

## *Sicydium adelum*, a new species of gobiid fish (Pisces: Gobiidae) from Atlantic slope streams of Costa Rica

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(Rec. 21-IX-1994. Rev. 26-I-1995. Accep. 2-III-1995)

**Abstract:** A new diminutive species of the diadromous goby genus *Sicydium* is described from 346 specimens collected between 10 and 800 m elevation in Costa Rica. The new form is almost always syntopic with its congener, *S. altum*. The new species is compared to other Costa Rican species (*S. altum*, *S. salvini* and *S. cocoensis*) with special emphasis on details of the premaxillary dentition, which is shown to be of primary importance in understanding the relationships of *Sicydium* species. Specimens of *Sicydium* sp. (Honduras), *S. hildebrandi* (Colombia) and *S. plumieri* (Puerto Rico) were also examined. On the basis of the study material, two distinct lineages of *Sicydium* which differ sharply in tooth structure and mode of replacement appear to exist.

**Key words:** New species, freshwater Gobiidae, Pisces, Costa Rica.

Fishes of the genus *Sicydium* are the neotropical and West African representatives of the Sicydiinae, a gobiid subfamily found throughout tropical freshwaters. The most derived of these genera, *Sicydium*, *Sicyopterus* and *Stiphodon* (Parenti and Maciolek 1993) share unique dentary modifications which, combined with a pelvic sucking disc, allow the fish to scrape algae from rocks in swift stream habitats. A fleshy sac is present above the upper jaw that contains replacement teeth in successive stages of development; as each tooth becomes worn, it is resorbed in the soft tissue of the premaxilla and replaced by another tooth from above (Mochizuki *et al.* 1991). The functional uniserial premaxillary teeth of *Sicydium* may have their tips in an even or an uneven row, with each functional tooth alternating with a shorter, worn tooth located slightly behind the former. The crown of each tooth in different species is reported to be tricuspid, bicuspid or simple. The presence or absence of long papillae overlying the outer bases of the teeth is another important diagnostic character of *Sicydium* species.

Early descriptions relied heavily on the extent of squamation on the occipital region and belly, the length of dorsal fin spines and pectoral fin, and, in the case of *Sicydium vincente* Jordan & Evermann and *S. plumieri* (Bloch), perhaps on juvenile characters. It is now known that these characteristics vary to a large degree with the age and sex of the fish. Differences in coloration are still important. Scale counts, pectoral ray counts and especially variations related to dentition, are used in the present study to describe a new species, syntopic with *Sicydium altum* Meek along the Atlantic slope of Costa Rica. The new species is remarkably similar in coloration, yet smaller and differing strikingly in dentition.

### MATERIAL AND METHODS

Characters of premaxillary teeth were recorded with a Scanning Electron Microscope. The premaxillary bones were dissected from cleared and stained specimens or the jaws alone were dissected out. Specimens were placed for two

days in buffered trypsin solution, oven-dried and platinum-coated. Methodology follows Hubbs & Lagler (1958) except where otherwise specified. The dorsal pterygiophore insertion pattern is expressed in the formula defined by Birdsong *et al.* Cephalic lateralis pore terminology follows Akihito *et al.* Institutional acronyms follow Leviton *et al.* (1985). Specimens are deposited at LACM and UCR.

*Sicydium adelum*, new species

(Fig. 1, 2 & 3)

*Sicydium* sp., Bussing 1987 (photograph, keys, descrip.)

**Holotype:** LACM 45941-1, 57.1 mm SL male, Río Schui, a tributary of Río Telire, Sixaola drainage near the Costa Rica-Panama border, elevation 90 m, (9°30'06"N; 83°00'04"W). Collected with seine on 2 July 1982 by A. Corrales, C. Jiménez, E. Rodríguez and H. Rojas (ex. UCR 1401-2).

