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Two New Species of Freshwater Gobies (Gobiidae: Sicydiaphiinae) from Ishigaki Island, Japan

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Abstract *Sicyopus leprurus* and *Lentipes armatus* are described as new species of the Sicydiaphiinae, Gobiidae, from a hill stream on Ishigaki Island, Ryukyu Islands, Japan. They are distinguishable from other species of each genus mainly in their squamation. Morphological comparison of four genera and six species of hill-stream sicydiaphiine gobies suggests that *Sicyopterus* is the highest and *Sicyopus* is the lowest in the degree of adaptation to torrential environments, *Lentipes* and *Stiphodon* are intermediate between *Sicyopterus* and *Sicyopus*.

Fishes of the gobiid subfamily Sicydiaphiinae inhabit various habitats ranging from offshore seas to mountain torrents. As hill-stream forms some thirty species are known in the world, of which four falling into three genera have been recorded from Japan: *Sicyopterus japonicus* (Tanaka) from middle and southern Japan (Nakamura, 1975), *Sicyopterus* sp., *Stiphodon elegans* (Steindachner) and *Sicyopus zosterophorum* (Bleeker) from the Ryukyu Islands (Kawanabe, 1975). The two new species described in this study, *Sicyopus leprurus* and *Lentipes armatus*, were caught from a hill stream on Ishigaki Island of the Ryukyu Islands.

Comparing five out of the six species now known from Japan and one species of *Lentipes* from the Hawaiian Islands and the Philippines, discussions are made on morphological relationships among the four genera.

Methods

Counting and measuring procedures followed Hubbs and Lagler (1958). The alphabet markings of sensory pores followed Prince Akihito (1971) and Prince Akihito and Meguro (1975). The methods of measuring the length of the pelvic fin and its base are shown in Fig. 1. Counts for vertebrae and vertical fin rays were taken from radiographs. Osteological observations were made on cleared and stained specimens.

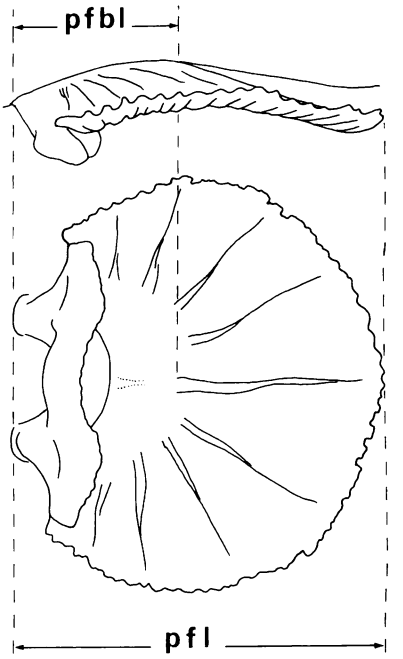

Fig. 1. Pelvic fins of *Sicyopus leprurus* in lateral (top) and ventral (bottom) views, showing the methods of measuring the length of the fins (pfl) and its base (pfbl) used in this study.

Sicyopus leprurus, sp. nov.
(New Japanese name: Kaeru-haze)
(Fig. 2)

Holotype: NSMT-P (Department of Zoology, National Science Museum, Tokyo)

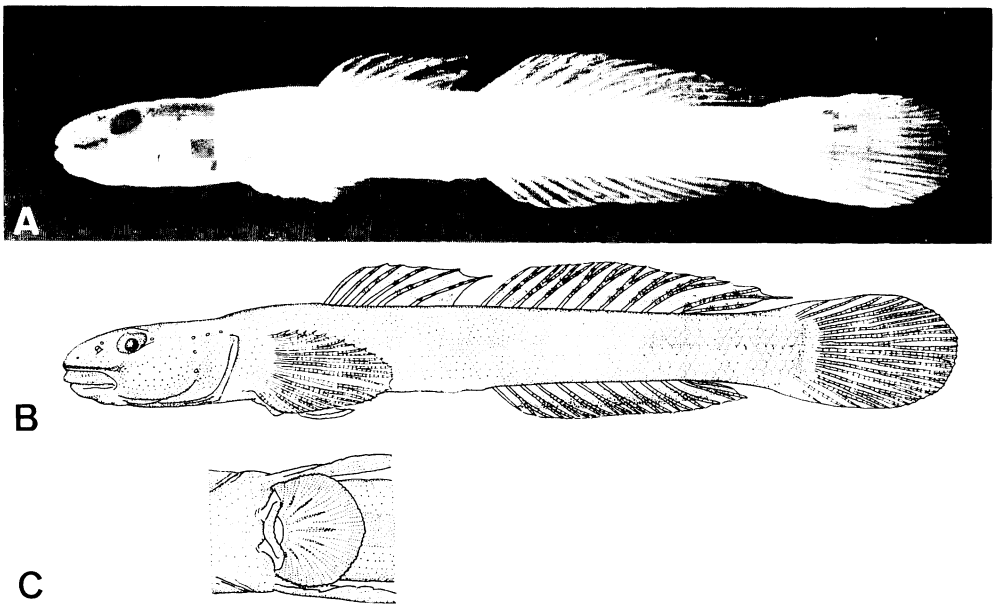

Fig. 2. *Sicyopus leprurus*, sp. nov. A and B: Holotype, NSMT-P 15979, 43.0 mm SL. C: Pelvic sucking disc of the holotype.

15979, adult male, 43.0 mm in standard length, 52.3 mm in total length, collected from the Arakawa River, a small swift-running stream 1.5 km long originating on a mountain at 300 m above sea level, at about 500 m above its mouth to the sea, Ishigaki Island (24°20′N, 124°15′E), Okinawa Pref., Japan, Oct. 25, 1973.

