The *Pristipomoides* (Pisces: Lutjanidae) of Guam with Notes on Their Biology[1]

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Abstract

Taxonomic data as well as information on the biology of four species of deep water snappers, genus *Pristipomoides*, are presented. The genus is represented in Guam by the following species, *P. auricilla* (Jordan, Evermann, and Tanaka), *P. sieboldii* (Bleeker), *P. filamentosus* (Cuvier and Valenciennes), and *P. flavipinnis* Shinohara.

Close affinities are found between *P. auricilla* and *P. sieboldii* and between *P. filamentosus* and *P. flavipinnis*. Sexual dichromatism of *P. auricilla* and *P. filamentosus* is described. *P. sieboldii* and *P. flavipinnis* displayed no sexual dichromatism.

Limited information on the feeding habits of these snappers indicates that pelagic tunicates are important food items.

Differences in number between the males and females taken of *P. auricilla* and *P. filamentosus* were significant, but *P. sieboldii* and *P. flavipinnis* showed no such differences.

INTRODUCTION

Considerable taxonomic confusion exists among the Indo-Pacific *Pristipomoides*. Smith (1954), Abe (1960), and Shinohara (1963) have worked extensively with the genus, but all express a need for further study.

Because of the commercial value of these snappers, it is important that their taxonomy be clarified. More accurate records and fisheries research statistics would result.

In the Indo-Pacific, the lutjanid genus *Pristipomoides* is presently represented by five species, *P. auricilla* (Jourdan, Evermann, and Tanaka), *P. filamentosus* (Cuvier and Valenciennes), *P. flavipinnis* (Shinohara), *P. sieboldii* (Bleeker), and *P. typus* (Bleeker). Of these species, all but *P. typus* occur in Guam waters.

MATERIALS AND METHODS

This study is based primarily on 1,213 Guam specimens collected with handline by the crew of the Division of Fish and Wildlife exploratory commercial fishing vessel, M/V PANGLAU ORO (Department of Agriculture, Government of Guam). Specimens from other localities were also examined from the United States National Museum (USNM); the Bernice P. Bishop Museum (BPBM); the University of the Ryukyus (UR); the University of Tokyo (UT); Science College Museum in Tokyo (SCM); U. S. Bureau of Commercial Fisheries, Tropical Atlantic Biological

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Laboratory (TABL); and the personal collection of Dr. T. Abe (TA), Japan.

Detailed counts and measurements, corresponding to the definitions of Hubbs and Lagler (1949), were taken from 124 Guam specimens and a total of 36 specimens from Hawaii, Philippines, Japan, and the Caribbean Islands. However, the counts and measurements of only Guam specimens are presented in this study. With few exceptions, scale and gill raker counts were taken from the left side of the body. Gill arches from five samples of each species were removed, stained with Alizarin S and photographed. Equal numbers of samples of each species were skeletonized for vertebral counts.

Freshly caught fish were measured prior to marketing. Fork length in millimeters and weight to the nearest quarter pound (113 g) were taken. Regression analysis was used to test length-weight relationships. Standard error and standard deviation were used to analyze the following morphometric and meristic characters; gill raker counts, pored lateral line scale counts, ratio of suborbital width in eye diameter, and ratio of snout length in head length. Analysis of variance was applied to the mean length between species and between sexes within the species for samples from all areas of Guam.

Reliability of sexual dichromatism in *P. filamentosus* and *P. auricilla* was determined by predicting the sex of individuals based on the color pattern prior to dissection. Individuals whose gonads were not distinguishable by gross examination were labeled as immature.

The depth from which the snappers were taken varied according to whether the vessel was at anchor or adrift. Even while at anchor the vessel would swing from deep to shallow and back depending on current and wind direction. Because of the precipitousness of the ocean bottom, even a shift of a few meters in the vessel's position resulted in changes as much as 110 meters in depth, and these depth changes are magnified when the vessel is adrift. Therefore, it was not possible to keep a precise record of the depth from which each snapper was caught. Only the range of the depth fished or the depth at which the vessel was anchored was recorded by the captain. These depths varied from 90 to 360 m.

Because of the depth (90–360 m) at which most of the snappers were hooked, stomachs were usually everted and the contents expelled before the fishes were brought to the surface. Occasionally, some of the stomach contents were lodged on the gill rakers. These items as well as items from the few intact stomachs were preserved and examined. The volume of food was measured by water displacement. Loss of food items greatly limited the study on the food habits of these snappers.

RESULTS

Pristipomoides Bleeker, 1852

Aphareus Cuvier and Valenciennes, 1830:485 (type-species *Aphareus caerulescens* Cuvier and Valenciennes).

Aprion Cuvier and Valenciennes, 1830:543 (type-species *Aprion virescens* Cuvier

and Valenciennes).

Apsilus Cuvier and Valenciennes, 1830:548 (type-species *Apsilus fuscus* Cuvier and Valenciennes).

Chaetopterus Temminck and Schegel, 1844:718 (type-species not specified).

Pristipomoides Bleeker, 1852: 575 (type-species *Pristipomoides typus* Bleeker).

Bowersia Jordan and Evermann, 1903:182 (type-species *Bowersia violescens* Jordan and Evermann).

Ulaula Jordan and Thompson, 1911:459–460 (new subgenus; type-species *Bowersia ulaula* Jordan and Evermann).

Arnillo Jordan, Evermann, and Tanaka, 1927:667–668 (type-species *Arnillo auricilla* Jordan, Evermann, and Tanaka).

DESCRIPTION: Body oblong, robust; interorbital naked, flat; cheek and opercle scaled; three to four rows of scales in a narrow patch on nape, separated by a thin naked groove from dorsal body scales; two opercular spines, the uppermost spine weak; no distinct pre-opercular notch; base of dorsal and anal fins without scaly sheath; dorsal fin continuous without deep indentation between spinous and soft rays; pectoral fin falcate, longer than head; maxillary naked.

An Artificial Key to the Species of the Genus *Pristipomoides* known from Guam.

