B).

Mesopterygoids (Figs. 6, 8): Each crescent-shaped mesopterygoid is grooved on its convex margin to receive the anteroventral corner of the metapterygoid, the dorsal half of the ectopterygoid, and the posteroventral tip of the palatine.

Ectopterygoids (Figs. 6, 8): The narrow, ventral half of each ectopterygoid is firmly attached to the upper two-thirds of the anterior margin of the quadrate. The anteriorly directed, dorsal half of the ectopterygoid lies lateral to, and within a groove on the ventrolateral side of the mesopterygoid. A posteriorly directed extension of the palatine overlaps the lateral surface of the anterior one-fourth of the ectopterygoid.

Palatines (Figs. 6, 8): The anterior head of each palatine is loosely held within a shallow concavity of the respective maxillary bone by connective tissue and by the palatamaxillary ligament. A second ligament originating on the head of the palatine inserts on the short ascending process of the **premaxillary** bone of the opposite side. Immediately posterior to the palatine-maxillary articulation, the medial surface of the palatine is firmly attached to the ethmoid cartilage. This cartilage thus acts as a keystone between the lateral ethmoids, the anterior tips of the frontals and the anterior heads of the palatines. Posteriorly, each palatine overlaps the ectopterygoid dorsolaterally, and lies within the grooved, anterior tip of the mesopterygoid, ventrally.

Hyoid Arch

Figs. 6, 8-10

Hyomandibular (Figs. 6, 8): Dorsally, each hyomandibular bone is forked forming two heads: a slightly longer and wider anterior head which articulates within an oval-shaped cartilaginous area between the sphenotic, prootic, and anterior corner of the pterotic; and a shorter posterior head which articulates on the ventrolateral face of the pterotic. An articular head for the proximal end of the operculum is found on the upper half of the posterior margin of the hyomandibular. The ventral half of the hyomandibular is bordered by the metapterygoid anteriorly, and widely separated by cartilage from the symplectic ventrally. A postero-

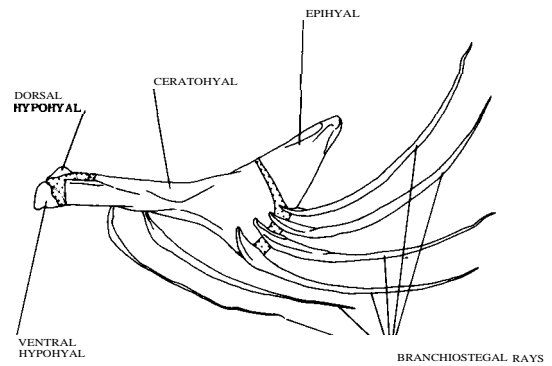


FIGURE 9. Lateral view of hyoid apparatus of *Oneirodes acanthias*, left side. Interhyal not shown.

ventrally directed extension of each hyomandibular overlaps the dorsal end of the respective preoperculum.

Symplectics (Figs. 6, 8): Each symplectic consists of two parts: a tapering dorsal portion which is in contact with the metapterygoid anteriorly, the preoperculum posteriorly, and separated from the hyomandibular by cartilage; and a broad, spatulate ventral portion, the ventral one-half of which lies in a groove on the medial surface of the upper two-thirds of the quadrate. The upper one-half of the ventral portion of the symplectic is overlapped by the preoperculum.

Quadrates (Figs. 6, 8): Ventrally, each triangular-shaped quadrate forms an articulating head which fits into a socket on the posterior margin of the respective articular. A posteriorly and ventrolaterally directed quadrate spine is attached by connective tissue to the slightly smaller mandibular spine.

Interhyals (Figs. 6, 8): Each interhyal is a slender, rodlike bone the dorsal end of which is loosely attached by connective tissue to the medial side of the cartilage that lies between the **hyomandibular** bone and symplectic. Ventrally, the **interhyal** makes a cartilaginous connection with the posterior end of the epihyal.

The remaining elements of the hyoid arch, including the epihyals, ceratohyals, dorsal and ventral hypohyals, and branchiostegal rays do not differ substantially from those described for other ceratioids (Pietsch, 1972a).

Opercular Apparatus

Figs. 6, 8

Operculum (Figs. 6, 8): The posterior margin of each operculum is deeply notched, the two forks of which are at an angle of approximately 45°. The lower fork is about twice the length of

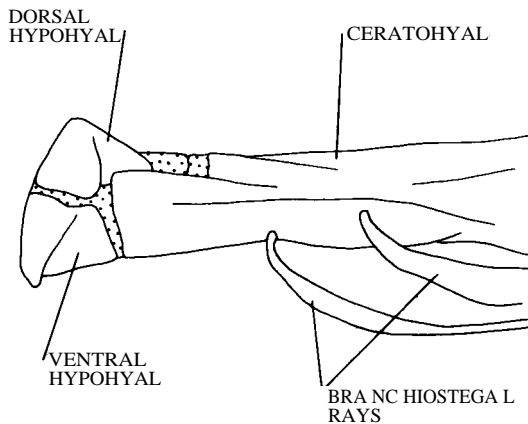


FIGURE 10. Medial view of anterior portion of hyoid apparatus of *Oneirodes acanthias*, right side.

the upper, and bears the respective suboperculum on its distal end.

Two ligaments insert on the articular head of the operculum. One of these originates on the posterior head of the double-headed hyomandibular bone; the other originates on the posterior margin of the preoperculum.

Suboperculum (Figs. 6, 8) : Each suboperculum is firmly attached by its lateral surface to the distal tip of the lower fork of the respective operculum. The lower part of the suboperculum is semicircular and bears no spine on its anterior margin; the upper part is short, and rounded in smaller specimens, but becomes longer, narrower, and pointed in larger specimens. The dorsal tip of the upper part of the suboperculum is notched in some large individuals.

Interoperculum (Fig. 6) : The interoperculum is narrow, and flattened, the upper one-fifth extending beyond its articulation with the posterior end of the epihyal. The tapering ventral end of each interoperculum is attached by a strong ligament to the posterior tip of the respective angular bone.

Preoperculum (Figs. 6, 8) : The large, posteriorly curved preoperculum strengthens the entire length of the long hyoid arch. The anterior margin of the upper one-fifth of this element is overlapped by a posteroventral extension of the hyomandibular bone. Ventrally, the preoperculum covers the lateral surface of the ventral portion of the symplectic, and is ankylosed to the posterior margin of the quadrate. A short ligament originates on the ventral tip of each preoperculum and inserts on the mandibular spine of the respective articular bone. A second ligament passes from the posterior

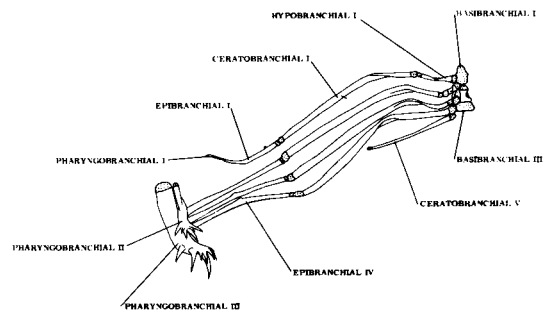


FIGURE 11. Branchial arches of *Oneirodes acanthias*. The ventral part of the branchial basket is shown in dorsal view, the dorsal part (epibranchials and pharyngobranchials) is folded back and shown in ventral view.

margin of each preoperculum to the articulating head of the respective operculum.

Branchial Arches

Pharyngobranchials (Fig. 11) : There are three pharyngobranchials. That of the first arch, the suspensory pharyngobranchial, is reduced, its dorsal end lying free in the connective tissue matrix with no ossified or ligamentous connection to the medial side of the hyoid arch.

The pharyngobranchials of the second and third arches are attached to each other and to the dorsal ends of the epibranchials of the second, third and fourth arches. Pharyngobranchial II, which is slightly more than half as long, and approximately half as wide as pharyngobranchial III, bears on its expanded ventral end as many as 10 large, depressible and recurved teeth of mixed sizes. As many as 12 similar teeth, some of which are considerably larger than those of pharyngobranchial II, are borne on the expanded ventral end of pharyngobranchial III. As in all ceratioids a pharyngobranchial of the fourth arch is absent.

Epibranchials (Fig. 11) : The epibranchial of the first arch is a long, narrow, dorsally curved bone that supports the reduced suspensory pharyngobranchial on its distal tip. Although teeth are absent on epibranchial I, all specimens of *O. acanthias* examined have a minute, rounded ossification lying free in the connective tissue matrix on the anterior margin of the first epibranchial. This element may be a remnant of a tooth-plate. Well-developed teeth are present on the epibranchial of the first arch of other species of *Oneirodes* (see below, p. 25, Fig. 50).

The epibranchials of the second, third and fourth arches are approximately twice as long as that of the first arch and support the toothed pharyngobranchials II and III distally. At mid-length,

epibranchials II and III each bear a short, blunt process on their anterior margins. These spines are interconnected by a short ligament which securely binds these bones to each other. The cartilaginous articulations of all four epibranchials with their respective ceratobranchials are loosely interconnected by short ligaments.

Ceratobranchials (Fig. 11): The ceratobranchials are the longest elements of the branchial arches. The ventral one-fourth of the first three of these is bent at an angle of approximately 140°; the cartilaginous ventral tip of each articulates with its respective hypobranchial. The ventral one-third of the ceratobranchial of the fourth arch is bent at a similar angle; its cartilaginous ventral tip articulates directly with the cartilaginous third basibranchial. The fifth ceratobranchial, like the first four, lacks teeth but is only slightly bent and approximately one-half as long. The cartilaginous ventral tip of ceratobranchial V articulates with the cartilaginous ventral tip of ceratobranchial IV and is not in contact with the third basibranchial. Dorsally, ceratobranchial V lies free in the connective tissue matrix.

The remaining elements of the branchial arches, the hypobranchials of the first three arches and basibranchials I, II, and III, are similar to those described for other ceratioids (Pietsch, 1972a).

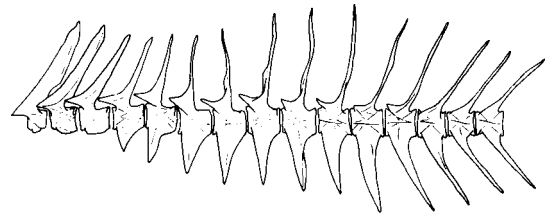


FIGURE 12. Lateral view of 5th-19th pre-ural centra of *Oneirodes acanthias*, anterior to the left.

Vertebrae

Figs. 2-3, 6, 12-13

Of 24 specimens examined (either alizarin-stained or X-rayed), the number of vertebral centra (including the half-centrum to which is fused the hypural plate) varied from 19 to 21. Of these, two had 19, 20 had 20 and two had 21 centra. Of seven cleared and stained specimens examined, the number of precaudal vertebrae was four or five, and caudal vertebrae varied from 14 to 16 (the separation between precaudal and caudal vertebrae is taken at the point of the first complete haemal arch, after Weitzman, 1967, and Pietsch, 1972a).

The vertebrae are similar to those of *Centropryne spinulosa* (see Pietsch, 1972a: 36-37) differing, however, in the considerably greater development of the neural and haemal spines and in

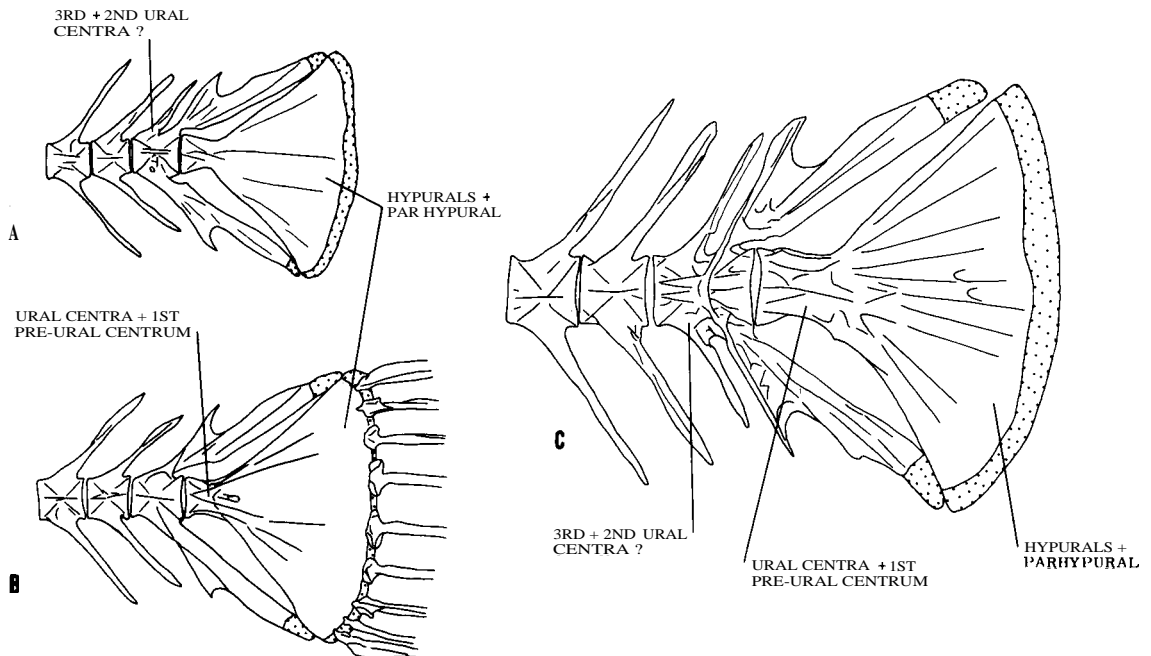


FIGURE 13. Caudal skeletons of *Oneirodes acanthias*, lateral views, showing what appears to be fusion of 2nd and 3rd pre-ural centra (A and C): A. LACM 6839-14, 34.0 mm SL; B. LACM 9960-4, 71.0 mm SL; C. LACM 9773-21, 132.0 mm SL.

the unusually small size of the second anteriormost centrum.

Two individuals (34.0 and 132.0 mm) appear to have undergone an ontogenetic reduction in the number of vertebral centra through fusion of the second and third pre-ural centra (Fig. 13 A, C). This complex, double centrum bears two neural spines and two haemal spines in the larger specimen but only a single, large haemal spine in the 34.0 mm individual. The problem of two neural or haemal spines borne on a single centrum is discussed in detail by Totten (1914; see also Schultz, 1963).

Caudal Skeleton

Fig. 13

The caudal skeleton is like that of other ceratioids in having the ural centra fused with the first pre-ural centrum (postterminal centra and terminal centrum, respectively, of Gosline, 1960; Pietsch, 1972a) to form a single, complex half-centrum which is fused to a single hypural plate (Rosen and Patterson, 1969:441).

The hypural plate, unnotched posteriorly, and consisting of an unknown number of fused hypurals plus the parhypural (haemal spine of the terminal vertebra of Gosline, 1960; Pietsch, 1972a), bears the overlapping bases of nine principal caudal rays. These rays are all biserial and segmented. The third ray (from the top) through the sixth are bifurcated distally.

Dorsal Fin and Illicial Apparatus

Figs. 14-15

The dorsal fin consists of six biserial, segmented and unbranched rays. Each ray is supported by a pterygiophore which consists of a cartilaginous distal radial and a proximal radial. There are no

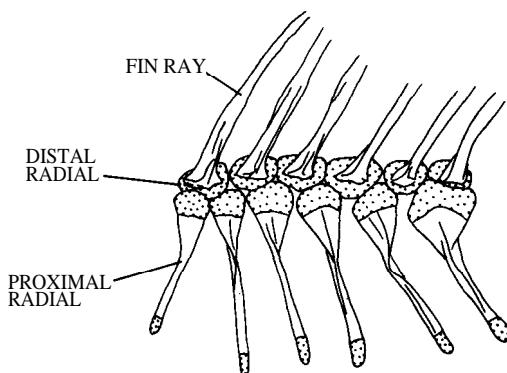


FIGURE 14. Bones of dorsal fin of *Oneirodes acanthias*, lateral view.

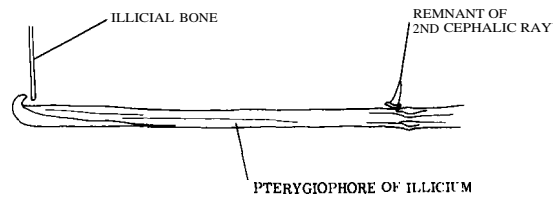


FIGURE 15. Part of illicial apparatus of *Oneirodes acanthias*, lateral view.

medial radials. All six proximal radials are similar in appearance, each having their proximal and expanded distal ends unossified.

In all cleared and stained specimens of *O. acanthias* examined the proximal end of the first pterygiophore lies above the neural spine of the 12th pre-ural centrum, while the proximal end of the last pterygiophore lies just anterior to the neural spine of the seventh pre-ural centrum.

The long, rodlike pterygiophore of the illicial apparatus, including its long, tapering, unossified posterior portion, is approximately half of standard length.

The remnant of the second cephalic ray (Fig. 15) is a minute, toothlike ossification.

Anal Fin

Fig. 16

The anal fin consists of four biserial, segmented, and unbranched rays. Each ray is supported by a cartilaginous distal radial. The first two distal radials are, in turn, supported by a proximal radial. The last two distal radials, however, share the support of a single proximal radial. There are no medial radials. The three proximal radials are similar

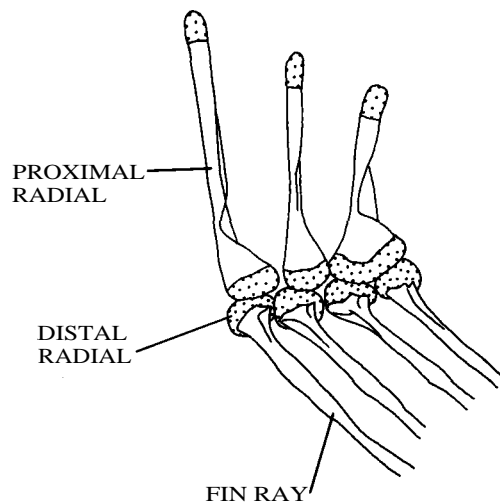


FIGURE 16. Bones of anal fin of *Oneirodes acanthias*, lateral view.

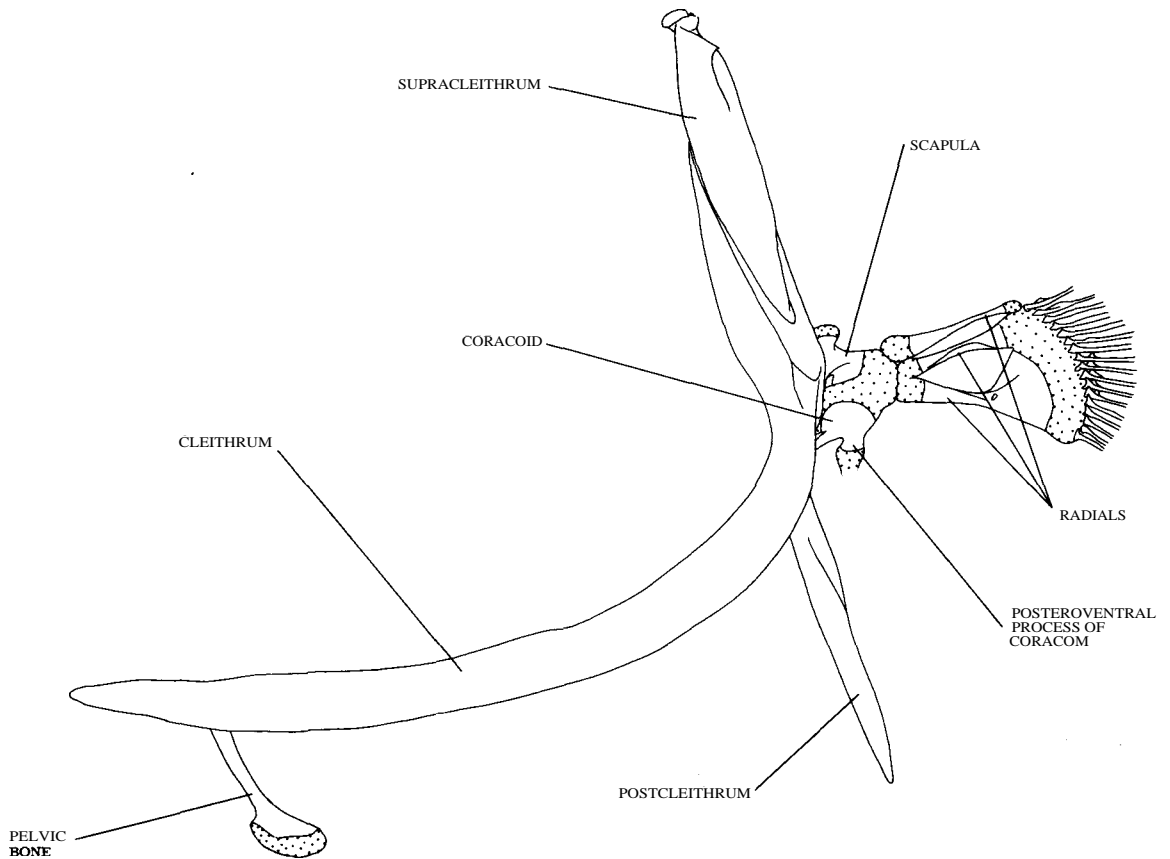


FIGURE 17. Lateral view of pectoral girdle, pectoral fin, and pelvic bones of *Oneirodes acanthias*, left side.

in appearance, each having their proximal and expanded distal ends unossified.

In all cleared and stained specimens of *O. acanthias* examined the proximal end of the first pterygiophore lies between the haemal spines of the eighth and ninth pre-ural centra, while the proximal end of the last pterygiophore lies between the haemal spines of the sixth and seventh pre-ural centra.

Pectoral Girdle and Pectoral Fin Figs. 5-6, 17

Posttemporals (Figs. 5-6) : The posttemporals are securely fixed to the posterolateral corners of the cranium. A deep notch is present on the anterolateral margin of each posttemporal. The flared-out, posteroventrally directed projections of each posttemporal bear a facet on the ventral surface for the articulation of the respective supraclithrum.

Supracleithrum (Fig. 6, 17) : The pectoral girdle is suspended from the skull by an elongate supraclithrum. The dorsal end of this bone articulates on the ventral surface of the lateral tip of the re-

spective posttemporal. Its tapering, posterior end lies in a shallow groove on the lateral surface of the cleithrum.

Cleithrum (Figs. 6, 17-18) : The upper part of the flat, crescent-shaped cleithrum is shallowly grooved on its lateral surface to receive the supraclithrum. Similarly, the posteriormost margin of the cleithrum is recessed on its medial side to receive the cartilage of the respective scapula. The ventral end of each cleithrum bears the respective pelvic bone on its medial surface. Ligaments originating on the tips of the haemal spines of the 16th and 15th pre-ural centra insert on the dorsal tip of each cleithrum.

Postcleithrum (Fig. 6, 17-18) : There is a single, long rod-like postcleithrum. Its proximal end articulates within a shallow socket on the medial side of the cleithrum, just anterior to the cartilage of the scapula.

Scapula (Fig. 6, 17-18) : The scapula is largely unossified. It consists of a rounded ossification bounded on three sides by cartilage. The anterior half of this cartilage is securely fixed within a recess on the medial side of the cleithrum just

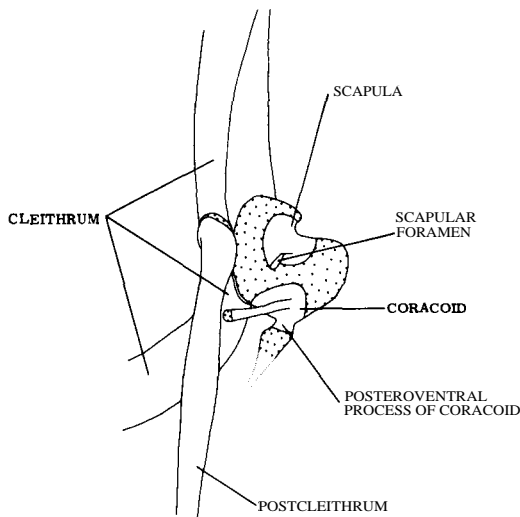


FIGURE 18. Medial view of portion of pectoral girdle of *Oneirodes acanthias*, right side.

posterior to the cleithrum-postcleithrum articulation. The scapular cartilage meets the coracoid ventrally and bears the radials of the pectoral fin posteriorly. On the ventral margin of the ossified part of the scapula, there is a small scapular foramen.

Coracoid (Figs. 6, 17-18): The coracoid consists of an expanded posterior portion, the dorsal margin of which meets the cartilage of the scapula, and an anteroventral prong which lies medial to the cleithrum. The unossified tip of a stout, **posteroventral** process of the coracoid is connected to the posterior margin of the postcleithrum by a ligament.

Radials (Figs. 6, 17): There are three separate, well-ossified pectoral radials, the first (uppermost) of which is approximately 75 percent of the length of the third. The cartilaginous proximal end of the first radial and the fused cartilaginous proximal tips of the second and third radials articulate with the cartilage of the scapula. The broad, fused, cartilaginous distal ends of the second and third radials support 15 to 18 moveable fin rays. In all osteological preparations examined a small foramen is present near the mid-dorsal margin of the third radial.

Bertelsen (1951:71; see also Regan and Trewavas, 1932: 35, 37, Figs. 41, 47) described a "small, oblong bone" which lies in contact with, "but is never fused" to the posterodorsal margin of the first pectoral radial. Although present in only the largest (132.0 mm) of the seven osteological preparations of *Oneirodes acanthias* examined, this element is found in most oneirodids;

but, contrary to Bertelsen (1951), it is fused to the first radial in all cases (see below, p. 29).

Pelvic Bones

Figs. 6, 17

The expanded, oval-shaped and unossified distal ends of the elongate pelvic bones are loosely attached to each other on the midline. Proximally, each pelvic bone is connected to the ventromedial margin of its respective cleithrum.

Skin Spines

Microscopic examination of all osteological preparations of *O. acanthias* revealed the presence of extremely small, widely separated dermal spines on the sides of the trunk and caudal peduncle. In an area of approximately 5 mm², just anterior to the base of the pectoral lobe of a 40.0 mm specimen, there are 18 spinules.

Comparative Osteology of Oneirodid Genera

Cranium

Ethmoid region: With few exceptions the ethmoid regions of all *Oneirodes* species examined are similar to that of *O. acanthias*. The supraethmoid of *O. luetkeni*, however, is Y-shaped rather than T-shaped, the ventro-medial process of the supraethmoid is short relative to its lateral processes, and the medial portion of the ethmoid cartilage is relatively thin (Fig. 19). Consequently, the illicial trough of *O. luetkeni* is deeper and narrower than that of other members of the genus. The supraethmoid of *O. basili* is T-shaped, and its ventromedial and lateral processes are approximately equal in length, but in this species the supraethmoid is displaced dorsally by the relatively thick medial portion of the ethmoid cartilage (Fig. 20). Thus, the posterior ends of the lateral ethmoids,

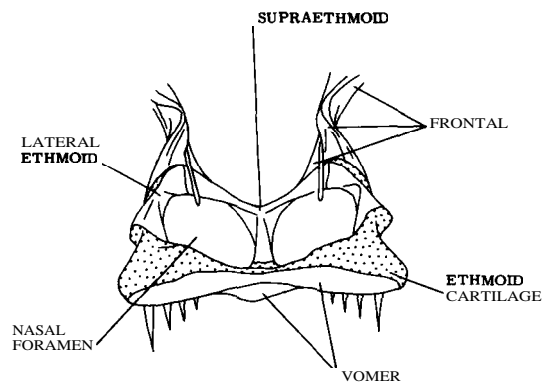


FIGURE 19. Anterior view of anterior half of cranium of *Oneirodes luetkeni*, LACM 31801-1, 61.0 mm SL.

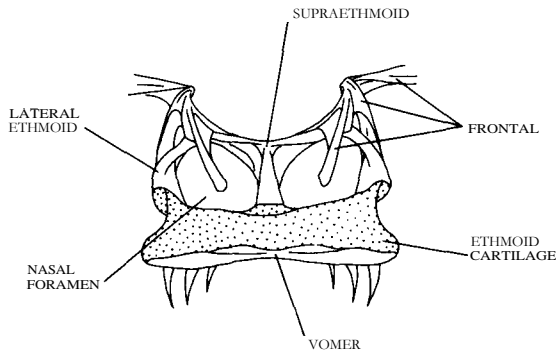


FIGURE 20. Anterior view of anterior half of cranium of *Oneirodes basili*, LACM 30028-30, 115.0 mm SL.

and the frontal bones are relatively far apart, resulting in a wider, shallower illicial trough than that of other members of the genus.

The ethmoid regions of *Microlophichthys* and *Danaphryne* closely resemble that of *Oneirodes*. In these three genera the relatively long ventromedial process of the supraethmoid, together with the large lateral ethmoids and relatively thin, dorsally concave ethmoid cartilage, form large, nearly circular nasal foramina. Correspondingly, the relatively large symphyseal cartilages of these genera have prominent posterior lobes (see below, p. 19). Both *Microlophichthys* and *Danaphryne* have relatively deep and narrow illicial troughs, comparable to that of *O. luetkeni*, but whereas this condition results from a medial, dorsoventral depression of the ethmoid region in *O. luetkeni* and *Microlophichthys*, *Danaphryne* has undergone a lateral compression of the entire anterior portion of the cranium (Fig. 21). Unlike all other oneirodid genera examined, the width of the ethmoid cartilage and vomer of *Danaphryne* is considerably less than the distance

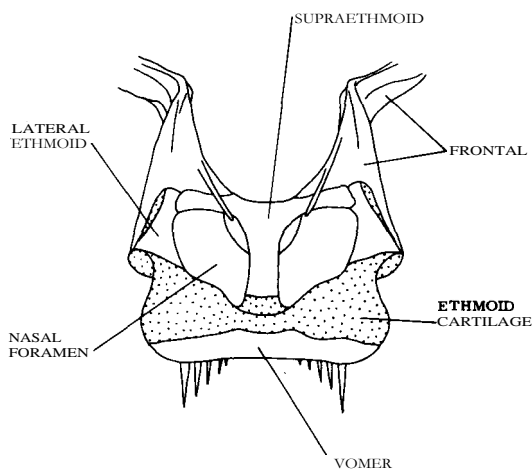


FIGURE 21. Anterior view of anterior half of cranium of *Danaphryne nigrifilis*, ISH 2658/71, 82.0 mm SL.

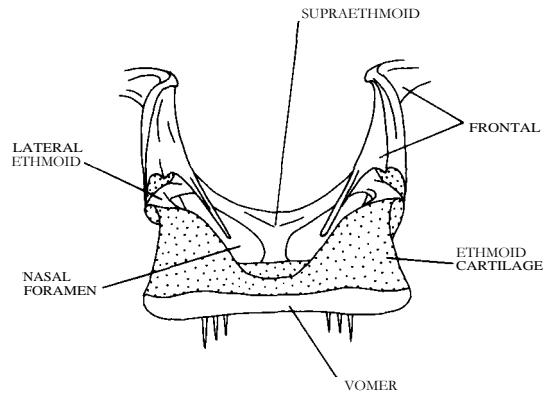


FIGURE 22. Anterior view of anterior half of cranium of *Leptacanthichthys gracilispinis*, ROM 27284, 54.0 mm SL.

between the anterior tips of the lateral ethmoids and frontals.

In *Leptacanthichthys*, *Dolopichthys*, *Bertella*, *Pentherichthys*, and *Chaenophryne*, relatively small lateral ethmoids, a ventromedial process of the supraethmoid which is less than half as long as the lateral processes of this bone, and a relatively thick anteromedial portion of the ethmoid cartilage (except in *Leptacanthichthys*), contribute to the formation of narrow, oval-shaped nasal foramina (Figs. 22-26). As in *O. luetkeni* and *Microlophichthys*, the ethmoid region of these genera is dorsoventrally depressed, but unlike the former, this depression is accompanied by a greater lateral separation of the frontal bones, thus forming a much wider, as well as a deeper, illicial trough. The extreme of this dorsoventral flattening of the ethmoid region and enlargement of the illicial trough is found in *Pentherichthys* (Fig. 25).

The anterodorsal surface of the ethmoid cartilage of *Leptacanthichthys* (Fig. 22) is deeply excavated medially to receive the relatively narrow symphyseal cartilage of the upper jaw (Fig. 39C).

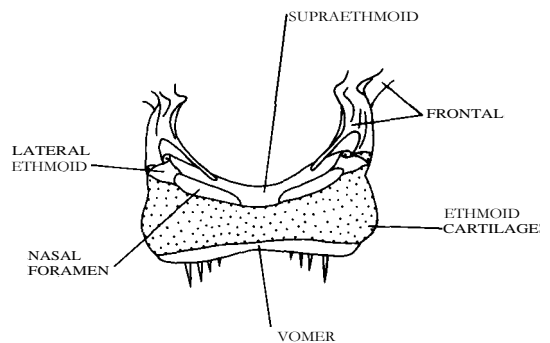


FIGURE 23. Anterior view of anterior half of cranium of *Dolopichthys pullatus*, LACM 6723-33, 76.0 mm SL.

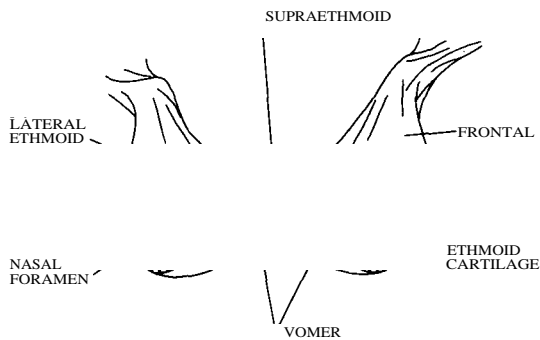


FIGURE 24. Anterior view of anterior half of cranium of *Bertella idiomorpha*, LACM 30561-1, 78.0 mm SL.

This part of the ethmoid cartilage is only slightly depressed in *Chaenophryne* and not depressed in *Dolopichthys*, *Bertella*, and *Pentherichthys*.

The ethmoid region of *Lophodolos* is similar to that of *Oneiroides*, *Microlophichthys* and *Danaphryne* (Fig. 27), but the lateral ethmoids are much larger, apparently to compensate for the greatly reduced frontal bones of this genus (see below, p. 18). Unlike all other genera examined, the ethmoid cartilage of *Lophodolos* has no posteromedial connection with the frontal bones.

Vomer: Vomerine teeth, present in most genera, vary in number and size among oneirodids. Of osteological preparations of oneirodid species and genera examined, teeth in moderate numbers and size are present on the vomer of *O. acanthias* (as many as four), and other *Oneiroides* species with the exception of *O. luetkeni*. High numbers of small vomerine teeth (10 or more) are found in *O. luetkeni*, *Microlophichthys*, *Danaphryne*, *Lep-tacanthichthys*, and *Dolopichthys*. As many as six extremely large teeth are present on the vomer of *Chaenophryne* (Fig. 26). In *Bertella* and in some species of *Dolopichthys* (Pietsch, 1972c, 1973) vomerine teeth are lost with growth. Vomerine teeth are absent in *Lophodolos* and *Pentherichthys*.

Frontal and parietal region: In *O. luetkeni* (Fig.

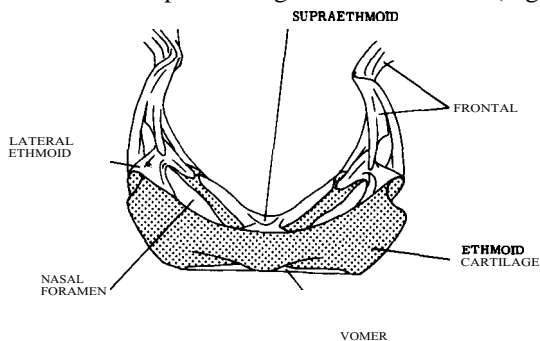


FIGURE 25. Anterior view of anterior half of cranium of *Pentherichthys venustus*, ISH 130/67, 119.0 mm SL.

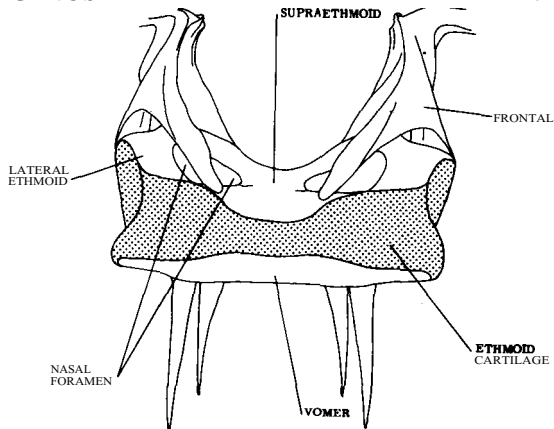


FIGURE 26. Anterior view of anterior half of cranium of *Chaenophryne parviconus*, LACM 30427-17, 88.0 mm SL.

28) the frontals occupy a more posterior position than those of other *Oneiroides* species examined (compare with Figs. 2, 29). Their posterior, ventromedial extensions form an angle of approximately 70° with the parasphenoid (compared to an angle of about 55° in *O. acanthias*), their dorsal profile is less curved, and their anteromedial forks are much weaker, and together with the pterosphenoïd, prootic, and parasphenoid, they form roughly circular orbital foramina. In contrast, the frontals of *O. basili* (Fig. 29), lie in a more anterior position. Their well developed anteromedial forks extend considerably beyond the anterior limits of the ethmoid cartilage, their posterior, ventromedial extensions form an angle of roughly 45° with the parasphenoid, their dorsal margins are more sharply curved at mid-length, and they contribute to the formation of oval-shaped orbital foramina.

Further differences in the shape of the frontals occur among species of *Oneiroides*. The dorso-

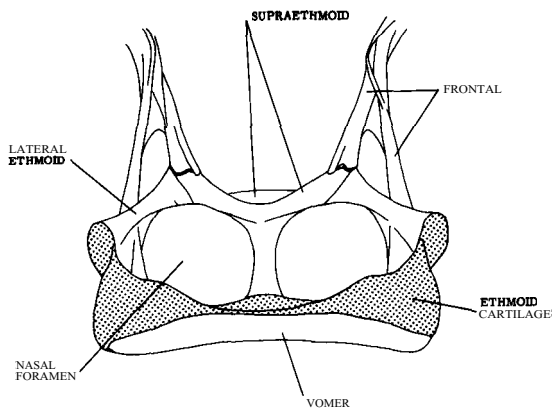


FIGURE 27. Anterior view of anterior half of cranium of *Lophodolos acanthognathus*, ROM 27285, 57.0 mm SL.

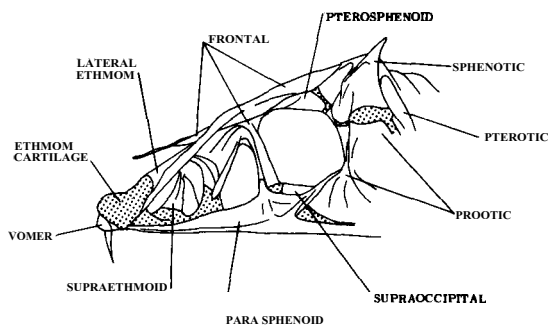


FIGURE 28. Lateral view of cranium of *Oneirodes luetkeni*, LACM 31801-1, 61.0 mm SL.

lateral edge of the posterior half of these bones in *O. notius* is convex, compared to a linear shape of this part of the frontal in *O. acanthias* and other *Oneirodes* species examined (Fig. 30).

Among oneirodid genera, the shape and position of the frontals of *Microlophichthys* and *Danaphryne* (Figs. 31, 32) are similar to those of *Oneirodes*. Those of *Lophodolos* (Fig. 33), however, are considerably reduced in size and thickness, differing from those of all other genera in a number of ways: their dorsal margins are slightly concave, ventromedial extensions are absent (the frontals thus make no contact with the parasphenoid and meet with the ethmoid cartilage only at their extreme anterior tips), and the anterior two-thirds of each is deeply incised, forming a short medial fork which slightly overlaps the posterior tip of the enlarged lateral ethmoid, and a considerably longer lateral fork which extends beyond the anterior limits of the lateral ethmoid. In addition, the posterior ends of the frontals of *Lophodolos* extend ventrally, providing a brace against the sphenotic and prootic, perhaps helping to compensate for the lack of a pterosphenoïd in this genus.

In contrast to the frontals of *Oneirodes*, *Microlophichthys*, *Danaphryne*, and *Lophodolos*, those of *Leptacanthichthys*, *Dolopichthys*, *Bertella*,

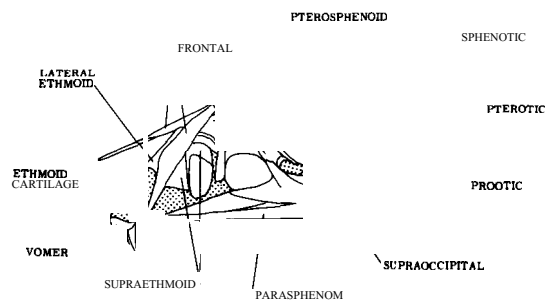


FIGURE 29. Lateral view of cranium of *Oneirodes basili*, LACM 30028-30, 115 mm SL.

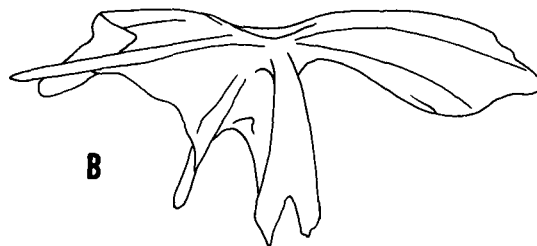
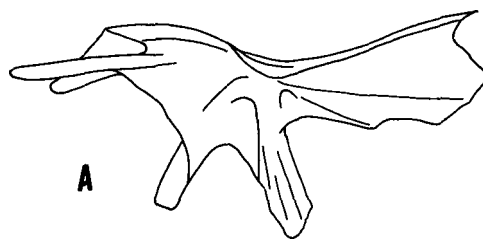


FIGURE 30. Dorso-medial views of right frontal bone, anterior to the left: A. *Oneirodes acanthias*, LACM 9960-4, 71.0 mm SL; B. *Oneirodes notius*, paratype, LACM 11184-6, 54.0 mm SL.

Chaenophryne, and *Pentherichthys* (Figs. 34-38) are longer and occupy a more anterior position, overhanging and extending past the anterior limits of the ethmoid cartilage and vomer. The posterior, ventromedial extensions of these bones are longer and more posteriorly directed, forming smaller angles with the parasphenoid (as small as 25° in *Dolopichthys*). The dorsal margin of the frontals of *Leptacanthichthys*, *Bertella*, and *Dolopichthys* is nearly linear; that of *Pentherichthys* and *Chaenophryne* is convex.

Besides contributing to the formation of a longer cranium, the greater length and anterior extension of the frontals in these genera are accompanied by considerably larger, narrower, orbital

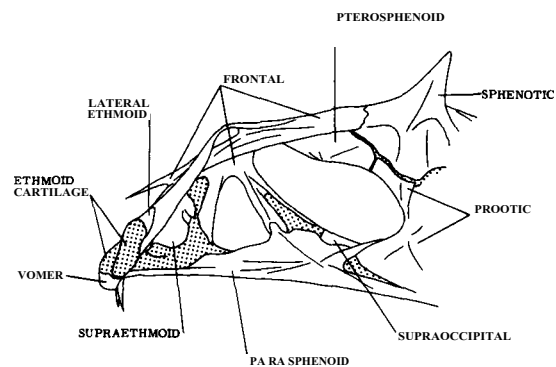


FIGURE 31. Lateral view of cranium of *Danaphryne nigrifilis*, ISH 2658/71, 82.0 mm SL.

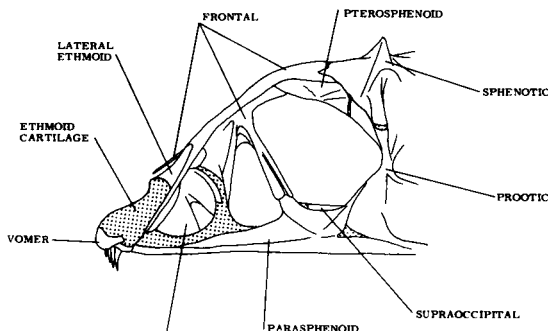


FIGURE 32. Lateral view of cranium of *Microlophichthys microlophus*, ROM 27286, 99.0 mm SL.

foramina, and by a decrease in the depth of the cranium. The extreme of this elongation and depression of the cranium is represented by *Dolopichthys* (Fig. 35).

The dorsomedial margins of the frontals and parietals of *Oneirodes* and *Pentherichthys* diverge posteriorly, the posterior end of the illicial trough being considerably wider and shallower than its anterior end. In contrast, the dorsomedial margins of these bones in all other genera are parallel, contributing to the formation of an illicial trough that is approximately equal in width and depth along its entire length.

Pterosphenoids, sphenotics, pterotics: A pterosphenoid, similar to that of *O. acanthias* (Figs. 2-3), is present in all oneirodids examined except for *Lophodolos* (erroneously said to be present in *Lophodolos* by Pietsch, 1972a:29).

The sphenotic bone forms a spine of varying size in all oneirodids except for *Chaenophryne* (Fig. 37). In this genus the sphenotic is only slightly raised on its dorsolateral surface; the dorsal surface of the sphenotic region is concave, the parietal being the most dorsally protruding bone

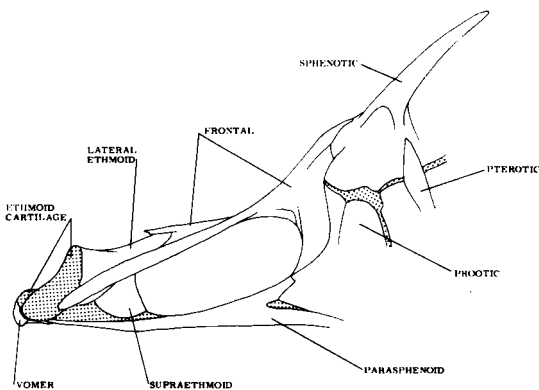


FIGURE 33. Lateral view of cranium of *Lophodolos acanthognathus*, ROM 27285, 57.0 mm SL.

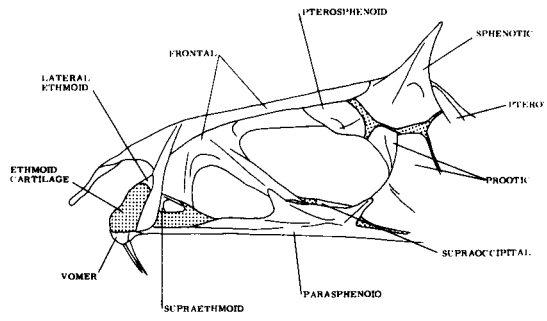


FIGURE 34. Lateral view of cranium of *Leptacanthichthys gracilispinis*, ROM 27284, 54.0 mm SL.

of the skull. *Lophodolos* is unique among oneirodids in bearing extraordinarily developed, posteriorly curved, sphenotic spines (Fig. 33).

The pterotics of all oneirodids examined are like those described for *O. acanthias*. All possess an anterodorsally directed process that overlaps the posterolateral surface of the respective sphenotic bone.

Mandibular Arch

Upper Jaw

Premaxillaries and symphyseal cartilage: The premaxillaries of the various oneirodids examined differ considerably in the number and size of the teeth which they bear. These differences are the same as those found in the teeth of the dentary described below.

As described above for *O. acanthias* (Fig. 1, 7), the symphyseal cartilage of *Danaphryne*, *Microlophichthys*, *Leptacanthichthys*, *Chaenophryne*, and *Lophodolos* (Fig. 39, A-E) is considerably longer than wide and deeply notched on its posterior margin. The well-developed posterior lobes of the symphyseal cartilage correspond to the concave, dorsal surface of the ethmoid cartilage and wide nasal foramina of these genera. In contrast, the symphyseal cartilage of *Dolopichthys*, *Bertella*, and *Pentherichthys* (Fig. 39, F-H) is much wider

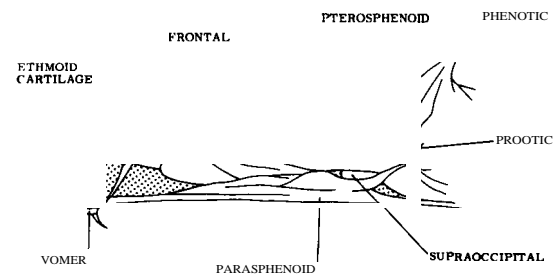


FIGURE 35. Lateral view of cranium of *Dolopichthys pullatus*, LACM 6723-33, 76.0 mm SL.

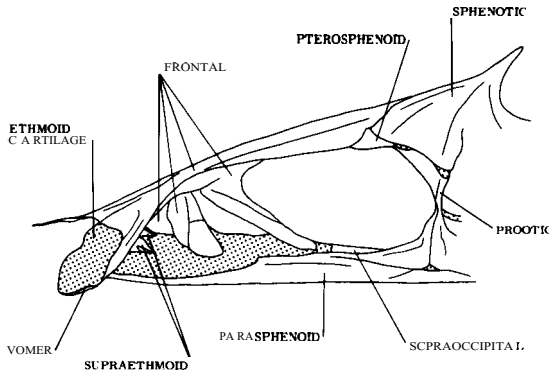


FIGURE 36. Lateral view of cranium of *Bertella idiomorpha*, LACM 30561-1, 78.0 mm SL.

than long, its posterior margin is only slightly concave in *Bertella* and *Dolopichthys* and slightly convex in *Pentherichthys*.

Maxillaries: The maxillaries of all oneirodids examined, except *Chaenophryne*, are similar to those described above for *O. acanthias* (Figs. 1, 3, 6). Those of *Chaenophryne* differ from the maxillaries of the other genera in the greater expansion of their anterior portions (overlapping the premaxillaries to a considerably greater extent), and their much longer ventromedial processes.

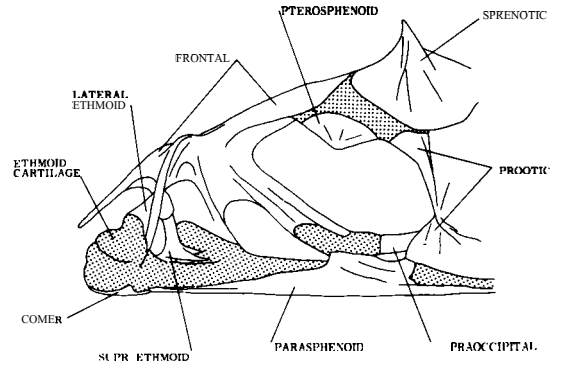


FIGURE 38. Lateral view of cranium of *Pentherichthys venustus*, ISH 130/67, 119.0 mm SL.

Chaenophryne is not "peculiar in that the maxillary gradually tapers backwards" as stated by Regan and Trewavas (1932:35).

Lower Jaw

Differences in the size of the bones of the lower jaw are correlated with differences in the length and depth of the cranium; oneirodids with relatively short, deep dentary and articular bones such as *Oneirodes*, *Danaphryne*, and *Microlophichthys* (Figs. 8, 40, 41) have short, deep crania as compared to longer-jawed genera such as *Leptacan-*

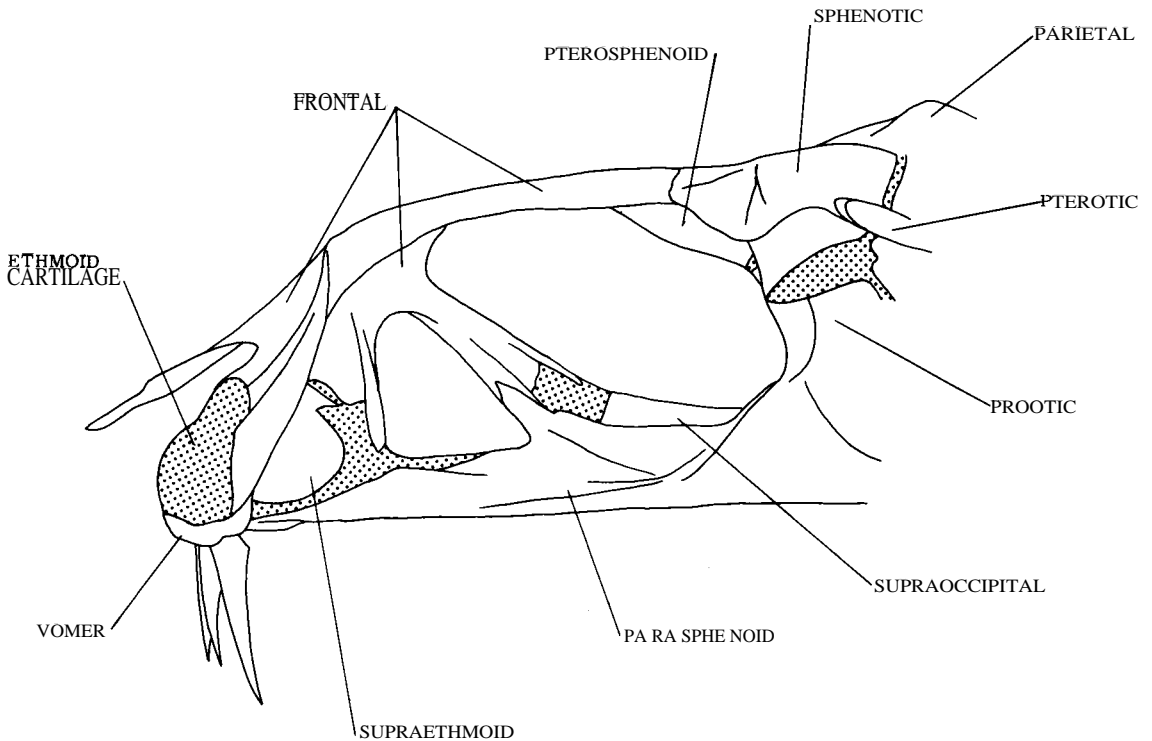


FIGURE 37. Lateral view of cranium of *Chaenophryne parviconus*, LACM 30427-17, 88.0 mm SL.

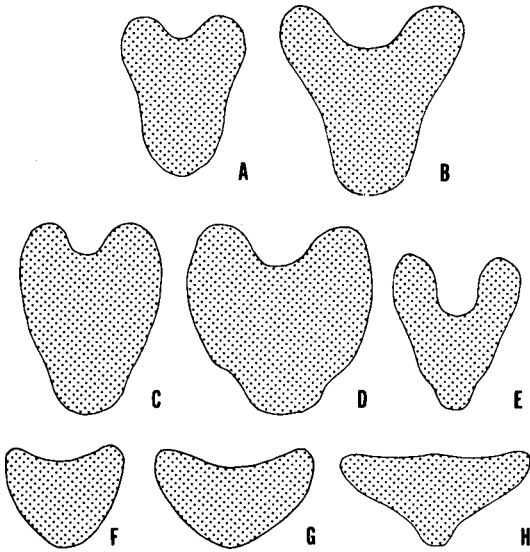


FIGURE 39. Dorsal view of symphyseal cartilage: A. *Danaphryne nigrifilis*, ISH 2658/71, 82.0 mm SL; B. *Microlophichthys microlophus*, ROM 27286, 99.0 mm SL; C. *Leptacanthichthys gracilispinis*, ROM 27284, 54.0 mm SL; D. *Chaenophryne parviconus*, LACM 30427-17, 88.0 mm SL; E. *Lophodolos acanthognathus*, ROM 27285, 57.0 mm SL; F. *Dolopichthys pullatus*, LACM 6723-33, 76.0 mm SL; G. *Bertella idiomorpha*, LACM 30561-1, 78.0 mm SL; H. *Pentherichthys venustus*, ISH 130/67, 119.0 mm SL.

thichthys, *Bertella*, and *Dolopichthys* (Figs. 42-44).

In other ways, the bones of the lower jaw do not differ substantially from those described for *O. acanthias* except in the development of the symphyseal and articular spines, and the number and size of the teeth on the dentary. Among *Oneirodes* species the symphyseal spine is moderately developed, the mandibular spine, although varying considerably in length, is never longer than the quadrate spine, and dentary teeth range from numerous and small, as in *O. luetkeni* (as many as 48 on each dentary), to relatively few and large, as in *O. acanthias* (fewer than 20 on each dentary, Fig. 8). In all *Oneirodes* species upper and lower jaw teeth are more or less recurved.

Of oneirodids examined, the symphyseal spine is extremely well-developed in *Lophodolos* (Fig. 45), small and blunt to absent in *Chaenophryne* (Fig. 46), absent in *Pentherichthys* (Figs. 47-48), and moderately developed in all other genera. The symphysis of the lower jaw of *Pentherichthys* (Fig. 48) is unlike that of any other genus; immediately lateral to its union on the midline, each dentary forms a broad, thick, posteroventrally-directed flange. Thus, viewed anteriorly, the ventral margin of the lower jaw at the symphysis is concave.

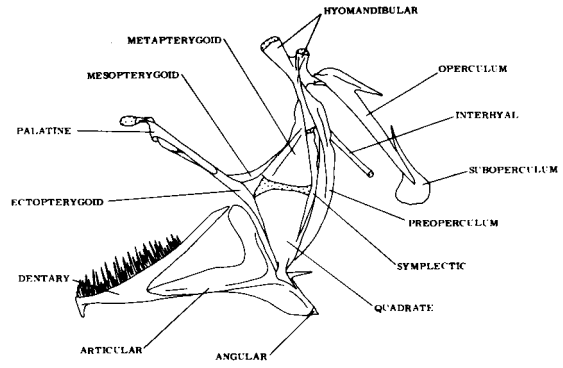


FIGURE 40. Lateral view of left side of lower jaw and suspensorium of *Danaphryne nigrifilis*, ISH 2658/71, 82.0 mm SL, with part of opercular apparatus in place.

A distinct pattern in tooth placement is present in both upper and lower jaws of those forms having high tooth counts (for example, *O. luetkeni*, *Microlophichthys*, *Lophodolos*, and especially *Pentherichthys*). This pattern is like that described for *Dolopichthys* (see Pietsch, 1972c).

Palatine Arch

The bones of the palatine arch are much alike in all oneirodids examined. The anterior margin of the upper half of the metapterygoid of *Oneirodes*, however, forms a thin, weakly ossified flange which is absent in all other genera (Fig. 8). Variation among oneirodid genera in the length and width of the palatine arch is associated with the length and depth of the jaws and cranium. Those forms with longer, shallower jaw bones and crania (*Leptacanthichthys*, *Bertella*, and *Dolopichthys*) have longer, narrower mesopterygoid, ectopterygoid, and palatine bones (Figs. 42-44).

Hyoid Arch

The various elements of the hyoid arch are very similar in all oneirodids except that, unlike all other oneirodid genera, the hyomandibular of *Bertella* (Fig. 43) is undivided dorsally, forming a single broad articulation with the cranium.

Opercular Apparatus

The size and shape of the opercular and subopercular bones vary considerably among the species and genera of oneirodids. The form of these bones is a diagnostic feature of many genera (Bertelsen, 1951:73, Fig. 31), in spite of some intrageneric variation. Within *Oneirodes* the suboperculum is relatively short and broad in *O. notius* and *O. myrionemus*, long and narrow in *O. rosenblatti*, *O. macrosteus*, and members of the *O.*

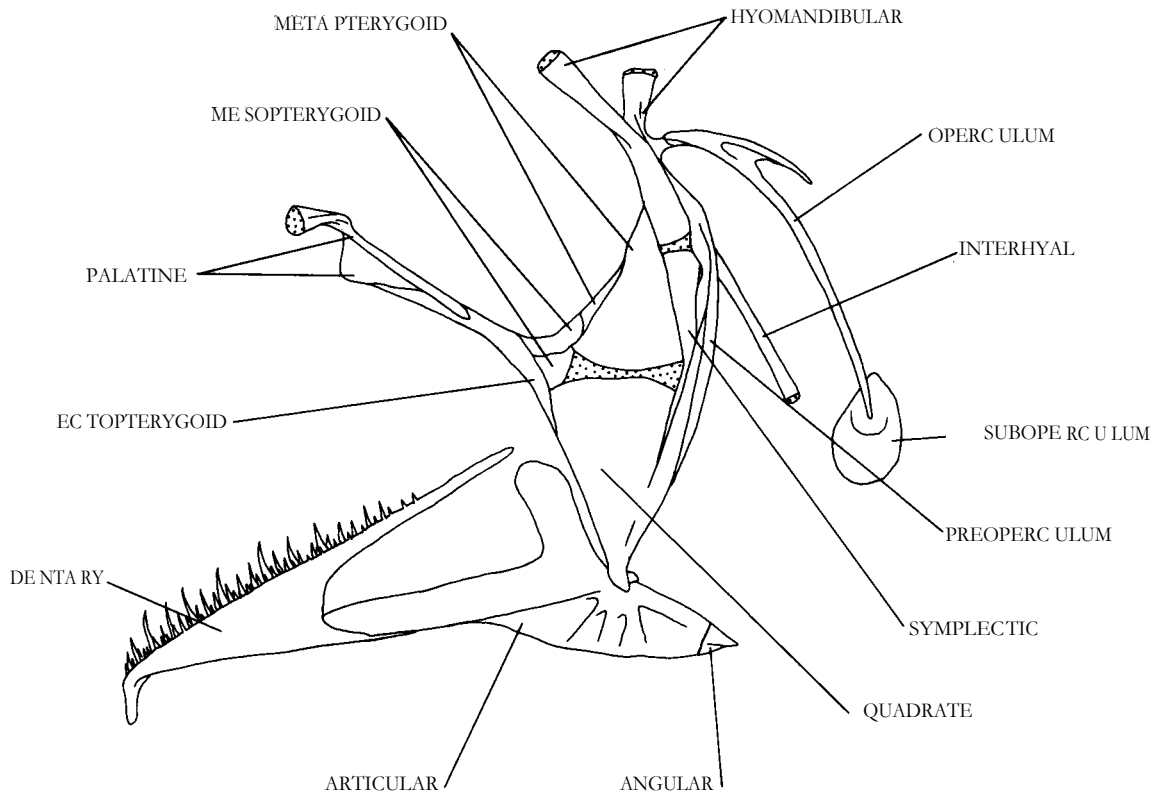


FIGURE 41. Lateral view of left side of lower jaw and suspensorium of *Microlophichthys microlophus*, ROM 27286, 99.0 mm SL, with part of opercular apparatus in place.