Paratypes: NSMT-P 28619-1～2, 2 adult males, 36.7 and 38.3 mm in standard length (SL), NSMT-P 28619-3～4, 2 adult females, 35.9 and 42.6 mm SL, Sept. 2, 1974; NSMT-P 28174-1～2, 2 adult males, 32.9 and 34.5 mm SL, NSMT-P 28174-3, adult female, 35.1 mm SL, Sept. 3, 1974; NSMT-P 20774 (cleared and stained), adult female, 36.1 mm SL, Aug. 6, 1977; YCM-P (Yokosuka City Museum) 3976-1～4, 4 adult males, 37.1～41.7 mm SL, YCM-P 3976-5～6, adult females, 33.7 and 34.5 mm SL, Mar. 21, 1977; YCM-P 4089-1～6, 6 adult males, 32.0～44.0 mm SL, YCM-P 4089-7～10, 4 adult females, 31.8～39.3 mm SL, May 4, 1977; all the paratypes were collected from the type locality.

Diagnosis

A species of *Sicyopus* easily distinguishable from other members of the genus chiefly by its cycloid scales covering only the caudal peduncle and dentaries without horizontal (=labial) teeth. Second dorsal rays I, 9; anal rays I,10; pectoral rays 14 or 15, branched caudal rays 7+6 or 7+7.

Description

Total length, standard length and proportional measurements in hundredths of standard or pelvic fin length are shown in Table 1. In the following counts, those of the holotype are given first, followed by counts of the paratypes differing from those of the holotype.

Dorsal rays VI-I, 9; anal rays I, 10; pectoral rays 15 (14 or 15); pelvic rays I, 5; branched caudal rays 7+6 (7+6 or 7+7); vertebrae 10+16=26, urostylar vertebra is counted as one.

Body elongate, nearly cylindrical. Head depressed, cheeks very swollen. Mouth horizontal, upper jaw a little prominent. Posterior end of maxillae extending below anterior margin of eyes. Upper lip very thick. Snout not exceeding upper lip, nearly round in dorsal view. Anterior nostril a short slender tube positioned halfway between anterior margin of eye and anterior margin of snout. Posterior nostril a pore positioned halfway

between anterior margin of eye and anterior nostril. Gill opening narrow, extending from before upper margin to before lower margin of pectoral base. Spines of first dorsal fin not prolonged, nearly equal in length. Caudal fin round. Length of pelvic fin base about half the length of the fin. Scales cycloid, 19 (14~23) in longitudinal series, covering caudal peduncle. First gill arch with 3~5 small gill rakers on lower limb.

Cephalic lateral line system (Fig. 3): Anterior oculoscapular canal with pores A′, B, C, D (single), F and H′; the pore A′ positioned immediate inner side of anterior nostril; double canals between the pores C and D. Posterior oculoscapular canal with pores K′ and L′. Preopercular canal with M′ and O′. Pit organs are shown in Fig. 3 as small black dots.

Dentition (Fig. 8A): A single row of conical curved teeth covering most of premaxillae

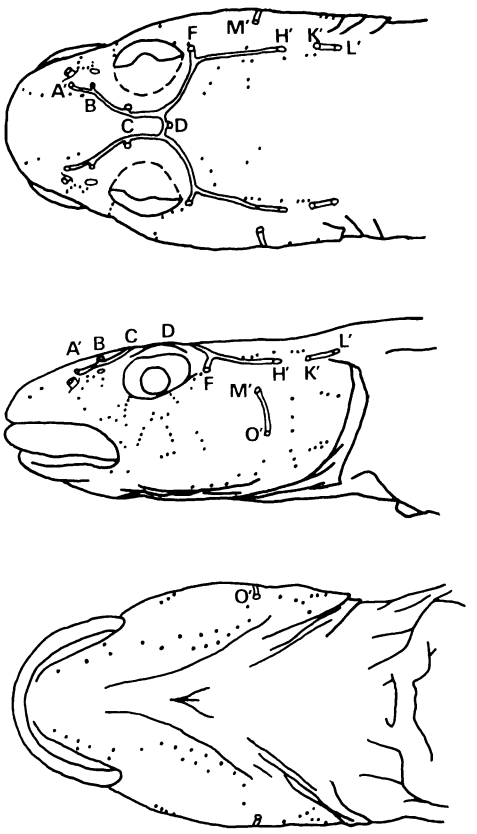

Fig. 3. Cephalic lateral line system of *Sicyopus leprurus*. NSMT-P 15979, holotype, 43.0 mm SL. Top, dorsal; middle, lateral; bottom, ventral views. A′~H′, pores of the anterior oculoscapular canal; K′~L′, pores of the posterior oculoscapular canal; M′~O′, pores of the preopercular canal; ..., pit organs.

Table 1. Length and proportional measurements in hundredths of standard or pelvic fin length of *Sicyopus leprurus* and *Lentipes armatus*.