**Paratypes:** All paratypes are from the Atlantic versant of Costa Rica. Collections are listed by drainages in order from north to south. Additional data are available as *Sicydium* sp. through gopher over the Internet. Parismina drainage: UCR 289-4, 1 specimen (61.7 mm SL), confluence of Río Birrís and Río Reventazón, 800 m elevation, 22 Sep. 1968. Matina drainage: UCR 1126-25, 5 (47.5-69.6, 2 cleared & stained), Río San Miguel, 12 m, 30 Sep. 1977. Moin drainage: UCR 1294-24, 1 (46.9), Río Cuba, 12 m, 5 Oct. 1979. UCR 214-18, 2 (35.2-42.1), Quebrada Chocolate, 15 m, 20 Oct. 1967. Banano drainage: UCR 374-10, 10 (23.6-44.0) and LACM 45942-1, 14 (24.2-39.4), Río Banano, 25 m, 24 Oct. 1969. Carbón drainage: UCR 894-14, 2 (42.6-44.2), Río Patiño, 40 m, 4 Oct. 1975. UCR 1352-17, 9 (20.8-38.9), Río Hone, 10 m, 25 Sep. 1981. Sixaola drainage: UCR 1141-15, 9 (40.9-64.1), stream near Shirolés, 60 m, 13 Nov. 1977. UCR 1299-24, 164 (22.2-48.7, 7 cleared & stained), and LACM 45943-1, 120 (25.0-45.4), Río Cocolis, 40 m, 6 Oct. 1979. UCR 1394-8, 1 (58.5), Quebrada Niabri at Suki, 125 m, 12 June 1982. UCR 1373-7, 2 (49.8-54.2), Río Urén, 100 m, 7 Apr. 1982. UCR 1372-7, 4 (38.4-75.5), Río Urén, 110 m, 8 Apr. 1982. LACM 45941-2, 1 (38.8), same data as holotype.

**Comparative material:** *Sicydium altum*, Costa Rica, UCR 214-11, 215-1, 289-2, 374-2, 894-6, 984-3, 1126-22, 1141-12, 1144-8, 1293-5, 1299-5 and 1373-3. *Sicydium cocoensis*, Isla del Coco, Costa Rica, UCR 736-6. *Sicydium salvini*, Costa Rica, UCR 178-7, 452-3, 798-10. *Sicydium* sp., Honduras, UCR 199-4, 1624-9. *Sicydium hildebrandi*, Colombia, LACM 20038 and 20039. *Sicydium plumieri*, Puerto Rico, LACM 4962. Additional data for UCR collections are available on Internet.

**Diagnosis:** A small *Sicydium* species (largest, 75.5 mm SL, a ripe female of 35.5 mm SL). Premaxillary teeth tricuspid without overlying papillae, lateral cusps much longer than median cusp; enameloid crown short; 61-78 teeth on each premaxilla. Mouth narrow. Longitudinal scales 61-68, transverse scales 20-23. Belly unscaled in largest specimen.

**Description:** Morphometrics are shown in Table 1. First dorsal fin with six flexible spines, elongated in males (Fig. 1c), especially second and third spines which extend to mid-base of soft dorsal fin in largest male. Second dorsal fin I,10. Anal fin I,10. Pectoral fin 20 (8), 21 (1), 22 (3); holotype 20. Pelvic fin I,6. Principal caudal rays 15, tail longer and more pointed on large males. Vertebrae 10 + 16 = 26. Spinous dorsal fin pterygiophore formula 3-12210.

TABLE 1

Proportional measurements in percent of SL of holotype and nine paratypes (UCR 289-4, 1126-25, 1372-7, 1394-8, 1141-15) of *Sicydium adelum*

	Holotype	Paratypes
Standard length (mm)	57.1	47.5 - 75.5
Head length	23.1	22.1 - 25.7
Mouth width	16.6	13.7 - 16.5
Upper jaw length	12.3	10.4 - 13.4
Interorbital distance	8.8	7.5 - 9.1
Eye diameter	6.8	4.0 - 5.3
Snout length	9.8	8.4 - 10.9
Greatest body depth	18.0	15.2 - 20.8
Caudal peduncle depth	13.0	12.0 - 13.5
Predorsal (1st) distance	35.0	33.5 - 36.8
Predorsal (2nd) distance	55.9	53.8 - 60.0
Preal anal distance	54.8	55.6 - 62.3
Pectoral fin length	25.2	18.5 - 22.6
1st dorsal spine length	15.8	12.7 - 22.7