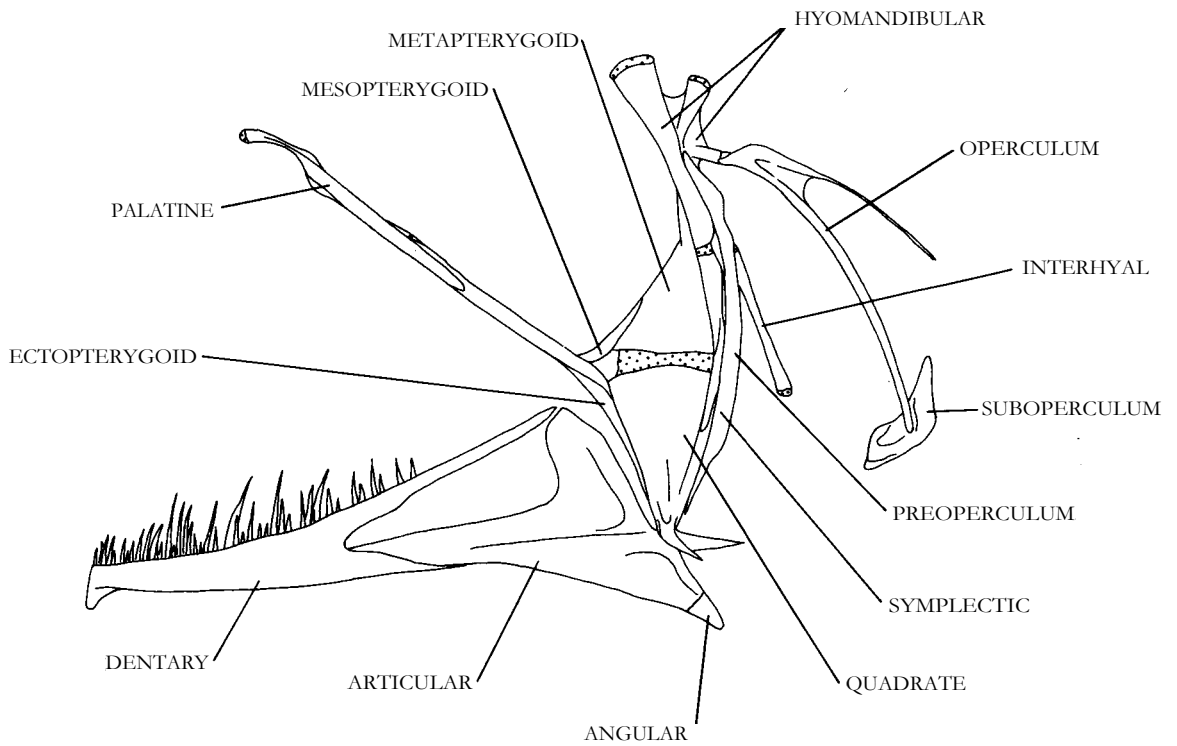


FIGURE 42. Lateral view of left side of lower jaw and suspensorium of *Leptacanthichthys gracilispinis*, ROM 27284, 54.0 mm SL, with part of opercular apparatus in place.

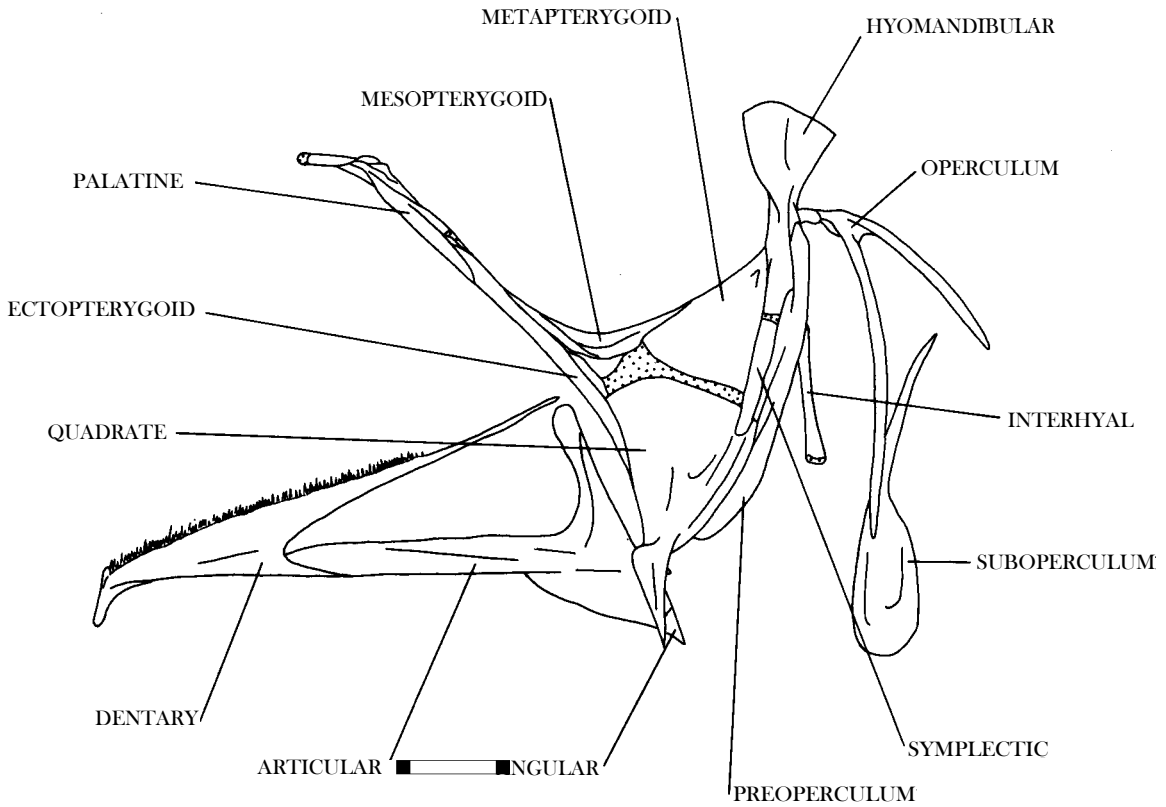


FIGURE 43. Lateral view of left side of lower jaw and suspensorium of *Bertella idiomorpha*, LACM 30561-1, 78.0 mm SL, with part of opercular apparatus in place.

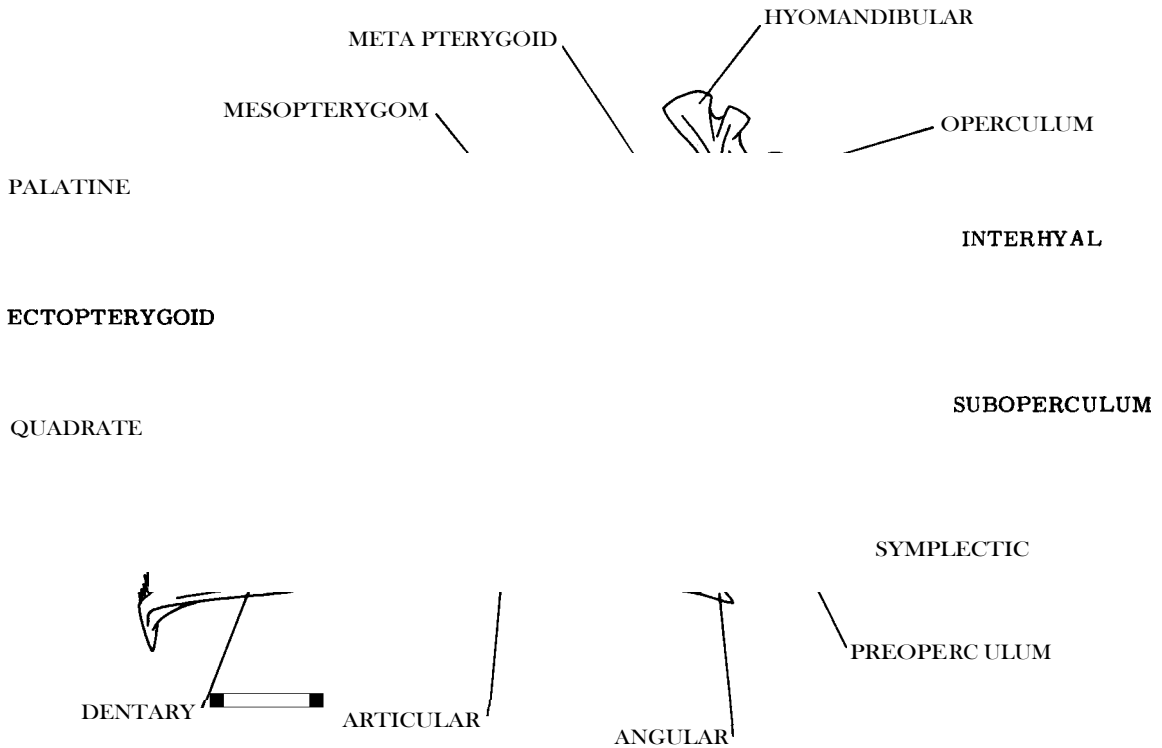


FIGURE 44. Lateral view of the left side of lower jaw and suspensorium of *Dolopichthys pullatus*, LACM 6723-33, 76.0 mm SL, with part of opercular apparatus in place.

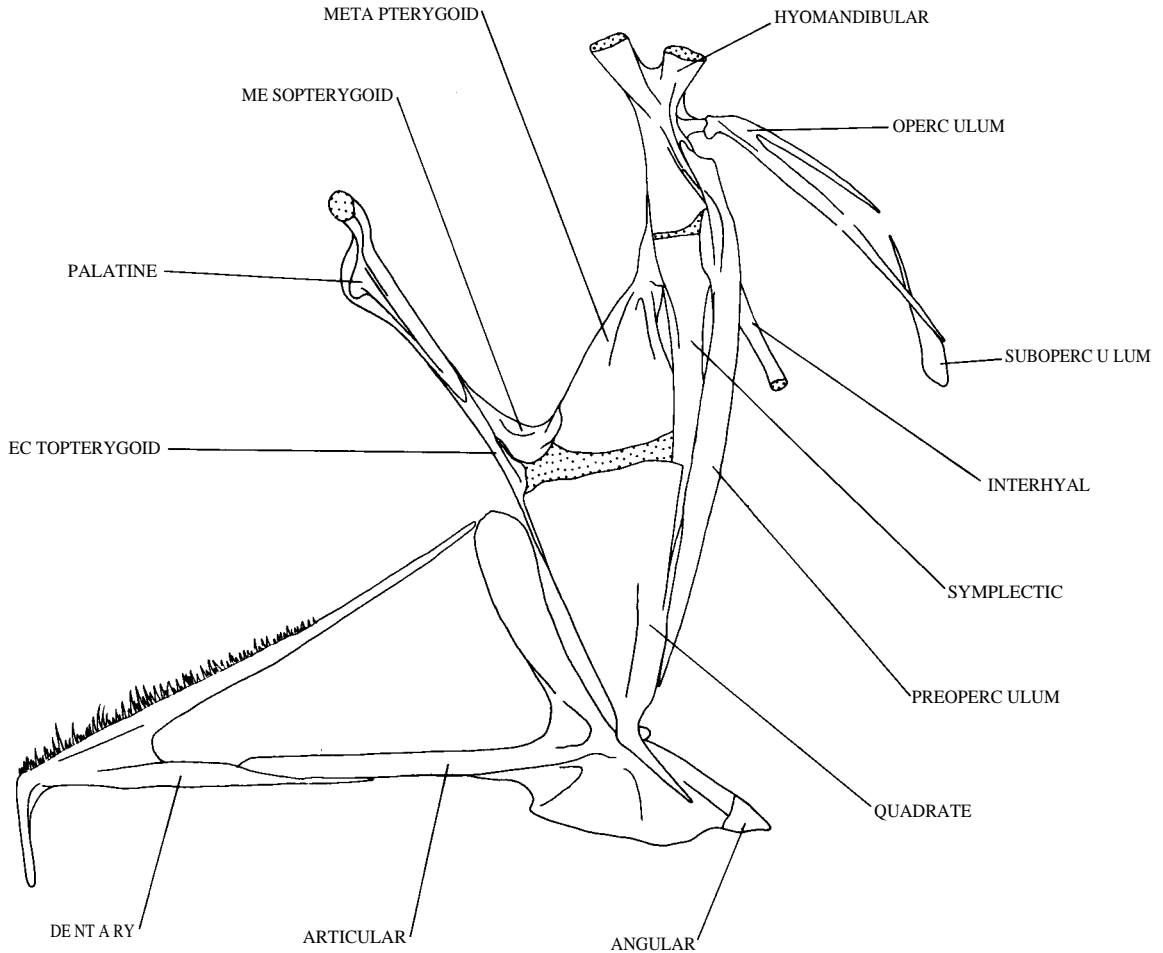


FIGURE 45. Lateral view of left side of lower jaw and suspensorium of *Lophodolos acanthognathus*, ROM 27285, 57.0 mm SL, with part of opercular apparatus in place.

schmidti-group, and intermediate in length and width in all other species. The posterior margin of the upper part of this bone is indented to deeply notched in *O. thompsoni* and in most specimens of *O. bulbosus* (see Species Accounts).

Like *Oneirodes*, *Microlophichthys* and *Leptacanthichthys* (as well as *Phyllorhinichthys*, *Tyrannophryne*, and *Chirophryne*; Pietsch, 1969; Bertelsen, 1951:93, 94, Figs. 48, 50) have a short, relatively broad suboperculum (Figs. 41-42). Nevertheless, distinct differences in the shape of this bone occur in these genera. The upper part of the suboperculum of *Danaphryne* (Fig. 40; see also Bertelsen, 1951:102, Fig. 58) is considerably longer and slenderer than that of the above forms. The suboperculum of *Ctenochirichthys* is short, and narrow (Bertelsen, 1951:95, Fig. 51). *Lophodolos*, *Bertella*, *Dolopichthys* and *Pentherichthys* have long, relatively narrow subopercula (Figs. 43-45,

47). Although its considerably smaller size is distinct in *Lophodolos*, the form of the suboperculum cannot be used to distinguish between *Pentherichthys*, *Bertella*, and *Dolopichthys*, being especially similar in the latter two genera.

Although similar to that of *Oneirodes* in shape, the suboperculum of most specimens of *Chaenophryne* (Figs. 46, 49) bears a small, blunt spine on its anterior margin. A small projection is also present on the anterior margin of the suboperculum of some adolescent females (25.0 mm or less) of *Lophodolos* and some larvae and males of *Dolopichthys* and *Pentherichthys* (Bertelsen, 1951:98, 102, 107, Figs. 54A-B, 60B-C, 64C-d). The absence of this spine was heretofore considered a diagnostic character of the Oneirodidae (Bertelsen, 1951:71).

The preoperculum of *Chaenophryne* (Figs. 46, 49) is sigmoidal in shape and extends considerably

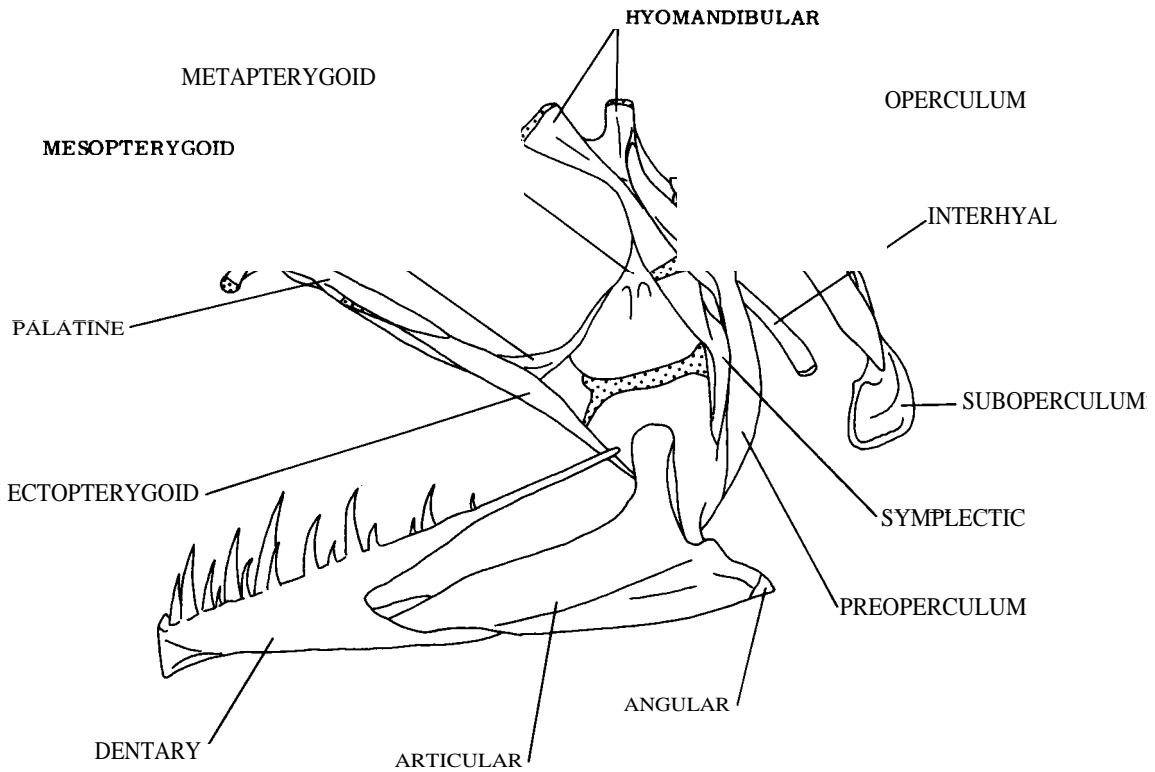


FIGURE 46. Lateral view of left side of lower jaw and suspensorium of *Chaenophryne parviconus*, LACM 9319-11, 59.0 mm SL, with part of opercular apparatus in place.

beyond the articulation of the hyomandibular bone and operculum, whereas this bone in other oneirodids is crescent-shaped and terminates ventral to, or at the level of, this articulation. The posterior margin of the operculum of *Chaenophryne* is only moderately concave compared to the deeply notched opercula of all other genera. One osteological preparation of *Chaenophryne* examined (LACM 30427-17, Fig. 49) has a ventrally directed, hooked projection on the upper anterior margin of the operculum, and a similar, but dorsally directed projection on the upper posterior margin of the preoperculum from which extends a short ligament to the dorsal head of the operculum.

Branchial Arches

There is considerable variation in the branchial arches among oneirodids. Those of all *Oneirodes* species examined are similar to those of *O. acanthias* with a few exceptions. Pharyngobranchial II is reduced and lacks teeth in *O. luetkeni* (Fig. 50). *Oneirodes luetkeni* and *O. carlsbergi* bear up to 17 and 5 recurved, depressible teeth, respectively, on the anterior margin of each epibranchial (Fig. 50).

Epibranchial teeth are not found in any other oneirodid.

Among oneirodid genera, *Oneirodes* is unique in having a pharyngobranchial of the first arch. Pharyngobranchials II and III are present and bear teeth in *Danaphryne*, *Leptacanthichthys*, and *Chaenophryne* (Figs. 51A, C, F). Pharyngobranchial II, reduced, yet bearing up to six teeth in *Dolopichthys* (Fig. 51D), is further reduced and lacks teeth in *Bertella* (Fig. 51E). This bone is represented by a tiny ossified remnant in *Microlophichthys* (Fig. 51B), and is absent in *Pentherichthys* and *Lophodolos* (Fig. 51G-H).

The epibranchials, ceratobranchials, and basibranchials of all genera are similar to those of *O. acanthias*. Hypobranchial II is absent in *Microlophichthys*, *Bertella*, and *Dolopichthys*. Unlike all other genera, the medial ends of the second, as well as the third, hypobranchials of *Lophodolos* pass ventral to the second basibranchial and approach, but do not meet each other on the midline.

Vertebrae

Except for minor differences in the length of neural and haemal spines, the vertebrae are similar

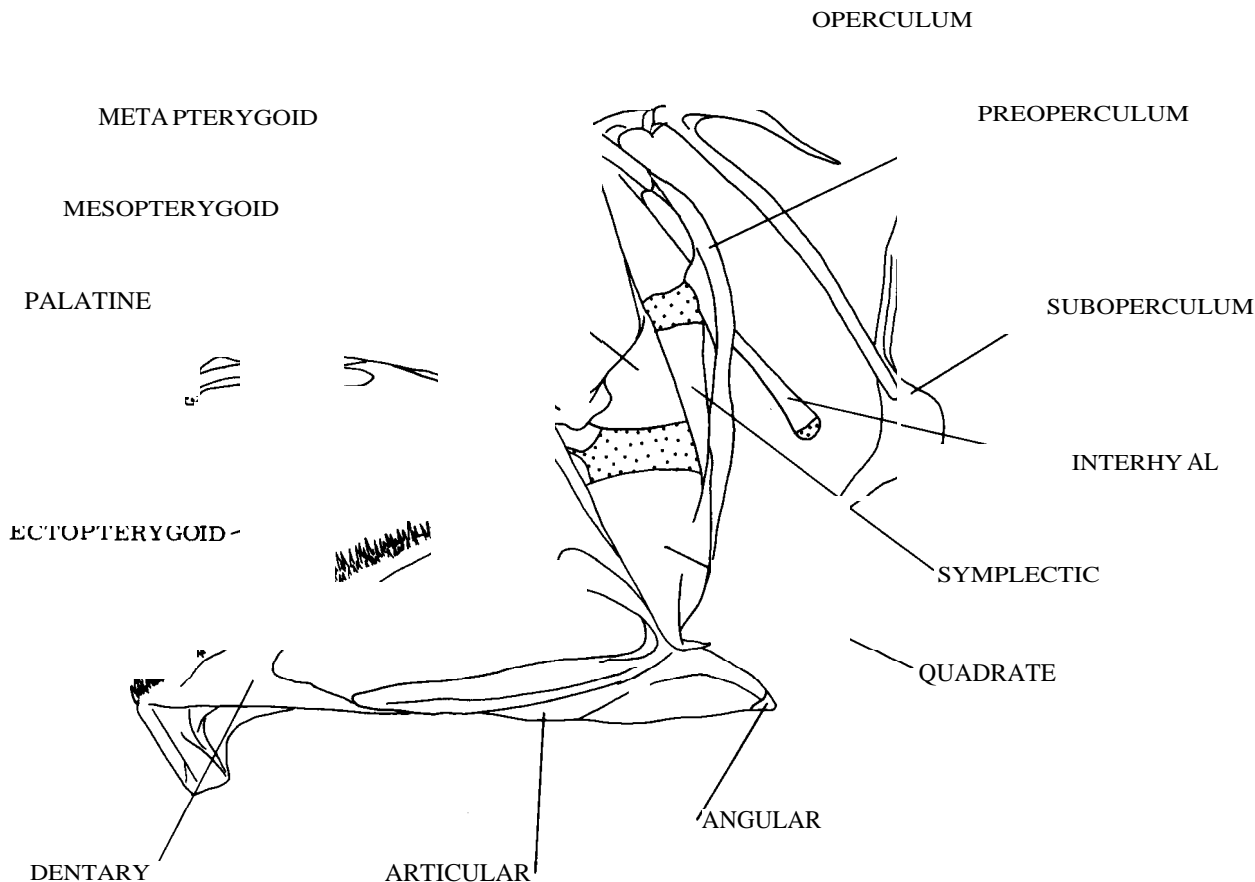


FIGURE 47. Lateral view of left side of lower jaw and suspensorium of *Pentherichthys venustus*, ISH 130/67, 119.0 mm SL, with part of opercular apparatus in place.

in the various oneirodids. Most specimens of *Onerodes* species and the single osteological preparation of *Danaphryne* have 20 vertebrae (4 precaudal + 16 caudal). Osteological preparations of *Microlophichthys* have 21 vertebrae (4 + 17), *Lophodolos* and *Pentherichthys* 23 (4 + 19), *Bertella* 20 (5 + 15), *Dolopichthys* and *Chaenophryne* 21 (5 + 16), and *Leptacanthichthys* 22 (5 + 17).

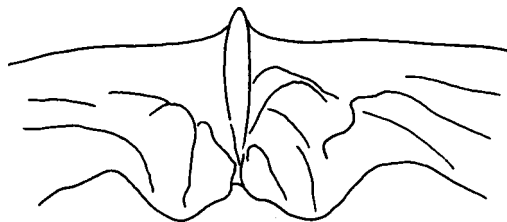


FIGURE 48. Anterior view of symphysis of lower jaw of *Pentherichthys venustus*, ISH 130/67, 119.0 mm SL. Teeth not shown.

An extra neural and haemal spine on the second pre-ural centrum of the single specimen of *Danaphryne* examined (Fig. 52A) may be the result of fusion of the second and third pre-ural centra as described above for *O. acanthias* (p. 13; see also Totten, 1914).

Caudal Skeleton

The caudal skeleton of all oneirodids is like that of *O. acanthias* described above, with one exception. The larger of the two osteological preparations of *Chaenophryne* (88.0 mm, Fig. 52B) has an anteriorly-directed, dorsal and ventral process located near the point of fusion of the first pre-ural and ural centra. The smaller specimen of *Chaenophryne* examined (56.0 mm) has a similar, but less prominent process, only on the ventral margin of this part of the caudal skeleton.

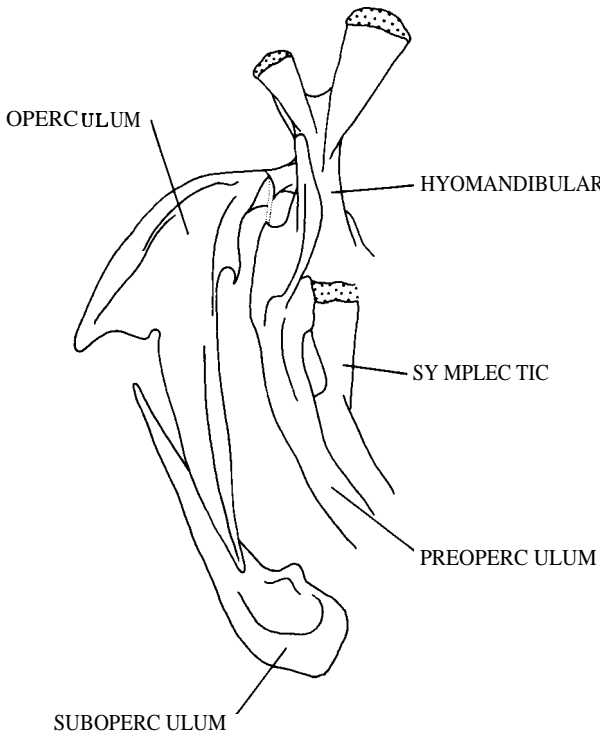


FIGURE 49. Lateral view of opercular bones and part of hyoid arch of *Chaenophryne parviconus*, LACM 30427-17, 88.0 mm SL.

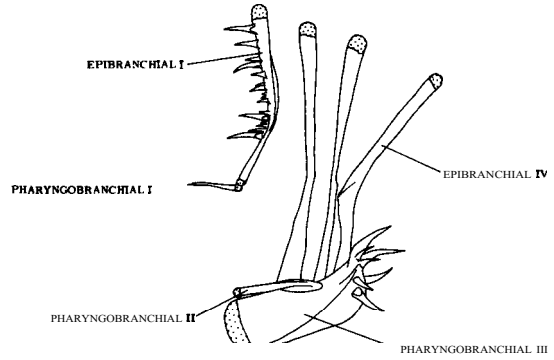


FIGURE 50. Ventral view of dorsal part of branchial arches of *Oneirodes luetkeni*, LACM 31110-1 45.0 mm SL.

Dorsal Fin, Illicial Apparatus, and Anal Fin

Except for the number of pterygiophores and fin rays, the dorsal and anal fins are similar in all oneirodids. Frequently in the dorsal fin, and always in the anal fin, there is one less pterygiophore than the number of rays. Unlike that of other genera, the first dorsal ray of *Lophodolos* is reduced to a small stub.

The number of dorsal rays varies considerably even within genera (5 to 8 in *Dolopichthys* and *Lophodolos*) and counts overlap among all genera. The number of anal rays, however, is less variable. *Oneirodes* has four anal rays, very rarely three or

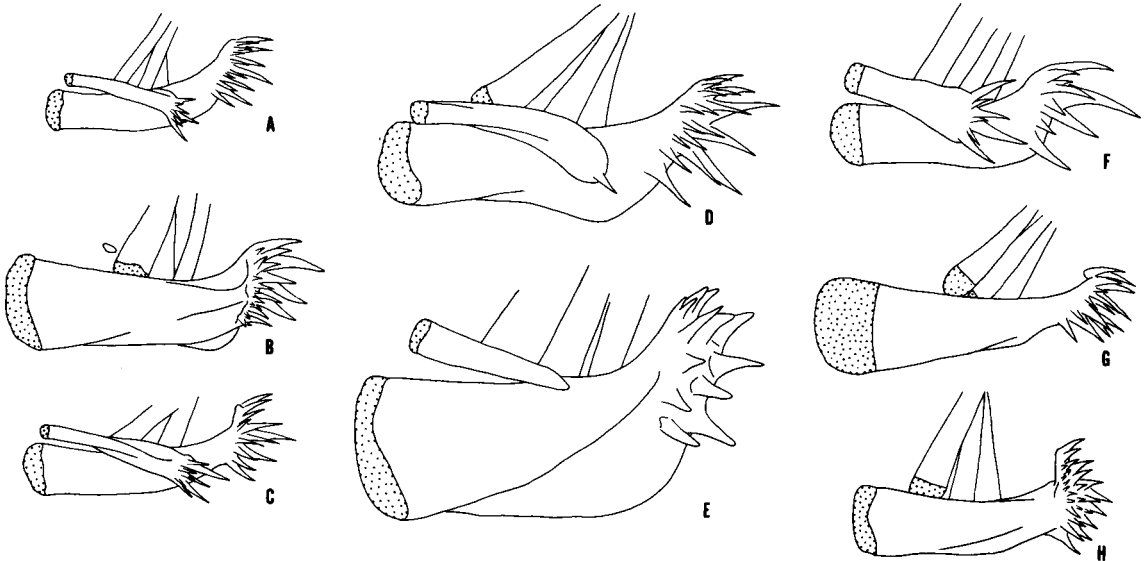


FIGURE 51. Ventral view of pharyngobranchials II and III; A. *Danaphryne nigrifilis*, 2658/71, 82.0 mm SL; B. *Microlophichthys microlophus*, ROM 27286, 99.0 mm SL; C. *Leptacanthichthys gracilispinis*, ROM 27284, 54.0 mm SL; D. *Dolopichthys pullatus*, LACM 6723-33, 76.0 mm SL; E. *Bertella idiomorpha*, LACMA 30561-1, 78.0 mm SL; F. *Chaenophryne parviconus*, LACM 9319-11, 59.0 mm SL; G. *Pentherichthys venustus*, ISH 130/67, 119.0 mm SL; H. *Lophodolos acanthognathus*, ROM 27285, 57.0 mm SL.

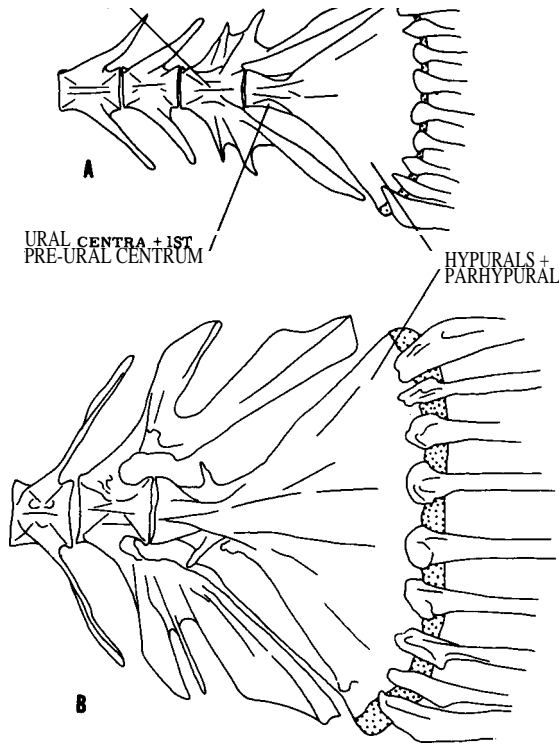
3RD + 2ND URAL
CENTRA

FIGURE 52. Lateral view of caudal skeleton: *Danaphryne nigrifilis*, ISH 2658/71, 82.0 mm SL, showing extra neural and haemal spines on 2nd pre-ural centrum; B. *Chaenophryne parviconus*, LACM 30427-17, 88.0 mm SL.

five. All other oneirodids have five or more, very rarely four.

The illicial apparatus of all *Oneirodes* species examined is similar except for considerable differences in the length of the illicial bone: less than 20 percent of SL in *O. luetkeni*, 50 percent of SL in *O. basili*, and more than 70 percent of SL in *O. bradburyae*.

The illicial bone of *Microlophichthys* (as well as that of *Phyllorhinichthys* and *Tyrannophryne*; Pietsch, 1969, 1972b; Bertelsen, 1951:93), is considerably shorter than that of other genera, approximately 9 percent of SL (Fig. 53A). In addition, the remnant of the second cephalic ray on the dorsal surface of the pterygiophore is much further anterior than in the other genera examined.

Except for small differences in the length of the illicial bone, the illicial apparatus of *Danaphryne*, *Leptacanthichthys*, *Bertella* and *Dolopichthys* is

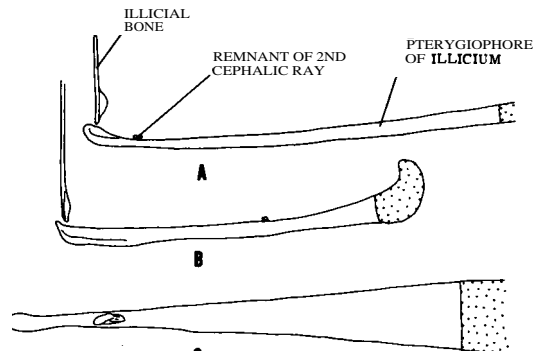


FIGURE 53. Illicial apparatus: A. *Microlophichthys microlophus*, ROM 27286, 99.0 mm SL, lateral view; B. *Lophodolos acanthognathus*, ROM 27285, 57.0 mm SL, lateral view; C. *Pentherichthys venustus*, ISH 130/67, 119.0 mm SL, dorsal view, illicial bone not shown.

much like that described above for *O. acanthias*. The pterygiophore of *Chaenophryne* is much longer than that of any other genus (70 to 82 percent of SL, compared to less than 50 percent of SL in other oneirodids). *Lophodolos* has a relatively short, stout pterygiophore (about 25 percent of SL) with a peculiar upturned, cartilaginous posterior end (Fig. 53B). The pterygiophore of *Pentherichthys* (Fig. 53C) is nearly as short as that of *Lophodolos* (about 30 percent of SL) but differs from that of all other oneirodids in its much wider, dorsoventrally flattened posterior end.

Pectoral Girdle and Pectoral Fin

Except for some differences in the number of pectoral fin rays, the pectoral girdle and pectoral fin are much the same in all *Oneirodes* species examined. Among oneirodid genera the shape of the coracoid and pectoral radials vary somewhat. The coracoid of *Oneirodes* is unique in having a large, posteroventral process (Fig. 17, 18). The coracoid of all other genera examined is like that of *Microlophichthys* (Fig. 54).

In all oneirodids there are three pectoral radials. Without exception the cartilaginous proximal and distal ends of the second radial are ankylosed to the cartilaginous ends of the third (or most ventral) radial. Although the third radial is always longer than the first, the length of these two elements relative to each other varies considerably among oneirodid genera. In *Chaenophryne* the length of the first radial is approximately 85 percent of the length of the third, 70 to 75 percent in *Oneirodes* and *Danaphryne*, 60 to 65 percent in *Microlophichthys*, *Lophodolos*, *Bertella*, *Dolopichthys* and

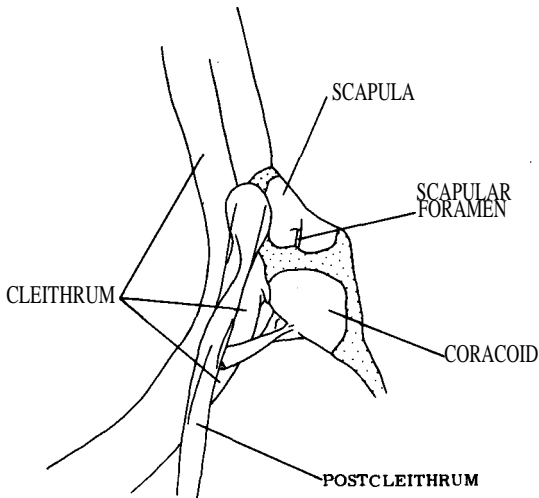


FIGURE 54. Medial view of portion of pectoral girdle of *Microlophichthys microlophus*, ROM 27286, 99.0 mm SL, right side.

Pentherichthys, and 30 percent in *Leptacanthichthys*.

The pectoral lobe (pectoral fin not including fin rays) of *Leptacanthichthys* (as well as *Ctenochirichthys* and, to a lesser degree, *Chirophryne*; Regan and Trewavas, 1932:36, 81-82, Figs. 42C, D, 131) is unusually long and narrow (Fig. 55). Unlike that of other genera, the first radial is considerably shorter than the second; the cartilaginous distal end of the third radial is expanded in an anteroposterior direction to meet the distal end of the considerably shorter second radial. The fin rays, thus, articulate along the upper margin of the pectoral fin lobe (Regan and Trewavas, 1932, **Pl. III**, Fig. 3).

In all genera examined the third radial has a small foramen as described above for *O. acanthias* (see also Regan and Trewavas, 1932:37, Fig. 47; Bertelsen, 1951:72, 82, Figs. 30, 35). A small process on the dorsal margin of the first radial is present in *O. acanthias* and in all genera examined osteologically except for *Microlophichthys*, *Leptacanthichthys*, and *Pentherichthys*. Frequencies of pectoral fin ray counts are given by Bertelsen

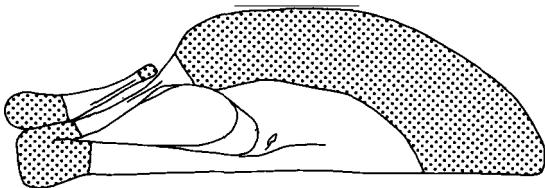


FIGURE 55. Lateral view of pectoral radials of *Leptacanthichthys gracilispinis*, ROM 27284, 54.0 mm SL, left side.

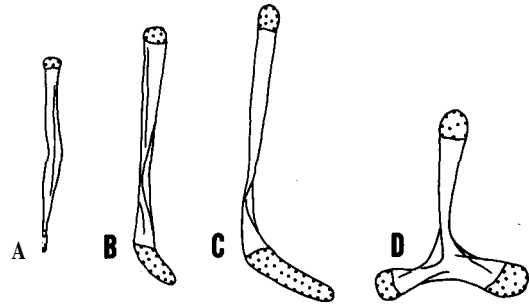


FIGURE 56. Medial views of pelvic bones, right side: A. *Microlophichthys microlophus*, CAS 43430, 27.0 mm SL; B. *Bertella idiomorpha*, LACM 30561-1, 78.0 mm SL; C. *Dolopichthys pullatus*, LACM 6723-33, 76.0 mm SL; D. *Chaenophryne parviconus*, LACM 9319-11, 59.0 mm SL.

(1951) and Pietsch (1972b,c), and summarized in Table 23.

The pectoral lobe of *Phyllorhinichthys* is considerably shorter and broader than that of other oneirodid genera (Pietsch, 1972b :337, Fig. 4).

Pelvic Bones

The shape of the distal end of the pelvic bone of oneirodids is quite variable, even within a single species. Although a distally expanded pelvic bone was previously thought to be diagnostic of the Oneirodidae (Bertelsen, 1951:71), this is not the case in some specimens of *Microlophichthys*, *Bertella*, and *Dolopichthys* (Fig. 56A-C). In contrast to all other genera, the pelvic bones of *Chaenophryne* are triradiate (Fig. 56D). Among ceratoids, triradiate pelvic bones were previously known only in the family Himantolophidae.

Skin Spines

In all osteological preparations of *Oneirodes* species examined, extremely small, widely separated dermal spines are present in the skin. Skin spines could not be detected microscopically in cleared and stained specimens of any other oneirodid genus.

SYSTEMATICS

Family Oneirodidae Regan

Type genus *Oneirodes* Lütken, 1871.

Oneirodidae Regan, 1925:562 (diagnosis; includes *Lasiognathus*). Regan, 1926:25 (diagnosis; key to genera; includes *Lasiognathus* and *Thaumatichthys*). Regan and Trewavas, 1932:62 (diagnosis; key to genera; includes *Centrophryne*, *Lasiognathus*, *Thaumatichthys*, *Amacrodon* and *Trematorhynchus*). Fowler, 1936:1336, 1365 (diagnosis after Regan, 1926, Regan and Trewavas, 1932; key

to genera; includes *Trematorhynchus*). Fowler, 1949; 159 (diagnosis after Regan, 1926, Regan and Trewavas, 1932; includes *Centrophryne*). Bertelsen, 1951:71 (diagnosis; key to genera; includes *Lasiognathus*, *Thaumatichthys*, *Amacrodon* and, in part, *Trematorhynchus*; erection of **Centro-phrynidae** for *Centrophryne spinulosa*, *Spiniphryne* for *C. gladiusfenae*). Grey, 1956a:243 (generic synonymies, in part after Bertelsen, 1951). Beaufort and Briggs, 1962:247 (diagnosis after Regan, 1926, Regan and Trewavas, 1932; includes *Centrophryne*, *Thaumatichthys*, and *Trematorhynchus*). Pietsch, 1972a:18 (key to ceratioid families; resurrection of *Thaumatichthyidae* for *Lasiognathus*, *Thaumatichthys* and *Amacrodon*).

Diagnosis for females.—The females of the family Oneirodidae are distinguished from those of all other ceratioid families by the following combination of characters: jaws equal anteriorly; **supra-ethmoid** present; parietals present; 2 hypohyals; 6 branchiostegal rays; ceratobranchial teeth absent; operculum bifurcate, upper fork supported by a single rib; sphenotic overlapped by anterolateral projection of pterotic; posterior margin of hypural plate entire; 3 pectoral radials; esca without **denticles**; only an ossified remnant of second cephalic ray present; labial cartilage well developed (Pietsch, 1972a:31).

Although not characteristic of all members of the family, the following additional features are important in differentiating the Oneirodidae: pterosphenoid usually present (absent in *Lophodolos*); hyomandibular usually with a double head (single head in *Bertella*); pharyngobranchial I usually absent (present in *Oneirodes*); epibranchial teeth usually absent (present on epibranchial I of some species of *Oneirodes*); anterior subopercular spine usually absent (blunt projection present in most specimens of *Chaenophryne*, adolescent females of *Lophodolos* and some larvae and males of *Dolopichthys* and *Pentherichthys*); pelvic bone usually rodlike, not expanded to slightly expanded distally

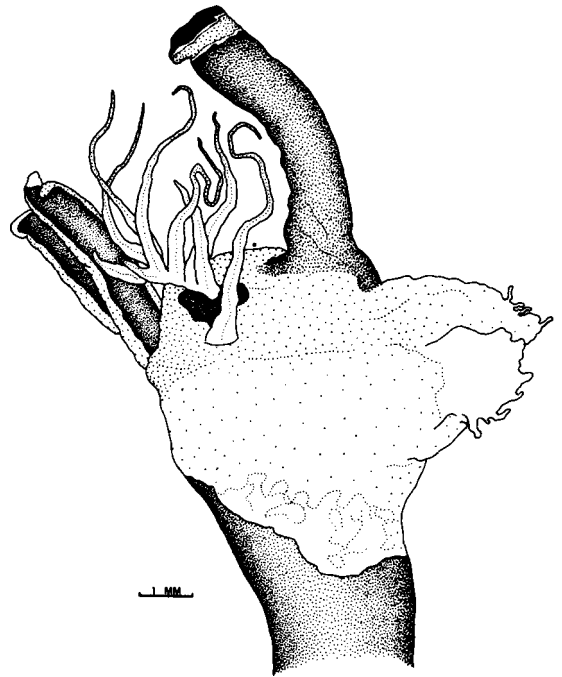


FIGURE 57. Esca of *Phyllorhinichthys micractis*, IOM uncatalogued, 96.0 mm SL, left side.

(triradiate in *Chaenophryne*); skin spines usually absent (present in *Oneirodes*).

Diagnosis for males.—See Bertelsen (1951:71).

Key to the Genera of the Oneirodidae

The following key (modified from Bertelsen, 1951) will differentiate adolescent and adult female specimens only. For larvae and males see Bertelsen (1951:75). Since several genera are known only from one or two adolescent specimens, the key is tentative and may not include the best diagnostic characters. The genus *Spiniphryne* Bertelsen, 1951, included in the **Oneirodidae** by Bertelsen (1951), most likely belongs to the family *Centrophrynidae* and thus does not appear below.

- 1A. Sphenotic spines present; operculum deeply notched posteriorly (Fig. 40); pelvic bones rod-shaped, not expanded or slightly expanded distally 2
- 1B. Sphenotic spines absent; operculum not deeply notched posteriorly (Fig. 46); pelvic bones triradiate *Chaenophryne* Regan, 1925
- 2A (1A). Pectoral fin-lobe short and broad, shorter than longest pectoral fin rays 3
- 2B. Pectoral fin-lobe long and narrow, longer than longest pectoral fin rays 10
- 3A (2A). Lower jaw with a symphyisial spine, ventral margin of dentaries at symphysis convex; caudal rays not internally pigmented 4
- 3B. Lower jaw without a symphyisial spine, ventral margin of dentaries at symphysis concave; caudal rays internally pigmented *Pentherichthys* Regan and Trewavas, 1932

- 4A (3A). Illicial apparatus emerging from between frontal bones 5
- 4B. Illicial apparatus not emerging from between frontal bones but between sphenotic spines or further posterior *Lophodolos* Lloyd, 1909
- 5A (4A). Dorsal margin of frontal bones strongly curved; suboperculum short and broad, lower part nearly circular (Figs. 8, 40-41) 6
- 5B. Dorsal margin of frontal bones nearly straight; suboperculum long and narrow, lower part strongly oval (Figs. 43-44) 12
- 6A (5A). Caudal fin covered with black skin to some distance beyond fin base; anal fin rays 5, rarely 4 7
- 6B. Caudal fin not covered by black skin except at base; anal fin rays 4, rarely 5 *Oneirodes* **Lütken**, 1871
- 7A (6A). Cleft of mouth extending beyond base of pectoral fin *Tyrannophryne* Regan and Trewavas, 1932
(a single known specimen, 12.0 mm)
- 7B. Cleft of mouth not extending beyond base of pectoral fin 8
- 8A (7B). A pair of leaflike, unpigmented appendages on snout; fewer than 25 teeth in lower jaw; esca with three, stout, nontapering, internally pigmented appendages arising from dorsal surface (Fig. 57) *Phyllorhinichthys* Pietsch, 1969
(two specimens known, 52.0 and 96.0 mm)
- 8B. No leaflike appendages on snout; more than 25 teeth in lower jaw; esca without stout appendages arising from dorsal surface 9
- 9A (8B). Cleft of mouth extending past eye; length of esca bulb more than half length of illicial bone; upper part of suboperculum broad and rounded (Fig. 41) *Microlophichthys* Regan and Trewavas, 1932
- 9B. Cleft of mouth not extending past eye; esca bulb considerably shorter than half length of illicial bone; upper part of suboperculum slender and tapering to a point (Fig. 40) *Danaphryne* Bertelsen, 1951
- 10A (2B). Sphenotic and articular spines short, not piercing skin; pectoral fin rays 27-30 *Ctenochirichthys* Regan and Trewavas, 1932
(two female specimens known, 12.5 and 38.0 mm)
- 10B. Sphenotic and articular spines well-developed; pectoral fin rays 17-21 11
- 11A (10B). Length of quadrate spine greater than length of mandibular spine; esca with five separate appendages arising from dorsal surface (Fig. 58) *Chirophryne* Regan and Trewavas, 1932
(two specimens known, 11.0 and 22.0 mm)
- 11B. Length of quadrate spine less than length of mandibular spine; esca with a single appendage arising from dorsal surface (Fig. 59) . . . *Leptacanthichthys* Regan and Trewavas, 1932
- 12A (5B). Hyomandibular bone with a single head (Fig. 43) *Bertella* Pietsch, 1973
- 12B. Hyomandibular bone with a double head (Fig. 44) *Dolopichthys* Garman, 1899

Generic Synonymies and List of
Nominal Species in Each Genus

Oneirodes **Lütken**

Synonymy given below under account of genus.

- Oneirodes luetkeni* (Regan, 1925).
Oneirodes carlsbergi (Regan and Trewavas, 1932).
Oneirodes rosenblatti, new species.
Oneirodes eschrichtii **Lütken**, 1871.
Oneirodes bulbosus Chapman, 1939.
Oneirodes anisacanthus (Regan, 1925).

- Oneirodes kreffti*, new species.
Oneirodes myrionemus, new species.
Oneirodes heteronema (Regan and Trewavas, 1932).
Oneirodes macrosteus, new species.
Oneirodes cristatus (Regan and Trewavas, 1932).
Oneirodes acanthias (Gilbert, 1915).
Oneirodes thompsoni (Schultz, 1934).
Oneirodes notius, new species.
Oneirodes flagellifer (Regan and Trewavas, 1932).
Oneirodes dicromischus, new species.

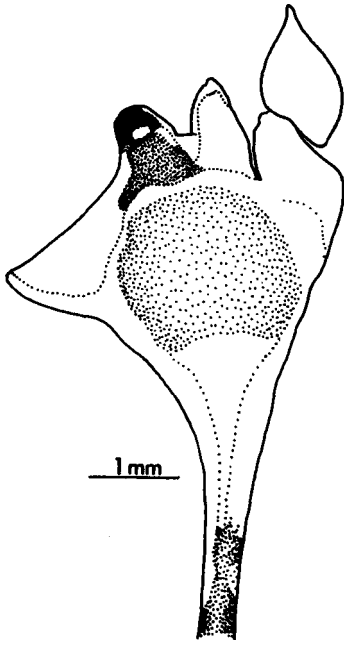


FIGURE 58. Esca of *Chirophryne xenolophus*, SIO 70-306, 22.0 mm SL, left side.

Oneirodes bradburyae Grey, 1956b.

Oneirodes macronema (Regan and Trewavas, 1932).

Oneirodes melanocauda Bertelsen, 1951.

Oneirodes schmidti (Regan and Trewavas, 1932).

Oneirodes mirus (Regan and Trewavas, 1932).

Oneirodes basili, new species.

Oneirodes theodoritissieri Belloc, 1938.

Danaphryne Bertelsen

Danaphryne Bertelsen, 1951:101, Figs. 58-59 (type species *Dolopichthys* [subgenus *Dermatias*] *nigrifilis* Regan and Trewavas, 1932, by monotypy).

Danaphryne nigrifilis (Regan and Trewavas, 1932).

Microlophichthys Regan and Trewavas

Microlophichthys Regan and Trewavas, 1932: 77, Figs. 118-122 (type species *Dolopichthys microlophus* Regan, 1925, by subsequent designation of Burton, 1932).

Microlophichthys microlophus (Regan, 1925).

Microlophichthys andracanthus Bertelsen, 1951.

Phyllorhinichthys Pietsch

Phyllorhinichthys Pietsch, 1969:365, Figs. 1-4 (type species *Phyllorhinichthys micractis* Pietsch, 1969, by original designation and monotypy).

Phyllorhinichthys micratis Pietsch, 1969.

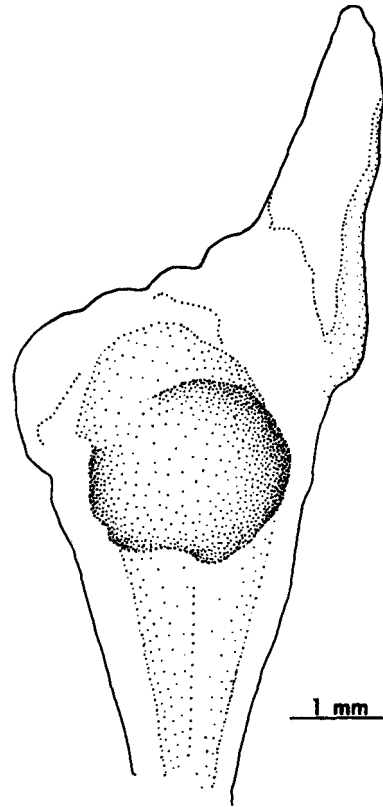


FIGURE 59. Esca of *Leptacanthichthys gracilispinis*, LACM 32776-1, 22.0 mm SL; left side.

Tyrannophryne Regan and Trewavas

Tyrannophryne Regan and Trewavas, 1932:83, pl. 4, Fig. 1 (type species *Tyrannophryne pugnax* Regan and Trewavas, 1932, by monotypy).

Tyrannophryne pugnax Regan and Trewavas, 1932.

Chirophryne Regan and Trewavas

Chirophryne Regan and Trewavas, 1932:81, Figs. 131-132 (type species *Chirophryne xenolophus* Regan and Trewavas, 1932, by monotypy)

Chirophryne xenolophus Regan and Trewavas, 1932.

Leptacanthichthys Regan and Trewavas

Leptacanthichthys Regan and Trewavas, 1932:-80, Fig. 128 (type species *Dolopichthys gracilispinis* Regan, 1925, by monotypy).

Leptacanthichthys gracilispinis (Regan, 1925).

Ctenochirichthys Regan and Trewavas

Ctenochirichthys Regan and Trewavas, 1932:-82, pl. III, Fig. 3 (type species *Ctenochirichthys*

longimanus Regan and Trewavas, 1932, by monotypy).

Ctenochirichthys longimanus Regan and Trewavas, 1932.

Dolopichthys Garman

Dolopichthys Garman, 1899:81, pls. 13-15, Figs. 5-7 (type species *Dolopichthys allector* Garman, 1899, by original designation and monotypy).

Dolopichthys pullatus Regan and Trewavas, 1932.

Dolopichthys longicornis Parr, 1927.

Dolopichthys danae Regan, 1926.

Dolopichthys jubatus Regan and Trewavas, 1932.

Dolopichthys allector Garman, 1899.

Dolopichthys dinema Pietsch, 1972c.

Bertella Pietsch

Bertella Pietsch, 1973:193, Figs. 1-6 (type species *Bertella idiomorpha* Pietsch, 1973, by original designation and monotypy).

Bertella idiomorpha Pietsch, 1973.

Chaenophryne Regan

Chaenophryne Regan 1925:564 (type species *Chaenophryne longiceps* Regan, 1925, by original designation and monotypy).

Chaenophryne longiceps-group Bertelsen, 1951.

Chaenophryne longiceps Regan, 1925.

Chaenophryne bicornis Regan and Trewavas, 1932.

Chaenophryne quadrifilis Regan and Trewavas, 1932.

Chaenophryne crenata Regan and Trewavas, 1932.

Chaenophryne crossota Beebe, 1932.

Chaenophryne draco-group Bertelsen, 1951.

Chaenophryne draco Beebe, 1932.

Chaenophryne parvicornis Regan and Trewavas, 1932.

Chaenophryne ramifera Regan and Trewavas, 1932.

Pentherichthys Regan and Trewavas

Pentherichthys Regan and Trewavas, 1932:81, Figs. 129-130 (type species *Dolopichthys atratus* Regan and Trewavas, 1932, by subsequent designation of Burton, 1932).

Pentherichthys atratus Regan and Trewavas, 1932.

Pentherichthys venustus Regan and Trewavas, 1932.

Lophodolos Lloyd

Lophodolos Lloyd, 1909:167 (type species *Lophodolos indicus* Lloyd, 1909, by original designation and monotypy).

Lophodolos indicus Lloyd, 1909.

Lophodolos acanthognathus Regan, 1925.

Lophodolos dinema Regan and Trewavas, 1932.

Genus *Oneirodes* Lütken

Frontispiece, and figure 60

Females: *Oneirodes* Lütken, 1871:72, Figs. 1-2, pl. 2 (type species *Oneirodes eschrichtii* Lütken, 1871, by original designation and monotypy).

Onirodes Jordan and Gilbert, 1883:848 (erroneous spelling of *Oneirodes*, therefore taking the same type species *Oneirodes eschrichtii*; generic description after Gill, 1878a). Alcock, 1899:52, 57 (erroneous spelling; in key; includes *Paroneirodes*).

Dermatias Smith and Radcliffe, 1912, *In* Radcliffe, 1912: 206, pl. 17, Fig. 3 (type species *Dermatias platynogaster* Smith and Radcliffe, 1912, by original designation and monotypy).

Monoceratias Gilbert, 1915:379, pl. 22, Fig. 24 (type species *Monoceratias acanthias* Gilbert, 1915, by original designation and monotypy).

Dolopichthys (*in part*; all erroneous designations subsequently corrected by Bertelsen, 1951; type species *Dolopichthys allector* Garman, 1899, by original designation and monotypy): Regan, 1925:562; Regan, 1926:27-29, pl. 4, Fig. 2, pl. 5, Fig. 1; Parr, 1927:14-16, Fig. 5; Norman, 1930:353; Beebe, 1932:88, Fig. 23; Schultz, 1934:66, Figs. 1-4; Fraser-Brunner, 1935:324, 325, Figs. 3-4; Fowler, 1936:1337-1339, 1365, 1366; Beebe, 1937:207; Norman, 1939:115, Figs. 40-41; Koefoed, 1944: 6, pl. 1, Figs. 4a-b, pl. 1, Fig. 5, pl. 3, Fig. 6; Beebe and Crane, 1947:159; Maul, 1949:39-40; Bolin and Myers, 1950:206, 207; Maul, 1961:129, 130; Beaufort and Briggs, 1962:248-251; Bussing, 1965:223; Wheeler, 1969:585.

Dolopichthys (subgenus *Dermatias*) Regan and Trewavas, 1932:66-77, Figs. 91, 93-117 (*in part*; erroneous designations; genus *Dolopichthys* broadened to incorporate five subgenera, amended by Bertelsen, 1951).

Oneiroides Fowler, 1936:1139, 1140, Fig. 479 (erroneous spelling of *Oneirodes*, therefore taking the same type species *Oneirodes eschrichtii*; generic description after Günther, 1887).

Males: *Lipactis* Regan, 1926:43 (*in part*; erroneous designations; six specimens, one, DANA 1152, referred to *Oneirodes* by Bertelsen, 1951; type species *Lipactis tumidus* Regan, 1925, by original designation and monotypy). Norman,

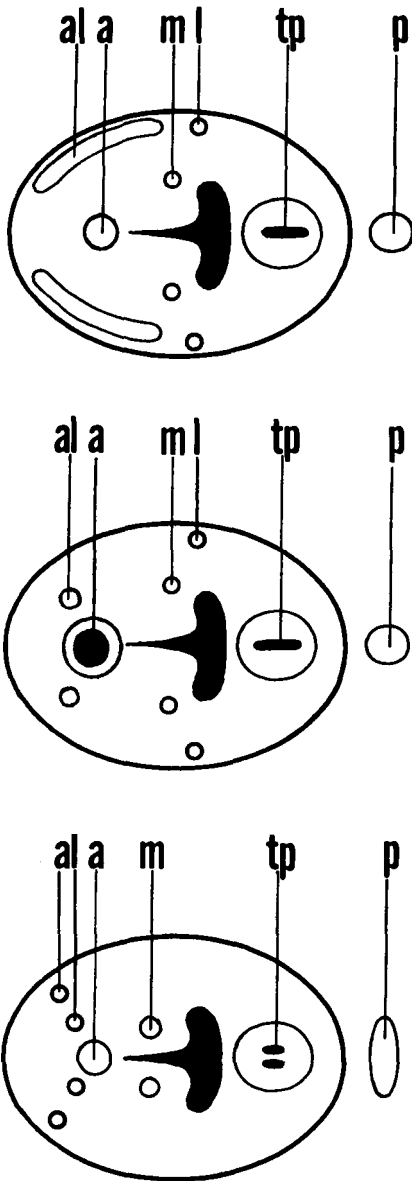


FIGURE 60. Escal appendage patterns of species of *Oneirodes*; diagrammatic representation of dorsal surface of escal bulb, indicating placement pattern of appendages, papillae, and pigment. a = anterior appendage; al = anterolateral membranous flap or filamentous appendage; l = lateral appendage; m = medial appendage; p = posterior appendage; tp = terminal papilla. Dark areas indicate pigment. See text for description and species included in each.

1930:357 (erroneous designation; a male referred to *Trematorhynchus* by Regan and Trewavas, 1932).

Rhynchoceratias Regan, 1926:44 (in part; erroneous designations; two males referred to *Trematorhynchus* by Regan and Trewavas, 1932,

subsequently referred to *Oneirodes* by Bertelsen, 1951; type species *Rhynchoceratias brevirostris* Regan, 1925, by subsequent designation of Fowler, 1936).

Trematorhynchus Regan and Trewavas, 1932:91 (in part; erroneous designations; four males referred to *Oneirodes* by Bertelsen, 1951; type species *Rhynchoceratias leucorhinus* Regan, 1925, by subsequent designation of Burton, 1932).

Caranactis Regan and Trewavas, 1932:58, 59, Fig. 86 (type species *Caranactis pumilus* Regan and Trewavas, 1932, by monotypy).

Diagnosis

Females: The genus *Oneirodes* is distinguished from all other genera of the family Oneirodidae by having a pharyngobranchial of the first arch, coracoid with a posteroventral process, skin with minute, scattered dermal spines (detected microscopically in cleared and stained specimens), and skin not extending past base of caudal fin. In addition, *Oneirodes* is unique in having the following combination of characters: mouth large, cleft extending past eye; frontal bones convex along entire dorsolateral margin; vomerine teeth present; pterygiophore of illicium emerging on snout between frontal bones, its anterior end exposed, its posterior end protruding on back behind head; illicium length greater than 13 percent of SL; lower jaw with a well-developed symphyseal spine; sphenotic spines well-developed; articular spines present, quadrate spine larger than mandibular spine; angular spines absent; pharyngobranchial II present and bearing teeth (teeth absent in *Oneirodes luetkeni*); hypobranchial II present; pectoral lobe short and broad, shorter than longest rays of pectoral fin; posterior margin of operculum deeply notched; suboperculum short and broad, its upper part rounded to bluntly pointed, its lower part semicircular, without anterior spine; anal fin with 4 rays, very rarely 5.

Males: Nonparasitic; septa between anterior nostrils and between posterior nostril and eye pigmented; septa between anterior and posterior nostril unpigmented; medial side of suboperculum unpigmented; caudal peduncle without subdermal pigment (except *Oneirodes melanocauda*; Bertelsen, 1951:12); 6-12 olfactory lamellae; 6-17 upper, 7-28 lower denticular teeth (Bertelsen, 1951:21); shape of pectoral fin lobe, opercular bones, and anal fin-ray counts as for females.

