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STUDIES ON EASTERN PACIFIC SAND STARGAZERS
(PISCES: DACTYLOSCOPIDAE) 4. *GILLELLUS*, *SINDOSCOPIUS* NEW GENUS,
AND *HETERISTIUS* WITH DESCRIPTION OF NEW SPECIES

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ABSTRACT: The dactyloscopid genera *Gillellus* and *Heteristius* are diagnosed and described and a new genus, *Sindoscopus*, is proposed for the Chilean endemic, *Gillellus australis* Fowler and Bean. A key is provided for all Pacific genera and the seven species treated here. *Gillellus* includes one species, *G. searcheri* n. sp. (Islas Tres Mariás and Nayarit, Mexico and Costa Rica to Panama), with some paired infraorbital pores. There are four more closely related species without paired pores. The latter group includes the generic type, *G. semicinctus* Gilbert (Isla Guadalupe, Baja California peninsula and western Gulf of California, mainland shores from Nayarit, Mexico to Colombia, and the Revillagigedos and Galápagos Islands). *Gillellus arenicola* Gilbert occurs in the vicinity of Cape San Lucas, fails to enter the Gulf of California, and has been collected off mainland coasts of Colima and Oaxaca, Mexico. *Gillellus ornatus* Gilbert is apparently restricted to the Gulf of California where all but one specimen has been taken along its western shores. *Gillellus chathamensis* n. sp. is an insular endemic known only from Cocos Island, Costa Rica. The monotypic *Heteristius* occurs along the southern portion of Baja California. It is not recorded from the Gulf of California. This species also appears off Mexican mainland shores (Isla Tres Mariás, Nayarit to Oaxaca) and is found off Costa Rica, Panama and Ecuador (to about 00°27'N). *Heteristius jalisconis* Myers and Wade, type species of *Heteristius*, is considered a junior synonym of *Dactyloscopus cinctus* Osburn and Nichols. *Sindoscopus*, also monotypic, is known only from the Chilean coast (ca. 23°S-33°S). All treated species are illustrated and distribution maps are provided for species of *Gillellus* and *Heteristius*. This represents the final part of a review of Pacific dactyloscopids wherein a total of 7 genera and 29 species or subspecies are recognized.

INTRODUCTION

This report, the last of a series reviewing Pacific dactyloscopids, treats known populations of *Gillellus* Gilbert and *Heteristius* Myers and Wade, and a new genus, *Sindoscopus*, is proposed for the Chilean endemic, *Gillellus australis* Fowler and Bean.

As with other Pacific sand stargazers, these forms have never been adequately treated systematically, existing illustrations are few and inaccurate, and identification has been difficult or impossible. Material from the Revillagigedo Is., mainland coast of South America and the Galápagos Is. is minimal and further study is needed in these areas. Nevertheless, present data clarify the systematic status of all known museum holdings and establish a basis for identification of future collections.

METHODS AND MATERIALS

Counts and measurements, recorded in millimeters (mm), follow methods of Dawson (1969, 1974, 1975). Standard length (SL) is used throughout; counts of meristic characters are total counts; preopercular canal pores are enumerated in the 1st (anterior) primary canal (Fig. 1). Counts of lateral-line scales were routinely made on the right side, but left side counts were substituted where right side squamation was incomplete. The posteriormost short spiniform caudal elements may occasionally be irregularly segmented in *Gillellus* and *Sindoscopus*, but these are omitted from counts of principal rays which include only the long, well-developed, segmented elements. Branching of principal segmented caudal rays is indicated by the formula: number of upper simple rays + number of branched rays + simple lower rays. Measurements are given for undamaged primary types except for *Sindoscopus australis* where a specimen of similar length has been substituted for the damaged holotype. Observations on dentition and general osteological features are from one or more cleared and stained specimens of each species; vertebral counts are from radiographs. Materials examined include virtually all known museum holdings, but meristic data were not taken on all specimens.

Abbreviations for repositories of examined material are: AMNH - American Museum of Natural History; ANSP - Academy of Natural Sciences

of Philadelphia; BC - Institute of Animal Resource Biology, University of British Columbia; CAS - California Academy of Sciences; CAS-SU - Stanford University specimens now housed at CAS; GCRL - Gulf Coast Research Laboratory Museum; LACM - Los Angeles County Museum of Natural History; MNHN - Museo Nacional de Historia Natural, Santiago, Chile; SIO - Scripps Institution of Oceanography; UCLA - University of California, Los Angeles; UCR - Universidad de Costa Rica, San José; USNM - National Museum of Natural History, Smithsonian Institution.

KEY TO GENERA AND SELECTED SPECIES OF PACIFIC DACTYLOSCOPIDS

- 1a. Dorsal-fin origin on nape 2
- 1b. Dorsal-fin origin behind nape, near vertical from anal-fin origin 10
- 2a. Dorsal fin usually discontinuous; principal preopercular canals 3 or more than 6 3
- 2b. Dorsal fin continuous; principal preopercular canals 4
.....*Sindoscopus australis* (Fowler and Bean)
- 3a. Anterior dorsal-fin elements a series of free spines; eyes on protrusile stalks
.....*Dactyloscopus* Gill (see Dawson, 1975)
- 3b. Anterior dorsal-fin elements united to form a distinct 3 or 2-spined finlet; eyes protruding but not stalked 4
- 4a. Principal segmented caudal rays 10; pectoral rays modally 12 or 13; upper lip without fimbriae; venter always naked.... 5
- 4b. Principal segmented caudal rays more than 10; pectoral rays modally 14; fimbriae present on upper and lower lips; venter at least partly scaled in late juveniles and adults 9
- 5a. Dorsal spines total 11-15; 18-29 scales in straight portion of lateral line; infraorbital canal pores in single series 6
- 5b. Dorsal spines total 20-23; 9-13 scales in straight lateral line; some paired pores in infraorbital canal
.....*Gillellus searcher* sp. nov.
- 6a. Anterior dorsal finlet 3-spined 7
- 6b. Anterior dorsal finlet 2-spined 8

- 7a. Pectoral rays usually 12; segmented anal rays 30-35 (usually 32-34); 18-23 (usually 19-21) scales in straight lateral line
.....*Gillellus semicinctus* Gilbert
- 7b. Pectoral rays usually 13; segmented anal rays 33-36 (usually 34-35); 23-25 (usually 24) scales in straight lateral line
.....*Gillellus chathamensis* sp. nov.
- 8a. Tip of lower jaw neither distinctly fleshy nor strongly protruding anteriad; 22-26 scales in straight lateral line; lateral line deflects between verticals from dorsal-fin elements 18-22*Gillellus ornatus* Gilbert
- 8b. Tip of lower jaw fleshy and strongly protruding in undamaged fish; 27-29 scales in straight lateral line; lateral line deflects between verticals from dorsal-fin elements 14-17
.....*Gillellus arenicola* Gilbert
- 9a. Principal segmented caudal rays 11, some branched in adults; dorsal finlet 3-spined; narrow band of scales across venter and scales on pectoral-fin base in late juveniles and adults; principal preopercular canals 3
.....*Platygillellus* Dawson (see Dawson, 1974)
- 9b. Principal segmented caudal rays 12, unbranched; dorsal finlet 2-spined; venter fully scaled; pectoral-fin base naked in late juveniles and adults; principal preopercular canals more than 6
.....*Heteristius cinctus* (Osburn and Nichols)
- 10a. Head truncate to broadly rounded in front; upper lip fimbriae 12-21, usually more than 13; infraorbital canal pores more than 10
.....*Dactylagnus* Gill (see Dawson, 1976)
- 10b. Head conically pointed in front; upper lip fimbriae 4-13, usually less than 13; infraorbital canal pores less than 10, typically 6-7
.....*Myxodagnus* Gill (see Dawson, 1976)

SYSTEMATIC DESCRIPTIONS

Genus *Gillellus* Gilbert

Gillellus Gilbert, 1890: 98 (type-species by original designation, *Gillellus semicinctus* Gilbert, 1890).

DIAGNOSIS: With separate 2- or 3-spined dorsal finlet originating on nape, with or without iso-

lated spines between finlet and remainder of dorsal fin; eyes not stalked, usually with a minute flap or papilla; pectoral fin-rays modally 12 or 13; principal segmented caudal rays 10, some branched in late juveniles and adults; lower lip with up to 7 fleshy fimbriae, upper lip entire; head, pectoral-fin base and venter naked; principal preopercular canals 3, unbranched; without predorsal bones (interneurals).

DESCRIPTION: Body rather slender, broader and deeper in front, laterally compressed and narrowing caudad; head moderately large, rounded dorsad, broadest near posterior margin of preopercle, somewhat narrowed in front; lower jaw slightly to strongly protruding, rounded in dorsal profile; upper lip entire, smoothly rounded and devoid of broad emarginations or fimbriae; lower lip with up to 7 (usually 4 or 6) unbranched fleshy papilla-like fimbriae (Fig. 5); eyes dorso-lateral, protruding but not on long protrusile stalks, usually with a flap or papilla; anterior naris tubiform, the aperture simple or with valve-like emargination, located on preorbital; posterior naris, a simple pore with slightly elevated rim, located behind tubiform naris and adjacent to anterior rim of orbit; principal preopercular canals 3, unbranched, and typically with but a single pore in the 1st (anterior) canal; infraorbital canal pores in single series or paired posteriad (Fig. 1); opercle with a fringe of up to 12 short, usually unbranched fimbriae overlying upper posterior margin, the frequency ontogenetic (Fig. 7); opercles broadly expanded, the membranous margins cover pectoral- and pelvic-fin bases and overlap on underside of head.

Dorsal-fin origin on nape, in advance of upper opercular angle; dorsal fin with an isolated 2- or 3-spined anterior finlet, 1st and 2nd spines more closely spaced than 2nd and 3rd; when 2-spined, finlet is followed by one or two isolated spines; remainder of spinous dorsal continuous with a series of segmented rays behind, the fin slightly to deeply emarginate between; anal spines 2, the 1st about a third shorter than 2nd which is similarly shorter than 1st segmented ray; anterior anal-fin elements of mature (transformed) males modified, the spines angled caudad, 1st and 2nd segmented rays angled forward, modified segmented rays not appreciably thickened or fleshy but membranes stretched or elongated between. Posteriormost dorsal and anal rays usually free, occasionally bound to caudal peduncle by short membranes; last anal ray reaches to or beyond vertical through rear of

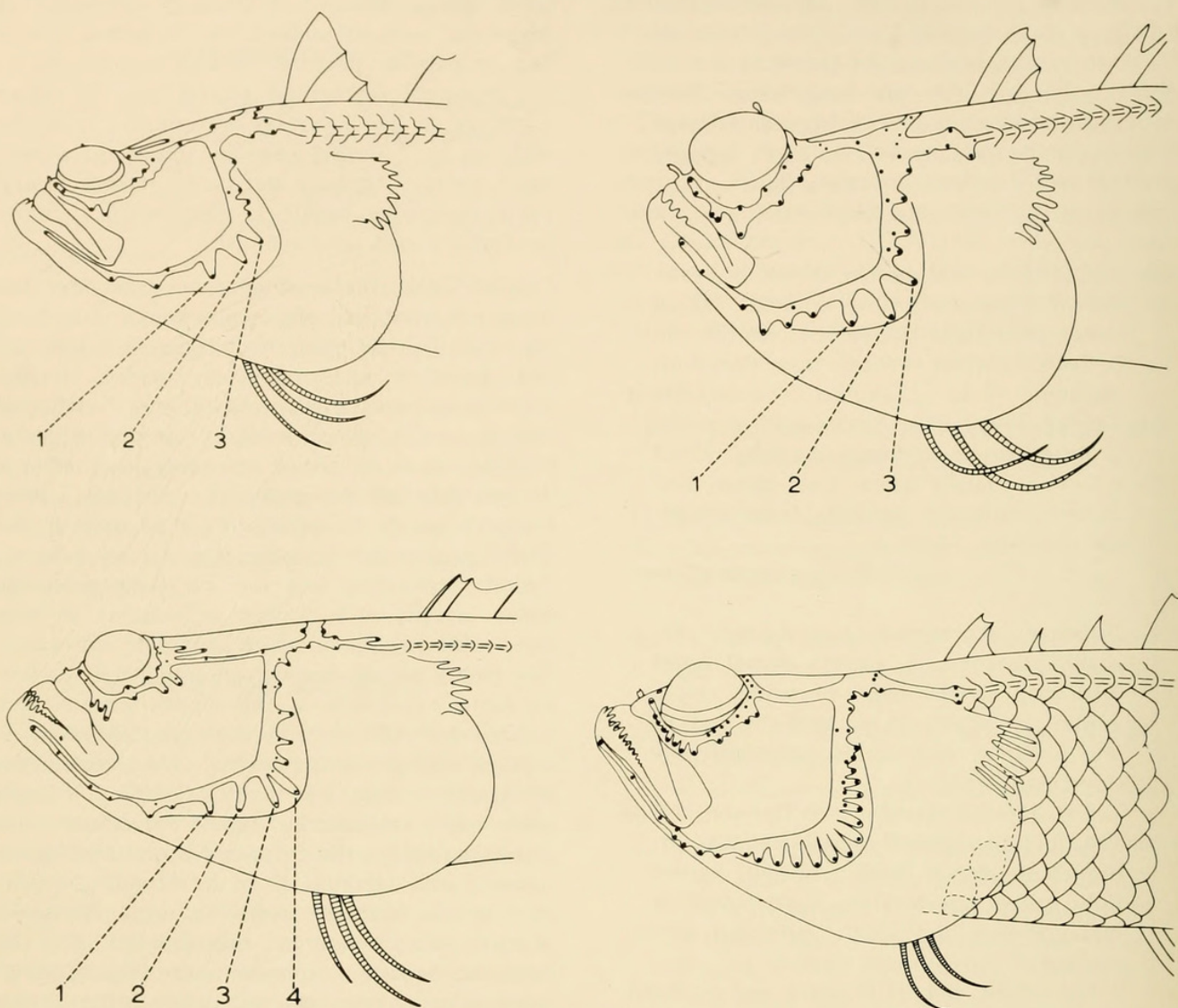


Fig. 1. Configuration of infraorbital pores and preopercular canals. Top: *Gillellus semicinctus* (left), *G. searcheri* (right). Bottom: *Sindoscopus australis* (left), *Heteristius cinctus* (right). Principal preopercular canals numbered 1-4; note complete abdominal squamation in *Heteristius*.

hypural, last dorsal ray usually shorter; caudal peduncle entire, without notch in ventral margin (Fig. 2); caudal fin rounded, upper and lower-most rays typically simple, lower ray usually the shorter, middle rays simple in early juveniles but branch ontogenetically in larger fish (Table 9).

Pectoral fin-rays 11-14, most frequently 12 or 13; pectoral fin narrowly rounded to pointed, 5th-7th from dorsalmost rays the longest, rays gradually shorter ventrad but lower rays not appreciably swollen or thickened; tip of straightened and adpressed pectoral fin may reach to

or slightly beyond descending portion of lateral-line arch, usually falls short of descending arch; pectoral fin somewhat elongate and cupped or outwardly convex in transformed males; pelvic fin with a short spine closely bound to 1st of three segmented rays, the tips free with emarginate membranes between; longest pelvic ray may reach anal-fin origin but usually falls short of anus; all fin-rays simple except for branched caudal rays of late juveniles and adults.

Lateral line continuous, originates just above and in advance of upper opercular angle (near

vertical from 1st dorsal spine), arches upward to follow near dorsal-fin base, deflects (between 14th-32nd dorsal-fin supports) and continues midlaterally to terminate as the penultimate scale on caudal-fin base; canal of straight lateral-line scales parallel to longitudinal body axis, that of last scale not strongly angled ventrad (Fig. 2). Scales of upper portion of arched lateral line persistent, outwardly convex and more or less pointed posteriad; scales of descending arch and straight lateral line thin and often deciduous, rounded in outline, the canal straight and without a distinct terminal branch anteriorly, often with a minute dorsal pore on anterior third of canal. Squamation variable above lateral-line arch, naked in early juveniles and some adults, fully or partially scaled in others; head, predorsum, venter, sides below line between upper angle of pectoral axil and 1st to 3rd anal rays, and all fins (except caudal base) naked; 5-9 longitudinal scale rows cross vertical near origin of straight lateral line. Premaxillaries somewhat protractile, the pedicels reach middle or posterior third of orbit but fall well short of posterior margin; jaw teeth small, none distinctly enlarged, conical and more or less bluntly pointed, in 2-3 rows near symphysis but mainly uniserial posteriad; vomer and palatines edentate; tongue rounded in front; basihyal slender, barely spatulate near tip. Three complete gill arches plus a hemibranch; no gill rakers on outer margin of 1st arch, often with a few rudimentary rakers that barely pick up stain on inner margin; pseudobranchiae present; branchiostegals 6; without predorsal bones (interneurals); proximal pterygiophore of 1st dorsal spine usually inserted in advance of 1st neural spine (Fig. 3); abdominal vertebrae 10-12, modally 11 (from radiographs); caudal fin with 2-4 simple spiniform elements above and below, upper and lower hypurals each bear 5 segmented rays.

Recognized species marked (in alcohol) with 6-10 principal dark saddle-like bands crossing dorsum between dorsal-fin origin and caudal-fin base, these often supplemented with secondary bands between and seldom extend ventrad of lateral midline; body and fins elsewhere plain, flecked or spotted with brown; ground color pale to brownish.

