

## A Revision of the Gunnel Family Pholididae (Pisces, Blennioidei)

By

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The gunnel family Pholididae is one of the most specialized groups of the northern blennies distributed in the North Pacific, the North Atlantic, and the Arctic Oceans. They generally live on the bottom and occupy littoral and coastal sea shore habitats. Since the Pholididae lack conspicuous external characters such as complicated lateral lines or fleshy crests, they are still confused with other members of the northern blennies, *e.g.*, with Opisthocentrinae by GREENWOOD *et al.* (1966). Compared to external morphology, internal features such as the hemanephropophyses (MAKUSHOK, 1958) are unique among the northern blennies and supply the definitive information on monophyly (*sensu* HENNIG, 1966).

As the first step in trying to elucidate the phylogenetic relationship and the diversity of the Pholididae and to offer some aid for the northern blenny classification, this taxonomic review is made below.

### Methods and Abbreviations

*Measurements.* Proportional measurements are made point to point with a needle-point divider and recorded to 0.1 millimeter. Measurements used in this paper are defined as follows: total length (TL), the distance from the anterior mid tip of the upper jaw to the posterior tip of caudal fin; standard length (SL), from the mid tip of the upper jaw to the caudal flexure; predorsal length, from the mid tip of the upper jaw to the origin of dorsal fin; pre-anus length, from the mid tip of the upper jaw to the center of anus, the measurements substitute for the ordinary preanal length which is difficult to measure in this family because the thick skin around the anal spine makes the anal-fin origin obscure; body depth, the vertical distance from the center of anus to the base of dorsal fin; head length (HL), from the mid tip of the upper jaw to the uppermost cleavage of gill opening; snout length, the least distance between the mid tip of the upper jaw and fleshy rim of the orbit; eye diameter, the horizontal diameter of fleshy rim of the orbit; upper jaw length, from the mid tip of the upper jaw to the posterior tip of maxillary; interorbital width, the least distance between fleshy rim of the orbits; pectoral fin length, from its insertion to its posterior tip;

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caudal fin length, from the caudal flexure to its posterior tip. These measurements are expressed in hundredths of SL or HL (abbreviated as % of SL or % of HL, respectively) and their ranges and mean values  $\pm$  S.D. are given.

*Meristics.* Pectoral fin ray counts are made on both sides and are shown by mean  $\pm$  S.D. Pelvic fin ray counts are made on cleared and stained specimens. Counts for the unpaired fins and vertebrae are taken from X-ray negative films. Definition of "abdominal" and "caudal" vertebrae followed that of MAKUSHOK (1958: 9), *i.e.*, those precede the insertion of the first anal proximal pterygiophore are abdominal. The formula of caudal fin rays expresses dorsal procurrent rays + dorsal principal rays + ventral principal rays + ventral procurrent rays, such as 5+7+7+3, where these rays are defined as: those rays that precede the dorsal principal rays, those attached to the hypurals 3, 4, and 5, those attaching to hypurals 1 and 2, those preceding the ventral principal rays, respectively. When heretofore reported counts exceed the observed range from present material, then reported values are indicated in parentheses.

*Cephalic sensory canal openings.* Opening series recognized in this study are presented in Fig. 1. Since these openings are usually hidden with mucus, mucus must be removed with care when we try to recognize the openings. Nasal series (**na**), pores on the snout near the nostril. Interorbital series (**ito**), a single pore on the supra-orbital commissure; this is indicated by an arrow in Fig. 1. Infraorbital series (**ifo**), pores surrounding the lower half of the orbit. Anterior postorbital series (**apo**), pores on the postorbital canal between the junction of the supraorbital, infraorbital and postorbital canals and the junction of the supratemporal commissure and the post-orbital canal, including its terminal pores. Posterior postorbital series (**ppo**), pores on the postorbital canal posterior from the junction of the supratemporal commissure, not including its junction. Occipital series (**oc**), pores on the supratemporal commissure which connects the posterior postorbital canals of both sides excluding its junction; exceptionally this series is expressed by the following formula: number of pore on left side–pore on the dorsal midline–pore on right side, such as 1–1–1. Mandi-

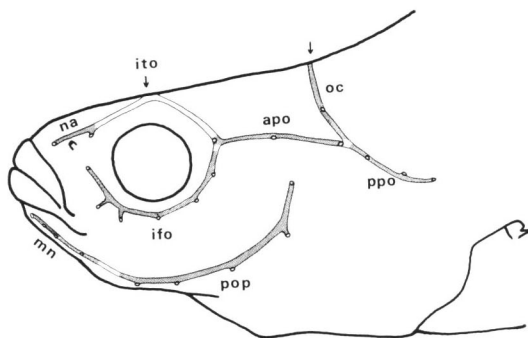


Fig. 1. Semidiagrammatic drawing of cephalic sensory canal opening series in *Apodichthys sanctaerosae*, NSMT-P 18535. **apo**, anterior postorbital series; **ifo**, infraorbital series; **ito**, interorbital pore (represented by an arrow above eye); **mn**, mandibular series; **na**, nasal series; **oc**, occipital series; **pop**, preopercle series; **ppo**, posterior postorbital series.

bular series (**mn**), pores on the lower jaw beginning with the pore nearest to the symphysis and terminating with the pore just behind the posterior tip of the articular bone. Preopercular series (**pop**), pores on the preopercle bone.

*Synonymy.* The synonymy cites only new names, not later identification.

*Material examined.* Material used in this study is presented in the section preceding to the diagnosis of each species. It is arranged in the following fashion: catalogue number, number of specimens in parentheses followed by SL in mm, and collection locality. Dissected and/or cleared and stained specimens with asterisk.

*Color pattern.* The described color pattern is based on the preserved specimens, otherwise noted.

*Distribution.* Geographical distribution of each species is derived from present material and the acceptable literature which is shown with ecological data in p. 185.

*Institutional abbreviations.* BC: Department of Zoology, University of British Columbia. BCPM: Marine Biology Division, British Columbia Provincial Museum. FAKU: Department of Fisheries, Faculty of Agriculture, Kyoto University. FSKU: School of Fishery Science, Kitasato University. HUMZ: Laboratory of Marine Zoology, Faculty of Fisheries, Hokkaido University. MTUF: Museum, Tokyo University of Fisheries. NMC: Division of Ichthyology, National Museum of Canada. NSMT-P: Department of Zoology, National Science Museum, Tokyo. RMNH: Rijksmuseum van Natuurlijke Historie, Leiden. YCM-P: Yokosuka City Museum. ZUMT: Department of Zoology, University Museum, University of Tokyo.

### Family **Pholididae**

Pholididae GILL, 1893, Mem. Natn. Acad. Sci., **6**, p. 136.

*Type-genus.* *Pholis* SCOPOLI by subsequent designation.

*Diagnosis.* Fishes of the superfamily Stichaeoidea with, 1) hemanephrapophyses on abdominal vertebrae, 2) no pleural bone, 3) all dorsal and anal spines and rays possessing their own pterygiophores (the posteriormost pterygiophores do not seem to support two spines or rays), 4) branched caudal procurrent rays, 5) no lateral line canal on body, 6) no fleshy flap or crest, 7) toothless palatines, 8) five branchiostegals, 9) a pair of free median extrascapulars (tabulare supraoccipitale of MAKUSHOK).

*Description.* Diagnostic characters are not repeated. Body elongate and laterally compressed. Small scales on body (and head in *Enedrias*). Dorsal fin contains pungent spines only, counting from 73 to 100 (except for *Apodichthys sanctaerosae* which has a dwarf segmented ray in the posteriormost position). Anal fin contains two spines (very rarely three) and 32 to 53 soft rays. Anteriormost dorsal proximal pterygiophore embedded between the neural processes of the first and second vertebrae. No predorsal bone. Pectoral rays 7 to 16. Pelvic fin minute. Pelvic rays I, 1 or absent. Caudal rays 5-9+6-7+6-7+3-7. All soft rays branched save for several anterior procurrent rays. Vertebral column asymmetric. Vertebral number 80 to 105. Hemal process autogenous to the second pre-ural centrum (CP<sub>2</sub>) (fused in *Ap.*

*sanctaerosae*). Stegural one paired. Epurals three. Parhypural and hypurals 1 and 2 fused to each other but not to CP<sub>1</sub>. Hypurals 3 and 4 separated from each other and autogenous to CP<sub>1</sub>. Hypural 5 present or absent. Postcleithrum absent. Skull relatively deep with a high and almost truncate (except for *Ap. sanctaerosae*) ethmo-vomerine block. Frontals of both sides not fused to each other. Basisphenoid absent. Parasphenoid meets frontal at the posterior border of the orbit. Several conical teeth on vomer. Median extrascapulars (tabulare supraoccipitale of MAKUSHOK) and lateral extrascapulars not fused to the skull. Parietal with a fused median extrascapulars (tabulare parietale). BAUDELLOT's ligament to basioccipital. Hyoid apparatus made of dorsal and ventral hypohyals, a ceratohyal, an epihyal, an interhyal, an urohyal and five branchiostegals. The dorsal and ventral hypohyals interdigitated to the ceratohyal. Ceratohyal and epihyal not distinctly interdigitated in each other. Each of them with an exterior lateral flange. Just below these flanges, three branchiostegals to ceratohyal and two to epihyal. Branchial arches made of three basibranchials, three hypobranchials, four ceratobranchials, four epibranchials, three toothed upper and a toothed lower pharyngobranchials. Gill membranes broadly jointed and free from the isthmus.