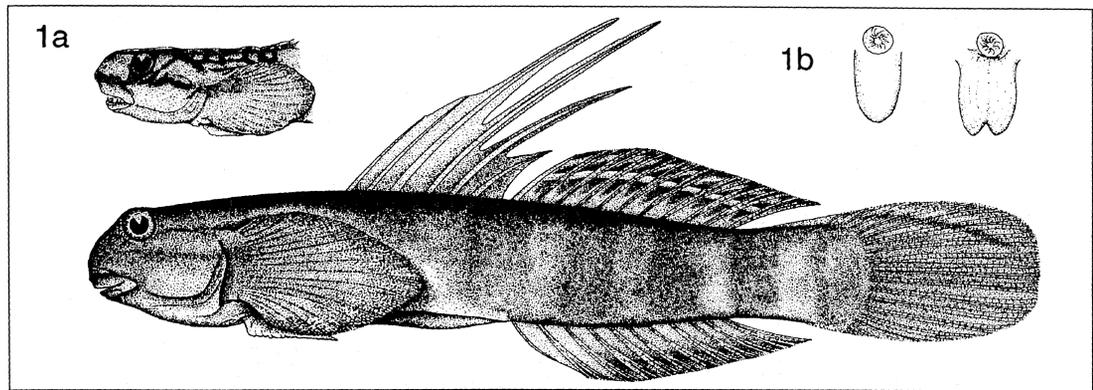


Fig. 1. *Sicydium adelum*, sp. nov., LACM 45941-1, holotype, 57.1 mm SL, from Río Sixaola drainage, Costa Rica; 1a. A young male paratype, UCR 1299-24, 35.5 mm SL also from Sixaola drainage to show head coloration; 1b. Ventral view of male and female paratypes (UCR 1141-15) to show urogenital papillae.

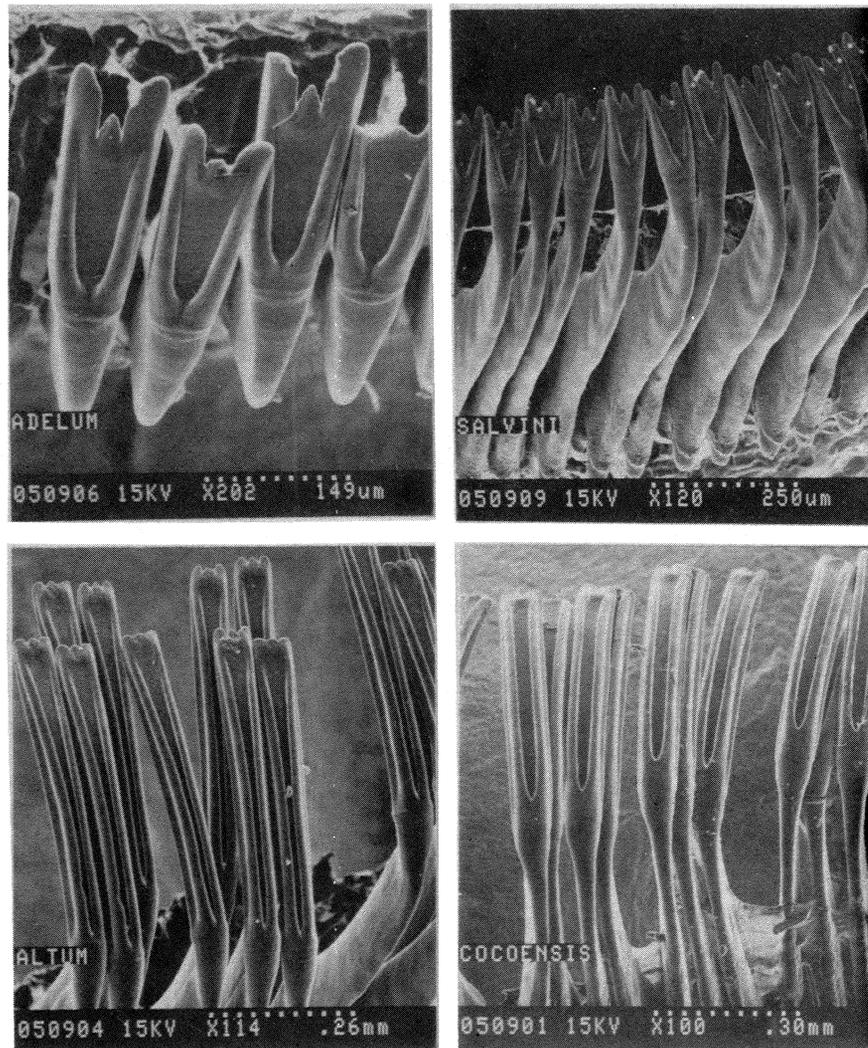


Fig. 2. Premaxillary teeth of four species of Costa Rican *Sicydium*. *S. adelum*, paratype UCR 1372-7, 75.5 mm SL; *S. salvini*, UCR 798-10, 86 mm SL; *S. altum*, UCR 289-2, 92 mm SL and *S. cocoensis*, UCR 736-6, 69.7 mm SL.