Character	*S. leprurus*		*L. armatus*	
	Holotype NSMT-P 15979	Paratypes N=23	Holotype NSMT-P 29296	Paratypes N=3
Total length (mm)	52.3	38.3~52.2	50.0	36.8~44.9
Standard length (mm)	43.0	31.8~44.0	40.5	30.4~36.7
In % of standard length				
Preanal length	59.3	56.3~63.2	61.0	57.2~61.3
Body depth at anal origin	12.1	11.0~13.9	16.8	11.4~17.8
Head length	26.7	23.7~27.0	25.7	25.0~26.2
Head width at preopercular margin	17.0	17.5~21.7	18.0	18.0~19.1
Head depth at preopercular margin	11.2	11.6~14.0	13.3	12.5~14.1
Snout length	12.8	8.4~12.7	10.4	9.9~10.1
Eye diameter	5.3	4.3~ 6.4	5.2	4.9~ 5.7
Interorbital width	5.1	2.8~ 5.5	6.4	5.6~ 6.3
Caudal peduncle depth	10.7	9.2~12.7	12.6	9.0~12.2
Pelvic fin length	14.2	13.4~16.8	20.0	19.7~19.9
Pelvic fin width	15.1	13.9~18.2	19.8	19.9~21.7
Pectoral fin length	19.8	18.4~23.0	21.0	20.4~21.7
In % of pelvic fin length				
Pelvic fin base	49.2	40.0~54.0	67.9	61.6~73.3

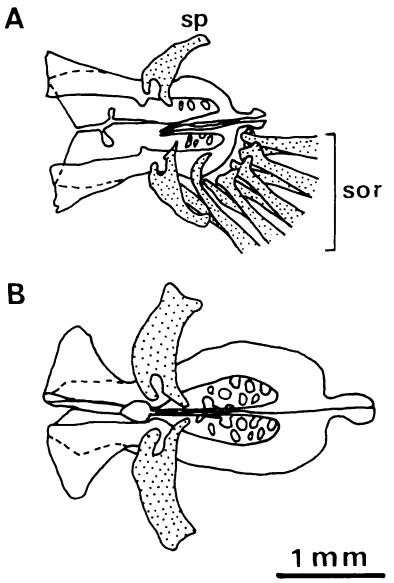

Fig. 4. Pelvic girdles of *Sicyopus leprurus* (A) and *Lentipes armatus* (B). sp, spine; sor, soft rays.

and dentaries, comparatively small and coarse-set in posterior part. Dentaries without horizontal teeth.

Osteology: Articular and lateral processes of premaxillae indistinct. Maxillae thick, twisted-pole-shaped (Fig. 9A); anterior ends inserted under premaxillae. Premaxillae fitting into a concavity of twisted maxillae. Palatines somewhat T-shaped. No infraorbital bones. No mesopterygoids. Quadrates deeply forked. Sympletic and metapterygoid slender. Preoperculum broad, without a process extending to posterior flange of hyomandibular. Short downward process on outer face of hyomandibular holding upper flange of preoperculum. Glossohyal long, its tip truncate. Branchiostegals 5. Frontal ridge large, forming posterior and dorsal parts of orbit. Lateral ethmoid a laterally projecting fan-shaped bone forming the major portion of anterior wall of orbit. Supraoccipital diamond-shaped, with a prominent anterior flange covering posterior part of frontal, and with wedge-shaped lateral wings. Scapula and postcleithrum absent. Pelvic girdles closely adjoining each other to form base of sucking disc (Fig. 4A). First dorsal fin with six pterygiophores; first pterygiophore between third and fourth neural spines, the last pterygiophore between sixth and seventh neural spines, the middle four pterygiophores divided into two pairs, each pair inserted in the interspace between two neural spines. An interneural gap without pterygiophore between two dorsal fins. Dorsal ribs associated with first to twelfth vertebrae, last six almost free from vertebrae. Ventral ribs associated with third to tenth vertebrae, last four free from vertebrae. Caudal skeleton with a single epural.

Color in life: Body semitranslucent, uniformly whitish brown, sometimes with dark broad transverse bands on side. In mature females, belly reddish orange. Margin of snout immediately above upper lip with a black horizontal stripe. Each dorsal fin rays with several dark spots.

Color in formalin: Body dusky, other coloration same as when alive.

Etymology

The Greek *lepros*, meaning scaly, and *oura*, tail, alluding to the fact that the species is scaled only on the caudal peduncle.

Lentipes armatus, sp. nov.

(New Japanese name: Yoroi-bōzu-haze)

(Fig. 5)

Holotype: NSMT-P 29296, adult male, 40.5 mm in standard length, 50.0 mm in total length, collected from the Arakawa River at about 500 m from the river mouth, Ishigaki Island (24°20′N, 124°15′E), Okinawa Pref., Japan, Sept. 2, 1974.

Paratypes: NSMT-P 28175, male, 30.4 mm in standard length (SL); NSMT-P 29315 (very thin specimen), sex unknown, 36.7 mm SL; NSMT-P 20775 (cleared and stained), sex unknown, 37.5 mm SL; all the paratypes were collected from the type locality, Sept. 3, 1974.

Diagnosis

A species of *Lentipes* easily distinguishable from other members of the genus chiefly by its squamation; anterior half of body covered with forked scales, posterior half of body with ctenoid scales laterally and with cycloid scales dorsally and ventrally. Second dorsal rays I,10; anal rays I,10; pectoral rays 18～20; branched caudal rays 7+6; scales