REMARKS: *Gillellus* is similar to *Platygillellus* Dawson, *Leurochilus* Böhlke and *Heteristius* Myers and Wade in possessing an isolated (or semi-isolated) dorsal finlet inserted on the nape

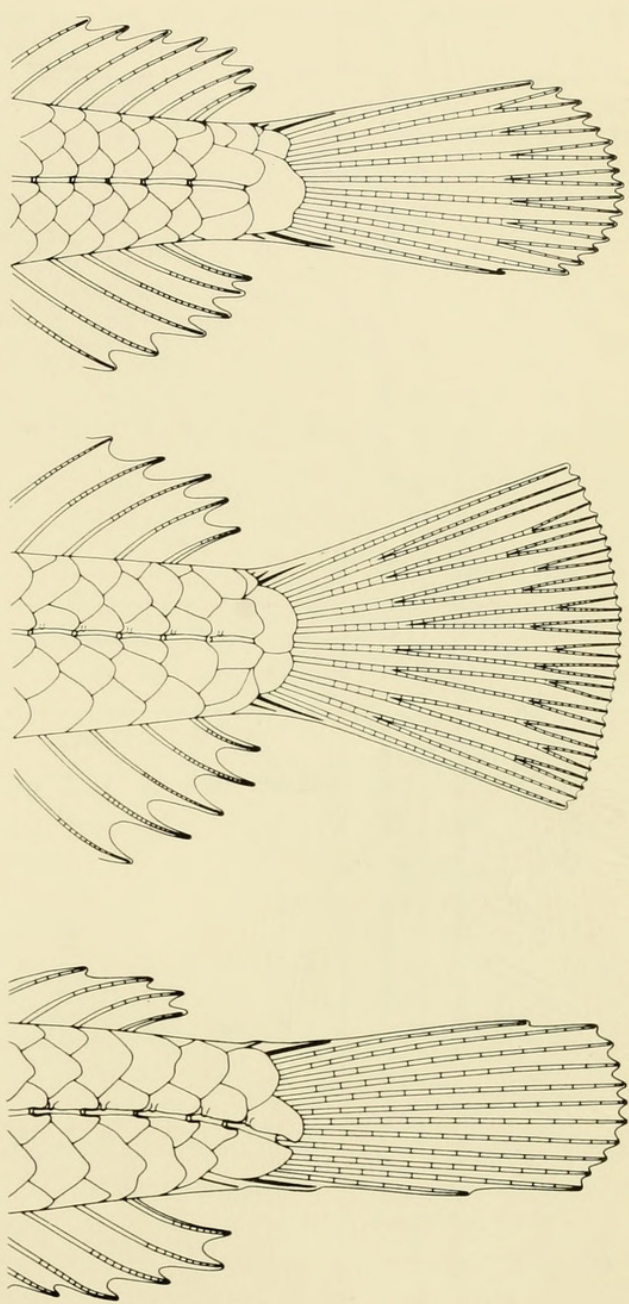


Fig. 2. Posterior body and fins, illustrating straight lateral-line scales and adult development of segmented caudal rays, in *Gillellus* (top), *Sindoscopus* (middle) and *Heteristius* (bottom).

(Table 1). In this feature it is immediately separable from *Dactyloscopus* Gill (continuous dorsal fin usually preceded by isolated spines) as well as from *Dactylagnus* Gill and *Myxodagnus* Gill wherein dorsal fin is continuous and originates well behind nape; these genera also have well developed upper lip fimbriae (absent in *Gillellus*).

TABLE 1. Comparison of selected characters distinguishing Pacific genera of the family Dactyloscopidae.

CHARACTER	<i>Dactyloscopus</i>	<i>Dactylagnus</i>	<i>Myxodagnus</i>	<i>Gillellus</i>	<i>Sindoscopus</i>	<i>Platygillellus</i>	<i>Heteristius</i>
Principal segmented caudal rays	10	10	10	10	10	11	12
Some branched caudal rays in adults	±	+	+	+	+	+	-
Predorsal bones (interneurals) present	-	+	+	-	-	-	-
Dorsal fin continuous	-	+	+	-	+	±	-
Distinct anterior dorsal finlet present	-	-	-	+	-	+	+
Anterior most dorsal spines free	+	-	-	-	-	-	-
Pectoral fin-rays modally	13	13, 15	13, 14, 15	12, 13	14	14	14
Principal preopercular canals	3	3	3	3	4	3	>6
1st (anterior) canal branched	+	+	-	-	-	-	-
Eyes stalked	+	-	-	-	-	-	-
Eye flap (papilla) present	±	-	-	±	-	±	-
Upper lip fimbriae	+	+	+	-	+	+	+
Lower lip fimbriae	+	+	+	+	+	+	+
Canals branched anteriorly in scales of straight lateral line	+	+	+	-	-	-	-
Venter scaled	-	-	-	-	-	+	+
Pectoral base scaled	-	-	-	-	-	+	-
Opercular scales present	-	-	-	-	-	+	-
Abdominal vertebrae modally	11	11, 13	12	11	11	10	10
No. of Pacific taxa	13	2	4	5	1	3	1

TABLE 2. Frequency distributions of dorsal spines, segmented dorsal rays and total dorsal-fin supports in Pacific species of *Gillellus*, *Sindoscopus* and *Heteristius*.

Genus and species	N	Dorsal spines												23
		11	12	13	14	15	16	17	18	19	20	21	22	
<i>Gillellus</i>														
<i>semicinctus</i>	220	1	31	157*	31									
<i>chathamensis</i>	60	1	14	39*	6									
<i>ornatus</i>	72		17	49*	6									
<i>arenicola</i>	45			9	30*	6								
<i>searcheri</i>	190										2	87*	48	3
<i>Sindoscopus</i>														
<i>australis</i>	81										26	39*	16	
<i>Heteristius</i>														
<i>cinctus</i>	102										3	21	59	19

	Segmented dorsal rays																		33
	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32		
<i>Gillellus</i>																			
<i>semicinctus</i>										5	20	54	97*	38	6				
<i>chathamensis</i>														3	23	28*	4	2	
<i>ornatus</i>															6	29*	23	12	
<i>arenicola</i>													2	11	14	16*	2		
<i>searcheri</i>	20	93*	74	3															
<i>Sindoscopus</i>																			
<i>australis</i>									8	35	25*	10	3						
<i>Heteristius</i>																			
<i>cinctus</i>			2	13	54	28	5												

	Total dorsal-fin supports													\bar{X}
	38	39	40	41	42	43	44	45	46	47	48	49		
<i>Gillellus</i>														
<i>semicinctus</i>		2	19	58	99*	38	4							40.7
<i>chathamensis</i>					2	32	21*	5						42.5
<i>ornatus</i>						7	32*	26	7					43.5
<i>arenicola</i>					2	11	18	11*	3					43.0
<i>searcheri</i>		46*	127	16	1									38.8
<i>Sindoscopus</i>														
<i>australis</i>									10	35	28*	7	1	46.5
<i>Heteristius</i>														
<i>cinctus</i>			3	12*	60	27								41.1

*Primary type.

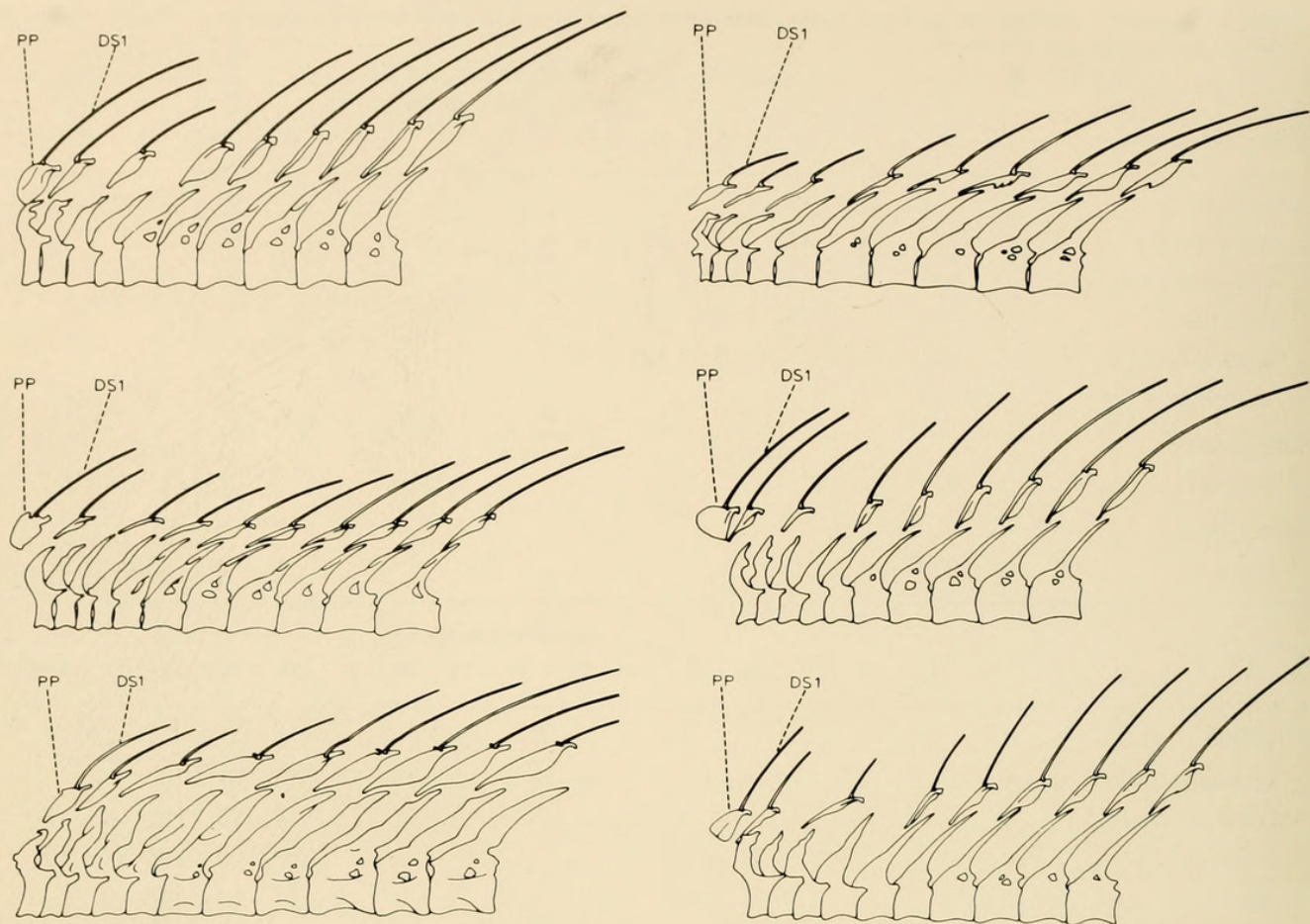


Fig. 3. Anterior abdominal vertebrae and dorsal-fin supports. Top: *Gillellus semicinctus* (left), *G. arenicola* (right). Middle: *G. ornatus* (left), *G. searcheri* (right). Bottom: *Sindosopus australis* (left), *Heteristius cinctus* (right). PP - proximal pterygiophore; DS1 - 1st dorsal spine.

Platygillellus has 11 principal segmented caudal rays and modally 14 pectoral rays (caudal rays 10, modally 12 or 13 pectoral rays in *Gillellus*), fimbriae occur on both lips, and late juveniles and adults have scales on venter and pectoral-fin base (naked in *Gillellus*). The monotypic Atlantic genus *Leurochilus* differs from *Gillellus* in having 11 rather than 10 principal caudal rays, longer premaxillary pedicels (reach posterior edge of orbits), and in the complete absence of labial fimbriae. For comparison with *Sindoscopus* and *Heteristius* see Key and descriptions of these genera below.

Gillellus is represented in Pacific waters by four closely related species and one somewhat aberrant form (*G. searcheri*). This is apparently a stenohaline genus and no collections are recorded from low salinity habitats. Maximum size is about 50 mm SL. Two species have been dredged in 137 m. The genus occurs from Isla

Guadalupe, Baja California Norte, Mexico (ca. 28°53'N) south to the mainland coast of Ecuador and the Galápagos Is. (Archipiélago de Colón).

***Gillellus semicinctus* Gilbert**

(Figure 4.)

Gillellus semicinctus Gilbert, 1890: 98 (original description, Gulf of California [and Atlantic]).

DIAGNOSIS: Dorsal finlet 3-spined, without isolated spines between finlet and remainder of dorsal fin; pectoral fin-rays modally 12; segmented anal rays modally 33; 18-23 (usually 19-21) scales in straight lateral line; eye flap usually present; without paired pores in infraorbital canal.

DESCRIPTION: Measurements (mm) of 27.8-mm-SL male lectotype follow: depth of caudal peduncle 1.2; body depth 3.6; predorsal length 6.0; preanal length 9.1; pelvic to anal distance 3.6;

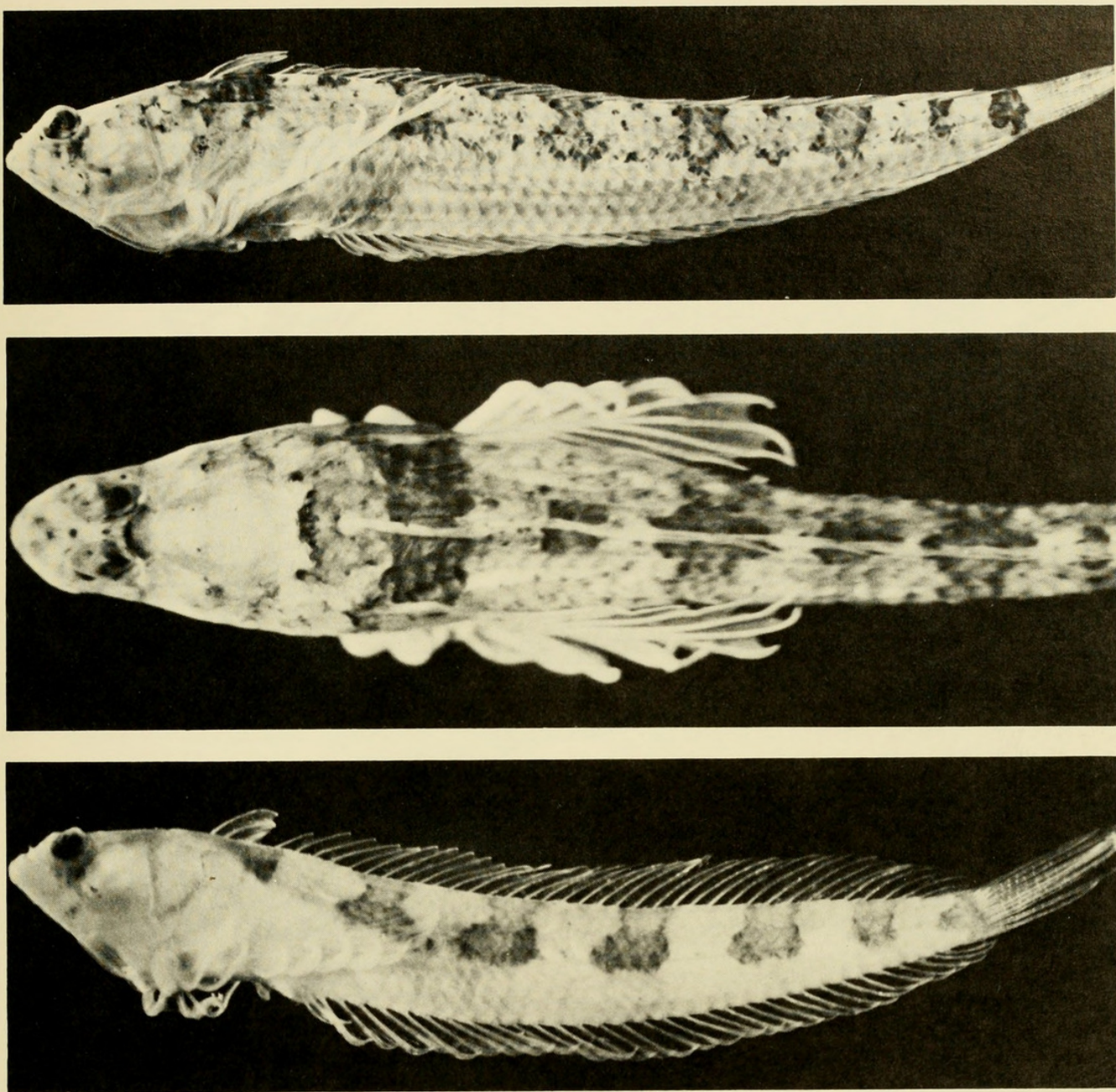


Fig. 4. *Gillellus semicinctus* Gilbert. Top and middle: Strongly pigmented with indications of secondary bands between primary bars crossing dorsum (GCRL 13244, 36 mm SL, female). Bottom: Pale pattern lacking secondary bands (CAS 31810, 32 mm SL, female).

head length 6.6; maxillary to upper opercular angle 6.1; maxillary to upper preopercular angle 4.4; length of anterior naris 0.2; diameter of bony orbit 1.4; postorbital length 4.0; snout length 1.2; length of maxillary 2.1. See Tables 2-8 for meristic data.

Lower jaw slightly protruding; lower lip typically with 4 fleshy fimbriae or papilla-like emarginations, the inner pair the larger (Fig. 5); pre-

orbital short, rather steeply inclined; tubiform anterior naris located close to anterior rim of preorbital; eye typically with a minute hyaline flap or papilla. Height of dorsal finlet equal to or slightly greater than height of remaining spinous dorsal fin, somewhat less (15-30%) than longest segmented dorsal rays (Fig. 6); last dorsal spine about 15-20% shorter than 1st segmented ray. Pectoral fin-rays 12 in 86% of 437 counts, 3

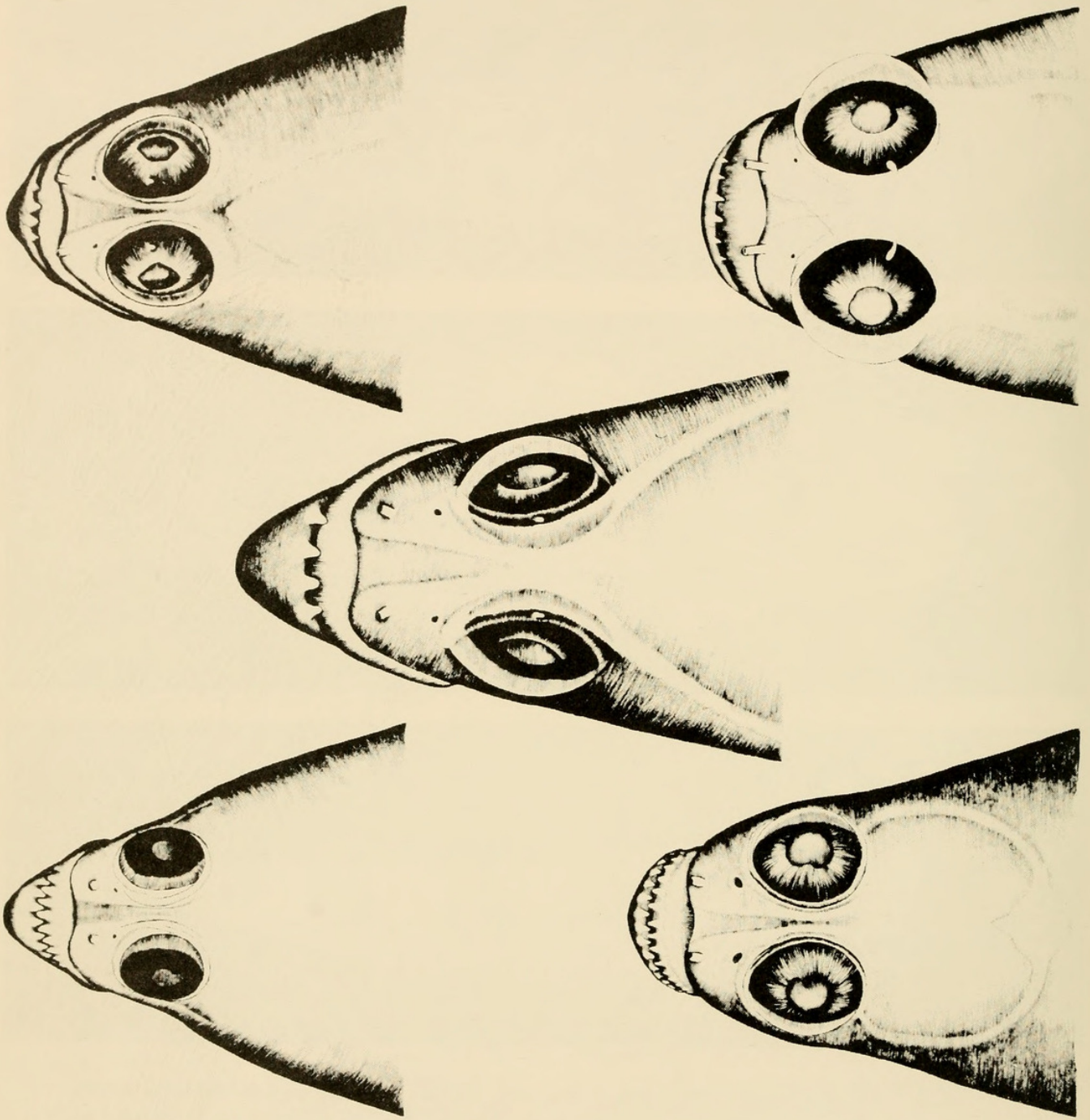


Fig. 5. Delineations of anterodorsal aspect of head. Top: *Gillellus semicinctus* (left), *G. searcheri* (right). Middle: *G. arenicola*. Bottom: *Sindoscopus australis* (left), *Heteristius cinctus* (right). Sensory canals and pores omitted.

fish had 11 rays in each fin, whereas 9 had bilateral counts of 13; pectoral fin not greatly elongate or expanded in transformed males, tip of adpressed fin reaches vertical between dorsal-fin elements 16 and 19, between 14 and 19 in

young and females; caudal fin formula modally $1 + 7 + 2$ in examined material (Table 9); opercular fimbriae 4-12 (Fig. 7; Table 10); infra-orbital canal pores usually 7, none paired (Fig. 1).