1a. Pored lateral line scales from dorsal edge of gill opening to base of caudal fin 70–74; total number of gill rakers on first gill arch 27–32.

2a. Tongue with tooth patch; vomerine tooth patch diamond shaped, projecting posteriorly; canines near symphysis of upper and lower jaws not greatly enlarged . . . *sieboldii* (Bleeker).

2b. Tongue edentate; vomerine tooth patch in shape of a broad triangle without posterior projection; canines near symphysis of lower jaw greatly enlarged . . . *auricilla* (Jordan, Evermann, and Tanaka).

1b. Pored lateral line scales 60–67; total number of gill rakers on first gill arch 18–27.

3a. Length of upper jaw 2.1–2.4 times into head length; pyloric caeca 4–6 (usually 5); canine teeth near symphysis of lower jaw greatly enlarged; distance between posterior nostril and anterior margin of eye less than 4 times eye diameter . . . *flavipinnis* Shinohara.

3b. Length of upper jaw 2.4–2.6 times into head length; pyloric caeca 7–9 (usually 8); canine teeth near symphysis of lower jaw not greatly enlarged; distance between posterior nostril and anterior margin of eye less than 4 times eye diameter . . . *filamentosus* (Cuvier and Valenciennes).

Pristipomoides sieboldii (Bleeker)

Plate 1, A

Chaetopterus sieboldii Bleeker, 1857:20 (original description; type locality, Japan). Regan, 1905:18–19 (description).

Chaetopterus dubius Gunther, 1859:385 (description: locality, Japanese Sea).

Jordan and Seale, 1905:265 (in list). Jordan and Snyder, 1906:213 (description).

Bowersia ulaula Jordan and Evermann, 1904:183–184 (original description; holotype, USNM 50661; type locality, Hawaii). Jordan and Evermann, 1905:237–238 (description of holotype).

Ulaula sieboldii (Bleeker). Jordan and Jordan, 1927:49 (description of subgenus).

Pristipomoides filamentosus (Valenciennes). Fowler, 1931b:191–193 (after type of *B. ulaula*).

Pristipomoides sieboldii (Bleeker). Jordan and Thompson, 1911:462–464 (description). Fowler and Ball, 1925:14 (in list). Fowler, 1928:183 (misindentified, specimen actually *P. filamentosus*). Fowler, 1929:634 (in list). Fowler, 1931a:22 (in list). Edmondson, 1946:337 (comments). Smith, 1954:490–491 (description and key). Gosline and Brock, 1960:182–186 (description and key). Shinohara, 1966:230–231, 295–296 (description in Japanese and key in English). Kami, Ikehara, and Deleon, 1968:108 (in list).

SPECIMENS EXAMINED: Of the 111 Guam-collected specimens, detailed measurements and counts were taken from 22 specimens (SL 170 to 350 mm). Additional material: Holotype, *B. ulaula* USNM 50661 (275 mm) Hawaii; USNM 88185 (2, 177 and 185 mm), Hawaii; USNM 151567 (3, 184 to 217), Hawaii; UR 138 (1, 244 mm), Okinawa; uncataloged (2, 269 and 326 mm), Japan.

DESCRIPTION: Dorsal rays X, 11; anal rays III, 8; pectoral rays ii, 12, ii; pored lateral line scales 71–74; predorsal scales 16–18; scale rows above lateral line to insertion of first dorsal spine 7 or 8; scale rows below lateral line to insertion of

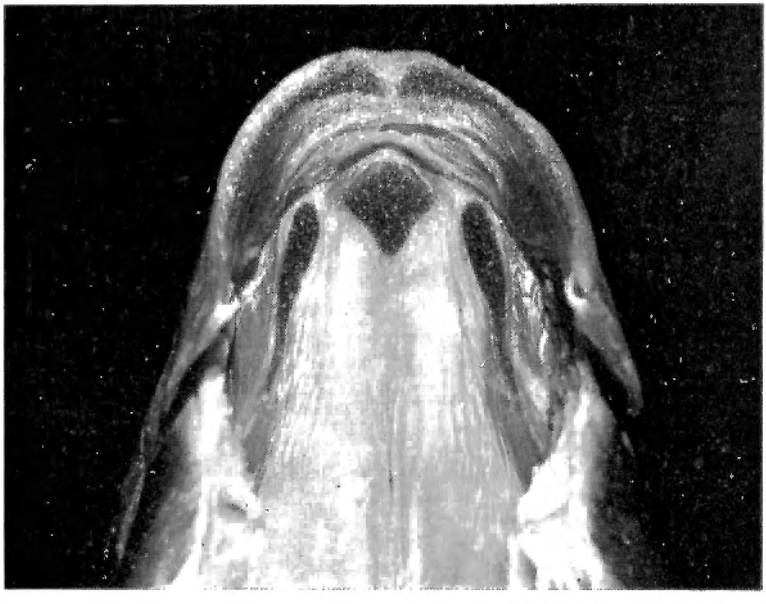

Fig. 1. Palatines and diamond-shaped vomer of *P. sieboldii*.