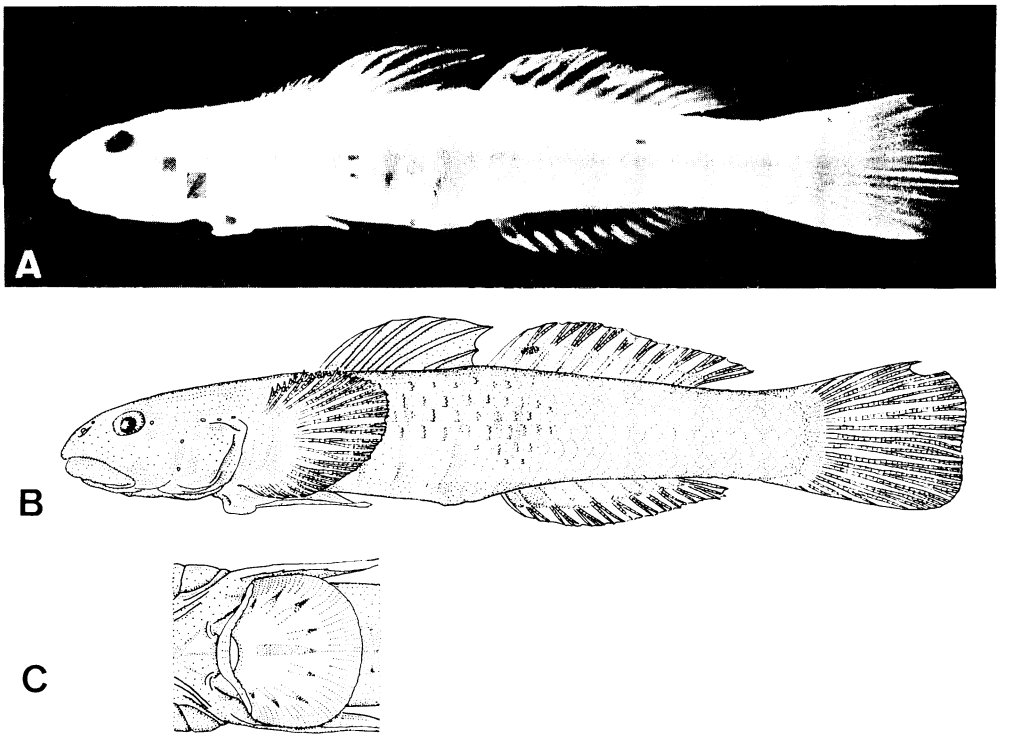

Fig. 5. *Lentipes armatus*, sp. nov. A and B: Holotype, NSMT-P 29296, 40.5 mm SL. C: Pelvic sucking disc of the holotype.

in a longitudinal series 33~35. A row of tricuspid teeth covering anterior half of premaxillae, followed by a row of conical teeth; dentaries with horizontal (=labial) teeth on anterior half.

Description

Total length, standard length and proportional measurements in hundredths of standard or pelvic fin length are shown in Table 1. Counts of holotype are given first, followed by those of paratypes differing from those of the holotype.

Dorsal rays VI-I, 10; anal rays I,10; pectoral rays 20 (18 or 19); pelvic rays I,5; branched caudal rays 7+6, scales in a longitudinal series 33 (33~35); vertebrae 10+16= 26, urostylar vertebra is counted as one.

Body elongate, nearly cylindrical. Head obtuse, somewhat depressed. Mouth horizontal, upper jaw prominent. Posterior end of maxillae extending below middle of eyes. Upper lip very thick, with wave-like clefts. Snout obtuse, exceeding upper lip. Anterior nostril a short slender tube positioned halfway between anterior margin of eye and anterior margin of snout. Posterior nostril a pore positioned halfway between anterior margin of eye and anterior nostril. Gill opening narrow, extending from before upper margin to before lower margin of pectoral base. Spines of first dorsal fin not prolonged, sixth spine short, other spines nearly equal. Caudal fin round. Pelvic fins connected to form a comparatively large strong sucking disc, length of its base longer than pelvic fin length. Anterior half of body with forked scales (Figs. 5B, 6A) which are more or less embedded in skin, difficult to observe from outside unless stained; posterior half of body with ctenoid scales laterally (Figs. 5B, 6B) and with cycloid scales dorsally and ventrally (Figs. 5B, 6C); head, nape and belly naked. First gill arch without gill rakers.

Cephalic lateral line system (Fig. 7): Anterior oculoscapular canal with pores A′, B,

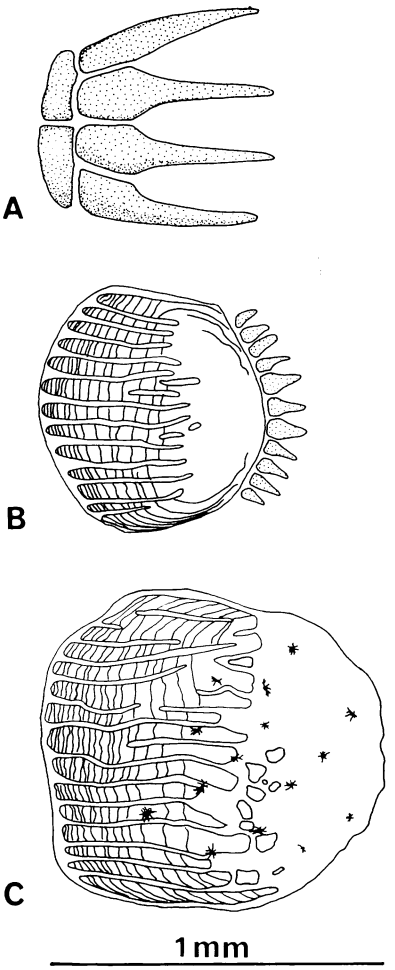

Fig. 6. Scales of *Lentipes armatus*, NSMT-P 20775, 37.5 mm SL. A: A scale on anterior lateral part of the body. B: A scale on posterior lateral part of the body. C: A scale on posterior dorsal part on the body.