Description

Adolescent and adult females: Body relatively short, globular to moderately fusiform (Frontis-

piece); depth of head 32.2 to 64.3 percent of SL; oral valve well developed, lining inside of both upper and lower jaws; two nostrils on each side, at end of a single short tube; eye small and subcutaneous, appearing through a circular translucent area of integument; gill opening oval in shape, situated just posteroventrad to pectoral lobe; lateral line papillae as described for other oneirodids (Pietsch, 1969, 1972c); ovaries paired; two short pyloric caeca.

Lumen of esca bulb containing rod-shaped luminous bacteria (Fig. 114) and connected to outside by a pore located between terminal papilla and base of posterior esca appendage; esca bulb with an internal, arrow-shaped patch of pigment on dorsal surface; pigment usually covering basal half of bulb. The escae of all species of the genus as presently understood fall into one of three basic esca appendage patterns described below:

Pattern A: Anterior appendage without internal pigment; terminal papilla with a single distal spot of pigment; posterior appendage cylindrical; lateral appendage present or absent; a single pair of anterolateral appendages each represented by a broad, membranous flap (Fig. 60A). *Oneirodes luetkeni* and *O. rosenblatti* show Pattern A.

Pattern B: Anterior appendage internally pigmented; terminal papilla usually with a single distal spot of pigment (two distal pigment spots in *O. macrosteus*); posterior appendage cylindrical or laterally compressed; lateral appendages present or absent; anterolateral appendages, if present, usually a single filamentous pair (four filamentous pairs in *O. myrionemus*) (Fig. 60B). All species of the genus with escae not assigned to Pattern A above and C below show Pattern B.

Pattern C: Anterior appendage without internal pigment; terminal papilla usually with two distal spots of pigment (single distal pigment spot in *O. schmidtii* and *O. mirus*); posterior appendage usually anteroposteriorly compressed (cylindrical in *O. schmidtii*); lateral appendages absent; usually two pairs of filamentous anterolateral appendages (a single bifurcated pair in *O. theodoritissieri*) (Fig. 60C). Members of the *O. schmidtii*-group show Pattern C.

Teeth slender, recurved and depressible, those in lower jaw in overlapping sets as described for other oneirodids (Pietsch, 1972c:5, Fig. 2); pattern of tooth placement especially obvious in species having high tooth-counts; pattern in upper jaw apparently same as lower jaw but not nearly as obvious; teeth in lower jaw larger and more numerous than those in upper jaw; number of teeth in upper jaw 18-65, in lower jaw 18-160;

total number of teeth on vomer 4-14, the largest outermost; pharyngobranchial I present but reduced, its dorsal end lying free in connective tissue matrix with no ossified or ligamentous connection to the medial side of hyoid arch; pharyngobranchial II slightly more than half as long as and approximately half as wide as pharyngobranchial III, and bearing none to numerous teeth; pharyngobranchial III with numerous teeth.

Color in preservation dark brown to black over entire external surface of body except for bulb and appendages of esca; oral cavity and viscera, except for outer surface of stomach wall unpigmented.

D. 5-7; A. 4 (of 306 specimens, one had A. 3, three had A. 5); p. 13-19 (Table 1); pelvics absent; C. 9 (2 unbranched-4 branched-3 unbranched).

TABLE 1
Frequencies of pectoral fin-ray counts for species of *Oneirodes*, left and right sides

Species	13	14	15	16	17	18	19
<i>Oneirodes luetkeni</i>			15	16	1		
<i>Oneirodes carlsbergi</i>				14	6	7	
<i>Oneirodes rosenblatti</i>	6	16	2				
<i>Oneirodes eschrichtii</i>		11	25	17	6	1	
<i>Oneirodes bulbosus</i>		4	13	7	2		
<i>Oneirodes anisacanthus</i>		4	3	3	2	3	
<i>Oneirodes kreffti</i>					2	4	
<i>Oneirodes myrionemus</i>						4	
<i>Oneirodes heteronema</i>			7	4			
<i>Oneirodes macrosteus</i>			2	4	2		
<i>Oneirodes cristatus</i>	2	4					
<i>Oneirodes acanthias</i>			18	98	75	12	
<i>Oneirodes thompsoni</i>	2	4	13	4			
<i>Oneirodes notius</i>					2	8	4
<i>Oneirodes flagellifer</i>	1	5					
<i>Oneirodes dicromisus</i>					2		
<i>Oneirodes bradburyae</i>	2						
<i>Oneirodes macronema</i>	2						
<i>Oneirodes melanocauda</i>				2			
<i>Oneirodes schmidtii</i>			2				
<i>Oneirodes mirus</i>				2			
<i>Oneirodes basili</i>			2	4			
<i>Oneirodes theodoritissieri</i>			1	3			
Total	2	17	91	203	121	45	8

The following measurements, expressed in percent of SL, are summarized for the females (20.0-213.0 mm) of all species: head length 32.1-64.3; head width 23.0-47.6; head depth 32.2-64.3; lower jaw 34.3-57.4; premaxillary 22.4-39.3; least outside width of frontals 7.5-19.0; illicium length 13.0-72.3.

Males: See Bertelsen (1951:83).

Etymology: The name *Oneirodes* is derived from the Greek *ὄνειρος* meaning dreamlike.

Keys to the Species of the Genus *Oneirodes*

Larvae

- 1A. Tips of caudal fin rays darkly pigmented; caudal peduncle subdermally pigmented
Q melanocauda Bertelsen, 1951, p. 76
- 1B. Caudal fin rays unpigmented; caudal peduncle without subdermal pigment. *Oneirodes* species

Adolescent and Adult Females

Oneirodes macronema, known from a single, damaged specimen (27.0 mm), is omitted from the key.

- 1A. Epibranchial of first arch toothed 2
- 1B. Epibranchial teeth absent 3
- 2A (1A). Epibranchial of first arch with 6-17 teeth; a single pair of tooth-bearing pharyngobranchials; escal appendage pattern A: anterior appendage without internal pigment, anterolateral appendage represented by a broad, membranous flap (Figs. 60A, 61); ratio of length of upper and lower forks of operculum .60-.71 *O. luetkeni* (Regan, 1925), p. 38
Eastern Tropical Pacific
- 2B. Epibranchial of first arch with 1-5 teeth; two pairs of tooth-bearing pharyngobranchials; escal appendage pattern B: anterior appendage internally pigmented, anterolateral appendage, if present, filamentous (Figs. 60B, 62); ratio of lengths of upper and lower forks of operculum .51-.61 *O. carlsbergi* (Regan and Trewavas, 1932), p. 39
Tropical Atlantic and Pacific
- 3A (1B). Escal appendage pattern C: anterior appendage without internal pigment, usually two pairs of filamentous anterolateral appendages (Fig. 60C) (*O. schmidti*-group, p. 77) 4
- 3B. Escal appendage pattern A: anterior appendage without internal pigment, a single pair of anterolateral appendages each represented by a broad, membranous flap; or escal appendage pattern B: anterior appendage internally pigmented, anterolateral appendages, if present, one or four filamentous pairs (Fig. 60A, B) 7
- 4A (3A). Ratio of lengths of upper and lower forks of operculum .54-.62; distal end of posterior escal appendage anteroposteriorly compressed, the posterior face slightly concave and darkly pigmented (Fig. 101) *O. basili*, new species, p. 79
Eastern Pacific off southern California and Baja California
- 4B. Ratio of lengths of upper and lower forks of operculum .44-.50; distal end of posterior escal appendage without concave, pigmented, posterior surface 5
- 5A (4B). Anterolateral escal appendage more than three times length of escal bulb 6
- 5B. Anterolateral escal appendage approximately as long as escal bulb (Fig. 102)
..... *O. theodoritissieri* Belloc, 1938, p. 80
Eastern Atlantic off French West Africa
- 6A (5A). Lower jaw with 49 teeth in 42 mm specimen; anterolateral appendage less than five times length of escal bulb *O. schmidti* (Regan and Trewavas, 1932), p. 78
(A single known specimen, 42.0 mm; Banda Sea)
- 6B. Lower jaw with 76 teeth in 32 mm specimen; anterolateral appendage greater than standard length *O. mirus* (Regan and Trewavas, 1932), p. 79
(A single known specimen, 32.0 mm; Indian Ocean)
- 7A (3B). Lower jaw with more than 90 teeth in specimens larger than 45 mm, more than 60 teeth in specimens larger than 25 mm; number of teeth on vomer of specimens larger than 25 mm 8-14, usually more than 9 8
- 7B. Lower jaw with fewer than 90 teeth in specimens larger than 45 mm, fewer than 60 teeth in specimens larger than 25 mm; number of teeth on vomer of specimens larger than 25 mm 4-9, usually less than 8 9
- 8A (7A). Escal appendage pattern A: anterior appendage without internal pigment, anterolateral appendage represented by a broad, membranous flap (Figs. 60A, 63); length of illicium less than 35 percent of SL *O. rosenblatti*, new species, p. 41
Eastern Tropical Pacific

- 8B. Escal appendage pattern B: anterior appendage internally pigmented, anterolateral appendage filamentous (Figs. 60B, 92); length of illicium 60 percent of SL in 35 mm specimen *O dicromischnus*, new species, p. 73
(A single known specimen, 35.0 mm; Central Pacific)
- 9A (7B). Length of illicium less than 50 percent of SL 10
- 9B. Length of illicium greater than 70 percent of SL in 23.5 mm specimen
..... *O. bradburyae* Grey, 1956b, p. 74
(A single known specimen, 23.5 mm; Gulf of Mexico)
- 10A (9A). Esca with a well-developed lateral appendage 11
- 10B. Esca with lateral appendage minute or absent 12
- 11A (10A). Esca with two or three medial filaments more than six times length of escal bulb (Fig. 75); head depth 43.9-47.6 percent of SL; head length 42.0-64.3 percent of SL; lower jaw 49.0-52.3 percent of SL *O. krefflti*, new species, p. 57
Eastern South Pacific and Indian Oceans
- 11B. Esca without elongate medial filaments (Fig. 73) ; head depth 38.5-42.9 percent of SL; head length 38.2-43.6 percent of SL; lower jaw 43.2-50.6 percent of SL
..... *O. anisacanthus* (Regan, 1925), p. 54
North Atlantic
- 12A (10B). Esca with well-developed medial appendages 13
- 12B. Esca with medial appendages minute or absent 17
- 13A (12A). Esca with anterior and posterior appendages laterally compressed (Fig. 83); pectoral fin rays 13-14 *O. cristatus* (Regan and Trewavas, 1932), p. 62
East Indies
- 13B. Esca with anterior and posterior appendages cylindrical; pectoral fin rays 15-19 14
- 14A (13B). Esca with posterior appendage highly branched (Fig. 79)
..... *O. heteronema* (Regan and Trewavas, 1932), p. 60
Eastern Tropical Pacific
- 14B. Esca with posterior appendage unbranched or bearing only minute filaments 15
- 15A (14B). Esca with four pairs of filamentous anterolateral appendages; internally pigmented portion of anterior appendage nearly twice length of escal bulb (Fig. 77)
..... *O. myrionemus*, new species, p. 58
Eastern North Atlantic
- 15B. Esca with only a single pair of anterolateral appendages present or absent; internally pigmented portion of anterior appendage less than length of escal bulb (Figs. 65-66, 71) .. 16
- 16A (15B). Esca with anterior appendage distally divided into numerous long filaments; posterior appendage usually with one or two short branches (Fig. 71); posterior margin of upper part of suboperculum usually indented to deeply notched (Fig. 72)
..... *O. bulbosus* Chapman, 1939, p. 52
North Pacific
- 16B. Esca with anterior appendage bearing papillae and a few short filaments at distal tip; posterior appendage never branched (Figs. 65-66); posterior margin of upper part of suboperculum not indented *O eschrichtii* Lütken, 1871, p. 44
Nearly cosmopolitan
- 17A (12B). Length of illicium greater than 33 percent of SL; suboperculum long and slender (Fig. 82); esca with an anterolateral appendage (Fig. 81) *O. macrosteus*, new species, p. 61
Western North Atlantic
- 17B. Length of illicium less than 33 percent of SL; suboperculum short and broad (Figs 88, 90); esca without anterolateral appendage 18
- 18A (17B). Esca with anterior appendage bearing one to five stout papillae along posterior margin, posterior escal appendage branched (Fig. 84); ratio of lengths of upper and lower forks of operculum .53-.71 *O. acanthias* (Gilbert, 1915), p. 63
Eastern Pacific off southern California and Baja California

- 18B. Esca with anterior appendage without stout papillae along posterior margin, posterior esca appendage unbranched; ratio of lengths of upper and lower forks of operculum .42-.59. 19
- 19A (18B) Esca with posterior appendage three to four times length of esca bulb in 22 mm specimen, two times length of esca bulb in 12.5 mm specimen (Fig. 91)
 - *O. flagellifer* (Regan and Trewavas, 1932), p. 72
 (Three known specimens, 12.5-22.0 mm; Indian Ocean, Sulu and South China Seas)
- 19B. Esca with posterior appendage less than three times length of esca bulb in specimens larger than 70 mm, as long as or less than length of esca bulb in specimens smaller than 70 mm 20
- 20A (19B). Esca with anterior appendage bearing a compressed papilla and several smaller papillae on distal end, papillae darkly pigmented in specimens larger than 40 mm (Fig. 87); posterior margin of upper part of suboperculum indented to deeply notched (Fig. 88); ratio of lengths of upper and lower forks of operculum .42-.54; pectoral fin rays 15-17
 - *O. thompsoni* (Schultz, 1934), p. 68
 North Pacific
- 20B. Esca with anterior appendage usually bearing a compressed papilla and two tapering filaments on distal end, papilla and filaments unpigmented (Fig. 89); posterior margin of upper part of suboperculum not indented (Fig. 90); ratio of lengths of upper and lower forks of operculum .52-.59; pectoral fin rays 17-19 *O. notius*, new species, p. 70
 - Atlantic and Pacific sectors of the Southern Ocean

Species Accounts

Oneirodes luetkeni (Regan)
 Figures 19, 28, 50, 60A, 61, 106
 Tables 1-3

Dolopichthys luetkeni Regan, 1925:562 (original description; single specimen; Gulf of Panama; holotype, ZMUC P9287). Regan, 1926:27-28, pl. 4, Fig. 2 (description; comparison with *Oneirodes eschrichtii*; in key). Parr, 1927:15 (in key; *Dolopichthys heteracanthus*, a synonym of *D. luetkeni*). Fowler, 1936; 1337 (description after Regan, 1926; in key). Beebe and Crane, 1947:159-160 (six additional specimens; synonymy; range; color; *D. heteracanthus* immature form of *D. luetkeni*).

Dolopichthys (subgenus *Dermatias*) *luetkeni*, Regan and Trewavas, 1932:76-77, Fig. 116 (description; in key).

Dolopichthys heteracanthus Regan, 1925:562 (in part; original description; ten specimens, no type designated; Gulf of Panama). Regan, 1926:28, pl. 5, Fig. 1 (in part; misidentifications; description; 21 specimens, 15 of which referred to *Oneirodes luetkeni* by Bertelsen, 1951; in key). Fowler, 1936 : 1338, 1339 [description after Regan, 1926; comparison with *D. megaceros* *eschrichtii*]; in key].

Dolopichthys (subgenus *Dermatias*) *heteracanthus*, Regan and Trewavas, 1932:77, Fig. 117 (misidentifications; description; four additional specimens all referred to *O. luetkeni* by Bertelsen, 1951; in key).

Oneirodes luetkeni, Bertelsen, 1951:86-87, Figs. 31P-S, 40 (new combination; diagnostic charac-

ters; available material listed; opercular bones described, figured; in key). Grey, 1956a:248 (synonymy; vertical distribution).

Material.-43 females, 11.5-123.0 mm (see Appendix A).

Diagnosis.—*Oneirodes luetkeni* is most similar to *O. carlsbergi*. Unlike all other oneirodids, these two species have well-developed teeth on the anterior margin of the epibranchial of the first arch. These teeth are present and easily discernible in the smallest known specimens (11.5 mm). In addition, *O. luetkeni* and *O. carlsbergi*, as well as *O. rosenblatti* and *O. dicromischnus* share a relatively high number of teeth in the jaws. *Oneirodes luetkeni*, however, is clearly differentiated from all its congeners by its esca morphology (Fig. 61), absence of teeth on pharyngobranchial II, and short illicium (13.0-20.4 percent of SL).

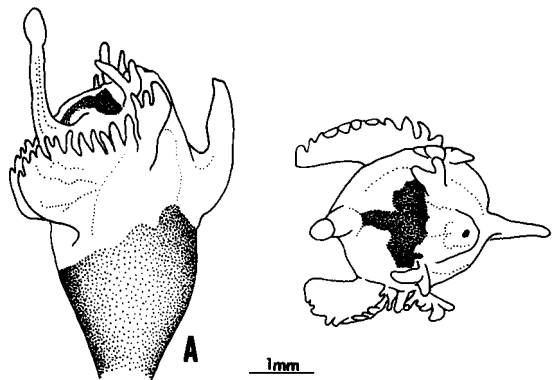


FIGURE 61. Esca of *Oneirodes luetkeni*, LACM 31110-1, 60.0 mm SL: A. left side; B. dorsal view.

TABLE 2
Counts and measurements of representative specimens of *Oneirodes luetkeni*.
Measurements expressed in percent of SL

Holotype	LACM 31110-1	ZMUC P92175	LA M 8 -1	LA M 801-1	SIO 6 3	ZMUC P92172	BMNH 1925.8. 11.10	ZM C .92	ZM 92.1°	LACM 326. -1
9287	0	49.0	42.0	38.0	32.0	0.	8.5	27.0	25.0	20.0
123.0										
2.	33	3 7	41.7	10.8	8.8	3.3	2.1	4.4	40.0	5
4	4	4 9	4.8	55.3	50.	55.0	52.6	5	52.0	45.0
3	3	30.6	35	38.2	4	6.7	33.3	8.9	34.0	0.
3.	8.0	3	0	8.7	8.	20.0	7.5	2	18.0	18
8	43.		51.2	2.6	0.0	0.0	5 6		-	2.
7	7	6	6	5	5	2	0		7	6
134	10	76	109	7	6	5	90	8	7	20
62	22	73	0	7	3	74	80		6	64

Description.-Escal appendage pattern A (Fig. 60A); esca with a stout anterior appendage, the distal tip of which is slightly swollen and pigmented in most specimens larger than approximately 60 mm; anterior appendage without internal pigment; a truncated terminal papilla with a distal spot of pigment in some specimens, flanked on each side by a medial appendage consisting of two or three short, unpigmented filaments; an un-

pigmented, tapering, posterior appendage less than length of escal bulb, becoming proportionately longer with growth; usually a pair of lateral appendages, each consisting of three or four short, unpigmented filaments; and a broad, fringed, membranous anterolateral flap (Fig. 61).

Suboperculum with posterior margin of upper part not indented (Bertelsen, 1951:87, Fig. 31P-S); length of lower fork of operculum 29.1 (22.8-35.7) percent of SL; ratio of lengths of upper and lower forks of operculum .64 (.60-.71) (measurements based on 11 specimens, 25.0-123.0 mm).

Epibranchial of first gill arch with 6-17 teeth on anterior margin (Fig. 50); teeth absent on pharyngobranchial II; total number of teeth on vomer 6-10; number of teeth in upper jaw 57-134, in lower jaw 51-93; D. 5-6; A. 4; P. 15-17 (Table 1).

Measurements in percent of SL, based on 21 specimens, 20.0-123.0 mm: head length 39.3 (32.5-46.4); head depth 46.5 (32.5-52.6); lower jaw 50.5 (42.9-57.4); premaxillary 34.1 (30.0-39.3); illicium length 17.9 (13.0-20.4). Complete counts and measurements of representative specimens are given in Table 2.

Rest of characters as for genus.

Distribution.-*Oneirodes luetkeni* was formerly known from the Gulf of Panama and adjacent waters of the eastern Pacific Ocean. The collections reported here extend the range along the west coast of the Americas to 20°21'N (VELERO IV Station 13759) and to 12°20'S (AKADEMIK KURCHATOV Cruise 4, Station 229) (Fig. 106).

The vertical distribution of *O. luetkeni* was analyzed by a procedure outlined by Gibbs (1969; see Methods and Materials, p. 3). Results indicate a concentration between 700 and 1250 m (Table 3).

Etymology.-*Oneirodes luetkeni* is named for the Danish zoologist Christian Frederik *Lütken*.

Oneirodes carlsbergi (Regan and Trewavas)
Figure 60B, 62, 107
Tables 1 and 4

Dolopichthys (subgenus *Dermatias*) *carlsbergi* Regan and Trewavas, 1932:76, Fig. 115 (original description; six specimens; Atlantic and Pacific; lectotype, ZMUC P9285; in key).

Oneirodes eschrichtii, Regan, 1926:26 (in part; misidentifications; two specimens, the holotype of *O. eschrichtii* and another referred to *O. carlsbergi* by Bertelsen 1951). Regan and Trewavas, 1932:63 (in part; after Regan, 1926).

Dolopichthys heteracanthus, Regan, 1926:28 [in part; misidentifications; 21 specimens, two of

TABLE 3

Vertical distribution of *Oneirodes luetkeni* based on specimens collected by the DANA. Meter-hours and specimens expressed as percent of total. See text for methods of calculation.

Depth (m)	Meter-hours	Specimens
0-100	16.5	0
101-200	5.9	0
201-300	0.1	0
301-400	15.4	5.3
401-500	0	—
501-600	2.4	0
601-700	0	—
701-800	1.6	10.5
801-900	0	—
901-1000	5.9	21.0
1001-1250	10.7	36.8
1251-1500	8.9	5.3
1501-1750	14.5	5.3
1751-2000	11.2	15.8
2001-3000	5.9	0
>3000	0	—
Number of specimens		19
Number of meter-hours	596.6	
Number of hauls	83	

which referred to *D.* (subgenus *Dermatias*) *carlsbergi* by Regan and Trewavas, 1932]. Norman, 1930:353 [in part; misidentifications; two specimens, the larger referred to *D.* (subgenus *Dermatias*) *carlsbergi*, the smaller to *D.* (subgenus *Dermatias*) *anisacanthus* (= *O. anisacanthus*) by Regan and Trewavas, 1932].

Dolopichthys megaceros, Regan, 1926:29 [in part; misidentifications; nine specimens, one of which referred to *D.* (subgenus *Dermatias*) *carlsbergi* by Regan and Trewavas, 1932].

Dolopichthys inimicus Fraser-Brunner, 1935:324-325, Fig. 3 (original description; single specimen; off Irish Atlantic Slope; 320 m; holotype, BMNH 1934.8.8.90). Wheeler, 1969:585 (reference to original description).

Oneirodes inimicus, Bertelsen, 1951:85 (new combination; diagnostic characters). Grey, 1956a:247 (synonymy; vertical distribution).

Oneirodes carlsbergi, Bertelsen, 1951:86, Figs. 31M-O, 39 (new combination; diagnostic characters; DANA material listed; lectotype designated; opercular bones described, figured; in key). Grey, 1956a:247-248 (synonymy; vertical distribution).

Oneirodes eschrichti-group, Bussing, 1965:223 misidentification; description of an additional spec-

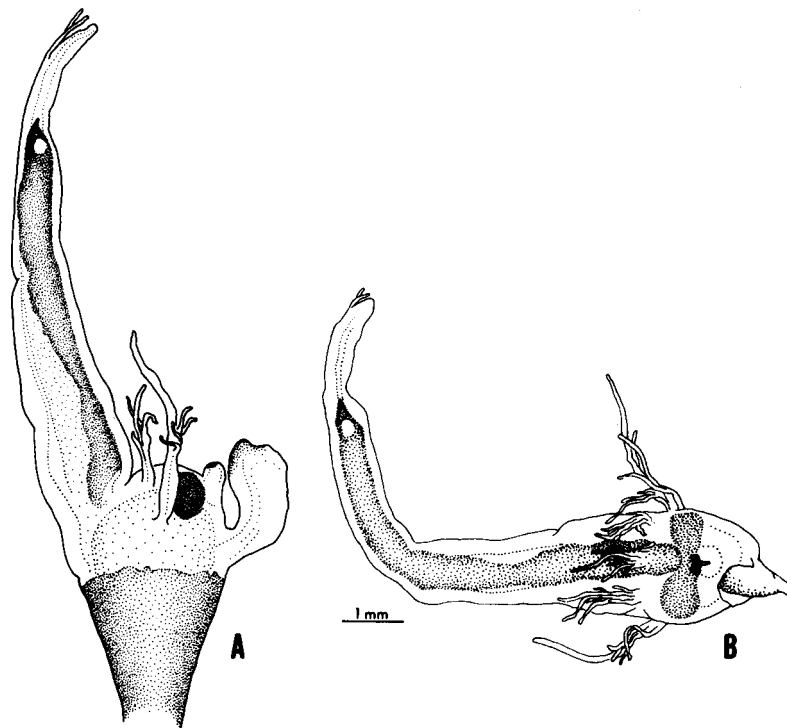


FIGURE 62. Esca of *Oneirodes carlsbergi*, SIO 55-246, 62.0 mm SL: A. left side, medial appendage not shown; B. dorsal view.

imen; comparison with *Dolopichthys brevifilis* (= *O. eschrichtii*).

Material.—25 known females, 18.0-159.0 mm (see Appendix A).

Diagnosis.—*Oneirodes carlsbergi* is most similar to *O. luetkeni* (see diagnosis for the latter, p. 38). *Oneirodes carlsbergi* is easily distinguished from all of its congeners by its esca morphology (Fig. 62), presence of teeth on epibranchial I and pharyngobranchial II, and a high number of jaw teeth.

Description.—Esca appendage pattern B (Fig. 60B); esca with a tapering, internally pigmented, anterior appendage, two to more than three times as long as esca bulb becoming proportionately longer with growth, and usually bearing two short, unpigmented filaments on anterior margin near distal tip; a medial, unpaired, unpigmented appendage usually consisting of numerous branched filaments, flanked on each side by a similar filamentous medial appendage; a truncated terminal papilla, with a distal spot of pigment in some specimens; a laterally compressed, crescent-shaped posterior appendage, pigmented on distal margin in some specimens; an unpigmented, filamentous lateral appendage on each side; anterolateral appendages absent (Fig. 62).

Suboperculum with posterior margin of upper part not indented (Bertelsen, 1951:86, Fig. 31M-O); length of lower fork of operculum 26.9 (23.3-30.0) percent of SL; ratio of lengths of upper and lower forks of operculum .55 (.51-.61) (measurements based on 7 specimens, 37.0-159.0 mm).

Epibranchial I with 1-5 teeth on anterior margin; teeth present on pharyngobranchial II; total number of teeth on vomer 4-10; number of teeth in upper jaw 29-180, in lower jaw 53-160; D. 5-7; A. 4-5 (one specimen had A. 5); P. 16-18 (Table 1).

Measurements in percent of SL, based on 17 specimens, 21.0-159.0 mm: head length 41.1 (34.8-47.6); head depth 48.3 (41.9-64.3); lower jaw 46.4 (40.9-54.8); premaxillary 31.8 (26.1-38.1); illicium length 24.1 (15.2-35.3). Complete counts and measurements of representative specimens are given in Table 4.

Rest of characters as for genus.

Distribution.—*Oneirodes carlsbergi* has been taken in tropical waters of the eastern Atlantic Ocean west to 35°49'W between 17°49'N and 5°34'S, in the eastern Pacific Ocean west to 148°35'W between 12°07'N and 7°45'S, and a single specimen from the western Pacific at 16°-55'N, 120°02'E (DANA Station 3730-1). One additional specimen, considerably outside the pre-

sumed **circumtropical** range of *O. carlsbergi*, was taken off the Irish Atlantic Slope. The lectotype is from the Gulf of Panama (Fig. 107).

The available data (maximum depths reached by fishing gear) suggest that *O. carlsbergi* has an extremely wide vertical range compared to that of other species of *Oneirodes*, and that it may be taken at relatively shallow depths. Thirty-six percent of the total material, including the largest specimens, was collected by gear that fished at maximum depths not exceeding 360 m; 72 percent was taken by nets fished above 1000 m. Two specimens (22.5 and 38.0 mm) were captured by a closing net between 690 and 900 m. Although data for the Atlantic and Pacific populations were analyzed separately, no significant differences in vertical distribution were found.

Geographic variation.—No geographic variation could be detected between the Atlantic and Pacific populations of *O. carlsbergi*.

Etymology.—This species is named **in honor** of the Danish Carlsberg Foundation.

Comments.—*Oneirodes inimicus* (Fraser-Brunner, 1935) was described from a single specimen reportedly collected from 320 m on the continental slope southwest of Ireland with a "small-meshed" net towed from the stern of a drifting commercial trawler. In describing *O. inimicus*, Fraser-Brunner (1935) failed to notice a posterior esca appendage characteristic of the esca of *O. carlsbergi*. The presence of epibranchial teeth, a toothed pharyngobranchial II, and high jaw-tooth counts confirm the identity of this specimen as *O. carlsbergi*.

***Oneirodes rosenblatti*, new species**

Figures 60B, 63, 64, 108

Tables 1 and 5

Material.—12 females, 12.5-94.0 mm.

Holotype.—SIO 69-351, 94.0 mm; PIQUERO Cruise 8; Gulf of Panama, 3°10'N, 84°10'W; 10-ft IKMT; 0950-1453 hr; 3 July 1969.

Paratypes.—SIO 55-246, 2 (67.0-91.0 mm); HORIZON; 5°00'N, 78°09'W; 10-ft IKMT, 0-1436 m; 2050-0100 hr; 14-15 November 1965. SIO 52-384, 84.0 mm; HORIZON, Shellback Expedition; 2°09'N, 84°53.5'W; 10-ft IKMT, 0-1286 m; 29 July 1952. SIO 70-384, 56.0 mm; ANTON BRUNN Cruise 11, Station 103; 8°59'S, 80°37'W; Menzies trawl, 0-4501 m; bottom depth 4486-4501 m; 4 November 1965. SIO 55-244, 26.0 mm; HORIZON, Eastropac Expedition, trawl 12; 10-ft IKMT, 0-1335 m; 14 November 1955.

IOM uncatalogued, 66.0 mm; AKADEMIK KURCHATOV Cruise 4, Station 282, Sample 208;

TABLE 4
Counts and measurements of representative specimens of *Oneirodes carlsbergi*.
Measurements expressed in percent of SL

	ZMUC P92182	ISH 394/66	ISH 2478/71	ISH 924/68	Lectotype ZMUC P9285	Paralecto- type BMNH 1930.1. 12.1079	SIO 60-239	Paralecto- type BMNH 1932.5. 3.15	Paralecto- type ZMUC P92163	Paralecto- type ZMUC P92162
Standard length	159.0	107.0	86.0	63.0	40.0	37.0	23.0	21.0	19.5	19.0
Length										
Head	35.8	38.3	40.7	42.1	43.8	41.9	34.8	47.6	41.0	39.5
Lower jaw	40.9	45.8	47.7	46.8	47.5	51.4	41.3	54.8	48.7	42.1
Premaxillary	28.9	30.8	33.1	33.3	31.2	33.8	26.1	38.1	—	—
Illicium	25.2	31.8	29.1	30.2	27.5	25.7	15.2	19.5	25.6	13.2
Head depth	—	44.6	41.9	46.0	50.0	52.7	43.4	64.3	—	—
Teeth										
Vomer	6	6	6	10	8	7	4	8	5	2
Upper jaw	67	76	99	180	120	87	29	54	50	25
Lower jaw	61	80	91	150	160	100	53	78	75	42

TABLE 5
Counts and measurements of *Oneirodes rosenblatti*.
Measurements expressed in percent of SL

	Holotype SIO 69-351	Paratype SIO 55-246	Paratype SIO 52-384	Paratype SIO 55-246	Paratype IOM uncata- logued	Paratype SIO 70-384	Paratype IOM uncata- logued	Paratype ZMUC P92188	Paratype SIO 55-244	IOM uncata- logued	Paratype USNM 201099	Paratype LACM 32613-4
Standard length	94.0	91.0	84.0	67.0	66.0	56.0	48.0	32.0	26.0	22.0	13.0	12.5
Length												
Head	33.5	34.1	32.1	32.1	36.4	35.7	37.5	40.6	40.4	36.8	39.4	39.0
Lower jaw	37.2	38.5	39.3	39.6	48.3	42.9	41.7	46.9	46.2	43.2	42.5	42.4
Premaxillary	27.1	27.5	27.4	26.8	28.0	31.2	29.2	31.2	29.2	30.0	—	—
Illicium	29.3	29.7	28.6	23.9+	28.8	27.7	28.1	31.2	30.8	—	21.3	21.2
Head depth	35.6	35.2	36.9	40.3	41.7	42.9	39.6	46.9	46.2	43.2	42.5	38.1
Teeth												
Vomer	14	14	12	8	12	13	9	9	10	6	2	2
Upper jaw	145	135	90	88	128	111	140	61	76	50	13	10
Lower jaw	137	137	106	96	135	122	120	66	64	59	16	10

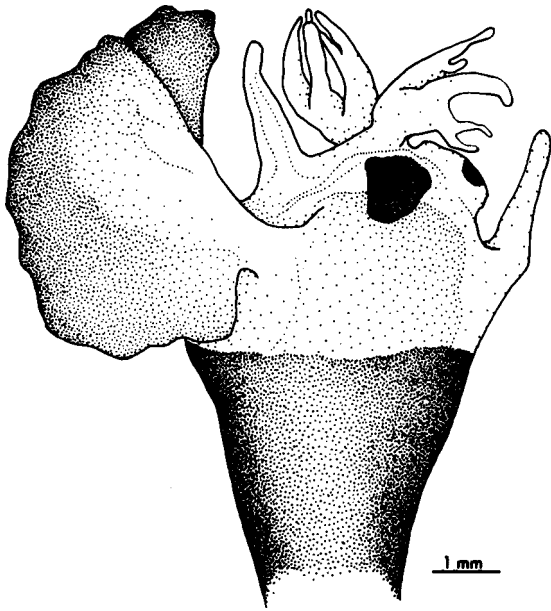


FIGURE 63. Esca of *Oneirodes rosenblatti*, holotype; SIO 69-351, 94.0 mm SL, left side.

8°01.5'S, 81°01.2'W; 10-ft IKMT, 0-1500 m; bottom depth 3870-4800 m; 1450-1900 hr; 28 October 1968. IOM uncatalogued, 48.0 mm; AKADEMIK KURCHATOV Cruise 4, Station 295, Sample 227; 8°25'S, 81°18'W; 10-ft IKMT, 0-910 m; 1940-0140 hr; 1-2 November 1968.

ZMUC P92188, 32.0 mm; GALATHEA Expedition Station 739; 7°22'N, 79°32'W; Herring Otter Trawl, 0-745 m; bottom depth 915-975 m; 15 May 1952.

USNM 201099, 13.0 mm; ANTON BRUNN Cruise 14, Station 570B; 8°33'S, 81°27'W; 10-ft IKMT, 0-2850 m; 0005-0505 hr; 14 March 1966.

LACM 32613-4, 12.5 mm; TE VEGA Cruise 20, Station B-16; 3°46'S, 85°37'W; 6-ft modified Tucker trawl with opening-closing device, 1000-1250 m.

Additional non-type material.—IOM uncatalogued, 22.0 mm; AKADEMIK KURCHATOV Cruise 4, Station 229, Sample 80; 12°14'S, 81°23'W; 10-ft IKMT, 0-1500 m; bottom depth 4550-4650 m; 2315-0335 hr; 7-8 September 1968.

Diagnosis.—*Oneirodes rosenblatti* can only be confused with *O. luetkeni*, both of which are characterized by a relatively high number of teeth in the jaws and on the vomer, and a similar esca morphology (Figs. 61, 63). The former, however, is clearly differentiated from *O. luetkeni* by the absence of epibranchial teeth, the presence of teeth on pharyngobranchial II, and a considerably longer illicium (see also diagnosis for *O. luetkeni*, p. 38).

Description.—Escal appendage pattern A (Fig. 60A); esca with a stout, unpigmented anterior appendage, without internal pigment; a pair of medial appendages each consisting of two or three branched filaments, the distal tips of which are pigmented in most specimens larger than approximately 48.0 mm; a truncated terminal papilla with a distal spot of pigment in some specimens; a stout, unpigmented posterior appendage; lateral appendages absent; and on each side, a large, membranous, oval or crescent-shaped, anterolateral flap, the distal half of which is darkly pigmented in most specimens larger than approximately 26.0 mm (Fig. 63).

Subopercular bone relatively long and slender, with posterior margin of upper part not indented (Fig. 64); length of lower fork of operculum 23.6 (20.7-26.5) percent of SL; ratio of lengths of upper and lower forks of operculum .49 (.45-54) (measurements based on seven specimens, 32.0-94.0 mm).

gibranchial teeth absent; teeth present on pharyngobranchial II; total number of teeth on vomer 6-14; number of teeth in upper jaw 50-145, in lower jaw 59-137; D. 5-6; A. 4; P. 14-16 (Table 1). Counts and measurements are given in Table 5.

Rest of characters as for genus.

Distribution.—*Oneirodes rosenblatti* is known only from the eastern tropical Pacific Ocean as far west as 85°37'W between 7°22'N and 12°24'S (Fig. 108).

Based on the maximum depths reached by fishing gear, *O. rosenblatti* appears to be a relatively deep dwelling form with a rather wide vertical range. Seventy-five percent of the known material, including the largest specimens, was captured by gear that fished at depths below 1280 m, in spite

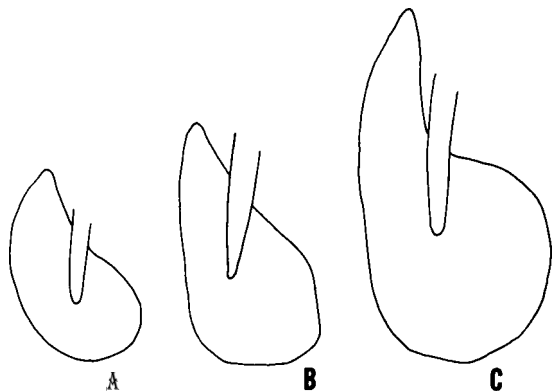


FIGURE 64. Subopercula of *Oneirodes rosenblatti*, lateral views, right side: A. paratype, IOM uncatalogued, 48.0 mm SL; B. paratype, SIO 55-246, 67.0 mm SL; C. paratype, SIO 52-384, 84.0 mm SL.

of the considerably greater fishing effort made above this depth during most oceanographic cruises to the eastern tropical Pacific (Gibbs, 1969:12-13). A single capture (12.5 mm) was made between 1000-1250 m with an opening-closing net. Although *O. rosenblatti* occurs between 750 m and perhaps as deep as 3000 m it seems to be concentrated between 1250 and 2000 m.

Etymology.—*Oneirodes rosenblatti* is named for Richard H. Rosenblatt, of the Scripps Institution of Oceanography, for his many contributions to ichthyology and for his help in making the present revision of *Oneirodes* possible.

Oneirodes eschrichtii Lütken

Frontispiece

Figures 60B, 65-70, 109

Tables 1, 6-9

Oneirodes eschrichtii Lütken, 1871:56-74, Figs. 1-2, **pl. 2** (original description; *eschrichtii* type species of *Oneirodes* by original designation and monotypy; off west coast of Greenland; holotype, ZMUC 64; in Danish). **Lütken**, 1872:329-344, Figs. 1-2, **pl. 9** (English translation of original description, **Lütken**, 1871). **Lütken**, 1878a:310, 326, **pl. 2**, Fig. 6 (reference to original description; esca figured; in Danish). **Lütken**, 1878b :343 (reference to original description; counts; in French). Gill, 1878a:218 (brief description). Gill, 1878b:228 (listed). Jordan, 1885:927 (listed). **Gunther**, 1887:56 (description after **Lütken**, 1871). Goode and Bean, 1896:492 (description after Gill, 1878a). Jordan and Evermann, 1898:2732 (description after Gill, 1878a). Ehrenbaum, 1902:76 (reference to holotype). Regan, 1926:26, Fig. 17 (in part; two specimens, the holotype of *O. eschrichtii* and another referred to *O. carlsbergi* by Bertelsen, 1951). Regan and Trewavas, 1932:63 (in part; after Regan, 1926). Maul, 1949: 34-42, Figs. 13-17 ("*sensu lato*"; *misidentification*; specimen here referred to *O. anisacanthus*; description; osteology; discussion of identity). Berry and Perkins, 1966:677 (four additional specimens). Lavenberg and Ebeling, 1967:195, Fig. 5 (vertical distribution; name misspelled *eschrichtii*). Fitch and Lavenberg, 1968:134 (comparison with *O. acanthias*). Ebeling et al., 1970:31, Fig. 4 (Ecological groups of deep-sea animals off southern California).

Oneirodes eschrichtii, Jordan and Gilbert, 1883: 848 (brief description after Gill, 1878a).

Oneirodes megaceros Holt and Byrne, 1908a: 93-95 (original description; single specimen, Irish Atlantic Slope, 51°21'N, 11°36'W; 0-1454m; **holotype**, NMI SR497; comparison with *O. esch-*

richtii). Holt and Byrne, 1908b:60 (listed; reference to original description). Murray and Hjort, 1912:94, 614, Fig. 81 (specimen thought to resemble *O. megaceros*).

Dermatias platynogaster Smith and Radcliffe, 1912, *In* Radcliffe, 1912:206-207, **pl. 17**, Fig. 3 (original description; single specimen; off coast of Luzon, western Pacific, 13°40'N, 123°57'E; 549 m; holotype, USNM 70269).

Dolopichthys megaceros, Regan, 1926:29 [brief description; *D. anisacanthus* (= *O. anisacanthus*), a synonym of *D. megaceros*; additional specimens; comparison with holotype; in key]. Parr, 1927:15, 18 [comparison with *D. obtusus* (= *O. eschrichtii*); in key]. Fowler, 1936:1339 (synonymy; description after Regan, 1926; in key). Koefoed, 1944:6, **pl. 1**, Figs. 4a-b, 5, **pl. 3**, Fig. 6 (description of two additional specimens; comparison with holotype). Maul, 1949:40 (a possible synonym of *O. eschrichtii*). Maul, 1961:130 (validity; synonymy; three specimens questionably referred to *D. megaceros*). Wheeler, 1969:585 (reference to original description).

Dolopichthys platynogaster, Regan, 1926:29-30 (brief description after Smith and Radcliffe, 1912; in key).

Dolopichthys sp. Regan, 1926:14 (listed). Norman, 1939:115, Fig. 41 (in part; two specimens, the smaller, DISCOVERY Station 186, is here referred to *O. eschrichtii*, the larger, DISCOVERY 193, is here referred to *O. schmidti-group*; esca figured).

Dolopichthys (subgenus *Dermatias*) *platynogaster*, Parr, 1927:14 (in key).

Dolopichthys obtusus Parr, 1927:16-18, Fig. 5 [original description; single specimen; off Bermuda, 32°19'N, 64°32'W; 8000 ft. wire; holotype, BOC 2028; comparison with *D. acanthias* (= *O. acanthias*) and *O. megaceros* (= *O. eschrichtii*); in key]. Maul, 1961:130 [comparison with other species of *Oneirodes*; a possible synonym of *D. megaceros* (= *O. eschrichtii*)].

Dolopichthys tentaculatus Beebe, 1932:88-90, Fig. 23 [original description; single specimen; off Bermuda, 1097 m; holotype, USNM 170945 (formally NYZS 23170); comparison with *D. obtusus* (= *O. eschrichtii*)]. Beebe, 1934:192 (figured). Beebe, 1937:207 (listed). Maul, 1961:130 [comparison with other species of *Oneirodes*; a possible synonym of *D. megaceros* (= *O. eschrichtii*)].

Dolopichthys (subgenus *Dermatias*) *digitatus* Regan and Trewavas, 1932:68, Fig. 94 (original description; single specimen; north of New Guinea, 1°20'S, 138°42'E; 4000 m wire; holotype ZMUC P9272).

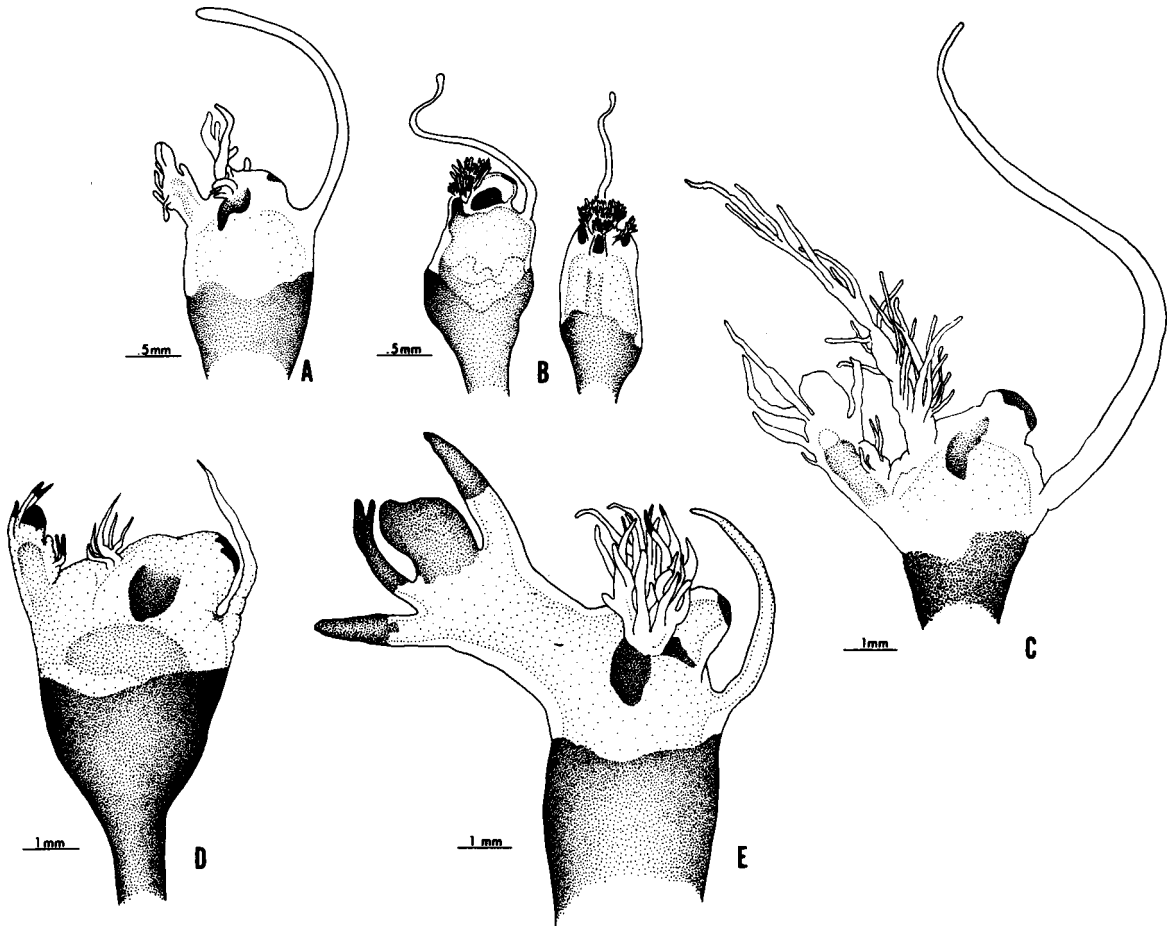


FIGURE 65. Escae of *Oneirodes eschrichtii*, left sides: A. BMNH 1939.5.24.1921, 14.5 mm SL; B. paralectotype of *Dolopichthys* (subgenus *Dermatias*) *thysanophorus*, ZMUC P9281, 18.5 mm SL, left side and anterior views; C. MMF 14045, 57.0 mm SL; D. holotype of *Oneirodes eschrichtii*, ZMUC 64, 153.0 mm SL; E. ISH 3048/71, 118.0 mm SL.

Dolopichthys (subgenus *Dermatias*) *platynogaster*, Regan and Trewavas, 1932:68, Fig. 95 (brief description after Smith and Radcliffe, 1912; in key).

Dolopichthys (subgenus *Dermatias*) *simplex* Regan and Trewavas, 1932:68, Fig. 96 (original description; single specimen; eastern Atlantic, 13°31'N, 18°03'W; 3500 m wire; holotype, ZMUC P9279).

Dolopichthys (subgenus *Dermatias*) *pollicifer* Regan and Trewavas, 1932:69, Fig. 97 (original description; single specimen; Gulf of Panama; 3500 m wire; holotype, ZMUC P9277).

Dolopichthys (subgenus *Dermatias*) *diadematus* Regan and Trewavas, 1932:69, Fig. 98 (original description; single specimen; South Atlantic, 15°41'S, 5°50'W; 3000 m wire; holotype, ZMUC P9271).

Dolopichthys (subgenus *Dermatias*) *brevifilis* Regan and Trewavas, 1932:69, Fig. 99 (original

description; single specimen; Gulf of Panama; 3000 m wire; holotype, ZMUC P9268).

Dolopichthys (subgenus *Dermatias*) *pennatus* Regan and Trewavas, 1932:69-70, Fig. 100 (original description; single specimen; Atlantic, 12°11'N, 35°49'W; 3000 m wire; holotype, ZMUC P9275).

Dolopichthys (subgenus *Dermatias*) *frondosus* Regan and Trewavas, 1932:70, Fig. 101 (original description; single specimen; eastern Atlantic, 15°31'N, 18°05'W; 1000 m wire; holotype, ZMUC P9273).

Dolopichthys (subgenus *Dermatias*) *cirrifer* Regan and Trewavas, 1932:70, Fig. 102 (original description; single specimen; western North Atlantic, 32°56'N, 23°47'W; 3500 m wire; holotype, ZMUC P9269).

Dolopichthys (subgenus *Dermatias*) *tentaculatus*, Regan and Trewavas, 1932:70 (brief description after Beebe, 1932; in key).

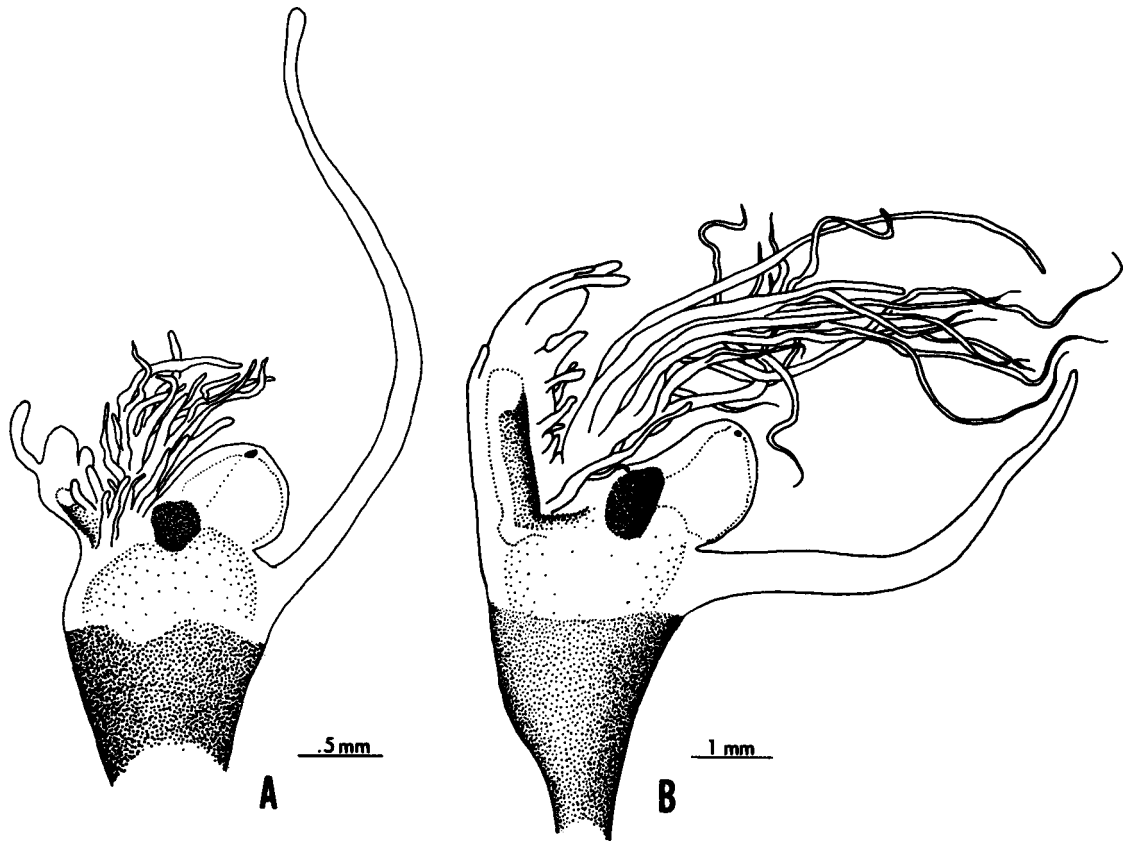


FIGURE 66. Escae of *Oneirodes eschrichtii* from southern California population, left sides: A. LACM 6838-10, 22.0 mm SL; B. LACM 31100-1, 71.0 mm SL.

Dolopichthys (subgenus *Dermatias*) *megaceros*, Regan and Trewavas, 1932:71, Fig. 103 (description; reference to holotype; in key).

Dolopichthys (subgenus *Dermatias*) *obtusus*, Regan and Trewavas, 1932:71 (brief description after Parr, 1927; in key).

Dolopichthys (subgenus *Dermatias*) *plumatus* Regan and Trewavas, 1932:71-72, Fig. 104 (original description; single specimen; Gulf of Panama; 2500 m wire; holotype, ZMUC P9276).

Dolopichthys (subgenus *Dermatias*) *ptilotus* Regan and Trewavas, 1932:73, Fig. 107 (original description; single specimen; Atlantic, 24°36.5'N, 17°27'W; 3000 m wire; holotype, ZMUC P9278).

Dolopichthys (subgenus *Dermatias*) *multifilis* Regan and Trewavas, 1932:73, Fig. 108 (original description; single specimen; Sulu Sea, 8°34'N, 119°55'E; 1000 m wire; holotype, ZMUC P9274).

Dolopichthys (subgenus *Dermatias*) *claviger* Regan and Trewavas, 1932:73-74, Fig. 109 (original description; two specimens; eastern Pacific near Galapagos; lectotype designated by Bertelsen, 1951, ZMUC P9270).

Dolopichthys (subgenus *Dermatias*) *thysanophorus* Regan and Trewavas, 1932:74, Fig. 110 (in part; original description; two specimens, the smaller, BMNH 1932 .5 .3 .14, lectotype of *O. thysanophorus*, the larger, ZMUC P9281, here referred to *O. eschrichtii*).

Dolopichthys hibernicus Fraser-Brunner, 1935: 325-326, Fig. 4 (original description; single specimen; Irish Atlantic Slope, 53°15'N, 12°28'W; holotype, BMNH 1934.8.8.91). Wheeler, 1969: 585 (reference to original description).

Oneirodes eschrichtii, Fowler, 1936:1139, 1140, 1337, Fig. 479 (description after Gunther, 1887; *O. megaceros* a synonym of *O. eschrichtii*; in key).

Dolopichthys simplex, Fowler, 1936:1365 (listed; in key).

Dolopichthys diadematus, Fowler, 1936:1366 (listed; in key).

Dolopichthys frondosus, Fowler, 1936:1366 (listed; in key).

Dolopichthys cirrifer, Fowler, 1936:1366 (listed; in key).

Dolopichthys ptilotus, Fowler, 1936:1366 (list-

ed; in key). Maul, 1961:130 [a possible synonym of *D. megaceros* (= *O. eschrichtii*)].

Oneirodes eschrichtii-group Bertelsen, 1951: 70-84, Figs. 31E-G, 32-37 (in part; 22 nominal species grouped; common characters; all available material listed; description of larvae, males, females; in key). Grey, 1956a:244-246 (synonymy; vertical distribution). Maul, 1961:122-130, Figs. 18, 22, Table 1 (in part; four additional specimens; description; comparison; discussion of possible valid species within *O. eschrichtii*-group). Maul, 1962:17-22, Figs. 7-9 (two additional specimens; description; discussion of proper identity). Bussing, 1965:223 [misidentification; single specimen here referred to *O. carlsbergi*; description; comparison with *D. brevifilis* (= *O. eschrichtii*)]. Taylor, F.,

1967:2111-2113 (misidentification; single specimen here referred to *O. bulbosus*; description; opercular bones described, figured; esca figured).

Oneirodes pollicifer, Rass, 1955:334, Table 2 (misidentification; specimen here referred to *O. eschrichtii*; distribution, Kurile-Kamchatka Trench). Rass, 1967:233, Table 22 (misidentification; after Rass, 1955).

Dolopichthys plumatus, Maul, 1961:130 [a possible synonym of *D. megaceros* (= *O. eschrichtii*)].

Dolopichthys digitatus, Beaufort and Briggs, 1962:249 (description after Regan and Trewavas, 1932; in key).

Dolopichthys multifilis, Beaufort and Briggs, 1962:249-250 (description after Regan and Trewavas, 1932; in key).

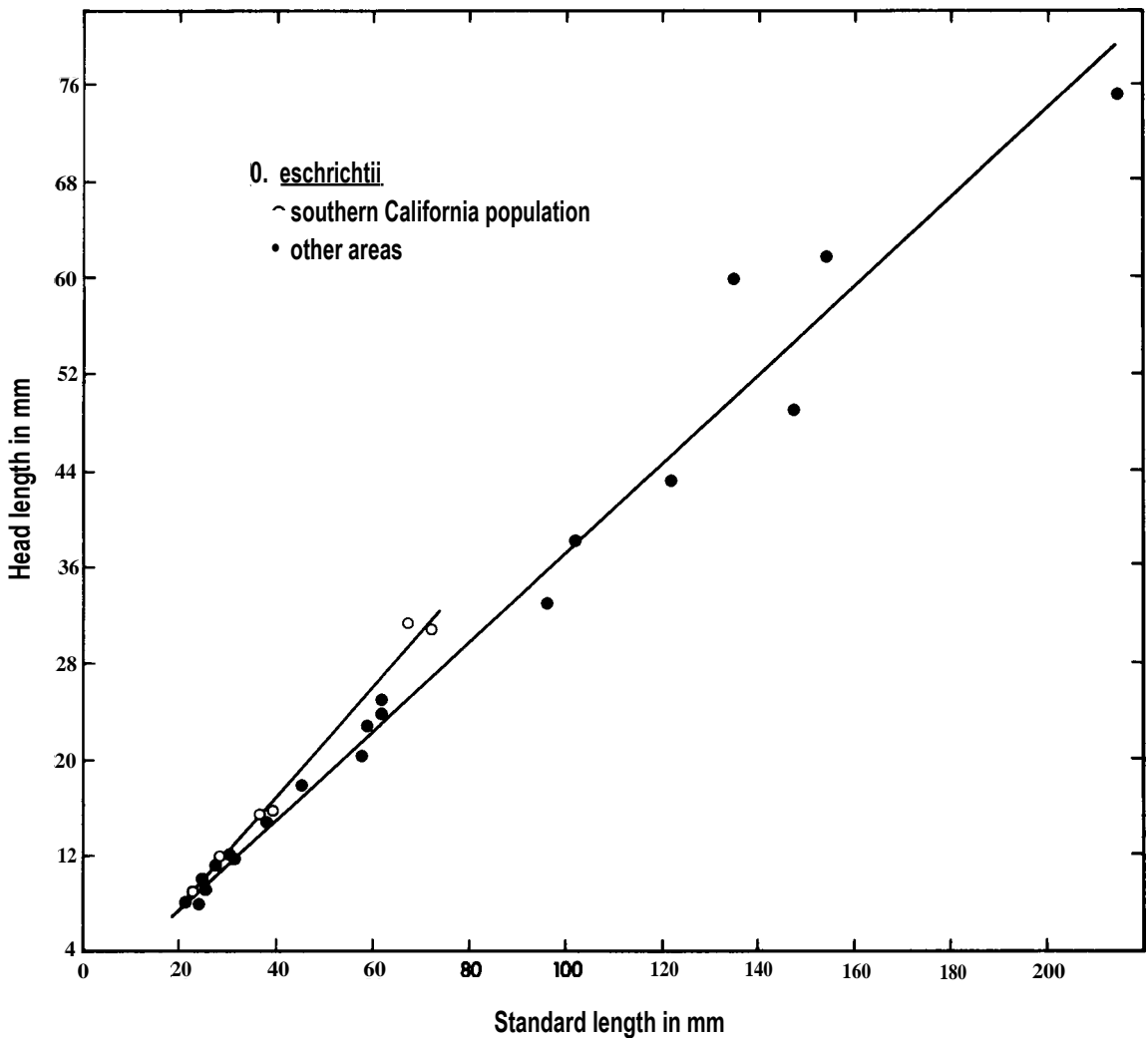


FIGURE 67. Regression ($y = a + bx$) of head length on standard length for two populations of *Oneirodes eschrichtii*. Statistics as in Table 8.

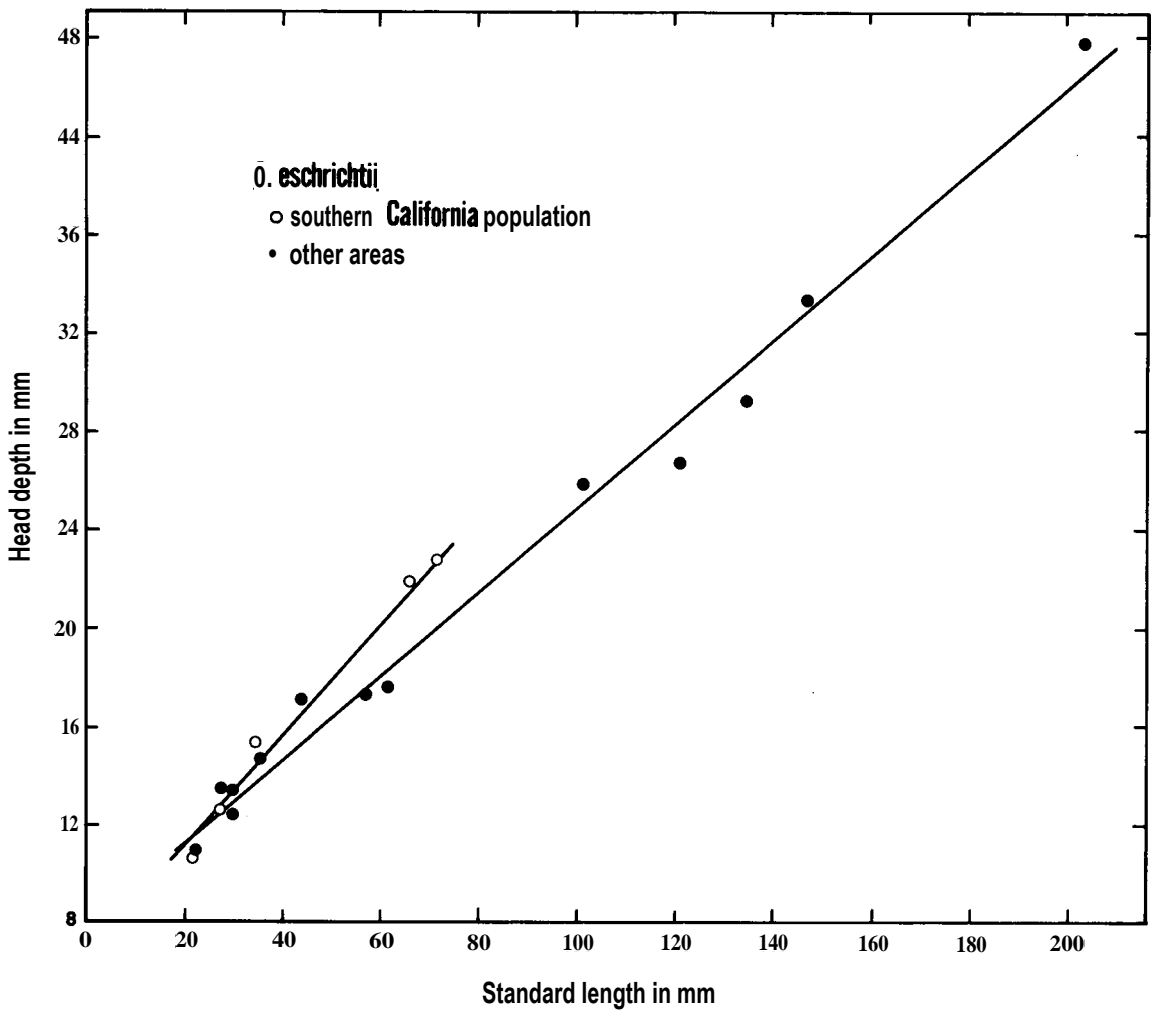


FIGURE 68. Regression ($y = a + bx$) of head depth on standard length for two populations of *Oneirodes eschrichtii*. Statistics as in Table 8.