*Phylogenetic position of the Pholididae.* MAKUSHOK (1958) classified the superfamily Stichaeoidea, all of whose members are included in the Zoarceoidae of GOSLINE (1968) that is finely defined by several osteological features, into four families, *i.e.*, Anarhichadidae, Pholididae, Ptilichthyidae, and Stichaeidae. Each of the former three families has its own unique character which is not shared in the other. Thus the three are considered monophyletic but their sister-group relationship can not be deduced from the data given by MAKUSHOK (1958). It may be postulated that intensive investigation of the Stichaeidae will reveal its polyphyly and that its members represent several plesiomorphic sisters of the highly specialized three other stichaeoid families. Or sister-groups of the stichaeoids should be invoked in the other northern blennioid lineages just as is the case of present classification of the perciform suborders and beryciform fishes (cf. GREENWOOD *et al.*, 1966; GOSLINE, 1968).

### Key to Genera

- 1a. Interorbital pore (**ito**) absent.
  - 2a. Head without scales.....*Pholis*
  - 2b. Head covered with small scales\* .....*Enedrias*
- 1b. **ito** present.
  - 3a. Pelvic fin present. Abdominal vertebrae less than 46. First and second anal spines equal in size.
    - 4a. Infraorbital pores (**ifo**) 6. Principal caudal rays 7+7 or 7+6. ....  
.....*Allopholis* gen. nov.
    - 4b. **ifo** 5. Principal caudal rays 6+6.....*Rhodymenichthys*

\* Scales may not appear in young less than about 50 mm SL.

- 3b. Pelvic fin absent. Abdominal vertebrae more than 49. First anal spine thicker than the second. . . . . *Apodichthys*

### Genus *Pholis* SCOPOLI

*Pholis* (GRONOVIVS) SCOPOLI, 1777, *Introductio ad Historiam . . .*, Tribus IX, p. 456 (type-species *Pholis maculis annulatis* [= *Blennius gunnellus*] by monotypy (GRONOVIVS, 1763, *Zoophylacii Gronoviani . . .*)). For the authorship, see International Commission of Zoological Nomenclature (1925, *Smithsonian Miscel. Coll.*, 73).

*Muraenoides* LACEPÈDE, 1800, *Hist. Nat. Poiss.*, 2, p. 324 (type-species *M. stujef* by monotypy).

*Centronotus* BLOCH and SCHNEIDER, 1801, *Syst. Ichth.*, p. 165 (type-species *C. fasciatus* by subsequent designation).

*Dactyleptus* RAFINESQUE, 1815, *Anal. de la Nature . . .*, p. 82 (type-species not given).

*Gunnellus* FLEMING, 1828, *Hist. Brit. Anim. . . .*, p. 207 (type-species *G. vulgaris*).

*Ophisomus* SWAINSON, 1839, *Nat. Hist. Monocard. Anim.*, p. 277 (type-species *Blennius gunnellus* by original designation).

*Asternopteryx* RÜPPELL, 1861, p. 288 (in GÜNTHER, *Cat. Brit. Mus.*, 3) (type-species *A. gunnelliformis* by monotypy).

*Urocentrus* KNER, 1868, *Sitzungsb. K. Akad. Wiss. Wien, math. nat.*, 58, p. 342 (type-species *U. pictus* by monotypy).

*Type-species.* *Blennius gunnellus* LINNAEUS.

*Diagnosis.* **ito** absent, **ifo** 6, head without scales, first and second anal spines equal in size.

*Description.* *Pholis* is the least specialized genus in the Pholididae and contains four species. Although *Pholis* is not proved to be monophyletic (possibly paraphyletic in the sense of NELSON, 1971), I tentatively treat it as a valid taxonomic unit. Body elongation is not so prominent for this family (*P. gunnellus* and *P. ornata*) or more or less prominent (*P. fasciata* and *P. picta*). In relation to the elongation, vertebrae (and dorsal and anal rays) increase in number from 81 to 101. Abdominal vertebrae less than 46. Body elongation does not accompany the reduction of paired fins except for some individual variation in *P. fasciata* (loss of pelvic fins; JENSEN, 1942). Cephalic sensory canal opening formula is generally: **na** 2, **ito** 0, **ifo** 6, **apo** + **ppo** 3+3, **oc** 1-1-1, **mn** + **pop** 4+5.

### Key to Species of *Pholis*

- 1a. Vertebrae less than 89. Head without faint vertical bar.  
 2a. Abdominal vertebrae 34 to 38. A series of 10 to 12 dark circles on dorsal fin base. . . . . *Pholis gunnellus*  
 2b. Abdominal vertebrae 38 to 41. A series of 12 to 14 U- or V-shaped dark markings on dorsal fin base . . . . . *Pholis ornata*  
 1b. Vertebrae more than 89. A faint vertical bar just behind eye.  
 3a. Pectoral fin length 38 to 54% of HL. . . . . *Pholis fasciata*  
 3b. Pectoral fin length 24 to 34% of HL. . . . . *Pholis picta*

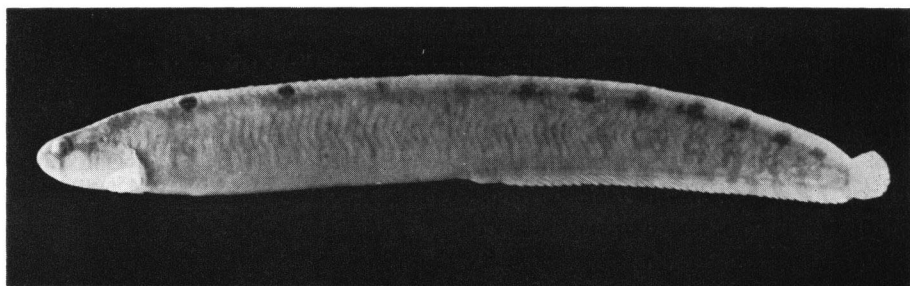


Fig. 2. *Pholis gunnellus* (LINNAEUS), NMC 73-68-1, 122.3 mm SL, collected from Kattegat Strait, Denmark, Jun., 1965.

*Pholis gunnellus* (LINNAEUS) "Rock gunnel"

(Fig. 2)

*Blennius gunnellus* LINNAEUS, 1758, Syst. Nat., ed. 10, p. 259.

*Ophidion imberbe* LINNAEUS, 1758, Syst. Nat., ed. 10, p. 259.

*Blennius enropoeus* OLAFSEN, 1772, Reisendurch Island., p. 81.

*Blennius muraenoides* SUJEF, 1779, Act. Acad. Petropol., p. 195.

*Muraenoides sujef* LACEPÈDE, 1800, Hist. Nat. Poiss., 2, p. 324.

*Ophidium mucronatum* MITCHILL, 1815, Fish. New York, p. 361.

*Gunnellus vulgaris* FLEMING, 1828, Hist. Brit. Anim., p. 207.

*Gunnellus guttata* YARREL, 1836, Hist. Brit. Fish., p. 269.

*Gunnellus ingens* STORER, 1857, Bost. J. nat. Hist., 6, p. 261.

*Gunnellus macrocephalus* GIRARD, 1857, p. 263 (in STORER, Bost. J. nat. Hist., 6).

*Material examined.* NMC 64-884 (1: 110.7), Quebec, Canada. NMC 72-246 (1: 82.8), Nova Scotia, Canada. NMC 73-68 (2: 122.3 and 119.1), Denmark. NMC 75-1895 (1: 31.7), Newfoundland I., Canada. NMC 73-337\* (1: 110.5), Newfoundland I.

*Diagnosis.* Abdominal vertebrae less than 38, dorsal spines less than 80, a series of 10 to 12 circles on dorsal fin base.

*Description.* D. (LXXIII)-LXXVI-LXXXVIII-(LXXXVI). A. II, (37)-40-42-(48). Vertebrae 35-36-(38)+48-50-(51)=83-85-(89). P<sub>1</sub>. (10)-11-13, 11.7±0.75. P<sub>2</sub>. I, 1. C. 5+6-7+6-8+2-4=20-22 (usually 5+7+7+3). Measurements (% of SL): predorsal length 12.8-15.5, 13.3±1.1; pre-anus length 49.6-53.6, 51.3±1.6; body depth 8.8-11.7, 10.7±1.1; head length 12.5-15.8, 13.6±1.2. Measurements (% of HL): snout length 16.0-20.0, 18.6±1.5; eye diameter 19.2-24.0, 21.0±1.9; upper jaw length 28.8-31.2, 30.1±0.8; interorbital width 8.9-11.6, 9.9±1.1; pectoral fin length 42.9-50.9, 47.4±3.0; caudal fin length 52.0-59.1, 55.9±2.9. Cephalic sensory canal openings show following variations: **ifo** 7 (2 of 12 instances), **apo+ppo** 3+5 (1 of 12), 4+3 (1 of 12), **oc** 1-1-2 (1 of 6), 2-1-1 (1 of 6).

*Color pattern.* An oblique dark bar across the eye. A series of equally spaced 10 to 12 dark circles on the dorsal fin base. Anterior circles clear while posterior ones obscured. Fourteen to twenty dark bars on the anal fin.

*Distribution.* From English Channel, England, north to Murman in the eastern

Atlantic (absent in the Baltic Sea). Iceland. Western Greenland north to about 70°N. From Massachusetts and the George Bank north to the eastern coast of Labrador in the western Atlantic (Fig. 16). The infraspecific status requires further investigation on the geographic variations among these several isolated populations.

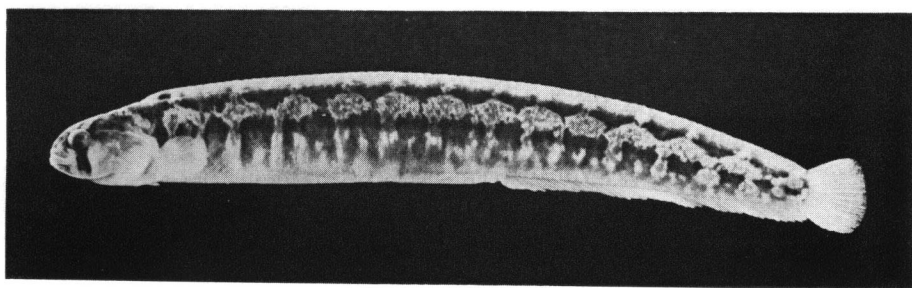


Fig. 3. *Pholis ornata* (GIRARD), NSMT-P 18583-1, 78.2 mm SL, collected from Patricia Bay (48°N, 123°W), British Columbia, Canada, May, 1978.