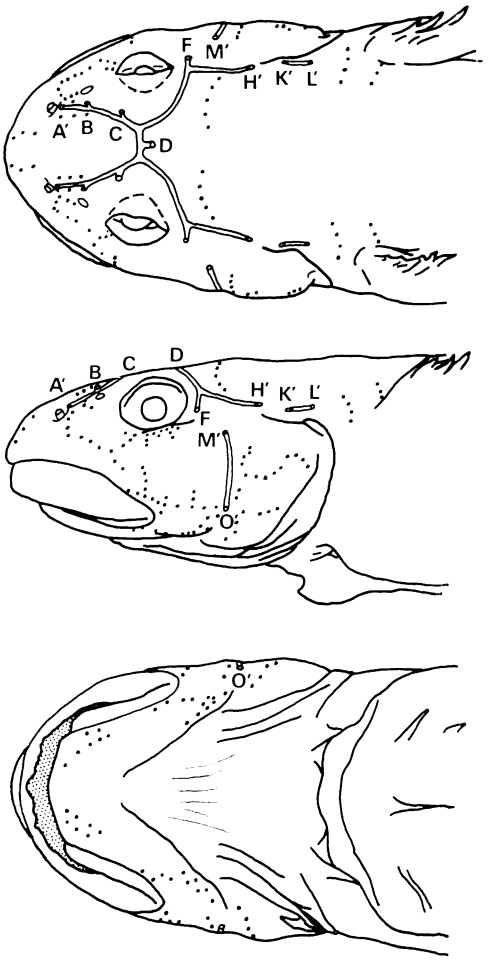

Fig. 7. Cephalic lateral line system of *Lentipes armatus*. NSMT-P 29296, holotype, 40.5 mm SL. Top, dorsal; middle, lateral; bottom, ventral views. A′～H′, pores of the anterior oculoscapular canal; K′～L′, pores of the posterior oculoscapular canal; M′～O′, pores of the preopercular canal; ..., pit organs.

C, D (single), F and H′; the pore A′ positioned immediate inner side of anterior nostril; double canals between the pores C and D. Posterior oculoscapular canal with pores K′ and L′. Preopercular canal with M′ and O′. Pit organs are shown in Fig. 7 as small black dots.

Dentition (Fig. 8C): A single row of close-set tricuspid teeth covering anterior half of premaxillae, followed by a single row of coarse-set conical curved teeth. Dentaries with a row of conical curved teeth and with a row of slender horizontal teeth on anterior half of outer margin. Horizontal teeth hidden in tough flesh of lower lip. Many parallel close-set series of replacement teeth forming a carpet-like fine patch, folded in gum between outer side of premaxilla and inner side of maxilla.

Osteology: Lateral process of premaxillae pointed, articular process indistinct, ends of premaxillae somewhat prolonged backward. Anterior ends of maxillae with an outer and an inner processes (Fig. 9C); premaxillae inserted between these two processes. Palatines

T-shaped. No infraorbital bones. No mesopterygoids. Quadrates broad, deeply forked. Sympletic and metapterygoid short and broad; the former with an angular downward expansion and the latter with a smaller upward expansion. Preoperculum broad; no process extending to posterior flange of hyomandibular. Short downward process on outer face of hyomandibular holding upper flange of preoperculum. Glossohyal short, triangular, its tip somewhat rounded. Branchiostegals 5. Frontal ridge large, forming posterior and dorsal part of orbit. Lateral ethmoid a laterally projecting fan-shaped bone forming the major portion of anterior wall of orbit. Supraoccipital diamond-shaped, with a prominent anterior flange covering posterior part of frontal. Scapula and postcleithrum absent. Pelvic girdles closely adjoined to form base of sucking disc with large posterior part directly supporting pelvic rays (Fig. 4B). First dorsal fin with six pterygiophores; first pterygiophore between third and fourth neural spines, the last pterygiophore between sixth and seventh neural spines, both of two pairs of middle four pterygiophores inserted in the interspace between two neural spines. An interneural gap without pterygiophore between two dorsal fins. Dorsal ribs associated with first to fourteenth vertebrae, last three free from vertebrae. Ventral ribs associated with third to tenth vertebrae, no rib free from vertebrae. Caudal skeleton with a single epural.

Color in life: In male, body semitranslucent, light brown; trunk with pale bluish tint. Basal half of second dorsal and anal fins darker. Second dorsal fin with a small distinct black dot on membrane between first and second soft rays.

Color in formalin: Pale blue coloration of trunk disappeared, a few transverse dark bands appeared on the trunk.

Etymology

The Latin *arma*, meaning a suit of armor, alluding to the body of this species armored with forked scales.

Key to four genera of Sicydiaphiinae and species of *Sicyopus* and *Lentipes*

The four genera of the hill-stream sicydiaphiine gobies occurring in Japan and all known species of *Sicyopus* and *Lentipes* are distinguished according to the following characters:

1. Premaxillae covered with numerous close-set tricuspid teeth; dentaries with a row of conical teeth and a row of slender horizontal teeth on outer margin.
   - 1a. Body entirely scaled; pelvic fin base longer than half pelvic fin length..... ..... *Sicyopterus*
   - 1b. Head and foremost part of body naked; pelvic fin base as long as half pelvic fin length..... *Stiphodon*
2. Close-set tricuspid teeth covering anterior half of premaxillae, followed posteriorly by coarse-set conical teeth; dentaries with a row of conical teeth and a row of horizontal teeth on anterior half of outer margin; pelvic fin base longer than half pelvic fin length. ..... *Lentipes*
   - 2a. Posterior part of body with a few to nearly 100 scattered cycloid scales (syn. *L. seminudus*, after Maciolek, 1977)..... ..... *L. concolor*
   - 2b. Trunk covered with forked scales, caudal peduncle with ctenoid and cycloid scales..... *L. armatus*, sp. nov.
3. Both premaxillae and dentaries with a row of conical teeth; pelvic fin base as long as half pelvic fin length. ..... *Sicyopus*
   - 3a. Body covered with 32~35 ctenoid scales in longitudinal series; pectoral fin rays 15 or 16; no horizontal teeth. .... *S. zosterophorum*
   - 3b. Body covered with 35 ctenoid scales in longitudinal series; pectoral fin rays 17 or 18; horizontal teeth sometimes visible (Koumans, 1953)..... *S. balinense*
   - 3c. Body covered with about 55 ctenoid scales in longitudinal series; no horizontal teeth..... *S. multisquamatus*
   - 3d. Caudal peduncle covered with cycloid scales, other part of body naked; no horizontal teeth..... *S. leprurus*, sp. nov.

Comparison of four genera and six species of Sicydiaphiinae

In table 2, comparison is made of *Sicyopus zosterophorum*, *Sicyopus leprurus*, *Lentipes armatus*, *Stiphodon elegans* and *Sicyopterus*

japonicus, all from Japan, and *Lentipes concolor* from the Hawaiian Islands and the Philippines. No specimens of *Lentipes concolor* were available at our disposal for osteological observations.

The six species here examined are divided into three groups according to their dentition. 1) *Sicyopus*: the premaxillae and dentaries

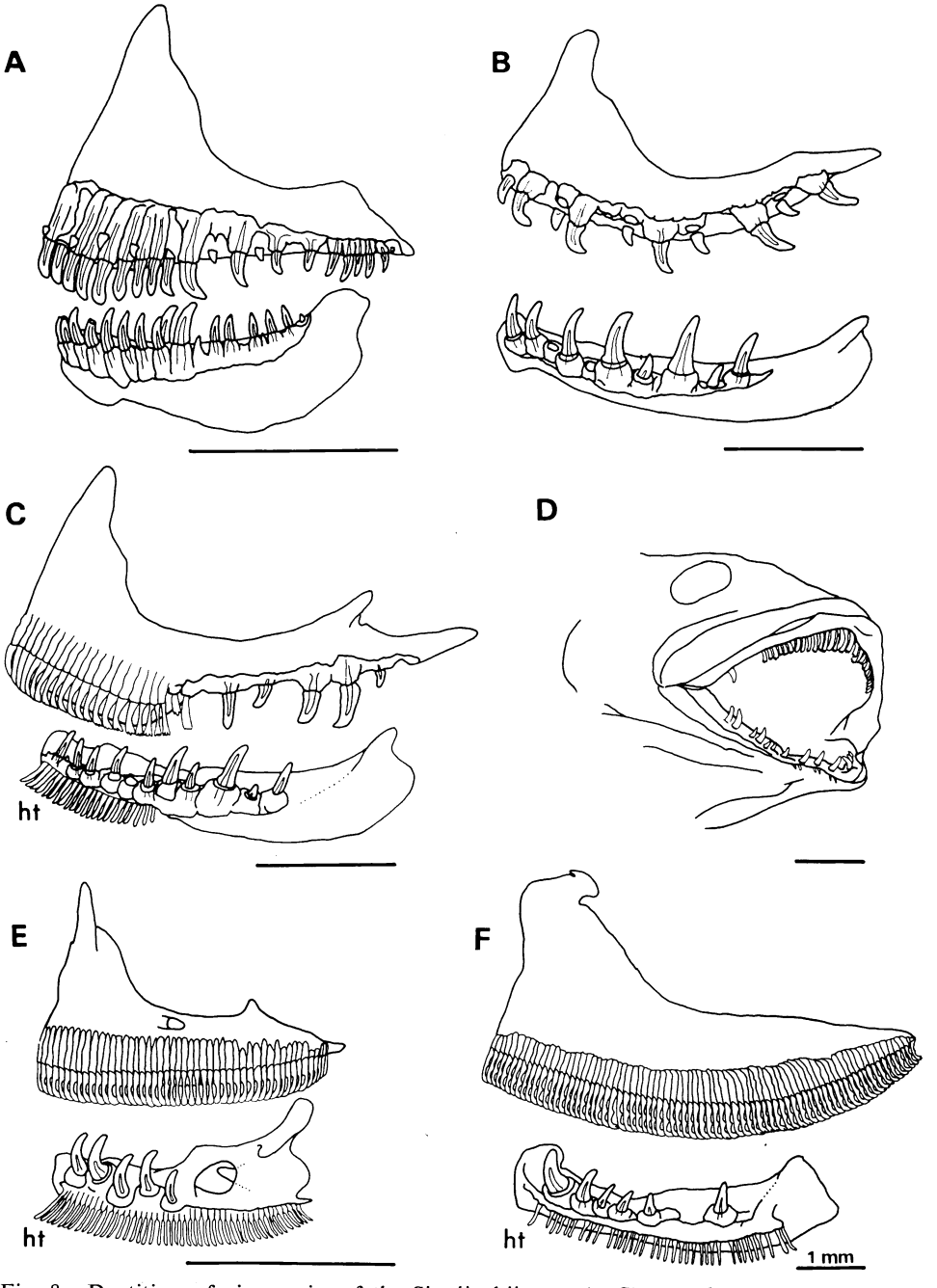

Fig. 8. Dentition of six species of the Sicydiaphiinae. A: *Sicyopus leprurus*. B: *Sicyopus zosterophorum*. C: *Lentipes armatus*. D: *Lentipes concolor*. E: *Stiphodon elegans*. F: *Sicyopterus japonicus*. ht, horizontal teeth. Scales indicate 1 mm.

with conical teeth (Fig. 8A, B). 2) *Lentipes*: the anterior half of the premaxillae with tricuspid and the posterior half with conical teeth, the horizontal teeth present only on the anterior half of the dentaries (Fig. 8C, D). 3) *Stiphodon* and *Sicyopterus*: the premaxillae with tricuspid teeth and the dentaries with the horizontal teeth along its entire length (Fig. 8E, F).