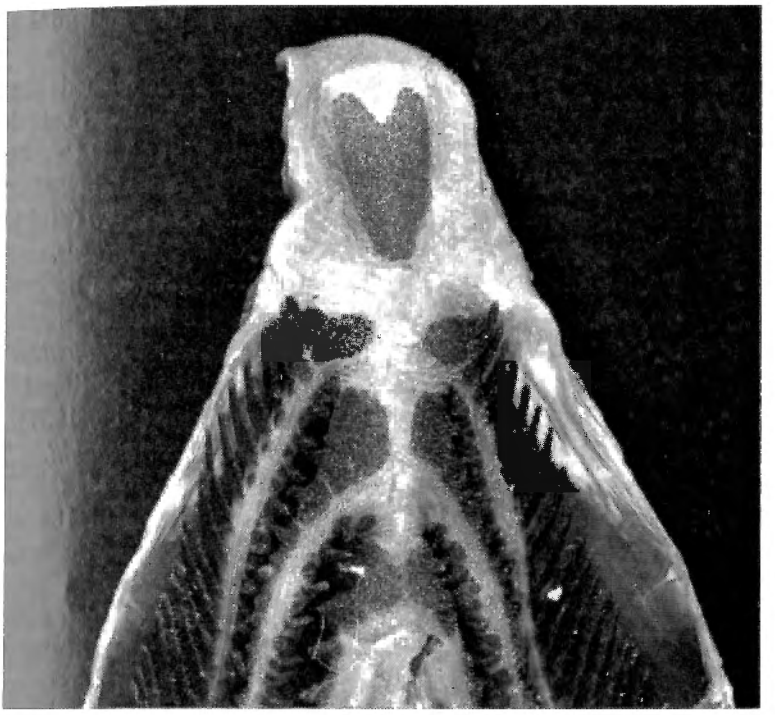

Fig. 2. Heart-shaped patch of villiform teeth on tongue of *P. sieboldii.*

first anal spine 14 or 15; total numbers of gill rakers on first gill arch 28–32 (9–10 + 1 + 18–21); pyloric caeca 7–9, vertebrae 24.

The following measurements are per cents of the standard lengths. Body depth 25.3–30.5; head length 28.3–32.9; snout length 7.7–9.1; eye diameter 7.1–10.0; length of upper jaw 9.7–11.0; sub-orbital width 2.2–2.9.

Maxillary terminating below anterior margin of pupil; palatine teeth in broad villiform bands; vomer diamond-shaped patch projecting posteriorly (Fig. 1); upper and lower jaws with an outer row of small canine teeth, canines near symphysis slightly larger than those on side of jaw; upper jaw with an inner, thin band of cardiform teeth along side of jaw, cardiform band much wider near region of symphysis; cardiform band on lower jaw narrow, restricted to area of symphysis; tongue with oval or heart-shaped patch of villiform teeth. (Fig. 2).

Pectoral fin reaching a vertical at base of tenth dorsal spine; pelvic fin not reaching anus; last dorsal ray barely reaching base of caudal fin; last anal ray not reaching base of caudal fin; caudal fin forked.

COLOR WHEN FRESH: Body light lavender, becoming pale ventrally; scales above lateral line with small, pale blue spot, forming thin length-wise lines; lines becoming indistince toward ventral region; margin of dorsal fin orange with light lavender; anal fin pale; caudal fin dark lavender with light margin.

COLOR WHEN PRESERVED: Body pale; interorbital with few scattered dark

spots; dorsal and caudal fins slightly dusky; pectoral, pelvic, and anal fins pale; iris dark.

REMARKS: *Pristipomoides sieboldii* can be easily distinguished from other *Pristipomoides* species by its diamond-shaped vomer projecting posteriorly and with either a heart shaped or an oval patch of villiform teeth on its tongue.

Fowler (1928) included this species in his Fishes of Oceania, however, in subsequent work (1931a), he found them to be specimens of *P. microdon* (Steindachner). *P. microdon* is presently considered to be a synonym of *P. filamentosus.*

Much confusion has stemmed from Fowler (1931b:192) when he erroneously reported *P. filamentosus* as having a "vomer with broad diamond-like patch of villiform teeth". The type and a second specimen of *Serranus filamentosus* Cuvier and Valenciennes were examined by Dr. J. Guibe at the Museum National d'Histore naturells, Paris, and he reported the vomer to be triangular (Abe, 1957). Therefore, Fowler's *P. filamentosus* is clearly synonymous with *P. sieboldii.*

P. sieboldii reaches 400 mm in fork length, but seldom exceeds this length.

BIOLOGY: *Pristipomoides sieboldii* was taken from depths of 181 to 360 m. with most of them taken from 181 to 270 m. However, none of them was taken from depths less than 180 m.

A single stomach sample from *P. sieboldii* was examined which contained a mixture of many organisms, however, fish remains formed the bulk of the contents. Other items mixed with the fish flesh were *Pyrosoma* and small amounts of crab megalops, copepods, shrimps, larval squids, polychaets, and material that could not be identified.

No significant differences at the 0.05 level (X^2 test, Table 1) were found between the number of males and females taken.

Table 1. Sex ratio of *Pristipomoides* species

	filamentosus		*auricilla*		*sieboldii*		*flavipinnis*	
Sex	No.	X^2	No.	X^2	No.	X^2	No.	X^2
Female	77		357		52		93	
		4.28		10.10		0.23		0.07
Male	106	d.f. = 1	276	d.f. = 1	58	d.f. = 1	87	d.f. = 1
Immature	14		69		0		0	
TOTAL	197		684		110		180	

DISTRIBUTION: This species is found in the eastern Indian and western, central, and southern Pacific Oceans. In the Indian Ocean, it is recorded from the cost of Kenya, (Smith, 1954). In the western Pacific, it is recorded from Japan (Bleeker, 1857; Gunther, 1859; Regan, 1905), the Ryukyus (Shinohara, 1963, 1966), and Guam (Kami *et al.*, 1968). In the central and south Pacific, it is recorded from Hawaii (Jordan and Evernmann, 1905; Jordan and Synder, 1906; Jordan and Jordan, 1927; Fowler, 1928, 1929, 1931b; Gosline and Brock, 1960), Johnston Island (Fowler and Ball, 1925), and Samoa (Jordan and Seale, 1905).

Pristipomoides auricilla (Jordan, Evermann, and Tanaka)

Plate 1, B

Arnillo auricilla Jordan, Evermann, and Tanaka, 1927:668–670 (original description; holotype, Mus. Cal. Acad. Sci. 348; type locality, Hawaii).

Pristipomoides auricilla (Jordan, Evermann, and Tanaka). Abe, 1960:161–165 (description). Shinohara, 1963:52 (key). Shinohara, 1966:231–233, 295–296 (description in Japanese, key in English). Kami, Ikehara, and Deleon, 1968: 108 (in list).

SPECIMENS EXAMINED: Of the 778 Guam-collected specimens, detailed measurements and counts were taken from 31 specimens (SL 200–347 mm). Additional material: UR 165 (1, 222 mm), Okinawa.