Arched portion of lateral line deflects between

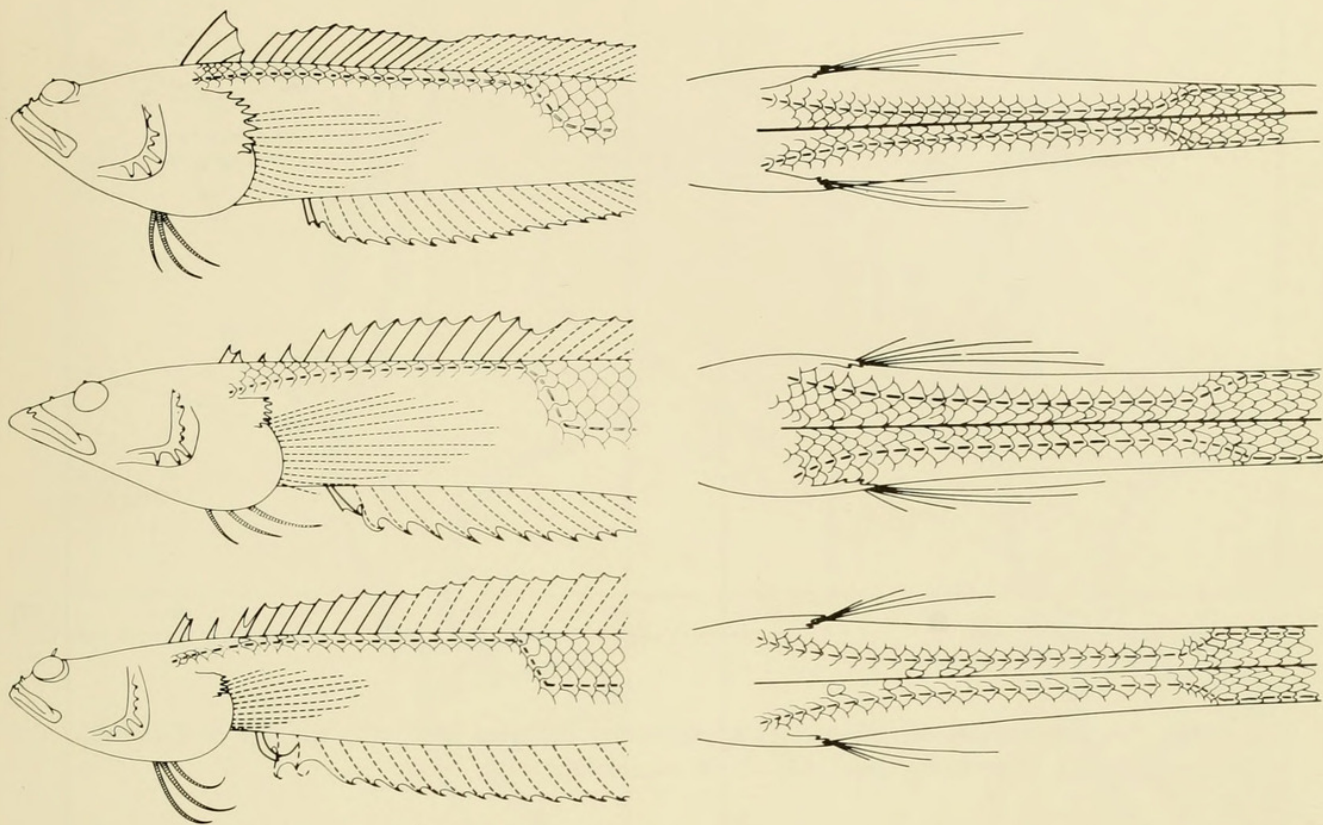


Fig. 6. Lateral and dorsal views illustrating lateral-line configuration and squamation above lateral-line arch in *Gillettus semicinctus* (top), *G. arenicola* (middle) and *G. ornatus* (bottom).

verticals from dorsal-fin elements 17 and 24, usually between 20 and 23; squamation variable above lateral-line arch, naked in early juveniles and some adults, usually with one or two scale rows anterior above 2nd or 3rd lateral-line scale, narrowing to a single row for a distance of some 10-11 scales and replaced posteriorly by the dorsalmost portions of 5-6 lateral-line scales in advance of lateral-line deflection; anteriormost scales often embedded, occasionally isolated; area between nape, origin of lateral lines and base of 1st or 2nd dorsal spine naked (Fig. 6); 8-9 longitudinal scale rows cross vertical near origin of straight lateral line; scales present in arched portion of lateral line in 13-mm fish, squamation may be complete in fish about 20 mm SL.

Lower jaw with a patch of teeth 2-3 rows broad and about 4-5 rows long near symphysis, uniserial posteriorly; anterior teeth similar in upper jaw but distinctly biserial behind; pseudo-branchiae 4-5 (7 specimens examined); proximal pterygiophore of 1st dorsal spine broad (Fig. 3).

Color in alcohol. —Usually with an indistinct bar crossing interorbital and continued below

eye to near posterior angle of gape; often with flecks of brown on snout, underside of lower jaw, upper portion of preopercle and predorsum; lips and labial fimbriae usually pale. Dorsum crossed by 6-8 (usually 7) principal saddle-like bars between nape and caudal-fin base; these primary bars equal to or slightly narrower than pale interspace, the 1st terminates ventrad near middle of opercle, last covers most or all of caudal base, whereas remainder terminate near lateral midline; well pigmented (usually large) specimens often with short secondary bars crossing dorsum between primary markings, numerous brown flecks on otherwise pale interspaces and two or more primary bars may be united ventrad by a narrow brown line; sides below midline mainly pale but occasionally with scattered brown flecks; pectoral fins usually pale but upper interrational membranes may be lightly streaked with brown, other fins typically immaculate. Shape and pigmentation of lateral portions of primary bars (behind nape) variable; within a single sample, bars may be narrowed between lateral midline and dorsal-fin base, rectangular, or narrowed below and somewhat tri-

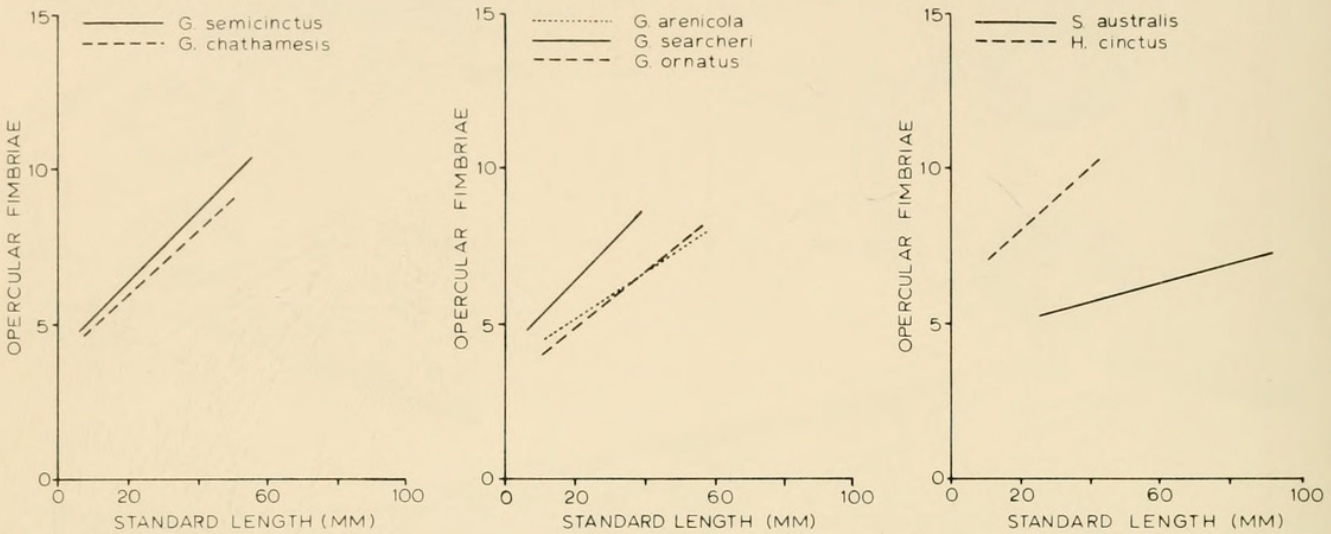


Fig. 7. Regressions of frequencies of opercular fimbriae in Pacific species of *Gillellus*, *Sindoscopus* and *Heteristius*. See Table 10 for supporting data.

angular; bars may have evenly distributed light to dark brown pigmentation or may have dark margins with light brown or pale between; inter-orbital bar and principal saddle-like markings are distinct in 14-mm fish.

REMARKS: Gilbert (1890) failed to select a holotype and based his description on specimens from both Atlantic (GRAMPUS Sta. 5108, 5112) and Pacific waters (ALBATROSS Sta. 2827, 2829). This ultimately resulted in uncertainty (Böhlke, 1968; Dawson, 1974) as to which of the two included species should be considered *semicinctus*, the type-species of *Gillellus*. I have recently found that no such problem exists and that the species must be based on Pacific material. Jordan (1897) referred to *Gillellus semicinctus* (p. 229) stating, "I present a figure of this interesting species from one of the types" and illustrated a specimen in Plate XXXII. The introduction (p. 20) indicates that Jordan's material was in the Stanford collection and the list of plates (p. 244) states, "*Gillellus semicinctus*: type. Gulf of California." Pacific specimens of the syntypic series include one from ALBATROSS station 2827 (US NM 126880) and two (CAS-SU 31) from ALBATROSS station 2829, located off Cabo San Lucas, Baja California Sur. Included in USNM 126880 is a handwritten label by Barton A. Bean ("B. A. B.") dated January 1918 stating, "According to Dr.

Jordan this is a cotype or paratype. The type is at Stanford. A third specimen (Florida) is in Nat. Museum."

There are two fish (25.8 and 27.6 mm SL) and a metal tag imprinted "drawn" in CAS-SU 31. The larger specimen has a total of 41 dorsal-fin supports, whereas the smaller has 42. Jordan's figure is very poor and shows a continuous rather than an anteriorly interrupted dorsal fin but dorsal-fin supports total 41. I conclude that Jordan figured the larger fish and thereby designated this specimen as the lectotype of *Gillellus semicinctus* in accord with Article 74b, International Code of Zoological Nomenclature. The paralectotype has been renumbered CAS-SU 67760.

Considerable study material is available from Baja California waters, but representation from other areas is minimal and most specimens are small (under 30 mm SL) and in poor condition. Total material from the Revillagigedos consists of 17 specimens (10-22 mm SL) and there are but 8 (15-31 mm) from the Galápagos Islands. Available data (Table 11) suggest that counts of dorsal and anal rays, vertebrae, and lateral-line scales average slightly higher in the Baja California population (including Isla Guadalupe) than those of Revillagigedos or Nayarit, Mexico or Galápagos material. These differences may indicate distinct populations or merely clinal varia-

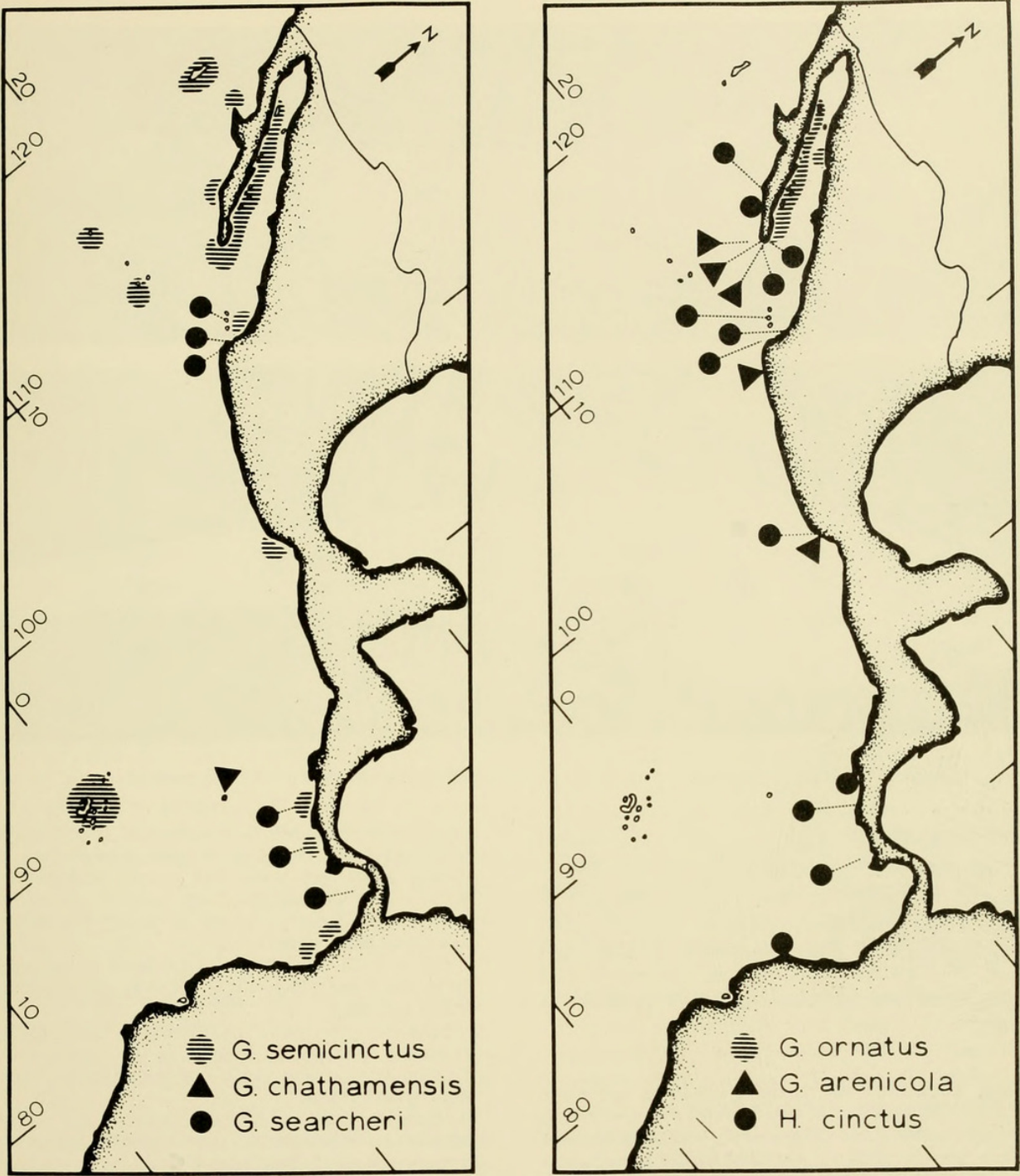


Fig. 8. General distribution maps of Pacific species of *Gillellus* and *Heteristius*.

tion, but further treatment of this problem must await receipt of additional specimens.

Among examined material, the smallest transformed male from Baja California waters was 28 mm SL, the smallest ovigerous female was 33 mm; a 26-mm transformed male and 7 ovigerous females (26-30 mm) occurred in a collection from Nayarit, Mexico. A 41-mm SL female contained 224 near-ripe eggs (maximum diameter about 0.7 mm) in the right gonad, together with about

an equal number approximately 0.3 mm in diameter.