***Pholis ornata* (GIRARD) "Saddleback gunnel"**

[Japanese name: Aya-ginpo]

(Fig. 3)

*Gunnellus ornatus* GIRARD, 1854, Proc. Acad. nat. Sci., Phila., 7, p. 149.

*Material examined.* BCPM 971-55 (8: 100.0–134.1), Washington, U.S.A. NSMT-P 18524–18526 (3: 100.6–107.6), Washington. NSMT-P 18583\* (3: 78.2–114.3), British Columbia, Canada. NSMT-P 17302–17303 (2: 87.5 and 89.3), Hokkaido, Japan. NSMT-P 10065–10070\*–10075 (11: 36.0–93.6), Hokkaido.

*Diagnosis.* Dorsal spines less than 80, anal soft rays less than 38, a series of U- or V-shaped markings on dorsal fin base.

*Description.* D. LXXIV–LXXX. A. II, 34–38. Vertebrae 38–41+42–46=81–86. P<sub>1</sub>. 11–13, 11.9±0.7. P<sub>2</sub>. I, 1. C. 5–6+6–8+6–7+2–4=20–24 (usually 6+7+7+3). Measurements (% of SL): predorsal length 11.6–15.8, 12.9±1.1; pre-anus length 47.9–68.2, 56.8±3.6; body depth 10.5–13.4, 11.8±0.8; head length 11.5–15.6, 13.1±1.1. Measurements (% of HL): snout length 15.7–23.1, 18.9±1.4; eye diameter 17.7–24.6, 20.2±1.5; upper jaw length 25.5–33.0, 30.3±2.2; interorbital width 7.9–14.4, 10.7±1.5; pectoral fin length 28.6–52.4, 40.5±5.6; caudal fin length 46.4–70.1, 56.9±5.6. Cephalic sensory canal openings show no variation.

*Color pattern.* Twelve to fourteen U- or V-shaped dark markings on the dorsal fin base. Dusky bars in series along sides of body broadest at midside and disappearing ventrally in the eastern Pacific form, while these bars are more or less obscured in the western Pacific form. Several radiating dark bands around eye; a vertical one below eye prominent.

*Distribution.* North California to British Columbia in the eastern Pacific.

Southern Hokkaido in the western Pacific (Fig. 16). Thus *P. ornata* is made of two geographic populations. These two forms show some differences in both meristics and proportions as well as coloration. Morphological comparison and taxonomic studies of these forms are in preparation by Dr. PEDEN (BCPM).

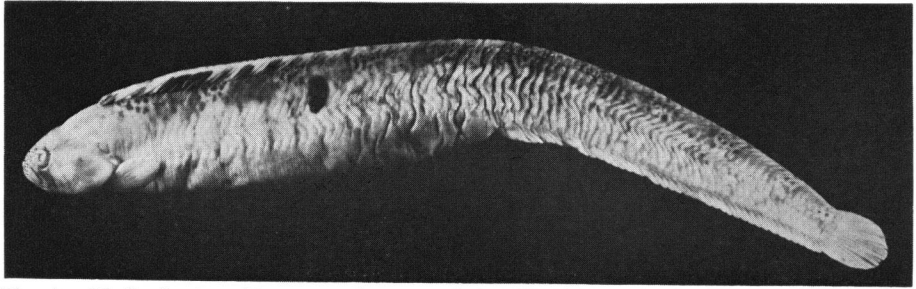


Fig. 4. *Pholis fasciata* (BLOCH et SCHNEIDER), NMC 74-250, 220.8 mm SL, collected from Hudson Bay (61.6°N, 94.0°W), NWT, Canada, Jul., 1974. A black blotch near the center of trunk is probably tumor, not specific character.

***Pholis fasciata* (BLOCH et SCHNEIDER) "Banded gunnel"**

(Fig. 4)

*Centronotus fasciatus* BLOCH and SCHNEIDER, 1801, Syst. Ichth., p. 165.

*Blennius taenia* PALLAS, 1811, Zoogr. Rosso-Asiat., 3, p. 178.

*Gunnellus groenlandicus* VALENCIENNES, 1836, Hist. Nat. Poiss., 11, p. 326.

*Gunnellus muraenoides* CUVIER and VALENCIENNES, 1836, p. 916, pl. 78, fig. 2 (in CUVIER, Règne Animal, ed. 3, Atlas).

*Asternopteryx gunnelliformis* RÜPPELL, 1861, p. 288 (in GÜNTHER, Cat. Brit. Mus., 3).

*Muraenoides maxillaris* BEAN, 1881, Proc. U. S. Natn. Mus., 4, p. 147.

*Pholis gilli* EVERMANN and GOLDSBOROUGH, 1907, Bull. Bur. Fish., 26, p. 337.

**Material examined.** NMC 62-568\* (1: 146.0), Northwest Territories (NWT), Canada (55.6°N, 79.4°W). NMC 67-311 (1: 203.4), NWT (67.5°N, 113.4°W). NMC 74-250\* (1: 220.8), NWT (61.1°N, 94.0°W).

**Diagnosis.** Dorsal spines 83 to 91, a dark vertical bar across eye posteriorly followed by a white band, pectoral fin length 42–49% of HL.

**Description.** D. (LXXXIII)–LXXXVII–LXXXIX–(XCI). A. II, (41)–43–45–(48). Vertebrae 44+50–52=(89)–94–96–(98). P<sub>1</sub>. 11–12–(13). P<sub>2</sub>. I, 1 (or absent). C. 6–7+7+7+4=24–25. Measurements (% of SL): predorsal length 10.4–12.0, 11.2±1.1; pre-anus length 54.1–55.3, 54.7±0.9; body depth 10.3–10.6, 10.5±0.2; head length 10.8–12.5, 11.7±1.2. Measurements (% of HL): snout length 18.1–18.6, 18.4±0.0; eye diameter 17.4–20.5, 19.0±2.2; upper jaw length 31.8–35.5, 33.7±2.6; interorbital width 8.6–9.1, 8.9±0.4; pectoral fin length 42.0–48.2, 45.1±4.4; caudal fin length 55.1–64.1, 59.6±6.4. Cephalic sensory canal openings show no variation.

**Color pattern.** About 11 dark bands on the trunk. A series of equally spaced 10 or 11 blotches in which several small dark dots exist at the dorsal edge of body.



A broad brown vertical bar across eye, posteriorly followed by a white vertical bar. Ground color is yellowish-gray, the sides a brilliant scarlet (LEIM & SCOTT, 1968).

*Distribution.* Widely distributed over the western Atlantic, the Arctic, the Hudson Bay, and the eastern Bering Sea. Contrary to western Atlantic records which show the relative abundance in the western coast of Greenland north to about 72°N and in the eastern coast of Labrador, the Arctic and Bering ones are rather scarce. Especially only one record in present material in the western Arctic (Fig. 16). The Bering representatives have been treated as *P. gilli*. Further investigations are required to determine the exact range of the species and the identity from these three oceans.

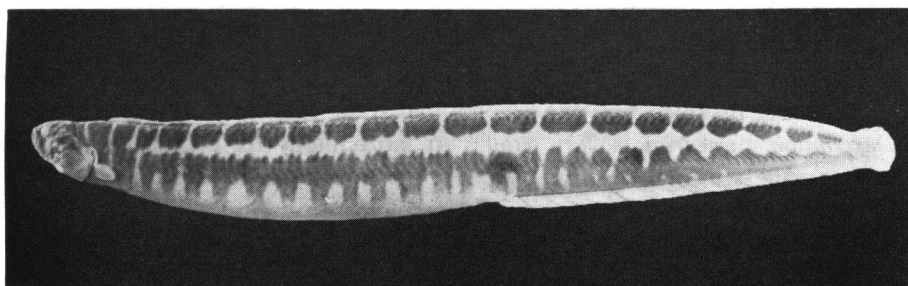


Fig. 5. *Pholis picta* (KNER), HUMZ 3883, 164.2 mm SL, collected from Etorofu Island, Kuril Islands, date unknown.

*Pholis picta* (KNER)

[Japanese name: Nishiki-ginpo]

(Fig. 5)

*Urocentrus pictus* KNER, 1868, Sitzungsab. K. Akad. Wiss. Wien, math. nat., **58**, p. 343.

*Material examined.* HUMZ 75530–75531 (2: 222.4 and 251.9), Hokkaido, Japan. HUMZ 3883\* and 3886 (2: 164.2 and 170.8), Kuril Islands. HUMZ 77993 (1: 202.0), Ishikawa Pref., Japan.

*Diagnosis.* Dorsal spines 89–95, pectoral fin length 25–31% of HL, a dark vertical bar across eye posteriorly followed by a white band.

*Description.* D. (LXXXIX)–XCI–XCIV–(XCV). A. II, 45–48. Vertebrae 45–46+53–55=98–101–(102). P<sub>1</sub>. (10)–12. P<sub>2</sub>. I, 1. C. 5–6+7+6–7+2–4=22–23 (usually 6+7+6+4). Measurements (% of SL): predorsal length 10.0–10.9, 10.3±0.4; pre-anus length 51.8–55.4, 54.1±1.4; body depth 9.3–12.6, 10.6±1.3; head length 9.9–11.0, 10.5±0.5. Measurements (% of HL): snout length 17.8–19.9, 18.9±0.8; eye diameter 14.5–18.8, 17.2±1.8; upper jaw length 29.4–31.8, 30.4±1.0; interorbital width 9.9–11.9, 11.1±0.8; pectoral fin length 25.6–30.4, 28.8±2.1; caudal fin length 50.9–53.7, 52.7±1.2. Cephalic sensory canal openings show following variations: **ifo** 7 (1 of 10 instances), **apo+ppo** 4+3 (1 of 10), **oc** 2-1-2 (1 of 5) and a pore on the left supraorbital canal (1 of 5).