Dolopichthys thysanophorus, Beaufort and Briggs, 1962:250 (in part; description after Regan and Trewavas, 1932; in key).

Material.—52 females, 10.0–213.0 mm (see Appendix A).

Diagnosis.—The esca morphology of *O. eschrichtii* is most similar to that of *O. bulbosus* and *O. anisacanthus* (Figs. 65–66, 71, 73). The esca of *O. eschrichtii*, however, does not have the numerous, tapering distal filaments of the anterior appendage of *O. bulbosus*, nor the lateral esca appendage of *O. anisacanthus*. Although, the differences in the shape of the subopercular bone between *O. eschrichtii* and *O. bulbosus* (Fig. 72; Bertelsen, 1951:83, Fig. 31E–G), and the slightly higher jaw-tooth counts of the former, are helpful in distinguishing these two forms, the characters of the esca are the only satisfactory means of separat-

ing *O. eschrichtii* from this and from most of the other species of the genus.

Description.—Esca appendage pattern B (Fig. 60B); esca with a stout, internally pigmented, anterior appendage, not longer than esca bulb, bearing distally a large, compressed papilla, at the anterior base of which usually arise a pair of filaments shorter than length of anterior appendage; one or two additional, shorter filaments along anterior margin and several to many along posterior margin of anterior appendage; papilla and distal ends of some filaments of anterior appendage darkly pigmented in most specimens approximately 100 mm and larger (and the 61.0 mm holotype of *O. megaceros*); a pair of filamentous, medial appendages half as long as esca bulb in smaller specimens (about 15 mm) to more than twice the length of esca bulb in specimens of intermediate size

(70 mm), less than half as long as esca bulb in largest specimens (150 mm); tips of tapering filaments of medial appendages darkly pigmented in a few large specimens (134 mm, 188 mm); a terminal papilla, truncated with a distal streak of pigment, or conical with a distal spot of pigment (see Geographic variation below, p. 51); an unpigmented, unbranched, tapering posterior appendage, one and a half to three times length of esca bulb in specimens less than approximately 100 mm, becoming proportionately shorter with further growth, less than length of esca bulb in 213.0 mm specimen; and in some specimens, on each side, a dorsolaterally to anterolaterally placed, unpigmented, filamentous appendage shorter than length of medial appendages (Figs. 65-66).

Suboperculum with posterior margin of upper part not indented (Bertelsen, 1951:83, Fig. 31E-G); length of lower fork of operculum 27.1 (20.7-31.9) percent of SL; ratio of lengths of upper and lower forks of operculum .56 (.44-.69) (measurements based on 8 specimens, 22.5-213.0 mm).

Epibranchial teeth absent; teeth present on pharyngobranchial II; total number of teeth on vomer 4-8; number of teeth in upper jaw 24-50, in lower jaw 29-56; D. 5-7; A. 4; P. 15-9 (Table 1).

Measurements in percent of SL, based on 30 specimens, 21.0-213.0 mm: head length 40.2 (33.3-46.2); head depth 44.1 (34.7-55.4); lower jaw 45.1 (34.3-55.7); premaxillary 31.6 (22.4-38.9); illicium length 26.2 (17.8-38.6). Complete counts and measurements of representative specimens are given in Tables 6-7.

Rest of characters as for genus.

Size at maturity. The ovaries of several large specimens (121.0-213.0 mm) of *O. eschrichtii* were large and tightly packed with eggs. The left ovary of the largest known specimen (213.0 mm, ROM 27277) was approximately 85 mm long or 40 percent of SL. Some of these ripe females were captured considerably outside the larval distribution of ceratioids found by Bertelsen (1951:224) to be limited to the warmer parts of the oceans between approximately 40°N and 35°S (see Ontogenetic Distribution, p. 95).

Distribution. *Oneirodes eschrichtii* is the only member of the genus with a nearly cosmopolitan distribution. It is known from both sides of the North Atlantic, in the west from off Greenland (the type locality) south to Bermuda, and in the east from the Irish Atlantic Slope as far south as 10°52'N. In the South Atlantic the range extends as far south as 40°S, between 43°W and 7°W. In the Pacific Ocean, *O. eschrichtii* is found off the slope of the Americas from 33°N to 34°S.

	Counts a		Measurements of rostrum		Measurements of rostrum in anterior view		Measurements of rostrum in lateral view		Measurements of rostrum in dorsal view		Measurements of rostrum in ventral view		Measurements of rostrum in posterior view		Measurements of rostrum in anterior view	
	ROM 7277	Ho Z	SN 029	R 27	N 2	M 2	L 2	N 2	M 2	L 2	N 2	M 2	L 2	N 2	M 2	L 2
total length	3.		34	101										9.	23.5	10
head length	2	10.5	4.8	3.6	4	39.	40.5	40.9	40.5	40.5	40.5	40.5	40.5	4	2	5
lower jaw	38.9	2	3	42.	39.3	4.8	48.	6.	48.	48.	48.	48.	48.	5	9	7.6
premaxillary	2	29.	2.4	27.	2.5	35.3	3	3	3	3	3	3	3	3	3	3
illicium	8	22.5	9	28.	2.6	8	28.4	28.4	3.4	3.4	3.4	3.4	3.4	25.	2	28.6
head depth	35.2		5.1	39.6			4.6	4.6	4.6	4.6	4.6	4.6	4.6			
eye	6			6												
lower jaw	34		32	35		38	34	34	6	6	6	6	6	4	3	35
upper jaw	36	3	3	36	4		48	48	5	5	5	5	5	4	4	4

¹Holotype of *Dermatias platynogaster* Smith and Radcliffe, 1912.
²Holotype of *Oneirodes megaceros* Holt and Byrne, 1908a.
³Holotype of *Dolopichthys* (subgenus *Dermatias*) *pennatus* Regan and Trewavas, 1932.

TABLE 7

Counts and measurements of specimens of southern California population of *Oneirodes eschrichtii*. Measurements expressed in percent of SL

	LACM 31100-1	LACM 6697-5	LACM 31663-5	LACM 30020-33	SIO 63-433	LACM 6838-10
Standard length	71.0	66.0	38.0	35.0	27.0	22.0
Length						
Head	43.7	46.2	41.6	44.3	44.4	40.9
Lower jaw	51.4	54.5	50.0	55.7	53.7	45.4
Premaxillary	37.3	37.8	35.5	37.1	38.9	34.1
Illicium	31.0	31.8	37.4	38.6	33.3	22.7
Head depth	47.8	48.4	47.4	54.2	50.0	43.2
Teeth						
Vomer	6	6	6	6	6	4
Upper jaw	38	40	43	50	42	24
Lower jaw	43	41	56	52	51	34

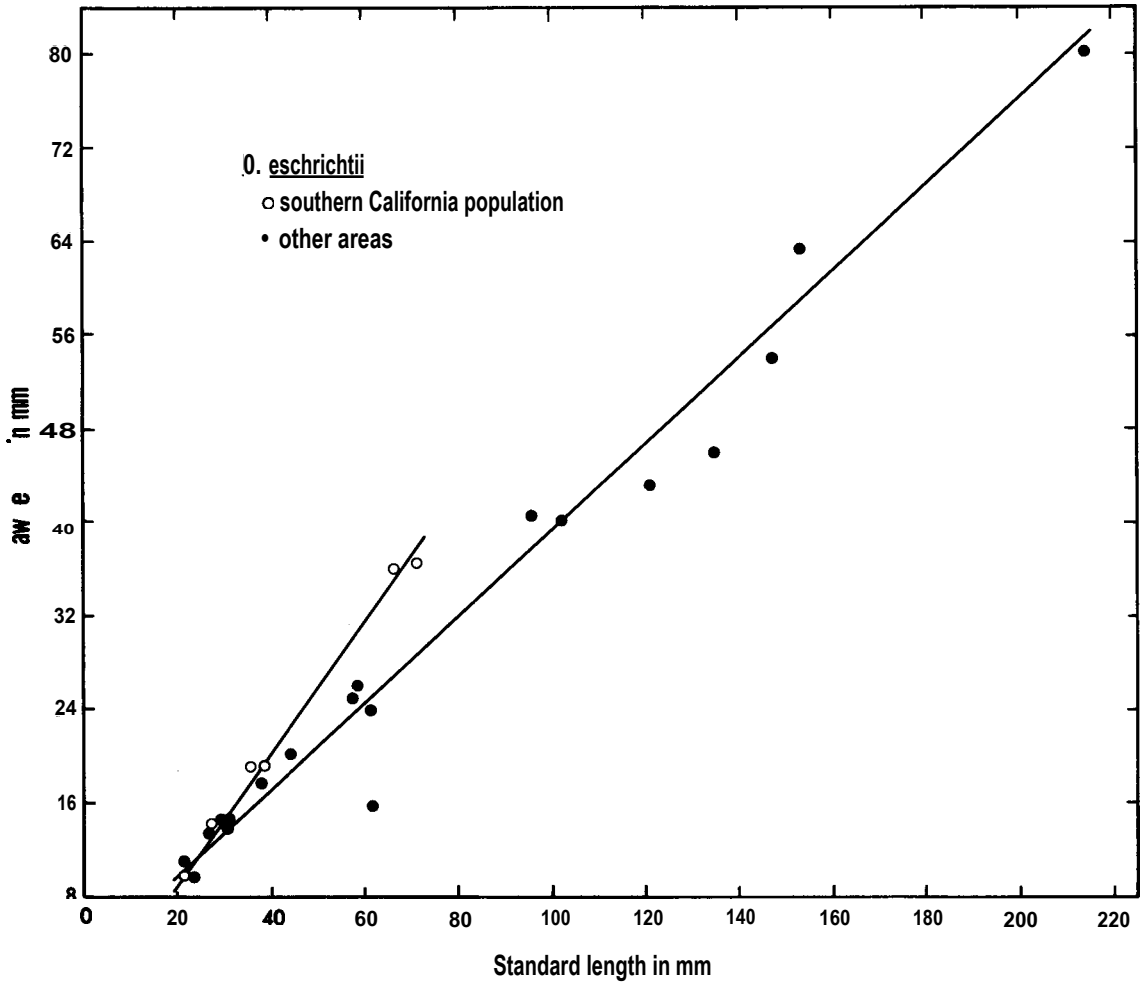


FIGURE 69. Regression ($y = a + bx$) of lower jaw length on standard length for two populations of *Oneirodes eschrichtii*. Statistics as in Table 8.

Two records are from the central Pacific, a single record from the Kurile-Kamchatka Trench at 49°29'N, 158°41'E, a single record just south of Tasmania, and several records from the East Indies. Three specimens are known from the Gulf of Aden and Arabian Sea (Fig. 109).

Data are not sufficient from any one geographic area to make meaningful suggestions about the vertical distribution of *O. eschrichtii*.

Geographic variation and ontogenetic change.—There appears to be a disjunct and morphologically distinct population of *O. eschrichtii* present in the waters off southern California. Morphological differences in the esca are apparent: the medial esca appendages of the southern California population are generally longer and more highly branched than those of specimens collected from other areas;

the terminal esca papilla is considerably larger in southern California specimens and has a distal spot of pigment rather than a distal streak of pigment (Figs. 65-66). Several morphometrics average higher in the southern California population (Figs. 67-70, Table 8). Counts and measurements of specimens of the southern California population of *O. eschrichtii* are given in Table 7.

Ontogenetic changes and intraspecific variation in the morphology of the esca are outlined in the description of the esca above and shown in Figures 65-66.

Etymology.—*Oneirodes eschrichtii* is named for the Danish naturalist D. F. Eschricht.

Comments.—Bertelsen (1951) erected the *Oneirodes eschrichtii*-group to include 22 nominal species most of which were described by Regan and

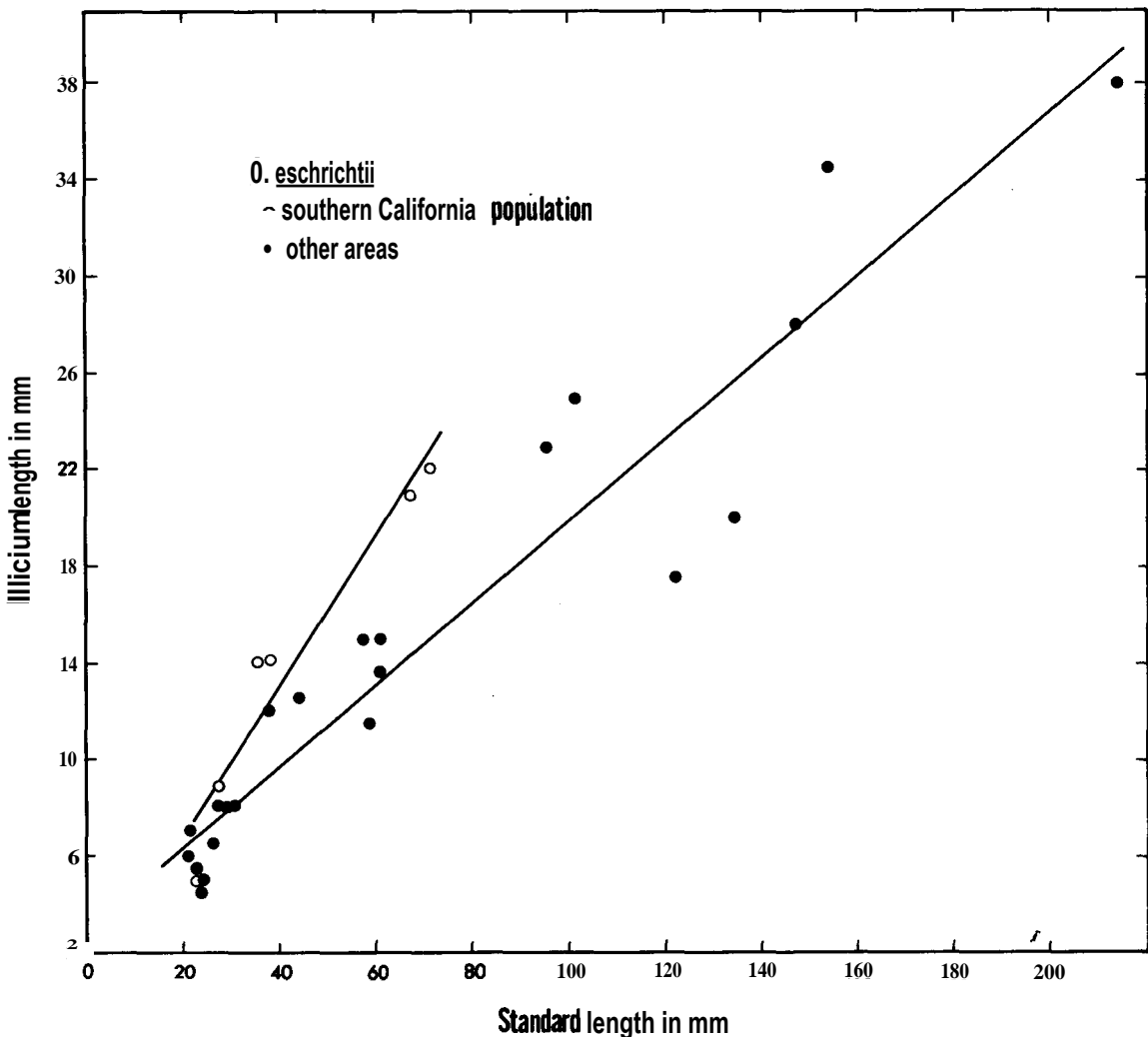


FIGURE 70. Regression ($y = a + bx$) of illicium length on standard length for two populations of *Oneirodes eschrichtii*. Statistics as in Table 8.

TABLE 8

Statistics describing regressions ($y = a + bx$) of several morphometrics on standard length (Figs. 67-70) of two populations of *Oneiroides eschrichtii*. \bar{x} = mean SL; \bar{y} = mean of particular morphometric character; N = number of specimens; a = y intercept; b = slope; CL-b = 95 percent confidence limits for b; r = correlation coefficient

	\bar{x}	\bar{y}	N	a	b	CL-b	r
Head length							
Southern California population	43.2	19.0	6	-0.912	0.460	0.411-0.510	0.997
Material from other areas	66.8	25.6	23	1.367	0.363	0.338-0.388	0.988
Head depth							
Southern California population	43.2	21.0	6	0.238	0.481	0.407-0.555	0.994
Material from other areas	80.0	31.4	14	4.703	0.334	0.310-0.358	0.994
Lower jaw							
Southern California population	43.2	22.6	6	-0.748	0.540	0.463-0.618	0.995
Material from other areas	66.8	27.6	23	3.342	0.363	0.344-0.383	0.993
Illicium length							
Southern California population	43.2	14.2	6	0.775	0.311	0.192-0.431	0.964
Material from other areas	66.8	14.4	23	3.085	0.170	0.146-0.194	0.956

Trewavas (1932) on the basis of one or two adolescent female specimens less than 25 mm SL, and on relatively minute differences in the morphology of the esca. With a better understanding of individual and ontogenetic variation since Bertelsen's (1951) monograph, these differences in the esca morphology are, in most cases, regarded as variations shown by widely distributed conspecific populations. In the absence of significant differences, the maintenance of specific distinction for 18 forms previously included in the *O. eschrichtii*-group is considered unjustified. These are here synonymized with *O. eschrichtii*. The reallocation of the nominal forms included in Bertelsen's (1951) *O. eschrichtii*-group is outlined in Table 9.

Oneiroides thysanophorus (Regan and Trewavas, 1932) was described on the basis of two specimens (12.5 and 18.5 mm) both collected at the same station (DANA 3686-7) in the Sulu Sea. The smaller of these (BMNH 1932.5.3.14), the lectotype of *O. thysanophorus*, is here referred to *O. flagellifer* (see comments under the latter species, p. 73). The 18.5 mm specimen (ZMUC P9281) has an esca that compares well with the known material of *O. eschrichtii* and is here referred to the latter (Fig. 65B).

Oneiroides bulbosus Chapman
Figures 60B, 71-72, 109
Tables 1 and 10

Oneiroides bulbosus Chapman, 1939:538-540, Fig. 70 (original description; single specimen; Gulf of Alaska, 53°50' N, 133°54' W; 693-891 m; **holotype**, USNM 108149; comparison with *O. esch-*

richtii). Rass, 1955:334, 336, Table 2 (distribution, Kurile-Kamchatka Trench, Alaska and northern California). Rass, 1967:233, Table 22 (after Rass, 1955). Ueno, 1971:102 (after Rass, 1955). Clemens and Wilby, 1946:338, Fig. 253 (description after Chapman, 1939). Maul, 1961:130 (comparison with other species of *Oneiroides*).

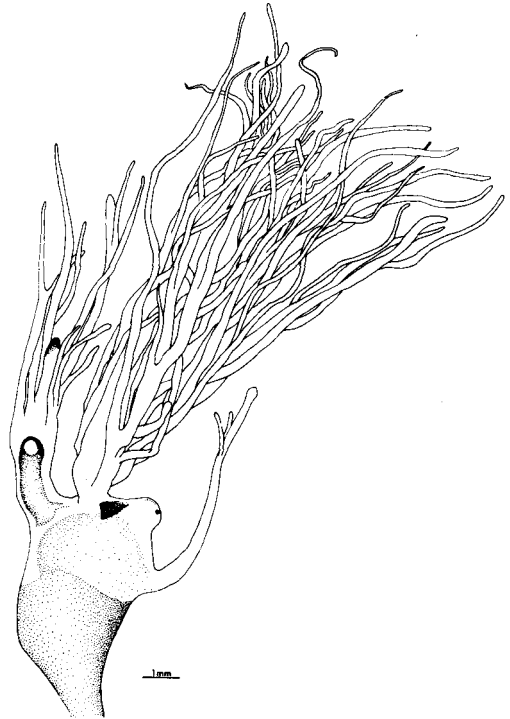


FIGURE 71. Esca of *Oneiroides bulbosus*, IOM uncatalogued, 81.0 mm SL, left side.

TABLE 9

Reallocation of nominal forms previously included in Bertelsen's (1951)
Oneirodes eschrichtii-group

<i>Oneirodes eschrichtii</i> Lütken, 1871	
<i>Oneirodes megaceros</i> Holt and Byrne, 1908a	
<i>Dermatias platynogaster</i> Radcliffe, 1912	
<i>Dolopichthys platynogaster</i> Regan and Trewavas, 1932	
<i>Dolopichthys obtusus</i> Parr, 1927	
<i>Dolopichthys tentaculatus</i> Beebe, 1932	
<i>Dolopichthys digitatus</i> Regan and Trewavas, 1932	
<i>Dolopichthys simplex</i> Regan and Trewavas, 1932	
<i>Dolopichthys pollicifer</i> Regan and Trewavas, 1932	
<i>Dolopichthys diadematus</i> Regan and Trewavas, 1932	
<i>Dolopichthys brevifilis</i> Regan and Trewavas, 1932	<i>Oneirodes eschrichtii</i> Lütken, 1871
<i>Dolopichthys pennatus</i> Regan and Trewavas, 1932	
<i>Dolopichthys frondosus</i> Regan and Trewavas, 1932	
<i>Dolopichthys cirrifer</i> Regan and Trewavas, 1932	
<i>Dolopichthys megaceros</i> Regan and Trewavas, 1932	
<i>Dolopichthys plumatus</i> Regan and Trewavas, 1932	
<i>Dolopichthys ptilotus</i> Regan and Trewavas, 1932	
<i>Dolopichthys multifilis</i> Regan and Trewavas, 1932	
<i>Dolopichthys claviger</i> Regan and Trewavas, 1932	
<i>Dolopichthys hibernicus</i> Fraser-Brunner, 1935	
<i>Dolopichthys</i> sp. Regan, 1926	
<i>Dolopichthys anisacanthus</i> Regan, 1925	<i>Oneirodes anisacanthus</i> (Regan, 1925)
<i>Dolopichthys heteronema</i> Regan and Trewavas, 1932	<i>Oneirodes heteronema</i> (Regan and Trewavas, 1932)
<i>Oneirodes theodori-tissieri</i> Belloc, 1938	<i>Oneirodes theodoritissieri</i> Belloc, 1938
<i>Oneirodes bulbosus</i> Chapman, 1939	<i>Oneirodes bulbosus</i> Chapman, 1939
<i>Oneirodes eschrichtii</i> (sensu lato) Maul, 1949	<i>Oneirodes anisacanthus</i> (Regan, 1925)
	5 (in part) <i>Oneirodes eschrichtii</i> Lütken, 1871
	(in part) <i>Oneirodes schmidti</i> -group Bertelsen, 1951

Oneirodes eschrichtii-group Bertelsen, 1951:79 (in part). Taylor, F., 1967:2111-2113, Figs. 3-4 (misidentification; description of an additional specimen; esca, opercular bones described, figured).

Material.—31 females, 47.0-110.0 mm (see Appendix A).

Diagnosis.—*Oneirodes bulbosus* is most similar to *O. eschrichtii* and *O. anisacanthus* (see diagnosis for *O. eschrichtii*, p. 48). In addition to differences in esca morphology, the shape of the suboperculum of most specimens of *O. bulbosus* differs from that of these forms and all other species of the genus with the exception of *O. thompsoni*. The posterior margin of the upper part of this bone is indented to deeply notched in all specimens of *O. bulbosus* examined except for the holotype (Fig. 72). *O. bulbosus* further differs from *O. anisacanthus* in having slightly fewer teeth in the jaws (Tables 10, 11).

Description.—Escal appendage pattern B (Fig. 60B); esca with a stout, internally pigmented anterior appendage bearing distally numerous tapering

filaments some of which may be twice length of esca bulb and darkly pigmented distally; a pair of highly branched, unpigmented, tapering medial filaments, two to nearly five times length of esca bulb in large specimens (81.0 mm); a short, rounded terminal papilla with a distal spot of pigment in specimens 57.0 mm and larger; and an unpigmented, tapering posterior appendage, nearly twice length of esca bulb, and usually bearing one



FIGURE 72. Subopercula of *Oneirodes bulbosus*, lateral views, right side: A. UBC 65-623, 47.5 mm SL; B. holotype, USNM 108149, 57.0 mm SL; C. IOM uncatalogued, 81.0 mm SL; D. IOM uncatalogued, 96.0 mm SL.

or two small, unpigmented filaments at one half to one third the distance from distal tip; lateral and anterolateral appendages absent (Fig. 71).

Suboperculum with posterior margin of upper part usually indented to deeply notched (Fig. 72); length of lower fork of operculum 31.0 (28.6-35.0) percent of SL; ratio of lengths of upper and lower forks of operculum .57 (.55-.60) (measurements based on six specimens, 47.5-109.0 mm).

Epibranchial teeth absent; teeth present on pharyngobranchial II; total number of teeth on vomer 4-8; number of teeth in upper jaw 23-39, in lower jaw 24-40; D. 6-7; A. 4; P. 15-18 (Table 1).

Measurements in percent of SL, based on 23 specimens, 47.0-110.0 mm; head length 42.2 (37.6-49.1); head depth 43.7 (39.1-50.8); lower jaw 48.5 (44.1-56.1); premaxillary 32.4 (29.1-38.6); illicial length 26.9 (23.1-38.6). Complete counts and measurements of representative specimens are given in Table 10.

Rest of characters as for genus.

Distribution.-*Oneirodes bulbosus* is known only from the north Pacific Ocean and Bering Sea. The range extends south to 44°N in the east and to 49°N in the west. The holotype was taken at 53°50'N, 133°54'W (Fig. 109).

Although little is known about the relative fishing effort at various depths in the North Pacific, *O. bulbosus*, based on maximum depths reached by gear, appears to inhabit relatively shallow depths, the bulk of the population concentrated between 600 and 850 m with, perhaps, a second peak below approximately 950 m.

Etymology.-The specific name is from the Latin *bulbosus*, referring to the bulbous body shape.

Oneirodes anisacanthus (Regan)

Figures 60B, 73-74, 106

Tables 1 and 11

Dolopichthys anisacanthus Regan, 1925:562-563 (original description; four specimens; north Atlantic; lectotype, ZMUC P9267). Regan, 1926:29 [synonymized with *D. megaceros* (*Oneirodes eschrichtii*) without comment]. Fowler, 1936:1365-1366 (listed; in key). Maul, 1949:39-40, Figs. 13-17 [*Oneirodes eschrichtii* (sensu lato) of Maul, 1949, a possible synonym of *D. anisacanthus*; description; osteology]. Maul, 1961:129-130, Figs. 19-21, Table 1 [*Oneirodes* sp. of *O. eschrichtii*-group of Maul, 1961, includes *O. eschrichtii* (sensu lato) of Maul, 1949; five specimens, the largest here referred to *O. anisacanthus*, remaining specimens here referred to *O. eschrichtii*]. Bertelsen, 1951:267 (lectotype designated).

Dolopichthys megaceros, Regan, 1926:29 (in part; *D. anisacanthus*, a synonym of *D. megaceros*).

Dolopichthys heteracanthus, Norman, 1930:353 [in part; misidentifications; two specimens, the larger referred to *D. carlsbergi* (= *O. carlsbergi*), the smaller to *D. anisacanthus* (= *O. anisacanthus*), by Regan and Trewavas, 1932.

Dolopichthys (subgenus *Dermatias*) *anisacanthus*, Regan and Trewavas, 1932:72, pl. 2, Fig. 2, text Fig. 105 (description; three additional specimens; in key).

Oneirodes eschrichtii (sensu lato) Maul, 1949:

TABLE 10
Counts and measurements of representative specimens of *Oneirodes bulbosus*.
Measurements expressed in percent of SL

	ZIL 31-968	ZIL 31- 968/14	ZIL 31- 968/19	ZIL 31- 968/12	ZIL 31- 968/13	ZIL 31- 968/14	Holotype USNM 108149	ZIL 31- 968/7	UBC 65-623	ZIL 31- 968/20
Standard length	110.0	98.0	83.0	78.0	68.0	59.0	57.0	57.0	47.5	47.0
Length										
Head	39.1	39.8	43.4	46.2	45.6	39.0	40.4	49.1	43.2	42.6
Lower jaw	44.5	44.9	47.0	53.8	51.5	44.1	50.8	56.1	52.6	51.1
Premaxillary	30.0	29.6	31.3	34.6	32.4	30.5	33.3	38.6	33.7	29.8
Illicium	23.6	27.6	24.1	34.6	27.9	24.6	28.1	29.8	27.4	29.8
Head depth	39.1	42.9	42.2	46.2	45.6	47.5	45.6	50.8	47.4	46.8
Teeth										
Vomer	6	6	4	6	4	6	6	4	8	4
Upper jaw	28	26	29	34	25	23	31	32	39	33
Lower jaw	24	30	26	34	25	25	31	40	40	36

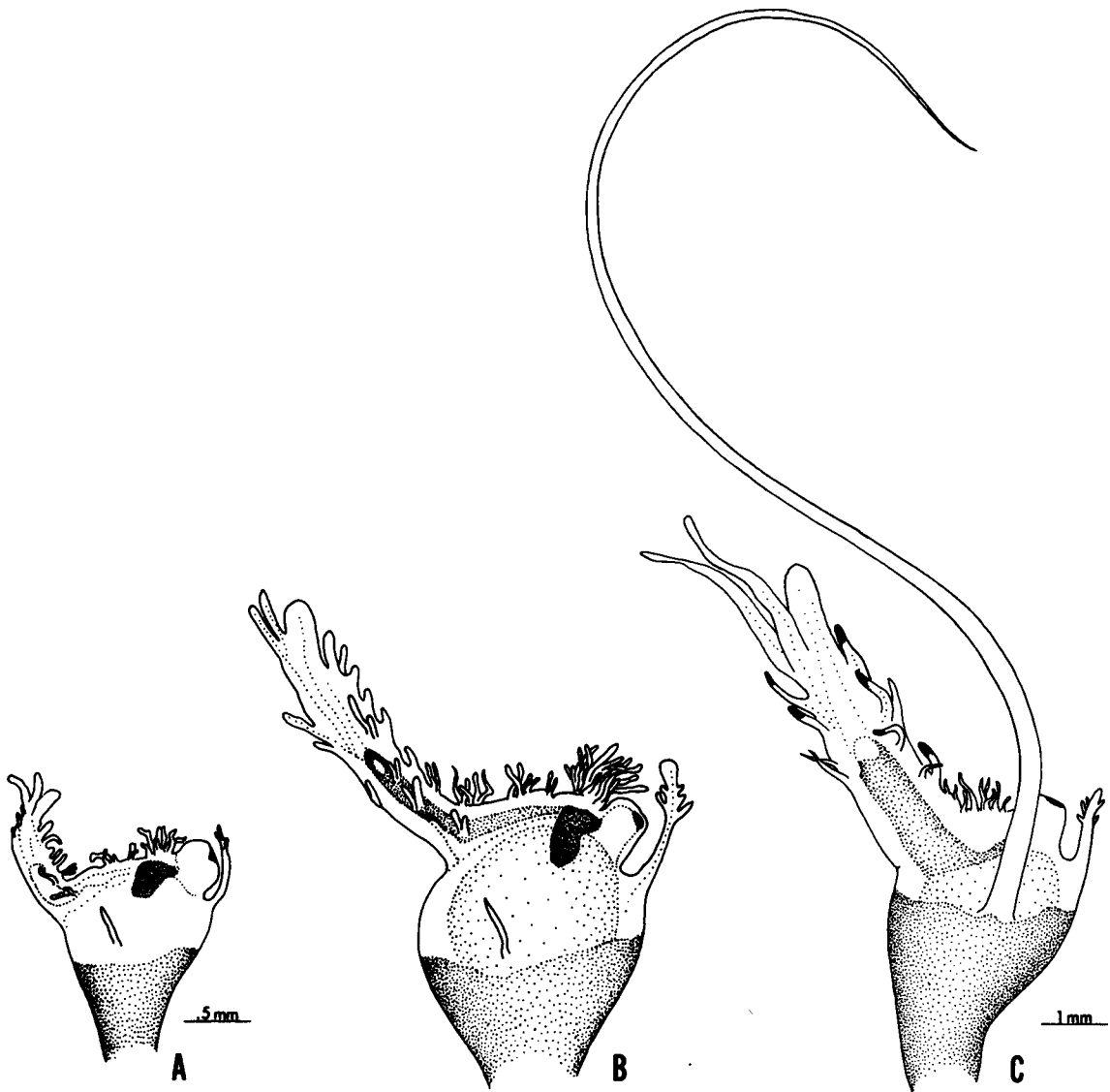


FIGURE 73. Escae of *Oneiroides anisacanthus*, left side: A. BMNH 1930.1.12.1080, 22.0 mm SL; B. NIO uncatalogued, 47.0 mm SL, freehand sketch; C. ISH 2730/71, 78.0 mm SL, left lateral appendage not shown.

34-42, Figs. 13-17 (description; osteology; a possible synonym of *D. anisacanthus*).

Oneiroides eschrichtii-group Bertelsen, 1951:79 (in part).

Oneiroides sp. of *Oneiroides eschrichtii*-group Maul, 1961:122-130, Figs. 19-21, Table 1 [=in part, *O. eschrichtii* (*sensu lato*) of Maul, 1949; five specimens, the largest here referred to *O. anisacanthus*, remaining specimens here referred to *O. eschrichtii*; description in part after Maul, 1949].

Material.—9 females, 10.5-173.0 mm (see Appendix A).

Diagnosis.—The esca of this species is most similar to that of *O. eschrichtii* and *O. bulbosus*, (see

diagnosis for *O. eschrichtii*, p. 48), but differs in having a well-developed lateral escal appendage (Figs. 65, 71, 73). The escal characters are the only satisfactory means of separating *O. anisacanthus* from most of the other species of the genus.

Description.—Escal appendage pattern B (Fig. 60B); esca with a stout anterior appendage as long as, or slightly longer than esca bulb, bearing two, unpigmented, tapering filaments on anterior margin near distal tip, and numerous shorter filaments along anterior, posterior, and lateral margins, with distal tips of some darkly pigmented in specimens 78.0 mm and larger; proximal half of anterior appendage internally pigmented; a series of short,

TABLE 11

Counts and measurements of *Oneiroides anisacanthus*.
Measurements expressed in percent of SL

	MMF 3101	ISH 2730/71	NIO uncata- logued	ZMUC P92183	Lectotype ZMUC P9267	BMNH 1930.1. 12.1018	UMML 30269
Standard length	173.0	78.0	47.0	39.0	27.0	22.0	13.0
Length							
Head	38.2	42.3	40.4	43.6	42.6	—	38.5
Lower jaw	43.4	50.6	45.7	46.2	48.1	43.2	38.5
Premaxillary	29.5	33.3	34.0	33.3	29.6	27.3	26.9
Illicium	20.8	28.2	27.6	30.8	24.1	22.7	21.5
Head depth	39.3	42.9					38.5
Teeth							
Vomer	5	6	6	8	5	7	4
Upper jaw	35	53	42	40	30	21	20
Lower jaw	28	54	45	50	36	26	23

unpigmented filaments arranged along distal midline of escal bulb, usually three distinct groups, the posteriormost group paired; a truncated terminal papilla with a distal streak of pigment in specimens 47.0 mm and larger; an unpigmented posterior appendage, approximately half length of escal bulb, and bearing two to five short, unpigmented filaments near distal tip in most specimens; an unpigmented, tapering, unbranched lateral appendage less than one-third length of escal bulb in specimens 47.0 mm and smaller, unbranched and nearly six times length of escal bulb in 78.0 mm specimen, and branched and nearly seven times length of escal bulb in 173.0 mm specimen (Maul, 1949:37, Fig. 17); anterolateral appendage absent (Fig. 73).

Suboperculum with posterior margin of upper part not indented (Fig. 74); length of lower fork of operculum 27.0 (24.9-29.6) percent of SL; ratio of lengths of upper and lower forks of operculum .51 (.44-.60) (measurements based on six specimens, 22.0-173.0 mm).

Epibranchial teeth absent; teeth present on pharyngobranchial II; total number of teeth on vomer 5-8; number of teeth in upper jaw 21-53, in lower jaw 26-54; D. 6-7; A. 4; P. 15-19 (Table 1). Counts and measurements are given in Table 11.

Rest of characters as for genus.

Size at maturity.—Only the largest known individual of *O. anisacanthus* (173.0 mm) appears to be mature. The right ovary is about 40 mm long or 23.1 percent of SL and contains numerous eggs measuring approximately .08-.10 mm in diameter.

Distribution.—*Oneiroides anisacanthus* is known

from the eastern tropical Atlantic, off Madeira (type locality) south to 10°46'N, the Gulf of Guinea and from the Caribbean Sea (Fig. 106).

The 47.0 mm specimen was captured with a closing net between 900 and 1040 m. The remaining vertical distributional data are too few to allow reasonable conclusions.

Etymology.—The name *anisacanthus* is derived from the Greek *anisos*, meaning unequal, and *akanthos*, a thorn or prickle, apparently in allusion to the unequal lengths of the articular spines.

Comments.—*Oneiroides anisacanthus* (Regan, 1925) was described from four individuals, only one of which actually represents this species. Two specimens (DANA Stations 1165 and 1183) are here referred to *O. eschrichtii*; the specimen from

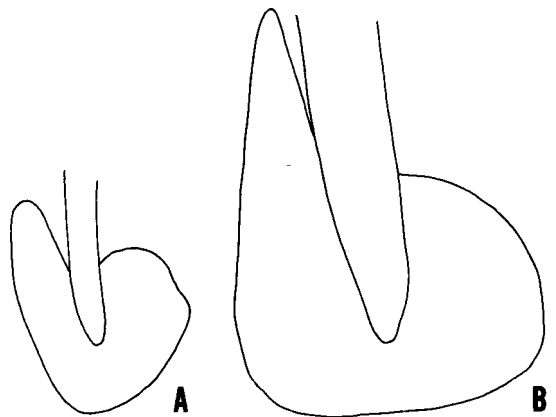


FIGURE 74. Subopercula of *Oneiroides anisacanthus*, lateral views, right side: A. ISH 2730/71, 78.0 mm SL; B. MMF 3101, 173.0 mm SL.

DANA Station 1256 was described as new by Regan and Trewavas (1932) and remains as the **holotype** of *O. macronema*.

Oneirodes kreffti, new species

Figure 60B, 75, 76, 107

Tables 1 and 12

Material.-3 females. 21.0-53.5 mm.

Holotype.-ISH 1536/71, 50.0 mm; WALTHER HERWIG Station 431 III/71; 30°04'S, 5°22'E; CMBT-1600, 0-500 m; 2130-2252 hr; 31 March 1971.

Paratypes.-ISH 1463/71, 53.5 mm; WALTHER HERWIG Station 427/71; 33°00'S, 7°50'E; CMBT-1600, 0-2000 m; 1925-2343 hr; 30 March 1971.



FIGURE 75. Esca of *Oneirodes kreffti*, holotype, ISH 1536/71, 50.0 mm SL: A. antero-lateral view; B. postero-lateral view, anterior appendage not shown.

TABLE 12

Counts and measurements of *Oneirodes kreffti*.
Measurements expressed in percent of SL

	Paratype ISH 1463/71	Holotype ISH 1536/71	Paratype MCZ 47554
Standard length	53.5	50.0	21.0
Length			
Head	43.0	42.0	64.3
Lower jaw	52.3	49.0	50.0
Premaxillary	35.5	35.0	31.0
Illicium	24.3	24.0	23.8
Head depth	43.9	44.0	47.6
Teeth			
Vomer	8	6	6
Upper jaw	46	41	31
Lower jaw	50	39	40

MCZ 47554, 21.0 mm; ANTON BRUNN Cruise 3, Station 160, Trawl 27, APB 7133; 41°07'S, 59°52'E; 10-ft IKMT with Foxton closing device, deep fraction, 150-635 m; 1725-2105 hr; 12 September 1963.

Diagnosis.-*Oneirodes kreffti* is most similar to *O. anisacanthus*. These two species are the only members of the genus that possess a well-developed lateral esca appendage. The esca of *O. kreffti*, however, bears a pair of stout, medial appendages that are absent in *O. anisacanthus*. In addition, *O. kreffti* appears to be a more globose form, having a deeper and longer head, and a longer lower jaw than *O. anisacanthus* (Tables 11-12).

Description.-Esca appendage pattern B (Fig. 60B); esca with a stout, internally pigmented anterior appendage, not longer than esca bulb, that of the holotype bearing two tapering filaments near distal tip and one or two similar filaments along posterior margin; filaments of anterior appendage lightly pigmented in 53.5 mm paratype; a pair of branched, tapering, unpigmented medial filaments, more than six times length of esca bulb; in 53.5 mm paratype, a similar, branched, tapering filament arises between medial pair of filaments; a truncated terminal papilla with a distal streak of pigment; an unbranched, tapering posterior appendage, more than two times length of esca bulb; on each side, an unpigmented, tapering lateral appendage, unbranched, bifurcated or trifurcated, and considerably longer than medial filaments; anterolateral appendage absent (Fig. 75).

Suboperculum with posterior margin of upper part not indented (Fig. 76); length of lower fork of operculum 29.2 (28.6-29.9) percent of SL; ratio of lengths of upper and lower forks of operculum .52 (.50-.53).

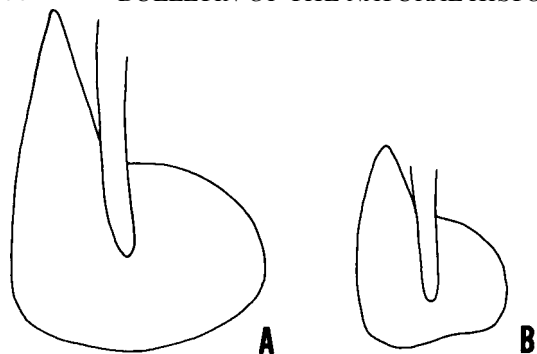


FIGURE 76. Subopercula of *Oneirodes kreffti*, lateral views, right side: A. holotype, ISH 1536/71, 50.0 mm SL; B. paratype, ISH 1463/71, 53.5 mm SL.

Epibranchial teeth absent; teeth present on pharyngobranchial II; total number of teeth on vomer 6-7; number of teeth in upper jaw 31-46, in lower jaw 39-50; D. 5-6; A. 4; P. 17-18 (Table 1). Counts and measurements are given in Table 12.

Rest of characters as for genus.

Distribution.-*Oneirodes kreffti* is known from two stations in the eastern South Atlantic and from the Indian Ocean west of the Kerguelen Islands (Fig. 107).

The 53.5 mm specimen was captured between 2000 m and the surface, the 50.0 mm specimen between 500 m and the surface, and the 21.0 mm specimen was taken with a 10-ft IKMT equipped with a Foxton closing device between 150 and 635 m.

Etymology.-*Oneirodes kreffti* is named in honor of Gerhard Kreffit, of the Institut für Seefischerei, Hamburg, for his many valuable contributions to ichthyology.

***Oneirodes myrionemus*, new species**

Figures 60B, 77, 78, 110

Tables 1 and 13

Material.-2 females, 43.0-121.0 mm.

Holotype.-ISH 3100a/71, 43.0 mm; WALTHER HERWIG Station 512/71; 32°47'N, 16°-24'W; CMBT-1600, 0-1800 m; 1945-2348 hr; 22 April 1971.

Paratype.-ISH 3100b/71; 121.0 mm; WALTHER HERWIG Station 512/71; data as for holotype.

One additional specimen, not included in the description below, is questionably identified as *O. myrionemus* (see Comments below, p. 59): ISH 2325/71, 137.0 mm; WALTHER HERWIG Station 478/71; 1°04'N, 18°22'W; CMBT-1600, 0-2100 m; 1842-2245 hr; 12 April 1971.

Diagnosis.-In addition to differences in esca



FIGURE 77. Esca of *Oneirodes myrionemus*, holotype, ISH 3049/71, 43.0 mm SL, left side.

TABLE 13
Measurements of *Oneirodes myrionemus*,
expressed in percent of SL

	Paratype ISH 3100b/71	Holotype ISH 3100a/71
Standard length	121.0	43.0
Length		
Head	33.1	39.5
Lower jaw	38.0	50.0
Premaxillary	27.3	32.6
Illicium	16.1	22.1
Head depth	40.0	51.2

morphology, *O. myrionemus* is distinguished from all species of *Oneirodes* by a combination of features including a relatively short head (less than that of all other species of the genus with the exception of *O. rosenblatti*) and illicium (less than that of all other species with the exception of *O. luetkeni*), and a short and broad subopercular bone (Fig. 78).

Description.—Escal appendage pattern B (Fig. 60B); esca with a stout, internally pigmented anterior appendage, approximately twice length of escal bulb, and bearing distally two or three, **unpigmented**, tapering filaments (shorter than to more than twice length of anterior appendage), and one or two branches or papillae which are darkly pigmented in 121.0 mm paratype; numerous, highly filamentous, medial appendages in the 43.0 mm holotype; a single unpaired, highly filamentous medial appendage in 121.0 mm paratype; a large truncated terminal papilla with a distal spot of pigment; an unpigmented, tapering posterior appendage approximately as long as escal bulb and bearing two small filaments in 43.0 mm holotype; lateral appendages absent; and four highly branched, unpigmented, anterolateral appendages on each side (Fig. 77).

Suboperculum relatively short and broad, posterior margin of upper part not indented (Fig. 78); length of lower fork of operculum 25.5 (23.1-27.9) percent of SL; ratio of lengths of upper and lower forks of operculum .47 (.42-.52).

Epibranchial teeth absent; teeth present on pharyngobranchial II; total number of teeth on vomer 4-6; number of teeth in upper jaw 31-33, in lower jaw 38-40; D. 5-6; A. 4; P. 18 (Table 1). Measurements are given in Table 13.



FIGURE 78. Subopercula of *Oneirodes myrionemus*, lateral views, right side: A. holotype, ISH 3049/71, 43.0 mm SL; B. paratype, ISH 3047/71, 121.0 mm SL.

Rest of character as for genus.

Distribution.—Both known specimens of *O. myrionemus* were captured in the same haul in the eastern North Atlantic at 32°47'N, 16°24'W between 1800 m and the surface (Fig. 110).

Etymology.—The name *myrionemus* is derived from the Greek *myrios*, meaning numberless, and *nema*, meaning thread, alluding to the highly filamentous esca of this species.

Comments.—A 137.0 mm specimen (ISH 2325/71) is questionably identified as *O. myrionemus*. Although the illicium and esca are lost, all counts, morphometrics, and the shape of the suboperculum compare well with the two known individuals of this species. This additional specimen would extend the known geographical range of *O. myrionemus* south to 1°04'N, 18°22'W (Fig. 110).

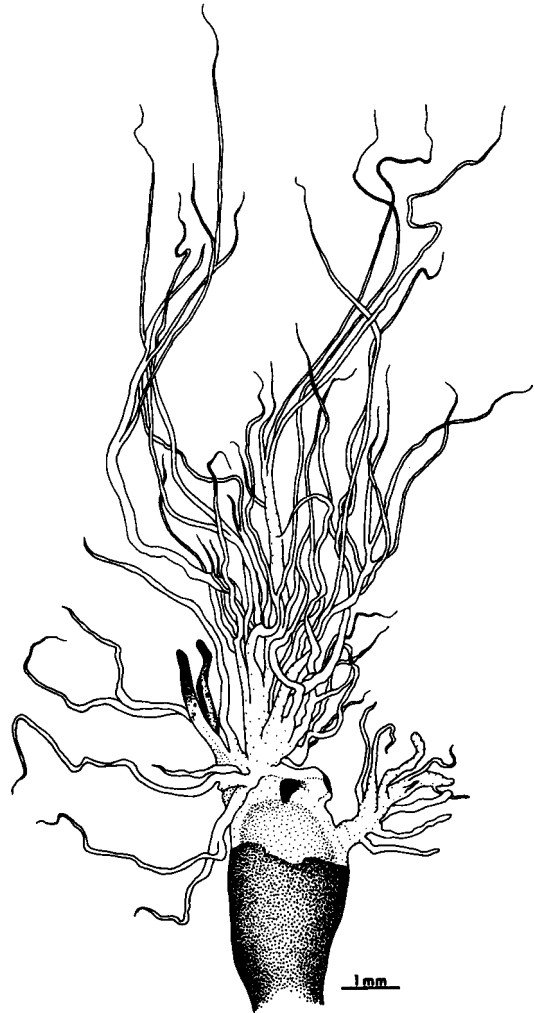


FIGURE 79. Esca of *Oneirodes heteronema*, SIO 70-385, 91.0 mm SL, left side.

TABLE 14
Counts and measurements of *Oneirodes heteronema*.
Measurements expressed in percent of SL

	IOM uncatalogued	SIO 70-385	IOM uncatalogued	SIO 70-386	LACM 32613-2	Holotype ZMUC P92150
Standard length	95.0	91.0	65.0	44.0	14.0	13.5
Length						
Head	36.3	34.6	40.0	45.4	41.4	48.1
Lower jaw	44.2	47.2	44.6	52.3	43.6	59.2
Premaxillary	29.5	33.5	32.3	35.2	30.7	29.6
Illicium	18.9	18.7	20.8	21.6	18.6	22.2
Head depth	42.1	41.8	40.0	51.1	42.9	44.4
Teeth						
Vomer	7	4	5	6	4	6
Upper jaw	46	39	30	48	25	30
Lower jaw	56	37	30	49	29	33

Oneirodes heteronema (Regan and Trewavas)

Figures 60B, 79, 80, 110

Tables 1 and 14

Dolopichthys heteracanthus, Regan, 1926:28 [in part; misidentifications; 21 specimens, one of which described as *D.* (subgenus *Dermatias*) *heteronema*, new species by Regan and Trewavas, 1932].

Dolopichthys (subgenus *Dermatias*) *heteronema* Regan and Trewavas, 1932:72, Fig. 106 (original description; single specimen; Gulf of Panama; 3000 m wire; holotype, ZMUC P92150).

Oneirodes eschrichti-group Bertelsen, 1951:80 (in part).

Material.-6 females, 13.5-95.0 mm (see Appendix A).

Diagnosis.-Except for the relatively short illicium and high ratio between the lengths of the upper and lower forks of the operculum, the essential characters of *O. heteronema* are the only satisfactory means of separating this species from most of the other members of the genus.

Description.-Escal appendage pattern B (Fig. 60B); esca with an anterior appendage bearing several filaments, two or three of which are stouter than others and darkly pigmented on distal one-third of length in specimens approximately 65 mm and larger; anterior appendage internally pigmented in 91.0 mm specimen; a pair of medial appendages each consisting of three main branches which give rise to numerous, unpigmented, tapering filaments some of which may be six times length of escal bulb; a truncated terminal papilla with a distal streak of pigment in specimens 44.0 mm and larger; a stout posterior appendage bearing from four to nine tapering filaments, the distal

tips of which are lightly pigmented in some specimens; lateral appendages absent; and on each side, a filamentous anterolateral appendage usually consisting of two bifurcated, unpigmented filaments (Fig. 79).

Suboperculum with posterior margin of upper part not indented (Fig. 80); length of lower fork of operculum 30.4 (27.9-33.0) percent of SL; ratio of lengths of upper and lower forks of operculum .60 (.57-.62) (measurements based on 4 specimens, 44.0-95.0 mm).

Epibranchial teeth absent; teeth present on pharyngobranchial II, total number of teeth on vomer 4-7; number of teeth in upper jaw 30-48, in lower jaw 30-56; D. 5-6; A. 4 (the posteriormost anal ray of the 91.0 mm specimen is divided at its base); P. 15-16 (Table 1). Counts and measurements are given in Table 14.

Rest of characters as for genus.

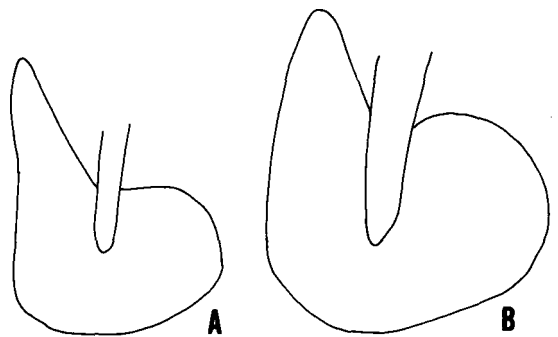


FIGURE 80. Subopercula of *Oneirodes heteronema*, lateral views, right side: A. SIO 70-386, 44.0 mm SL; B. IOM uncatalogued, 65.0 mm SL.

Size at maturity.-The right ovary of the 91.0 mm specimen of *O. heteronema* is 22.0 mm long (or 24.2 percent of SL) and filled with numerous eggs approximately 0.15 to 0.20 mm in diameter. The 65.0 mm specimen has small, undeveloped ovaries, as do all other individuals examined.

Distribution.-*Oneirodes heteronema* is known only from the Gulf of Panama and Peru-Chile Trench as far south as 20°S. The holotype is from 7°15'N, 78°54'W (Fig. 110).

Little information concerning vertical distribution is available. The 65.0 mm specimen was taken between 500 m and the surface; the 14.0 mm specimen was captured in a closing net between 1000 and 1250 m.

Etymology.-The specific name is derived from the Greek *heteros*, meaning different, and *nema*, meaning thread, in allusion to the appendages of the esca.

Comments.-The 13.5 mm holotype of *O. heteronema*, from DANA Station 1209 (4), was originally described and listed as *Dolopichthys heteracanthus* by Regan (1926), described as new by Regan and Trewavas (1932), and mislabeled and listed as *O. luetkeni* by Bertelsen (1951).

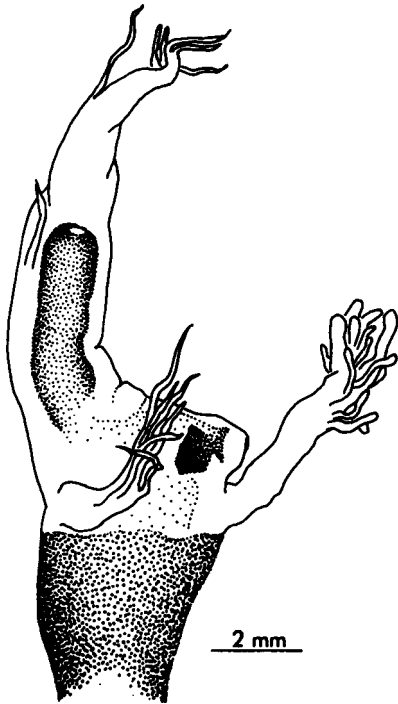


FIGURE 81. Esca of *Oneirodes macrosteus*, holotype, ROM 27262, 124.0 mm SL, left side.

***Oneirodes macrosteus*, new species**

Figures 60B, 81, 82, 110

Tables 1 and 15

Material.-5 females, 11.5-185.0 mm.

Holotype.-ROM 27262, 124.0 mm; BRANDAL Tow 10; 49°00'N, 45°00'W; Engel trawl, 0-990 m; 1511-1830 hr; 16 July 1968.

Paratypes.-ROM 27265, 185.0 mm; BRANDAL Tow 12; 47°30'N, 43°00'W; Engel trawl, 0-1000 m; 1810-2228 hr; 17 July 1968. ROM 27259, 87.0 mm; BRANDAL Tow 9; 49°00'N, 45°00'W; Engel trawl, 0-990 m 0901-1324 hr; 16 July 1968.

USNM 207855, 20.0 m; OCEAN ACRE 2-6N; 31°51'N, 63°40'W; 6-ft IKMT, 0-1025 m; 1110-1820 hr; 7 March 1968. USNM 207856, 11.5 mm; OCEAN ACRE 9-13N; 31°57'N, 63°56'W; 10-ft IKMT, 0-1550 m; 0715-1220 hr; 19 March 1969.

Two additional specimens, not included in the description below, are questionably identified as *O. macrosteus* (see Comments below, p. 62): ISH 2657/71, 110.0 mm; WALTHER HERWIG Station 490 11/71; 10°52'N, 22°09'W; CMBT-1600, 0-608 m; 2027-2152 hr; 15 April 1971. ISH 1956/71, 59.0 mm; WALTHER HERWIG Station 459/71; 10°57'S, 11°20'W; CMBT-1600, 0-1900 m; 1818-2218 hr; 7 April 1971.

Diagnosis.-In addition to the diagnostic esca

TABLE 15

Counts and measurements of *Oneirodes macrosteus*. Measurements expressed in percent of SL

	Paratype ROM 27265	Holotype ROM 27262	Paratype ROM 27259	Paratype USNM 207855
Standard length	185.0	124.0	87.0	20.0
Length				
Head	38.4	40.3	39.1	42.5
Lower jaw	40.5	45.2	42.5	47.5
Premaxillary	29.7	32.2	29.9	33.5
Illicium	33.0	36.3	40.2	40.0
Head depth	33.5	39.9	32.2	45.0
Teeth				
Vomer	8	8	7	6
Upper jaw	62	58	58	38
Lower jaw	58	58	55	38



FIGURE 82. Subopercula of *Oneirodes macrosteus*, lateral views, right side: A. paratype, USNM 207856, 11.5 mm SL; B. paratype, ROM 27259, 87.0 mm SL; C. holotype, ROM 27262, 124.0 mm SL; D. paratype, ROM 27265, 185.0 mm SL.

morphology and the relatively long illicium (comparable only to members of the *O. schmidti*-group, see below, p. 77), the elongate shape of the suboperculum of *O. macrosteus* (Fig. 82) can be used to distinguish this species from all of its congeners with the exception of members of the *O. schmidti*-group, *O. rosenblatti* and perhaps *O. cristatus*. *Oneirodes macrosteus* is easily separated from *O. rosenblatti* by its fewer teeth in the jaws (Tables 5, 15), and from *O. cristatus* by its greater number of pectoral fin rays (Table 1) and more vomerine teeth. *Oneirodes macrosteus* and forms included in the *O. schmidti*-group can be separated with certainty only by means of the esca characters.

Description.-Esca appendage pattern B (Fig. 60B); esca with a stout, internally pigmented anterior appendage less than half length of esca bulb to nearly twice length of bulb in largest specimens, and bearing numerous tapering filaments at distal tip and two or three filaments along anterior margin; medial appendages absent; a truncated terminal papilla with two bilaterally placed, distal, pigmented spots in specimens 20.0 mm and larger; a posterior appendage, approximately one-half as long as to longer than esca bulb in largest specimens; distal one-third to one-half of posterior appendage split into numerous filaments; lateral appendages absent; a filamentous, anterolateral appendage, less than the length of anterior appendage (extremely small in 185.0 mm specimen); distal tips of filaments of anterior and posterior appendages and entire length of filaments of anterolateral appendage with dark melanophores in specimens 124.0 mm and larger (Fig. 81).

Suboperculum relatively long and narrow, posterior margin of upper part not indented (Fig. 82); length of lower fork of operculum 25.3 (24.4-26.0) percent of SL; ratio of lengths of upper and lower forks of operculum .51 (.46-.53) (measurements based on four specimens, 20.0-185.0 mm).

Epibranchial teeth absent; teeth present on pha-

ryngobranchial II; total number of teeth on vomer 6-8; number of teeth in upper jaw 38-62, in lower jaw 38-58; D. 6; A. 4; P. 15-17 (Table 1). Counts and measurements are given in Table 15.

Rest of characters as for genus.

Size at maturity.-*Oneirodes macrosteus* appears to attain sexual maturity at a length somewhere between 87.0 and 124.0 mm. The right ovary of the 185.0 mm specimen, about 68 mm long (36.8 percent of SL) and 47 mm wide, contains numerous eggs that are approximately 0.5-0.6 mm in diameter. The 124.0 mm specimen has ovaries (right ovary 29 mm long or 23.4 percent of SL) that appears to be spent. These sexually mature female were captured considerably outside the larval distribution of ceratioids, found by Bertelsen (1951:224-225, Fig. 139) to be limited to the warmer parts of the oceans between approximately 40°N and 35°S (see Ontogenetic Distribution below, p. 95). All other individuals of *O. macrosteus* examined have small, undeveloped gonads.

Distribution.-*Oneirodes macrosteus* is known only from the western north Atlantic off the Grand Bank, Newfoundland, and off Bermuda. The type locality is at 49°00'N, 45°00'W (Fig. 110).

Four individuals, including the largest specimen (87.0-185.0 mm), were caught between 1000 m and the surface. The remaining vertical distributional data are too few to allow reasonable conclusions.

Etymology.-The specific name is derived from the Greek *makros*, meaning long, and *osteon*, bone, alluding to the elongate subopercular bone which, among other features, distinguishes *O. macrosteus* from most of the other members of the genus.

Comments.-Two specimens (59.0 mm, ISH 1956/71; 110.0 mm, ISH 2657/71) are questionably identified as *O. macrosteus*. Although the illicia and escae of these specimens are lost, all counts, morphometrics, and the shape of the suboperculum compare well with the type material. These additional records would extend the known geographic range of *O. macrosteus* to the eastern North Atlantic from 10°52'N to 10°57'S between 11°20'W and 22°09'W (Fig. 110).