Among Pacific dactyloscopids, the recorded bathymetric range of *Gillellus semicinctus* is matched only by that of *G. arenicola* and *Dactyloscopus lunaticus*. Whereas the latter forms may occur in depths of a meter or less, I have no confirmed records of *Gillellus semicinctus* from less than 5 m. Among collections with complete data, 29 were by dredge and 15 with SCUBA; 8 were

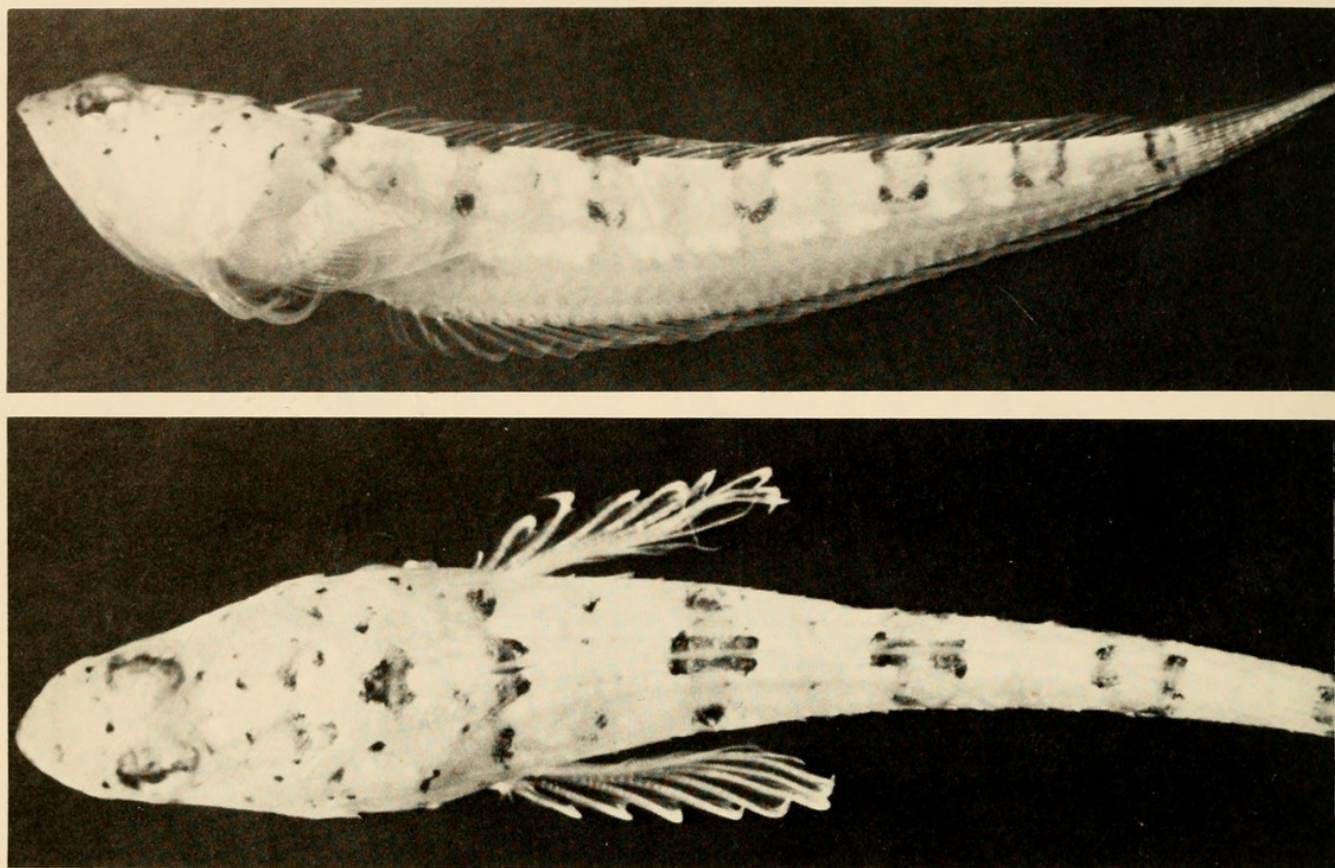


Fig. 9. *Gillellus chathamensis* n. sp. (GCRL 13215, female paratype, 23 mm SL).

in confirmed depths of 5-15 m, 22 in 17-46 m, and 9 in 50-137 m. Known from Islas Revillagigedos, Isla Guadalupe (ca. 28°53'N) and Pacific coast of Baja California, western Gulf of California, various mainland and insular shores from Nayarit, Mexico to Isla Gorgona, Colombia and Galápagos Is. (Archipiélago de Colón), Ecuador (Fig. 8).

MATERIAL EXAMINED: Two hundred eighty-two specimens, 9.6-48.3 mm SL, including lectotype and two paralectotypes.

Lectotype. —CAS-SU 31 (27.6 mm SL, male), Mexico, Baja California Sur, 22°52'00"N, 109°55'00"W, 56.7 m, 1 May 1888, ALBATROSS Sta. 2829.

Paralectotypes. —CAS-SU 67760 (25.8 mm), taken with lectotype. USNM 126880 (ca. 31.2 mm), Mexico, Baja California Sur, 24°11'45"N, 109°55'00"W, 18.3 m, ALBATROSS Sta. 2827.

Other Material. —MEXICO, Baja California Norte (Pacific). —Isla Guadalupe: SIO 50-31, 57-190, 58-497 and GCRL 13241. —Isla Cedros: SIO 63-168, 71-33 and LACM 23999. Baja California Sur (Pacific). —Bahía Magdalena to Cabeza Ballena: LACM 23985, 23986, 23996, 23997 and SIO 64-61. Baja California Sur (Gulf of California). —Punta de los Frailes to Punta Concepción: CAS 32037; CAS-SU 5934; GCRL 13242 through 13245; LACM 9728-2, 23987 through 23989, 23994 and 23998; SIO 61-247, 61-249, 65-243, 65-270, 65-278, 65-295, 65-311, 65-317, 65-321, 65-335 and 65-337; UCLA W65-49 and W65-86. Baja California Norte (Gulf of California). —Isla Santa

Inéz to Isla Ángel de la Guarda: CAS 31809 and 31810; GCRL 13246 and 13341; LACM 23982 through 23984, 23990 through 23992, and 23995; SIO 65-306; UCLA W53-69 and W53-73. Islas Revillagigedos. —Isla Socorro: SIO 70-392. Isla Clarión: UCLA W55-136. Nayarit to Oaxaca: CAS 6923, 32035 and 32036; LACM 23993.

COSTA RICA. —Puntarenas: UCR 664-6. —Isla del Caño: GCRL 13247 and 13248; LACM 32547-48 and 32562-46, UCR 675-11 and 685-1.

PANAMA. —Islas Secas: USNM 101734. —Isla Jicarón: SIO 71-87.

COLOMBIA. —LACM 23981 and USNM 101725. —Isla Gorgona: USNM 101738.

ECUADOR, Galápagos Islands (Archipiélago de Colón). —Isla Isabela (Albemarle Is.): LACM 23980. —Isla Santa María (Charles Is.): UCLA W67-43 and USNM 101735. —Isla Baltra (S. Seymour Is.): USNM 109426. —Isla Santa Cruz (Indefatigable Is.): CAS-SU 39962. —Isla Marchena (Bindloe Is.): USNM 205457.

***Gillellus chathamensis* Dawson, new species**
(Figure 9.)

DIAGNOSIS: Dorsal finlet 3-spined, without isolated spines between finlet and remainder of dorsal fin; pectoral fin-rays modally 13; segmented anal rays modally 34; straight lateral-line scales 23-25 (usually 24); eye flap usually obsolete or vestigial; without paired pores in infra-orbital canal.

DESCRIPTION: Measurements (mm) of 25.8-mm SL transformed male holotype follow: caudal fin length 3.8; length of uppermost segmented caudal ray 3.0; length of lowermost segmented caudal ray 2.7; depth of caudal peduncle 1.1; body depth 2.8; predorsal length 4.5; preanal length 6.8; pelvic to anal distance 3.0; head length 5.2; head breadth 2.8; maxillary to upper opercular angle 4.8; maxillary to upper preopercular angle 3.4; length of anterior naris 0.2; eye diameter 1.2; postorbital length 3.0; snout length 1.2; maxillary length 1.8; length of 1st dorsal spine 1.5, 3rd spine 0.5, 4th spine 0.9, last spine 1.5; length of 1st segmented dorsal ray 1.9. See Tables 2-8 for meristic data.

Lower jaw slightly protruding, rounded to subtriangular in front; 4 fimbriae on lower lip; preorbital short, moderately inclined; tubiform anterior naris located near anterior rim of preorbital; eye flap usually vestigial or obsolete; height of dorsal finlet about equals that of remaining spinous dorsal fin, somewhat less than length of longest segmented dorsal ray. Pectoral-fin rays 13 in 87% of 134 counts, one fish had 12 rays in each fin, whereas three had bilateral counts of 14; pectoral fins not broadly expanded in transformed males, may reach past lateral-line deflection; tip of adpressed fin reaches vertical between dorsal-fin elements 17 and 22 in transformed males, between 14 and 18 in young and females; segmented caudal rays frequently simple, but some median rays branched in most material examined (Table 9); opercular fimbriae 4-8 (Fig. 7; Table 10); infraorbital canal pores 7, none paired.

Arched portion of lateral line deflects between verticals from dorsal-fin elements 17 and 21, usually between 18 and 20; squamation above lateral-line arch similar to that of *G. semicinctus*; 9 longitudinal scale rows cross vertical near origin of straight lateral line; squamation apparently complete in 16-mm fish. Dentition essentially as in *semicinctus*; pseudobranchiae 4-5 in two specimens examined; proximal pterygiophore of 1st dorsal spine broad.

Color in alcohol. —Ground color is pale in all material, markings tan to dark brown. Usually with only faint indication of an interorbital bar and without suborbital bar to angle of gape; 4-5 prominent spots about eye and with additional spots on upper sides and dorsum of head, some fish with a rather large brownish blotch on dorsum immediately behind each eye; usually with a faint narrow bar cross-

ing upper and lower jaws on either side of symphysis and 2-4 isolated spots on ventral margins of lower jaw; there is a small blotch dorsad before 1st dorsal spine and 7-8 (usually 7) saddle-like primary bars cross dorsum from finlet to caudal-fin base, margins of bars often incompletely pigmented and median areas poorly marked; secondary bars often indicated by spots or faint blotches on upper portions of pale interspaces; head and sides elsewhere pale. Dorsal finlet usually with some brown pigmentation, this may be restricted to posterior membrane, to a few isolated spots, or may shade entire finlet; other fins immaculate. Specimens from SEARCHER Sta. 517 are more strongly marked and approach *G. semicinctus* in general coloration. They have prominent interorbital and suborbital bars, there is little or no pigment on snout or jaws, the predorsal spot (if any) is included in the 1st (anterior) primary bar, primary bars are more or less evenly pigmented and some fish have a few brown flecks anteriorly above anal fin base.

ETYMOLOGY: The name *chathamensis* refers to the type-locality, Chatham Bay, Isla del Coco.

COMPARISONS: This species is distinguished from the closely related *G. semicinctus* by modal counts of 13 pectoral rays and 24 straight lateral-line scales (12 and 19-20 in *semicinctus*). The combination of unpaired infraorbital canal pores, 3-spined dorsal finlet, and modally 13 pectoral rays and 24 straight lateral-line scales separates *Gillellus chathamensis* from all Pacific congeners.

REMARKS: This species may readily be confused with *G. semicinctus*, and careful examination is required for identification. Among material examined, the smallest transformed male is 18.9 mm SL, the smallest ovigerous female (19.6 mm) contained 104 developing eggs, about 0.5 mm in maximum diameter.

All specimens have been taken with SCUBA in depths of 5-12 m. *Gillellus chathamensis* is known only from Isla del Coco, Costa Rica (Fig. 8).

MATERIAL EXAMINED: Holotype and sixty-six paratypes, 15-32 mm SL.

Holotype. —LACM 32256-23 (25.8 mm SL, male), Costa Rica, Isla del Coco, Chatham Bay, 05°33'12"N, 87°02'14"W, 6 m, SCUBA, R/V SEARCHER, sta. 511, 1 April 1972, R. J. Lavender and party.

Paratypes. —COSTA RICA, Isla del Coco, Chatham Bay: UCR 711-16, GCRL 13215 and 13216, 05°33'29"N, 87°02'48"W, 11 m, SCUBA, R/V SEARCHER Sta. 509. LACM 32260-22,

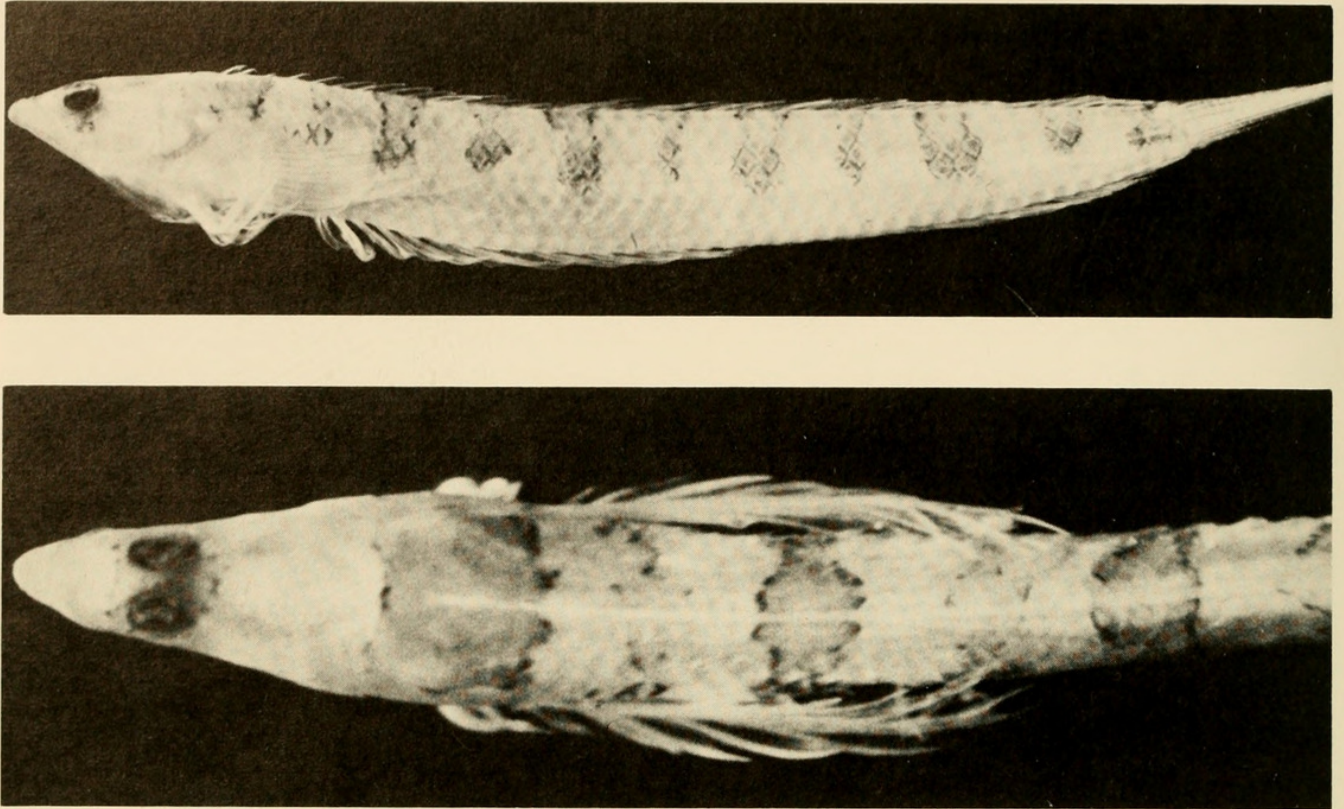


Fig. 10. *Gillellus arenicola* Gilbert (GCRL 13240, 34 mm SL, young male).

GCRL 13213, 05°33'21"N, 87°03'15"W, 12 m, SCUBA, R/V SEARCHER Sta. 517. LACM 32256-24, GCRL 13211 and 13212, taken with holotype. —Wafer Bay: LACM 32272-18, GCRL 13214, 05°32'45"N, 87°03'49"W, 5 m, SCUBA R/V SEARCHER Sta. 532.

***Gillellus arenicola* Gilbert**

(Figure 10.)

Gillellus arenicola Gilbert, 1890: 99 (original description; Cape San Lucas, Baja California Sur).

DIAGNOSIS: Dorsal finlet 2-spined; pectoral fin-rays modally 12; scales in straight lateral line 27-29 ($\bar{x} = 28$); lateral line deflects between verticals from dorsal-fin elements 18 and 22; lower jaw fleshy and strongly protruding (in undamaged fish); without paired pores in infraorbital canal.

DESCRIPTION: Measurements (mm) of 41.1-mm SL neotype follow: caudal-fin length 7.5; length of uppermost segmented caudal ray 5.5; length of lowermost segmented caudal ray 5.0; depth of caudal peduncle 2.0; body depth 4.6; predorsal length 7.7; preanal length 11.5; pelvic to anal distance 3.9; head length 8.9; head breadth 3.6; maxillary to upper opercular angle 8.0; maxillary to upper preopercular angle 5.8; length of anterior naris 0.2; eye diameter 1.6; postorbital length 5.4; snout length 2.1; maxillary length 2.8; length of 1st dorsal spine 0.9, 2nd spine

0.7, 4th spine 0.6, last spine 2.1. See Tables 2-8 for meristic data.

Lower jaw distinctly protruding and produced anteriorly as a conical fleshy prominence (Fig. 5); labial fimbriae 4; preorbital long, about equals diameter of pigmented eye, not steeply inclined; tubiform anterior naris located near middle of preorbital length, well removed from anterior rim; eye usually with a flap. Height of dorsal finlet about 1/3 to 1/4 that of spinous portion of continuous dorsal fin; dorsal fin slightly notched or emarginate between last spines and anterior segmented rays. Finlet typically 2-spined (3-spined in two of 58 examined) and with one or two (40% of 35 examined) isolated spines between finlet and continuous dorsal fin (Fig. 6). Pectoral fin-rays 12 in 75% of 89 counts, 7 fish with bilateral counts of 13; pectoral membranes expanded and the fin elongate in transformed males, may reach to or somewhat beyond origin of straight lateral line; tip of adpressed fin reaches vertical between dorsal-fin elements 15 and 20 in transformed males, between 12 and 17 in young and females; some median caudal rays branched in adults (Table 9); opercular fimbriae 3-8 (Fig. 7; Table 10); infraorbital canal pores usually 7, none paired.

TABLE 3. Frequency distributions of segmented anal and pectoral fin-rays in Pacific species of *Gillellus*, *Sindoscopus* and *Heteristius*.

Genus and species	N	Segmented anal fin-rays												\bar{x}
		30	31	32	33	34	35	36	37	38	39	40	41	
<i>Gillellus</i>														
<i>semicinctus</i>	219	4	17	64	100*	31	3							32.7
<i>chathamensis</i>	56				3	27	23*	3						34.5
<i>ornatus</i>	75				2	10	35*	23	5					35.2
<i>arenicola</i>	52					1	17	27*	6	1				35.8
<i>searcheri</i>	195	22*	125	48										31.1
<i>Sindoscopus</i>														
<i>australis</i>	89								3	36	38*	10	2	38.7
<i>Heteristius</i>														
<i>cinctus</i>	107				2	46*	57	2						34.6

	N	Pectoral fin-rays					\bar{x}
		11	12	13	14	15	
<i>Gillellus</i>							
<i>semicinctus</i>	437	12	378*	45	2		12.1
<i>chathamensis</i>	134		5	116*	13		13.1
<i>ornatus</i>	150	4	139*	7			12.0
<i>arenicola</i>	89		67*	22			12.2
<i>searcheri</i>	306		2	285*	19*		13.1
<i>Sindoscopus</i>							
<i>australis</i>	185			37	148*		13.8
<i>Heteristius</i>							
<i>cinctus</i>	208			17	164*	27	14.0

*Primary type.

Arched portion of lateral line deflects between verticals from dorsal-fin elements 14 and 17, usually between 15 and 16; area above arch usually fully scaled in adults, 3-4 scale rows between base of 1st dorsal spine and 1st or 2nd lateral-line scale, narrowing to a single row above posterior half of arch (Fig. 6); 9 longitudinal scale rows cross vertical near origin of straight lateral line; lateral-line scales present in 14-mm SL fish, squamation apparently complete in some 22-mm specimens. Dentition essentially as described for *G. semicinctus*; pseudobranchiae 4 (2 examined); proximal pterygiophore of 1st dorsal spine comparatively slender (Fig. 3).