*Color pattern.* A longitudinal faint line with 19 to 22 short slender vertical

branches to the dorsal fin base on the dorsal one third of body, beginning above pectoral fin and terminating at the caudal fin base against dark background. About 13 vertical faint short bars on the ventral half of trunk and anterior part of tail. A slender vertical band across eye, posteriorly followed by a broad white band.

*Distribution.* Northern part of the Sea of Japan to the southwestern Kamchatka via the Kuril Islands. Not recorded from the Okhotsk Sea (Fig. 16).

#### Genus *Enedrias* JORDAN et GILBERT

*Enedrias* JORDAN and GILBERT, 1898, p. 2414 (in JORDAN and EVERMANN, Bull., U. S. Natn. Mus., 47) (type-species *Gunnellus nebulosus* by monotypy).

*Type-species.* *Gunnellus nebulosus* TEMMINCK et SCHLEGEL.

*Diagnosis.* **ito** absent, **ifo** 6, small cycloid scales on head (snout, interorbital space, cheek and opercle), first and second anal spines equal in size.

*Description.* *Enedrias* is very similar in morphology to, and externally distinguishable by the scaled head from *Pholis*. The development of scales on head is unique and is considered to have been formed hypermorphically. Thus I recognize this character state as apomorphic and *Enedrias* as a valid taxonomic genus. *Enedrias* contains three species. Body elongation is not so prominent. Number of vertebrae 76 to 88. Abdominal vertebrae less than 41. Paired fins not reduced in both size and number of fin rays. *E. fangi* has the largest pectoral fin among the Pholididae. Cephalic sensory canal opening formula is generally: **na** 2, **ito** 0, **ifo** 6, **apo**+**ppo** 3+3, **oc** 1-1-1, **mn**+**pop** 4+5.

#### Key to Species of *Enedrias*

- 1a. Pectoral fin 30 to 46% of HL in length, containing 12 or 13 rays. Caudal fin evenly yellowish or light brown. A series of oblong dark markings on dorsal fin base.....*Enedrias crassispinia*
- 1b. Pectoral fin 40 to 66% of HL in length, containing 14 or 15 rays. Margin of caudal fin transparent or white; other part of it often mottled with dark blotches.
  - 2a. Pectoral fin length less than 56% of HL. A series of triangular black markings on dorsal fin base. ....*Enedrias nebulosa*
  - 2b. Pectoral fin length more than 58% of HL. A series of II-shaped small markings on dorsal fin base. ....*Enedrias fangi*

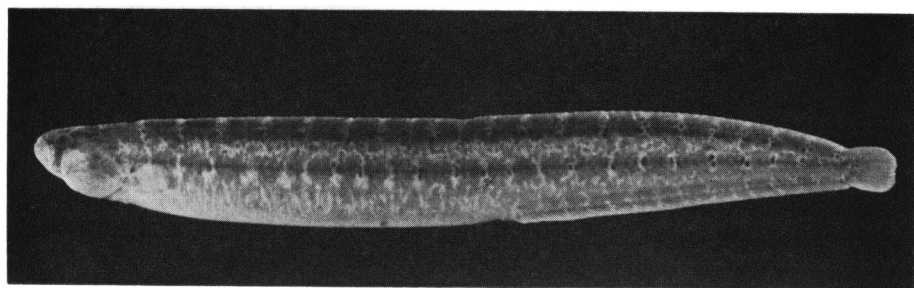


Fig. 6. *Enedrias crassispina* (TEMMINCK et SCHLEGEL), MTUF 24192-4, 127.8 mm SL, collected from Hachimori, Akita Pref., Japan, Aug., 1978.

*Enedrias crassispina* (TEMMINCK et SCHLEGEL)

[New Japanese name: Take-ginpo]

(Fig. 6)

*Gunnellus crassispina* TEMMINCK and SCHLEGEL, 1845, Fauna Japonica, Poiss., p. 139.

**Material examined.** RMNH 1781 (Holotype, only X-ray negative film examined) (1), probably Nagasaki Pref., Japan. YCM-P (1: 168.1), Kanagawa Pref. ZUMT 49036 (1: 133.0), Aichi Pref. ZUMT 31795–31799 (5: 95.7–165.5), Hyogo Pref. (Inland Sea). ZUMT 18238–18241 (4: 86.2–139.0), Aomori Pref. NSMT-P 5130, 5131, 5139–5141, 5143–5145, 5312, 5320, and 6417–6420 (15: 69.6–160.2), Iwate Pref. HUMZ 59575, 59586, and 59587 (3: 110.3–132.2), Niigata Pref. HUMZ 68180, 68190, and 75532 (3: 144.9–202.1), Hokkaido. MTUF 24185 (1: 174.7), Tokushima Pref. MTUF 24186 (1: 156.2), Shizuoka Pref. MTUF 24187 (1: 187.6), Yamaguchi Pref. MTUF 24155\* (2: 105.4 and 114.5), Hokkaido.

**Diagnosis.** Pectoral fin rays 12 or 13, pectoral fin length 30–46% of HL, caudal fin length 45–58% of HL, caudal fin uniformly yellowish or light brown.

**Description.** D. LXXIII–LXXXI. A. II, 34–41. Vertebrae 37–42+42–49=80–88. P<sub>1</sub>. 11–13, 12.5±0.5. P<sub>2</sub>. I, 1. C. 4–7+6–7+7+2–4=20–25 (usually 5+7+7+3). Measurements (% of SL): predorsal length 10.8–13.9, 12.4±0.7; pre-anus length 43.5–63.6, 55.3±3.1; body depth 10.1–16.9, 13.1±1.5; head length 10.8–13.8, 12.4±0.7. Measurements (% of HL): snout length 16.8–22.9, 18.5±1.3; eye diameter 17.9–22.7, 19.5±1.4; upper jaw length 25.6–37.0, 29.7±2.6; interorbital width 9.2–16.4, 11.8±1.4; pectoral fin length 30.3–46.0, 37.8±3.4; caudal fin length 45.0–57.3, 51.4±2.7. Cephalic sensory canal openings show no variation.

**Color pattern.** Body mottled with brown small spots against yellowish to greenish background. A series of 18 to 24 equally spaced light brownish blotches in which several brown or black dots exist on the dorsal edge of body against dark oblong interspaces. Caudal fin uniformly light brown or faint yellow.

**Distribution.** The Yellow Sea, Po-hai, and around Japan north to Hokkaido (Fig. 16). Probably in the western part of the Sea of Japan.

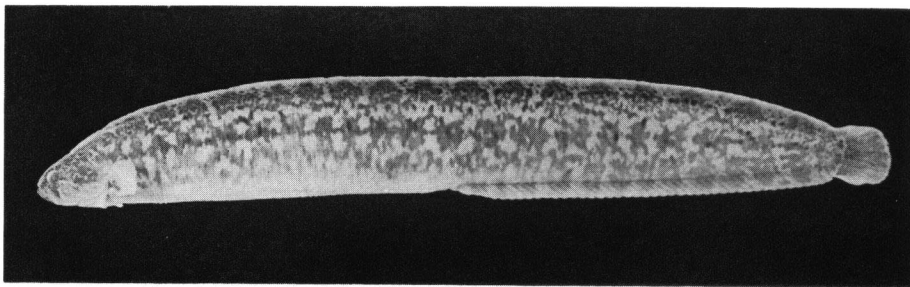


Fig. 7. *Enedrias nebulosa* (TEMMINCK et SCHLEGEL), MTUF 24173-3, 208.3 mm SL, collected from Hamana-ko, Shizuoka Pref., Japan, Apr., 1978.

*Enedrias nebulosa* (TEMMINCK et SCHLEGEL)

[Japanese name: Ginpo]

(Fig. 7)

*Gunnellus nebulosus* TEMMINCK and SCHLEGEL, 1845, Fauna Japonica, Poiss., p. 138.

*Centronotus subfraenatus* GILL, 1860, Proc. Acad. nat. Sci. Phila., 1860, p. 146.

*Material examined.* RMNH 1788 (Lectotype, only X-ray negative film examined) (1), Nagasaki Pref., Japan. MTUF 24176 (4: 230.0–265.3), Kanagawa Pref. MTUF 24172 (9: 116.8–216.2), Shizuoka Pref. MTUF 24170 (2: 219.3 and 221.2), Yamaguchi Pref. MTUF 24167–24168 (8: 181.4–217.6), Nagasaki Pref. MTUF 24180–24181 (4: 220.8–290.2), Iwate Pref. HUMZ 75426–75428 (3: 206.0–253.2), Hokkaido. MTUF 24156\* (2: 116.0 and 116.5), Kanagawa Pref. MTUF 24177 (1: 200.5), Chiba Pref. FAKU 11973–11976 (4) (only meristic data taken), Kyoto Pref. ZUMT 32382, 32674, and 32718 (3: 197.4–246.9), Toyama Pref. HUMZ 65607 (1: 203.0), Ishikawa Pref.

*Diagnosis.* Pectoral fin 40–54% of HL in length, containing 14 or 15 rays, caudal fin length 51–70% of HL, a series of triangle black markings on dorsal fin base.

*Description.* D. LXXVI–LXXXIII. A. II, 35–42 (very rarely III; 1 of 40 specimens). Vertebrae 39–43+43–49=83–90. P<sub>1</sub>. 13 (3 of 80 instances)–15, 14.4±0.6. P<sub>2</sub>. I, 1. C. 5–6+6–7+7+3–5=22–25 (usually 6+7+7+4). Measurements (% of SL): predorsal length 9.9–13.4, 11.1±0.7; pre-anus length 52.2–67.1, 55.4±2.6; body depth 11.2–15.3, 13.2±0.9; head length 10.7–14.0, 11.8±0.7. Measurements (% of HL): snout length 16.3–22.2, 19.4±1.3; eye diameter 14.1–19.2, 17.3±1.4; upper jaw length 24.6–38.8, 31.9±2.6; interorbital width 11.0–16.4, 13.7±1.3; pectoral fin length 39.6–53.9, 48.0±3.2; caudal fin length 51.8–69.5, 61.8±4.7. Cephalic sensory canal openings show following variations: **ifo** 7 (3 of 42 instances), **mn+pop** 4+3 (1 of 42).