Oneirodes cristatus (Regan and Trewavas)
Figures 60B, 83, 108
Tables 1 and 16

Dolopichthys (subgenus *Dermatias*) *cristatus*
Regan and Trewavas, 1932:67-68, Fig. 93 (original description; three specimens; Banda and Cele-

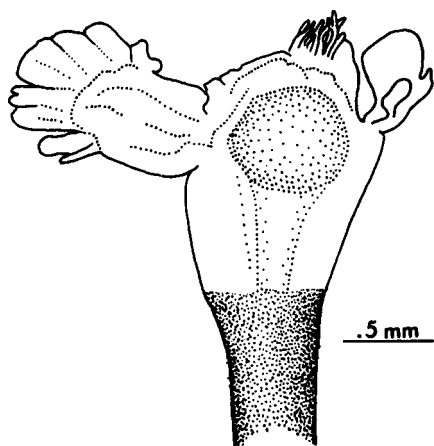


FIGURE 83. Esca of *Oneirodes cristatus*, lectotype, ZMUC P9286, 165.0 mm SL, left side.

bes Seas, western Pacific; lectotype, ZMUC P9286).

Dolopichthys cristatus, Beaufort and Briggs, 1962:249 (description after Regan and Trewavas, 1932; in key).

Oneirodes cristatus, Bertelsen, 1951:79, Fig. 31C-D (new combination; diagnostic characters; lectotype designated; opercular bones described, figured; in key). Grey, 1956a:244 (synonymy; horizontal, vertical distribution).

Material.-3 females, 20.0-165.0 mm (see Appendix A).

Diagnosis.-In addition to the diagnostic esca morphology, *O. cristatus* can be separated from all other species of the genus by the following combination of characters: illicium length less than 35 percent of SL, lower-jaw teeth 34-53, and pectoral fin rays 13-14.

Description.-Esca appendage pattern B (Fig. 60B); esca with a large, laterally compressed, internally pigmented anterior appendage with a membranous, scalloped distal margin; a pair of filamentous medial appendages, the distal tips of which are lightly pigmented in 52.5 mm specimen; a conical terminal papilla; a short, compressed posterior appendage with a single, small branch on posterior margin, and a similar branch on each side; lateral and anterolateral appendages absent (Fig. 83).

Suboperculum with posterior margin of upper part not indented (Bertelsen, 1951:79, Fig. 31C-D); length of lower fork of operculum 26.0 (23.0-30.1) percent of SL; ratio of lengths of upper and lower forks of operculum .47 (.42-.50).

Epibranchial teeth absent; teeth present on pharyngobranchial II; total number of teeth on vomer

TABLE 16
Counts and measurements of *Oneirodes cristatus*.
Measurements expressed in percent of SL

	Lectotype ZMUC P9286	Paralectotype BMNH 1932.5.3.12	Paralectotype ZMUC P92164
Standard length	165.0	52.5	20.0
Length			
Head	33.3	41.0	40.0
Lower jaw	43.6	52.4	45.0
Premaxillary	32.7	36.2	30.0
Illicium	23.6	31.4	22.5
Head depth	-	43.8	
Teeth			
Vomer	4	4	4
Upper jaw	39	53	28
Lower jaw	36	53	34

4; number of teeth in upper jaw 28-53, in lower jaw 34-53; D. 6; A. 4-5 (only the lectotype has A. 5); P. 13-14 (Table 1). Counts and measurements are given in Table 16.

Rest of characters as for genus.

Distribution.-*Oneirodes cristatus* is known only from the Banda and Celebes Seas. No conclusions can be made concerning vertical distribution (Fig. 108).

Etymology.-The specific name is from the Latin *cristatus*, meaning crested, apparently in allusion to the large, laterally compressed and scalloped anterior esca appendage of this species.

Oneirodes acanthias (Gilbert)
Figures 1-18, 30A, 60B, 84-86, 107
Tables 1, 17, 18

Monoceratias acanthias Gilbert, 1915:379-380, pl. 22, Fig. 24 (original description; single specimen; off Santa Cruz Island, southern California; 1397-1629 m; holotype, USNM 75825).

Dolopichthys acanthias, Regan, 1926:28 [new combination; description after Gilbert, 1915; comparison with *D. heteracanthus* (= *Oneirodes luetkeni*, in part); in key]. Parr, 1927:18 [comparison with *D. obtusus* (= *O. eschrichtii*)]. Schultz, 1934:66-68, Figs. 1-2 [comparison with *D. thompsoni* (= *O. thompsoni*)]. Bolin and Myers, 1950:206-207 (two additional specimens).

Dolopichthys (Monoceratias) acanthias, Parr, 1927:15 (in key).

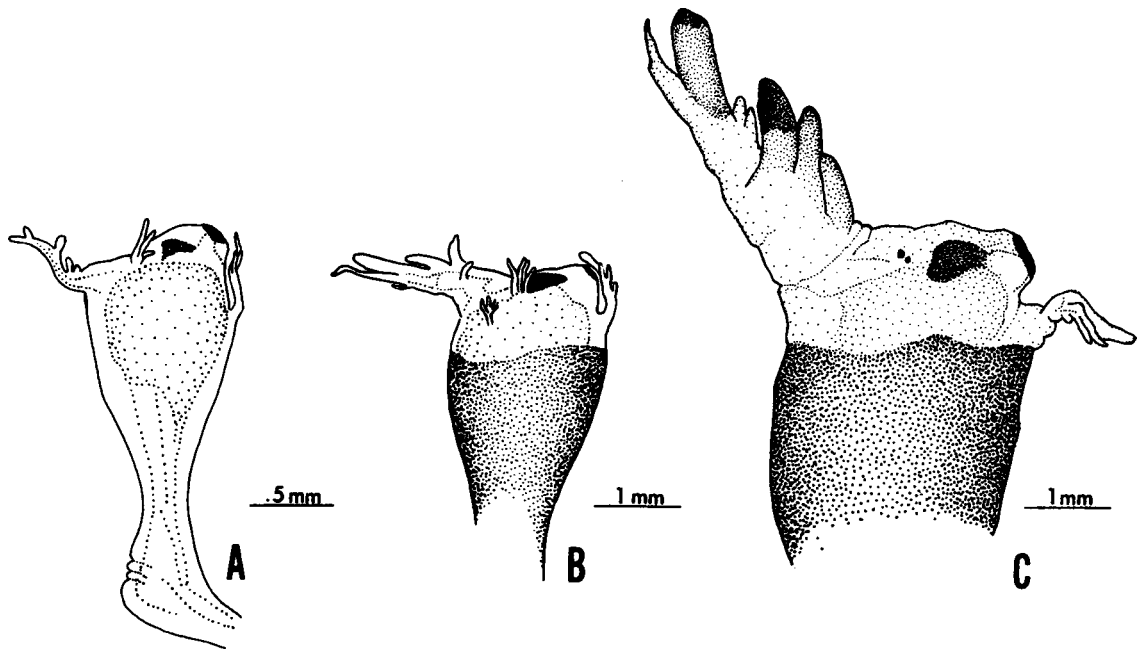


FIGURE 84. Escae of *Oneirodes acanthias*, left side: A. LACM 8988-31, 11.0 mm SL; B. CAS 63575, 42.0 mm SL; C. LACM 9960-4, 110.0 mm SL.

Dolopichthys (subgenus *Dermatias*) *acanthias*, Regan and Trewavas, 1932:76, Fig. 114 (description after Gilbert, 1915, and Regan, 1926; in key).

Oneirodes acanthias, Bertelsen, 1951:85, Fig. 38A-B (in part; new combination; diagnostic characters; comparison with an additional specimen; in key). Rass, 1955:334, Table 2 (misidentifications; specimens here referred to *O. thompsoni*; distribution). Grey, 1956a:247 (synonymy; vertical distribution). Fast, 1957:237 (one of three ceratioid species known from California). Berry and Perkins, 1966:677, Fig. 30 (one additional specimen). Lavenberg and Ebeling, 1967:195, Fig. 5 (vertical distribution). Rass, 1967:233, Table 22 (misidentification; after Rass, 1955). Taylor, F., 1967:2113-2114, Figs. 3-4 (misidentification; description of a specimen here referred to *O. thompsoni*; opercular bones described, figured). Fitch and Lavenberg, 1968:132-135, Fig. 73 (distinguishing characters; natural history notes; fishery information; comparison with other family members). Pietsch, 1969: 367, Fig. 3 (opercular bones figured). Ebeling et al., 1970:19, Figs. 3-4 (ecological groups of deep-sea animals off southern California). Ueno, 1971:102 (misidentifications; after Rass, 1955). Pietsch, 1972a: Fig. 24(4) (osteological comments, branchial arches; otolith described, figured).

Material.—147 females, 11.5-167.0 mm (see Appendix A).

Diagnosis.—The esca morphology of *O. acanthias* is most similar to that of *O. thompsoni* and *O. notius* (Figs. 84, 87, 89). The posterior esca appendage, however, always branched in *O. acanthias*, is never branched in *O. thompsoni* and *O. notius*. Although, the slightly higher number of teeth in the jaws (Tables 17, 19) of *O. acanthias* and greater ratio between the lengths of the upper and lower forks of the operculum (.53-.71 and .42-.54 for *O. acanthias* and *O. thompsoni*, respectively) further distinguish this species from *O. thompsoni*, the characters of the esca are the only satisfactory means of separating *O. acanthias* from this and from most of the other species of *Oneirodes*.

Description.—Esca appendage pattern B (Fig. 60B); esca with a stout, internally pigmented, anterior appendage not longer than esca bulb, bearing distally a large, compressed papilla, at the anterior base of which usually arise two or three short filaments; posterior margin of anterior appendage bearing one to five (usually three) stout papillae; filaments and papillae of anterior appendage darkly pigmented in most specimens larger than approximately 50 mm; a minute pair of filamentous medial appendages in most specimens smaller than approximately 110 mm, unpigmented in most specimens smaller than approximately 80 mm, darkly pigmented in most specimens 80 mm to 110 mm; each medial appendage rep-

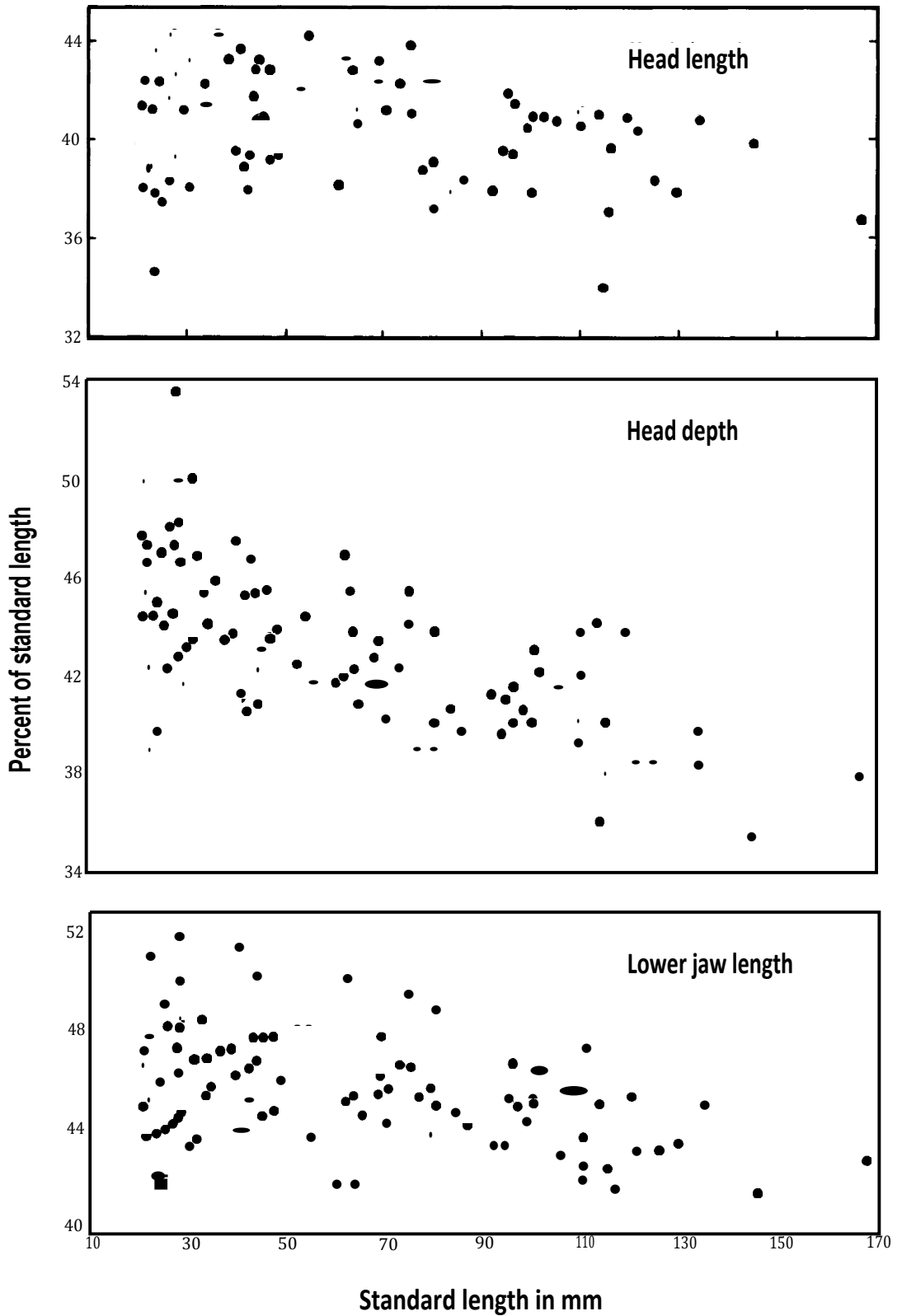


FIGURE 85. Ratio-on-size scatter diagrams for three morphometric characters of *Oneiroides acanthias*.

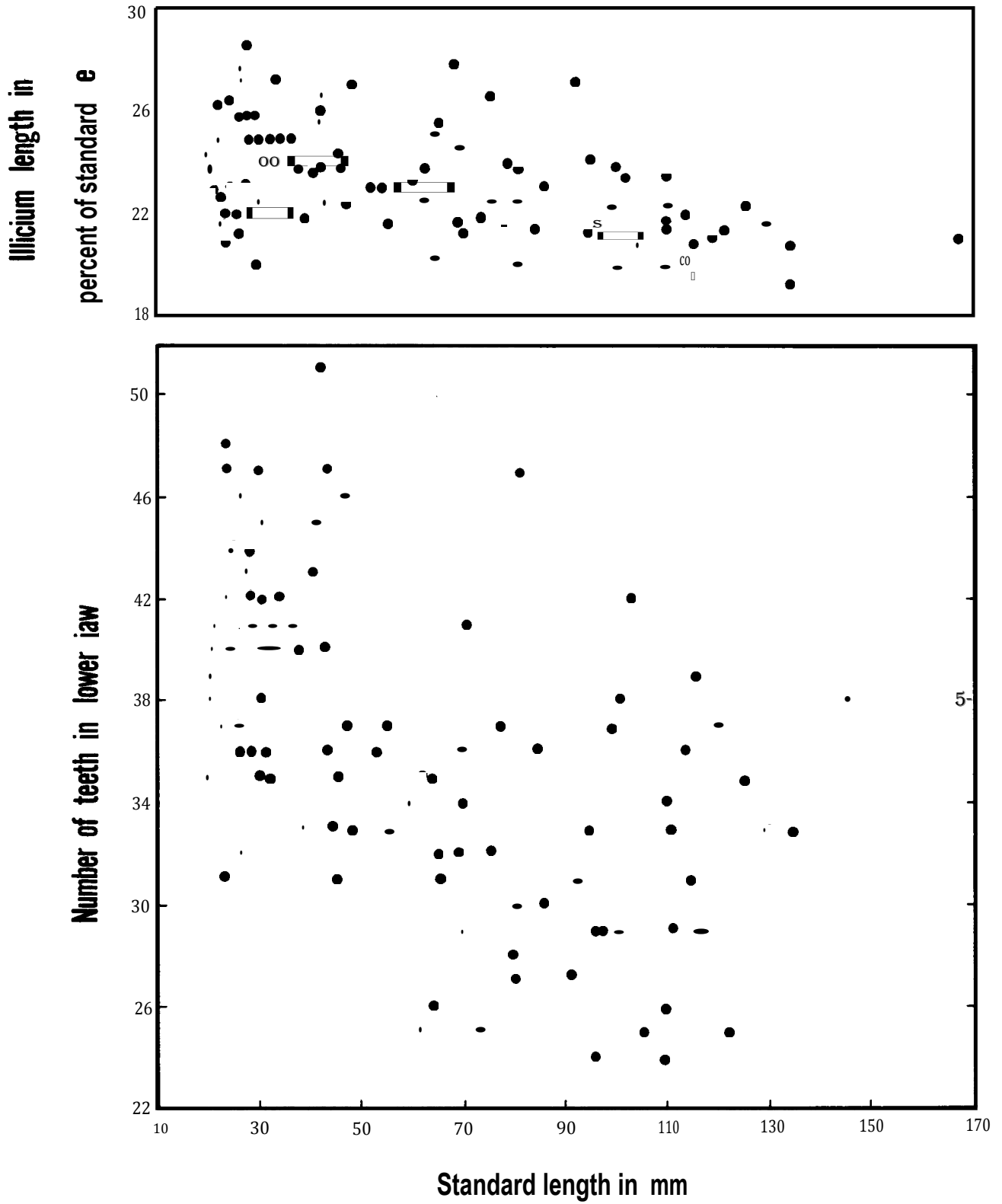


FIGURE 86. Ratio-on-size scatter diagram for illicium length, and number of teeth in lower jaw versus standard length of *Oneirodes acanthias*.

TABLE 18

Vertical distribution of *Oneirodes acanthias* based on specimens collected by the VELERO IV. Meter-hours and specimens expressed as percent of total. See text for methods of calculation

Depth (m)	Meter-hours	Specimens
0-100	4.3	0.8
101-200	2.1	0
201-300	6.3	2.6
301-400	7.7	4.4
401-500	5.2	4.4
501-600	6.5	10.6
601-700	8.2	11.5
701-800	8.2	11.5
801-900	8.3	6.2
901-1000	6.0	8.8
1001-1250	14.4	27.4
1251-1500	17.7	8.8
1501-1750	3.4	2.6
1751-2000	1.1	0
2001-3000	0.7	0
>3000	0	-
Numbers of specimens		113
Number of meter-hours		10143.7
Number of hauls		547

The vertical distribution of *O. acanthias* was analyzed by a procedure outlined by Gibbs (1969; see Methods and Materials, p. 3). Results based on the total horizontal range of the species indicate a concentration between 500 and 1250 m (Table 18).

Etymology.—The specific name is derived from the Greek, *akanthos*, meaning thorn or prickle, apparently in allusion to the sphenotic and articular spines present in various degrees of development in all *Oneirodes* species.

Oneirodes thompsoni (Schultz)

Figures 60B, 87, 88, 106
Tables 1 and 19

Dolopichthys thompsoni Schultz, 1934:66-68, Figs. 1-4 [original description; single specimen; Gulf of Alaska; 100-900 m; holotype, USNM 104495 (formally Department of Fisheries, University of Washington Cat. No. 2890); comparison with *D. acanthias* (= *O. acanthias*)]. Bertelsen, 1951:85, Fig. 38C (*D. thompsoni* a synonym of *O. acanthias*). Rass, 1955:334 (a synonym of *O. acanthias*; distribution).

Oneirodes acanthias, Bertelsen, 1951:85, Fig. 38C (in part; *D. thompsoni* a synonym of *O. acanthias*).

Material.—20 females, 33.0-128.0 mm (see Appendix A).

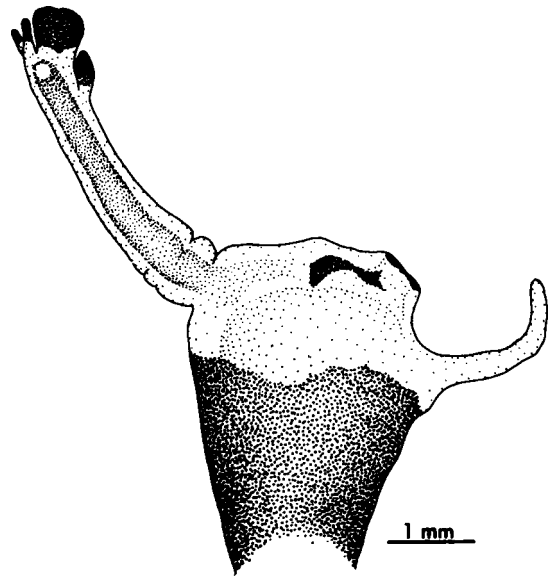


FIGURE 87. Esca of *Oneirodes thompsoni*, OSUO 532, 69.0 mm SL, left side.

Diagnosis.—*Oneirodes thompsoni* is most similar to *O. acanthias* and *O. notius* (see diagnosis for *O. acanthias*, p. 64). In addition to differences in escal morphology, the shape of the suboperculum of *O. thompsoni* differs from that of these forms and all other species of the genus with the exception of *O. bulbosus*. The posterior margin of the upper part of this bone is indented to deeply notched in all specimens of *O. thompsoni* examined (Fig. 88). *Oneirodes thompsoni* further differs from *O. notius* in having a lower pectoral fin-ray count (Table 1) and a smaller ratio between the lengths of the upper and lower forks of the operculum (.42-.54 and .52-.59 for *O. thompsoni* and *O. notius*, respectively).

Description.—Escal appendage pattern B (Fig. 60B); esca with a stout, internally pigmented anterior appendage, shorter than esca bulb in smaller

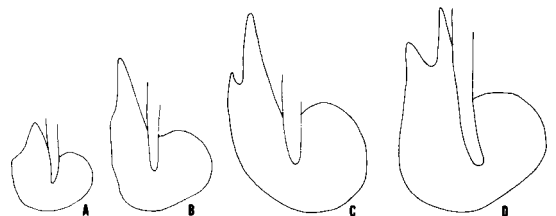


FIGURE 88. Subopercula of *Oneirodes thompsoni*, lateral views, right side: A. holotype, USNM 104495, 33.0 mm SL; B. SJO 51-362, 37.0 mm SL; C. UBC 65-623, 58.0 mm SL; D. OSUO 532, 69.0 mm SL.

specimens (33.0 mm) to more than three times length of escal bulb in the largest specimen (128.0 mm), and bearing a large, compressed distal papilla, closely associated with one to several smaller papillae on posterior margin and usually two on anterior margin; papillae of anterior appendage darkly pigmented in most specimens approximately 40 mm and larger; medial appendages absent; a truncated or conical terminal papilla with a distal streak of pigment; and an unpigmented, tapering, unbranched posterior appendage, less than length of escal bulb in smaller specimens (69.0 mm) to more than twice length of escal bulb in the largest specimen (128.0 mm); lateral and anterolateral appendages absent (Fig. 87).

Suboperculum with posterior margin of upper part indented to deeply notched (Fig. 88); length of lower fork of operculum 33.2 (30.5-37.3) percent of SL; ratio of lengths of upper and lower forks of operculum .49 (.42-.54) (measurements based on six specimens, 33.0-69.0 mm).

Epibranchial teeth absent; teeth present on pharyngobranchial II, total number of teeth on vomer 4-9; number of teeth in upper jaw 19-42, in lower jaw 18-36; D. 5-6; A. 4; P. 14-17 (Table 1).

Measurements in percent of SL, based on 16 specimens, 33.0-128.0 mm: head length 42.8 (37.7-48.6); head depth 44.3 (39.1-54.1); lower jaw 48.1 (41.3-54.1); premaxillary 31.4 (28.4-34.1); illicium length 23.9 (26.4-39.0). Complete counts and measurements of representative specimens are given in Table 19.

Rest of characters as for genus.

Distribution.—*Oneirodes thompsoni* is known only from the north Pacific Ocean and Bering Sea. The range extends south to approximately 40°N in the east and 47°N in the west. The holotype was taken at 54°13'N, 159°06'W (Fig. 106).

Although little is known about the relative fishing effort at various depths in the north Pacific, *O. thompsoni*, based on maximum depths reached by gear, appears to inhabit relatively shallow depths, the bulk of the population concentrated between 600 and 800 m, with a second peak between 950 and 1250m.

Etymology.—*Oneirodes thornpsoni* is named for the late William Francis Thompson, at one time Director of the International Fisheries Commission, and Chairman of the Department of Fisheries, University of Washington, Seattle.

Comments.—*Oneirodes thornpsoni*, described by Schultz (1934), was synonymized with *O. acanthias* by Bertelsen (1951:85, Fig. 38) on the basis of similarity in escal morphology and morphometrics. Additional material of both species, how-

TABLE 19
Counts and measurements of representative specimens of *Oneirodes thompsoni*.
Measurements expressed in percent of SL

	28.0		0	5.0	9.0	83.	69.	5*	5°	5°	3*0	0 JK 0
Standard length												33.0
Head length	40.6	4.4	3	4.0	4	4.2	4	44.1	3.7	48.6		
Head depth	46.1	4.7	3	45.7	4	4.0	4.2	49.2	8.	54.1		48.5
Lower jaw	28.9	2.4	±0.3	3.5	±.2	3.3	29.0	31.4	31.	32		33.3
Premaxillary	19.5	2.4	20.2		25.8	2.5	18.8	±0.3	—	2	4	22.7
Illicium	39.	±9.7	40.		41.9	.6	43.5	45.8	7.2	46.3	4.	48.
Teeth												
Vomer	7	6	2	5	4	8	7	6	5	6	4	4
Upper jaw	26	4	20	24	26	3±	3	31	30	23	5	9
Lower jaw	±0	3		30	25	27	3	29	35	22	29	±

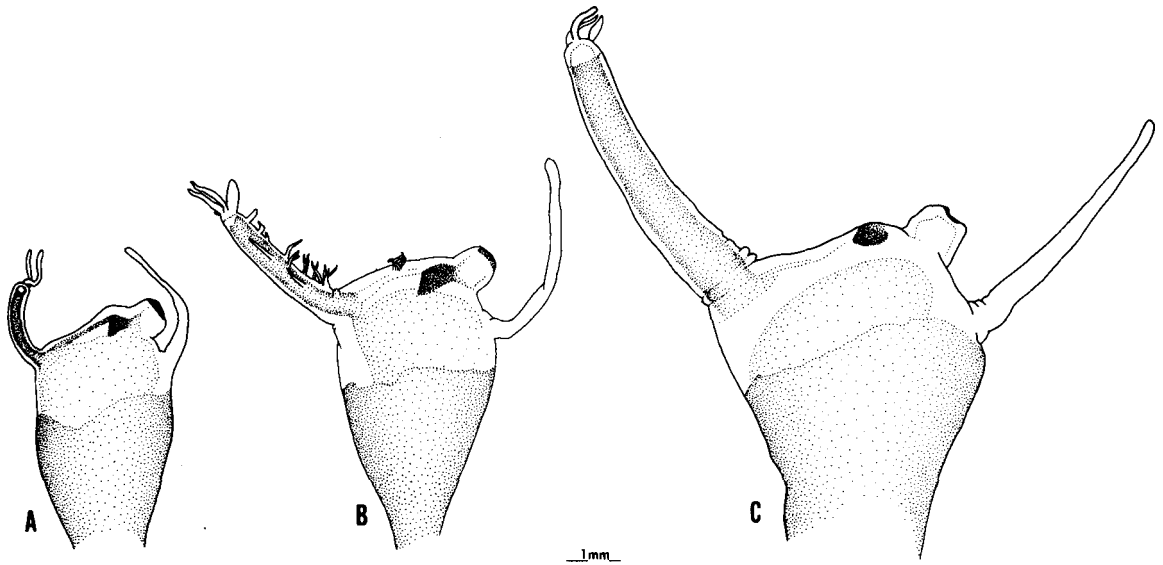


FIGURE 89. Escae of *Oneirodes notius*, left sides: A. paratype, LACM 11184-6, 54.0 mm SL; B. paratype, LACM 10841-4, 60.0 mm SL; C. paratype, LACM 10716-6, 106.0 mm SL.

ever, has shown distinct differences in the esca and in the shape of the subopercular bone (see Diagnosis, p. 68). *Oneirodes thompsoni* is here resurrected from the synonymy of *O. acanthias* and given specific status.

***Oneirodes notius*, new species**

Figures 30B, 60B, 89, 90, 106

Tables 1 and 20

Material.—10 females, 30.0-150.0 mm.

Holotype.—LACM 11165-9, 132.0 mm; USNS ELTANIN Cruise 23, Station 1615; 62°13'S, 95°39'W; 10-ft IKMT, 0-1025 m; bottom depth 4914-4912 m; 0610-0919 hr; 9 April 1966.

Paratypes.—LACM 10716-6, 106.0 mm; USNS ELTANIN Cruise 11, Station 949; 65°47'S, 88°48'W; 10-ft IKMT, 0-1028 m; bottom depth 4502-4526 m; 1845-2200 hr; 28 January 1964. LACM 10841-4, 60.0 mm; USNS ELTANIN Cruise 13, Station 1120; 62°05'S, 89°56'W; 10-ft IKMT, 0-850 m; bottom depth 4721 m; 1825-2055 hr; 29 May 1964. LACM 11184-6, 54.0 mm; USNS ELTANIN Cruise 23, Station 1648; 58°14'S, 101°02'W; 10-ft IKMT, 0-825 m; bottom depth 4685-4575 m; 1500-1758 hr; 19 April 1966. LACM 10875-8, 45.0 mm; USNS ELTANIN Cruise 14, Station 1204; 55°57'S, 159°23'W; 10-ft IKMT, 0-1080 m; bottom depth 4145-3962 m; 0650-1035 hr; 10 August 1964.

ISH 590/71, 150.0 mm; WALTHER HERWIG Station 354-11/71; 39°19'S, 48°02'W; CMBT-1600, 0-2000 m; 2053-0021 hr; 6 March 1971.

ISH 648/71, 115.0 mm; WALTHER HERWIG Station 358-111/71; 39°47'S, 43°30'W; CMBT-1600, 0-1015 m; 2035-2305 hr; 7 March 1971.

SIO 61-45, 30.0 mm; MONSOON EXPEDITION midwater trawl no. 17; 46°53'S, 179°48'W; 10-ft IKMT, 0-2000m; 28 February 1961.

Additional non-type material.—ISH 822/71, 42.0 mm; WALTHER HERWIG Station 371-111/71; 40°00'S, 30°30'W; CMBT-1600, 0-700 m; 2104-2304 hr; 10 March 1971.

ZMUC P92189, 40.0 mm; GALATHEA EXPEDITION Station 664; 36°34'S, 178°57'W; Herring Otter trawl, 8900 m wire; bottom depth 4540m; 1130 hr; 24 February 1952.

Diagnosis.—*Oneirodes notius* is most similar to *O. acanthias* and *O. thompsoni* (see diagnosis for *O. acanthias*, p. 64). Although, the high pectoral fin-ray count of *O. notius* (17-19) is helpful in dis-

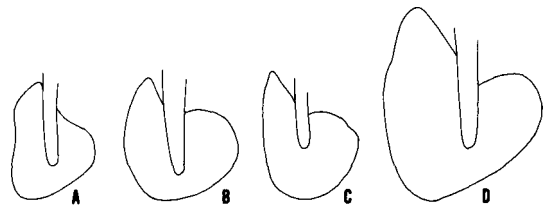


FIGURE 90. Subopercula of *Oneirodes notius*, lateral views, right side: A. paratype, SIO 61-45, 30.0 mm SL; B. ZMUC P92189, 40.0 mm SL; C. paratype, LACM 1184-6, 54.0 mm SL; D. paratype, ISH 648/71, 115.0 mm SL.

tinguishing this species from its congeners the characters of the esca are the only satisfactory means of identification.

The shape of the frontal bones of *O. notius* differs from those of all other species of *Oneirodes* examined osteologically (p. 17, Fig. 30).

Description.—Escal appendage pattern B (Fig. 60B); esca with a stout, internally pigmented anterior appendage, shorter than escal bulb in smaller specimens (60 mm) to slightly longer than length of bulb in largest specimen (150.0 mm), usually bearing a compressed papilla and two tapering filaments on distal tip; several small, tapering filaments along posterior margin of anterior appendage of 60.0 mm specimen; papilla and filaments of anterior appendage unpigmented; a pair of minute, unpigmented, filamentous medial appendages present in all but 115.0 mm specimen; a rounded or truncated terminal papilla with a distal streak of pigment; an unpigmented, unbranched, tapering posterior appendage as long as, or shorter than escal bulb; lateral and anterolateral appendages absent (Fig. 89).

Suboperculum relatively short and broad, posterior margin of upper part not indented (Fig. 90); length of lower fork 28.4 (25.2-32.2) percent of SL; ratio of lengths of upper and lower forks of operculum .55 (.52-.59) (measurements based on 10 specimens, 30.0-150.0 mm).

Epibranchial teeth absent; teeth present on pharyngobranchial II; total number of teeth on vomer 4-7; number of teeth in upper jaw 20-37, in lower jaw 24-48; D. 5-7; A. 4; P. 17-19 (Table 1). Counts and measurements are given in Table 20.

Rest of characters as for genus.

Distribution.—*Oneirodes notius* is known only from subantarctic waters: three stations from the Atlantic sector of the Southern Ocean along the 40th parallel between 30°30'W and 48°02'W, and seven from the Pacific sector extending from off New Zealand at 46°53'S, 179°48'W southeast to 65°47'S, 88°48'W. The holotype was collected at 62°13'S, 95°39'W (Fig. 106).

Based on maximum depth reached by fishing gear, *O. notius* appears to have a relatively wide vertical distribution, from about 700 to 2000 m, with the greatest concentration between 800 and 1100 m.

Geographic variation.—No geographic variation was noted between the Atlantic and Pacific populations of *O. notius*.

Etymology.—The name *notius* is from the Greek *notios* meaning southern in allusion to the distribution of this species, apparently restricted to the Southern Ocean.

	Paratype		Holotype		ar y		i d m a		o		e o		P		Pa t e		ISH		ZMUC		Paratype		
	ISH	SH	LACM	LACM	SH	C	CM	CM	CM	CM	CM	CM	CM	L	CM	CM	CM	CM	CM	CM	CM	SIO	SIO
	590/71	48	11165-9	11165-9	48	0	81-	81-	81-	81-	81-	81-	81-	84-	84-	08	08	822/71	822/71	P92189	P92189	61-45	61-45
Standard length			32.0	32.0	5.0	06.0	0.0	0.0	0.0	0.0	4.0	4.0	4.0	4.0	4.0	45.	45.	2.	2.	4	4	0.	0.
Length																							
Head	380		35.6	35.6	38.3	3	3	5	5	5	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.9	2.9	40Z	40Z	3.3	3.3
Lower jaw	383		38.6	38.6	40.0	4	4	5	5	5	46.	46.	46.	46.	46.	46.	46.	48.8	48.8	50.0	50.0	46.	46.
Premaxillary	26.0		25.0	25.0	27.0	2-4	2-4	28.3	28.3	28.3	31.	31.	31.	31.	31.	31.	31.	33.3	33.3	5.	5.	33.3	33.3
Illicium	22.7		.6	.6		20.8	21.6	21.6	21.6	21.6	5.9	5.9	5.9	5.9	5.9	24.4	24.4	—	—	7.5	7.5	28.3	28.3
Head depth	30		36.3	36.3	3	3	6	40.	40.	40.	6.2	6.2	6.2	6.2	6.2	8.8	8.8	5.2	5.2	7.5	7.5	406	406
Teeth																							
Vomer			7	7		3	6	6	6	6	0	0	0	0	0	6	6	25	25	6	6	4	4
Upper jaw			31	31	37	3	3	34	34	34	2	2	2	2	2	28	28	28	28	28	28	23	23
Lower jaw			30	30	40	35	3	3	3	3	2	2	2	2	2	2	2	28	28	9	9	26	26

Oneirodes flagellifer (Regan and Trewavas)
 Figures 60B, 91, 110
 Tables 1 and 21

Dolopichthys (subgenus *Dermatias*) *flagellifer* Regan and Trewavas, 1932:74, Fig. 111 (original description; single specimen; Indian Ocean, off Ceylon; 3500 m wire; holotype, ZMUC P9280).

Dolopichthys (subgenus *Dermatias*) *thysanophorus* Regan and Trewavas, 1932:74, Fig. 110 (in part; original description; two specimens, the larger here referred to *O. eschrichtii*; Sulu Sea; 3500 m wire; lectotype, BMNH 1932.5.3.14).

Oneirodes flagellifer-group Bertelsen, 1951:84, Fig. 31J-K (in part; new combination; characters; comparison with *O. eschrichtii-group*; opercular bones described, figured; in key). Grey, 1956a:246 (in part; synonymy; vertical distribution).

Dolopichthys thysanophorus, Beaufort and Briggs, 1962:250 (in part; description after Regan and Trewavas, 1932).

Material.-3 females, 12.5-22.0 mm (see Appendix A).

Diagnosis.-The characters of the esca of *O. flag-*

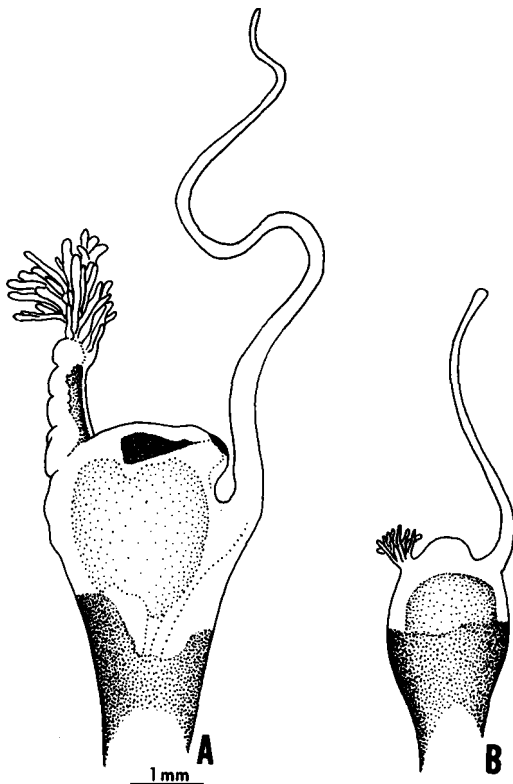


FIGURE 91. Escae of *Oneirodes flagellifer*, left sides: A. holotype, ZMUC P9280, 22.0 mm SL; B. lectotype of *Dolopichthys* (subgenus *Dermatias*) *thysanophorus*, BMNH 1932.5.3.14, 12.5 mm SL.

TABLE 21

Measurements of *Oneirodes flagellifer*, expressed in percent of SL

	Holotype ZMUC P9280	ZMUC P92190	BMNH ¹ 1932.5.3.14
Standard length	22.0	22.0	12.5
Length			
Head	40.9	45.4	
Lower jaw	50.0	50.0	
Premaxillary	36.4	34.1	
Illicium	22.7	25.0	20.0
Head depth	45.4	37.7	

¹Lectotype of *O. thysanophorus* Regan and Trewavas, 1932

ellifer are the only means of separating this species from its congeners.

Description.-Escal appendage pattern B (Fig. 60B); esca with an anterior group of short, unpigmented filaments arising from a common base in 12.5 mm specimen, larger specimens with a stout, internally pigmented anterior appendage, slightly more than half length of escal bulb, and bearing numerous unpigmented filaments on distal end, some of which are as long as anterior appendage; medial appendages absent; a truncated or rounded terminal papilla with a distal streak of pigment in 22.0 mm specimens; an unpigmented, tapering posterior appendage nearly twice as long as escal bulb in 12.5 mm specimen, three to four times length of bulb in 22.0 mm specimens; lateral and anterolateral appendages absent (Fig. 91).

Suboperculum with posterior margin of upper part not indented (Bertelsen, 1951:84, Fig. 31J-K); length of lower fork of operculum 28.2-28.6 percent of SL; ratio of lengths of upper and lower forks of operculum .48-.56 (measurements based on two specimens, both 22.0 mm).

Epibranchial teeth absent; teeth present on pharyngobranchial II; total number of teeth on vomer 4-6; number of teeth in upper jaw 18-22, in lower jaw 25-30; D. 6; A. 4; P. 14-15 (Table 1). Measurements are given in Table 21.

Rest of characters as for genus.

Distribution.-*Oneirodes flagellifer* is known from three specimens collected in the Indo-Pacific region: the holotype from approximately 1750 m in the Indian Ocean off Ceylon (5°21'N, 80°38'E), the lectotype of *O. thysanophorus* from 1750 m in the Sulu Sea (8°34'N, 119°55'E), and the GALATHEA specimen from 3800 m in the South China Sea (12°10'N, 114°56'E) (Fig. 110).

Etymology.—The specific name is from the Latin *flagellum*, a whip, apparently in allusion to the long, tapering posterior esca appendage of this species.

Comments.—*Oneirodes flagellifer* and *O. thysanophorus* were described by Regan and Trewavas (1932) from one and two specimens, respectively. On the basis of similarity in the shape of the opercular bones and esca morphology, Bertelsen (1951: 84, fig. 31J-K) placed all three of these specimens into what he called the *Oneirodes flagellifer*-group. The larger of the two syntypes of *O. thysanophorus* (ZMUC P9281) is here referred to *O. eschrichtii* (see Comments under the latter, p. 52). The 12.5 mm syntype, hereby designated as the lectotype of *O. thysanophorus*, compares well with the known material of *O. flagellifer*, except for differences in the esca morphology. The anterior esca appendage of the former consists of a short tuft of filaments arising from a common base, whereas that of the holotype of *O. flagellifer* is stout, internally pigmented, and bears a tuft of filaments distally (Fig. 91). These differences, however, are most likely ontogenetic (Bertelsen, 1951:84); the esca appendages of *O. heteronema* and *O. myrionemus* appear to undergo similar changes with growth, the anterior appendage in the case of the former, the medial appendage in the latter. As no significant differences can be found in the material, *O. thysanophorus* is hereby placed in the synonymy of *O. flagellifer*.

***Oneirodes dicromischus*, new species**

Figures 60B, 92, 93, 108

Table 1

Material.—A single female, the holotype: LACM 31463-1, 35.0 mm; CARIDE Cruise III, Station 59; 00°01'N, 139°06'W; 10-ft IKMT, 0-840 m; 0816 hr; 18 February 1969.

Diagnosis.—Although represented by a single specimen, *O. dicromischus* is described as new on the basis of a relatively long illicium (comparable only to that of *O. bradburyae* and some members of the *O. schmidti*-group), high tooth counts, and a distinct esca morphology. The illicium length and tooth counts alone, easily separate this form from all other described species of *Oneirodes*. In addition, *O. dicromischus* appears to be a relatively elongate member of the genus. Proportional measurements of head length and depth, and premaxillary and lower-jaw length lie near the bottom of the range of variation for females of all species combined (see Generic Description, p. 35).

Description.—Esca appendage pattern B (Fig. 60B); esca with a stout, internally pigmented anterior appendage, the bifurcated distal end of which



FIGURE 92. Esca of *Oneirodes dicromischus*, holotype, LACM 31463-1, 35.0 mm SL, left side.

bears numerous, unpigmented, tapering filaments; three pairs of filamentous medial appendages, most anterior pair the longest, nearly as long as esca bulb; a rounded terminal papilla with a distal streak of pigment; an unpigmented tapering posterior appendage, slightly expanded and trifurcated at distal tip; lateral appendages absent; a stout, unpigmented, anterolateral appendage bearing a few small filaments (Fig. 92).

Suboperculum with posterior margin of upper part not indented (Fig. 93); length of lower fork of operculum 21.4 percent of SL; ratio of lengths of upper and lower forks of operculum .47.

Epibranchial teeth absent; teeth present on pharyngobranchial II; total number of teeth on vomer 8; number of teeth in upper jaw 65, in lower jaw 70; D. 6; A. 4; P. 17 (Table 1).

Measurements in percent of SL: head length 35.7; head depth 38.6; lower jaw 38.6; premaxillary 25.7; illicium length 60.0.

Rest of characters as for genus.

Distribution.—*Oneirodes dicromischus* is known from a single specimen captured between 840 m

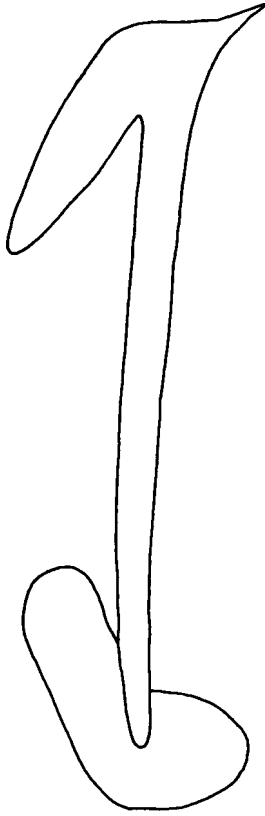


FIGURE 93. Opercular bones of *Oneirodes dicromischus*, holotype, LACM 31463-1, 35.0 mm SL, lateral view, right side.

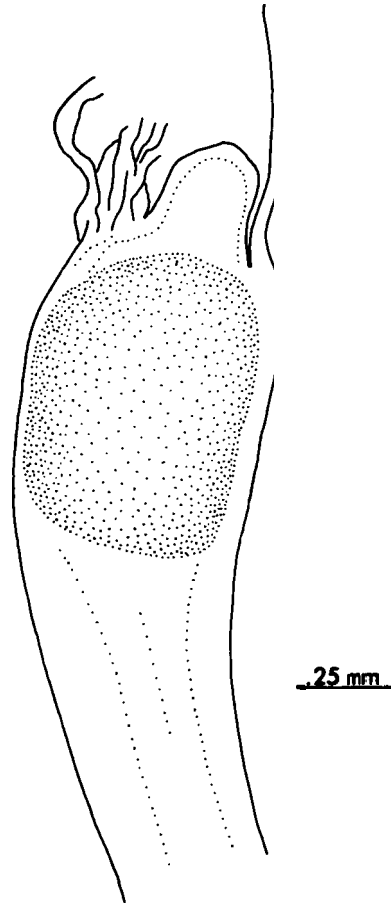


FIGURE 94. Esca of *Oneirodes bradburyae*, holotype, USNM 164359, 23.5 mm SL, left side.

and the surface in the central Pacific at 0°01'N, 139°06'W (Fig. 108).

Etymology.—The name *dicromischus* refers to the forked anterior esca appendage of this species. It is derived from the Greek *dikros*, meaning forked or cloven, and *mischos*, meaning stalk or pedicel.

Oneirodes bradburyae Grey

Figures 94, 95, 107

Table 1

Oneirodes bradburyae Grey, 1956b:245, Fig. 2 (original description; single specimen).

Material.—A single female, the holotype: USNM 164359, 23.5 mm; OREGON Station 1028; Gulf of Mexico, 28°28'N, 87°18'W; 0-1426 m; 21 April 1954.

Diagnosis.—*Oneirodes bradburyae* is distinguished by having a long illicium (72.3 percent of SL), comparable to no other species of the genus.

Description.—The esca of the holotype and only known specimen of *O. bradburyae* is badly damaged. The following is taken from the original description (Grey, 1956b:245): "A rather long,

fine filament arising from left side of distal end of esca; a shorter, club-tipped prolongation on right side; and a short, delicate cluster of filaments centrally; all filaments colorless. . . . longest filament 15.7, . . ." percent of SL (Fig. 94).

Opercular bones shown in Figure 95; length of lower fork of operculum 24.7 percent of SL; ratio of lengths of upper and lower forks of operculum .45.

Epibranchial teeth absent; teeth present on pharyngobranchial II; total number of teeth on vomer 8; number of teeth in upper jaw 42, in lower jaw 54 (jaw-tooth counts are low due to damage); D. 5; A. 4; P. 14 (Table 1).

Measurements in percent of SL: head length 43.8; head depth 42.6; lower jaw 48.9; premaxillary 34.0; illicium length 72.3.

Distribution.—*Oneirodes bradburyae* is known from a single specimen collected between 1426 m

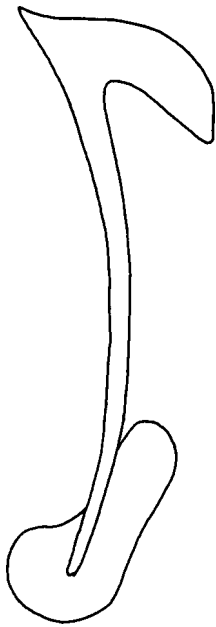


FIGURE 95. Opercular bones of *Oneiroides bradburyae*, holotype, USNM 164359, 23.5 mm SL, lateral view, left side.

and the surface in the Gulf of Mexico at 28°28'N, 87°18'W (Fig. 107).

Etymology.—This species is named for Margaret G. Bradbury.

Comments.—Although the esca of the only known specimen of *O. bradburyae* is badly damaged, it appears to be like those of forms here included in the *O. schmidti*-group. The illicium, however, is considerably longer than that of members of this group and of any other known species of *Oneiroides*.

Oneiroides macronema (Regan and Trewavas)

Figures 96, 97, 110

Table 1

Dolopichthys (subgenus *Dermatias*) *macronema* Regan and Trewavas, 1932:66-67, Fig. 91 (original description; single specimen).

Oneiroides schmidti-group Bertelsen, 1951:84 (in part).

Material.—A single female, the holotype: ZMUC P9282, 27.0 mm; DANA 1256 (1); 17°43'N, 64°56'W; 1000 m wire; 1920 hr; 4 March 1922.

Diagnosis.—The characters of the esca are the only means of separating this species from its congeners (see Comments below, p. 76).

Description.—The esca of the holotype and only known specimen of *O. macronema* is badly damaged. The following is modified from the original

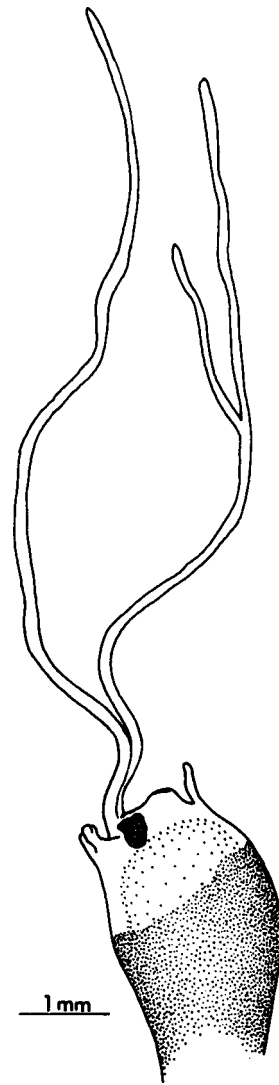


FIGURE 96. Esca of *Oneiroides macronema*, holotype, ZMUC P9282, 27.0 mm SL, left side. Tiny hair-like filaments along length of medial appendages not shown.

description (Regan and Trewavas, 1932:66-67): a short anterior appendage of uncertain morphology; a pair of medial appendages, nearly as long as illicium, each bearing minute hair-like filaments along entire length, and one of which bears a single short branch; a truncated terminal papilla; an **unpigmented** posterior appendage less than one-fourth length of escal bulb; lateral and anterolateral appendages absent (Fig. 96).

Opercular bones shown in Figure 97; length of lower fork of operculum 27.8 percent of SL; ratio of lengths of upper and lower forks of **operculum**.47.

Epibranchial teeth absent; teeth present on pha-



FIGURE 97. Opercular bones of *Oneirodes macronema*, holotype, ZMUC P9282, 27.0 mm SL, lateral view, left side.

ryngobranchial II; total number of teeth on vomer 7; number of teeth in upper jaw 38, in lower jaw 44; D. 5; A. 4; P. 15 (Table 1).

Measurements in percent of SL: head length 40.8; head depth 42.2; lower jaw 46.3; premaxillary 29.6; illicium length 22.2.

Rest of characters as for genus.

Distribution.—*Oneirodes macronema* is known from a single specimen collected in the Caribbean Sea at 17°43'N, 64°56'W with 1000 m of wire out (Fig. 110).

Etymology.—The specific name is derived from the Greek *makros*, meaning long, and *nema*, thread, alluding to the two long medial filaments of the esca.

Comments.—Bertelsen (1951:84) included *O. macronema* in the *O. schmidti*-group, together with *O. mirus* and *O. schmidti*, because of the long medial esca filaments shared by all three species. The

short illicium of the single known specimen of *O. macronema*, however, is considerably outside the range of that of the *O. schmidti*-group as here restricted. In addition, the shape of the subopercular bone of *O. macronema* does not agree with the relatively elongate suboperculum characteristic of this group. Until comparative material becomes available, *O. macronema* is retained as a distinct species.

Oneirodes melanocauda Bertelsen

Figure 108

Table 1

Oneirodes melanocauda Bertelsen, 1951:76, 87-88, Figs. 31L, 41, Tables 11, 14 (original description; four larval specimens; Caribbean Sea, Indian Ocean, and South China Sea; 2500-4000 m wire out; holotype, ZMUC P9288; in key). Grey, 1956a: 248-249 (synonymy; vertical distribution).

Material.—5 larval specimens, four females (6.5-15.5 mm) and a male (5.0 mm) (see Appendix A).

Diagnosis.—*Oneirodes melanocauda* is easily separated from other larvae of the genus by the presence of pigment on the tips of the caudal fin rays and subdermal pigment on the caudal peduncle.

Description.—See Bertelsen (1951:87-88).

Etymology.—The specific name is derived from the Greek *melas*, meaning black and the Latin *cauda*, meaning tail, alluding to the darkly pigmented posterior ends of the caudal-fin rays of this form.

Distribution.—*Oneirodes melanocauda* is represented only by larvae; two specimens are from the Caribbean Sea and three from the East Indies (Fig. 109).

Comments.—Bertelsen (1951) described *O. melanocauda* on the basis of four larval specimens (5.0-15.5 mm) possessing several features not found in any other *Oneirodes* larvae. These features include the presence of pigment on the tips of the caudal fin rays, presence of subdermal pigment on the caudal peduncle, apparent absence of sphenotic, articular, and symphyseal spines, a short illicium (in the 15.5 mm specimen), a large suboperculum and a short opercular bone (Bertelsen, 1951:87-88, Fig. 41). In addition, the esca of the 15.5 mm specimen is poorly developed in contrast to all other known forms of *Oneirodes* in which the characteristic esca morphology of the species is fully formed at a standard length of 10 or 11 mm. There is a good possibility that *O. melanocauda* represents the larvae of an undescribed ceratioid genus.

Careful comparison of the 6.5 mm PILLSBURY specimen (UMML 30270) with the 7.0 mm DANA

jaw 44-76; D. 5-7; A. 4; P. 15-16 (Table 1). Counts and measurements are given in Table 22.

Rest of characters as for genus.

Distribution.—Representatives of the *O. schmidti*-group are known from all three major oceans: five records from the Atlantic, off Newfoundland, Bermuda, and French West Africa; five from the Indo-Pacific north of the equator, from the Gulf of Aden in the Indian Ocean to the Caroline Islands, Micronesia; and six from the eastern Pacific to 140°W between 33°N and 2°N (Fig. 111).

Oneirodes schmidti (Regan and Trewavas)

Figures 60C, 98A, 99, 111

Tables 1 and 22

Dolopichthys (subgenus *Dermatias*) *schmidti*
Regan and Trewavas, 1932:75, Fig. 113 (original description; single specimen).

Oneirodes schmidti-group Bertelsen, 1951:84, Fig. 311 (in part). Grey 1956a:246 (in part; after Bertelsen, 1951; vertical distribution).

Material.—A single female, the holotype: ZMUC P9284, 32.0 mm; DANA Station 3678(1), 4°05'S; 128°16'E; 5000 m wire; bottom depth 4700 m; 1840 hr; 24 March 1929.

Diagnosis.—*Oneirodes schmidti* is a member of the *O. schmidti*-group as diagnosed above (p. 77). In addition to differences in esca morphology (Figs. 99-102), *O. schmidti* differs from other members of the *O. schmidti*-group by having a greater number of teeth in the jaws (Table 22).

Description.—Esca with a filamentous anterior appendage, shorter than length of esca bulb, without internal pigment; a pair of unpigmented, filamentous, medial appendages, shorter than length of anterior appendage; a rounded terminal papilla with a distal streak of pigment; a short, unpigmented, unbranched posterior appendage; lateral appendages absent; two pairs of filamentous anterolateral appendages: an inner pair of stout, tapering appendages flanking anterior appendage each more than four times length of esca bulb, with upper two-thirds branched; and an outer pair of branched appendages less than half length of esca bulb (Fig. 99).

Suboperculum shown in Figure 98A; length of lower fork of operculum 25.0 percent of SL; ratio of lengths of upper and lower forks of operculum .44. Counts and measurements are given in Table 22.

Rest of characters as for *O. schmidti*-group.

Distribution.—*Oneirodes schmidti* is known from a single specimen collected in the Banda Sea with 3500 m of wire out (Fig. 111).

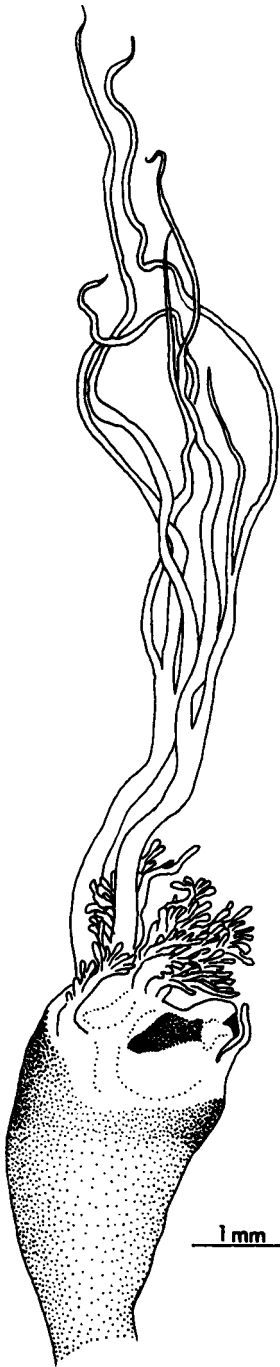


FIGURE 99. Esca of *Oneirodes schmidti*, holotype, ZMUC P9284, 32.0 mm, left side.

Etymology.—*Oneirodes schmidti* is named for Johannes Schmidt, leader of DANA Expeditions.

Oneirodes mirus (Regan and Trewavas)

Figures 60C, 98B, 100, 111

Tables 1 and 22

Dolopichthys (subgenus *Dermatias*) *mirus* Regan and Trewavas, 1932:74-75, Fig. 112 (original description; single specimen).

Oneirodes schmidti-group Bertelsen, 1951:84, Fig. 31H (in part). Gray, 1965a:246 (after Bertelsen, 1951; vertical distribution).

Material.—A single female, the holotype: ZMUC P9283, 42.0 mm; DANA Station 3828 (10), 1°22'N, 96°06.5'E; 3000 m wire; bottom depth 4980 m; 1600 hr; 18 September 1929.

Diagnosis.—*Oneirodes mirus* ♀ a member of the *O. schmidti*-group as diagnosed above (p. 77). It differs from other members of the *O. schmidti*-group in its escal morphology (Figs. 99-102) and is further differentiated from *O. schmidti* by having fewer teeth in the jaws (Table 22).

Description.—Esca with a stout anterior appendage, shorter than escal bulb, without internal pigment, bearing a single short branch; a pair of unpigmented, filamentous medial appendages, slightly longer than anterior appendage; a rounded terminal papilla with a distal spot of pigment; an anteroposteriorly compressed, unpigmented posterior appendage, as long as escal bulb, bearing two short branches at mid-length; lateral appendages absent; two pairs of filamentous anterolateral appendages: an inner pair of stout, tapering appendages flanking anterior appendage each longer than SL, lightly pigmented internally except for slightly expanded

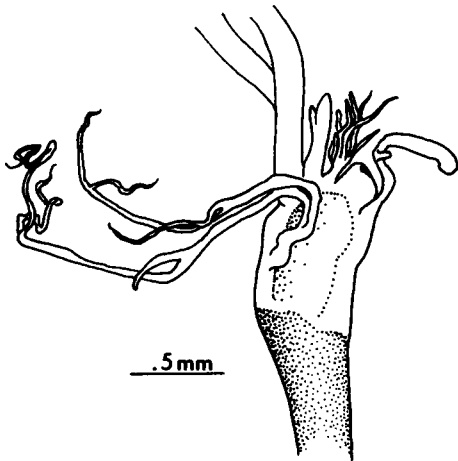


FIGURE 100. Esca of *Oneirodes mirus*, holotype, ZMUC P9283, 42.0 mm SL, left side. Extent of filaments associated with anterior appendage not shown.

distal tip, and bearing numerous, short filaments; and an outer pair of unpigmented, bifurcated appendages, each tapering branch of which is more than three times length of escal bulb and bears two short filaments (Fig. 100).

Suboperculum shown in Figure 98B; length of lower fork of operculum 23.8 percent of SL; ratio of lengths of upper and lower forks of operculum .50.

Counts and measurements are given in Table 22.

Rest of characters as for *O. schmidti*-group.

Distribution.—*O. mirus* ♀ known from a single specimen collected in the Indian Ocean, off Sumatra, with 3000 m of wire out (Fig. 111).

Etymology.—The specific name is from the Latin *mirus*, meaning wonderful.

Oneirodes basili, new species

Figures 20, 29, 60C, 98C, 101, 111

Tables 1 and 22

Oneirodes, new species Pietsch, 1972a:42-43, 45, Fig. 24(5) (otolith described, figured).

Material.—3 females, 95.0-159.0 mm.

Holotype.—LACM 30020-34, 95.0 mm; VE-LERO IV Station 11635; 28°08'N, 117°31'W; 10-ft IKMT, 0-700 m; bottom depth 3520-3493 m; 2340-0430 hr; 20 August 1967.

Paratypes.—LACM 31100-2, 159.0 mm; VE-LERO IV Station 13721; 33°06'N, 118°22'W; 10ft. IKMT, 0-990 m; bottom depth 1152-1353 m; 2320-0530 hr; 18 December 1969. LACM 30028-30, 115.0 mm; VE-LERO IV Station 11644; 29°40'N, 118°15'W; 10-ft IKMT, 0-1400 m; bottom depth 3383-3292 m; 1300-2117 hr; 22 August 1967.

Diagnosis.—*Oneirodes basili* ♀ a member of the *O. schmidti*-group as diagnosed above (p. 77). It differs from other members of the *O. schmidti*-group in its escal morphology (Figs. 99-102). It is further differentiated from *O. schmidti* by having fewer jaw teeth (Table 22), and from *O. theodoritissieri* by having a greater ratio between the lengths of the upper and lower forks of the operculum (.44-.50 and .54-.62 for the *O. theodoritissieri* and *O. basili*, respectively).