DESCRIPTION: Dorsal rays X, 11; anal rays III, 8; pectoral rays ii, 12, ii; pored lateral line scales 70–74; predorsal scales 14–18; scale rows above lateral line to insertion of first dorsal spine 7 or 8; scale rows below lateral line to insertion of first anal spine 15–16; total number of gill rakers on first gill arch 27–32 (8–10 + 1 + 18–20); pyloric caeca 5–7; vertebrae 24.

The following measurements are in per cents of the standard lengths. Body depth 27.9–31.7; head length 30.8–33.7; snout length 8.4–10.5; eye diameter 7.5–9.6; length of upper jaw 13.0–18.8; suborbital width 2.4–4.3.

Maxillary terminating anterior to margin of eye; palatine teeth in broad villiform band; vomerine teeth in a triangular-shaped, villiform patch with the vertex pointing anteriorly (Fig. 3); upper jaw with an outer row of strong, slightly recurved, canine teeth, canines near symphysis larger than those on side, an inner band of

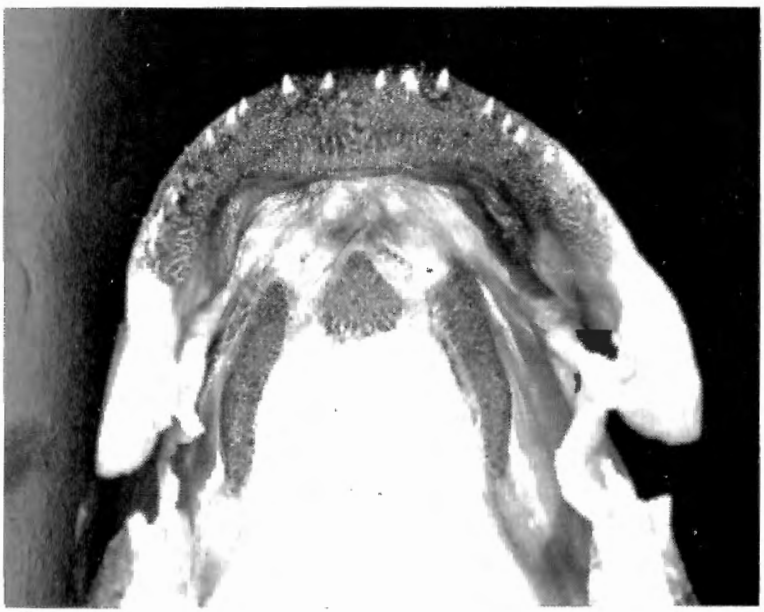

Fig. 3. Palatines and vomer of *P. auricilla*.

cardiform teeth along side of jaw; cardiform band near symphysis with few, small canines projecting posteriorly; lower jaw with an outer row of strong canines near symphysis and small closely spaced canines on side of jaw, inner band of cardiform teeth with several well developed small canine teeth projecting posteriorly restricted to area of symphysis; tongue edentate.

Pectoral fin reaching a vertical at base of tenth dorsal spine; pelvic fin reaching anus; last dorsal ray reaching base of caudal fin; last anal ray not quite reaching base of caudal fin; caudal fin forked.

COLOR WHEN FRESH: Body mainly purplish with 17–18 narrow, broken, yellow, chevron-shaped bands; iris yellow; edge of upper lip yellow; two horizontal yellow bands running from snout through eye to operculum, the first originating just above upper lip, the second passing through posterior nostril; a third transverse irregular yellow band between orbits; dorsal fin membrane yellow; pectoral fins pale; anal fin rays dusky, membrane yellow; dorsal lobe of caudal fin yellow with purple margin.

SEXUAL DICHROMATISM: Female: Ventral lobe of caudal fin may or may not be tinged with yellow, if tinged, not forming a distinct yellow blotch.

Male: Ventral lobe of caudal fin with much yellow, usually forming a distinct yellow blotch. Only large males with fork lengths exceeding 270 mm displayed sexual dichromatism.

COLOR WHEN PRESERVED: Tip of upper and lower jaws dusky; head dusky with three pale bands; first band just above upper lip and terminating in front of eye; second band passing through posterior nostrils meeting first band in front of eye; first and second band separated by a narrow, broken, horizontal dark band which extends over anterior nostril; third irregular pale band between orbits; pre- and post-orbital with narrow pale area; body dusky with pale mottling; dorsal and anal rays slightly dusky, membranes clear; pectoral fins pale; pelvic fins slightly dusky.

REMARKS: Based on the above described sexual dichromatism the sex of 284 individuals exceeding 220 mm in fork length was predicted with 81.7% accuracy.

P. auricilla, although first described from specimens taken from Hawaii, is not a common species there. Gosline and Brock (1960), not certain of this species, erroneously synonymized it with *P. sieboldii*. However, in Guam, it is the most common member of the genus.

All specimens taken from Guam were under 400 mm in fork length except one measuring 410 mm.

BIOLOGY: The depths from which *P. auricilla* was taken ranged from 90 to 360 m. However, most of the specimens were taken from 181 to 270 m.

Stomach samples of five specimens were examined. Of the five, a small cod-like fish, *Bregamaceros macclellandi* Thompson (Family Bregmacerotidae), was the only item found in one; and a pelagic tunicate, *Pyrosoma* sp. (Family Pyrosomatidae), was the sole food item of another. Two others contained a mixture of items: One, equal amounts of salps (Family Salpidae) and unidentifiable material

resembling cotton; the other, a large amount of *Pyrosoma* sp. mixed with fish remains. Stomach contents in the last specimen were also of cotton-like matter that could not be identified.

More females of this species were taken than males. The difference in number between the males and females was significant at the 0.05 level (X^2 test, Table 1).

DISTRIBUTION: This species is recorded from Japan and the Bonin Islands (Abe, 1960), the Ryukyu Islands (Shinohara, 1963, 1966), Guam Island (Kami *et al.*, 1968), and Hawaii (Jordan, Evermann, and Tanaka, 1927).