*Color pattern.* Body mottled with brown or black spots and with irregularly shaped dark reticulation. A series of equally spaced 17 to 24 dark and more or less triangular blotches on the dorsal fin base. Caudal fin with irregular dark blotches or

uniformly dark excepting its white or transparent margin.

*Distribution.* Around Japan from Nagasaki and Kochi north to the southern Hokkaido (Fig. 16). Probably in the western part of the Sea of Japan.

*Enedrias fangi* WANG et WANG

(Fig. 8)

*Enedrias fangi* WANG and WANG, 1935, Contr. biol. Lab. Sci. Soc. China, 11, p. 215.

*Material examined.* ZUMT 51391 and 51482–51484\*–51485 (5: 126.8–150.1), East China Sea (northern part). NSMT-P 18656\* (3: 136.3–153.7), Pusan fish market, Korea.

*Diagnosis.* Pectoral fin 58–64% of HL in length, containing 14 or 15 rays, caudal fin length 57–67% of HL, a series of II-shaped small markings on dorsal fin base.

*Description.* D. LXXVII–LXXXI. A. II, (39)–40–45. Vertebrae 35–37+47–51=84–87. P<sub>1</sub>. 13 (1 of 16 instances)–15–(16), 14.4±0.6. P<sub>2</sub>. I, 1. C. 5–7+7–8+7+3–5=23–27 (usually 6+7+7+5). Measurements (% of SL): predorsal length 12.2–14.7, 13.2±0.8; pre-anus length 50.2–53.9, 51.9±1.3; body depth 12.5–13.2, 12.9±0.2; head length 12.2–14.1, 13.2±0.7. Measurements (% of HL): snout length 17.6–23.3, 21.2±1.6; eye diameter 18.1–23.5, 21.2±1.8; upper jaw length 27.9–35.2, 30.8±2.4; interorbital width 13.1–15.7, 14.3±1.0; pectoral fin length 58.4–63.6, 60.1±2.5; caudal fin length 56.7–66.5, 62.3±2.9. Cephalic sensory canal openings show following variation: **apo+ppo** 4+3 (1 of 10 instances).

*Color pattern.* A series of equally spaced 15 or 16 faintly dark H-shaped reticulation on body. A series of 16 to 18 II-shaped small dark markings on dorsal fin base.

*Distribution.* Restricted in the Yellow Sea and Po-hai (Fig. 16). Possibly also in the northern part of the East China Sea.



Fig. 8. *Enedrias fangi* WANG et WANG, ZUMT 51391, 137.4 mm SL, collected from East China Sea (36.2°N, 120.5°E), Oct., 1959.

*Allopholis* gen. nov.

*Type-species.* *Centronotus laetus* COPE.

*Diagnosis.* **ito** present, head without scales, first and second anal spines equal in size, principal caudal rays 7+7 or 7+6, **ifo** 6.

*Description.* *Allopholis* is considered monophyletic due to the presence of the fragmented infraorbital bones: more than 7 including the lacrimal, in contrast to 5 in *Apodichthys* or 6 in the other genera. *Allopholis* contains three species. Body elongation is not so prominent (*Al. laeta*) or prominent (*Al. clemensi* and *Al. schultzi*). The elongation accompanies the increase of vertebral number from 82 to 92, but paired fins do not show any reduction. Cephalic sensory canal opening formula is generally: **na** 2, **ito** 1, **ifo** 6, **apo+ppo** 3+3, **oc** 1-1-1, **mn+pop** 4+5 (*Al. laeta* and *Al. clemensi*) or 3+5 (*Al. schultzi*).

*Etymology.* A combination of the Greek *allos* (meaning other, different) and *pholas* (one who lies in wait; original form of the generic name *Pholis*) referring to its phyletic position in the family.

Key to Species of *Allopholis*

- 1a. Mandibular pores (**mn**) 4. Anal soft rays less than 39 or more than 48.
  - 2a. Pectoral fin length 30 to 41% of HL. Vertebrae less than 90. Anal soft rays 34 to 39. .... *Allopholis laeta*
  - 2b. Pectoral fin length 45 to 50% of HL. Vertebrae more than 90. Anal soft rays 48 to 53. .... *Allopholis clemensi*
- 1b. **mn** 3. Anal soft rays 40 to 44. .... *Allopholis schultzi*

*Allopholis laeta* (COPE) "Crescent gunnel"

(Fig. 9)

*Centronotus laetus* COPE, 1873, Proc. Amer. phil. Soc., 13, p. 27.

*Material examined.* ZUMT 19784–19786 (4: 79.0–98.9), Alaska, U.S.A. NSMT-P 18527–18528\*–18529 (3: 83.1–143.8), Alaska. NMC 61-15 (4: 30.0–36.1), Alaska.



Fig. 9. *Allopholis laeta* (COPE), NSMT-P 18596, 80.6 mm SL, collected from Patricia Bay (48°N, 123°W), British Columbia, Canada, May, 1978.

NMC 61-141 (1: 84.7), Alaska. NMC 61-146 (2: 78.8 and 113.9), Alaska. NMC 61-162 (1: 80.0), Alaska. NMC 63-13 (2: 31.9 and 36.2), Alaska. NMC 68-1337 (3: 100.0–109.5), British Columbia, Canada. BC 63-305 (3: 47.1–50.0), Amchitka I., Aleutian Archipelago. NMC 61-151 (1: 94.9), Alaska. NSMT-P 18580\* (3: 78.7–136.3), British Columbia.

*Diagnosis.* Dorsal spines 74–81, anal soft rays 34–39, a series of ( )-shaped markings on the dorsal fin base.

*Description.* D. (LXXIV)–LXXV–LXXXI. A. II, 34–39. Vertebrae 39–42+41–46=82–87. P<sub>1</sub>. 11–12–(13), 11.9±0.4. P<sub>2</sub>. I, 1. C. 5–6+7+6–7+2–4=21–24 (usually 6+7+7+3–4). Measurements (% of SL): predorsal length 11.5–14.4, 12.6±1.1; pre-anus length 50.5–57.9, 55.2±2.0; body depth 10.1–11.7, 11.1±0.6; head length 11.3–15.5, 12.8±1.3. Measurements (% of HL): snout length 15.7–20.8, 18.4±1.4; eye diameter 17.5–24.5, 20.8±2.0; upper jaw length 25.4–32.9, 29.2±1.8; interorbital width 8.2–13.0, 10.0±1.5; pectoral fin length 30.7–40.9, 37.7±2.5; caudal fin length 46.7–63.3, 54.9±4.5. Cephalic sensory canal openings show following variations: **ifo** 7 (1 of 48 instances), **apo+ppo** 4+3 (1 of 48), **mn+pop** 6+5 (1 of 48).

*Color pattern.* Body slightly mottled with faint spots against dark background. A series of equally spaced ( )-shaped black markings on the dorsal edge of body. Each of these pair of parentheses encloses an orange or yellow area which extends beyond the parentheses on the body and on the fin to its margin (HART, 1973). A slender vertical bar below eye and two slender oblique lines above eye.

*Distribution.* North California to the Aleutian Archipelago (west to the Attu I.) (Fig. 16).

*Allopholis clemensi* (ROSENBLATT) “Longfin gunnel”

(Fig. 10)

*Pholis clemensi* ROSENBLATT, 1964, J. Fish. Res. Board Canada, 21, p. 935.

*Material examined.* BCPM 976-1291\* (3: 90.2–112.5), British Columbia, Canada. BC 75-7 (1: 51.5), British Columbia.

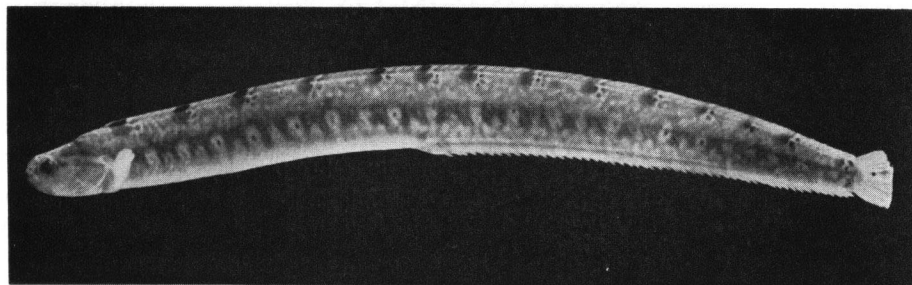


Fig. 10. *Allopholis clemensi* (ROSENBLATT), BCPM 976-1290-3, 91.4 mm SL, collected from Finlayson Arm, Vancouver Island, British Columbia, Canada, Mar., 1976.

*Diagnosis.* Dorsal spines 87–92, anal soft rays 48–53, pectoral fin length 45–49% of HL.

*Description.* D. (LXXXVII)–LXXXIX–XCII. A. II, (48)–51–53. Vertebrae (37)–39–40+56–59=95–98. P<sub>1</sub>. (11)–12–14, 13.1±0.7. P<sub>2</sub>. I, 1. C. 6+7+6–7+3–5=23–24 (usually 6+7+6+5). Measurements (% of SL): predorsal length 10.5–13.0, 11.3±1.2; pre-anus length 45.4–47.5, 46.5±1.0; body depth 8.5–9.3, 8.5±0.4; head length 10.7–13.2, 11.5±1.1. Measurements (% of HL): snout length 17.5–20.6, 18.4±1.5; eye diameter 22.5–25.5, 24.5±1.4; upper jaw length 26.5–32.4, 28.8±2.7; interorbital width 11.8–12.5, 12.0±0.3; pectoral fin length 45.0–49.0, 46.9±1.9; caudal fin length 64.7–69.6, 67.2±2.0. Cephalic sensory canal openings show no variation.