Description.—Esca with a branched, filamentous anterior appendage, two times length of escal bulb, without internal pigment; spots of dark pigment present on most branches of anterior appendage; medial appendage absent; a rounded or conical terminal papilla with two, bilaterally placed distal spots of pigment; a posterior appendage, as long as escal bulb, with an anteroposteriorly compressed distal end, the posterior surface of which is slightly concave and darkly pigmented; lateral appendages

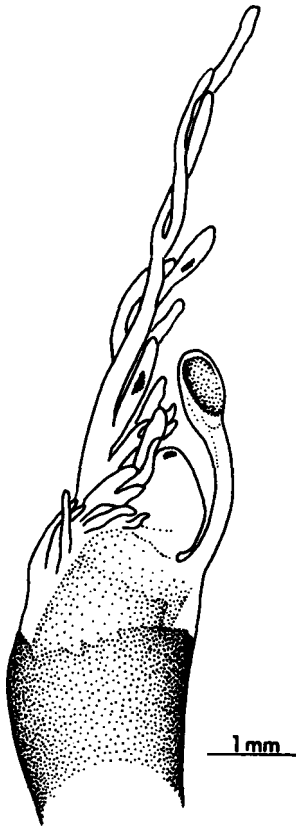


FIGURE 101. Esca of *Oneirodes basili*, paratype, LACM 30028-30, 115.0 mm SL, left side.

absent; two pairs of filamentous anterolateral appendages: an inner pair of tapering, branched appendages flanking anterior appendage, each less than one-half length of esca bulb; and a similar, outer pair of appendages equal to or less than length of inner pair (Fig. 101).

Opercular bones shown in Figure 98C; length of lower fork of operculum 27.1 (25.3-28.6) percent of SL; ratio of lengths of upper and lower forks of operculum .58 (.54-.62).

Total number of teeth on vomer 4-8; number of teeth in upper jaw 49-69, in lower jaw 46-60; D. 5-6; A. 4; P. 15-16 (Table 1). Counts and measurements are given in Table 22.

Rest of characters as for *O. schmidti*-group.

Size at maturity.—The length of the right ovary of the 159.0 mm specimen of *O. basili* 33.0 mm or 20.8 percent of SL. The ovaries of the 115.0 mm specimen are small and undeveloped.

Distribution.—*Oneirodes basili* is known only from the southern California borderland region and off Guadalupe Island, Mexico. Vertical distribution data are too few to make any reasonable statement (Fig. 111).

Etymology.—*Oneirodes basili* is named for Basil G. Nafpaktitis of the University of Southern California, for his encouragement and guidance as major professor and friend.

Oneirodes theodoritissieri Belloc

Figures 60C, 98D, 102, 111

Tables 1 and 22

Oneirodes theodori-tissieri Belloc, 1938:303, Figs. 23-25 (original description; single specimen; 11°13'N, 17°26'W; 1000 m wire; holotype, MHLR P448).

Oneirodes theodoritissieri, Aloncle, 1968:691 (listed).

Oneirodes eschrichti-group Bertelsen, 1951:79 (in part). Grey, 1956a:245 (after Bertelsen, 1951; vertical distribution).

Material.—3 females, 58.0-183.0 mm (see Appendix A).

Diagnosis.—*Oneirodes theodoritissieri* is a member of the *O. schmidti*-group as diagnosed above (p. 77). It differs from other members of the *O. schmidti*-group in its esca morphology (Figs. 99-

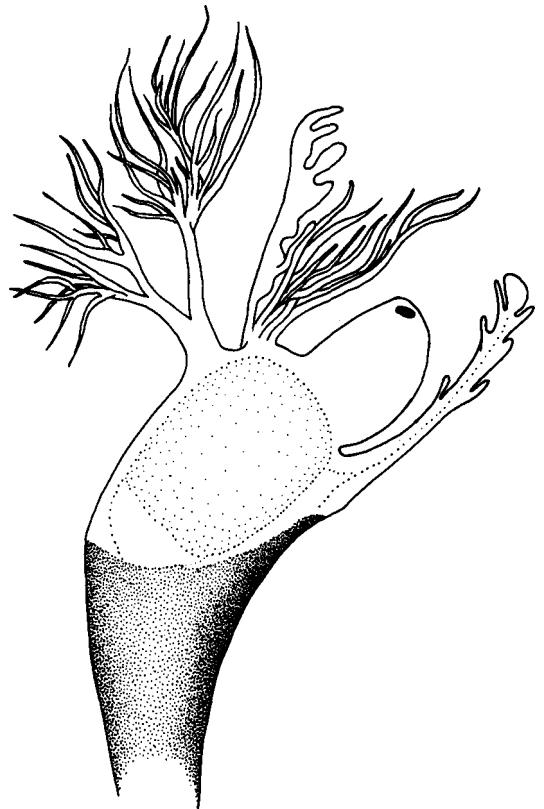


FIGURE 102. Esca of *Oneirodes theodoritissieri*, NIO uncatalogued, 58.0 mm SL, left side, freehand sketch.

102). It is further differentiated from *O. schmidti* by having fewer jaw teeth (Table 22), and from *O. basili* by having a smaller ratio between the lengths of the upper and lower forks of the operculum (.44-.50 and .54-.62 for *O. theodoritissieri* and *O. basili*, respectively).

Description.—Esca with a branched, filamentous anterior appendage, as long as esca bulb, without internal pigment; a pair of filamentous medial appendages as long as esca bulb; a conical terminal papilla with two, bilaterally placed, distal spots of pigment; an unpigmented, anteroposteriorly compressed posterior appendage, as long as esca bulb, the distal half of which bears six short branches in 58.0 mm specimen; lateral appendages absent; a single pair of unpigmented, bifurcated, anterolateral appendages each fork of which is highly branched and longer than esca bulb (Fig. 102).

Subopercular bone shown in figure 98D; length of lower fork of operculum 26.2 (25.9-26.6) percent of SL; ratio of lengths of upper and lower forks of operculum .48 (.44-.50).

Total number of teeth on vomer 5-7; number of teeth in upper jaw 40-55, in lower jaw 44-58; D. 5-6; A. 4; P. 15-16 (Table 1). Counts and measurements are given in Table 22.

Rest of characters as for *O. schmidti*-group.

Distribution.—*Oneirodes theodoritissieri* is known only from the eastern north Atlantic Ocean off Portuguese Guinea, and the Cape Verde Islands. The 58.0 mm specimen was captured with a closing net between 810 and 900 m (Fig. 111).

Etymology.—This species is named for Theodore Tissier, at one time **Président** du Conseil d'administration de l'Office scientifique et technique des **Pêches** Maritimes.

Oneirodes species of *Oneirodes schmidti*-group

Dolopichthys sp. Norman, 1939:115, Fig. 40 (in part). Bertelsen, 1951:80 (in part; specimen of Norman, 1939, listed under *O. eschrichti*-group).

Oneirodes eschrichti-group Bertelsen, 1951:80 (in part; *Dolopichthys* sp. of Norman, 1939).

Eight additional specimens (12.0-42.0 mm) here assigned to the *O. schmidti*-group cannot be referred to any described species. Although some of these appear to represent new forms, description is deferred until adequate material is available. Collection data for these specimens are given in Appendix A.

Oneirodes species

Adolescent and adult males and females, metamorphosis stages, and larvae not identifiable to species.

A considerable number of metamorphosed female specimens cannot be identified to species, including a number which may represent new species, but remain undescribed due to a lack of adequate material. These are listed in Appendix A.

Synonymy of *Males*.—*Lipactis tumidus*, Regan, 1926:43 (in part; erroneous designations; six specimens, one, DANA Station 1152, referred to *O. eschrichti*-group by Bertelsen, 1951). Norman, 1930:357 (erroneous designation, specimen subsequently described as *Trematorhynchus exiguus*, new species by Regan and Trewavas, 1932). Fowler, 1936:1349, Fig. 567 (in part; after Regan, 1926).

Rhynchoceratias leucorhinus, Regan, 1926:44 (in part; erroneous designations; 17 specimens, two referred to *Trematorhynchus leucorhinus* by Regan and Trewavas, 1932, subsequently referred to *O. eschrichti*-group by Bertelsen, 1951).

Trematorhynchus leucorhinus, Regan and Trewavas, 1932:91 (in part; new combination; erroneous designations; four specimens referred to *O. eschrichti*-group by Bertelsen, 1951).

Trematorhynchus exiguus Regan and Trewavas, 1932:91, Fig. 147 (original description, single specimen, holotype BMNH 1930.1.12.1102; *Lipactis tumidus* of Norman, 1930). Bertelsen, 1951:73-74 (referred to the Oneirodidae).

Caranactis pumilus Regan and Trewavas, 1932:59, Fig. 86 (original description, single specimen, holotype ZMUC P9266; referred to *O. eschrichti*-group by Bertelsen, 1951).

Oneirodes eschrichti-group Bertelsen, 1951:83, Figs. 31A-B, 32B, D, E, 35-37 (in part). Grey, 1956a:245 (in part; after Bertelsen, 1951; synonymy, vertical distribution).

Oneirodes sp. ? Bertelsen, 1951:88.

Of six adolescent and adult *Oneirodes* males examined by Bertelsen (1951), five appeared to be nearly identical. These were placed in what was the commonest group of species, the *O. eschrichti*-group. The somewhat divergent sixth specimen was designated by Bertelsen (1951) as *Oneirodes* sp. ?. At present 35 adolescent and adult males of *Oneirodes* are known. In spite of this increase in material no characters have been found which would allow males to be included in any species based on females. Furthermore, no significant differences within the material could be found in spite of its world-wide distribution. All of this material, including Bertelsen's (1951) *Oneirodes* sp. ?, is therefore designated as *O. sp.* until means of identifying these specimens are found. Adolescent and adult males of the DANA collections are listed by Bertelsen (1951:88, 267, Appendix, Table 6). Additional material is listed in Appendix A.

Larval and metamorphosing males and females of the DANA collections are listed by Bertelsen (1951:267, Appendix, Table 6). Additional material is listed in Appendix A.

EVOLUTIONARY RELATIONSHIPS

Intergeneric Relationships

Patterns of phenetic similarity and phylogenetic relationship among the nine oneirodid genera examined are here deduced on the basis of 30 characters. These characters were chosen from the comparative osteological description (see above, pp. 15-30) for their intrageneric stability and intergeneric variability. They are summarized in Table 23 and listed below with a discussion of the evolutionary direction of each. Determination of directional change in character states was based on the assumption that a character state of wide distribution in many divergent taxa of the ancestral group, or of universal occurrence in related, primitive families, is primitive for the smaller group under consideration. To apply this premise meaningfully it is necessary to have data available for the central group from which the smaller group under discussion was derived. No subgroup of the Ceratioidei is accepted as ancestral to the Oneirodidae. Thus, the following analysis incorporates the phenetic variation of the entire suborder Ceratioidei as representing the ancestral character pool for the family Oneirodidae (see Marx and Rabb, 1970: 530). Of the 33 genera and 11 families of the Ceratioidei, cleared and stained material was available for 16 genera in eight families (Appendix B; Pietsch, 1972a). For these genera, the character states of all 30 characters are known, with few exceptions. The character states for the remaining 17 genera are not known for all characters (Table 23); all possible osteological data were taken from whole specimens or from the literature (Lütken, 1878a, 1887; Regan and Trewavas, 1932; Waterman, 1948; Bertelsen, 1951; and Pietsch, 1972a).

For each character the primitive state is given a lower case letter, the derived state a capital letter, a secondary derivation a capital letter starred, a tertiary derivation a capital letter double starred.

1. Width of ethmoid cartilage. In 18 of 19 ceratioid genera, for which the states of this character are known, the ethmoid cartilage is as wide as or wider than the distance between the anterolateral tips of the frontals (a). In *Danaphryne* the width of the ethmoid cartilage is less than this distance (A).

2. Size of lateral ethmoid. In 18 of 19 genera the lateral ethmoids are large, contributing one-fourth or more of the perimeter of the natal foramina (b).

Dolopichthys has small lateral ethmoids that form less than one-sixth the perimeter of the nasal foramina (B).

3. Vomerine teeth. Throughout the Ceratioidei there is a trend toward the loss of teeth. Of 32 genera vomerine teeth are present in 21 (c). Vomerine teeth are lost with growth in *Bertella* (C) and absent in *Pentherichthys* and *Lophodolos* (C*).

4. Shape of nasal foramina. Roughly circular nasal foramina, found in eight of 18 genera, are considered the primitive state (d). In derived states nasal foramina are vertically oval in three genera (*Caulophryne*, *Ceratias*, and *Cryptopsaras*), obliquely oval in six genera (*Leptacanthichthys*, *Dolopichthys*, *Bertella*, *Chaenophryne*, *Pentherichthys*, and *Borophryne*), and absent in one (*Gigantactis*) (D).

5. Shape of dorsal margin of frontals. The frontal bones are dorsally convex in 17 of 26 genera (e). The dorsal margin of these bones is straight in *Leptacanthichthys*, *Dolopichthys*, and *Bertella* (E), and concave in *Lophodolos* (E*).

6. Length of frontals. The frontal bones are shorter than the distance between the anterolateral tips of the sphenotics in 16 of 19 genera (f). The length of the frontals is greater than this distance in *Leptacanthichthys* and *Dolopichthys* (F).

7. Relation of frontals to ethmoid region. In 18 of 23 genera the frontals lie posterior to the ethmoid region (g). In *Leptacanthichthys*, *Dolopichthys*, *Bertella*, *Chaenophryne*, and *Pentherichthys* the frontals lie further anteriorly, overhanging and extending past the anterior limits of the ethmoid cartilage (G).

8. Ventromedial extensions of frontals. The frontals are either narrowly separated by cartilage or have ventromedial extensions which approach each other on the midline in 15 of 23 ceratioid genera (h). In *Lophodolos* the frontal bones are widely separated and lack ventromedial extensions (H).

9. Relation of frontal to prootic. There is no connection between the frontal and prootic in 16 of 18 genera (i). These bones meet in *Lophodolos* (I).

10. Pterosphenoid. This element is present in 14 of 18 genera (j). A pterosphenoid is absent in *Lophodolos* (J).

11. Sphenotic spines. Sphenotic spines are present in 25 of 33 genera (k). In derived states sphenotic spines may be absent (*Chaenophryne*) or markedly enlarged (*Lophodolos*) (K).

12. Length of symphyseal cartilage. The symphyseal cartilage is longer than wide in 10 of 14 genera (l). This element is wider than long in *Dolopichthys*, *Bertella*, and *Pentherichthys* (L).

TABLE 23

Comparison of selected characters of thirty-three genera of Ceratioidea

Characters	<i>Oneirodes</i>	<i>Danaphryne</i>	<i>Microlophichthys</i>	<i>Leptacanthichthys</i>	<i>Dolopichthys Bertella</i>	<i>Chaenophryne</i>	<i>Pentherichthys</i>	<i>Lophodolos</i>	<i>Caulophryne</i>	<i>Melanocetus</i>
1. Width of ethmoid cartilage	Wide	Narrow	Wide	Wide	Wide	Wide	Wide	Wide	Wide	Wide
2. Size of lateral ethmoid	Large	Large	Large	Large	Small	Large	Large	Large	Large	Large
3. Vomerine teeth	Present	Present	Present	Present	Present	Present	Absent	Absent	Present	Present
4. Shape of nasal foramina	Circular	Circular	Circular	Obliquely oval	Obliquely oval	Obliquely oval	Obliquely oval	Circular	Vertically oval	Circular
5. Shape of dorsal margin of frontals	Convex	Convex	Convex	Straight	Straight	Straight	Convex	Convex	Concave	Concave
6. Length of frontals	Short	Short	Short	Long	Long	Short	Short	Short	Short	Short
7. Relation of frontals to ethmoid region	Posterior	Posterior	Posterior	Anterior	Anterior	Anterior	Anterior	Anterior	Posterior	Posterior
8. Ventromedial extensions of frontals	Present	Present	Present	Present	Present	Present	Present	Present	Absent	Absent
9. Relation of frontal to prootic	Separated	Separated	Separated	Separated	Separated	Separated	Separated	In contact	In contact (?)	Separated
10. Pterospheoid	Present	Present	Present	Present	Present	Present	Present	Present	Absent	Absent (?)
11. Sphenotic spines	Developed	Developed	Developed	Developed	Developed	Developed	Developed	Developed	Enlarged	Developed
12. Length of symphyseal cartilage	Long	Long	Long	Long	Short	Short	Long	Long	Long	Short
13. Symphyseal spine	Developed	Developed	Developed	Developed	Developed	Developed	Rudimentary	Absent	Enlarged	Developed
14. Dorsal head of hyomandibular	Double	Double	Double	Double	Double	Single	Double	Double	Double	Double
15. Quadrate spine	Long	Long	Long	Short	Long	Long	Rudimentary	Rudimentary	Long	Rudimentary
16. Posterior margin of operculum	Notched	Notched	Notched	Notched	Notched	Notched	Concave	Notched	Notched	Notched
17. Shape of preoperculum	Crescent	Crescent	Crescent	Crescent	Crescent	Crescent	Sigmoid	Crescent	Crescent	Crescent
18. Pharyngo-branchial I	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
19. Pharyngo-branchial II	Developed	Developed	Vestigial	Developed	Reduced	Reduced	Developed	Absent	Absent	Developed
20. Hypobranchials II	Present	Present	Absent	Present	Absent	Absent	Present	Present	Present	Present
21. Relation of hypobranchials II to basibranchials II	Articulate	Articulate	Articulate	Articulate	Articulate	Articulate	Articulate	Articulate	Pass ventral	Articulate
22. Caudal ray pigmentation	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent
23. Pterygiophore of illicium	Cylindrical	Cylindrical	Cylindrical	Cylindrical	Cylindrical	Cylindrical	Cylindrical	Depressed	Cylindrical	Cylindrical
24. First ray of dorsal fin	Developed	Developed	Developed	Developed	Developed	Developed	Developed	Developed	Reduced	Developed
25. Number of anal fin rays	4 (rarely 5)	5-6 (rarely 4)	5-6 (rarely 4)	5	5-6 (rarely 4)	5 (rarely 4)	5-6 (rarely 4)	6-7 (rarely 5)	5-6 (rarely 4)	13-19
26. Pectoral fin lobe	Short	Short	Short	Long	Short	Short	Short	Short	Short	Short
27. Number of pectoral fin rays	14-18	14-18	18-22	18-22	18-22	18-22	18-22	22-27	18-22	15-20
28. Posteroventral process of coracoid	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present
29. Pelvic bones	Rod	Rod	Rod	Rod	Rod	Rod	Triradiate	Rod	Rod	Rod
30. Skin spines	Reduced	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Reduced

TABLE 23 (Continued)

Characters	<i>Paroneirodes</i>	<i>Centrophryne</i>	<i>Ceratias</i>	<i>Gigantactis</i>	<i>Borophryne</i>	<i>Himantolophus</i>	<i>Diceratias</i>	<i>Phyllorhinichthys</i>	<i>Tyrannophryne</i>	<i>Chirophryne</i>	<i>Ctenochirichthys</i>
1. Width of ethmoid cartilage	Wide	Wide	Wide	Wide	Wide	Wide	Wide	?	?	?	?
2. Size of lateral ethmoid	Large	Large	Large	Large	Large	Large	Large	7	?	?	?
3. Vomerine teeth	Present	Present	Present	Absent	Present	Absent	Present	Present	Present	Present	Present
4. Shape of nasal foramina	Circular	Circular	Vertically oval	Absent	Vertically oval	Circular	?	?	?	?	?
5. Shape of dorsal margin of frontals	Convex	Convex	Straight	Straight	Convex	Convex	Convex	Convex	7	Convex	Convex
6. Length of frontals	Short	Short	Long	Short	Short	Short	Short	?	?	?	?
7. Relation of frontals to ethmoid region	Posterior	Posterior	Posterior	Posterior	Posterior	Posterior	Posterior	?	7	7	?
8. Ventromedial extensions of frontals	Present	Present	Present	Absent	Absent	Absent	Present	?	?	7	?
9. Relation of frontal to prootic	Separated	Separated	Separated	?	Separated (?)	Separated	?	?	?	?	7
10. Pterospheneid	Present	Present	Present	Absent (?)	Absent (?)	Present	?	?	?	?	?
11. Sphenotic spines	Developed	Absent	Absent	Absent	Developed	Developed	Developed	Developed	Developed	Developed	Developed
12. Length of symphyseal cartilage	Long	Long	Long	?	Absent (?)	?	?	?	?	?	?
13. Symphyseal spine	Developed	Developed	Developed	Absent	Developed	Developed	Developed	Developed	Developed	Developed	Absent
14. Dorsal head of hyomandibular	Double	Double	Double	Single	Single	Double	Double	Double	Double	Double	Double
15. Quadrate spine	Rudimentary	Rudimentary	Rudimentary	Rudimentary	Rudimentary	Rudimentary	Rudimentary	Long	Long	Long	Rudimentary
16. Posterior margin of operculum	Notched	Notched	Notched	Notched	Concave	Notched	Notched	Notched	Notched	Notched	Notched
17. Shape of preoperculum	Crescent	Crescent	Crescent	Crescent	Crescent	Crescent	?	?	?	?	?
18. Pharyngo-branchial I	Present	Present	Present	Absent	Absent	Present	?	?	?	?	?
19. Pharyngo-branchial II	Developed	Developed	Developed	Developed	Developed	Developed	?	Developed	?	Developed	?
20. Hypobranchials II	Present	Present	Present	Present	?	?	?	?	?	?	?
21. Relation of hypobranchials II to basibranchials H	Articulate	Articulate	Articulate	Articulate	Articulate	Articulate	?	?	?	7	?
22. Caudal ray pigmentation	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
23. Pterygiophore of illicium	Cylindrical	Cylindrical	Cylindrical	Laterally compressed	Cylindrical	Laterally compressed	Cylindrical	?	?	?	?
24. First ray of dorsal fin	Developed	Developed	Developed	Developed	Developed	Developed	?	Developed	?	7	7
25. Number of anal fin rays	4	5-6	4	4-8	3	4-5	4	5	5	4	4-5
26. Pectoral fin lobe	Short	Short	Short	Short	Short	Short	Short	Short	Short	Long	Long
27. Number of pectoral fin rays	13	15-16	16-19	16-21	16-18	15-18	13-15	21-24	20	0-19	27-30
28. Posteroventral process of coracoid	Absent	Absent	Present	Present (?)	Absent	Absent	?	7	?	?	7
29. Pelvic bones	Rod	Rod	Rod	Rod	Absent	Triradiate	Rod	Rod	?	?	7
30. Skin spines	Reduced	Developed	Developed	Developed	Absent	Bony plates	Developed	Absent	?	?	7

TABLE 23 (Continued)

Characters	<i>Lasiognathus</i>	<i>Thaumatichthys</i>	<i>Amacrodon</i>	<i>Spiniphryne</i>	<i>Cryptopsaras</i>	<i>Rhynchaetis</i>	<i>Neoceratias</i>	<i>Photocorynus</i>	<i>Edriolychus</i>	<i>Linophryne</i>	<i>Acentrophryne</i>
1. Width of ethmoid cartilage	?	?	?	?	Wide	?	?	?	?	?	?
2. Size of lateral ethmoid	?	?	?	?	Large	?	?	?	?	?	?
3. Vomerine teeth	Absent	Absent	Absent	Present	Present	Absent	Present	Absent	Absent	Present	?
4. Shape of nasal foramina	?	?	?	?	Vertically oval	?	?	?	?	?	?
5. Shape of dorsal margin of frontals	?	?	?	?	Straight	?	Straight	Convex	Convex	Convex	?
6. Length of frontals	?	?	?	?	?	?	Short	?	?	?	?
7. Relation of frontals to ethmoid region	?	?	?	?	Posterior	?	Posterior	Posterior	Posterior	Posterior	?
8. Ventromedial extensions of frontals	?	?	?	?	Present	?	Present	Absent	Absent	Absent	?
9. Relation of frontal to prootic	?	?	?	?	Separated	?	Separated	?	?	?	?
10. Pterospheonid	?	?	?	?	?	?	Present	?	?	?	?
11. Sphenotic spines	Developed	Absent	Absent	Developed	Absent	Absent	Developed	Developed	Developed	Developed	Developed
12. Length of symphyseal cartilage	?	?	?	?	?	?	?	?	?	?	?
13. Symphyseal spine	Absent	Absent	Absent	Absent	Developed	Absent	Absent	Developed	Developed	Developed	Developed
14. Dorsal head of hyomandibular	Double	Double	Double	Double	Double	Single	Single	Single	Single	Single	Single
15. Quadrate spine	Short	Absent	Absent	Rudimentary	Rudimentary	Rudimentary	Rudimentary	Rudimentary	Rudimentary	Rudimentary	Rudimentary
16. Posterior margin of operculum	Notched	Notched	?	Notched	Notched	?	Notched	Notched	Notched	Notched	?
17. Shape of preoperculum	?	?	?	?	Crescent	?	Straight	Straight	Crescent	Crescent	Crescent
18. Pharyngo-branchial I	?	?	?	?	?	?	?	?	?	?	?
19. Pharyngo-branchial II	?	?	?	?	?	?	?	?	?	?	?
20. Hypobranchials II	?	?	?	?	?	?	?	?	?	?	?
21. Relation of hypobranchials II to basibranchials II	?	?	?	?	?	?	?	?	?	?	?
22. Caudal ray pigmentation	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
23. Pterygiophore of illicium	?	?	?	?	Cylindrical	?	Cylindrical	?	?	?	?
24. First ray of dorsal fin	?	?	?	?	Developed	?	?	?	?	?	?
25. Number of anal fin rays	5	4	4	5	4	3-4	10-13	3	3-4	3 (rarely 2)	3
26. Pectoral fin lobe	Short	Short	Short	Short	Short	Short	Short	Short	Short	Short	Short
27. Number of pectoral fin rays	17	15	18(?)	16	14-18	17-20	12-15	15-17	15-16	13-19	17-18
28. Posteroventral process of coracoid	?	?	?	?	?	?	?	?	?	?	?
29. Pelvic bones	?	Rod	?	?	Rod	Rod	Rod	Absent	Absent	Absent	Absent
30. Skin spines	?	Developed	Developed	Developed	Developed	?	?	?	?	?	?
		on lower body	on lower body								

13. Symphyseal spine. A symphyseal spine is well-developed in 23 of 33 genera (m). In derived states this spine may be rudimentary to absent (*Chaenophryne* and *Pentherichthys*), or markedly enlarged (*Lophodolos*) (M).

14. Dorsal head of hyomandibular. The hyomandibular has a double dorsal head in 24 of 33 genera (n). The hyomandibular of *Bertella* has a single dorsal head (N).

15. Quadrate spine. In 20 of 33 genera the quadrate spine is rudimentary to absent (o). This spine is shorter than the mandibular spine in *Leptacanthichthys* (O), and longer than the mandibular spine in *Oneirodes*, *Dana phryne*, *Microlophichthys*, *Dolopichthys*, *Bertella*, and *Lophodolos* (O*).

16. Posterior margin of operculum. The posterior margin of the opercular bone is deeply notched in 28 of 30 genera (p). In *Chaenophryne* the posterior margin of the bone is only slightly concave (P).

17. Shape of preoperculum. This bone is crescent-shaped or straight in 22 of 23 genera (q). The preoperculum of *Chaenophryne* is sigmoidal (Q).

18. Pharyngobranchial I. Although a pharyngobranchial I is found in only 5 of 18 genera the presence of this bone is considered the primitive state (r). Pharyngobranchial I is present in *Oneirodes* and absent in all other oneirodid genera examined (R).

19. Pharyngobranchial II. This element is well-developed in 14 of 19 genera (s). Pharyngobranchial II is reduced in *Dolopichthys* and *Bertella* (S), vestigial in *Microlophichthys* (S*), and absent in *Pentherichthys* and *Lophodolos* (S**).

20. Hypobranchial II. Hypobranchial II is present in 11 of 14 genera (t). This element is absent in *Microlophichthys*, *Dolopichthys*, and *Bertella* (T).

21. Relation of hypobranchials II to basibranchial II. In 15 of 16 genera the hypobranchials of the second arch articulate directly with **basibranchial II**, whereas hypobranchials III pass ventral to basibranchial II and approach each other on the midline (u). In *Lophodolos* hypobranchials II and III pass ventral to basibranchial II and approach each other on the midline (U).

22. Caudal ray pigmentation. The caudal rays are without internal pigment in 32 of 33 genera (v). Internally pigmented caudal rays are present in *Pentherichthys* (V).

23. Pterygiophore of illicium. The posterior end of the pterygiophore of the illicium is cylindrical or laterally compressed in 19 of 20 genera (w). This part of the pterygiophore of *Pentherichthys* is depressed (W).

24. First ray of dorsal fin. The first ray of the dorsal fin is well-developed in 18 of 19 genera (x).

In *Lophodolos* this ray is reduced to a small stub (X).

25. Number of anal fin rays. The loss of fin rays is a general trend among ceratioids. Among oneirodids examined osteologically three character states are recognized: six (y), five (Y), and four (Y).

26. Pectoral fin lobe. In 30 of 33 genera the pectoral-fin lobe is shorter than the longest rays of the pectoral fin (z). In *Leptacanthichthys* the pectoral fin lobe is longer than the longest rays of the pectoral fin (Z).

27. Number of pectoral fin rays. The loss of fin rays is a general trend among ceratioids. Among oneirodids examined osteologically three character states are recognized: 22-27 (aa), 18-22 (AA), and 14-18 (AA*).

28. Posteroventral process of coracoid. A posteroventral process of the coracoid, found in only four of 17 genera (*Oneirodes*, *Caulophryne*, *Ceratiias*, and *Gigantactis*), is considered to represent a primitive condition rather than a secondary specialization (bb). The absence of this process represents a derived state (BB).

29. Pelvic bones. Throughout the Ceratioidei there is a trend toward reduction and loss of the apparently functionless pelvic bones (Pietsch, 1972a:44). **Tri-radiate** pelvic bones, found in only two of 27 ceratioid genera (*Chaenophryne* and *Himantolophus*), are considered to represent a primitive condition rather than a secondary specialization (cc). Rod-shaped pelvic bones represent a derived state (CC).

30. Skin spines. Skin spines or bony plates bearing spines are present in 12 of 23 genera. Of these 12, skin spines are well developed in nine genera (dd), reduced to microscopic size and widely scattered as in *Oneirodes* (DD), or absent as in all other oneirodids examined (DD*).

A similarity matrix, based on the percentage of total number of characters shared in the same state, regardless of whether the states are primitive or derived, is presented in Table 24. The greatest phenetic similarity is found between *Danaphryne* and *Microlophichthys*, and between *Dolopichthys* and *Bertella*, each pair sharing 87 percent of their characters in the same state. *Oneirodes* is most similar to *Dana phryne* sharing 83 percent of their characters in the same state. *Leptacanthichthys* is most similar to *Dolopichthys* (80 percent). *Chaenophryne* is most similar to *Leptacanthichthys* (70 percent), and *Pentherichthys* is most similar to *Chaenophryne* (67 percent). *Lophodolos* has the greatest phenetic similarity with *Microlophichthys* (63 percent) and the least with *Oneirodes* and

TABLE 24

Similarity matrix of nine genera of Oneirodidae based on the total number of characters shared in the same state regardless of whether the states are primitive or derived. Absolute values on the right, percentage on the left

		<i>Microlophichthys</i>	<i>Leptacanthichthys</i>		<i>Chaenophryne</i>	<i>Pentherichthys</i>			
<i>Oneirodes</i>		25	23	19	17	16	17	16	14
<i>Danaphryne</i>	83		26	22	20	20	20	18	18
<i>Microlophichthys</i>	77	87		22	23	23	20	18	19
<i>Leptacanthichthys</i>	63	73	73		24	22	21	18	15
<i>Dolopichthys</i>	57	67	77	80		26	19	18	14
<i>Bertella</i>	53	67	77	73	87		18	19	15
<i>Chaenophryne</i>	57	67	67	70	63	60		20	16
<i>Pentherichthys</i>	53	60	60	60	60	63	67		15
<i>Lophodolos</i>	47	60	63	50	47	50	53	50	

Dolopichthys (47 percent). The phenetic similarities among the nine oneirodid genera, based on the osteological character states discussed above, are illustrated in the form of a dendrogram (Fig. 103).

A hypothetical phylogeny for the nine genera was constructed on the basis of shared patterns of advanced character states. Each level in the phylogeny (Fig. 104) represents the maximum number of shared advanced character states for the maximum number of taxa. For example, all nine genera share one advanced character state (DD); *Leptacanthichthys*, *Dolopichthys*, and *Bertella*, in addi-

tion to sharing advanced character states **DDRBBDD*YAAOCC**, all share advanced character states DEG. A hypothetical oneirodid ancestor with all 30 characters in the primitive state is indicated at the base of the phylogeny.

For comparison of the nine genera with respect to evolutionary specialization the following numbers are assigned to the character states: 0 = lower case letter, 1 = capital letter, 2 = capital letter starred, 3 = capital letter double starred. The maximum index of specialization is 38. The actual total for the taxa are: *Oneirodes* 8, *Danaphryne* 11, *Microlophichthys* 12, ***Leptacanthichthys*** 13, *Dolopichthys* 17, *Bertella* 17, *Chaenophryne* 12, ***Pentherichthys*** 16, *Lophodolos* 23. The length of the line between any two levels in the phylogeny (Fig. 104) corresponds to the degree of evolutionary specialization found between those two levels. For example, the distance from the base of the phylogeny to YAA is six units long, equalling the sum of the values of evolutionary specialization assigned to advanced character states **DDRBBDD*YAA**.

Evolution within the family Oneirodidae, as deduced from the comparative osteological examination of nine of the 13 known genera appears to be characterized by several morphological trends. Most obvious is a tendency toward elongation and depression of the bones of the jaws, palatine arch, and cranium, accompanied by a shortening of the hyoid arch, a widening and deepening of the illicial trough, and an anterior movement and flattening of the frontal bones. Other evolutionary trends in-

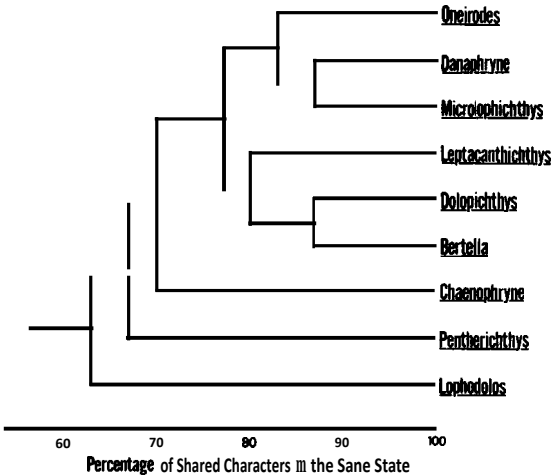


FIGURE 103. Dendrogram showing phenetic similarities of nine genera of Oneirodidae. The length of each line indicates the percentage of character states not shared between related genera.

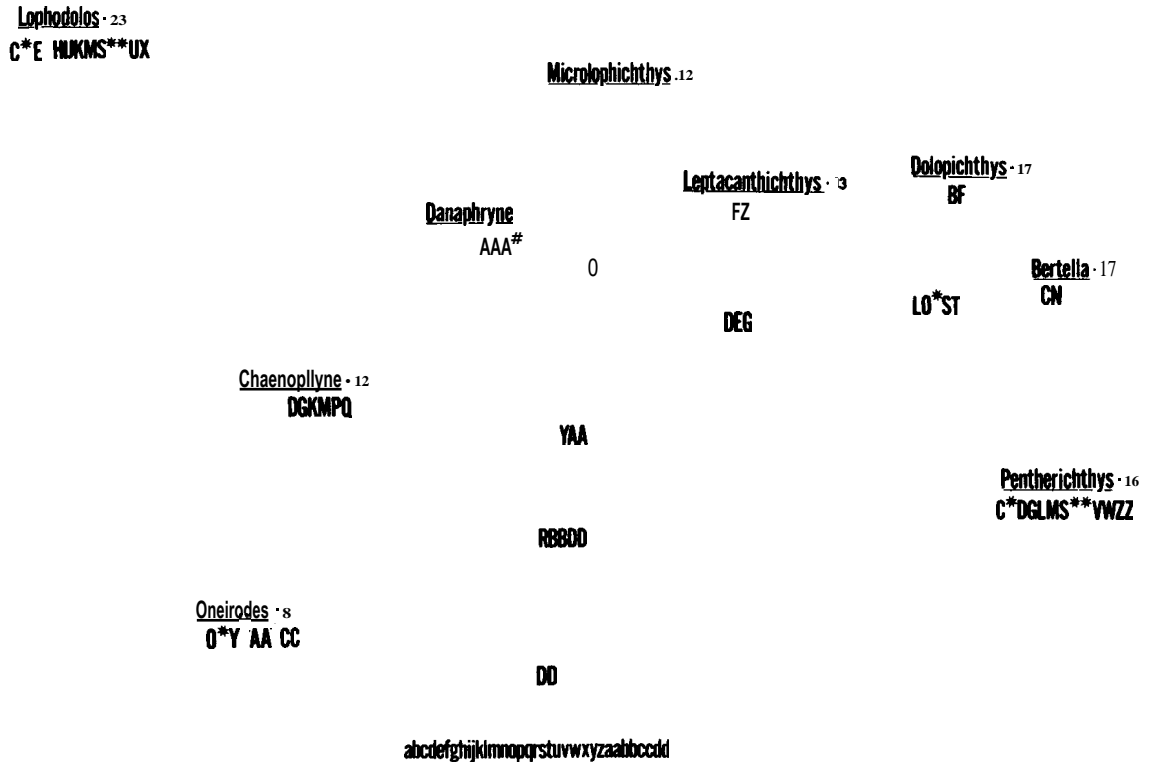


FIGURE 104. Proposed phylogenetic relationships of nine genera of Oneirodidae. Each level in the phylogeny represents the maximum number of shared advanced characters states for the maximum number of taxa. See text for details.

dude elongation of the pectoral-fin lobe, a loss of certain bony parts, particularly in the branchial arches, and, although not as well defined, a tendency toward fewer but larger pharyngeal, vomerine, and jaw teeth. The genus *Oneirodes* lies near the base of these evolutionary trends. It is considered to be the least derived of the group, being close to the ancestral stock which gave rise to the family Oneirodidae. Evolution within the genus *Oneirodes* (and within *Dolopichthys*; Pietsch 1972c) in some ways parallels the trends found within the family. *Oneirodes luetkeni* and closely related forms such as *O. carlsbergi*, having relatively shorter, deeper skulls, frontal bones placed further posterior, teeth on the first epibranchial, and high numbers of vomerine and jaw teeth, are considered to be the least derived members of the genus. In fact (and as foreseen by Gregory 1933: 404, Fig. 277), *O. luetkeni* appears to be most like the ancestor that gave rise to the entire family Oneirodidae. Members of the *O. schmidti*-group, lying at the opposite end of these morphological trends, are considered to be the most derived forms of the genus. Phylogenetic relationships of *Onei-*

rodes species are discussed at greater length below (p. 89).

Danaphryne and *Microlophichthys* are clearly related phylogenetically, and although specialized in several ways, both are phylogenetically close to *Oneirodes*. They both lack skin spines, a posteroventral process of the coracoid, and pharyngobranchial of the first arch, three character states retained by *Oneirodes*. *Microlophichthys* differs from *Danaphryne* most strikingly in the absence of a second hypobranchial and a greatly reduced second pharyngobranchial.

Leptacanthichthys appears in many ways intermediate between *Microlophichthys* and *Dolopichthys*, especially in the length and depth of the skull, the shape of the ethmoid cartilage, supraethmoid, symphyial cartilage, suboperculum, and the length and shape of the frontal bones. *Leptacanthichthys*, however, is not without its own specializations, the narrow, elongate pectoral fin lobe of which is most striking.

Bartella and especially *Dolopichthys* represent the extreme condition in the trends toward elongation and depression of the cranium and facial bones,

elongation of the jaws, and anterior displacement and flattening of the frontal bones. These two genera have a reduced pharyngobranchial II (a character state not found in any other genus), and lack a hypobranchial of the second arch (as does *Microlophichthys*). *Bertella* differs from *Dolopichthys* most strikingly in having a single-headed hyomandibular bone. Whereas the second pharyngobranchial is reduced and bears few teeth in *Dolopichthys*, this element is further reduced and lacks teeth in *Bertella*.

Chaenophryne is unique in several ways and does not appear to be phylogenetically closely related to any other oneirodid genus. Derived character states found only in *Chaenophryne* include the absence of sphenotic spines, a slightly concave posterior opercular margin, and a sigmoid-shaped preoperculum. The **tri-radiate** pelvic bones of *Chaenophryne* form an interesting link to the ceratioid family Himantolophidae for which pelvic bones of this shape were previously thought to be diagnostic.

Although phenetically similar to *Chaenophryne* (67 percent of their characters in the same state), *Pentherichthys* shows little close phylogenetic relationship with any genus. *Pentherichthys* represents the extreme condition in the trend toward a widening and deepening of the illicial trough. Derived character states unique to *Pentherichthys* include internally pigmented caudal fin rays, and a depressed pterygiophore of the illicium; the absence of both vomerine teeth and a second pharyngobranchial is shared with *Lophodolos*.

Lophodolos is the most derived genus of the family. It is extremely specialized in many ways and, although having the greatest phenetic similarity with *Microlophichthys* (63 percent of their characters in the same state), shows little resemblance to any other oneirodid. Whereas many bones of the skull have been reduced or lost (frontals, ethmoid cartilage, first ray of the dorsal fin reduced; pterosphenoid, pharyngobranchial II, vomerine teeth lost), other elements have become enlarged (lateral ethmoids, sphenotic and symphyseal spines). Other derived character states include the following: dorsal margin of frontals concave, frontal in contact with the respective prootic, hypobranchials II (as well as hypobranchials III) approaching each other on the midline ventral to basibranchial II.

Four of the 13 genera included in the family Oneirodidae are known from only one or two adolescent female specimens and thus could not be examined osteologically. These are: *Phyllorhinichthys*, *Tyrannophryne*, *Chirophryne*, and *Ctenochirichthys*. Upon superficial examination the first of

these appears to be **most** similar to *Oneirodes*, *Danaphryne*, and *Microlophichthys*, being rather deep-bodied and having similarly shaped frontal and opercular bones. The pectoral-fin lobe of *Phyllorhinichthys* is considerably shorter and broader than that of other oneirodid genera (Pietsch, 1972b: 337, Fig. 4). Except for its markedly elongate jaws, *Tyrannophryne* resembles *Microlophichthys*, especially in the shape of the opercular bones and esca (Bertelsen, 1951:93, Fig. 48). *Chirophryne* and *Ctenochirichthys* seem to be phylogenetically closely related to *Leptacanthichthys*. These three forms share a peculiarly modified pectoral-fin lobe which is unique among the Ceratioidei (see p. 29; Fig. 55).

Interspecific Relationships of *Oneirodes*

Osteological variation within the genus *Oneirodes* is known from an examination of cleared and stained specimens of six species: *O. luetkeni*, *O. acanthias*, *O. notius*, *O. eschrichtii*, *O. bulbosus*, and *O. basili*. This variation, described above (p. 15), in addition to externally evident characters known for all species of the genus, may be summarized as follows:

1. Shape and position of the supraethmoid. A Y-shaped supraethmoid is considered to be the primitive state, a T-shaped supraethmoid a derived state, and a T-shaped supraethmoid displaced dorsally by the ethmoid cartilage represents a secondarily derived state.

2. Position of the frontal bones. The frontals occupy a posterior position in the primitive state, an anterior position in a derived state.

3. Shape of orbital foramina. The orbital foramina are circular in the primitive state and oval in a derived state.

4. Pharyngobranchial II. This element is toothed in the primitive state, toothless in the derived state.

5. Vomerine teeth. Vomerine teeth are numerous in the primitive state, few in the derived state.

6. Dentary teeth. These are numerous in the primitive state, few in the derived state.

7. Epibranchial I. This element bears teeth in the primitive state; teeth are absent in the derived state.

8. Escal appendage pattern. The escae of all known species of *Oneirodes* fall into one of three escal-appendage patterns that correspond to three character states (p. 35, Fig. 60). Appendage pattern A is considered the primitive state, pattern B and pattern C are derived states.

Of the six species examined in detail (cleared and stained specimens), *O. luetkeni* is primitive in seven of the above eight characters (1235678),

whereas *O. basili* of the *O. schmidti*-group shows the derived states of the same seven characters. *Oneirodes acanthias*, *O. notius*, *O. eschrichtii*, and *O. bulbosus* are primitive in one (4) and derived in four characters (1238).

With regards to characters 5-8, *O. luetkeni* is primitive in all four, *O. carlsbergi* and *O. rosenblatti* are each primitive in three (567 and 568, respectively), and all other species of the genus *Oneirodes*, with few exceptions (see below, p. 90), are derived in all four characters.

On the basis of this character analysis the 23 described species of the genus are divided into three groups. The first of these includes the least derived members of the genus, *O. luetkeni*, *O. carlsbergi*, and *O. rosenblatti*. *O. luetkeni* has retained the greatest number of primitive character states and appears to be most like the ancestral form which gave rise to the genus *Oneirodes*. *Oneirodes carlsbergi* is phylogenetically most closely related to *O. luetkeni*, representing an intermediate between the latter and *O. rosenblatti* in the reduction of the number of epibranchial teeth, in the length of the lower jaw, premaxillary and illicium, and in the ratio between the lengths of the upper and lower forks of the operculum. The basic esca appendage pattern of *O. carlsbergi* differs from that of *O. luetkeni* and *O. rosenblatti*, and in this feature it is intermediate between the members of this primitive group and the more derived forms included in the third group discussed below.

The second group, considered to be the most derived, includes the forms assigned to the *O.*

schmidti-group. Sample sizes of the four included species are inadequate to make meaningful statements concerning intra-group relationships.

The remaining 16 species constitute an assemblage of forms, the inter-relationships of which are difficult to assess. Within this group the esca morphology is by far the most important taxonomic character; in most cases it is essential for correct identification. On the basis of this character alone, *O. acanthias*, *O. thompsoni*, and *O. notius* are similar and most probably closely related. Similarly, *O. heteronema* and *O. macrosteus* seem related, as do *O. eschrichtii*, *O. bulbosus*, and *O. anisacanthus*, the latter perhaps representing an intermediate between *O. eschrichtii* and *O. kreiffi*. Within and between these subgroups morphological differences are few and small, such that no meaningful statements concerning relationships can be made. *Oneirodes cristatus* is unique in having the lowest pectoral fin-ray count of any species. *Oneirodes bradburyae* and *O. dicromisichus* are specialized in having a considerably longer illicium than any other form. *Oneirodes dicromisichus* is further specialized in having low values for head, premaxillary, and lower-jaw length, and head depth, but primitive in having high jaw and vomerine-tooth counts, comparable to those of *O. luetkeni*.

Of the remaining four species, *O. flagellifer*, *O. myrionemus*, and *O. macronema* are each represented by only one to three specimens; *O. melano-cauda* is known only from larvae. Consequently, nothing can be said concerning their affinity with other species of the genus.

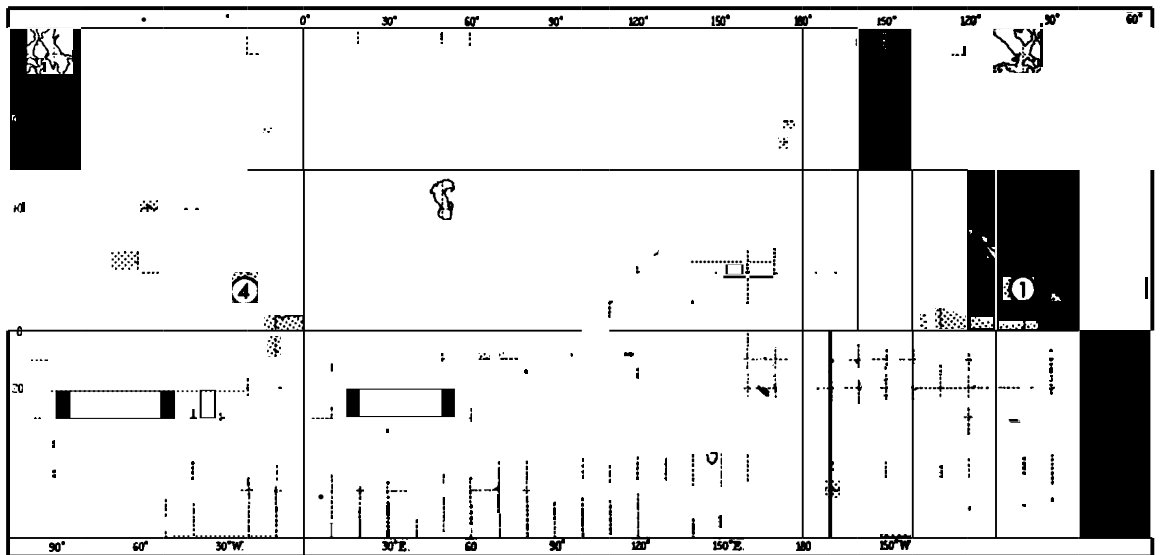


FIGURE 105. Known distribution of the genus *Oneirodes* showing the number of sympatric species in each area.

DISTRIBUTION

The genus *Oneirodes* is found in the more productive waters of all three major oceans of the world in a broad belt between approximately 60°N and 65°S (Fig. 105). It is present in the Gulfs of Aden, California, and Mexico, and the Caribbean Sea; but, like all other ceratioids, it is absent from the Mediterranean Sea (Bertelsen, 1951:223). Contrary to Bertelsen's (1951:223) prediction that "the majority of the ceratioid species will be found distributed in all the oceans," the species of *Oneirodes* are not cosmopolitan, but for the most part restricted geographically into oceanic areas defined by distinct physico-chemical and biological parameters.

Since the majority of collections of *Oneirodes* were made with nonclosing nets, the actual depth of capture is unknown. Furthermore, because sample sizes are small for most species a statistical treatment of the nonclosing net data is impossible (exceptions are *O. luetkeni* and *O. acanthias*, pp. 39, 65). However, ceratioids are relatively rare; therefore, the chance that most specimens are caught at depths where gear is fished for the longest period of time is great. Thus, vertical distributions estimated with reference to the maximum depth reached by gear for each capture seem justifiable: members of the genus *Oneirodes* may be taken anywhere between 300 and 3000 m, but they are commonly found between roughly 800 and 1500 m. Although some vertical separation of species in areas of high sympatry (for example, the eastern tropical Pacific) may exist, horizontally sympatric forms overlap in vertical range wherever they are found. There is no indication that species of *Oneirodes* undergo any vertical diel migration.

Distribution Relative to Water Masses

For each species of *Oneirodes*, localities of capture were plotted on charts which indicate the horizontal extents of the various water masses (Figs. 106-111). Eleven of the 23 recognized species of the genus are so poorly represented that the boundaries of their distributions are unknown; these are not dealt with further. For the 12 remaining species, *O. luetkeni*, *O. carlsbergi*, *O. rosenblatti*, *O. eschrichtii*, *O. bulbosus*, *O. anisacanthus*, *O. acanthias*, *O. notius*, *O. thornpsoni*, *O. macrosteus*, and *O. heteronema*, horizontal ranges, and to a lesser extent, vertical ranges are known with some confidence. Nine of these 12 species are limited to a single water mass; three cross one or more water mass boundaries. The known vertical and hori-

zontal distributions relative to water masses of these 12 better known forms are discussed below.

Species limited to a single water mass.-Most of these occur in the north and eastern Pacific Ocean where they inhabit four types of water masses, Subarctic, Transitional, Equatorial, and Subantarctic. The productively poor central water masses of the Pacific are avoided. Only the relatively rich eastern and western margins of the Atlantic central water masses are inhabited by *Oneirodes*.

Oneirodes thornpsoni and *O. bulbosus* occur sympatrically in Pacific Subarctic Water, including the Alaska Central Water (Alaskan Gyre) and Bering Sea (Western Gyre). Neither form extends southward into the Transitional Water of the California Current (Figs. 106, 109). These species apparently occupy the same depths, occurring between 500 and 1500 m with peaks at 700 and 1000 m.

Oneirodes acanthias, *O. basili*, and the southern California population of *O. eschrichtii* are found only in the mixed Transition Water of the eastern North Pacific off the coasts of California and Baja California (Figs. 107, 109, 111). Vertically, *O. acanthias* appears to be concentrated between 500 and 1250 m (Table 18). Data are insufficient to make meaningful inferences concerning the vertical ranges of *O. basili* and the southern California population of *O. eschrichtii*.

Oneirodes luetkeni, *O. rosenblatti*, and *O. heteronema* (except for a single record) are confined to the more productive eastern part of the Pacific Equatorial Water Mass (Figs. 106, 108, 110). Vertically, these forms are all sympatric between 750 and 2000 m. *Oneirodes luetkeni* ranges between 350 and 2000 m with peaks at about 500 and 1250 m; *O. rosenblatti* appears to inhabit slightly deeper strata, between 700 and 3000 m with a single peak at 1500 m; and *O. heteronema* occurs between 500 and 2000 m with a single peak at 1250m.

Oneirodes notius inhabits Subantarctic Water of both Pacific and Atlantic sectors of the Southern Ocean (Fig. 106) between 700 and 2000 m with a single peak of concentration at roughly 1000 m.

Extending north into the region of mixing between North Atlantic Central and Arctic Intermediate Water masses (Ebeling, 1962:145), *O. macrosteus* occurs in the western part of the North Atlantic Central Water Mass (Fig. 110). Vertically, this species is found between approximately 1000 and 1500 m.

Species that cross water mass boundaries.-*Oneirodes anisacanthus* inhabits the relatively productive eastern and western margins of the North

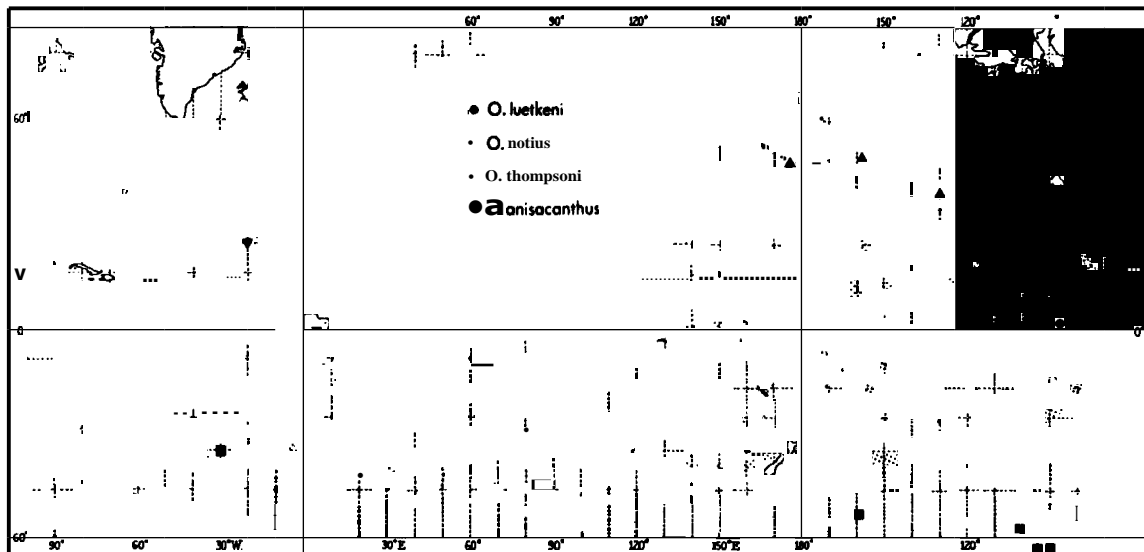


FIGURE 106. Distributions of four species of *Oneirodes*. Horizontal extents of water masses taken from Sverdrup et al., 1960.

Atlantic Central Water Mass, extending southward into the gulf of Guinea (Fig. 106). Two other species commonly occur in and on both sides of the transition zone between the North and South Atlantic Water masses: *O. carlsbergi*, which in addition, is found in the eastern half of the Pacific Equatorial Water and Indonesian waters (Fig. 107), and *O. eschrichtii*. The latter has a broad distribution (Fig. 110) inhabiting (in addition to the more productive areas of the North and South Atlantic

masses) the Transition Zone of the California Current (southern California population), the Pacific Equatorial and the waters off Chile, the Indonesian and Indian Equatorial Water masses, and the western margin of the **Pacific** Subarctic Water Mass (a single record). Vertically, these three forms are all sympatric over a wide range between 600 and 2000 m. *O. carlsbergi* has the widest vertical range between 100 and 2000 m with its greatest concentration at roughly 300 m. *O. anisacanthus* appears

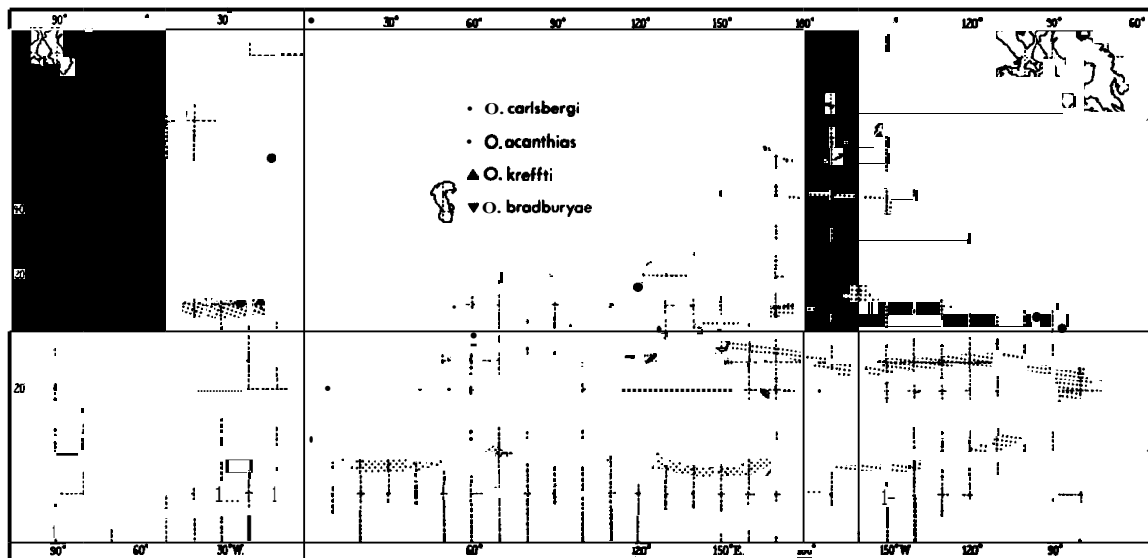


FIGURE 107. Distributions of four species of *Oneirodes*. Horizontal extents of water masses taken from Sverdrup et al., 1960.

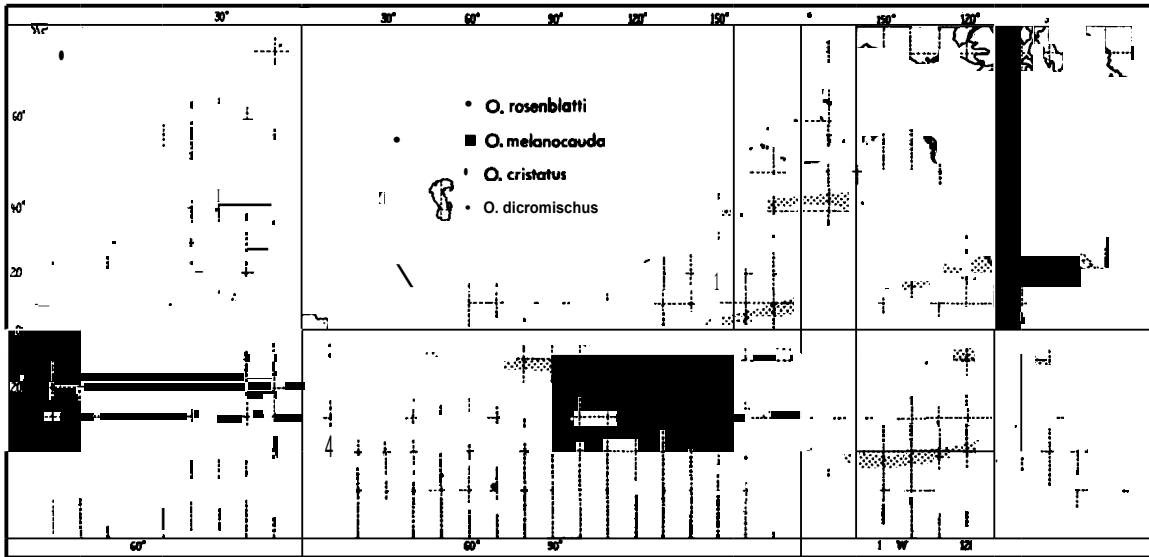


FIGURE 108. Distributions of four species of *Oneirodes*. Horizontal extents of water masses taken from Sverdrup et al., 1960.

evenly distributed between 600 and 2000 m. The *O. eschrichtii* from the eastern tropical Atlantic were taken between 350 and 2000 m.

The distribution of *O. carlsbergi* in the Atlantic might be better explained if reference is made to the 200-m isotherm for 14°C (Schroeder, 1963; Backus et al., 1965, 1970) which appears to be a better indication of the meeting of the North and South Atlantic Central Water masses than given by Sverdrup et al. (1960). This boundary runs from

the coast of Africa at about 20°N west-southward to British Guiana. Although *O. anisacanthus* and *O. eschrichtii* commonly occur on both sides of this boundary, *O. carlsbergi* does not, and is thus limited (in the Atlantic) to the South Atlantic Central Water Mass. *Oneirodes anisacanthus* and *O. eschrichtii*, however, generally occupy deeper strata than *O. carlsbergi* (see above, p. 92), and thus may cross the boundary of the North and South Atlantic Central Water masses at depths

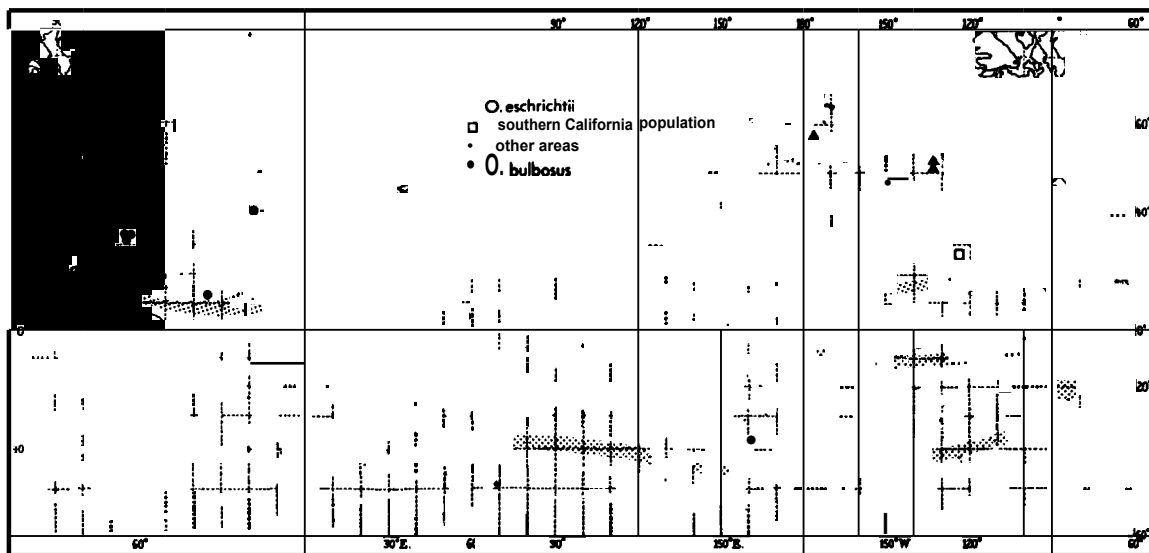


FIGURE 109. Distributions of two species of *Oneirodes*. Horizontal extents of water masses taken from Sverdrup et al., 1960.