The species of group 1 have a few gill rakers on the lower limb of the first gill arch, whereas those belonging to groups 2 and 3 have none on the first gill arch.

In *Sicyopus leprurus* of group 1, the maxillae are twisted-pole-shaped (Fig. 9A) and the head of the T-shaped palatines is small. The maxillae and palatines of *Sicyopterus japonicus* of group 3 are of more complicated shape; the maxillae are warped upward and develop a broad outer lobe (Fig. 9E) which forms a canopy over the premaxillae, and the head of the T-shaped palatines is large. Other species are intermediate between them in these characters (Table 2, see also Fig. 9). The shape of the maxillae and palatines shift from simple to complicated in the following sequence: *Sicyopus leprurus*—*Sicyopus zosterophorum*—*Lentipes armatus*—*Stiphodon elegans*—*Sicyopterus japonicus*.

In *Sicyopus leprurus* the premaxillae and maxillae are firmly articulated together, and the maxillae do not move forward and downward. While in *Sicyopterus japonicus* the premaxillae can be detouched from the maxillae and are movable forward and downward. The degree of this mobility of the premaxillae increases in the same order as in the complexity of the shape of the maxillae and palatines.

In our feeding experiments, *Sicyopus leprurus* and *Sicyopus zosterophorum* fed on waterfleas. *Lentipes armatus*, *Stiphodon elegans* and *Sicyopterus japonicus* did not feed on such organisms, but scraped off and fed on algae attached to the glass wall of aquaria, using their close-set tricuspid teeth of the movable

Table 2. Comparison of selected characters in the six species of hill-stream Sicydiaphiinae. int., intermediate condition between *Sicyopus leprurus* and *Sicyopterus japonicus*.

Character	*Sicyopus leprurus*	*Sicyopus zosterophorum*	*Lentipes armatus*	*Lentipes concolor*	*Stiphodon elegans*	*Sicyopterus japonicus*
Maxilla	twisted-pole-shaped	int.	int.	not examined	int.	outer lobe forming a canopy over premaxilla
Head of T-shaped palatine	small	int.	int.	not examined	int.	large
Premaxillary teeth	conical	conical	conical and tricuspid	conical and tricuspid	tricuspid	tricuspid
Horizontal teeth on dentary	absent	absent	present on anterior half	present on anterior half	present on entire length	present on entire length
Gill rakers on first gill arch	3~5	3~5	absent	not examined	absent	absent
Pelvic fin base	short	short	long	long	short	long
Squamation	cycloid scales on caudal peduncle	ctenoid scales on whole body	forked scales anteriorly, ctenoid and cycloid scales posteriorly on body	cycloid scales on caudal peduncle	ctenoid scales on whole body	ctenoid scales on whole body
Anterior and posterior oculoscapular canals	separated	separated	separated	separated	separated	linked together, partly covered with pterotic
Open pores of preopercular canal	2	2	2	2	2	3, canal enclosed in a tube of preoperculum

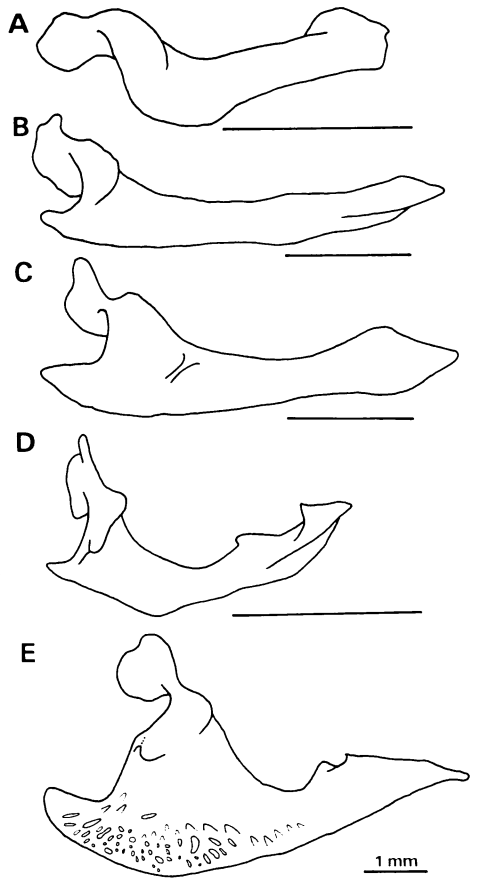

Fig. 9. Maxillae of five species of the Sicydiaphiinae. A: *Sicyopus leprurus*. B: *Sicyopus zosterophorum*. C: *Lentipes armatus*. D: *Stiphodon elegans*. E: *Sicyopterus japonicus*.

premaxillae. *Sicyopterus japonicus* is known to feed on diatoms and blue-green algae growing on the surface of river stones (Dōtu and Mito, 1955).