*Color pattern.* Body mottled with faint small spots, those on the ventral half are relatively large, against brown or tan background. A series of equally spaced 14 to 16 dark spots, each of which followed posteriorly by a faint blotch with several dots in it on the dorsal edge of body.

*Distribution.* Restricted to Washington and British Columbia (Fig. 16).

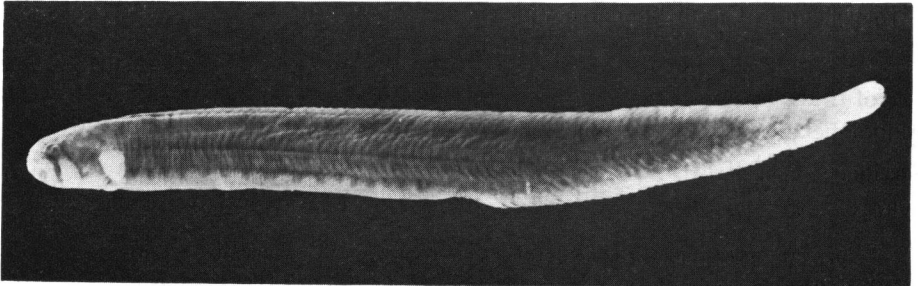


Fig. 11. *Allopholis schultzi* (HUBBS), NSMT-P 18522, 63.2 mm SL, collected from St. George (41.5°N, 124.2°W), California, U.S.A., Nov., 1950.

*Allopholis schultzi* (HUBBS) "Red gunnel"

(Fig. 11)

*Pholis schultzi* HUBBS, 1931, p. 45 (in SCHULTZ, Fish. Wash. Ore.).

*Material examined.* NSMT-P 18521\*–18523 (3: 56.0–93.3), California, U.S.A. NMC 65-136 (2: 48.9 and 66.9), British Columbia, Canada.

*Diagnosis.* Dorsal spines 80–89, anal soft rays 40–44, mandibular series of cephalic sensory canal openings (mn) 3.

*Description.* D. (LXXX)–LXXXV–LXXXVII–(LXXXIX). A. II, (40)–42–44. Vertebrae 41–43+49–52=(89)–91–93. P<sub>1</sub>. (10)–12–13, 12.3±0.5. P<sub>2</sub>. I, 1. C. 5–6+7+7+2–3=22–23 (usually 6+7+7+3). Measurements (% of SL): predorsal length 10.7–14.4, 12.3±1.4; pre-anus length 52.4–53.4, 52.7±0.5; body depth 8.9–9.7, 9.2±0.4; head length 11.3–13.3, 12.2±0.9. Measurements (% of HL): snout length 14.3–18.5, 17.2±2.0; eye diameter 20.0–24.4, 22.0±2.2; upper jaw length 28.4–30.8, 30.0±1.6; interorbital width 11.4–13.4, 12.3±0.8; pectoral fin length 38.1–40.5, 39.0±1.1; caudal



fin length 50.0–55.4,  $52.9 \pm 2.2$ . Cephalic sensory canal openings show no variation.

*Color pattern.* Body uniformly brown and spotted with small faint circles. A vertical slender dark bar below eye followed by an oblique broad white space posteriorly.

*Distribution.* Middle California to Vancouver I., British Columbia.

### Genus *Rhodymenichthys* JORDAN et EVERMANN

*Rhodymenichthys* JORDAN and EVERMANN, 1896, Rept. U. S. Fish Comm., 21, p. 474 (type-species *Gunnellus ruberrimus* [= *Blennius dolichogaster*] by original designation).

*Type-species.* *Blennius dolichogaster* PALLAS.

*Diagnosis.* **ito** present, **ifo** 5, head without scales, first and second anal spines equal in size, principal caudal rays usually 6+6.

*Description.* Monotypic *Rhodymenichthys* has some specialized character states whose evolutionary direction seems to be different from that of *Apodichthys*. Body relatively elongated with entire paired fins. Vertebrae much variable in number from 87 to 101. Cephalic sensory canal opening formula is: **na** 2, **ito** 1, **ifo** 5, **apo**+**ppo** 3+3, **oc** 1-1-1, **mn**+**pop** 4+5.

### *Rhodymenichthys dolichogaster* (PALLAS) “Stippled gunnel”

[Japanese name: Hakodate-ginpo]

(Fig. 12)

*Blennius dolichogaster* PALLAS, 1811, Zoogr. Rosso-Asiat., 3, p. 175.

*Gunnellus ruberrimus* VALENCIENNES, 1836, Hist. Nat. Poiss., 11, p. 324.

*Centronotus taczanowskii* STEINDACHNER, 1881, Sitzungsab. K. Akad. Wiss. Wien, math. nat., 82, p. 261.

*Material examined.* FSKU 750812 (1: 134.0), Iwate Pref., Japan. ZUMT 16172–16175 (4: 96.4–126.3), Iwate Pref. NSMT-P 10076, 10100, 10225–10228 and 10410 (7: 54.1–152.7), Hokkaido. ZUMT 13533 (1: 57.8), Niigata Pref. NSMT-P 3207 (1: 131.6), Kuril Islands. ZUMT uncatalogued (1: 120.2), probably Voedimir Bay, USSR.



Fig. 12. *Rhodymenichthys dolichogaster* (PALLAS), NSMT-P 10076, 70.4 mm SL, collected from Hidaka, Hokkaido, Japan, Aug., 1964.

*Diagnosis.* Cephalic sensory canal openings in infraorbital series (**ifo**) 5, a silver (dark, in preserved condition) streak across eye to pectoral fin base.

*Description.* D. LXXX-XCII-(XCVI). A. II, 40-49-(51) (rarely III; 1 of 15 specimens). Vertebrae 37-44-(45)+48-57=87-98-(101). P<sub>1</sub>. 13-15, 13.9±0.7. P<sub>2</sub>. I, 1. C. 5-6+6-7+5-6+2-4=19-23 (usually 6+6+6+3). Measurements (% of SL): predorsal length 10.2-15.1, 12.7±1.2; pre-anus length 51.8-57.0, 54.8±1.5; body depth 10.2-13.5, 11.8±1.0; head length 10.9-14.0, 12.6±1.0. Measurements (% of HL): snout length 18.5-22.9, 20.6±1.3; eye diameter 17.9-26.3, 21.5±2.3; upper jaw length 28.3-31.0, 29.6±0.8; interorbital width 12.3-15.8, 13.9±1.0; pectoral fin length 30.6-40.8, 35.8±2.8; caudal fin length 38.1-46.2, 42.5±3.0. Cephalic sensory canal openings show no variation.

*Color pattern.* Body uniformly olive but sometimes mottled with dark dots. A narrow black (silver when alive) longitudinal streak across eye and obliquely downward to pectoral fin base. Body color when alive varies from dark brown to green matching the vegetation (TOYOSHIMA, pers. comm.).

*Distribution.* Northern part of the Sea of Japan, northern Honshu (Iwate Pref., Japan), southern Sakhalin northeast to the Commander Islands through the Kuril Islands (Fig. 16). LINDBERG and KRASYUKOVA (1975) reduced *dolichogaster* and *taczanowskii* to conspecific and regarded them as two subspecies; *i.e.*, *dolichogaster* (*sensu stricto*) from the Okhotsk, the Bering and northern part of the Sea of Japan on one hand, *taczanowskii* from the southern part of the Sea of Japan and the southern part of the Kuril chain on the other. LINDBERG and KRASYUKOVA (1975) distinguished these subspecies by the number of dorsal spines, the presence or absence of dark dots on body, etc. However, when we take into accounts that two Japanese *Enedrias* species show much geographic cline in vertebral number (YATSU, 1980), we should wait to accept these subspecific separation until numerous specimens from broad geographic range are examined.

#### Genus *Apodichthys* GIRARD

*Apodichthys* GIRARD, 1854, Proc. Acad. nat. Sci. Phila., 7, p. 150 (type-species *A. flavidus* by subsequent designation).

*Xererpes* JORDAN and GILBERT, 1895, p. 846 (in JORDAN and STARKS, Proc. Calif. Acad. Sci., 5) (type-species *A. fucorum* by monotypy).

*Ulvicola* GILBERT and STARKS, 1897, p. 455 (in GILBERT, Proc. U.S. Natn. Mus., 19) (type-species *U. sanctaerosae* by monotypy).

*Type-species.* *Apodichthys flavidus* GIRARD.

*Diagnosis.* **ito** present, **ifo** 6, head without scales, first anal spine thicker than the second, principal caudal rays 6+6 or 7+7, pelvic fin absent, abdominal vertebrae more than 49.

*Description.* *Apodichthys* is the most specialized group among the Pholididae. Three species included in the genus show considerable morphological differences, *e.g.*, in pectoral fin and caudal fin and their supporting skeletons. Body elongated accom-

panying the increase of vertebral number and reduction of paired fins. Pelvic fin is absent and pectoral fin reduced completely in *Ap. sanctaerosae* via *Ap. fucorum* (about 12% of HL in length, containing 11 or 12 rays). Cephalic sensory canal opening formula is: **na** 2, **ito** 1, **ifo** 6, **apo**+**ppo** 3+3, **oc** 1-1-1, **mn**+**pop** 4+5.