Pristipomoides flavipinnis Shinohara

Plate 1, C

Shinohara, 1963:49–53 (original description; holotype, UR 163; type locality, Okinawa).

SPECIMENS EXAMINED: Of the 211 Guam-collected specimens detailed measurements and counts were taken from 31 specimens (SL 167–427 mm). Additional material: Paratype, UR 164 (1, 297 mm), Okinawa.

DESCRIPTION: Dorsal rays X, 11; anal rays III, 8; pectoral rays ii, 12, ii; pored lateral line scales 62–67; predorsal scales 13–17; scale rows above lateral line to insertion of first dorsal spine 6–7; scale rows below lateral line to insertion of first anal spine 13–16; total number of gill rakers on first gill arch 22–27, (7–9 + 1 + 14–17); pyloric caeca 4;6; vertebrae 24.

The following measurements are in per cents of standard lengths. Body length 20.1–31.5; head length 30.9–34.1; snout length 11.3–12.3; eye diameter 7.2–9.5; length of upper jaw 13.1–14.7; suborbital width 4.1–6.3.

Fig. 4. Palatines and vomer of *P. flavipinnis*.

Maxillary terminating slightly anterior to pupil; palatine teeth in narrow villiform band; vomerine teeth in a broad triangular-shaped villiform patch (Fig. 4); upper and lower jaws with an outer row of irregularly spaced canine teeth, canines near symphysis much larger than those on side of jaw; upper jaw with inner band of cardiform teeth, band near symphysis with few small posteriorly projecting canine-like teeth on band; tongue edentate.

Pectoral fin reaching a vertical from base of tenth dorsal spine to base of first soft dorsal ray; pelvic fin reaching anus; last dorsal ray reaching base of caudal fin; last anal ray not reaching base of caudal fin; caudal fin forked.

COLOR WHEN FRESH: Body lavender-brown becoming pale ventrally; iris yellow; interorbital and snout lavender-brown, mottled with narrow, irregular light yellow streaks; naked groove around temporal scale-patch lavender-brown; scales on body above lateral line with yellow spots forming about five thin horizontal stripes; scales below lateral line with indistinct yellow spots; spiny dorsal fin yellow with broken blotches of yellow on soft dorsal fin; pectoral fin rays light yellow with clear membrane; pectoral axis yellow; pelvic spine and first ray on fin white, rest of pelvic fin rays yellow; anal fin with yellow blotches on membranes, margin of fin white; caudal fin purplish-brown with yellow margin.

COLOR WHEN PRESERVED: Body light grayish brown; edge of scales with dusky margin forming mottling effect; caudal fin pale with slightly dusky margins; pectoral, pelvic, dorsal and anal fins pale.

REMARKS: Comparison of Guam specimens with the paratype of *P. flavipinnis* from Okinawa leaves no doubt that Guam and Okinawa specimens are conspecific. Although Shinohara (1963) found this species to be rare in the Ryukyus, *P. flavipinnis* is a relative common species (ranking third in the order of abundance) in Guam waters. Specimens exceeding 400 mm in fork length are frequently taken.

BIOLOGY: Like *P. auricilla*, the depth from which *P. flavipinnis* was taken ranged from 90 to 360 m, but most of the specimens were collected between 181 to 270 m.

Small, benthic fishes were the major food items of *P. flavipinnis*. Specimens of *Champsodon vorax* Gunther (Family Champsodontidae), *Dactyloptena* sp. (Family Dactylopteridae), *Trigla* sp. (Family Triglidae), flathead (Family Platycephalidae), an unidentified larval fish, and the remains of an eel-like fish mixed with crab fragments, were recovered from four of the six stomachs examined. Of the other two stomach samples, one contained *Pyrosoma*, while the other had larval squids.

The difference between the number of males and females taken was found to be insignificant (Table 1).

DISTRIBUTION: This species is recorded from the Ryukyus (Shinohara, 1963, 1966) and Guam (Kami *et al.*, 1969).

Pristipomoides filamentosus (Cuvier and Valenciennes)
Plate 1, D

Serranus filamentosus Cuvier and Valenciennes, 1830:382–383 (original description;

type locality, Bourbon).

Chaetopterus microlepis Bleeker, 1869:80 (original description; type locality, Amboina).

Aprion (*Aprion*) *microlepis* Bleeker, 1876–1877:78–79 (description).

Aprion microdon Steindachner, 1876:158–160 (original description; type locality, Hawaii).

Aphareus roseus Castelnau, 1879:373 (original description; type locality, presumably Port Jackson).

Bowersia violescens Jordan and Evermann, 1904:183 (original description; holotype USNM 50660; type locality, Hawaii). Jordan and Evermann, 1905:236 (description of holotype). Jordan and Seale, 1905:265 (in list). Jordan and Snyder, 1906:213 (description).

Apsilus microdon (Steindachner). Jordan and Evermann, 1905:234 (description).

Aprion filamentosus (Cuvier and Valenciennes). Gilchrist and Thompson, 1909:226–227 (description). Gilchrist and Thompson, 1917:345–346 (in list).

Aprion microlepis (Bleeker). Ogilby, 1916:182–183 (statement of synonymy with *A. roseus* of Castelnau).

Aprion roseus (Castelnau). McCulloch, 1917:173–174 (description).

Pristipomoides filamentosus (Cuvier and Valenciennes). Barnard, 1927:648–649 (description). Kamohara, 1967:65 (description).

Pristipomoides violescens (Jordan and Evermann). Jordan and Jordan, 1927:48 (in list).

Pristipomoides sieboldii (Bleeker). Fowler, 1928:193 (misidentification).

Pristipomoides microlepis (Bleeker). Fowler, 1928:192–193 (description). Fowler, 1929:634 (in list). Fowler, 1931a:22 (in list). Fowler, 1931b:190–191 (description). Smith, 1954:488–489 (key and description). Gosline and Brock, 1969:183–186 (key and description). Kami, Ikehara, and Deleon, 1968:108 (in list).

Pristipomoides microdon (Steindachner). Fowler, 1931b:187–188 (description in part).