Color in alcohol. —Coloration is poorly preserved in study materials but well marked specimens have indications of an interorbital bar and

a more or less distinct suborbital bar crosses posterior third of gape to terminate on ventral margin of lower jaw; a narrow bar crosses underside of lower jaw; upper sides and dorsum of head plain, lightly spotted or blotched with brown. Dorsum crossed by 7 principal saddle-like bars between nape and caudal-fin base; late juveniles and adults often with secondary bars which may approach size and pigmentation of primary bars, the net effect being a series of 12-14 saddles; pale interspaces of upper side sometimes flecked with brown and a few scattered flecks may be present on lower portion of side; all fins immaculate.

COMPARISONS: The 2-spined dorsal finlet and long, distally fleshy, lower jaw separate undamaged *Gillellus arenicola* from all Pacific con-

genera. Specimens with damaged lower jaw can be confused with *G. ornatus*, the only other species with 2-spined finlet (see *ornatus* for further comparisons). It is distinguished from *searcheri* by a number of meristic characters (Tables 2-8) and from both *semicinctus* and *chathamensis* by modal frequency of total dorsal spines (14 in *arenicola* against 13), number of straight lateral-line scales (27-29 against 18-25), and position of lateral-line deflection (between dorsal-fin elements 14 and 17 versus 17 and 24 in *semicinctus* and *chathamensis*). The several Pacific species of *Myxodagnus* (see Dawson, 1976) also have projecting lower jaws and are superficially similar to *Gillellus arenicola*. In *Myxodagnus*, however, there are both upper and lower labial fimbriae, dorsal fin is continuous and originates near vertical from anal-fin origin, and there are no prominent saddle-like blotches crossing the dorsum.

REMARKS: Gilbert's (1890) description was based on "A single specimen, 1-1/2 inches long, from Cape San Lucas." This fish was not illustrated; there is no record of its receipt at the National Museum, and it is apparently lost. I therefore select a 41-mm SL specimen (CAS-SU 67821) as the neotype of *Gillellus arenicola* Gilbert. This fish, apparently an immature male, was collected near the type-locality; see measurements above, material examined and Tables 2-8 for additional data.

There are relatively few specimens in collections and most of these are in rather poor condition. Among material examined, the smallest transformed male is 32 mm SL, the smallest ovigerous female 40 mm; a 49-mm female contained 129 developing eggs in the right gonad. *Gillellus arenicola* has been taken with seine, dredge or SCUBA to depths of 137 m. It is known from the southern portion of Baja California Sur and from single collections off the states of Colima and Oaxaca, Mexico (Fig. 8).

MATERIAL EXAMINED: Fifty-eight specimens, 13-50 mm SL, including neotype.

Neotype. —CAS-SU 67821 (41.1 mm SL), Mexico, Baja California Sur, Bahía de San Lucas, 22°53'00"N, 109°52'00"W, Sefton-Stanford ORCA Expdn. Sta. 44-D-2, 19 May 1952.

Other Material. —MEXICO, Baja California Sur. —San Jaime Bank to Bahía de las Palmas: AMNH 5398 and BC 60-513; CAS 2716, 14212 and 32038 through 32040; CAS-SU 18915; GCRL 13237 through 13240; LACM 23968, 23969 and 31774-45; SIO 61-232, 61-247 and 62-704 or 59-210 (loc. uncertain); UCLA W59-251; and USNM 2533. Colima: LACM 23967. Oaxaca: CAS 32034.

TABLE 4. Frequency distribution of arched lateral-line scales in Pacific species of *Gillellus*, *Sindoscopus* and *Heteristius*.

Genus and species	N	Number of arched lateral-line scales																				\bar{x}
		18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	
<i>Gillellus</i>																						
<i>semicinctus</i>	87							1	5	9	20	20	17	9	5	1						29.0
<i>chathamensis</i>	25								1	7	9	5*	2	1								28.2
<i>ornatus</i>	47								1	3*	8	10	9	4	9	3						28.8
<i>arenicola</i>	29						1	4	13	7*	2	2										25.4
<i>searcheri</i>	93																			1	1	57.2
<i>Sindoscopus</i>																						
<i>australis</i>	62												7	3	6	7	8	13	12	4	1	33.0
<i>Heteristius</i>																						
<i>cinctus</i>	49	1		8	16	17	7															21.4

*Primary type.

TABLE 5. Frequency distributions of straight lateral-line scales in Pacific species of *Gillellus*, *Sindoscopus* and *Heteristius*.

Genus and species	N	Number of straight lateral-line scales																																			\bar{x}
		9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35									
<i>Gillellus</i>																																					
<i>semicinctus</i>	87															4	32	32	14	3	2												19.8				
<i>chathamensis</i>	25																			8	15*	2											23.8				
<i>ornatus</i>	47																			5	13	23*	5	1									23.7				
<i>arenicola</i>	29																																27.6				
<i>searcheri</i>	93	15*	22	39	15	2																15	10*	4									10.6				
<i>Sindoscopus</i>																																					
<i>australis</i>	62																																30.7				
<i>Heteristius</i>																																					
<i>cinctus</i>	49																																32.8				

*Primary type.

TABLE 6. Frequency distribution of total lateral-line scales in Pacific species of *Gillellus*, *Sindoscopus* and *Heteristius*.

Genus and species	N	Total lateral-line scales																								\bar{x}								
		44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67		68	69	70	71	72	73		
<i>Gillellus</i>																																		
<i>semicinctus</i>	87	1	1	4	14	21	18	13	9	5	1																						48.8	
<i>chathamensis</i>	25						4	8	4	6*	2		1																				51.9	
<i>ornatus</i>	47						2	4*	10	12	6	4	4	4	1																		52.5	
<i>arenicola</i>	29								3	8	8	6*	4																				53.0	
<i>searcheri</i>	93																					2	6	9	20	23	22	6*	3	1	1		67.9	
<i>Sindoscopus</i>																																		
<i>australis</i>	62																																	63.7
<i>Heteristius</i>																																		
<i>cinctus</i>	49												4	10	14	15	6																54.2	

*Primary type.

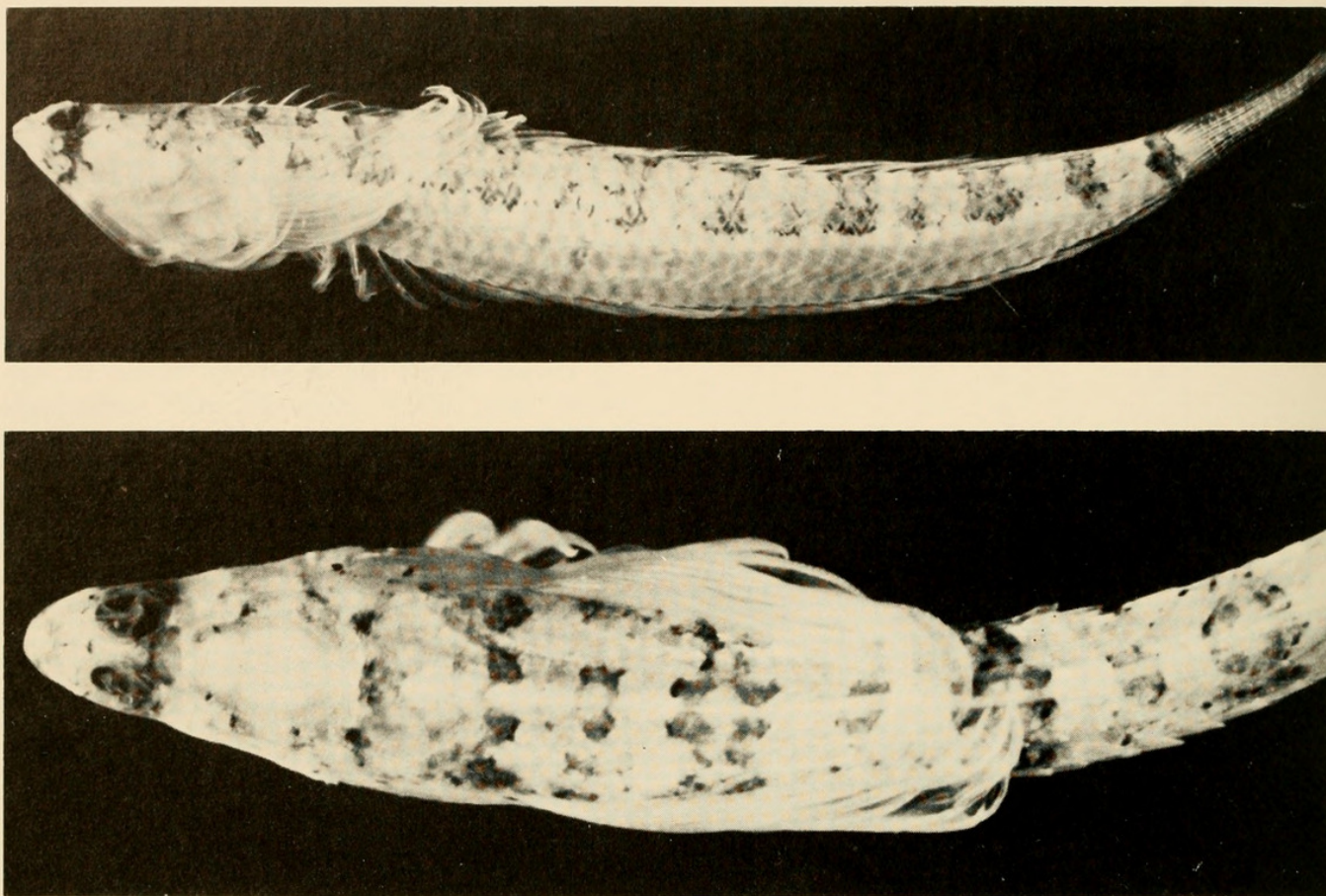


Fig. 11. *Gillellus ornatus* Gilbert (GCRL 13234, 41 mm SL, transformed male).

***Gillellus ornatus* Gilbert**

(Figure 11.)

Gillellus ornatus Gilbert, 1892: 558 (original description, Gulf of California).

DIAGNOSIS: Dorsal finlet 2-spined; pectoral fin-rays modally 12; scales in straight lateral line 22-26 (mean = 24); lateral line deflects between verticals from dorsal-fin elements 18 and 22; lower jaw neither fleshy nor strongly protruding anteriad; without paired pores in infraorbital canal.

DESCRIPTION: Measurements (mm) of 36.2-mm SL transformed male neotype follow: caudal fin length 6.4; length of uppermost segmented caudal ray 5.0; length of lowermost segmented caudal ray 4.3; depth of caudal peduncle 1.7; body depth 3.6; predorsal length 6.2; preanal length 9.2; pelvic-anal distance 3.4; head length 7.5; head breadth 3.5; maxillary to upper opercular angle 7.1; maxillary to upper preopercular angle 4.7; length of anterior naris 0.2; eye dia-

meter 1.5; postorbital length 5.1; snout length 0.6; maxillary length 2.0; length of 1st dorsal spine 1.3, 2nd spine 0.8, 3rd spine 0.6, 4th spine 1.7, last spine 1.8; length of 1st segmented dorsal ray 2.2. See Tables 2-8 for meristic data.

Lower jaw slightly protruding, not continued as a fleshy prominence anteriad; labial fimbriae 4; preorbital short, moderately inclined; tubiform anterior naris slightly nearer anterior rim than middle of preorbital length; eye usually with a prominent flap. Height of dorsal finlet usually less than that of continuous portion of dorsal fin, segmented dorsal rays longer than spines. Finlet always 2-spined, with one (95%) or two isolated spines between finlet and continuous portion of dorsal fin (Fig. 6); membrane rather deeply incised between 1st and 2nd spines of continuous dorsal fin, the fin emarginate between last spine and 1st segmented ray. Pectoral fin-rays 12 in 93% of 150 counts, one fish with 11 rays in each fin, three with bilateral counts of 13; pectoral fin elongate in transformed males,

TABLE 7. Frequency distributions of caudal vertebrae and opercular fimbriae in Pacific species of *Gillellus*, *Sindoscopus* and *Heteristius*.

Genus and species	N	Caudal vertebrae												\bar{x}	
		30	31	32	33	34	35	36	37	38	39	40	41		42
<i>Gillellus</i>															
<i>semicinctus</i>	190		8	19	57	85*	21							33.5	
<i>chathamensis</i>	56					3	27*	23	3					35.5	
<i>ornatus</i>	72					1	23*	30	18					35.9	
<i>arenicola</i>	47						10	28*	8	1				36.0	
<i>searcheri</i>	198	1	31	134*	30	2								32.0	
<i>Sindoscopus</i>															
<i>australis</i>	93										26	43	21*	3	40.0
<i>Heteristius</i>															
<i>cinctus</i>	134					7	60*	60	7						35.5

	N	Opercular fimbriae											
		2	3	4	5	6	7	8	9	10	11	12	
<i>Gillellus</i>													
<i>semicinctus</i>		365			4	7	58*	109*	102	55	27	2	1
<i>chathamensis</i>		133			3	16*	59	45*	10				
<i>ornatus</i>		146	1	1	4	51*	39	32	13	4	1		
<i>arenicola</i>		79		1	2	17	23*	25	11				
<i>searcheri</i>		318			1	33	102	116*	58	8			
<i>Sindoscopus</i>													
<i>australis</i>		180			2	19	70*	56	28	4	1		
<i>Heteristius</i>													
<i>cinctus</i>		217				1	1	19	67	88	29	11	1

*Primary type.

the interradi al membranes expanded, the fin somewhat cupped or outwardly convex; tip of adpressed fin falls short of origin of straight lateral line, reaches vertical between dorsal-fin elements 15 and 19 in transformed males, between 12 and 15 in young and females; caudal fin formula modally 2 + 6 + 2 in examined material (Table 9); opercular fimbriae 2-10 (Fig. 7; Table 10); infraorbital canal pores 6-7, none paired.

Arched portion of lateral line deflects between verticals from dorsal-fin elements 18 and 22, usually between 18 and 21, squamation variable above lateral-line arch; naked in early juveniles and some adults; some with a few scattered scales anteriad (Fig. 6), others with about two rows originating above 2nd or 3rd lateral-line

scale, narrowing to a single crowded row behind and replaced by impinging lateral-line scales over posterior half of arch; 7-9 longitudinal scale rows cross vertical near origin of straight lateral line; arch scales present in 12-mm SL fish, squamation apparently complete in some 19-mm specimens. Jaw teeth apparently in two rows over anterior half of upper jaw and in 2-3 rows near symphysis of lower jaw, teeth in single row posteriad; pseudobranchiae 3-4 (3 examined); proximal pterygiophore of 1st dorsal spine broad (Fig. 3).

Color in alcohol. —An interorbital bar present and continued across suborbital as a broad blotch which may extend around and below posterior angle of gape to posteroventral margin of lower jaw; a faint narrow bar extends across

upper and lower jaw on either side of symphysis; upper sides and dorsum of head blotched and spotted with brown, head elsewhere mainly pale. Dorsum crossed by 8-10 (usually 9) principal saddle-like bars between nape and caudal-fin base; well marked late juveniles and adults have secondary bars, most distinct near dorsal-fin base, but frequently indicated only by brown flecks on upper sides; ventral margins of primary bars (behind nape) may be more or less united by irregular brown flecks along midline of sides; body elsewhere mainly pale, but some specimens lightly flecked with brown on lower sides; fins mainly pale but occasionally there is a trace of brown shading on dorsal finlet; primary bars are distinct in 12-mm fish.

COMPARISONS: Among Pacific congeners, *Gillellus ornatus* shares the 2-spined dorsal finlet only with the sympatric *G. arenicola*. It differs from that species in average counts of arched and straight lateral-line scales (29 and 24 versus 25 and 28 in *arenicola*) and modal counts of total dorsal spines (13 against 14). In addition, the lateral-line arch deflects between verticals from dorsal-fin elements 18 and 22 in *ornatus* (between 14 and 17 in *arenicola*) and lower jaw is short and scarcely protruding (distally fleshy and protruding in undamaged *arenicola*). A number of meristic characters (Tables 2-7) distinguish *ornatus* from the aberrant *G. searcheri* but the remaining 3-spined species (*semicinctus* and *chathamensis*) may be confused with *ornatus* wherein the finlet has been damaged. In such cases, *Gillellus ornatus* is best separated from *chathamensis* by the lower modal count of pectoral rays (12 against 13 in *chathamensis*), and from *semicinctus* by higher average values for total dorsal-fin elements and straight lateral-line scales (44 and 24 versus 41 and 20 in *semicinctus*).

REMARKS: Gilbert (1892) based his description on a single specimen ("about 2 inches long") from ALBATROSS Sta. 2828 located off the W side of Isla Cerralvo in the Gulf of California (24°11'30"N, 109°55'00"W). This specimen was never received at the National Museum, has never been illustrated and is presumably lost. I therefore select a mature male (LACM W65-86-1) as the neotype of *Gillellus ornatus* Gilbert (see measurements above, material examined and Tables 2-8 for additional data).

* Among material examined, the smallest transformed male is 28.0 mm SL, the smallest oviger-

ous female 30.6 mm; a 51-mm female contained 214 near-ripe eggs, maximum diameter about 0.9 mm.

Available data suggest that all collections have been made with dredge or SCUBA over a 3-55 m depth range. *Gillellus ornatus* is known only from the Gulf of California between Los Frailes and Isla Ángel de la Guarda in the west and from a single eastern Gulf collection near Guaymas, Sonora (Fig. 8).

MATERIAL EXAMINED: Ninety-seven specimens, 12-51 mm SL, including neotype.

Neotype. —LACM W65-86-1 (37.0 mm SL, male), Mexico, Baja California Sur, Isla Santa Cruz, 22 July 1965, B.W. Walker and party.

Other Material. —MEXICO, Gulf of California. —Baja California Sur: CAS 24624 and GCRL 13234 through 13236; LACM 23964 and 23966; SIO 61-247 through 61-249, 65-295, 65-311 and 65-323; UCLA W65-71 and W65-86. —Baja California Norte: LACM 23965, UCLA W53-73 and W53-86. —Sonora: SIO 70-84.

Gillellus searcheri Dawson, new species

(Figure 12.)

DIAGNOSIS: Dorsal finlet 3-spined, without isolated spines between finlet and remainder of dorsal fin; dorsal spines total 20-23; pectoral fin rays modally 13; scales in straight lateral line 9-13; lateral line deflects between verticals from dorsal-fin elements 27 and 32; eye flap present; paired pores in posterior portion of infraorbital canal.

DESCRIPTION: Measurements (mm) of 24.5-mm SL transformed male holotype follow: caudal fin length 4.4; length of uppermost segmented ray 3.8; length of lowermost segmented ray 3.6; depth of caudal peduncle 1.5; body depth 2.9 predorsal length 4.3; preanal length 6.7; pelvic to anal distance 2.7; head length 5.3; head breadth 3.2; maxillary to upper opercular angle 4.8; maxillary to upper preopercular angle 3.4; length of anterior naris 0.3; eye diameter 1.1; postorbital length 3.1; snout length 1.0; maxillary length 1.7; length of 1st dorsal spine 1.6, 3rd spine 0.6, 4th spine 1.1, last spine 0.5; length of 1st segmented dorsal ray 1.4. See Tables 2-8 for meristic data.