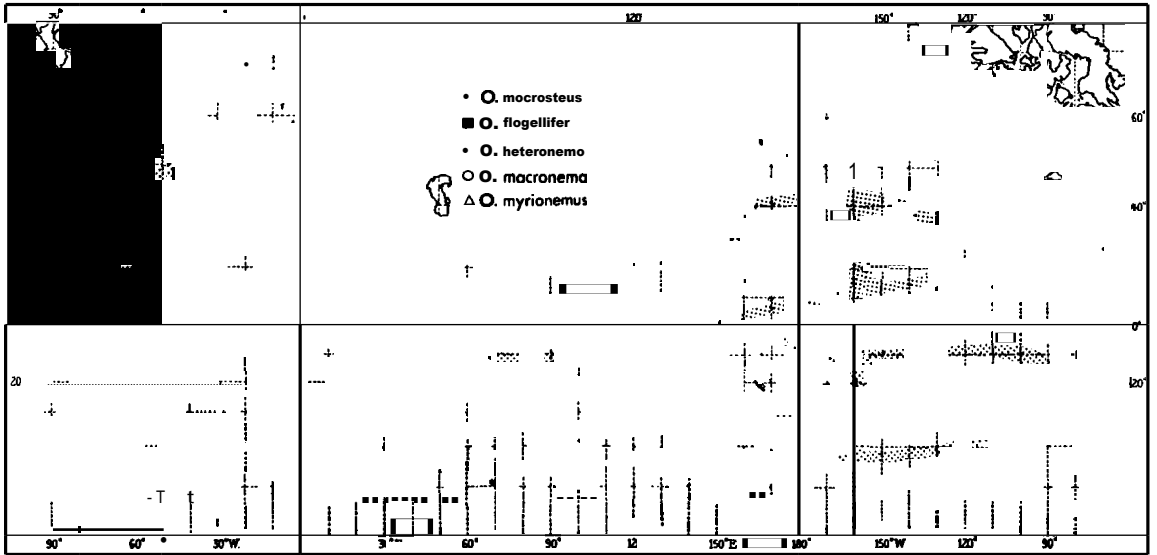


FIGURE 110. Distributions of five species of *Oneirodes*. Horizontal extents of water masses taken from Sverdrup et al., 1960.

where physico-chemical differences between these waters are appreciably less.

In general, the distribution of the genus *Oneirodes* follows the contours of organic productivity (Fig. 105; Ebeling, 1962:146, Fig. 72) only rarely occurring in waters of low productivity. At the present time, the water mass concept (suggesting that the ranges of pelagic animals conform to the water masses as defined by their temperature-salinity relationships) is sufficient to explain the

distributions of species of *Oneirodes*. Most members of the genus appear limited to a discrete water mass; in some cases, departing from this pattern at great depths where water mass boundaries become weak. In summary, the distributional patterns exhibited by species of *Oneirodes* are similar to those of many other groups of mid-water organisms, thus conforming to zoogeographic regions proposed by Ebeling (1962), Baird (1971), and others.

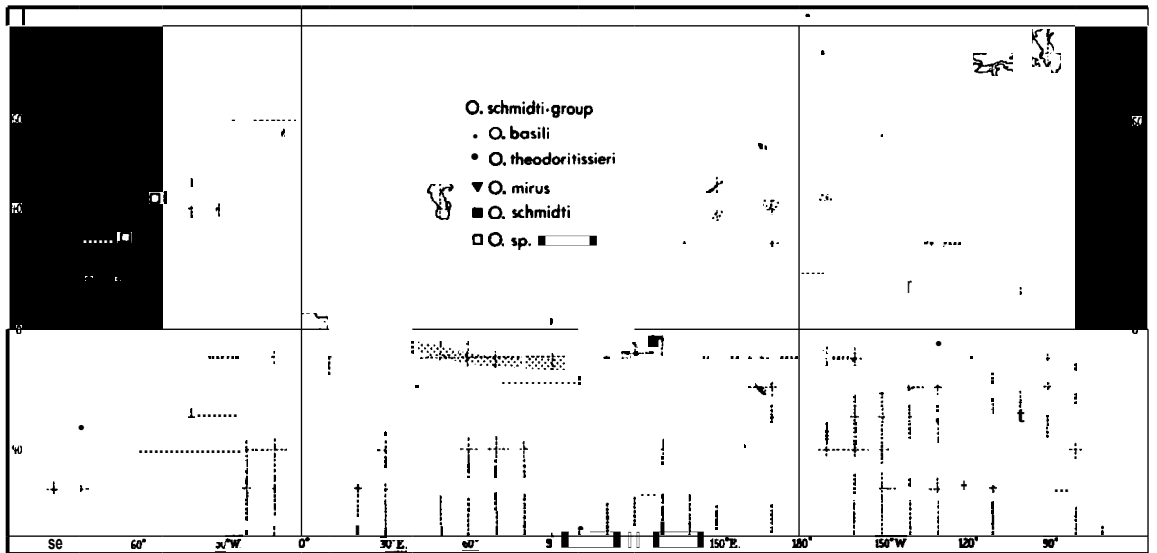


FIGURE 111. Distributions of members of the *Oneirodes schmidti*-group. Horizontal extents of water masses taken from Sverdrup et al., 1960.

Ontogenetic Distribution

As is characteristic of many midwater fishes, ceratioids pass through their entire larval development in the relatively rich, sunlit waters of the upper 200 m.

. . . metamorphosis leads to a rapid descent, the small metamorphosis stages and youngest adolescents most frequently occur in 2000 to 2500 m. The metamorphosing or metamorphosed males are most frequent at about 2000 m depth, where probably there is the greatest chance of meeting the mature females. According to the early development of the testes those males that encounter such a specific companion will probably spawn during the next spawning season. The females seek after metamorphosis somewhat lesser depths and are now most numerous between 1500 and 2000 m below the surface. According to their growth rate, which at least in the first six months after metamorphosis is very slow, the females take more than one, presumably several, years to reach maturity. When this approaches, they again move downwards and have when mature their greatest frequency probably at fully 2000 m like the free-living adolescent or adult males. (Bertelsen, 1951: 220.)

At all stages in their life cycle, ceratioids, especially the more globose representatives such as *Oneirodes*, are incapable of any prolonged horizontal locomotion and are to a considerable extent passively transported along by water movements. The movements of water masses, and current gyres which help form and maintain these water masses, are important in the integration and concentration of populations of midwater organisms (Ebeling, 1962). Most species of *Oneirodes*, despite their planktonic nature (Parin, 1970:24), occupy a restricted horizontal range. Since, in their ontogenetic vertical migration, these organisms frequently pass through shallow and deep currents flowing in opposite directions, these horizontal ranges may be maintained, or, for that matter, altered through regulating their vertical migration (Hardy and Gunther, 1935; Ebeling, 1962).

Anton Bruun (1958), accounting for the restricted distribution of the deep-sea anglerfish, *Borophryne apogon*, in the Gulf of Panama, described a cycle in which larvae are carried westward, away from the Gulf, by the shallow, equatorial current, and metamorphosis stages and adolescents seeking deeper layers, are returned by the

deeper, eastward flowing countercurrent. This hypothesis may explain the unusually high concentration and high degree of endemism of ceratioids in the eastern tropical Pacific as well as in the eastern tropical Atlantic. These two regions have yielded most of the specimens of *Oneirodes* and support the greatest number of sympatric species (Fig. 106).

Mackintosh (1937:411) and Moore (1958:228) noted that the limits of distribution of species of the Antarctic Ocean may be controlled by vertical migrations between surface water, which has a northward-moving component of flow, and southward-moving deep water. In the case of many antarctic midwater fishes with epipelagic larval stages, it is probable that shallow currents carry eggs and larvae into lower latitudes, and deeper water movements return adolescents and adults to higher latitudes. The ontogenetic vertical migration of *O. notius* in the Pacific sector of the Antarctic Ocean, associated with the shallow and deep waters flowing in opposite directions in this area, explains the direct relationship between standard length of this species and latitude (Fig. 112). According to Richard F. McGinnis (personal communication) at least 16 Antarctic myctophids show this size-latitude distribution, the juveniles occupying areas considerably north of conspecific adult populations. In an analogous way, this cyclic system may explain how ceratioid larvae can be restricted to the warmer parts of the oceans between approximately 40°N and 35°S (Bertelsen 1951: 224-225, Fig. 139) yet large females, some of which are gravid (e.g., *O. macrosteus*, *O. eschrichtii*, pp. 62-49; and *Himantolophus groenlandicus*, Bertelsen, 1951:26), are found well outside these limits in the north Atlantic.

Thus, each distribution appears to be "dependent

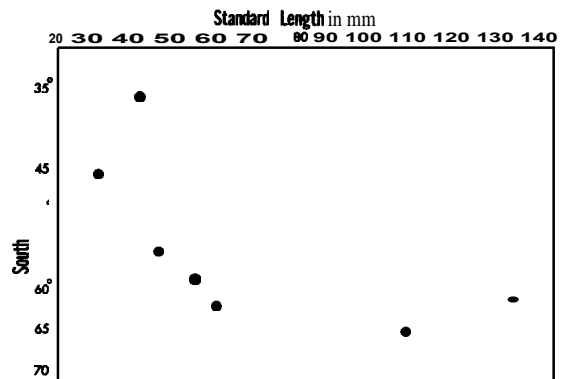


FIGURE 112. Relationship of standard length and latitude of capture of *Oneirodes notius* from the Pacific sector of the Southern Ocean. See text.

upon a system of circulation, either an oceanic gyral or a current with associated countercurrents. These maintain both the water masses and the distribution" of the physico-chemical parameters that relate to oceanic planktonic distributions (Brinton, 1962:198). The life cycles of geographically restricted forms (such as *O. acanthias*, endemic to the transitional water of the California Current) must be finely tuned to the dynamics of the waters in which they live.

STRUCTURE AND FUNCTION OF THE CERATIOID ESCA

The terminal light-organ of the illicium of deep-sea anglerfishes is a conspicuous and structurally complicated organ which is the essential part of a presumably highly efficient luring apparatus, unique to the Ceratioidei. Appropriately, this organ is termed the esca, a Latin word meaning bait (Garman, 1899; Waterman, 1939; Bertelsen, 1951; and

others). Although the external morphology of the esca shows considerable diversification throughout the suborder, the internal structure appears similar in all ceratioids examined. Histological studies of escae have been made by Brauer (1908), Dahlgren (1928), Bertelsen (1951), Hulet and Musil (1968), and most recently by O'Day (1972). O'Day described the esca of *O. acanthias* as consisting of the following elements: 1) a thin outer epithelium; 2) a thick layer of connective tissue perforated by nerve fibers, which gives the esca its characteristic shape; 3) a layer of dark pigment; 4) a layer of reflective tissue; 5) tubules lined with glandular cells and continuous with the central lumen; 6) blood vessels; 7) a central lumen containing bacteria and communicating with the external environment by means of a pore (Fig. 113).

That the luminescence of anglerfishes involves symbiotic bacteria has been confirmed by O'Day (1972). He described the bacteria of the esca of *O. acanthias* (Fig. 114) as Gram-negative rods, having a double-layered cell wall, but lacking capsules, spores, and flagella. These bacteria were cultured in seawater nutrient broth and agar, but were not seen to luminesce.

In addition to the bioluminescent capacity of the esca, the organ is apparently sensitive to touch. Waterman (1948) found that the illicium of *Gigantactis* is innervated by two large nerves, a branch of the superficial ophthalmic of the trigeminal and a branch of the first spinal nerve. Although both nerves extend out to the esca, the latter, in addition, provides all the innervation to the five pairs of muscles which control movement of the illicial apparatus (Waterman, 1948; Bertelsen, 1951:17). Personal examination of *Oneirodes* confirmed Waterman's (1948) description of *Gigantactis*, and further showed that terminally these nerves split up into a number of small fibers which send branches into all the appendages, filaments, and papillae of the esca. Thus, the ceratioid esca is capable of: 1) attracting other organisms through its bioluminescence and external embellishment of appendages and filaments, 2) detecting the close presence of other organisms through its nervous supply and 3) a wide range of movement by the muscles which insert on the bones of the illicial apparatus.

Parr (1927:4) was the first to recognize the diagnostic value of the external escal morphology in ceratioid fishes, pointing out the need for a closer examination of individual variation in the structure of this organ. Since that time differences in the escal morphology have been, for the most part, the sole basis on which new forms have been described.

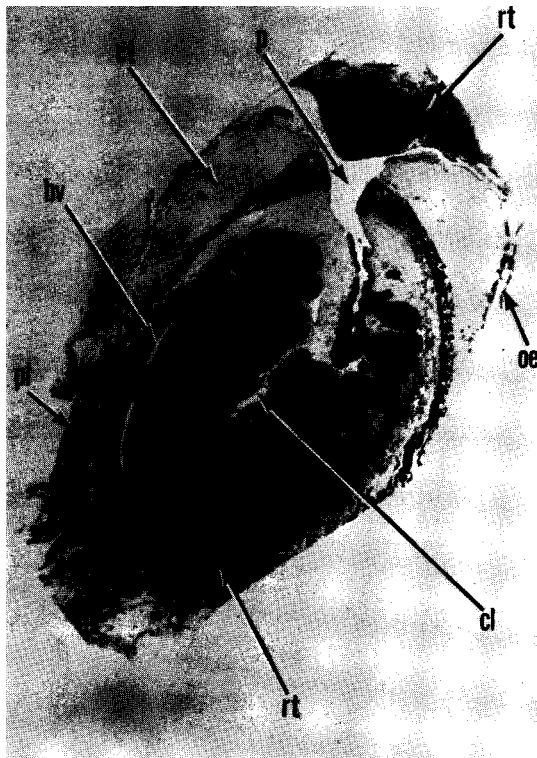


FIGURE 113. Photomicrograph of cross-section through esca bulb of *Oneirodes acanthias*. bv = blood vessel; cl = central lumen containing bacteria; ct = connective tissue; oe = outer epithelium; p = pore; pl = pigment layer; rt = reflective tissue. Courtesy of William T. O'Day.

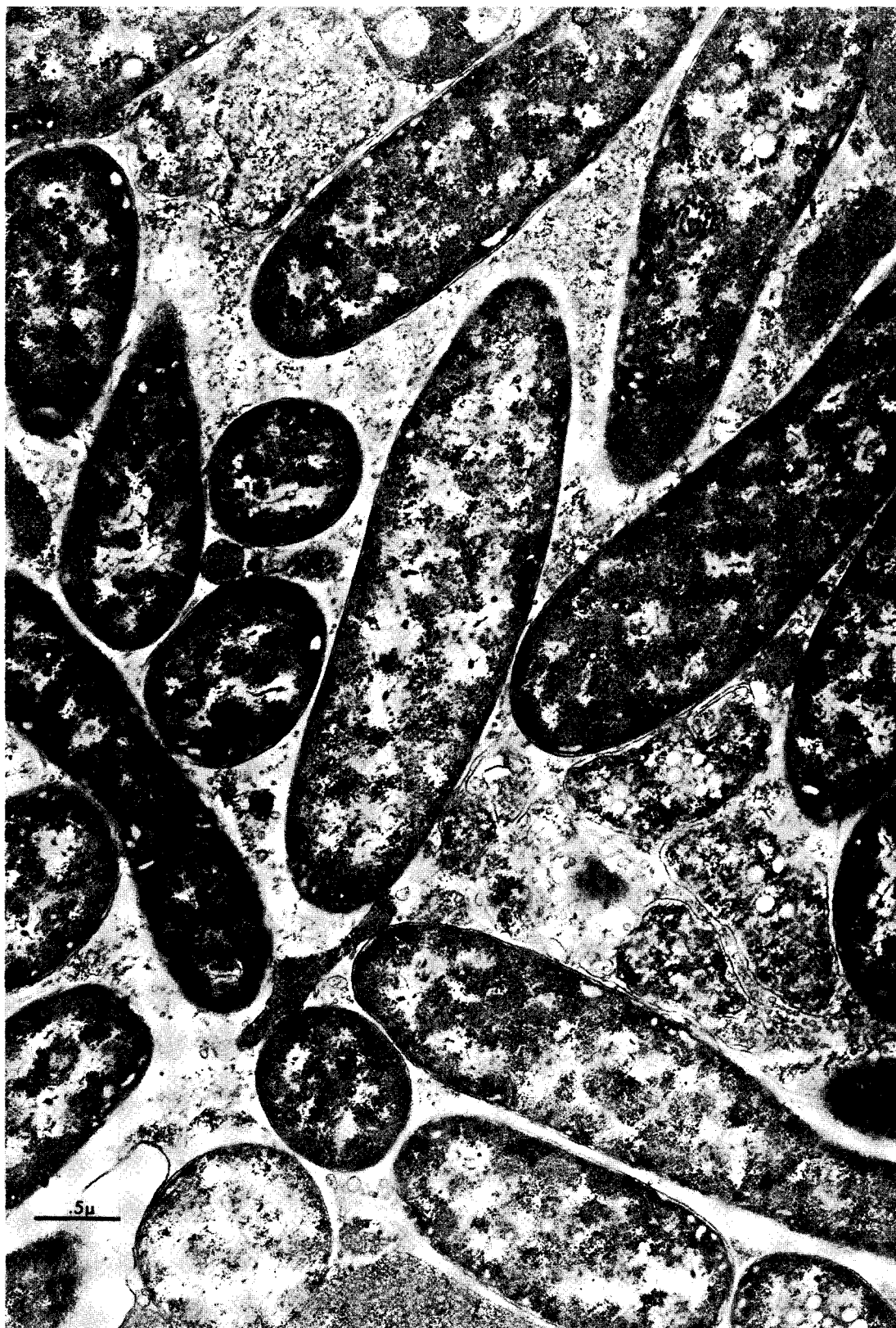


FIGURE 114. Electron micrograph of cross-section through central lumen of escal bulb of *Oneirodes acanthias* showing bacteria. X28, 800. Courtesy of William T. O'Day.

It now appears that the Oneirodidae may attain the form of the adult when quite small, and that in this family specimens only 15 to 20 mm long may show a definite and characteristic structure of the illicium. Although we cannot be sure that specimens that differ only in slight details of the illicium are specifically distinct, and we do not like basing new species on single specimens 15 mm in total length, we consider that to give specific names freely is probably the best way to describe the material now available. (Regan and Trewavas, 1932:3-4.)

Forty-four oneirodids were thus introduced as new to science, more than half of which were based on one or two adolescent female specimens less than 25 mm SL (many of Regan and Trewavas's, 1932, figures of escae are inaccurate and should not be referred to).

Although used without caution by some workers in the past, the escal morphology is of great diagnostic value. Without exception, the shape, arrangement and relative length of filaments and appendages of the escal bulb separate all presently known species of the genus *Oneirodes*.

Figure 115 shows the escae and latitudinal ranges of species of *Oneirodes* from the eastern Pacific Ocean. This diagram indicates the kinds and degrees of differences in escal morphology found in the genus. It can be seen that the esca of each species is morphologically unique. Further, the degree of difference between escae appears greater among sympatric species than between allopatric forms. For example, in the north Pacific the esca of *O. thompsoni* is considerably more similar to that of *O. acanthias* (to which it is probably most closely related) off southern California than to the esca of its sympatric congener, *O. bulbosus*. The same points can be made for the four species from the Gulf of Panama and the species of *Oneirodes* in the Atlantic Ocean. It is, therefore, reasonable to conclude that 1) the escae of *Oneirodes* are morphologically species-specific, and 2) the maintenance of a certain degree of morphological difference between escae is most likely essential, especially among sympatric forms.

There are at least two functions attributable to the ceratioid esca. The first of these is one for which lophiiforms are well-known: the attraction of prey. In a general way, the escae of deep-sea lophiiforms seem to mimic small luminescent organisms. Lütken (1872:334), in describing the esca of *O. eschrichtii*, wrote, "I am, of course, not in a position to indicate the purpose of this singular

structure; but I will not conceal that the whole arrangement has above all produced a 'mimetic' impression upon me, . . ." Garman (1899:81) made a similar statement in his description of *Dolopichthys allector*, "The escae evidently simulates the appearance of certain prey." By being morphologically different (by mimicking different kinds of organisms), the esca of closely related forms (such as species of *Oneirodes*) may attract different kinds of prey, and in so doing, split up the food resource. In this way, closely related sympatric forms with similar needs may avoid competition for food. However, analysis of stomach contents of all available material of *Oneirodes* revealed no differences between species in the kinds of prey taken (stomachs contained a diverse array of organisms including chaetognaths, amphipods, copepods, squid, and various kinds of fishes; see also Bertelsen 1951:241). Nevertheless, sample sizes of each species examined were small; differences in diet may be shown by a more detailed statistical analysis of stomach contents of larger samples.

A second possible function of the esca, and an explanation for its species-specificity, is one that has been previously suggested by several authors (Bertelsen, 1951:249; Munk, 1964, 1966; Marshall, 1971a:45, 49, 1971b:218): the attraction of a species-specific male. Most male ceratioids, unlike most other deep-dwelling midwater fishes, have well-developed eyes (Munk, 1964, 1966; Marshall, 1971a:45, 47). In addition, the olfactory organs of most ceratioid males are extremely large in relation to their body size (Marshall, 1967). It seems probable that a species-specific chemical communicant excreted by the female is the initial stimulus for the male to begin his search for a mate (Bertelsen, 1951:249). At close range the species-specific escal morphology may be the necessary behavioral cue required before the male (in forms in which the males apparently attach only for a short time, as well as in those in which the sexes become permanently attached) will attach to the female and undergo subsequent spawning. Such a dual mechanism for sexual encounter and intraspecific sex discrimination would prevent wastage of gametes in an environment which is vast and dark, and where population densities of forms with restricted activities are low. Absence of hermaphroditism among ceratioids may reflect the effectiveness of the reproductive strategies employed by them.

Assuming that the esca acts as a lure, it would be highly susceptible to loss or damage by the attacks and nibblings of potential prey as well as predators; and if the species-specificity of the esca is essential as a cue for intraspecific sex discrimina-

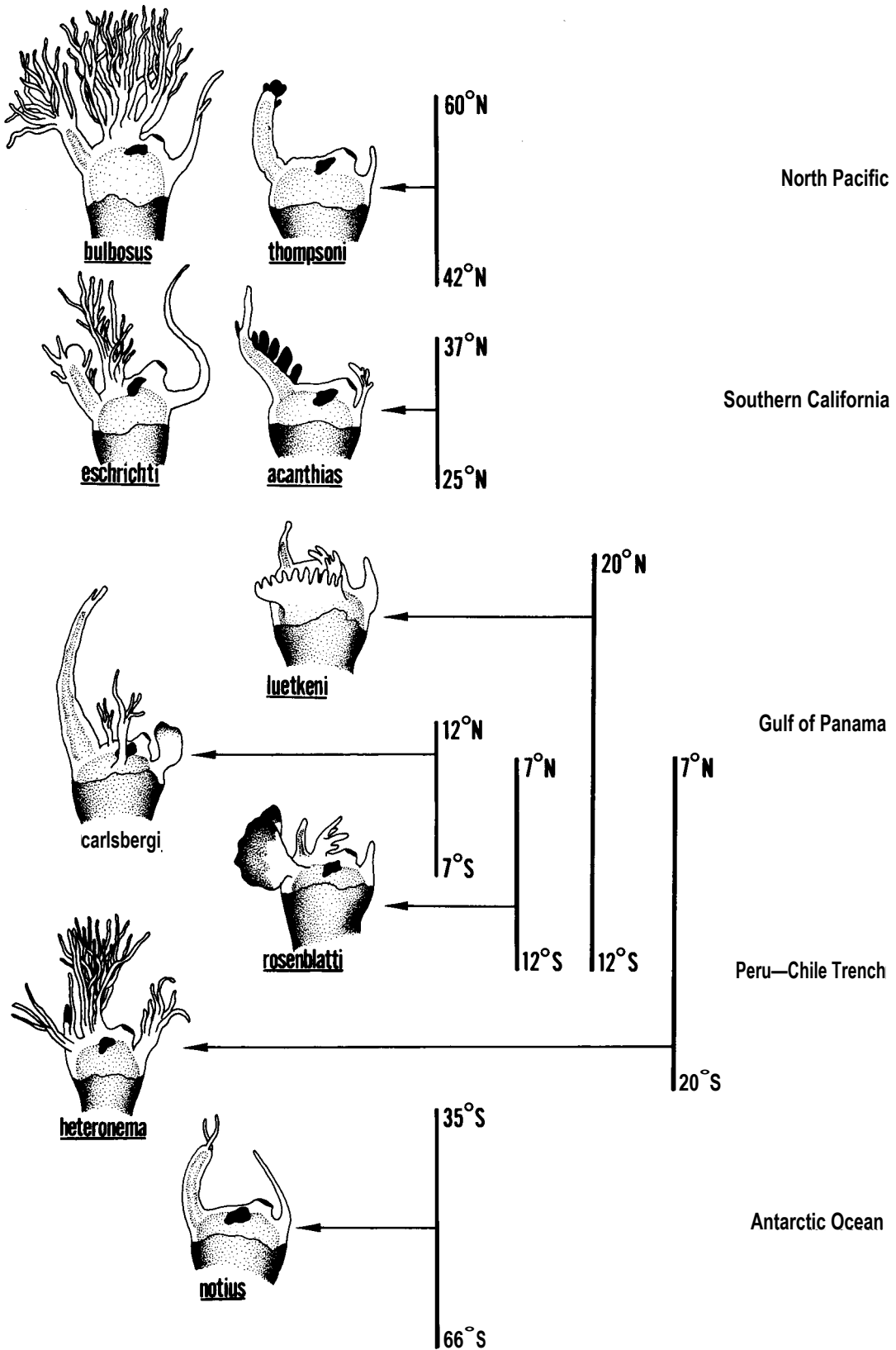


FIGURE 115. Escae and latitudinal ranges of nine species of *Oneirodes* from the eastern Pacific Ocean.

tion, some mechanism for the maintenance of this specificity would be extremely advantageous. The possibility that these fishes may be capable of regenerating lost parts or entire escae was considered. Although present throughout the whole animal kingdom, the ability to regenerate lost parts differs both in the extent to which, and in the process by which, it occurs in various animal groups. In teleost fishes regeneration is, with some exceptions, restricted to the replacement of scales and fins (Bryant, 1970). Thus, the esca of anglerfishes, being part of a modified dorsal-fin ray, may very well regenerate. Some evidence that lost escae are regenerated in *Lophius piscatorius* was given by Wilson (1937). Finally, the escae of a number of mature specimens of *Oneirodes* examined in the course of this study appear to have been damaged or lost and were possibly in the process of regeneration when captured (Fig. 116).

For support of a hypothesis regarding esca regeneration, experiments were conducted on shallow-water representatives of the lophiiform suborder Antennarioidei. Several individuals of *Antennatus bigibbus* and a single specimen of *Antennarius sanguineus* were kept in a 60 gallon, closed-system, polyethylene tank, and maintained

on a diet of goldfish (*Carassius auratus*). Escae were surgically removed, after which regenerating escae were drawn on the live fish as several intervals with the aid of a Wild M-5 Camera Lucida. Preliminary results show that not only does the complete esca regenerate, but the regenerated esca is morphologically similar to the original, intact esca. It is reasonable to assume that deep-sea anglerfishes, like their shallow-water relatives, also have the ability to regenerate their escae, and thus maintain the species-specific lure which presumably is of prime importance to their survival.

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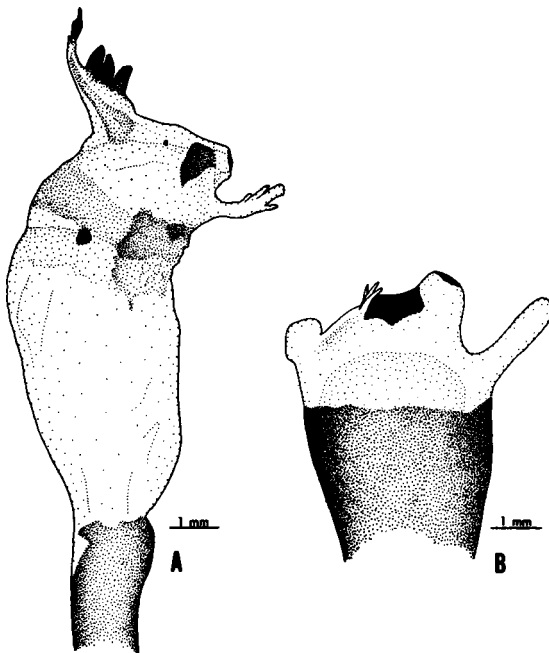


FIGURE 116. Escae appearing to have been damaged or lost and possibly in the process of regeneration prior to capture: A. *Oneirodes acanthias*, LACM 30404-2, 119.0 mm SL; B. *Oneirodes eschrichtii*, SIO 70-339, 121.0 mm SL.

Leslie Knapp, Smithsonian Oceanographic Sorting Center, Washington, D.C.; Erik G. Barham, Naval Undersea Research and Development Center, San Diego; James E. Böhlke, The Academy of Natural Sciences, Philadelphia; Bruce H. Robison, Stanford University and Woods Hole Oceanographic Institution; J. Guibé and M. L. Bauchot, Musée National d'Histoire Naturelle, Paris; R. Duguay, Musées d'Histoire Naturelle et d'Ethnographie, La Rochelle; and Gerard Belloc, Musée Océanographique de Monaco.

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APPENDIX A

List of Material Examined

Oneirodes luetkeni

Holotype of *Oneirodes luetkeni*: ZMUC P9287, 123.0 mm; DANA Station 1203(10); 7°30'N, 79°19'W; 3500 m wire; bottom depth 2550 m; 1500 hr; 1 November 1922.

Syntypes of *Dolopichthys heteracanthus*: BMNH 1925.8.11.10, 28.5 mm; DANA Station 1205(2); 6°49'N, 80°25'W; 1000 m wire; 0420 hr; 14 December 1922. BMNH 1925.8.11.11, 18.0 mm; DANA Station 1208(8); 6°48'N, 80°33'W; 1500 m wire; 0810 hr; 16 December 1922.

Additional non-type material: ZMUC P92167-68, 2(14.0-60.0 mm); DANA Station 1203(13). ZMUC P92174-75, 2(20.0-49.0 mm); DANA Station 1206(2). ZMUC P92180-81, 2(17.5-44.0 mm); DANA Station 3548(3). ZMUC P92170-73, 4(27.0-41.0 mm); DANA Station 1203(14). ZMUC P92177, 27.0 mm; DANA Station 1208(8). ZMUC P92178, 25.0 mm; DANA Station 1209(3). ZMUC P92179, 16.5 mm; DANA Station 3548(2). ZMUC P92169, 14.5 mm; DANA Station 1203(12). ZMUC P92176, 11.5 mm; DANA Station 1208(6).

IOM uncatalogued (the following were all taken on Cruise 4 of the AKADEMIK KURCHATOV with a 10-ft IKMT unless otherwise indicated): 95.0 mm; Station 229, Sample 81; 12°20'S, 81°42'W; 0-500 m; 0400-0600 hr; 7 September 1968. 45.0 mm; Station 307, Sample 249; 2°02'S, 82°30'W; 0-1000 m; 0045-0335 hr; 8 November 1968. 2(21.0-43.0 mm); Station 283, Sample 209; 8°11'S, 80°39'W; 0-500 m; 2020-2210 hr; 28 October 1968. 31.0 mm; Station 284, Sample 210; 8°13'S, 80°22'W; 0-500 m; 2215-0010 hr; 28-29 October 1968. 20.0 mm; Station 282, Sample 208; 8°06'S, 80°51'W; 0-1500 m; 1450-1700 hr; 28 October 1968. 15.0 mm; LYRA Eastern Pacific Cruise, Sample 10; 5°37'N, 93°58'W; 0-900 m; 2100-0130 hr; 20-21 November 1965. 13.0 mm; BAIKAL Cruise 3, Sample 104; 5°52'N, 90°01'W; conical ring net, 160 cm diameter, 0-1000 m; 1432-1445 hr; 6 November 1967.

LACM 31801-1, 2(38.0-61.0 mm); ANTON BRUUN Cruise 16, Station 645-B; 7°43'S, 80°26'W; otter trawl/midwater, 0-765 m; bottom depth 775-770 m; 7 June 1966. LACM 31110-1, 2(45.0-60.0 mm); VELERO IV Station 13740; 17°54'N, 103°36'W; 10-ft IKMT, 0-1070 m; bottom depth 3200-2835 m; 1051-1515 hr; 15 January 1970. LACM 31802-1, 42.0 mm; ANTON BRUUN Cruise 16, Station 656-Q; 11°52'S, 78°24'W; 10-ft IKMT, 0-900 m; bottom depth 2400 m; 13 June 1966. LACM 32613-1, 20.0 mm; TE VEGA Cruise 20, Station 16-B; 3°46'S, 85°37'W; 6-ft modified Tucker Trawl with closing device, 1000-1250 m. LACM 31118-1, 15.0 mm; VELERO IV Station 13759; 20°21'N, 106°10'W; 10-ft IKMT, 0-1310 m; bottom depth 2268-3292 m; 0607-1215 hr; 19 January 1970.

NYZS 6011, 22.0 mm; ARCTURUS Oceanographic Expedition Station 74, OT-4; 4°50'N, 87°00'W; 0-1143 m; 30 May 1925. NYZS 5944, 14.0 mm; ARCTURUS Oceanographic Expedition Station 74, PT-3; 4°50'N, 87°00'W; 0-1134 m; 27 May 1925. NYZS 28247, 14.0 mm; Eastern Pacific ZACA Expedition Station 210, T-1; 9°12'N, 85°05'W; 0-540 m; 7 February 1938.

NYZS 28768, 3(12.5-13.5 mm); Eastern Pacific ZACA Expedition Station 219, T-1; 8°08'N, 83°17'W; 0-540 m; 10 March 1938.

SIO 65-608, 36.0 mm; 11°52'S, **79°01'W**; 24 November 1965. **SIO** 70-386, 34.0 mm; ANTON BRUUN Cruise 18B, Station 765C; 4°06'S, 81°24'W; 10-ft IKMT, 0-1900 m; 9 September 1966. **SIO** 61-503, 32.0 mm; Step I Expedition Station 9; 7°32'S, 82°56'W; 0-333 m; 0243-0316 hr; 10 October 1960.

BMNH 1932.5.3.16, 16.5 mm; DANA Station 3550(6).

Oneirodes carlsbergi

Lectotype of *Oneirodes carlsbergi*: ZMUC P9285, 40.0 mm; DANA Station 1206(7); 6°40'N, 80°47'W; 1200 m wire; 0350 hr; 15 January 1922.

Paralectotypes of *Oneirodes carlsbergi*: BMNH 1930.1.12.1079, 37.0 mm; DISCOVERY; 13°25'N, 18°22'W; 4.5 m net, 0-900 m; 28 October 1925. BMNH 1925.8.11.9, 30.5 mm; DANA Station 1208(16); 6°48'N, 80°33'W; 2100 m wire; 1715 hr; 16 January 1922. BMNH 1932.5.3.15, 21.0 mm; DANA Station 3730(1); 16°55'N, 120°02.5'E; 1000 m wire; 2245 hr; 15 June 1929.

ZMUC P92163, 19.5 mm; DANA Station 3556(1); 2°52'N, 87°38'W; 2500 m wire; bottom depth 2285 m; 1530 hr; 14 September 1928. ZMUC P92162, 19.0 mm; DANA Station 1165(8); 12°11'N, 35°49'W; 3000 m wire; 0800 hr; 9 November 1921.

Holotype of *Dolopichthys inimicus*: BMNH 1934.8.8.90, 22.0 mm; Commercial Trawler DYNEVOR CASTLE; 53°15'N, 12°28'W; 0-320 m; July 1934.

Additional non-type material: ISH 394/66, 3 (25.0-107.0 mm); WALTHER HERWIG Cruise 15, Station 182; 10°46'N, 23°54'W; 0-300 m; bottom depth 5300 m; 2100-2320 hr; 16 May 1966. ISH 2478/71, 86.0 mm; WALTHER HERWIG 482 111/71; 4°38'N, 19°41'W; CMBT-1600, 0-756 m; 2112-2307 hr; 13 April 1971. ISH 660/66, 85.0 mm; WALTHER HERWIG Cruise 15, Station 187; 5°34'S, 26°58'W; 0-360 m; bottom depth 5660 m 2000-2315 hr; 20 May 1966. ISH 924/68, 63.0 mm; WALTHER HERWIG Cruise 23, Station 16 Haul I; 3°00'S, 26°16'W; 0-2000 m; 1915-1945 hr; 3 February 1968. ISH 2729/71. 52.5 mm; WALTHER HERWIG 494/71; 14°05'N, 23°12'W; CMBT-1600, 0-1900 m; 1942-2253 hr; 16 April 1971. ISH 988/68, 23.5 mm; WALTHER HERWIG Cruise 23, Station 18, Haul I; 5°58'S, 26°52'W; 0-120 m; 2030-2045 hr; 4 February 1968.

SIO 55-246, 62.0 mm; HORIZON; 5°00'N, 78°09'W; 10-ft IKMT, 0-1436 m; 2050-0100 hr; 14-15 November 1955. **SIO** 60-245, 23.0 mm; Tethys Expedition trawl 20' 12°07'N, 148°35'W; 0-2100 m; 9-10 July 1960. **SIO** 60-239, 23.0 mm; Tethys Expedition; 4°56'N, 142°54'W; 0-2500 m; 6 July 1960.

ZMUC P92182, 159.0 mm; DANA Station 1160(2).

NIO uncatalogued, 38.0 mm; DISCOVERY II Station 6662-12; 17°34'N, 25°26'W; RMT 8/5, 690-900 m; 15 February 1968. NIO uncatalogued, 22.5 mm; DISCOVERY II Station 7089-45; 17°49'N, 25°26'W; RMT 8/5, 690-800 m; 20 November 1969.

CAS 63714, 70.0 mm; ALBATROSS Station 4742; 0°04'S, **117°07'W**; 8-ft. Agassiz beam trawl, benthic; bottom depth 4243 m; 1239 hr; 15 February 1904.

UMML 30267, 27.0 mm; PILLSBURY Station 295; **0°25'N**, 5°09'E; 10-ft IKMT, 0-850 m; bottom depth 3730 m; 23 May 1965.

IOM uncatalogued, 21.5 mm; BAIKAL Cruise 3, Sample 125; 6°27'N, 96°49'W; 10-ft IKMT, 0-250 m; 0400-0730 hr; 12 November 1967.

LACM 10100, 18.0 mm; USNS ELTANIN Cruise 3, Station 34; **7°45'S**, 81°37'W; 10-ft IKMT, 0-683 m; bottom depth 4941-5051 m; 0215-0530 hr; 7 June 1962.

Oneirodes eschrichtii from areas other than southern California

Holotype of *Oneirodes eschrichtii*: ZMUC 64, 153.0 mm; west coast of Greenland.

Holotype of *Oneirodes megaceros*: NMI SR497, 61.0 mm; 51°02'N, 11°36'W; 0-1454 m; 10 September 1907.

Holotype of *Dermatias platynogaster*: USNM 70269, 134.0 mm; ALBATROSS Station 5463; 13°40'N, 123°57'E; beam trawl, 0-549 m.

Holotype of *Dolopichthys obtusus*: BOC 2028, 13.0 mm; PAWNEE Station 59; 32°19'N, 64°32'W; 8000 ft wire; 21 April 1927.

Holotype of *Dolopichthys tentaculatus*: USNM 170945 (originally NYZS 23170), 13.5 mm; Bermuda Oceanographic Expedition Station 1271; 0-1097 m; 7 September 1931.

Holotype of *Dolopichthys* (subgenus *Dermatias*) *digitatus*: ZMUC P9272, 21.0 mm; DANA Station 3768(1); 1°20'S, 138°42'E; 4000 m wire; 1340 hr; 24 July 1929.

Holotype of *Dolopichthys* (subgenus *Dermatias*) *simplex*: ZMUC P9279, 26.0 mm; DANA Station 4005(2); 13°31'S, 18°03'W; 3500 m wire; 1145 hr; 12 March 1930.

Holotype of *Dolopichthys* (subgenus *Dermatias*) *pollicifer*: ZMUC P9277, 11.5 mm; DANA Station 1208(4); 6°48'N, 80°33'W; 3500 m wire; 0810 hr; 16 January 1922.

Holotype of *Dolopichthys* (subgenus *Dermatias*) *diadematus*: ZMUC P9271, 11.0 mm; DANA Station 3996(2); 15°41'S, 5°50'W; 3000 m wire; bottom depth 3620 m; 1800 hr; 25 February 1930.

Holotype of *Dolopichthys* (subgenus *Dermatias*) *brevifilis*: ZMUC P9268, 14.0 mm; DANA Station 1209(2); 7°15'N, 78°54'W; 3000 m wire; 1845 hr; 17 January 1922.

Holotype of *Dolopichthys* (subgenus *Dermatias*) *pennatus*: ZMUC P9275, 58.0 mm; DANA Station 1165(8); 12°11'N, 35°49'W; 3000 m wire; 0800 hr; 9 November 1921.

Holotype of *Dolopichthys* (subgenus *Dermatias*) *frondosus*: ZMUC P9273, 23.5 mm; DANA Station 4006(1); 15°31'N, 18°05'W; 1000 m wire; bottom depth 2425 m; 1830 hr; 13 March 1930.

Holotype of *Dolopichthys* (subgenus *Dermatias*) *cirrifer*: ZMUC P9269, 29.0 mm; DANA Station 4180(4); 32°56'N, 23°47'W; 3500 m wire; bottom depth 5225 m; 1115 hr; 8 June 1931.

Holotype of *Dolopichthys* (subgenus *Dermatias*) *plumatus*: ZMUC P9276, 10.0 mm; DANA Station 1208(6); 6°48'N, 80°33'W; 2500 m wire; 0810 hr; 16 January 1922.

Holotype of *Dolopichthys* (subgenus *Dermatias*) *pilolus*: ZMUC P9278, 10.5 mm; DANA Station 4009(8); 24°36'N, 17°27'W; 3000 m wire; bottom depth 2425 m; 0700 hr; 18 March 1930.

Holotype of *Dolopichthys* (subgenus *Dermatias*) *multifilis*: ZMUC P9274, 17.5 mm; DANA Station

3686(1); 8°34'N, 119°55'E; 1000 m wire; bottom depth 2725 m; 0045 hr; 6 April 1929.

Lectotype of *Dolopichthys* (subgenus *Dermatias*) *claviger*: ZMUC P9270, 21.5 mm; DANA Station 3556(1); 2°52'N, 87°38'W; 2500 m wire; bottom depth 2285 m; 1530 hr; 14 September 1928.

Paralectotype of *Dolopichthys* (subgenus *Dermatias*) *claviger*: BMNH 1932.5.3.13, 10.5 mm; DANA Station 3558(2); 0°18'S, 99°07'W; 3000 m wire; bottom depth 3360 m; 0830 hr; 18 September 1928.

Paralectotype of *Dolopichthys* (subgenus *Dermatias*) *thysanophorus* hereby designated: ZMUC P9281, 18.5 mm; DANA Station 3686(7); 3500 m wire; bottom depth 2725 m; 0745 hr; 6 April 1929.

Holotype of *Dolopichthys hibernicus*: BMNH 1934.8.8.91, 23.0 mm; Commercial Trawler DYNEVOR CASTLE; 53°15'N, 12°28'W; 0-320 m; July 1934.

Additional non-type material: SIO 70-339, 121.0 mm; Antipodes 4-21; 19°35'N, 122°57'E; 10-ft IKMT, 0-1450 m; 1845-0225 hr; 15-16 September 1970. SIO 65-667, 37.0 mm; ANTON BRUUN Cruise 12, Station 14; 32°48'S, 72°02'W; 10-ft IKMT, 0-750 m; bottom depth 2500 m; 2145-0515 hr; 19-20 December 1965. SIO 59-201, 18.0 mm; Vermillion Sea Expedition; 26°15'N, 110°36'W; 0-1700 m; 21 March 1959. SIO 69-20, 14.0 mm; Circe 20; 6°32'N, 114°16'E; 10-ft IKMT, 3000 m wire; 24 April 1968.

ROM 27277, 213.0 mm; BRANDAL Tow 16; 45°30'N, 47°30'W; Engel trawl, 0-1025 m; 1237-1707 hr; 19 July 1968. ROM 27275, 147.0 mm; BRANDAL Tow 14; 46°00'N, 44°30'W; Engel trawl, 0-1000 m; 1559-1826 hr; 18 July 1968. ROM 27260, 101.0 mm; BRANDAL Tow 9; 49°00'N, 45°00'W; Engel trawl, 0-990 m; 0901-1324 hr; 16 July 1968.

LACM 31483-1, 44.0 mm; CARIDE Cruise 3, Station 150; 00°02'N, 149°32'W; 10-ft IKMT, 0-910 m; 2104 hr; 26 February 1970. LACM 11451-13, 28.0 mm; USNS ELTANIN Cruise 27, Station 1985; 45°14'S, 147°22'E; 10-ft IKMT, 0-3843 m; 0235-0829 hr; 26 February 1967. LACM 32613-3, 22.5 mm; TE VEGA Cruise 20, Station 16-B; 3°46'S, 85°37'W; 6-ft modified Tucker Trawl with closing device, 1000-1250 m.

MCZ 47565, 16.5 mm; ANTON BRUUN Cruise 13, Station 59; 33°47'S, 72°18'W; 10-ft IKMT, 0-1280 m; 0425-0720 hr; 3 February 1966. MCZ 47553, 13.5 mm; ANTON BRUUN Cruise 3, Station 147, Trawl 5, APB 7022; 6°54'N, 59°55'E; 10-ft IKMT with Foxton's Trousers, deep fraction, 150-750 m; 1845-2213 hr; 16 August 1963. MCZ 47551, 11.0 mm; ANTON BRUUN Cruise 3, Station 147, Trawl 5, APB 7020; 6°54'N, 59°55'E; 10-ft IKMT with Foxton's Trousers, shallow fraction, 0-150 m; 1845-2213 hr; 16 August 1963.

ISH 3101/71, 188.0 mm; WALTHER HERWIG 512/71; 32°47'N, 16°24'W; CMBT-1600, 0-1800 m; 1945-2348 hr; 22 April 1971. ISH 2656/71, 26.0 mm; WALTHER HERWIG 490 11/71; 10°52'N, 22°09'W; CMBT-1600, 0-608 m; 2027-2152 hr; 15 April 1971.

MMF 9921, 95.0 mm; stomach of *Aphanopus carbo* off Madeira; 24 October 1956. MMF 14045, 57.0 mm; stomach of *Aphanopus carbo* off Madeira; 16 June 1958.

IOM uncatalogued, 61.0 mm; VITYAZ Cruise 14, Station 2208, Sample 158; 49°29'N, 158°41'E; 1.6 m diameter conical ring net, 0-6200 m; bottom depth 7700 m; 22 June 1953. IOM uncatalogued, 21.0 mm;

VITYAZ Cruise 34, Station 5098, Sample 151; 5°10'S, 139°50'W; 1.6 m diameter conical ring net, 0-3150 m; bottom depth 4332-4360 m; 0918-1235 hr; 25 September 1961.

USNM 207914, 18.5 mm; SANDS, Ocean Acre 9-4N; 31°55'N, 64°16'W; 10-ft IKMT, 0-870 m; 0955-1455 hr; 17 March 1969. USNM 207918, 14.0 mm; SANDS, Ocean Acre 10-IN; 32°00'N, 64°29'W; 10-ft IKMT, 0-925 m; 1418-1940 hr; 1 June 1970.

BMNH 1961.10.5.8, 16.0 mm; DISCOVERY II Station 3473; 40°17'N, 19°56'W; 10-ft IKMT, 0-2000 m; 17 September 1956. BMNH 1939.5.24.1921, 14.5 mm; John Murray Expedition Station 186; Gulf of Aden; 0-952 m.

IFAN uncatalogued, 2(30.0 mm); 15°57'N, 20°39'W; 0-1000 m; bottom depth 3600 m; 17 January 1959.

CAS 43426 (originally NYZS 11005), 13.0 mm; GLADISFEN Station 228; 32°12'N, 64°36'W; 27 June 1929.

Oneirodes eschrichtii southern California population

LACM 31100-1, 71.0 mm; VELERO IV Station 13721; 33°06'N, 118°22'W; 10-ft IKMT, 0-990 m; bottom depth 1152-1353 m; 2320-0530 hr; 18-19 December 1969. LACM 6697-5, 66.0 mm; California Fish and Game; San Diego Trough, west end of Santa Catalina Island. LACM 31663-5, 38.0 mm; VELERO IV Station 8795; Santa Catalina Basin; 10-ft IKMT, 0-800 m; 1115-1433 hr; 18 July 1963. LACM 30020-33, 35.0 mm; VELERO IV Station 11635; 28°08'N, 117°31'W; 10-ft IKMT, 0-700 m; bottom depth 3520-3475 m; 2340-0430 hr; 20 August 1967. LACM 6838-10, 22.0 mm; VELERO IV Station 7273; 33°39'N, 118°31'W; 10-ft IKMT, 0-600 m; bottom depth 838-832 m; 1015-1503 hr; 23 January 1961.

SIO 63-433, 27.0 mm; HORIZON Cruise 6204, Station 100.140; 27°59'N, 124°06'W; 10-ft IKMT, 0-1680 m; bottom depth 4209 m; 1008-1416 hr; 15 April 1962.

Oneirodes bulbosus

Holotype of *Oneirodes bulbosus*: USNM 108149, 57.0 mm; International Fisheries Commission Station 1109C; 53°50'N, 133°54'W; 11 March 1934.

Additional non-type material: (the following were taken by the Fisheries Trawler ADLER with a commercial bottom trawl except where otherwise indicated) ZIL 31-968/9, 109.0 mm; Cruise 5, Haul 4; 55°30'N, 165°53'E; 0-670 m; 1752-1852 hr; 30 July 1964. ZIL 31-968/5, 103.0 mm; Cruise 3, Haul 259/260; 60°18'N, 179°17'W; 0-600 m; 0310-0440 hr; 25 November 1963. ZIL 31-968/14, 2(59.0-98.0 mm); Haul 127; 54°34'N, 167°36'W; 0-720 m; 0055-0230 hr; 26 September 1967. ZIL 31-968, 98.0 mm; Cruise 3, Haul 52; 54°40'N, 167°39'W; 0-850 m; 0230-0330 hr; 7 September 1963. ZIL 31-968/15, 94.0 mm; Haul 15; 49°05'N, 155°36'E; 0-520 m; 2140-2240 hr; 25 July 1967. ZIL 31-968/10, 88.0 mm; Cruise 5, Haul 63; 53°02'N, 180°00'; 0-840 m; 1835-1935 hr; 28 August 1964. ZIL 31-968/16, 2(82.0-91.0 mm); Haul 135; 58°23'N, 177°27'W; 0-700 m; 1720-1835 hr; 28 September 1967. ZIL 31-968/17, 85.0 mm; Haul 59; 51°10'N, 158°28'E; 0-625 m; 1305-1405 hr; 4 August 1967. ZIL 31-968/19, 83.0 mm; Haul 12; 48°42'N, 155°10'E; 0-700 m; 0335-0425 hr; 25 July 1967. ZIL 31-968/8, 82.0 mm; Cruise 5, Haul 42; 53°00'N, 179°49'W; 0-890 m; 0500-0600 hr; 25 August 1964.

ZIL 31-968/4, 78.0 mm; Cruise 3, Haul 47; 54°22'N, 167°33'W; 0-880 m; 1150-1250 hr; 6 September 1963. ZIL 31-968/6, 70.0 mm; Cruise 3, Haul 267/268; 60°00'N, 179°08'W; 0-680 m; 0635-0805 hr; 26 November 1963. ZIL 31-968/2, 64.0 mm; Cruise 2, Haul 323; 54°31'N, 167°37'W; 0-1160 m; 1405-1445 hr; 27 May 1963. ZIL 31-968/7, 57.0 mm; Cruise 2, Haul 14; 55°29'N, 166°02'E; 0-640 m; 0915-1015 hr; 9 March 1963. ZIL 31-968/20, 47.0 mm; Haul 70; 50°19'N, 157°12'E; 0-700 m; 1255-1355 hr; 6 August 1967. ZIL uncatologued, 3(86.0-100.0 mm); Fisheries Trawler OGON Haul 14; 60°46'N, 179°58'W; 0-830 m; 0430-0530 hr; 6 July 1962. ZIL 31-968/12, 3 (65.0-83.0 mm); Fisheries Trawler OGON Haul 178; 54°33'N, 167°35'W; 0-755 m; 1755-1925 hr; 5 January 1964. ZIL 31-968/13, 68.0 mm; Large Refrigerator Fisheries Trawler AKADEMIK BERG Haul 174; 61°21'N, 176°18'E; 0-1020 m; 0702-0802 hr; 8 November 1966.

IOM uncatologued, 96.0 mm; EQUATOR Cruise 3, Haul 47; 54°27'N, 167°22'W; 0-670 m; 2330-0120 hr; 22-23 June 1969. IOM uncatologued, 81.0 mm; Equator Cruise 3; 53°23'N, 163°06'W; 10-ft IKMT, 0-1000 m; 1450-1510 hr; 18 June 1969. IOM uncatologued, 64.0 mm; VITYAZ Cruise 14, Station 2218, Sample 177; 43°48'N, 149°55'W; 1.6 m diameter conical ring net, 0-9000 m; bottom depth 9900 m; 1625-1825 hr; 1-2 July 1953.

UBC 65-623, 47.5 mm; G. B. REED Cruise 65-7; 52°11'N, 133°11'W; Engel trawl 0-597 m; bottom depth 2654 m; 1500 hr; 11 July 1965.

Oneirodes anisacanthus

Lectotype of *Oneirodes anisacanthus*: ZMUC P9267, 27.0 mm; DANA Station 1152(3); 30°17'N, 20°44'W; 3000 m wire; 1930 hr; 22 October 1922.

Additional non-type material: BMNH 1930.1.12, 1080, 22.0 mm; DISCOVERY; 4.5 m net, 0-900 m; 28 October 1925. BMNH 1932.5.3.11, 16.0 mm; DANA Station 1273(6); 17°43'N, 64°56'W; 1200 m wire; 2315 hr; 24 March 1922.

MMF 3101, 173.0 mm; alive on surface outside Câmara de Lobos, Funchal, Madeira; 13 December 1948.

ISH 2730/71, 78.0 mm; WALTHER HERWIG 494/71; 14°05'N, 23°12'W; CMBT-1600, 0-1900 m; 1942-2253 hr; 16 April 1971.

NIO uncatologued, 47.0 mm; DISCOVERY II Station 6662-34; 10°46'N, 19°54'W; RMT 8/5, 900-1040 m; 20 February 1968.

ZMUC P92183, 39.0 mm; DANA Station 4005(1); 13°31'N, 18°03'W; 4000 m wire; bottom depth 2850 m; 1145 hr; 12 March 1930.

UMML 30269, 13.0 mm; PILLSBURY Station 290; 00°18'S, 5°27'E; 10-ft IKMT, 0-600 m; bottom depth 3502 m; 22 May 1965. UMML 454, 10.5 mm; PILLSBURY Station 454; 12°55'N, 72°04'W; 10-ft IKMT, 0-1500 m; bottom depth 1628-1507 m; 27 July 1966.

Oneirodes heteronema

Holotype of *Oneirodes heteronema*: ZMUC P92150, 13.5 mm; DANA Station 1209(4); 7°15'N, 78°54'W; 2000 m wire; 1845 hr; 17 January 1922.

Additional non-type material: IOM uncatologued, 95.0 mm; AKADEMIK KURCHATOV Cruise 4, Station 315, Sample 262; 3°20'N, 81°02'W; 10-ft IKMT,

0-1300 m; bottom depth 3200 m; 0130-0455 hr; 14 November 1968. IOM uncatologued, 65.0 mm; AKADEMIK KURCHATOV Cruise 4, Station 236, Sample 108; 20°00'S, 76°42'W; 10-ft IKMT, 0-500 m; bottom depth 4680 m; 0010-0157 hr; 17 September 1968.

SIO 70-385, 91.0 mm; ANTON BRUUN Cruise 18-B, Station 765B; 4°14'S, 81°26'W; 10-ft IKMT, 0-1830 m; 8 September 1966. SIO 70-386, 44.0 mm; ANTON BRUUN Cruise 18-B, Station 765C; 4°06'S, 81°24'W; 10-ft IKMT, 0-1900 m; 9 September 1966.

LACM 32613-2, 14.0 mm; TE VEGA Cruise 20, Station 16-B; 3°46'S, 85°37'W; 6-ft modified Tucker Trawl with closing device, 1000-1250 m.

Oneirodes cristatus

Lectotype of *Oneirodes cristatus*: ZMUC P9286, 165.0 mm; DANA Station 3676(8); 5°52'S, 131°14'E; 4000 m wire; bottom depth 7120 m; 0145 hr; 23 March 1929.

Paralectotypes of *Oneirodes cristatus*: ZMUC P92164, 20.0 mm; DANA Station 3676(6); 6000 m wire; rest of data as for lectotype.

BMNH 1932.5.3.12, 52.5 mm; DANA station 3739(6); 3°20'N, 123°50'E; 5000 m wire; bottom depth 4475 m; 0700 hr; 2 July 1929.

Oneirodes acanthias

Holotype of *Oneirodes acanthias*: USNM 75825, 33.0 mm; ALBATROSS Station 4428; off Santa Cruz Island; 0-1629 m.