Aprion kanekonis Tanaka, 1935:300–302 (original description; holotype SCM 3687; type locality, Japan).

Aprion (*Pristipomoides*) *microlepis* (Bleeker). Weber and deBeaufort, 1936:312–313 (key and description).

Pristipomoides argyrogrammiscus (Cuvier and Valenciennes). Smith 1937:183–185 (description).

Pristipomoides filamentosus roseus (Castelnau). Abe and Takashima, 1956:15–19 (description). Abe, 1957:1155–1163 (description). Abe, 1960:165 (comments). Shinohara, 1963:51 (key). Shinohara, 1966:233–243; 295 (description in Japanese, key in English).

SPECIMENS EXAMINED: Of the 213 Guam specimens, detailed measurements and counts were taken from 30 specimens (SL 179–509 mm). Additional material: Holotype, *B. violescens*, USNM 50660 (456 mm), Hawaii; USNM 196981 (2, 240

and 255 mm), Netherlands Indies; USNM 52738 (1, 386 mm), Hawaii; USNM 51200 (1, 424 mm), Hawaii; UT 18147 (1, 426 mm), Okinawa; UT 18146 (1, 486 mm), Okinawa; UT 146608 (1, 227 mm), Japan; TA 14274 (1, 517 mm) Japan; UR 138 (1, 244 mm), Okinawa; holotype, *A. kanekonis*, SCM 3687 (1, 188 mm), Japan.

DESCRIPTION: Dorsal rays X, 11; anal rays III, 8; pectoral rays ii, 12, ii; pored lateral line scales 61–65; predorsal scales 15–18; scale rows above lateral line to insertion of first dorsal spine 7 or 8; scale rows below lateral line to insertion of first anal spine 14–16; total number of gill rakers on first gill arch 22–26 (7–8 + 1 + 14–17); pyloric caeca 7–9; vertebrae 24.

The following measurements are in per cents of the standard lengths. Body depth 26.2–30.2; head length 28.1–34.6; snout length 9.6–11.5; eye diameter 5.8–10.4; length of upper jaw 11.1–13.7; suborbital width 3.3–5.5.

Maxillary terminating anterior to margin of pupil; palatine teeth in broad villiform band anteriorly, tapering to a point posteriorly; vomerine tooth patch broadly triangular-shaped (Fig. 5); upper and lower jaws with outer row of unevenly spaced recurved canine teeth, canines near symphysis larger than those on sides; upper jaw with an inner band of cardiform teeth restricted to region of symphysis; tongue edentate.

Pectoral fin reaching a vertical at base of tenth dorsal spine; pelvic fin not reaching anus; last dorsal and anal rays reaching base of caudal fin; caudal fin forked.

COLOR WHEN FRESH: Body pale lavender becoming silvery ventrally; iris yellow;

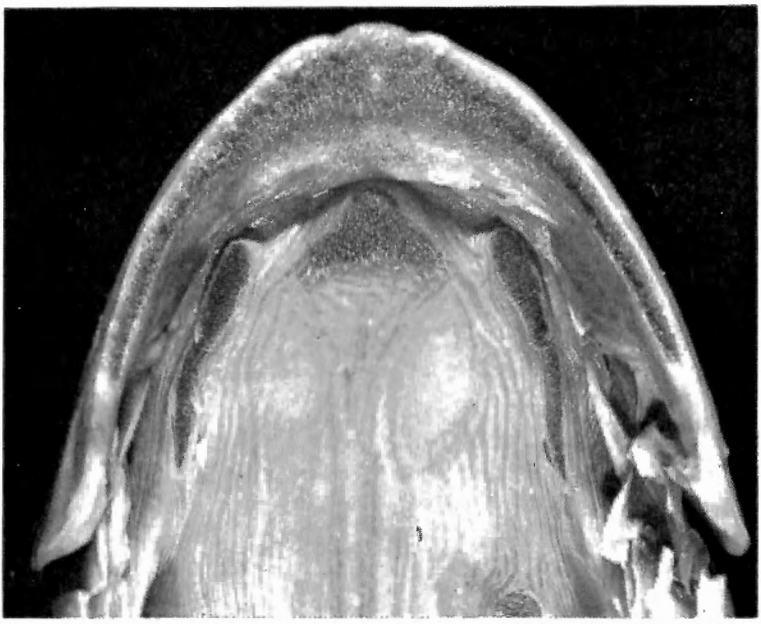

Fig. 5. Palatines and vomer of *P. filamentosus*.

interorbital and region of snout with narrow, irregular, yellowish streaks and scattered small, blue spots; scales on body with small, light blue spots, forming irregular horizontal lines; blue spots easily discernible above lateral line; spiny dorsal fin with pale yellow margin and yellow blotches, soft dorsal becoming lavender; pectoral fins pale; caudal fin lavender with orange margin.

SEXUAL DICHROMATISM: Female: Anal and pelvic fin membranes usually clear without black pigments or yellow tinge; occasionally anal fin membrane of large females may be slightly dusky but never tinged with yellow.

Male: Anal and pelvic fin membranes dusky, large males with orange-yellow tinge between first and second anal spines and between the last two rays (Plate 1, D); membrane of small individuals not pigmented.

Sexual dichromatism is apparently displayed only by large adults and not by juveniles and subadults. With experience the sex of large adults can be readily recognized by the markings of the anal fin membrane.

COLOR WHEN PRESERVED: Body light brown with pale belly; interorbital and snout flecked with small dark spots; dorsal and caudal fins dusky; pectoral and pelvic fins pale; iris dark.

REMARKS: The sex of 143 individuals, fork length 200–600 mm, was predicted with 89.5% accuracy. The sex of five large females, FL 368–527 mm, was predicted incorrectly because of dark pigmentation on their anal fin membrane, however, closer examination revealed that they lacked the yellow tinge. A few of the individuals which showed only slight pigmentation and lacked any trace of yellow were predicted as females; however, dissection showed them to be males. Four small in dividuals, FL 200–288 mm, were predicted correctly as immature, but two individuals, FL 310 and 330 mm, predicted as females were found to be immature upon dissection.