Lower jaw but slightly protruding; lower lip with 4-7 papilla-like fimbriae, typically 6 in late juveniles and adults (Fig. 5); preorbital very short, much less than eye diameter, steeply inclined; tubiform anterior naris located close to anterior rim of preorbital and with a distal valve-like emargination; eye with a distinctive flap located on posterior third of eye, narrow at base

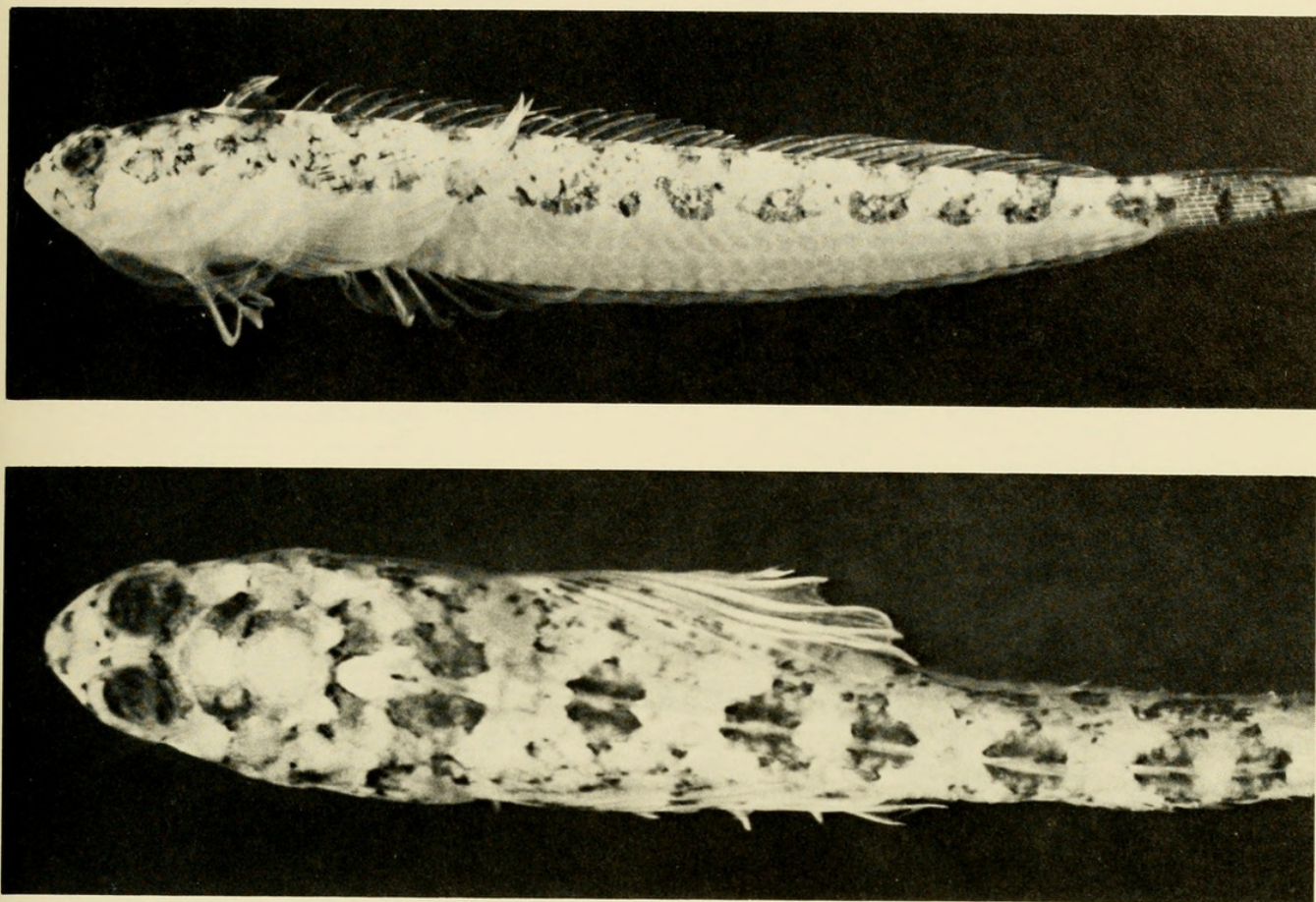


Fig. 12. *Gillellus searcheri* n. sp. (GCRL 13223, male paratype, 25 mm SL).

but distally expanded. Height of dorsal finlet equal to or somewhat less than maximum height of remainder of spinous dorsal; last dorsal spines of continuous dorsal fin much shorter than the following segmented rays, the fin deeply notched or emarginate between (Fig. 13). Pectoral fin-rays 13 in 93% of 306 counts, three fish had bilateral counts of 14; pectoral membranes somewhat expanded and the fin elongate in transformed males but always falls well short of origin of straight lateral line; tip of adpressed fin reaches vertical between dorsal-fin elements 14 and 18 (usually between 15 and 18) in transformed males, between 12 and 17 (usually 13 and 16) in young and females; caudal-fin formula modally $1 + 8 + 1$ in adults (Table 9); opercular fimbriae 4-9 (Fig. 7; Table 10). Infraorbital canal typically with paired pores in lachrymal branch and in three posterior positions (Fig. 1), pores usually total 11 or 12.

Arched portion of lateral line deflects between verticals from dorsal-fin elements 27 and 32, usu-

ally between 28 and 30; area above arch mostly naked, adults often with 1-6 embedded scales anteriorly on either side of dorsal-fin base (Fig. 13); 5-7 (usually 5) longitudinal scale rows cross vertical near origin of straight lateral line; scales present in lateral-line arch of 11-mm fish, squamation apparently complete in some 15-mm-SL specimens. Upper jaw teeth in about three rows near symphysis, narrowing to a single row posteriorly; lower jaw teeth mainly uniserial with but 1-2 paired teeth on either side of symphysis; pseudobranchiae 4-5 (3 examined); proximal pterygiophore of 1st dorsal spine broad (Fig. 3).

Color in alcohol. —Head usually without a dark interorbital bar but with a broad suborbital blotch which may include posterior portion of gape and continue on ventral margin of lower jaw; preorbital spotted or streaked with brown; usually with a narrow bar crossing upper lip and tip of lower jaw on either side of symphysis; upper sides and dorsum of head spotted, blotched or mottled with brown. Early juveniles with about

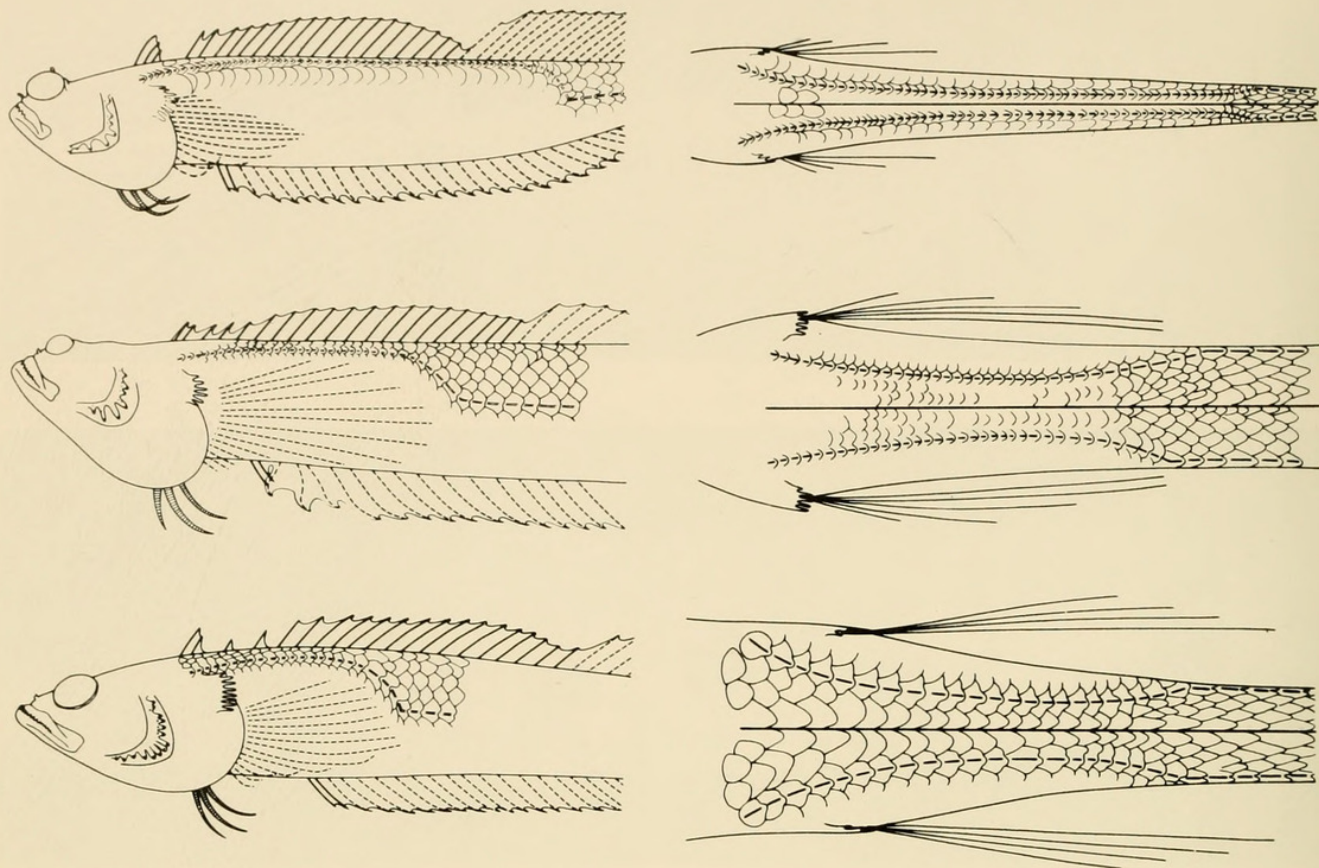


Fig. 13. Lateral and dorsal views illustrating lateral-line configuration and squamation above lateral-line arch in *Gillellus searcher* (top), *Sindoscopus australis* (middle) and *Heteristius cinctus* (bottom).

6 primary saddle-like bars crossing dorsum from nape to caudal-fin base and secondary bars may be present in 15-mm-SL specimens. In late juveniles and adults, primary and secondary bars are largely indistinguishable in lateral aspect (Fig. 12) and interspaces are often heavily spotted or flecked with brown. In dorsal aspect, 6 primary and 4-5 secondary bars are indicated for most specimens by darkly pigmented blotches along dorsal-fin base; secondary bars are represented by a single blotch, whereas primary bars are identified by two blotches separated by a short pale interspace; dark blotches along base of continuous dorsal fin usually total 13-14; lower sides pale or with a narrow stripe of brown flecks just above anal-fin base. Dorsal finlet with 2-3 brown spots on 1st spine, elsewhere usually spotted or shaded with brown; continuous dorsal fin with 3-5 well spaced brown spots on most fin-rays, the membranes mainly pale; caudal fin-rays

crossed by about 4 irregular vertical rows of spots; upper 5-6 pectoral rays crossed by a brown bar near their base and another near middle of pectoral length; pelvic and anal fins immaculate. Degree of pigmentation is variable but the individual character of the saddle-like bars is masked by flecks and spots in most adults and upper sides appear generally brownish to the naked eye.

ETYMOLOGY: The name *searcheri* refers to the R/V SEARCHER. Collections from this vessel, owned by the Janss Foundation and destroyed by fire in May 1972, have contributed much to our knowledge of Pacific dactyloscopids.

COMPARISONS: *Gillellus searcher* differs from Pacific congeners in counts of total dorsal spines (20-23 against 11-15 in other species), segmented dorsal rays (16-19 against 25-33), arched lateral-

line scales (52-62 against 23-33) and straight lateral-line scales (9-13 against 18-29). Other species typically have 4 labial fimbriae in adults, anterior naris is a simple tube, the eye flap (when present) is located near middle of eye diameter and there are no paired pores in the infraorbital canal. There are usually 6 labial fimbriae in adult *searcheri*, the anterior naris has a distal valve-like emargination, the eye flap is located over posterior third of eye and there are paired pores in the infraorbital canal. This species appears most closely related to the Atlantic *G. greyae* Kanazawa which shares the emarginate naris and eye-flap position, has more than 4 labial fimbriae and also has paired infraorbital canal pores. There are, however, fewer scales in the lateral-line arch of *greyae* (about 28-34) and total lateral-line scales are more numerous in *searcheri* (64-73 versus about 53-58 in *greyae*).

REMARKS: Although *Gillellus searcheri* (and *G. greyae*) is obviously distinct from Pacific congeners in several features, close relationship is indicated by a number of common characters such as general dorsal-fin configuration, number of principal caudal rays, the naked venter, restriction of labial fimbriae to lower lip, etc. I find no useful purpose in erecting a separate genus or subgenus to accommodate this somewhat aberrant species (or species group). The paired infraorbital pores suggest that *searcheri* is intermediate between the more typical species of *Gillellus* and *Sindoscopus* (described below).

Specimens from Mexican waters are somewhat more heavily pigmented than Costa Rican and Panamanian material, and there appear to be minor meristic differences in these populations (Table 11). Among material examined, the smallest transformed male is 21.6 mm SL, the smallest ovigerous female 21.5 mm; a 24-mm female contained 41 developing eggs in the right gonad.

Recorded to a confirmed maximum depth of 15 m, *Gillellus searcheri* is known from the Islas Tres Marias and Nayarit, Mexico and from insular localities in Costa Rica and Panama (Fig. 8).

MATERIAL EXAMINED: Two hundred fifty-six specimens, 11-31 mm SL, including holotype and one hundred thirty-four paratypes.

Holotype. —LACM 32546-45 (24.5 mm SL, male), Costa Rica, Isla del Caño, 08°43'15"N, 83°53'07"W, 9 m, SCUBA, R/V SEARCHER Sta. 471, 14 March 1972, W. A. Bussing and party.

Paratypes. —COSTA RICA, Isla del Caño: UCR 676-9, 08°43'16"N, 83°52'50"W, 14 m, SCUBA, R/V SEARCHER Sta. 474. LACM 32547-49 and GCRL 13217, 08°43'15"N,

83°53'07"W, 15 m, SCUBA, R/V SEARCHER Sta. 472. LACM 32546-46, GCRL 13222 and 13223, taken with holotype.

Other Material. —MEXICO, Islas Tres Marias: GCRL 13219 through 13221; SIO 62-25, 62-56 and 62-58. Nayarit: GCRL 13218, SIO 62-49 and UCLA W58-5.

PANAMA, Islas Secas: SIO 70-139. —Isla Saboga: SIO 67-40.

Sindoscopus Dawson new genus

TYPE-SPECIES: *Gillellus australis* Fowler and Bean, 1923.

DIAGNOSIS: Dorsal-fin origin on nape, the fin continuous but anterior membranes often deeply incised; eye not stalked and without minute flaps or papillae; pectoral fin-rays modally 14; principal segmented caudal rays 10, some branched in late juveniles and adults; well developed fimbriae on both upper and lower lips; head, pectoral-fin base and venter naked; principal preopercular canals 4, unbranched; some paired pores in infraorbital canal; without pre-dorsal bones (interneurons).

DESCRIPTION: The genus is monotypic; see description of *australis* below.

ETYMOLOGY: *sindo* plus *scopus*; in recognition of my Chilean field associate, Sr. Gumersindo Revuelta, who collected some of the present specimens and was instrumental in making all of the recent collections available for study; *scopus* - watcher, in reference to stargazers.

COMPARISONS: The continuous dorsal fin is shared with *Dactylagnus*, *Myxodagnus* and some species of *Platygillellus* (Table 1). Dorsal-fin origin is near vertical from anal-fin origin in *Dactylagnus* and *Myxodagnus* (on nape in *Sindoscopus*) and *Platygillellus* has 11 rather than 10 principal caudal rays. Closer relationship to *Gillellus* seems indicated by similarities in body configuration, caudal fin morphology, orientation and extent of straight lateral-line scales, and paired infraorbital pores (*searcheri* group only). *Sindoscopus* is distinguished by the continuous rather than interrupted dorsal fin, by development of both upper and lower lip fimbriae (on lower lip only in *Gillellus*) and by the presence of 4 rather than 3 primary preopercular canals.

Sindoscopus australis (Fowler and Bean)

(Figure 14.)

Gillellus australis Fowler and Bean, 1923: 23 (original description; Valparaiso, Chile).

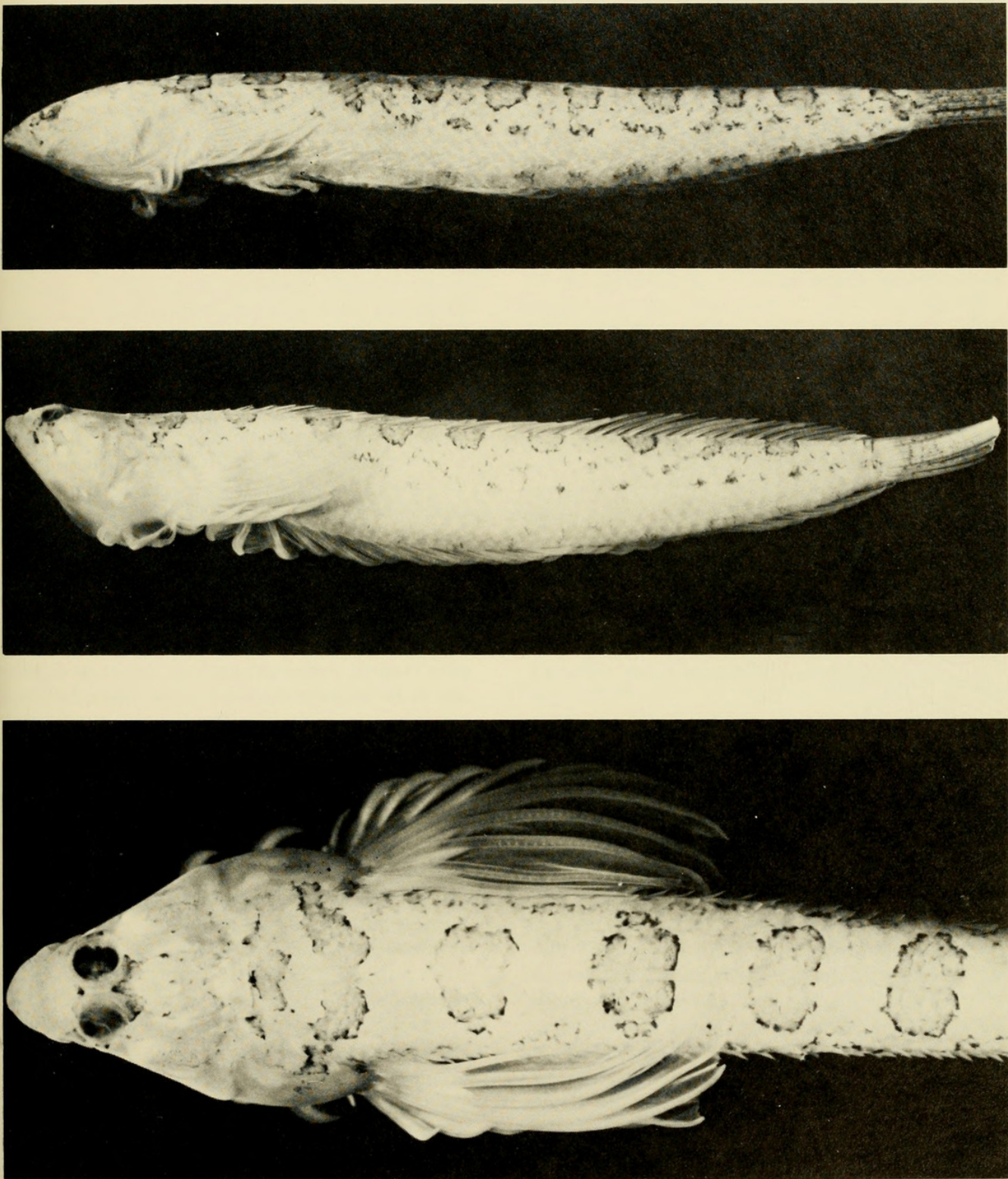


Fig. 14. *Sindoscopus australis* (Fowler and Bean). Top: GCRL 13399 (64 mm SL, male) from Algarrobo, Chile. Middle and bottom: GCRL 13404 (71 mm SL, transformed male) from Antofagasta, Chile.