### Key to Species of *Apodichthys*

- 1a. A groove present on the ventral surface of the first anal spine. Pectoral rays 14 or 15. . . . . *Apodichthys flavidus*
- 1b. First anal spine normal in shape. Pectoral rays less than 12.
  - 2a. Pectoral fin about 12% of HL in length and containing 11 or 12 rays. Vertebrae less than 100. . . . . *Apodichthys fucorum*
  - 2b. Pectoral fin minute and difficult to count its rays externally. Vertebrae more than 100. . . . . *Apodichthys sanctaerosae*

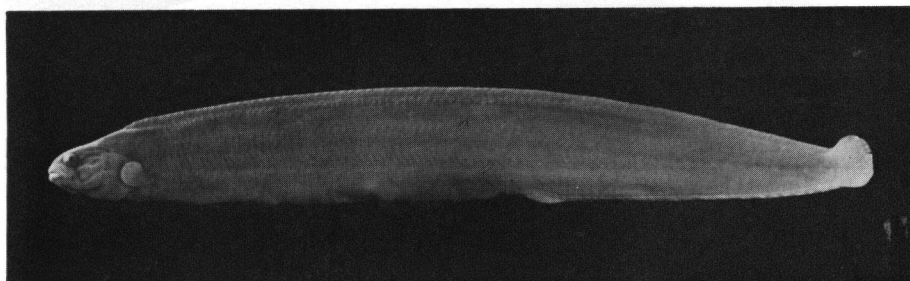


Fig. 13. *Apodichthys flavidus* GIRARD, NSMT-P 18531, 153.5 mm SL, collected from Point Arena (38.6°N, 123.4°W), California, U.S.A., Aug., 1964.

### *Apodichthys flavidus* GIRARD "Penpoint gunnel"

(Fig. 13)

*Apodichthys flavidus* GIRARD, 1854, Proc. Acad. nat. Sci. Phila., 7, p. 150.

*Apodichthys virescence* AYRES, 1855, Proc. Calif. Acad. nat. Sci., 1855, p. 55.

*Apodichthys inornatus* GILL, 1862, Proc. Acad. nat. Sci. Phila., 1862, p. 279.

*Apodichthys sanguensis* GILL, 1862, Proc. Acad. nat. Sci. Phila., 1862, p. 279.

*Apodichthys univittatus* LOCKINGTON, 1881, Proc. Acad. nat. Sci. Phila., 1881, p. 118.

*Material examined.* NSMT-P 18530–18532\* (3: 67.2–163.2), California, U.S.A. NMC 66-240 (3: 58.4–76.9), British Columbia, Canada. NMC 61-25 (2: 26.6 TL and 40.6 TL), Alaska, U.S.A. NMC 61-26 (7: 29.0 TL–41.6 SL), Alaska.

*Diagnosis.* First anal spine has a groove on the ventral surface, dorsal spines 86–96, anal soft rays 35–43.

*Description.* D. (LXXXVI)–LXXXIX–XCVI. A. II, (35)–38–43. Vertebrae 49–51+47–52=96–101. P<sub>1</sub>. 14–15–(17), 14.8±0.4. P<sub>2</sub>. absent. C. 8+7+7+4–5=26–27 (usually 8+7+7+5). Measurements (% of SL): predorsal length 11.3–15.9, 13.6±1.6;

pre-anus length 56.3–60.8,  $58.4 \pm 1.4$ ; body depth 10.3–14.0,  $11.6 \pm 1.3$ ; head length 11.0–15.3,  $13.8 \pm 1.9$ . Measurements (% of HL): snout length 16.7–20.9,  $18.5 \pm 1.4$ ; eye diameter 17.5–23.0,  $20.6 \pm 2.2$ ; upper jaw length 26.0–30.0,  $27.8 \pm 1.4$ ; interorbital width 10.4–13.5,  $11.7 \pm 1.1$ ; pectoral fin length 33.3–40.6,  $36.5 \pm 2.7$ ; caudal fin length 42.5–50.7,  $45.9 \pm 2.6$ . Cephalic sensory canal openings show following variations: **apo+ppo** 4+3 (3 of 20 instances), **mn+pop** 5+5 (2 of 20), 4+6 (1 of 20).

*Color pattern.* Body uniformly olive. A narrow dark oblique bar across cheek downwardly from eye. Color when alive varies from green through brown to red (HART, 1973).

*Distribution.* Southern California (Santa Barbara) north to Kodiak I., Alaska (Fig. 16).

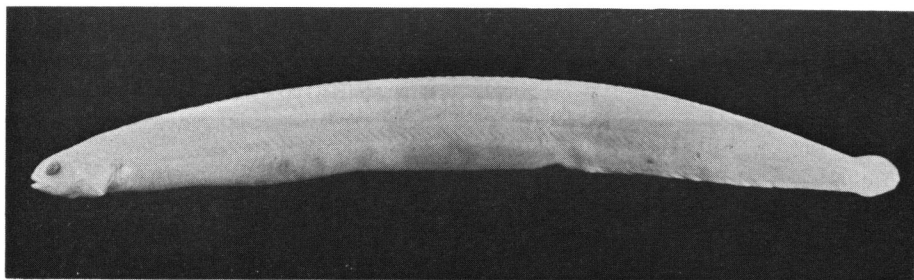


Fig. 14. *Apodichthys fucorum* JORDAN et GILBERT, NSMT-P 18538, 97.1 mm SL, collected from Jack Peters Creek (39.2°N, 128.5°W), California, U.S.A., Jul., 1964.

*Apodichthys fucorum* JORDAN et GILBERT "Rockweed gunnel"

(Fig. 14)

*Apodichthys fucorum* JORDAN and GILBERT, 1880, Proc. U.S. Natn. Mus., 3, p. 139.

*Material examined.* NSMT-P 18536–18538\* (3: 97.1–153.5), California, U.S.A. NMC 62-32 (1: 82.8), British Columbia, Canada.

*Diagnosis.* Pectoral fin 15–18% of HL in length and containing 11 or 12 rays, dorsal spines 82–87, anal soft rays 28–37.

*Description.* D. (LXXXII)–LXXXIV–LXXXVI–(LXXXVII). A. II, (28)–30–33–(37). Vertebrae 51–53+37–40=(84)–90–92–(93). P<sub>1</sub>. 11–12,  $11.5 \pm 0.5$ . P<sub>2</sub>. absent. C. 9+7+7+6–7=29–30 (usually 9+7+7+6). Measurements (% of SL): predorsal length 11.9–12.3,  $12.1 \pm 0.2$ ; pre-anus length 62.8–64.8,  $63.9 \pm 0.8$ ; body depth 10.1–10.9,  $10.5 \pm 0.3$ ; head length 10.8–12.1,  $11.3 \pm 0.6$ . Measurements (% of HL): snout length 18.1–20.6,  $19.2 \pm 1.0$ ; eye diameter 17.6–20.0,  $19.0 \pm 1.2$ ; upper jaw length 26.0–32.9,  $28.3 \pm 3.1$ ; interorbital width 9.5–13.0,  $11.3 \pm 1.5$ ; pectoral fin length 15.0–17.6,  $16.5 \pm 1.1$ ; caudal fin length 46.9–52.9,  $49.6 \pm 2.8$ . Cephalic sensory canal openings show following variations: **oc** 2-1-2 (1 of 4 instances), a pore on the left supraorbital canal (1 of 4).

*Color pattern.* Uniformly olive. When alive it is polychromatic with dark red

and bright green (BURGESS, 1978).

*Distribution.* Middle California (Monterey) to Vancouver I., British Columbia (Fig. 16).



Fig. 15. *Apodichthys sanctaerosae* (GILBERT et STARKS), NSMT-P 18535, 131.7 mm SL, collected from La Jolla (32.5°N, 117.2°W), California, U.S.A., Nov., 1948.

*Apodichthys sanctaerosae* (GILBERT et STARKS) "Kelp gunnel"

(Fig. 15)

*Ulvicola sarctaerosae* GILBERT and STARKS, 1897, p. 455 (in GILBERT, Proc. U.S. Natn. Mus., 19).

*Material examined.* NSMT-P 18533-18535\* (3: 131.7-246.6), California, U.S.A.

*Diagnosis.* Pectoral fin nearly absent, dorsal spines 98-109, anal soft rays 39-46.

*Description.* D. XCVIII-CIX, 1. A. II, (39)-45-46. Vertebrae 51-52+53-54=105-(107). P<sub>1</sub>. 7 (from a dissected specimen, externally uncountable). P<sub>2</sub>. absent. C. 7+6+6+4-5=23-24 (usually 7+6+6+4). Measurements (% of SL): predorsal length 9.3-11.0, 10.2±0.9; pre-anus length 53.1-54.1, 53.7±0.5; body depth 8.4-9.0, 8.7±0.3; head length 8.8-10.3, 9.6±0.8. Measurements (% of HL): snout length 20.6-25.6, 22.3±2.9; eye diameter 14.2-16.7, 15.4±1.3; upper jaw length 23.8-35.8, 28.2±6.6; interorbital width 9.3-11.9, 10.5±1.3; pectoral fin length unmeasurable; caudal fin length 45.7-63.5, 55.2±9.0. Cephalic sensory canal openings show no variation.

*Color pattern.* Uniformly olive. When alive color varies yellowish-tan to brown, and red-brown (MILLER and LEA, 1972).

*Distribution.* Guadalupe I. (29°N, 118°W), Baja California to middle California (Pacific Grove) (Fig. 16).

**Distributional Records both Geographical and Ecological**

*Geographical records.* The map (Fig. 16) is primarily based on the present material and subsequently on the acceptable records which are shown below.

*Pholis gunnellus:* JORDAN and EVERMANN (1898), JENSEN (1942), BACKUS (1957), GORDON and BACKUS (1957), LEIM and SCOTT (1968) and WHEELER (1969).