The morphometric data of Guam specimens show very close similarities to those of the type and a second specimen of *Serranus filamentosus* Cuvier and Valenciennes, as presented by Abe (1957).

Barnard (1927: 649) in discussing *P. filamentosus* from the Natal coast, reported that "the palatine teeth are quite obsolete in the Natal fish". However, Smith (1937) examined the same Natal specimen and reported the presence of palatine teeth, but he erroneously assigned this specimen as *P. argyrogrammicus* (Cuviver and Valenciennes).

Examples of *P. filamentosus* (USNM 19959) as listed by Fowler (1931b) were examined. This lot contained seven specimens, three were found to be *Etelis marshi* Jordan and Evermann, and four were not members of the genus *Pristipomoides*.

Abe and Takashima (1956) assigned the subspecific epithet *roseus*, to a specimen taken near the Bonin Islands. The name *roseus* was derived from *Aphareus roseus* Castelnau and is only provisional as expressed by these authors. Abe (1957) reported on two additional specimens of the subspecies. Although provisional, the assignation of subspecific epithet would seem unwarranted for no clearly defined

differences were shown between *P. filamentosus* and the subspecies.

Examination of the holotype of *Bowersia violescens* Jordan and Evermann, clearly showed that *B. violescens* is synonymous with *P. filamentosus.*

The holotype of *Aprion kanekonis* Tanaka, standard length 188 mm, was examined and found to be a juvenile *P. filamentosus.* Presumably, the specimen was taken in the coastal waters of Japan, [Tanaka (1935) reported that the specimen was obtained from the Nagasaki market].

Examples of *P. microdon* (Steindachner) of Fowler (1931b) were examined and found to be specimens of *P. filamentosus* and *Tropidinius amoenus* (Snyder). *T. amoenus* has been previously placed in the genus *Pristipomoides* by Tomiyama (1956) and Smith (1961), but recently, Shinohara (1966) placed it in the genus *Tropidinius* Poey.

The wide range in the lateral line scale count (47 to 60, plus 4 or 5 more on caudal base) given by Fowler (1931b) for *P. microdon*, leads one to suspect the validity of his count. Steindachner (1876) described *Aprion microdon* as having 70 pored scales in the lateral line with 4 or 5 more on the base of caudal.

P. filamentosus is the largest species in the genus, reaching 750 mm in fork length.

BIOLOGY: The depths from which *P. filamentosus* was taken ranged from 90 to 360 m and like *P. auricilla* and *P. flavipinnis*, most of the specimens were taken from depths of 181 to 270 m.

A wide variety of organisms were used as food by *P. filamentosus.* Three of the five stomach samples contained mixtures consisting largely of *Pyrosoma* sp. and salps mixed with lesser amounts of larval squids, polychaets, ascidians, stomatopods, fish, and heteropods. The organisms found mixed with the pelagic tunicates varied with each of the samples. Of the other two samples, one contained a mixture of the galatheid crustacean (*Munida* sp.) and *Pyrosoma*, while the other contained only *Pyrosoma.*

The difference in the number of males and females taken was found to be significant at the 0.05 level (X^2, Table 1). More males were taken than females.

DISTRIBUTION. *P. filamentosus* is widely distributed and has been recorded from Bourbon (Cuvier and Valenciennes, 1830), South Africa (Gilchrist and Thompson, 1909; Barnard, 1927), Bonin Islands (Abe and Takashima, 1956), the Ryukyu Islands (Shinohara, 1963, 1966), and Japan (Kamohara, 1967).

This species has also been recorded by its junior synonyms from Amboina (Bleeker, 1869; Weber and de Beaufort, 1936), New South Wales (Castelnau, 1879; McCulloch, 1917), Africa (Smith, 1954), Philippines (Fowl, 1931b; Herre, 1953), Hawaii (Jordan and Evermann, 1904; Jordan and Seale, 1905; Jordan and Snyder, 1906; Fowler, 1928, 1929, 1931b; Gosline and Brock, 1960), Samoa (Jordan and Seale, 1905), Guam (Kami *et al.*, 1968), and Japan (Tanaka, 1935).

DISCUSSION

Based on gill raker counts, pored lateral line scale counts, ratio of suborbital width to eye diameter and ratio of snout length to head length (Figs. 6, 7, 8, and 9), close affinities are shown between *P. auricilla* and *P. sieboldii*, and between *P. flavipinnis* and *P. filamentosus*.

In the Indo-Pacific region, the *Pristipomoides* may possibly be subdivided into three species-related groups, *auricilla* and *sieboldii*; *flavipinnis* and *filamentosus*; and *typus*, an Indo-Pacific species which is absent from Guam.

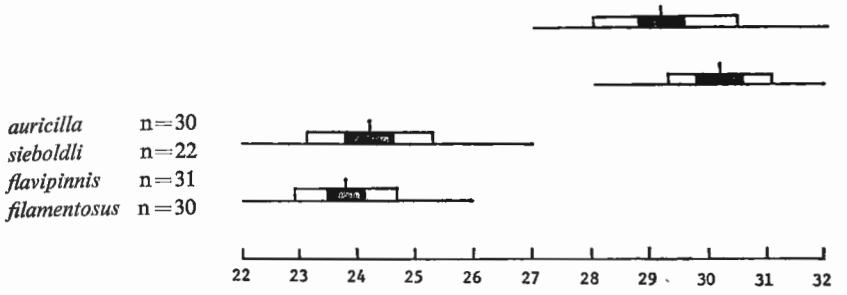

Fig. 6. Total number of gill rakers on first gill arch. Base line represents range, white bar one standard deviation, black bar twice standard error on either side of mean which is represented by a vertical line on black bar.