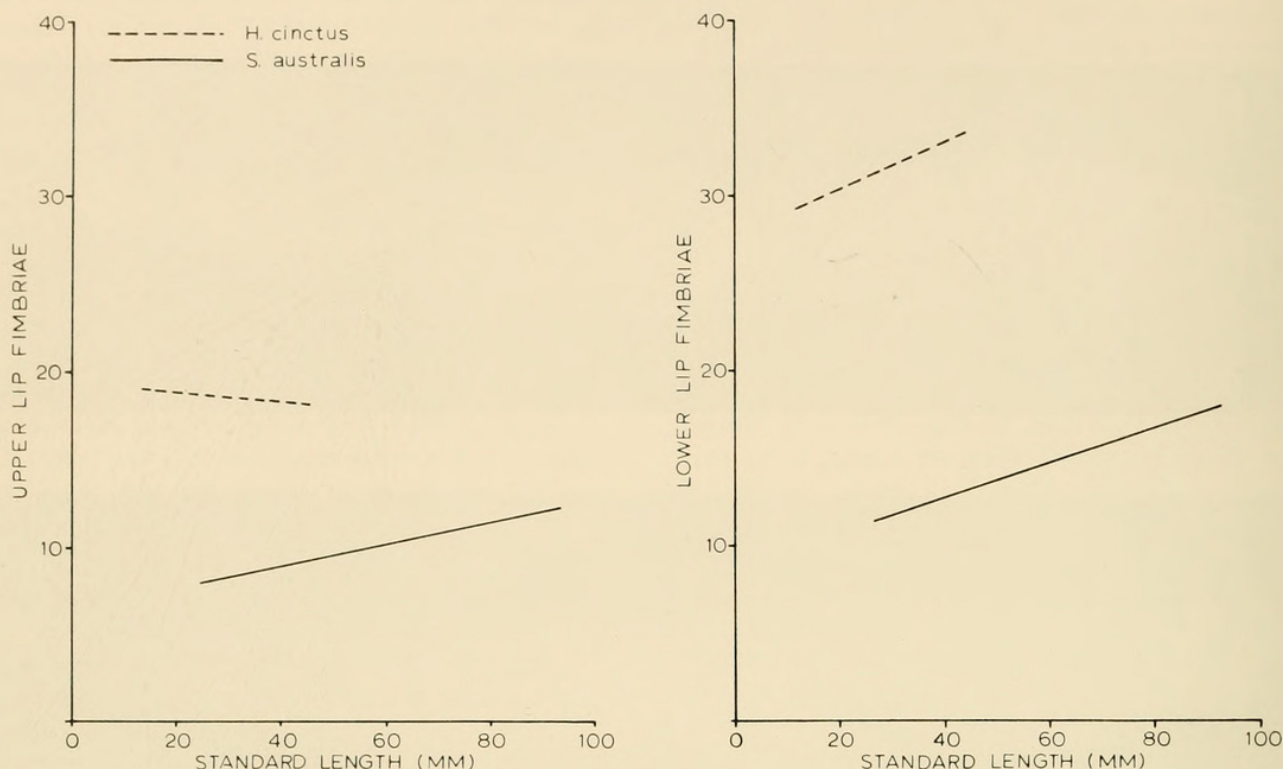


Fig. 15. Regressions of frequencies of labial fimbriae in *Heteristius cinctus* and *Sindocopus australis*. See Table 10 for supporting data.

DIAGNOSIS: Diagnostic characters are those of the genus.

DESCRIPTION: Measurements (mm) of 75.8-mm-SL male (GCRL 13399) follow: caudal fin length 10.7; length of uppermost segmented ray 10.3; length of lowermost segmented ray 9.4; depth of caudal peduncle 3.6; body depth 8.3; predorsal length 13.2; preanal length 19.9; pelvic to anal distance 9.0; head length 14.0; head breadth 6.8; maxillary to upper opercular angle 12.8; maxillary to upper preopercular angle 8.9; eye diameter 2.0; postorbital length 8.7; snout length 1.8; maxillary length 3.9; length of 1st dorsal spine 1.6, 2nd spine 1.6, 3rd spine 1.5, 4th spine 1.6, last dorsal spine 2.3; length of 1st segmented dorsal ray 2.7. See Tables 2-8 for meristic data.

Body rather slender, broader and deeper in front, more or less oval in cross section and gradually narrowing caudad; head flattened to slightly rounded dorsad, broadest near posterior margin of preopercle, snout not strongly inclined; head, in dorsal aspect, somewhat triangular anteriorly, distinctly narrowed in front (Fig. 5); lower jaw moderately protruding, rounded in dorsal profile, not continued anteriorly

as a conical, fleshy projection; upper and lower lips with well developed simple fleshy fimbriae, most numerous below, frequencies ontogenetic (Fig. 15; Table 10); preorbital length about 2/3 eye diameter; eye dorsolateral, protruding but not on long protrusile stalk, without minute flaps or papillae; anterior naris a very short tube with distal valve-like emargination, located about midway between eye and anterior rim of preorbital; posterior naris a simple pore with slightly raised rim, located behind anterior naris and adjacent to anterior rim of orbit; principal preopercular canals 4 (Fig. 1), not branched, the 1st (anterior) slightly shorter than remainder and usually with a single pore distad, occasionally with 1-3 smaller pores between this and base of canal; infraorbital canal typically with single pores anteriorly, single or paired pores in lachrymal branch, and paired (occasionally 3) pores in three posterior positions; opercle with a short fringe of up to 10 unbranched fimbriae overlying upper posterior margin, frequency ontogenetic (Fig. 7; Table 10); opercles broadly expanded, the membranous margins cover pectoral- and pelvic-fin bases and overlap on underside of head.

Dorsal-fin origin on nape, in advance of upper opercular angle (Fig. 13); dorsal fin continuous, anterior membranes often deeply incised; anterior 4-5 spines short and rather flexible, 1st and 2nd more closely spaced than 2nd and 3rd; last dorsal spine somewhat shorter than 1st segmented ray, the fin somewhat notched or emarginate between; anal spines 2, about equal in length and a third shorter than 1st segmented ray; anterior anal-fin elements modified in transformed males, spines angled caudad, 1st segmented ray angled forward (about 45°), the 2nd ray more nearly vertical, modified elements somewhat swollen or fleshy and membranes are stretched or elongate between. Posteriormost dorsal and anal rays usually free from peduncle, occasionally bound by short membranes; last anal ray reaches past rear of hypural, last dorsal ray somewhat shorter; caudal peduncle entire, without notch in ventral margin (Fig. 2); caudal fin rounded, upper and lowermost rays typically simple, subequal in length or lowermost the shorter; 6-9 median rays branched in study material, modal formula $1 + 8 + 1$ (83% of 84 specimens examined).

Pectoral fin-rays 14 in 80% of 185 counts, 11 fish with bilateral counts of 13; pectoral fin rounded to somewhat pointed, 5th-7th rays from dorsalmost the longest, rays gradually shorten ventrad but not appreciably swollen or thickened; pectoral fin somewhat elongate in transformed males but usually falls short of origin of straight lateral line, the interradi al membranes broad and fin cupped or outwardly convex; tip of straightened and adpressed fin reaches vertical between dorsal-fin elements 15 and 20 (usually 16 and 19) in transformed males, between 14 and 17 in young and females; pelvic fin I, 3; tips of segmented rays free with emarginate membranes between, longest ray seldom reaches anal-fin origin; all fin rays simple, except for branched caudal rays in late juveniles and adults.

Lateral line continuous, originates above and in advance of upper opercular angle (on or in advance of vertical from 1st dorsal spine), arched upward to follow near dorsal-fin base, deflects between verticals from dorsal-fin elements 14 and 18, and continues midlaterally to terminate as penultimate scale on caudal-fin base; canal of straight lateral-line scales parallels longitudinal body axis, last scale not angled ventrad (Fig. 2). Scales thin, more or less rounded and persistent in upper portion of lateral-line arch; scales of descending arch and straight lateral line some-

what deciduous; canal of straight lateral-line scales without terminal branch anteriorad, often with a short dorsal branch and terminal pore on anterior third of canal. Squamation variable above lateral-line arch, more or less fully scaled or with patches of embedded scales and naked areas between (Fig. 13); usually with small embedded scales beginning above 2nd or 3rd lateral-line scale about three rows between arch and base of 4th or 5th dorsal spine and with two crowded rows of larger scales above posterior half of elevated arch; head, pectoral-fin base, venter and sides (below line from upper pectoral angle to near 1st segmented anal ray) naked; 11-13 longitudinal scale rows cross vertical near origin of straight lateral line.

Premaxillaries somewhat protractile, the pedicels barely reach past middle of orbit; jaw teeth small, conical, somewhat curved inward, none distinctly enlarged; lower jaw teeth in two rows near symphysis, uniserial behind; upper teeth in three rows anteriorad, two rows near middle of jaw and in single row behind; vomer and palatines edentate; tongue subtriangular, narrowly rounded in front; basihyal slender, barely spatulate at tip. Three complete gill arches plus a hemibranch, a pore in membrane behind lower portion of hemibranch; no gill rakers on outer margin of 1st arch, 8-10 short rakers along inner margin; pseudobranchiae 4-6 (4 examined); branchiostegals 6; without predorsal bones; proximal pterygiophore of 1st dorsal spine not exceptionally broad, inserted slightly behind 1st neural spine (Fig. 3); abdominal vertebrae 10-11 (usually 11) in radiographs; caudal fin with 5 spiniform elements above and 3 below, upper and lower hypurals each bear 5 segmented rays (in 2 cleared specimens).

Color in alcohol. —Ground color light tan to pale, markings tan to dark brown. Well marked fish with a dark interorbital bar divided below eye to form a short bar across posterior third of gape and a long narrow bar extending postero-ventrad to slightly beyond middle of preopercle; underside of lower jaw with a dark-edged blotch on either side of symphysis; upper sides and dorsum of head variously spotted or faintly blotched, remainder of head pale. Dorsum crossed by 9-10 (usually 10) dark-edged blotches or bars between nape and caudal-fin base; the anterior bar, variously solid or interrupted so as to form two bars with a pale area between (Fig. 14), extends ventrad to upper margin of opercle; remaining bars usually fall well short of lateral

midline, seldom extending more than 3-4 scale rows below dorsal-fin base; usually without distinct secondary bars, pale interspaces and area between ventral margins of bars and midline irregularly streaked or flecked with brown; lower part of side pale in some fish, others with about 10 small blotches more or less equally spaced along 1st scale row above anal-fin base. Dorsal fin with pale membranes and 1-3 small spots on most fin rays; anal fin mainly pale, occasionally with a few isolated spots or brown shading on some rays and posterior membranes; pelvic fins pale; dorsalmost pectoral rays sometimes faintly spotted, the fin otherwise pale; caudal fin pale near base but crossed distad by about 10 vertical rows of small spots.

REMARKS: Fowler and Bean (1923) described *australis* from two specimens collected by the Wilkes Exploring Expedition at Valparaíso, Chile. There have apparently been no subsequent records of this species and Myers and Wade (1946) suspected that there may have been an error in type locality. Present material, some of which was collected within 40 km of Valparaíso, clarifies the matter and firmly establishes *australis* as the southernmost dactyloscopid. The holotype and paratype are now damaged, in very poor condition, and it is not possible to obtain meaningful measurements. The holotype was originally described as having 26 dorsal spines and 21 segmented rays, 38 segmented anal rays and 15 pectoral rays; the lips were described as "entire." I counted 21 spines and 25 segmented dorsal rays, 39 segmented anal rays, and 14 rays in each pectoral fin. In addition, there are about 11 fimbriae on the upper lip and at least 6 on the undamaged right side of the lower lip. Fowler and Bean (op. cit.) described the 6 anterior dorsal spines as separate but this is understandable as the anterior membranes are often broken (as they are now in the holotype) and, even in undamaged specimens, membranes are low and may be partly concealed in the somewhat depressed area along anterior portion of dorsal-fin base.

The bulk of recent collections have come from the vicinity of Valparaíso and from Antofagasta, some 1100 km to the north. The southern material averages somewhat higher in a number of meristic characters (Table 11), but I find no other substantial differences and consider such variation to be clinal. The upper, lower or both of the posteriormost spiniform caudal elements were segmented in all Algarrobo specimens with the

modal caudal formula of $1 + 8 + 1$, and in 31% of the Antofagasta material. Segmentation of these typically simple elements also occurs infrequently in *Gillellus* but it has not been noted in other Pacific dactyloscopids.

Among material examined, the smallest transformed male is 64 mm SL, the smallest ovigerous female 50 mm; a 74-mm female contained 419 well developed eggs in the left gonad, maximum diameter about 1.1 mm. An isopod, abundant in the stomachs of most Algarrobo specimens, has been identified as *Isocladus* sp. by Dr. Peter Glynn, Smithsonian Tropical Research Institute.

DISTRIBUTION: Most material has been seined in depths of 2 m or less; surface temperature range for 3 collections was 13-14°C. *Sindoscopus australis* is known only from coastal waters of Chile between about 23°34'S and 33°02'S.

MATERIAL EXAMINED: Eighty-six specimens, 32-92 mm SL, including holotype and paratype.

Holotype. —USNM 83315 (ca. 76 mm SL), Chile, Valparaíso, Wilkes Expdn., no other data.

Paratype. —USNM 83099 (60.7 mm SL), data as for holotype.

Other Material. —CHILE, Antofagasta: ANSP 131422, GCRL 13397 and 13400 through 13404, MNHN uncat. and USNM 214226. —Coquimbo: USNM 176588. —Valparaíso: GCRL 13398, 13399 and MNHN uncat. —Loc. uncertain: MNHN uncat.

Genus *Heteristius* Myers and Wade

Heteristius Myers and Wade, 1946: 160 (type-species by original designation, *Heteristius jalisconis* Myers and Wade, 1946 [= *Dactyloscopus cinctus* Osburn and Nichols]).

DIAGNOSIS: With 2-spined dorsal finlet originating on nape and with 1 or 2 isolated spines between finlet and remainder of dorsal fin; eyes not stalked, without flaps or papillae; pectoral fin-rays modally 14; principal segmented caudal rays 12, unbranched; fimbriae present on both upper and lower lips; venter scaled in late juveniles and adults, head and pectoral-fin base naked; principal preopercular canals more than 6, unbranched; some paired pores in infraorbital canal; without predorsal bones (interneurals).

DESCRIPTION: The genus is monotypic, see description of *cinctus* below.

COMPARISONS: *Heteristius* is a specialized genus, differing from other sand stargazers in caudal-fin morphology and in configuration of the preopercular canal system (Table 1). Principal segmented caudal rays are 12 and unbranched in *Heteristius*, whereas there are 10 or 11 in

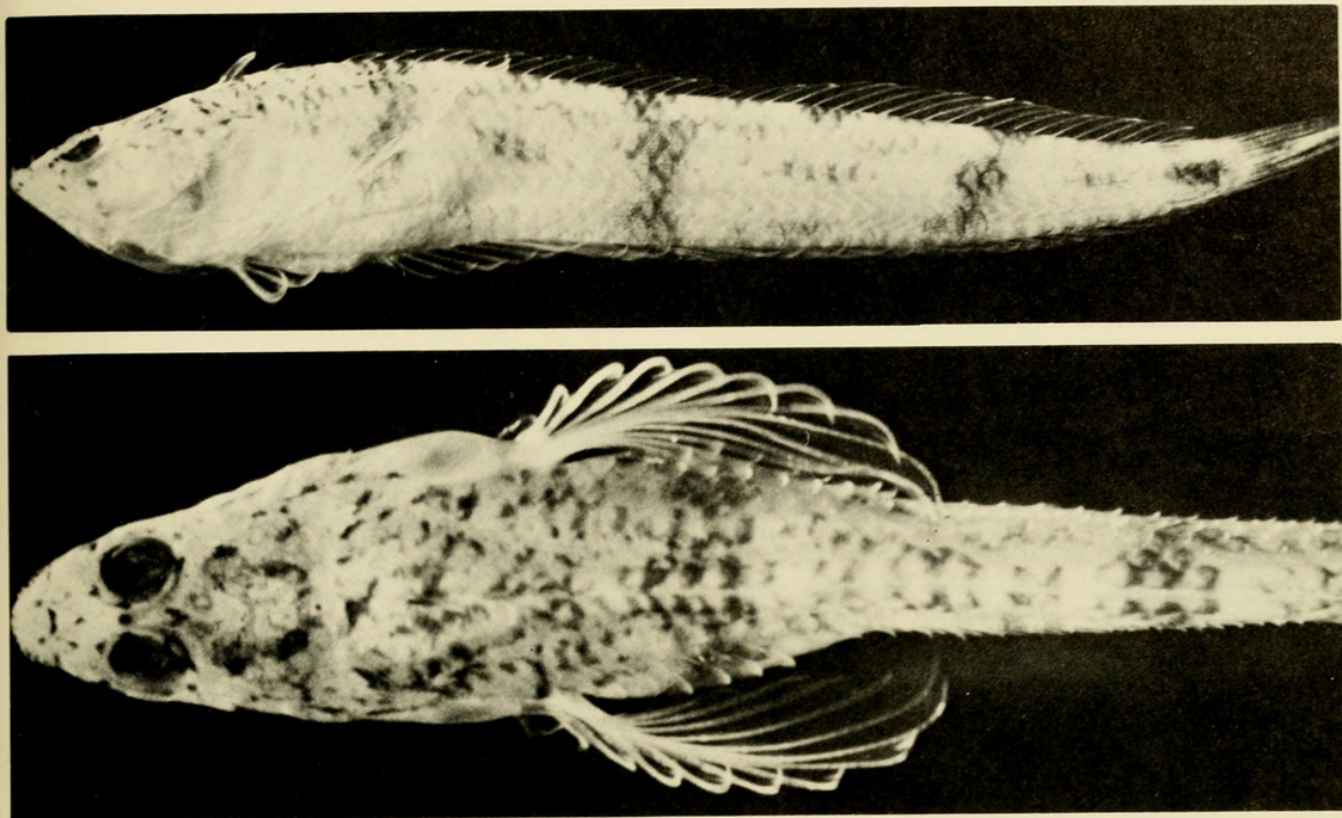


Fig. 16. *Heteristius cinctus* (Osburn and Nichols). SIO 62-720 (31 mm SL).

other genera and (except for a specialized species-group within *Dactyloscopus*) there is ontogenetic branching of the median rays. There are either 3 or 4 simple or distally branched principal preopercular canals in other genera, but these are replaced in *Heteristius* by about 7-9 simple canals on posteroventral portion of preopercle (Fig. 1). The scaled venter is shared only by *Platygilellus*, but scales are here confined to a narrow transverse band (venter completely scaled in *Heteristius*) and the pectoral-fin base is scaled in adults (naked in *Heteristius*).