Additional non-type material: (the following were taken by the VELERO IV from the eastern North Pacific Ocean as far west as 126°37'W between 37°48'N and 26°51'N with a 10-ft IKMT unless otherwise indicated) LACM 30403-24, 167.0 mm; Station 12392; 0-1110 m; bottom depth 1682-1664 m; 1100-1530 hr; 11 October 1968. LACM 9825-33, 145.0 mm; Station 11591; 0-1370 m; bottom depth 1646-1792 m; 0552-1342 hr; 27 July 1967. LACM 9773-21, 2(44.0-132.0 mm); Station 11695; 0-860 m; bottom depth 1756-1298 m; 0105-0540 hr; 12 October 1967. LACM 32205-1, 129.0 mm; Station 14369; 0-1350 m; bottom depth 1326-1454 m; 1723-2215 hr; 29 July 1970. LACM 9664-18, 125.0 mm; Station 11525; 0-1200 m; bottom depth 3840-2835 m; 0406-0958 hr; 17 June 1967. LACM 9584-26, 123.0 mm; Station 11259; 0-395 m; bottom depth 3255-3200 m; 1718-2013 hr; 21 October 1966. LACM 9010-32, 121.0 mm; Station 8122; 0-1050 m; bottom depth 1280-1289 m; 1835-2325 hr; 5 September 1962. LACM 30404-2, 119.0 mm; Station 12393; 0-880 m; bottom depth 1810-1920 m; 1648-2149 hr; 11 October 1968. LACM 31921-1, 118.0 mm; Station 14330; 0-1250 m; bottom depth 1646-1829 m; 1139-1705 hr; 26 June 1970. LACM 30141-26, 115.0 mm; Station 12092; 0-750 m; bottom depth 1554-1609 m; 1545-1912 hr; 9 May 1968. LACM 32237-1, 113.0 mm; Station 13451; 0-650 m; 22 October 1969. LACM 32204-1, 112.0 mm; Station 13083; 0-1225 m; bottom depth 2743-3566 m; 0714-1403 hr; 18 June 1969. LACM 9960-4, 2(71.0-110.0 mm); Station 10400; 0-1000 m; bottom depth 1518-1701 m; 0037-0814 hr; 8 March 1965. LACM 30436-15, 110.0 mm; Station 12701; 0-1500 m; bottom depth 2469-1829 m; 1245-1948 hr; 4 February 1969. LACM 31919-1, 2(102.0-110.0 mm); Station 14328; 0-1500

m; bottom depth 1829-1938 m; 0118-0630 hr; 26 June 1970. LACM 31090-1, 110.0 mm; Station 13711; 0-940 m; bottom depth 1262-1234 m; 2235-0340 hr; 17 December 1969. LACM 30401-27, 110.0 mm; Station 12390; 0-1010 m; bottom depth 1920-1829 m; 2335-0530 hr; 10 October 1968. LACM 30600-1, 105.0 mm; Station 12351; 0-320 m; bottom depth 1646-1829 m; 0020-0304 hr; 13 September 1968. LACM 32235-1, 105.0 mm; Station 16126; 0-1250 m; 0803-1450 hr; 22 July 1971. LACM 9059-12, 102.0 mm; Station 8880; 0-1090 m; bottom depth 1682-1756 m; 0706-1305 hr; 21 August 1963. LACM 9676-23, 100.0 mm; Station 11538; 0-1300 m; bottom depth 1829-1189 m; 0045-0903 hr; 21 June 1967. LACM 9698-30, 96.0 mm; Station 10840; 0-1430 m; bottom depth 2112-2652 m; 0023-0755 hr; 25 November 1965. LACM 30385-3, 94.0 mm; Station 12842; 0-1220 m; bottom depth 1829-1692 m; 2222-0525 hr; 26-27 March 1969. LACM 6902-37, 92.0 mm; Station 10998; 0-1250 m; bottom depth 1746-1829 m; 1135-1925 hr; 21 February 1966. LACM 9839-5, 87.0 mm; Station 11382; 0-280 m; bottom depth 1582-1801 m; 2107-2318 hr; 7 March 1967. LACM 6514-2, 85.0 mm; Station 8962; 0-800 m; bottom depth 1225 m; 1131-1800 hr; 18 October 1963. LACM 30391-1, 84.0 mm; Station 12848; 0-1250 m; bottom depth 1463-1829 m; 2220-0540 hr; 27-28 March 1969. LACM 9036-2, 2(45.0-80.0 mm); Station 8238; 0-1125 m; bottom depth 1262-1271 m; 0955-1513 hr; 25 October 1962. LACM 9100-1, 79.0 mm; Station 9661; 0-1042 m; bottom depth 1628 m; 0425-1031 hr; 14 May 1964. LACM 9682-42, 2(70.0-75.0 mm); Station 11617; 0-1130 m; bottom depth 1957-2012 m; 1130-1922 hr; 16 August 1967. LACM 9764-15, 75.0 mm; Station 10373; 0-1125 m; bottom depth 1280 m; 1225-1755 hr; 23 February 1965. LACM 9861-40, 73.0 mm; Station 11507; 0-1660 m; bottom depth 1856-2030 m; 2150-0317 hr; 19 May 1967. LACM 9008-8, 70.0 mm; Station 8118; 0-927 m; bottom depth 1244-1271 m; 1224-1716; 4 September 1962. LACM 9706-38, 68.0 mm; Station 11169; 0-1250 m; bottom depth 3932-3566 m; 0715-2028 hr; 31 July 1966. LACM 9620-2, 2(43.0-64.0 mm); Station 10602; 0-1125 m; bottom depth 1244-1234 m; 1218-1938 hr; 8 June 1965. LACM 30191-34, 64.0 mm; Station 12083; 0-600 m; bottom depth 3703-3292 m; 0025-0355 hr; 8 May 1968. LACM 9666-10, 63.0 mm; Station 11527; 0-880 m; bottom depth 4389-3932 m; 1414-2000 hr; 17 June 1967. LACM 9744-6, 60.0 mm; Station 11098; 0-225 m; bottom depth 1810-1792 m; 2002-2148 hr; 14 April 1966. LACM 30518-1, 59.0 mm; Station 10970; 0-1050 m; bottom depth 1207-1280 m; 1227-1920 hr; 12 February 1966. LACM 9723-31, 55.0 mm; Station 10855; 0-1250 m; bottom depth 1244-1326 m; 1205-1900 hr; 4 December 1965. LACM 9585-12, 55.0 mm; Station 10900; 0-575 m; bottom depth 2835-2926 m; 1655-2045 hr; 5 January 1966. LACM 7428, 48.0 mm; Station 8878; 0-1098 m; bottom depth 1710-1682 m; 2010-0211 hr; 20 August 1963. LACM 21499, 48.0 mm; Station 3313; 6-ft ring net, 0-1040 m; bottom depth 1291-1298 m; 0958-1247 hr; 8 March 1955. LACM 6866-9, 47.0 mm; Station 7413; 0-660 m; bottom depth 858-874 m; 2251-0215 hr; 6 September 1961. LACM 9087-28, 46.0 mm; Station 8879; 0-313 m; bottom depth 1692-1756 m; 0246-0625 hr; 21 August 1963. LACM 6881-21, 45.0 mm; Station 8446; 0-650 m; bottom depth 860-870 m; 1241-1545 hr; 18 January 1963. LACM 6559-7, 45.0

mm; Station 8298; 0-290 m; bottom depth 1262-1116 m; 1805-2103 hr; 9 November 1962. LACM 9876-4, 43.0 mm; Station 8697; 0-1000 m; bottom depth 1280 m; 1228-1520 hr; 23 May 1963. LACM 30839-19, 42.0 mm; Station 8346; 0-970 m; 1208-1659 hr; 6 December 1962. LACM 8989-9, 2(40.0-41.0 mm); Station 7905; 0-1278 m; bottom depth 1289-1240 m; 1030-1809 hr; 25 May 1962. LACM 32208-1, 40.0 mm; Station 16108; 6-ft Tucker trawl with closing device, 350 m; 20 July 1971. LACM 30388-1, 38.0 mm; Station 12845; 0-460 m; bottom depth 1692-1829 m; 1315-1515 hr; 27 March 1969. LACM 6546-6, 36.0 mm; Station 8291; 0-562 m; bottom depth 1189-1244 m; 1239-1622 hr; 8 November 1962. LACM 6839-14, 2(30.0-34.0 mm); Station 7279; 0-715 m; bottom depth 845-797 m; 1124-1647 hr; 2 February 1961. LACM 6561-18, 34.0 mm; Station 8295; 0-954 m; bottom depth 1262-1271 m; 0809-1300 hr; 9 November 1962. LACM 6843-4, 2(28.0-33.0 mm); Station 7299; 0-714 m; bottom depth 836-856 m; 1005-1510 hr; 24 February 1961. LACM 9025-16, 33.0 mm; Station 8030; 0-576 m; bottom depth 1216-1079 m; 0018-0345 hr; 9 August 1962. LACM 6694-10, 33.0 mm; Station 9857; 0-729 m; bottom depth 1298 m; 0117-0440 hr; 24 June 1964. LACM 32209-1, 32.0 mm; Station 17020; 0-500 m; bottom depth 823 m; 0020-0152 hr; 29 February 1972. LACM 30389-32, 31.0 mm; Station 12846; 0-530 m; bottom depth 1737-1829 m; 1522-1840 hr; 27 March 1969. LACM 7087, 31.0 mm; Station 8882; 0-900 m; bottom depth 1317-1298 m; 0825-1207 hr; 22 August 1963. LACM 6517-16, 30.0 mm; Station 7415; 0-655 m; bottom 819-838 m; 0616-1100 hr; 7 September 1961. LACM 32206-1, 30.0 mm; Station 16779; 0-700 m; 0434-0753 hr; 9 November 1971. LACM 30022-27, 2(12.0-29.0 mm); Station 11638; 0-570 m; bottom depth 3383 m; 1602-1945 hr; 21 August 1967. LACM 9867-19, 2(21.0-28.0 mm); 0-580 m; bottom depth 1682-1884 m; 0847-1235 hr; 18 May 1967. LACM 6856-6, 28.0 mm; Station 7371; 0-753 m; bottom depth 827-817 m; 1020-1605 hr; 28 June 1961. LACM 31172-1, 27.5 mm; Station 14189; 0-630 m; bottom depth 1280-1829 m; 0603-0918 hr; 28 May 1970. LACM 6503-3, 27.5 mm; Station 7064; 6-ft ring net; bottom depth 869 m; 1214-1445 hr; 1 July 1960. LACM 9621-15, 27.0 mm; Station 10978; 0-530 m; bottom depth 3383-3018 m; 1321-1652 hr; 17 February 1966. LACM 9317-15, 27.0 mm; Station 10608; 0-650 m; bottom depth 1646 m; 2127-0209 hr; 10 June 1965. LACM 30072-16, 27.0 mm; Station 12063; 0-580 m; bottom depth 3109-3146 m; 1804-2121 hr; 11 April 1968. LACM 6844-2, 26.0 mm; Station 7325; 0-640 m; bottom depth 841-817 m; 1129-1420 hr; 9 March 1961. LACM 6857-6, 2(12.0-25.0 mm); Station 7373; 0-710 m; bottom depth 874-849 m; 2150-0131 hr; 28 June 1961. LACM 6863-1, 24.0 mm; Station 7410; 0-750 m; bottom depth 786-768 m; 1227-1510 hr; 6 September 1961. LACM 9009-16, 23.0 mm; Station 8117; 0-650 m; bottom depth 1306 m; 0354-0741 hr; 23 August 1962. LACM 30474-22; 23.0 mm; Station 12138; 0-500 m; bottom depth 2743-2926 m; 0618-0933 hr; 23 June 1968. LACM 9864-6, 23.0 mm; Station 11498; 0-1000 m; bottom depth 1884-1920 m; 1250-1835 hr; 18 May 1967. LACM 9727-37, 22.5 mm; Station 10666; 0-1250 m; bottom depth 3493-3566 m; 1722-2311 hr; 26 August 1965. LACM 30421-15, 22.5 mm; Station 12784; 0-750 m; bottom depth 1792-2469 m; 0540-1112 hr; 15 March 1969. LACM 31548-1,

22.0 mm; Station 14630; 6-ft Tucker trawl with closing device, 550 m; bottom depth 841-860 m; 1210-1550 hr; 21 September 1970. LACM 9669-23, 21.0 mm; Station 11531; 0-625 m; bottom depth 3292 m; 1950-2342 hr; 19 June 1967. LACM 3287, 20.0 mm; Station 8796; 0-685 m; 18 July 1963. LACM 9690-59, 18.0 mm; Station 11625; 0-15 m; bottom depth 2213-2286 m; 2025-2109 hr; 17 August 1967. LACM 30413-27, 3(12.5-17.5 mm); Station 12776; 0-500 m; bottom depth 1463-1554 m; 1515-1830 hr; 12 March 1969. LACM 32207-1, 17.0 mm; Station 16790; 0-1200 m; 1547-2218 hr; 10 November 1971. LACM 9677-21, 16.0 mm; Station 11539; 0-950 m; bottom depth 1009-1646 m; 0915-1540 hr; 21 June 1967. LACM 30394-25, 14.5 mm; Station 12956; 0-810 m; bottom depth 1463-1646 m; 2222-0439 hr; 22-23 April 1969. LACM 9709-23, 14.5 mm; Station 11318; 0-530 m; bottom depth 1224-1097 m; 1704-2039 hr; 27 January 1967. LACM 9701-32, 14.0 mm; Station 10659; 0-1250 m; bottom depth 3658 m; 0240-1108 hr; 25 August 1965. LACM 30977-1, 13.5 mm; Station 13984; 6-ft Tucker trawl with closing device, 650-735 m; bottom depth 1262-1152 m; 0846-1102 hr; 25 February 1970. LACM 30119-14, 13.5 mm; Station 11312; 0-1325 m; bottom depth 4298-3749 m; 1620-0015 hr; 25-26 January 1967. LACM 9498-11, 13.0 mm; Station 9874; 0-312 m; bottom depth 1295-1308 m; 1905-2031 hr; 24 July 1964. LACM 30533-34, 13.0 mm; Station 11885; 0-1050 m; bottom depth 1554-1801 m; 2225-0918 hr; 27-28 January 1968. LACM 30393-23, 13.0 mm; Station 12955; 0-395 m; bottom depth 1554-1646 m; 2024-2204 hr; 22 April 1969. LACM 30608-16, 13.0 mm; Station 12484; 0-940 m; bottom depth 3932-3840 m; 1740-2254 hr; 19 November 1968. LACM 30603-2, 12.5 mm; Station 12466; 0-1220 m; bottom depth 2377-3795 m; 1003-1715 hr; 16 November 1968. LACM 30021-22, 12.5 mm; Station 11636; 0-1220 m; bottom depth 3475-3338 m; 0450-1240 hr; 21 August 1967. LACM 9530-30, 12.5 mm; Station 11258; 0-890 m; bottom depth 3566-3292 m; 1325-1710 hr; 21 October 1966. LACM 30588-1, 12.0 mm; Station 12337; 0-1220 m; bottom depth 1554-1829 m; 0800-1450 hr; 26 August 1968. LACM 32164-1, 11.5 mm; Station 9534; 0-625 m; 1215-1525 hr; 25 March 1964. LACM 31054-1, 11.5 mm; Station 13386; 0-640 m; bottom depth 3402-3656 m; 1210-1600 hr; 28 September 1969. LACM 9494-48, 11.0 mm; Station 11424; 0-800 m; bottom depth 3621-3656 m; 0422-0830 hr; 4 April 1967. LACM 8988-31, 11.0 mm; Station 10540; 0-1500 m; bottom depth 1829-3658 m; 2226-0530 hr; 6-7 May 1965.

SIO 63-423, 94.0 mm; HORIZON; 29°03'N, 126°38'W; 3 April 1962. SIO 67-56, 91.0 mm; THOMAS WASHINGTON MV 67-IA-2; 29°30'N, 117°21'W; 10-ft IKMT, 4000 m wire; 24 April 1967. SIO 67-47, 80.0 mm; THOMAS WASHINGTON MV 67-IA-2; 31°36'N, 117°54'W; 10-ft IKMT; 20 April 1967. SIO 54-123, 70.0 mm; HORIZON, R. L. Wisner and Party; 32°38'N, 117°34'W; 10-ft IKMT, 0-1053 m; 2145-0430 hr; 24-25 August 1954. SIO 66-388, 65.0 mm; San Diego Trough; 6-ft Tucker trawl. SIO 65-193, 54.0 mm; northwest of Cedros Island. SIO 63-413, 52.0 mm; HORIZON 6204, 80.80 MWT, J. McGowan and Party; 33°33'N, 122°35'W; 17 March 1962. SIO 63-869, 38.0 mm; R. L. Wisner and Party; 32°29'N, 117°33'W; 31 October 1963. SIO H51-70, 31.0 mm; HORIZON, L. Kidd and Party; 31 49'N, 117°30'W;

15 March 1951. SIO 63-395, 29.0 mm; 29°46'N, 116°00'W; 23 March 1963. SIO 67-116, 28.0 mm; MV 67-11-23; 37°48'N, 123°50'W. SIO 63-444, 2(12.5-24.5 mm); HORIZON 6204, 120.70; 26°51'N, 117°09'W; 15 April 1962. SIO 63-441, 24.0 mm; HORIZON 6204, 120.45; 27°43'N, 115°32'W; 22 April 1962. SIO 63-346, 22.0 mm; 26°58'N, 115°31'W; 28-29 March 1962. SIO 57-185, 14.5 mm; ORCA, Carl L. Hubbs and Party; 28°52'N, 118°12'W; 6-ft IKMT; 28 October 1957. SIO 66-549, 13.0 mm; 31°56'N, 120°27'W. SIO 69-489, 13.0 mm; 32°28'N, 117°30'W; 10-ft IKMT, 0-1200 m; 13-14 December 1969. SIO 67-61, 12.0 mm; 29°09'N, 118°13'W.

NMFS uncatalogued, 5(16.0-137.5 mm); DAVID STARR JORDAN; 32°01'N, 117°48'W; 0-571 m; 1230-1550 hr; 6 November 1968. NMFS uncatalogued, 45.0 mm; DAVID STARR JORDAN; Santa Catalina Canyon; 0-338 m; 1840-2150 hr; 31 October 1968.

CAS 63575, 42.0 mm; CROCKER-STANFORD Expedition Station 35; 33°15'N, 118°24'W; 3-ft, 7-inch plankton net, 0-967 m; 1002-1435 hr; 18 September 1938. CAS 63867, 40.0 mm; CROCKER-STANFORD Expedition Station 45; 32°49'N, 119°57'W; 3-ft, 7-inch plankton net, 0-967 m; 1610-2113 hr; 19 September 1938.

BMNH 1967.3.5.461, 95.0 mm; TE VEGA Station 567; 33°47'N, 119°40'W; Tucker trawl; 22 October 1966.

Oneirodes thompsoni

Holotype of *Oneirodes thompsoni*: USNM 104495 (originally University of Washington, Department of Fisheries 2890, not 2530 of Schultz, 1934). 33.0 mm; International Fisheries Commission Haul 530; 54°13'N, 159°06'W; 2-m ring net, 0-900 m; 0858 hr; 3 July 1931.

Additional non-type material: (the following were taken by the Fisheries Trawler ADLER with a commercial bottom trawl except where otherwise indicated) ZIL 31-968/17, 128.0 mm; Haul 59; 51°10'N, 158°28'E; 0-625 m; 1305-1405 hr; 4 August 1967. ZIL 31-968/21, 3(53.0-116.0 mm); Haul 144; 58°36'N, 176°02'W; 0-700 m; 0825-0930 hr; 30 September 1967. ZIL 31-968/6, 114.0 mm; Cruise 3, Haul 267/268; 60°01'N, 179°08'W; 0-680 m; 0635-0805 hr; 26 November 1963. ZIL 31-968/18, 105.0 mm; Fisheries Trawler SESKAR, Haul 49; 52°48'N, 160°15'E; 0-825 m; 0925-1055 hr; 21 January 1968. ZIL 31-968/11, 99.0 mm; Fisheries Trawler OGON, Haul 51; 50°10'N, 156°48'E; 0-740 m; 0508-0608 hr; 10 May 1964. ZIL 31-968/15, 93.0 mm; Haul 15; 49°05'N, 155°36'E; 0-520 m; 2140-2240 hr; 25 July 1967. ZIL 31-968/14, 3(75.0-91.0 mm); Haul 127; 54°34'N, 167°36'W; 0-720 m; 0055-0230 hr; 26 September 1967. ZIL 31-968/13, 83.0 mm; Large Refrigerator Fisheries Trawler AKADEMIK BERG, Haul 174; 61°21'N, 176°18'E; 0-1020 m; 0702-0802 hr; 8 November 1966. ZIL 31-968/3, 70.0 mm; Cruise 3, Haul 125; 58°52'N, 178°18'W; 0-720 m; 0730-0830 hr; 21 September 1963.

IOM uncatalogued, 119.0 mm; VITYAZ Cruise 24, Station 3596, Sample 105; 41°20'N, 144°10'W; 1.6 m diameter conical ring net, 0-4075 m; bottom depth 6460-6280 m; 2320-0320 hr; 23-24 May 1957. IOM uncatalogued, 109.0 mm; VITYAZ Cruise 14, Station 2124, Sample 74; 47°36'N, 153°04'E; 1.6 m diameter conical ring net, 0-1100 m; bottom depth 1250 m; 1645-1770 hr; 27 May 1953.

SIO H51-361, 41.0 mm; HORIZON, J. Isaacs and Party; 51°35'N, 150°00'W; 10-ft IKMT, 0-1600 m; 16 August 1951. **SIO H51-362**, 37.0 mm; HORIZON, J. Isaacs and Party; 52°48'N, 150°10'W; 10-ft IKMT, 0-1050m; 16 August 1951.

OSUO 532, 69.0 mm; YAQUINA Cruise 6508, **Station NH-265-305**, Haul 725; 44°39'N, 130°13'W; 10-ft IKMT, 0-1000 m; 0408-1344 hr; 24 August 1965.

UBC 65-623, 58.0 mm; G. B. REED Cruise 65-7, Haul 19; 52°11'N, 133°11'W; Engel trawl, 0-597 m; bottom depth 2654 m; 1500-1605 hr; 11 July 1965.

Oneirodes flagellifer

Holotype of *Oneirodes flagellifer*; ZMUC P9280, 22.0 mm; DANA Station 3909(3); 5°21'N, 80°38'E; 3500 m wire; 1900 hr; 22 November 1929.

Lectotype of *Dolopichthys* (subgenus *Dermatias*) *thysanophorus*: BMNH 1932.5.3.14, 12.5 mm; DANA Station 3686(7); 8°34'N, 119°55'E; 3500 m wire; 0745 hr; 6 April 1929.

Additional non-type material: ZMUC P92190, 22.0 mm; GALATHEA Expedition Station 407; 12°10'N, 114°56'E; 0-3800 m; bottom depth 4390 m; 1900-2200 hr; 3 July 1951.

Oneirodes melanocauda

Holotype of *Oneirodes melanocauda*: ZMUC P9288, female, 15.5 mm; DANA Station 3688(1); 6°55'N, 114°02'E; 4000 m wire; bottom depth 2900 m; 1700 hr; 8 April 1929.

Paratypes of *Oneirodes melanocauda*: ZMUC P92184, female, 9.0 mm; DANA Station 3690(3); 8°02'N, 109°36'E; 300 m wire; bottom depth 825 m; 2030 hr; 10 April 1929. ZMUC P92186, female, 7.0 mm; DANA Station 1250(2); 17°54'N, 67°30'W; 600 m wire; 0330 hr; 26 February 1922. ZMUC P92185, male, 5.0 mm; DANA Station 3860(20); 2°57'S, 99°36'E; 600 m wire; bottom depth 5175 m; 2030 hr; 20 October 1929.

Additional non-type material: UMML 30270, female, 6.5 mm; PILLSBURY Station 612; 16°50'N, 87°37'W; 10-ft IKMT, 0-990 m; bottom depth 1702-2132 m; 18 March 1968.

Oneirodes theodoritissieri

Holotype of *Oneirodes theodoritissieri*: MHLR P448, 64.0 mm; PRESIDENT THEODORE TISSIER Cruise 5, Station 733; 11°13'N, 17°26'W; Schmidt net, 1000 m wire; bottom depth 1460 m; 27 May 1936.

Additional non-type material: ISH 659/68, 183.0 mm; WALTHER HERWIG Cruise 23, Station 12, Haul 2; 12°07'N, 23°08'W; 0-2000 m; bottom depth 5000 m; 2235-2305 hr; 30 January 1968.

NIO uncatalogued, 58.0 mm; DISCOVERY II Station 6662-20; 10°53'N, 19°56'W; RMT 8/5, 810-900 m; 17 February 1968.

Oneirodes species of *Oneirodes schmidti*-group

SIO 60-197, 42.0 mm; no collection data available (illicium length 33.3 percent of SL; vomerine teeth 5; upper jaw teeth 71; lower jaw teeth 65; P. 16; esca like that of LACM 31114-2). **SIO 60-236**, 18.0 mm; TETHYS Expedition Station 16; 2°04'N, 140°39'W; 0-2100 m; 4 July 1960 (illicium length 38.9 percent of SL; vomerine teeth 2; upper jaw teeth 27; lower jaw teeth 27; P. 15).

LACM 31114-2, 23.5 mm; VELERO IV Station 13750; 19°14'N, 105°32'W; 10-ft IKMT, 0-1210 m; bottom depth 2926-3292 m; 2020-0150 hr; 17-18 January 1970 (illicium length 35.3 percent of SL; vomerine teeth 7; upper jaw teeth 61; lower jaw teeth 63; P. 15; esca like that of SIO 60-197).

ROM 27281, 35.0 mm; BRANDAL Tow 20; 43°20'N, 52°30'W; Engel Trawl, 0-1050 m; 25 July 1968 (illicium length 37.1 percent of SL; vomerine teeth 6; upper jaw teeth 45; lower jaw teeth 49; P. 15).

IOM uncatalogued, 27.0 mm; VITYAZ Cruise 27, Station 4000, Sample 305; 8°40'N, 138°06'E; 6-m diameter conical ring net, 7120 m wire; bottom depth 7380-8020 m; 0650-1140 hr; 19 May 1958 (illicium length 34.8 percent of SL; vomerine teeth 6; upper jaw teeth 58; lower jaw teeth 49; P. 16).

BMNH 1939.5.24.22, 17.0 mm; DISCOVERY Station 193; Gulf of Aden; 0-1080 m (illicium length 26.4 percent of SL; vomerine teeth 4; upper jaw teeth 20; lower jaw teeth 28; *Dolopichthys* sp. of Norman, 1939).

USNM 207916, 13.5 mm; OCEAN ACRE 9-9N; 31°58'N, 64°18'W; 10-ft IKMT, 0-1150 m; 1605-2110 hr; 18 March 1969 (illicium length 33.3 percent of SL).

MCZ 47555, 12.0 mm; ANTON BRUUN Cruise 3, Station 148, Trawl 6, APB 7027; 4°12'N, 60°08'E; 10-ft IKMT with Foxton's Trousers closing device, deep fraction, 150-840 m; 0605-0925 hr; 18 August 1963 (illicium length 25.0 percent of SL).

Oneirodes species (unidentifiable metamorphosed females)

Distinct forms representing possible new species: **SIO 61-44**, 77.0 mm; MONSOON Expedition MWT 16; 54°22'S, 177°17'W; 0-2500 m; 18 February 1961 (illicium length 32.4 percent of SL; vomerine teeth 7; upper jaw teeth 40; lower jaw teeth 41; P. 16). **SIO 61-35**, 45.0 mm; MONSOON Expedition MWT 7; 14°54'S, 70°12'E; 0-2000 m; 3 December 1960 (illicium length 80.0 percent of SL; vomerine teeth 8; upper jaw teeth about 120; lower jaw teeth about 130; P. 16; esca badly damaged).

USNM 207931, 26.5 mm; OCEAN ACRE 7-13N; 32°18'N, 63°30'W; 10-ft IKMT, 0-1500 m; 1430-1730 hr; 8 September 1969 (illicium length 28.3 percent of SL; vomerine teeth 6; upper jaw teeth 30; lower jaw teeth 34; P. 17).

Additional unidentifiable females: ISH 456/68, 97.0 mm; WALTHER HERWIG Cruise 23, Station 10, Haul 3; 20°04'N, 21°46'W; 0-600 m; bottom depth 4000 m; 2240-2310 hr; 28 January 1968. ISH 1724/66, 77.0 mm; WALTHER HERWIG Cruise 15, Station 187; 5°34'S, 26°58'W; 0-360 m; bottom depth 5660 m; 2000-2315 hr; 20 May 1966. ISH 1822/71, 76.0 mm; WALTHER HERWIG 451/71; 15°45'S, 6°06'W; CMBT-1600, 0-1900 m; 1849-2305 hr; 5 April 1971. ISH 2863/71, 64.5 mm; WALTHER HERWIG Station 498-111/71; 17°27'N, 22°55'W; CMBT-1600, 0-610 m; 2129-2250 hr; 17 April 1971. ISH 1063/71, 58.0 mm; WALTHER HERWIG Station 402-111/71, 40°01'S, 7°25'W; CMBT-1600, 0-820 m; 2115-2327 hr; 18 March 1971. **ISH 647/71**, 39.0 mm; WALTHER HERWIG Station 358-111/71; 39°47'S, 43°30'W; **CMBT-1600**, 0-1015 m; 2035-2305 hr; 7 March 1971.

SIO 70-387, 42.0 mm; ANTON BRUUN Cruise 8, Station 399C; 21°18'S, 36°18'E; 0-1600 m; 2 October 1964. **SIO 61-33**, 19.0 mm; MONSOON Expedition

MWT5; 10°39'S, 98°51'E; 0-1500 m; 22-23 November 1960. **SIO** 69-350, 15.0 mm; **PIQUERO VIII**, R. L. Wisner and Party; 1°25'N, 86°00'W; 19 August 1969. **SIO** 65-193, 13.0 mm; 28°58'N, 115°45'W.

LACM 30554-26, 23.0 mm; **VELERO IV** Station 11906; 32°02'N, 117°47'W; 10-ft IKMT, 0-230 m; bottom depth 1591-1920 m; 2134-2313 hr; 30 January 1968. LACM 31465-1, 19.0 mm; **CARIDE** Cruise III, Station 61; 00°08'S, 139°32'W; 10-ft IKMT, 0-1000 m; 1540 hr; 18 February 1969. LACM 31473-1, 18.0 mm; **CARIDE** Cruise III, Station 113; 00°05'S, 145°23'W; 10-ft IKMT, 0-810 m; 0831 hr; 23 February 1969.

CAS 43424 (originally NYZS 17524), 15.0 mm; **GLADISFEN** Station 824; 32°12'N, 64°36'W; 1 September 1930. CAS 43334 (originally NYZS 17739), 15.0 mm; **GLADISFEN** Station 834; 32°12'N, 64°36'W; 3 September 1930. CAS 43425 (originally NYZS 14984), 9.0 mm; **GLADISFEN** Station 576; 32°12'N, 64°36'W; 14 May 1930.

IOM uncatalogued, 120.0 mm; **AKADEMIK KURCHATOV** Cruise 4, Station 219A, Sample 25; 00°00', 85°00'W; 10-ft IKMT, 0-2000 m; bottom depth 3200-3430 m; 0705-1050 hr; 29 August 1968. IOM uncatalogued, 14.0 mm; **PETR LEBEDEV** Atlantic Cruise 2, Sample 44; 22°15'N, 66°30'W; 10-ft IKMT, 0-1750 m; bottom depth 2200 m; 2025-2122 hr; 26 April 1962.

MMF 16877, 98.0 mm; stomach of *Aphanopus carbo* off Madeira; 29 February 1960. MMF 14044, 55.0 mm; stomach of *Aphanopus carbo* off Madeira; 14 June 1958.

UMML 30272, 57.0 mm; **PILLSBURY** Station 153; 30°28'N, 66°52'W; 10-ft IKMT, 0-1250 m; bottom depth 4865-4938 m; 5 August 1964. UMML 30273, 10.5 mm; **PILLSBURY** Station 462; 11°32'N, 67°40'W; 10-ft IKMT, 0-910 m; bottom depth 1884-1893 m; 29 July 1966.

ROM 27251, 76.0 mm; **BRANDAL** Tow 5; 50°30'N, 50°00'W; Engel Trawl, 0-1070 m; 0800-1255 hr; 13 July 1968.

BMNH 1925.8.11.12, 29.5 mm; **DANA** Station 1183(1); 13°47'N, 61°26'W; 4500 m wire; bottom depth 3025 m; 1630 hr; 24 November 1921.

MCZ 47552, 13.0 mm; **ANTON BRUUN** Cruise 3, Station 1, APB 7001; 12°00'N, 60°54'E; 10-ft IKMT, 0-863 m; bottom depth 4280 m; 1730-2050 hr; 13 August 1963.

USNM 207917, 11.0 mm; **OCEAN ACRES** 3-4N; 33°10'N, 64°45'W; 10-ft IKMT, 0-480 m; 1745-2150 hr; 4 July 1967.

Oneirodes species (unidentifiable metamorphosed males: DANA material listed by Bertelsen, 1951:267).

Holotype of *Trematorhynchus exiguus*: BMNH 1930.1.12.1102, 10.0 mm; **DISCOVERY** Station 298; 13°01'N, 21°34'W; Young fish trawl, 0-1200 m; 29 August 1927 (*Lipactis tumidus* of Norman, 1930).

Holotype of *Caranactis pumilus*: ZMUC P9266, 8.0 mm; **DANA** Station 3909(5); 5°21'N, 80°38'E; 2500 m wire; bottom depth 4120 m; 1900 hr; 22 November 1929.

Additional non-type material: (the following were taken by the **VELERO IV** from the eastern North Pacific Ocean as far west as 119°46'W between 32°59'N and 27°30'N, with a 10-ft IKMT unless otherwise indicated) LACM 31919-2, 13.5 mm; Station 14328;

0-1500 m; bottom depth 1829-1938 m; 0118-0630 hr; 26 June 1970. LACM 32212-1, 13.5 mm; Station 14367; 0-1425 m; bottom depth 1472-1372 m; 0745-1210 h; 29 July 1970. LACM 30029-29, 2(12.0-13.0 mm); Station 11645; 0-315 m; bottom depth 3292-2286 m; 2126-0035 hr; 22-23 August 1967. LACM 30549-6, 2(11.5-13.0 mm); Station 11901; 0-300 m; bottom depth 2012 m; 0922-1205 hr; 30 January 1968. LACM 30441-35, 2(11.0-12.5 mm); Station 12523; 0-1380 m; bottom depth 1737-1829 m; 2220-0427 hr; 10-11 December 1968. LACM 30575-1, 12.5 mm; Station 12150; 0-500 m; bottom depth 2012-1875 m; 1857-2204 hr; 26 June 1968. LACM 30180-24, 12.5 mm; Station 12122; 1-1360 m; bottom depth 2377-1463 m; 1917-0155 hr; 29-30 May 1968. LACM 30444-36, 12.5 mm; Station 12526; 0-1250 m; bottom depth 1097-1829 m; 0820-1530 hr; 12 December 1968. LACM 30526-12, 12.0 mm; Station 11505; 0-30 m; bottom depth 1957-1884 m; 2015-2055 hr; 19 May 1967. LACM 30446-27, 12.0 mm; Station 12533; 0-1500 m; bottom depth 1317-1829 m; 0100-0758 hr; 13 December 1968. LACM 32210-1, 12.0 mm; Station 13085; 0-1640 m; bottom depth 3566-3922 m; 2047-0340 hr; 18-19 June 1969. LACM 30548-25, 11.5 mm; Station 11900; 0-1200 m; bottom depth 2002-2012 m; 0238-0914 hr; 30 January 1968. LACM 30415-26, 11.5 mm; Station 12778; 0-1350 m; bottom depth 3 109-3475 m; 2210-0722 hr; 12-13 March 1969. LACM 32236-1, 9.0 mm; **TERITU** Cruise Vanilla Fudge, Station 69-11-4; 22°09'N, 158°10'W; 10-ft IKMT, 0-1150 m; 1225-1635 hr; 12 November 1969.

SIO 60-225, 14.5 mm; **TETHYS** Expedition Station 11; 1°32'N, 132°12'W; 10-ft IKMT, 0-2750 m; bottom depth 4206 m; 1138-1925 hr; 28 June 1960. **SIO** H52-338, 2(9.5-13.5 mm); **SHELLBACK** Expedition; 0°18'N, 110°26'W; 10-ft IKMT, 0-1280 m; bottom depth 3822 m; 0545-1145 hr; 7 June 1952. **SIO** H52-372, 10.0 mm; **SHELLBACK** Expedition trawl 8; 14°01'N, 81°48'W; June 1952.

USNM 207920, 14.5 mm; **OCEAN ACRE** 9-26N; 31°53'N, 63°55'W; 10-ft IKMT, 0-1250 m; 0005-0438 hr; 22 March 1970. USNM 207919, 12.5 mm; **OCEAN ACRE** 5-2N; 32°16'N, 63°51'W; 10-ft IKMT, 0-2150 m; 1320-2015 hr; 7 December 1968.

ZMUC P92187, 16.5 mm; **GALATHEA** Station 237; 2°18'S, 45°18'E; triangular otter trawl, 0-750 m; bottom depth 4670 m; 1810 hr; 12 March 1951. ZMUC P92678, 13.0 mm; **DANA** Station 1358(4) (*Oneirodes* sp. ? of Bertelsen, 1951:88).

UMML 30271, 13.5 mm; **PILLSBURY** Station 578; 19°52'N, 85°43'W; 10-ft IKMT, 0-3000 m; bottom depth 4407 m; 22 May 1967.

IOM uncatalogued, 9.0 mm; **VITYAZ** Cruise 31, Station 4614, Sample 367; 0°21'N, 76°15'E; 1.6-m diameter conical ring net, 0-1000 m; bottom depth 4266-4329 m; 1500-1550 hr; 24 January 1960.

Oneirodes species (larvae: DANA material listed by Bertelsen, 1951:267).

The following material is from the larval fish collections of E. H. Ahlstrom, National Marine Fisheries Service, Fishery-Oceanography Center, La Jolla (standard lengths not taken; number of specimens in parentheses; all taken on **EASTROPAC** Expeditions with a 5-ft plankton net on the surface;): (1); **ROCKAWAY** Cruise 47, Station 053; 0°18'N, 81°58'W; 0025 hr;

6 August 1967. (4); ROCKAWAY Cruise 47, Station 244; 6°59'N, 84°54'W; 0845 hr; 27 August 1967. (1); ROCKAWAY Cruise 47, Station 246; 7°42'N, 85°04'W; 1450 hr; 27 August 1967. (2); ROCKAWAY Cruise 47, Station 490; 3°16'N, 94°41'W; 1504 hr; 19 September 1967. (1); DAVID STARR JORDAN Cruise 12, Station 218; 1°14'S, 112°03'W; 1015 hr; 12 March 1967. (1); WASHINGTON Cruise 45, Station 078; 2°48'N, 119°11'W; 2230 hr; 15 August 1967. (2); UNDAUNTED Cruise 46, Station 102; 5°36'N, 97°54'W; 2220 hr; 2 September 1967.

USNM 207913, female, 5.0 mm; OCEAN ACRE 4-3M; 31°49'N, 64°18'W; 10-ft IKMT, 0-360 m; 1900-2005 hr; 3 September 1968. USNM 207915, female, 4.8 mm; OCEAN ACRE 4-14P; 31°59'N, 64°19'W; 10-ft IKMT, 0-75 m; 1910-2025 hr; 5 September 1968.

APPENDIX B

The osteological evidence presented in this paper is based on the following list of specimens in addition to the lophiiform material listed in a study of the osteology and relationships of the Centrophrynidae (Pietsch, 1972a). Most of this material was cleared and stained with alizarin red S following the trypsin digestion technique (Taylor, W., 1967). Specimens marked with an asterisk (*) have not been cleared and stained.

Batrachoididae

- Thalassophryne maculosa* Gunther, 1861: LACM 20055, one (of 4), 73.0 mm.
Daector dowi (Jordan and Gilbert, 1887): LACM 31310-19, one (of 3), 97.0 mm.
Porichthys notatus Girard, 1855: LACM 22083, one, 114.5 mm.
Porichthys analis Hubbs and Schultz, 1939: LACM 22345, one (of 2), 125.0 mm.
Nautopaedium porosissimus (Cuvier and Valenciennes, 1837): LACM 30727-11, one (of 4), 96.0 mm.

Antennariidae

- Histrio histrio* (Linnaeus, 1758): LACM 8975-1, one (of 6), 91.0 mm.
Antennatus bigibbus (Lacépède, 1798): uncatalogued, one (of 5), 64.0 mm.
Antennarius sanguineus Gill, 1863: LACM 8125, one (of 2), 76.0 mm.

Ogcocephalidae

- Zalieutes elater* (Jordan and Gilbert, 1882): LACM 8824-13, one (of 3), 98.0 mm.

Diceratiidae

- Paroneirodes glomerulosus* Alcock, 1890: IOM uncatalogued, one female, 77.0 mm.
 **Paroneirodes glomerulosus* Alcock, 1890: IOM uncatalogued, one female, 64.0 mm.

Oneirodidae

- Oneirodes luetkeni* (Regan, 1925): LACM 31801-1, one female (of 2), 61.0 mm.

- Oneirodes eschrichtii* Lütken, 1871: LACM 31100-1, one female, 71.0 mm.
Oneirodes bulbosus Chapman 1939: IOM uncatalogued, one female, 81.0 mm.
Oneirodes acanthias (Gilbert, 1915): LACM 9960-4, one female, 71.0 mm (the osteology of this specimen is illustrated in this paper).
Oneirodes acanthias (Gilbert, 1915): LACM 32208-1, one female, 40.0 mm.
Oneirodes acanthias (Gilbert, 1915): LACM 6839-14, one female (of 2), 34.0 mm.
Oneirodes acanthias (Gilbert, 1915): LACM 9498-11, one female, 13.0 mm.
Oneirodes notius, new species: LACM 11184-6, a paratype, female, 54.0 mm.
Oneirodes basili, new species: LACM 30028-30, a paratype, female, 115.0 mm.
Danaphryne nigrifilis (Regan and Trewavas, 1932): ISH 2658/71, one female, 82.0 mm.
Danaphryne nigrifilis (Regan and Trewavas, 1932): LACM 32612-1, one female, 23.0 mm.
Microlophichthys microlophus (Regan, 1925): ROM 27286, one female, 99.0 mm.
 **Tyrannophryne pugnax* Regan and Trewavas, 1932: ZMUC P9294, the holotype, a female, 12.0 mm.
 **Phyllorhinichthys micractis* Pietsch, 1969: IOM uncatalogued, one female, 96.0 mm.
 **Phyllorhinichthys micractis* Pietsch, 1969: LACM 9567-14, the holotype, a female, 52.0 mm.
Leptacanthichthys gracilispinis (Regan, 1925): ROM 27284, one female, 54.0 mm.
 **Leptacanthichthys gracilispinis* (Regan, 1925): ZMUC P9295, the lectotype, a female, 52.0 mm.
 **Leptacanthichthys gracilispinis* (Regan, 1925): ROM 27293, one female, 43.0 mm.
 **Leptacanthichthys gracilispinis* (Regan, 1925): BMNH 1925.8.11.14, the paralectotype, a female, 43.0 mm.
 **Leptacanthichthys gracilispinis* (Regan, 1925): ROM 27274, one female, 41.0 mm.
 **Chirophryne xenolophus* Regan and Trewavas, 1932: ZMUC P9296, the holotype, a female, 11.0 mm.
 **Ctenochirichthys longimanus* Regan and Trewavas, 1932: BMNH 1932.5.3.20, the paralectotype, a female, 38.0 mm.
 **Ctenochirichthys longimanus* Regan and Trewavas, 1932: ZMUC P9297, the lectotype, a female, 12.5 mm.
Dolopichthys pullatus Regan and Trewavas, 1932: LACM 6723-33, one female, 76.0 mm.
Dolopichthys pullatus Regan and Trewavas, 1932: LACM 11539-1, one female, 65.0 mm.
Dolopichthys pullatus Regan and Trewavas, 1932: LACM 30385-1, one female, 56.0 mm.
Bertella idiomorpha Pietsch, 1973: LACM 30561-1, a paratype, a female, 78.0 mm.
Bertella idiomorpha Pietsch, 1973: LACM 30045-3, a paratype, a female, 11.0 mm.
Chaenophryne parviconus Regan and Trewavas, 1932: LACM 9319-11, one female, 59.0 mm.
Pentherichthys venustus (Regan and Trewavas, 1932): ISH 130/67, one female, 119.0 mm.
 **Pentherichthys* sp.: ISH 131/67, one female, ca. 98.0 mm.
Lophodolos acanthognathus Regan, 1925: ROM 27285, one female, 57.0 mm.

LITERATURE CITED

- ALCOCK, A. W. 1890. Natural history notes from H. M. Indian Marine Survey steamer "Investigator," Commander R. F. Hoskyn, R.N., commanding. No. 16. On the bathybial fishes collected in the Bay of Bengal during the season 1889-90. *Ann. Mag. Nat. Hist.*, Ser. 6, 6(26):197-222.
- _____. 1899. A descriptive catalogue of the Indian deep-sea fishes in the Indian Museum. Calcutta. 211 pp.
- ALONCLE, H. 1968. Catalogues des types de poissons téléostéens en collection au Museum de La Rochelle. *Bull. Mus. Nat. D'Hist. Nat.*, Ser. 2, 40(4):683-691.
- BAIRD, R. C. 1971. The systematics, distribution, and zoogeography of the marine hatchetfishes (family Sternoptychidae). *Bull. Mus. Comp. Zool.* 142 (1)1-128.
- BACKUS, R. H., J. E. CRADDOCK, R. L. HAEDRICH, AND D. L. SHORES. 1970. The distribution of mesopelagic fishes in the Equatorial and western North Atlantic Ocean. *J. Mar. Res.* 28(2):179-201.
- BACKUS, R. H., G. W. MEAD, R. L. HAEDRICH, AND A. W. EBELING. 1965. The mesopelagic fishes collected during Cruise 17 of the R/V CHAIN with a method for analyzing faunal transects. *Bull. Mus. Comp. Zool.* 145:139-157.
- BEAUFORT, L. F. DE, AND J. C. BRIGGS. 1962. The fishes of the Indo-Australian Archipelago XI. Scleroparei, Hypostomides, Pediculati, Plectognathi, Opisthomi, Discocephali, Xenopterygii. E. J. Brill, Leiden, Netherlands. 481 pp.
- BEEBE, W. 1932. Nineteen new species and four post-larval deep-sea fish. *Zoologica*, N.Y. 13:47-107.
- _____. 1934. Three new deep-sea fish seen from the Bathysphere. *Bull. N.Y. Zool. Soc.* 37(6):190-193.
- _____. 1937. Preliminary list of Bermuda deep-sea fish. *Zoologica*, N.Y. 22(14):197-208.
- BEEBE, W., AND J. CRANE. 1947. Eastern Pacific Expedition of the New York Zoological Society. XXX VII. Deep-sea ceratioid fishes. *Zoologica*, N.Y. 31(11):151-182.
- BELLOC, G. 1938. Résultats des croisières scientifiques du navire "President Théodore-Tissier." Liste des poissons pélagiques et bathypélagiques capturés au cours de la cinquième croisière avec diagnoses préliminaires de deux espèces nouvelles. *Rev. Tray. Pêches marit.* Paris 1(3):281-313.
- BERRY, F. H., AND H. C. PERKINS. 1966. Survey of pelagic fishes of the California Current area. *Fishery Bull. U. S. Fish Wildl. Serv.* 65(3):625-682.
- BERTELSEN, E. 1951. The ceratioid fishes. Ontogeny, taxonomy, distribution and biology. *Dana Rep.* 39, 276 pp.
- BOLIN, R. L., AND G. S. MYERS. 1950. Station records of the Crocker-Stanford Deep-sea Expedition, coast of California, September 1938. *Stanford Ichthyol. Bull.* 3:203-208.
- BRADBURY, M. G. 1967. The genera of batfishes (family Ogcocephalidae). *Copeia* 1967:399-422.
- BRAUER, A. 1908. Die Tiefsee-fische. II. Anatomischer Teil. *Wiss. Ergebn. dt. Tiefsee-Exp. "Valdivia"* 15(2):1-266.
- BRINTON, E. 1962. The distribution of Pacific euphausiids. *Bull. Scripps Inst. of Oceanog. Univ. Calif.* 8(2):51-270.
- BRUUN, A. F. 1958. On the restricted distribution of two deep-sea fishes, *Borophryne apogon* and *Stomias colubrinus*. *J. Mar. Res.* 17:103-112.
- BRYANT, S. V. 1970. Regeneration in amphibians and reptiles. *Endeavour* 29(106):12-17.
- BURTON, M. 1932. *Zoological Record* 69(13):1-62.
- BUSSING, W. A. 1965. Studies of the midwater fishes of the Peru-Chile Trench. *Biol. Antarctic Seas II. Amer. Geophys. Union Res. Ser.* 5:185-227.
- CARLSBERG FOUNDATION. 1934. Introduction to the reports from the Carlsberg Foundation's Oceanographical Expedition Round the World 1928-30 *Dana Rep.* 1. 130 pp.
- CHAPMAN, W. M. 1939. Eleven new species and three new genera of oceanic fishes collected by the International Fisheries Commission from the northeastern Pacific. *Proc. U. S. Nat. Mus.* 86:501-542.
- CLARKE, M. R. 1969. A new midwater trawl for sampling discrete depth horizons. *J. Mar. Biol. Assoc. U. K.* 49:945-960.
- CLEMENS, W. A., AND G. V. WILBY. 1946. Fishes of the Pacific coast of Canada. *Bull. Fish. Res. Bd. Canada.* 38:1-368.
- CUVIER, G., AND A. VALENCIENNES. 1837. Histoire naturelle des poissons. 12, xxiv + 507 pp. Bertrand, Paris.
- DAHLGREN, U. 1928. The bacterial light organ of *Cerattias*. *Science* 68:65-66.
- EBELING, A. W. 1962. Melamphidae I. Systematics and zoogeography of the species in the bathypelagic fish genus *Melamphaes* Gunther. *Dana Rep.* 58. 164 pp.
- EBELING, A. W., R. M. IBARA, R. J. LAVENBERG, AND F. J. ROHLF. 1970. Ecological groups of deep-sea animals off southern California. *Bull. Los Angeles Co. Mus. Nat. Hist. Sci.* 6:1-43.
- EHRENBAUM, E. 1902. Die Fische. Faune Arctica, eine Zusammenstellung der arktischen Tierformen, mit besonderer Berücksichtigung des Spitzbergen-Gebietes auf Grund der Ergebnisse der Deutschen Expedition in das Nordliche Eismeer in Jahre 1898. 2(1):65-168.
- FAST, T. N. 1957. The occurrence of the deep-sea anglerfish, *Cryptopsaras couesii* in Monterey Bay, California. *Copeia* 1957:237-240.
- FITCH, J. E., AND R. J. LAVENBERG. 1968. Deep-water fishes of California. University of California Press, Berkeley and Los Angeles. 155 pp.
- FOWLER, H. W. 1936. The marine fishes of West Africa. Based on the collections of the American Mu-

- seum Congo Expedition, 1909-1915. Bull. Amer. Mus. Nat. Hist. 70(2) :607-1493.
- . 1949. Fishes of Oceania-Supplement 3. Mem. Bernice P. Bishop Mus. 12(2) :37-186.
- FRASER-BRUNNER, A. 1935. New and rare fishes from the Irish Atlantic Slope. Proc. R. Irish Acad. 42B(9) :319-326.
- GARMAN, S. 1899. Reports on an exploration off the west coasts of Mexico, Central and South America, and off the Galapagos Islands, in charge of Alexander Agassiz, by the U. S. Fish Commission steamer "Albatross," during 1891, Lieut. Commander Z. L. Tanner, U.S.N., commanding. XXVI. The fishes. Mem. Mus. Comp. Zool. 24, 431 pp.
- GIBBS, R. H., Jr. 1969. Taxonomy, sexual dimorphism, vertical distribution, and evolutionary zoogeography of the bathypelagic fish genus *Stomias* (Stomiidae). Smithsonian Contrib. Zool. 31:1-25.
- GILBERT, C. H. 1915. Fishes collected by the United States Fisheries steamer "Albatross" in southern California in 1904. Proc. U. S. Nat. Mus. 48:305-380.
- GILL, T. N. 1863. Descriptions of some new species of Pediculati, and on the classification of the group. Proc. Acad. Nat. Sci. Phila. 15:88-92.
- . 1878a. Synopsis of the pediculate fishes of the eastern coast of extratropical North America. Proc. U.S. Nat. Mus. 1:215-221.
- . 1878b. Note on the Ceratiidae. Proc. U. S. Nat. Mus. 1:227-231.
- GIRARD, C. 1855. Enumeration of the species of marine fishes, collected at San Francisco, California, by Dr. C. B. R. Kennerly, naturalist attached to the survey of the Pacific R. R. Route, under Lieut. A. W. Whipple. Proc. Acad. Nat. Sci. Phila. 7:141-142.
- GOODE, G. B., AND T. H. BEAN. 1896. Oceanic Ichthyology. U. S. Nat. Mus. Spec. Bull. 2:1-553.
- GOSLINE, W. A. 1960. Contributions toward a classification of modern isospondylous fishes. Bull. Brit. Mus. (Nat. Hist.), Zool. 6:327-365.
- GREENWOOD, P. H., D. E. ROSEN, S. H. WEITZMAN, AND G. S. MYERS. 1966. Phyletic studies of teleostean fishes, with a provisional classification of living forms. Bull. Amer. Mus. Nat. Hist. 131: 339-456.
- GREGORY, W. K. 1933. Fish skulls. A study of the evolution of natural mechanisms. Trans. Amer. Phil. Soc. 23:75-481.
- GREY, M. 1956a. The distribution of fishes found below a depth of 2000 meters. Fieldiana, Zool. 36(2) :75-337.
- . 1956b. New records of deep-sea fishes, including a new species, *Oneirodes bradburyae* from the Gulf of Mexico. Copeia 1956:242-246.
- GUNTHER, A. 1861. Catalogue of the acanthopterygian fishes in the collection of the British Museum. Vol. 3. Taylor and Francis, London. xxv 586 pp.
- . 1887. Report on the deep-sea fishes collected by H.M.S. Challenger during the years 1873-1876. Rep. Sci. Res. Voy. Challenger. Zoology 22:1-335.
- HARDY, A. C., AND E. R. GUNTHER. 1935. The plankton of the South Georgia whaling grounds and adjacent waters, 1926-1927. Discovery Rep. 11:1-456.
- HOLT, E. W. L., AND L. W. BYRNE. 1908a. New deep-sea fishes from the southwest coast of Ireland. Ann. Mag. Nat. Hist. 1(8) :86-95.
- . 1908b. Second report on the fishes of the Irish Atlantic Slope. IV. Recent additions to the British and Irish list. Rep. fish. Ireland 1906, Part II. Sci. Invest. 5:51-63.
- HUBBS, C. L., AND L. P. SCHULTZ. 1939. A revision of the toad fishes referred to *Porichthys* and related genera. Proc. U. S. Nat. Mus. 86:473-496.
- HULET, W. H., AND G. MUSIL. 1968. Intracellular bacteria in the light organ of the deep-sea anglerfish, *Melanocetus murrayi*. Copeia 1968:506-512.
- JORDAN, D. S. 1885. A catalogue of the fishes known to inhabit the waters of North America, north of the Tropic of Cancer, with notes on the species discovered in 1883 and 1884. U. S. Comm. Fish and Fisheries, Rep. of the Commissioner, 13(24) : 789-973.
- JORDAN, D. S., AND B. W. EVERMANN. 1898. The fishes of North and Middle America. Bull. U. S. Nat. Mus. 47(3):2184-3136.
- JORDAN, D. S., AND C. H. GILBERT. 1882. Descriptions of thirty-three new species of fishes from Mazatlan, Mexico. Proc. U. S. Nat. Mus. 4:338-365.
- . 1883. Synopsis of the fishes of North America. Bull. U. S. Nat. Mus. 16:1vi + 1018 pp.
- . 1887. Description of a new species of *Thalassophryne* (*Thalassophryne dowi*) from Punta Arenas and Panama. Proc. U. S. Nat. Mus. 10:388.
- KOEFOED, E. 1944. Pediculati from the "Michael Sars" North Atlantic Deep-sea Expedition 1910. Rep. Sci. Res. "Michael Sars" Exped. IV. 2(1):11-18.
- LACÉPÈDE, B. 1798. Histoire naturelle des poissons. Vol. 1. Paris.
- LAVENBERG, R. J., AND A. W. EBELING. 1967. Distribution of midwater fishes among deep water basins of the southern California shelf. Proc. Symp. Biol. Calif. Islands, R. N. Philbrick, Ed., Santa Barbara Botanical Garden, Inc., pp. 185-201.
- LINNAEUS, C. 1758. Systema naturae, 10th ed., I. 824 II.
- LLOYD, R. E. 1909. A description of the deep-sea fish caught by the R.I.M.S. Ship "Investigator" since the year 1900, with supposed evidence of mutation in *Malthopsis*. Mem. Indian Muf., Calcutta 2(3):139-180.
- LÜTKEN, CHR. FR. 1871. *Oneirodes eschrichtii* Ltk. en ny gronlandsk Tudsefisk. Oversigt over det Kongl. Danske Vidensk. Selsk. forhandl. 1871:56-74.
- . 1872. On *Oneirodes eschrichtii*, Lütken, a new lophioid fish from Greenland. Ann. Mag. Nat. Hist., Ser. 4, 9(35) :329-344.

- _____. 1878a. Til Kundskab om to arktiske slægter af Dybhavs-Tudsefiske: *Himantolophus* og *Ceratiias*. Danske Vidensk. Selsk. Skr., 5, R. Nat. Math. Afd. 11(5) :309-388.
- _____. 1878b. Contributions pour servir à l'histoire de deux genres de poissons de la famille des Baudroies, *Himantolophus* et *Ceratiias*, habitant les grandes profondeurs des mers arctiques. Danske Vidensk. Selsk. Skr., 5, R. Nat. Math. Afd. 11(5) :339-348.
- _____. 1887. Fortsatte bidrag til Kundskab om de arktiske Dybhavs-Tudsefiske, saerligt Slaegten *Himantolophus*. Danske Vidensk. Selsk. Skr., 6, R. Nat. Math. Afd. 4(5) :325-334.
- MACKINTOSH, N. A. 1937. The seasonal circulation of the Antarctic macro-plankton. *Discovery Rep.* 16: 365-412.
- MARSHALL, N. B. 1967. The olfactory organs of bathypelagic fishes. *Symp. Zool. Soc., London* 19:57-70.
- _____. 1971a. Explorations in the Life of Fishes, Harvard University Press, Cambridge, Massachusetts. 204 pp.
- _____. 1971b. Animal Ecology. *In* Deep Oceans. P. J. Herring and M. R. Clarke, Eds. Praeger Publishers, New York, Washington, pp. 205-224.
- MARX, H., AND G. B. RABB. 1970. Character analysis: an empirical approach applied to advanced snakes. *J. Zool.* London 161:525-548.
- MAUL, G. E. 1949. Alguns peixes notáveis. *Bol. Mus. Mun. Funchal* 4:22-42.
- _____. 1961. The ceratioid fishes in the collections of the Museum Municipal do Funchal (Melanocetidae, Himantolophidae, Oneirodidae, Linophrynidae). *Bol. Mus. Mun. Funchal* 14(50) : 87-159.
- _____. 1962. On a small collection of ceratioid fishes from off Dakar and two recently acquired specimens from stomachs of *Aphanopus carbo* taken in Madeira (Melanocetidae, Himantolophidae, Diceratiidae, Oneirodidae, and Ceratiidae) *Bol. Mus. Mun. Funchal* 16(54) :5-27.
- MOORE, H. B. 1958. *Marine Ecology*. John Wiley and Sons, New York. vii + 493 pp.
- MUNK, O. 1964. The eyes of some ceratioid fishes. *Dana Rep.* 62, 17 pp.
- _____. 1966. Ocular anatomy of some deep-sea teleosts. *Dana Rep.* 70, 62 pp.
- MURRAY, J., AND J. HJORT. 1912. *The Depths of the Ocean*. Macmillian and Co., Limited, London. xx + 821 pp.
- NORMAN, J. R. 1930. Oceanic fishes and flatfishes collected in 1925-1927. *Discovery Rep.* 2:261-370.
- _____. 1939. *Fishes*. *Scient. Rep. John Murray Exped.* 7(1) :1-115.
- NYBELIN, O. 1963. Zur morphologie und terminologie, des Schwanzskelettes der Actinopterygier. *Ark. Zool.* 15(35) :485-516.
- O'DAY, W. T. 1972. The histology and fine structure of some bioluminescent organs in deep-sea fishes. PhD Dissertation, University of Southern California, Los Angeles, California.
- PARIN, N. V. 1970. Ichthyofauna of the Epipelagic Zone. *Israel Program for Scientific Translations, Jerusalem.* iii + 206 pp.
- PARR, A. E. 1927. Scientific results of the third Oceanographic Expedition of the "Pawnee" 1927. *Bull. Bingham Oceanogr. Coll.* 3(1) :1-34.
- PIETSCH, T. W. 1969. A remarkable new genus and species of deep-sea anglerfish (family *Oneirodidae*) from off Guadalupe Island, Mexico. *Copeia* 1969: 365-369.
- _____. 1972a. A review of the monotypic deep-sea anglerfish family Centrophrynidae: taxonomy, distribution and osteology. *Copeia* 1972:17-47.
- _____. 1972b. Second specimen of the deep-sea anglerfish *Phyllorhinichthys micractis* (family Oneirodidae), with a histological description of the snout flaps. *Copeia* 1972:335-340.
- _____. 1972c. Ergebnisse der Forschungsreisen des FFS "Walther Herwig" nach Südamerika. XIX. Systematics and distribution of ceratioid fishes of the genus *Dolopichthys* (family Oneirodidae) with the description of a new species. *Arch. Fischereiwiss.* 23(1) :1-28.
- _____. 1973. A new genus and species of deep-sea anglerfish (family Oneirodidae) from the northern Pacific Ocean. *Copeia* 1973:193-199.
- RADCLIFFE, L. 1912. Scientific results of the Philippine Cruise of the fisheries steamer "Albatross," 1907-1910. No. 16. New pediculate fishes from the Philippine Islands and contiguous water. *Proc. U.S. Nat. Mus.* 42:199-214.
- RASS, T. S. 1955. The deep water fishes from the Kurile-Kamchatka Trench. *Proc. Trudy Inst. Oceanol. Akad. Nauk, USSR* 12:329-339.
- _____. 1967. Some regularities in distribution of deep-sea fishes. *In* The Pacific Ocean, Vol. 7. Biology of the Pacific Ocean, Pt. 3, pp. 228-246. (In Russian.)
- REGAN, C. T. 1925. New ceratioid fishes from the N. Atlantic, the Caribbean Sea, and the Gulf of Panama, collected by the "Dana." *Ann. Mag. Nat. Hist., Ser. 8,* 8(62) :561-567.
- _____. 1926. The pediculate fishes of the suborder Ceratioidea. *Dana Oceanog. Rep.* 2, 45 pp.
- REGAN, C. T., AND E. TREWAVAS. 1932. Deep-sea anglerfish (Ceratioidea). *Dana Rep.* 2. 113 pp.
- ROSEN, D. E., AND C. PATTERSON. 1969. The structure and relationships of the Paracanthopterygian fishes. *Bull. Amer. Mus. Nat. Hist.* 141:357-474.
- SCHÄRFE, J. 1966. Germans develop midwater herring trawl. *Fish. News Int.* 5(7) :18-25.
- _____. 1969. The German One-Boat Midwater Trawl (development since 1959 to the beginning of 1968). *Protok. Fisch Tech.* 12(54), (not seen).
- SCHMIDT, E. J. 1929. Introduction to the Oceanographical Reports. *Dana Oceanog. Rep.* 1, 87 pp.
- SCHROEDER, E. H. 1963. North Atlantic temperatures at a depth of 200 meters. *Serial Atlas Mar. Environ., folio* 2.

- SCHULTZ, L. P. 1934. A new ceratioid fish from the Gulf of Alaska. *Copeia* 1934:66-68.
- SCHULTZ, R. JACK. 1963. Stubby, a hereditary vertebral deformity in the viviparous fish *Poeciliopsis prolifica*. *Copeia* 1963:325-330.
- SMITH, H. M., AND L. RADCLIFFE. 1912. In Radcliffe, 1912. Scientific results of the Philippine Cruise of the fisheries steamer "Albatross," 1907-1910. No. 16. New pediculate fishes from the Philippine Islands and contiguous waters. *Proc. U. S. Nat. Mus.* 42:199-214.
- SVERDRUP, H. U., M. W. JOHNSON, AND R. H. FLEMING. 1960. *The Oceans: Their Physics, Chemistry and General Biology*. 9th Ed. Englewood Cliffs, N.J., Prentice-Hall, Inc. x + 1060 pp.
- TAYLOR, F. H. C. 1967. Unusual fishes taken by mid-water trawl off the Queen Charlotte Islands. British Columbia. *J. Fish. Res. Bd. Canada* 24(10):2101-2115.
- TAYLOR, W. R. 1967. An enzyme method of clearing and staining small vertebrates. *Proc. U. S. Nat. Mus.* 122:1-17.
- TOTTEN, A. K. 1914. The structure and development of the caudal skeleton of the teleostean fish, *Pleuragramma antarcticum*. *Proc. Zool. Soc. London* 2(16):251-261.
- UENO, T. 1971. List of the marine fishes from the waters of Hokkaido and its adjacent regions. *Sci. Rep. Hok. Fish. Exp. Sta.*, No. 13, 46(3) :61-102.
- WALLS, GORDON L. 1942. *The Vertebrate Eye and its Adaptive Radiation*. Cranbrook Inst. Sci. Bull. 19. xiv + 785 pp.
- WATERMAN, T. H. 1939. Studies on deep-sea anglerfishes (Ceratioidea). I. An historical survey of our present state of knowledge. *Bull. Mus. Comp. Zool.* 85(3):65-81.
- . 1948. Studies on deep-sea angler fishes (Ceratioidea). III. The comparative anatomy of *Gigantactis longicirra* Waterman. *J. Morphol.* 82(2) : 81-147.
- WEITZMAN, S. H. 1967. The osteology and relationships of the Astronesthidae, a family of oceanic fishes. *Dana Rep.* 71, 54 pp.
- WHEELER, A. C. 1969. *The Fishes of the British Isles and North-West Europe*. Michigan State University Press, East Lansing. xvii + 613 pp.
- WILSON, D. P. 1937. The habits of the anglerfish *Lophius piscatorius* L., in the Plymouth Aquarium. *J. Mar. Biol. Assoc. U. K., N. S.* 21(2) :477-496.
- WISNER, R. L. 1970. Distribution and characters of the North Pacific myctophid fish *Lampanyctus jordani* Gilbert. *Copeia* 1970:420-429.

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