These observations on the mouth structure and feeding habits indicate that species with tricuspid teeth, horizontal teeth, complicated maxillae and palatines, greatly movable premaxillae, and no gill rakers on the first gill arch are herbivorous, and those with conical teeth, no horizontal teeth, simple maxillae and palatines, less movable premaxillae, and a few gill rakers on the first gill arch are not herbivorous. Horizontal and tricuspid teeth and other oral structures seen in *Lentipes armatus*, *Stiphodon elegans* and *Sicyopterus japonicus* should be highly specialized characters adapted to a herbivorous mode of life. Similar specializations of mouth structure correlated with herbivorous habit are known in some other teleosts such as *Plecoglossus altivelis* (e.g. Iwai, 1962), Salariini (e.g. Norman, 1943; Smith-Vaniz, 1976), Cichlidae (e.g. Fryer and Iles, 1972; Greenwood, 1974).

Sicyopus leprurus, *Sicyopus zosterophorum* and *Stiphodon elegans* have a relatively short base of the pelvic fins, while *Lentipes armatus*, *Lentipes concolor* and *Sicyopterus japonicus* have a relatively broad base. Five species other than *Lentipes concolor* occur sympatrically in the Arakawa River, Ishigaki Island, where all of the three species possessing a short base live in sluggish sections, and the broad-fin-based *Lentipes armatus* and *Sicyopterus japonicus* inhabit both slow-flowing and torrential sections. Life in torrents should require a strong sucking power of the pelvic disc, and the increase in the sucking power may have been accomplished partly by broadening the base of the disc. Hora (1932) referred to a similar adaptive change in homalopterid and gastromyzonid fishes.

Sicyopterus japonicus differs from the other five species in the pattern of sensory canals (Table 2). Takagi (1962) recognizes the phyletic significance of the reduction or suppression of the canals, noting that *Sicyopterus japonicus* is among the most primitive in the patterns of sensory canals of all gobiid fishes. Prince Akihito (1971) indicates the peculiarity in canal patterns of this species. At present it seems impossible to elucidate the phyletic significance of the peculiarity in sensory canals of this species.

The skull, shoulder girdle and caudal skeleton are similar in their components in the five species. Vertebral counts and the distributional pattern of the pterygiophores the of first dorsal fin are also similar (for these characters, see descriptions of the two new species). Five species other than *Sicyopterus japonicus* have the same pattern of the sensory canals, as mentioned above. Furthermore, *Lentipes armatus*, *Stiphodon elegans* and *Sicyopterus japonicus* share the mechanism of replacing tricuspid teeth (see description of *Lentipes armatus*). These features indicate close relationships of these

hill-stream sicydiaphiine gobies.

Based on the structures of the oral region and pelvic disc, *Sicyopterus japonicus* is considered to represent the highest degree of adaptive modification to torrential enviorenments, and *Sicyopus leprurus* the lowest. In *Stiphodon elegans*, the mouth is greatly modified, but the pelvic disc is not specialized. On the contrary, *Lentipes armatus* and *L. concolor* are less specialized in mouth structures, and specialized in the pelvic disc.

Comparative materials

Sicyopterus japonicus (Tanaka). NSMT-P 20778-1～3, 3 cleared and stained specimens, 59.8～66.7 mm SL, from the Shimonokae River, Kōchi Pref., Sept. 28, 1977; NSMT-P 29003-1～5, 5 specimens, 52.5～67.6 mm SL, from the Naoto River, Amami-ōshima Island, Kagoshima Pref., Aug. 17, 1975.

Stiphodon elegans (Steindachner). NSMT-P 20779, 1 cleared and stained specimen, 29.3 mm SL, Aug. 6, 1977; NSMT-P 28173-1～3, 3 specimens, 25.0～33.9 mm SL, Sept. 3, 1974; NSMT-P 28168, 1 specimen, 34.9 mm SL, Sept. 2, 1974; all specimens were collected from the Arakawa River, Ishigaki Island, Okinawa Pref.

Sicyopus zosterophorum (Bleeker). NSMT-P 20781, 1 cleared and stained specimen, 39.6 mm SL, NSMT-P 20782, 1 specimen, 34.3 mm SL, from the Miyara River, Ishigaki Island, Okinawa Pref., Aug. 7, 1973; NSMT-29314, 1 specimen, 37.4 mm SL, from the Arakawa River, Ishigaki Island, Okinawa Pref., Sept. 2, 1974; NSMT-P 20783, 1 specimen, 30.7 mm SL, from the Tēma River, Okinawa Island, Okinawa Pref., Mar., 1974.

Lentipes concolor (Gill). BMHN (British Museum, London, Natural History) 581, holotype of *L. seminudus*, 41.5 mm SL, from Honolulu, Hawaiian Ishlands; USNM (United States National Museum, Washington) 82888 in part, 1 specimen, 53.4 mm SL, from Maui Island, Hawaiian Islands; USNM 83078, 1 specimen, 68.4 mm SL, from Manila, Philippines.

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石垣島の渓流から得られたボウズハゼ亜科の2新種

酒井治己・中村守純

琉球列島石垣島の渓流から得られたボウズハゼ亜科の2新種，カエルハゼ *Sicyopus leprurus*，ヨロイボウズハゼ *Lentipes armatus* を記載した．これら2種はそれぞれの属の他種と，鱗の配列様式によって区別できる．また，渓流産ボウズハゼ亜科4属6種について，その形質を比較した結果，渓流環境に対する適応の程度は，ボウズハゼ属 *Sicyopterus* が最も高く，フデハゼ属 *Sicyopus* が最も低く，ヨロイボウズハゼ属 *Lentipes* およびナンヨウボウズハゼ属 *Stiphodon* がそれらの中間的度合を示した．

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