REMARKS: Osburn and Nichols (1916) described *Dactyloscopus cinctus* from ALBATROSS collections at Baja California Sur. Their description and accompanying figure indicate a continuous dorsal fin and there are other errors, but the venter is clearly scaled and characteristic bars are shown on the side of the illustrated specimen. Myers and Wade (1946) described *jalisconis* (type-species of *Heteristius*) from VELERO collections off Jalisco and Oaxaca, Mexico. Although these authors briefly reviewed described dactyloscopids and made generic comparisons in their description of *Heteristius*, they apparently overlooked Osburn and Nichols' publication. I have exam-

ined the type-material of these nominal species and find them to be conspecific.

***Heteristius cinctus* (Osburn and Nichols)**

(Figure 16.)

Dactyloscopus cinctus Osburn and Nichols, 1916: 176 (original description; Cape San Lucas, Mexico).

Heteristius jalisconis Myers and Wade, 1946: 160 (original description; Jalisco, Mexico).

DIAGNOSIS: Diagnostic characters are those of the genus.

DESCRIPTION: Measurements (mm) of 27.9-mm-SL lectotype follow: depth of caudal peduncle 1.5; body depth 4.1; predorsal length 5.7; preanal length 8.6; pelvic to anal distance 3.4; head length 6.1; head breadth 3.2; maxillary to upper opercular angle 5.7; maxillary to upper preopercular angle 3.9; eye diameter 1.5; postorbital length 3.4; preorbital length 1.0; maxillary length 2.2. See Tables 2-8 for meristic data.

Body broad and deep in front, compressed and slender caudad; dorsum of head somewhat rounded, lateral profile a descending arch from nape to tip of lower jaw; maximum head breadth near posterior margin of preopercle, not strongly

narrowed in front, lower jaw slightly protruding and rounded in dorsal profile (Fig. 5); lips with well developed simple fimbriae, most numerous below, frequency ontogenetic, at least on lower lip (Fig. 15; Table 10); eye dorsolateral, protruding but not on long protrusile stalk and without flaps or papillae; anterior naris a short tube with distal valve-like emargination, located close behind anterior rim of preorbital; posterior naris a pore with slightly elevated margin, located behind anterior naris and adjacent to anterior rim of orbit; preopercle with a closely set series of about 12-14 canals, usually unbranched, each with a distal pore and often with a few smaller pores between this and canal base (Fig. 1); infra-orbital canal typically with single pores in pre-orbital branch and with two or more pores in lachrymal branch and at most posterior positions; opercle with a fringe of up to 12 slender unbranched fimbriae overlying upper posterior margin, frequency ontogenetic (Fig. 7; Table 10); opercles broadly expanded, membranous margins cover pectoral- and pelvic-fin bases and overlap on underside of head.

Dorsal-fin origin on nape, in advance of upper opercular angle (Fig. 13); dorsal fin with a 2-spined anterior finlet, usually with one (42%) or two (56%) isolated spines between finlet and continuous dorsal fin; height of spinous portion of continuous dorsal fin nearly thrice that of finlet and about 25% less than longest segmented dorsal ray, the fin notched or emarginate between spines and segmented rays. Posterior-most dorsal and anal rays usually free, sometimes bound to peduncle by fragile membranes; last anal ray reaches beyond rear of hypural, last dorsal ray somewhat shorter, caudal peduncle entire, without notch in ventral margin (Fig. 2); caudal fin rounded; segmented caudal-fin rays 12, always simple, the upper and lowermost shorter than median rays.

Pectoral fin-rays 14 in 79% of 208 counts, 6 fish had 13 rays in each fin, whereas 10 had bilateral counts of 15; pectoral fin somewhat pointed, 4th-6th rays from dorsalmost the longest, rays gradually shorter but not enlarged ventrad; tip of straightened and adpressed fin reaches well beyond deflection of lateral-line arch, reaches vertical between dorsal-fin elements 14 and 18, usually between 14 and 16; pelvic fin I, 3, tips of segmented rays free with emarginate membranes between, longest ray usually falls short of anus; all fin-rays simple in examined material.

Lateral line continuous, originates above and in advance of upper opercular angle (on or just before vertical from 1st dorsal spine), arches upward to follow close to dorsal-fin base, deflects between verticals from dorsal spines 8-12 and continues midlaterally to terminate as the last scale overlying caudal-fin base (Fig. 2); canals of straight lateral-line scales generally parallel to longitudinal body axis, canal of last scale may be angled slightly ventrad; scales of upper part of lateral-line arch persistent, posterior margins somewhat trilobate; scales of descending arch and straight lateral line somewhat deciduous; canal of straight lateral-line scales without a terminal branch anteriorly, usually with a dorsal pore near middle or anterior third of canal. Area above lateral-line arch completely scaled in late juveniles and adults (Fig. 13), usually with three scales between base of finlet and 1st lateral-line scale and one scale between apex of arch and dorsal-fin base; venter, between anus and pelvic-fin base, and sides (except for pectoral axil) completely scaled; head, pectoral-fin base and all fins, except for caudal base, naked; 9 longitudinal scale rows cross vertical near origin of straight lateral line.

Premaxillaries somewhat protractile, pedicels fall just short of rear margin of orbit; jaw teeth conical, somewhat curved inward, about three rows near symphyses but in single row behind; vomer and palatines edentate; tongue narrowly rounded, basihyal spatulate; three complete gill arches plus a hemibranch with pore behind; no rakers on 1st gill arch; pseudobranchiae 7-9 (3 examined); branchiostegals 6; without predorsal bones; proximal pterygiophore of 1st dorsal spine broad, inserted in advance of 1st neural spine (Fig. 3); abdominal vertebrae 10 in radiographs; caudal fin with 3 spiniform elements above and below, upper and lower hypurals each bear 6 segmented rays (in 3 cleared specimens).

Color in alcohol. —Ground color is light tan to pale, markings tan to dark brown. Dorsum of head capped by a mottled brownish blotch behind eyes followed by a narrow pale bar crossing between upper margins of preopercles; short streaks of brown radiate from eye and cross upper and lower jaw near symphysis; underside of lower jaw often with two small blotches anteriorly; remainder of head mainly pale. From above, dorsum crossed by about 12 brown bars from nape to caudal base, bar length irregular, about equal to pale interspaces. In lateral aspect, sides crossed by three prominent bars and there is an elongate

blotch on caudal base; these markings persist in long-preserved and otherwise faded material. The anterior bar is located near origin of continuous dorsal fin and extends slightly below middle of side; 2nd bar (below 15th-19th dorsal spines) and 3rd bar (below 9th-12th segmented rays) extend ventrad to anal-fin base. Between these characteristic markings, bars crossing dorsum terminate on 1st or 2nd scale below dorsal-fin base and there are short stripe-like markings on midline and just above anal-fin base; pale areas elsewhere often irregularly flecked with brown. Dorsal finlet mainly brown, tip of 1st spine pale; remainder of dorsal fin usually pale, occasionally with some brown shading on basal portions of rays located over dark bars; middle of caudal fin crossed by faint band of micromelanophores, other fins mainly pale.

REMARKS: The short and partly inaccurate description of *Dactyloscopus cinctus* is based on three specimens, "about the same size," collected 23 March 1911. Neither figure nor description is specifically referred to the holotype which is numbered AMNH 5206. There are no specimens now shelved under this number at the American Museum of Natural History, but there is a lot of three fish (AMNH 5394) with an external jar label bearing the pencil notation, "Type and paratype." The jar contains a pencil note stating, "Cape San Lucas Mch. 23/11" and a printed ALBATROSS label penciled, "*Dactyloscopus cinctus* N..... March 23.....Cape San Lucas." I am advised by J. E. Darovec, Jr. (AMNH) that catalog cards for AMNH 5206 and 5394 show the same data, and it appears that these numbers were intended to accommodate the three specimens mentioned by Osburn and Nichols (1916). It is not known whether these authors actually separated the selected holotype from the two remaining fish or whether the holotype was subsequently reunited with AMNH 5394, but there is little doubt that the three original specimens are now included in this single lot. In any event, it is now impossible to identify the originally intended holotype and I treat these fish as syntypes. I select the best preserved specimen (27.9 mm SL) as the lectotype of *Dactyloscopus cinctus*. This fish (AMNH 5206) has about 27 fimbriae on the lower lip, about 21 scales in lateral-line arch, scaled venter and the characteristic body bars are distinct on both sides (for additional data, see measurements above and Tables 2, 3 and 7). The two remaining specimens (29 mm SL) are paralectotypes (AMNH 5394).

Labial fimbriae are distinct and characteristic body bars are present at 14 mm SL; squamation is apparently complete in some 16-mm fish. No specimens were found with modified anterior anal-fin rays or enlarged pectoral fins that characterize sexually mature (transformed) males of other sand stargazers. Examination of radiographs showed no evidence of the broadened anterior anal pterygiophores commonly associated with the externally modified anal rays. A number of ovigerous females were present among examined material and it seems unlikely that mature males were not included. No further efforts were made toward sex determination, but it is highly probable that anal rays and pectoral fins are not modified in *Heteristius cinctus*. Absence of such modifications would suggest that adult males do not carry incubating egg clusters beneath the pectoral fins as reported for other dactyloscopids (Böhlke and Chaplin, 1968; Petti, 1969). The complete squamation of venter and adjacent sides, naked or largely so in other dactyloscopids, would seem to support this assumption. Among material examined, the smallest ovigerous female is 22 mm SL; a 32-mm fish contained 171 developing eggs in the right gonad.

I have collected specimens at depths of less than a meter, others have been taken with SCUBA in 15 m and maximum recorded depth is from a dredge sample in 27.4m. There are no collections from low salinity or estuarine habitats. *Heteristius cinctus* is known from Bahía Magdalena to the vicinity of Punta Arena on the Baja California peninsula. It is apparently absent from the Gulf of California but reappears in collections from a number of insular and mainland shores from Nayarit, Mexico south to Cabo San Francisco, Ecuador (Fig. 8).

MATERIAL EXAMINED: Three hundred fifty-eight specimens, 14-40 mm SL, including lectotype and two paralectotypes.

Lectotype. —AMNH 5206 (27.9 mm SL), Mexico, Baja California Sur, Cape San Lucas, seine, 28 March 1911, Townsend ALBATROSS Expdn.

Paralectotypes. —AMNH 5394 (2, 29 mm SL), taken with lectotype.

Other Material. —MEXICO, Baja California Sur: CAS 32041 and LACM 31174-46; SIO 61-248, 62-706, 62-720, 64-42 and 64-43; UCLA W59-248. —Nayarit: GCRL 8500 and 13363; UCLA W58-5 and W58-8. —Islas Tres Marias: GCRL 13341, 13362 and SIO 62-25. —Jalisco: LACM 23185 (holotype of *H. jaliscoensis*). —Oaxaca: LACM 23186 and CAS-SU 39961 (paratypes of *H. jaliscoensis*).

COSTA RICA, Puntarenas: GCRL 11813. —Isla del Caño: GCRL 13360 and 13361; LACM 32546-47, 32549-59 and UCR 674-5.

PANAMA, Isla Coiba: SIO 71-211 and 71-213.

ECUADOR: USNM 116221.

TABLE 9. Ontogenetic development of branching of principal segmented caudal rays in Pacific species of *Gillellus*. N = number of specimens; standard-length range and mean (\bar{x}) in mm.

Fin-ray formula	<i>semicinctus</i>			<i>chathamensis</i>			<i>ornatus</i>			<i>arenicola</i>			<i>searcheri</i>		
	N	Range	\bar{x}	N	Range	\bar{x}	N	Range	\bar{x}	N	Range	\bar{x}	N	Range	\bar{x}
All simple	5	16-22	19.8	10	18-24	21.4	5	20-26	22.1	3	19-32	23.9	2	13-17	14.8
6 + 3 + 1													1		16.7
5 + 1 + 4	1		29.4												
4 + 2 + 4	1		25.0												
3 + 3 + 4	1		26.1							1		26.1			
3 + 4 + 3	1		27.6	2	21-27	24.1	1		42.7				1		14.8
3 + 5 + 2				1		24.5	2	32-39	34.8						
2 + 4 + 4									35.2	1*		41.1			
2 + 5 + 3	6	20-37	31.4	8*	23-28	24.9	4	27-36	31.2				1		17.1
2 + 6 + 2	14	28-39	33.6	3	23-28	24.9	18	28-39	35.0	4	24-44	35.4	11	16-26	21.8
2 + 7 + 1							1		42.2				1		21.6
1 + 6 + 3	1		29.7												
1 + 7 + 2	33	27-46	34.9	5	24-32	27.1	4	36-51	37.7	2	36-42	39.0	17	19-30	22.9
1 + 8 + 1	18	25-48	38.0	1		22.4	6	28-40	35.0	7	28-50	42.7	88*	17-34	25.1

*Primary type.

TABLE 10. Comparison of standard length with frequency of opercular fimbriae and upper and lower lip fimbriae in Pacific species of *Gillellus*, *Sindoscopus* and *Heteristius* (\bar{x} = mean; SD = standard deviation; r = coefficient of correlation).

Character Species	N	Range	Standard length \bar{x}	SD	Range	Character \bar{x}	SD	r	Regression equation
Opercular fimbriae									
<i>G. semicinctus</i>	278	14-49	32.4	6.6	4-12	7.6	1.3	0.562	$y = 3.987 + 0.114x$
<i>G. chathamensis</i>	133	15-32	22.7	3.3	4-8	6.3	0.8	0.386	$y = 4.020 + 0.101x$
<i>G. ornatus</i>	144	12-51	32.9	6.6	2-10	6.0	1.2	0.487	$y = 3.015 + 0.093x$
<i>G. arenicola</i>	79	18-51	33.9	8.7	3-8	6.2	1.1	0.609	$y = 3.661 + 0.080x$
<i>G. searcheri</i>	319	11-34	23.4	3.9	4-9	6.6	0.9	0.468	$y = 3.949 + 0.117x$
<i>S. australis</i>	178	32-92	69.9	13.1	4-10	6.5	1.0	0.369	$y = 4.582 + 0.029x$
<i>H. cinctus</i>	213	16-40	27.1	4.6	5-12	8.7	1.0	0.397	$y = 6.282 + 0.090x$
Upper lip fimbriae									
<i>S. australis</i>	72	32-92	71.5	11.8	6-15	10.8	1.6	0.449	$y = 6.345 + 0.063x$
<i>H. cinctus</i>	95	19-40	27.9	4.2	14-23	18.6	1.9	-0.073	$y = 19.536 - 0.033x$
Lower lip fimbriae									
<i>S. australis</i>	80	32-92	71.0	12.6	9-23	15.7	2.1	0.575	$y = 8.683 + 0.100x$
<i>H. cinctus</i>	93	19-40	27.5	4.1	26-38	31.3	2.2	0.252	$y = 27.554 + 0.137x$

TABLE 11. Geographic variation in selected meristic characters of *Gillellus semicinctus*, *G. searcherii* and *Sindoscopus australis*.

Species and locale	Total dorsal-fin elements			Segmented anal rays			Caudal vertebrae			Straight lateral-line scales			Total lateral-line scales		
	N	Range	\bar{x}	N	Range	\bar{x}	N	Range	\bar{x}	N	Range	\bar{x}	N	Range	\bar{x}
<i>G. semicinctus</i>															
Islas Revillagigedos	3	39-40	39.3	4	31-32	31.5	1	32	—	1	21	—	1	48	—
Isla Guadalupe	15	39-42	41.2	15	31-35	33.0	15	33-35	34.1	11	19-21	19.7	11	48-53	50.6
Baja California															
Pacific Coast	6	40-42	41.0	6	32-34	32.8	6	33-34	33.5	4	20-23	21.0	4	48-52	50.2
Cape San Lucas	8	40-42	41.2	8	32-34	33.0	8	33-35	33.7	3	19-21	20.0	3	48-50	49.0
Gulf of California	135	39-43	41.1	135	31-35	33.0	108	32-35	33.9	51	18-23	19.7	51	44-51	48.5
Total	149	39-43	41.1	149	31-35	33.0	122	32-35	33.9	58	18-23	19.3	58	44-52	48.9
Nayarit - Oaxaca	17	39-41	39.8	17	30-34	31.7	17	32-34	32.7	4	21-22	21.5	4	46-49	47.8
Costa Rica - Colombia	28	38-41	39.7	26	30-33	31.8	27	31-33	32.2	11	19-20	19.4	11	46-51	48.0
Galápagos Is.	8	39-40	39.8	8	30-33	32.1	8	31-33	31.9	2	19	—	2	47-48	47.5
<i>G. searcherii</i>															
Mexico	109	38-41	39.0	108	30-32	31.2	104	31-34	32.1	63	9-13	11.0	63	64-73	67.8
Costa Rica - Panama	81	38-40	38.7	87	30-32	31.0	94	30-33	31.9	30	9-12	9.8	30	65-71	68.0
<i>S. australis</i>															
Antofagasta	57	45-47	46.0	63	37-39	38.3	67	39-41	39.7	50	28-32	30.4	50	59-66	62.8
Algarrobo	24	46-49	47.4	26	39-41	39.5	26	40-42	40.9	12	29-34	31.9	12	64-70	66.9

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