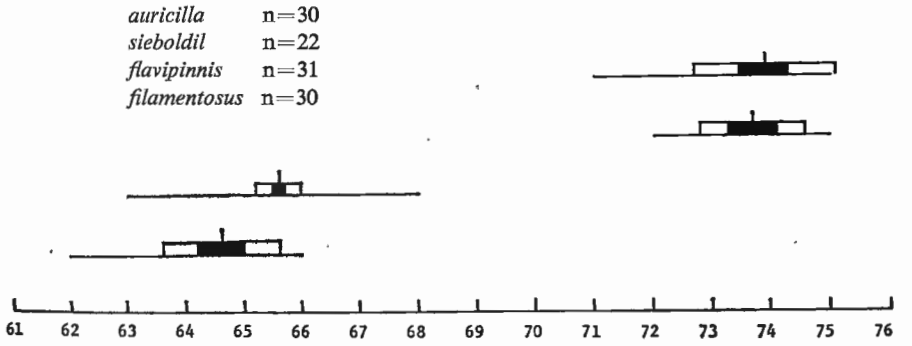

Fig. 7. Pored lateral line scales. Base line represents range, white bar one standard deviation, black bar twice standard error on either side of mean which is represented by a vertical line on black bar.

Regression analysis of length-weight showed this relationship to be linear for all of the species with a correlation coefficient, r of 0.9 for all of the species.

Differences in fork length among species caught in the fishery (Fig. 10), were subjected to analysis of variance and found to be significant at the .05 level. *P. auricilla* was found to be the smallest member of the Guam *Pristipomoides* fishery

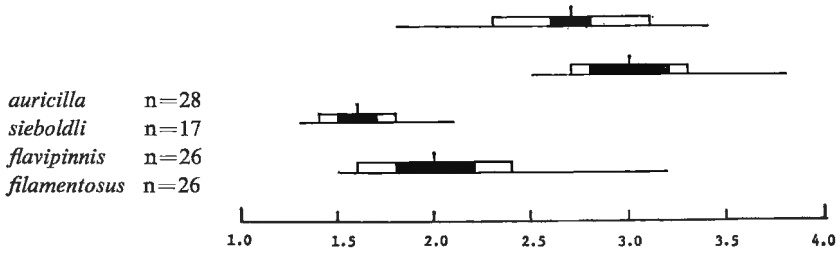

Fig. 8. Ratio of suborbital width to eye diameter. Base line represents range, white bar one standard deviation, black bar twice standard error on either side of mean which is represented by vertical line on black bar.

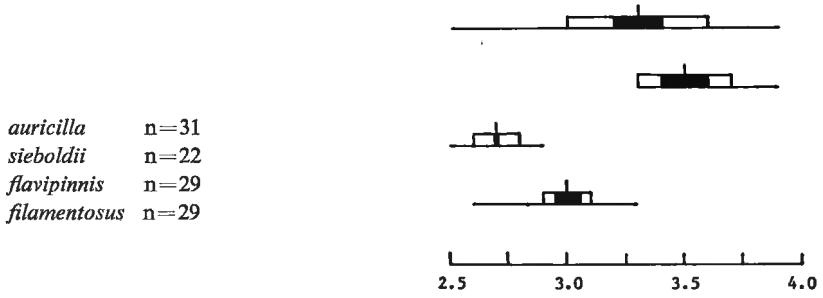

Fig. 9. Ratio of snout length to head length. Base line represents range, white bar one standard deivation, black bar twice standard error on either side of mean which is represented by vertical line on black bar.

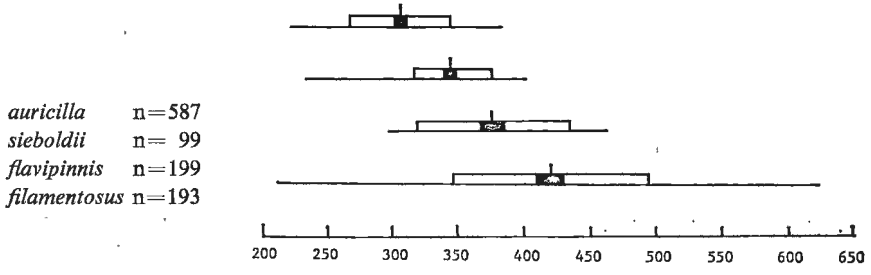

Fig. 10. Mean fork length between species. Base line represents range in mm, white bar one standard deviation, black bar twice standard error on either side of mean which is represented by vertical line on black bar.

with a mean fork length of 306.0 mm. The largest member was *P. filamentosus* with a mean fork length of 420.5 mm. *P. sieboldii* and *P. flavipinnis* were intermediate with fork lengths of 336.5 and 375.8 mm. The differences in the fork length between the sexes of the four species were not significant at the .05 level.

Five specimens of the western Atlantic *Pristipomoides* [*P. aquilonaris* (Good

and Bean), 2; *P. freemani* Anderson, 1; *P. macropthalmus* (Muller and Troschel), 2] were examined and found to have fewer (52–58) pored lateral line scales than the Guam *Pristipomoides*.

The Indo-Pacific species, *P. typus*, though unrecorded from Guam, also has fewer pored lateral line scales than those species present in Guam. The pored lateral line scale counts of three examples of *P. typus* were 52, 53, and 54.

Even though only a limited number of stomachs were examined, the frequency and the amount of *Pyrosoma* and salps ingested seemed to indicate that pelagic tunicates are important food sources for these snappers. In the Gulf of Mexico, *Pyrosoma* is referred to as "tapioca" by commercial fishermen, and is known as food of red snappers, [probably *Lutjanus aya* (Bloch)] (Anon, 1970). Pelagic tunicates are also utilized as food by other fishes. Yount (1958) found salps in the stomach of the butterfly fish, *Chaetodon unimaculatus* Bloch, taken from Hawaii. He also reported that Thompson (1948), Fraser (1949), Reintjes and King (1953), found pelagic tunicates in the stomachs of other fishes and pelagic turtles.

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PLATE 1

A. *Pristipomoides sieboldii* (Bleeker), 342 mm SL.
B. *Pristipomoides auricilla* (Jordan, Evermann, and Tanaka), female, 302 mm SL.
C. *Pristipomoides flavipinnis* Shinohara, 387 mm SL.
D. *Pristipomoides filamentosus* (Cuvier and Valenciennes), male, 388 mm SL.

PLATE 1