Table 1. An outline of habitat of fourteen species of the Pholididae. 1, WHEELER, 1969; 2, GORDON and BACKUS, 1957; 3, MILLER and LEA, 1972; 4, ARAI, pers. comm.; 5, HART, 1973; 6, NMC record; 7, GILBERT, 1895; 8, PINCHUK, 1976; 9, TOYOSHIMA, pers. comm.; 10, pers. observation; 11, ZUMT record; 12, WILIMOVSKY, 1963; 13, PEDEN and WILSON, 1976; 14, PEDEN, 1966; 15, NSMT-P record; 16, HUBBARD and REEDER, 1965; 17, BURGESS, 1978; 18, GILBERT, 1897.

species	depth	bottom	vegetation
<i>P. gunnellus</i>	tidepool (1, 2); littoral to 40 m (1)	rock, sand, mud (1)	
<i>P. ornata</i>	intertidal (3, 4) to 50 m (3)	rock (4), mud (5)	<i>Zostera</i> (4)
<i>P. fasciata</i>	midtidal (6) or subtidal (2) to 19 m (7)	opencoast gravel, rock boulders (6)	
<i>P. picta</i>	intertidal (8, 9) to 30 m (9)		<i>Phyllospadix</i> (9)
<i>E. crassispina</i>	intertidal to 5 m (10)	rock, sand, shellsand (10)	<i>Sargassum, Zostera</i> (10)
<i>E. nebulosa</i>	intertidal [young] to 20 m (10)	sand, mud (10)	
<i>E. fangi</i>	ca. 30 m (11)	probably sand or mud (11)	
<i>Al. laeta</i>	intertidal (5, 12) to 73 m (5)	gravel, shell, mud, sand clay (13)	<i>Zostera, Ulva</i> , etc. (13)
<i>Al. clemensi</i>	subtidal (13) to 64 m (5)	rock, shellsand, sand (13)	Laminarians, <i>Nereocystis</i> (13)
<i>Al. schultzi</i>	intertidal (3, 14) to subtidal (3), 0.5 m (14)	opencoast rock wall, rock cliff (13)	[Barnacle <i>Balanus unibilis</i> ] (13)
<i>R. dolichogaster</i>	intertidal (8, 15) to subtidal (15)		<i>Ulva, Zostera, Sargassum</i> (9)
<i>Ap. flavidus</i>	low-tide horizon (16)	rock, shellsand, mud (13)	<i>Zostera, Fucus</i> etc. (13)
<i>Ap. fucorum</i>	intertidal to 9 m (3, 17)	rock (17)	<i>Gigartina, Pelvetina, Rhodoglossum</i> (17)
<i>Ap. sanctaerosae</i>	rock pool (18) to 12 m (3)		Kelp canopy (3)

*Pholis ornata*: BEAN and BEAN (1897) and ROSENBLATT (1964) [North American records only].

*Pholis fasciata*: GIRARD (1854), BEAN (1881), GILBERT (1895), VLADYKOV (1933), JENSEN (1942), BACKUS (1957), GORDON and BACKUS (1957) and GREEN (1970).

*Pholis picta*: POPOV (1933) and PINCHUK (1976).

*Enedrias crassispina*: WANG and WANG (1935) [misidentified as *Enedrias nebulosus*].

*Enedrias nebulosa*: LINDBERG and KRASYUKOVA (1975) [they report from Peter the Great Bay and its proximity, but I can not determine the specific status].

*Enedrias fangi*: WANG and WANG (1935) and TCHANG *et al.* (1957).

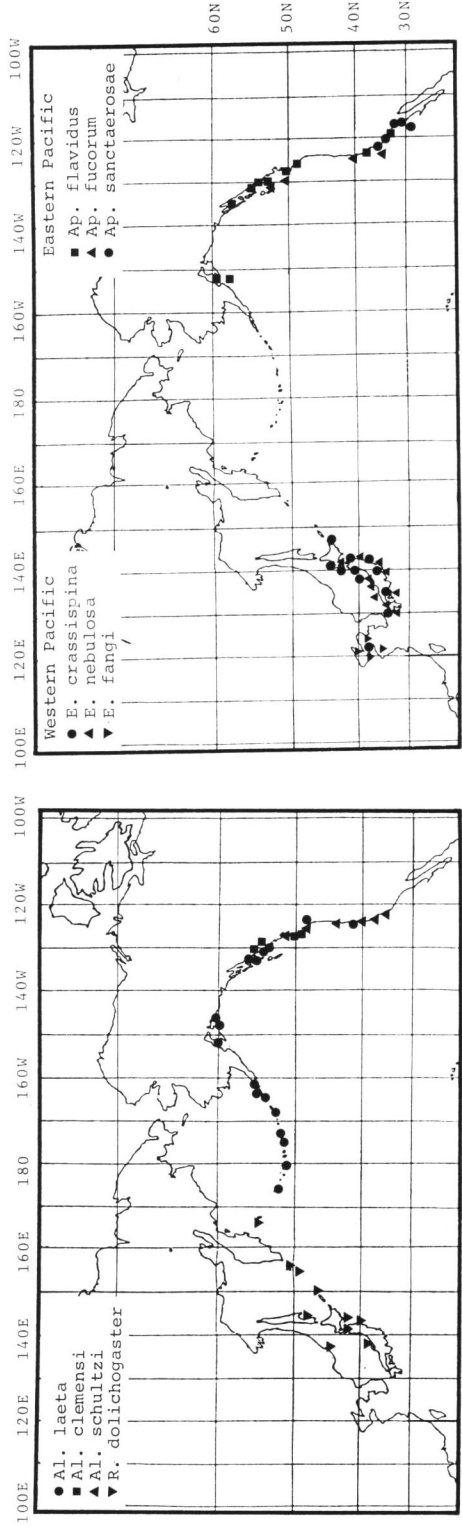
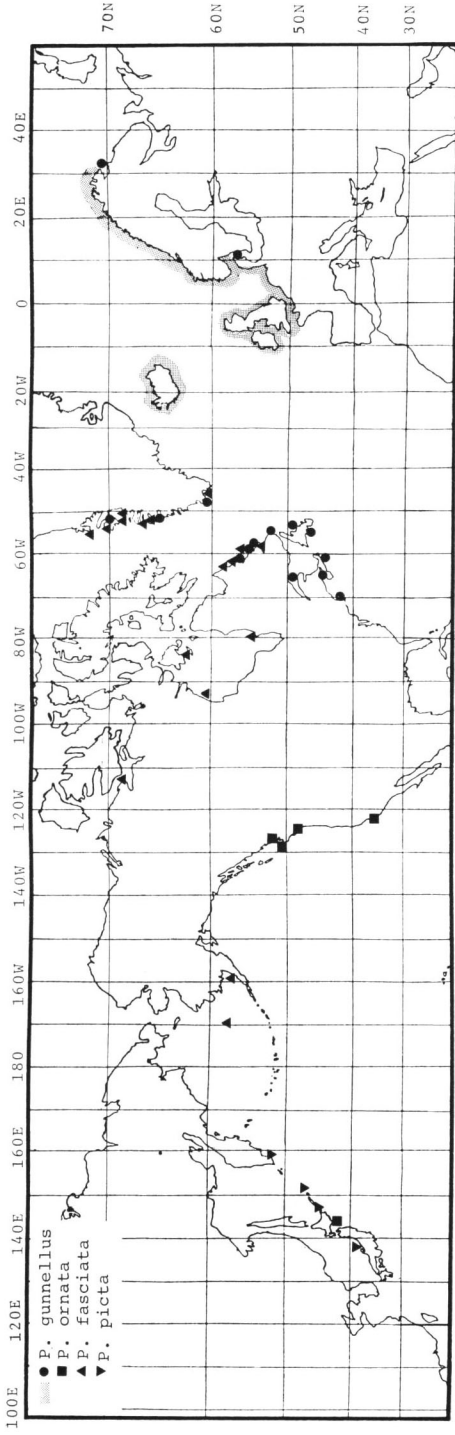
*Allopholis laeta*: COPE (1873), ROSENBLATT (1964), WILIMOVSKY (1964 and pers. comm.), MILLER and LEA (1972) and PEDEN and WILSON (1976).

*Allopholis clemensi*: ROSENBLATT (1964), HART (1973) and PEDEN and WILSON (1976).

*Allopholis schultzi*: SCHULTZ (1931), SCHULTZ and HUBBS (1961), ROSENBLATT (1964), PEDEN (1966), MILLER and LEA (1972) and PEDEN and WILSON (1976).

*Rhodymenichthys dolichogaster*: STEINDACHNER (1881), BEAN and BEAN (1897), JORDAN and EVERMANN (1898), JORDAN and SNYDER (1902), GILBERT and BURKE (1912), ANDRIYASHEV (1954) and ROSENBLATT (1964).

Fig. 16. Geographic distribution of fourteen species of the Pholididae. Top, *Pholis*; bottom, left, *Allopholis* and *Rhodymenichthys*; bottom, right, *Enedrias* and *Apodichthys*. Distributional records are based on present materials and reliable literature listed in the text.



*Apodichthys flavidus*: GIRARD (1854), JORDAN and EVERMANN (1898), HUBBARD and REEDER (1965), MILLER and LEA (1972), QUAST and HALL (1972), HART (1973) and PEDEN and WILSON (1976).

*Apodichthys fucorum*: JORDAN and GILBERT (1880), JORDAN and EVERMANN (1898), MILLER and LEA (1972), PEDEN and WILSON (1976) and BURGESS (1978).

*Apodichthys sanctaerosae*: GILBERT (1897) and MILLER and LEA (1972).

*Ecological records.* Table 1 shows an outline of the habitats as an aspect of the ecology of the pholidids.

So far as Table 1 and Fig. 16 concerned, the habitat shift or segregation or geographical isolation is reasonably assumed in the three species of *Allopholis*, *Enedrias* and possibly *Apodichthys*. The monotypic *Rhodymenichthys* is of some interest in that it shows polychromatic condition as seen in *Apodichthys* and in that it is the only taxon geographically distributed in the Northeastern Pacific among the group that is characterized by the presence of an opening on the supraorbital commissure. Four species of *Pholis* are separated geographically from one another except for *P. gunnellus* and *P. fasciata* in the Northwestern Atlantic where habitat segregation is reported (GORDON & BACKUS, 1957) and except for *P. ornata* and *P. picta* in the southern Hokkaido, Japan.

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