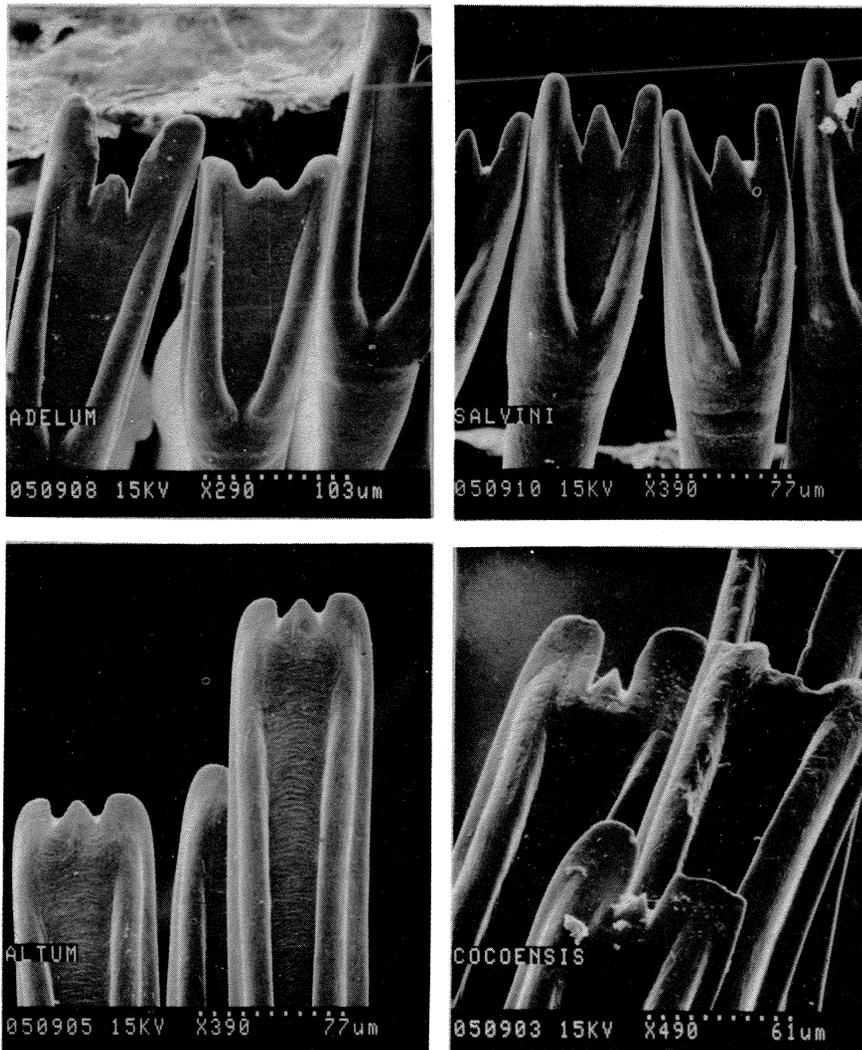


Fig. 3. Tips of premaxillary teeth of four species of Costa Rican *Sicydium*. Same specimens as Fig. 2.

Lateral scale rows extending from first scale posterior to dorsal edge of pectoral fin base (at this level, as noted by Regan 1906-08, scales not always present anterior to this point) to end of hypural 61-68, holotype 66. Transverse scale rows between origin of second dorsal fin and anal fin base 20-23, holotype 22. Entire belly unscaled in young, unscaled area reduced to a long triangular region with apex at anus in largest adults.

Head blunt, it and trunk nearly round in cross section, compressed at urosome; uniform body depth. Eye superior, diameter about twice snout length. Mouth subterminal, relatively

narrow when compared to *Sicydium altum*, 13.7-16.6 versus 16.9-22.5 percent of SL

Premaxillary teeth tricuspid, lateral cusps much longer than medial cusp (Figs. 2, 3) before wear; enameloid crown short compared to that of *S. altum*, *S. cocoensis* and *S. plumieri*; each succession of teeth including a functional tooth, all closely spaced to form an even scraping edge, as opposed to an uneven row whereby functional teeth alternate with half-erupted replacement teeth; 61-78 teeth on each premaxilla of fish over 50 mm SL.

Lower jaw with a single row of slender teeth on anterior side of jaw embedded in soft tissue

to form a sharp-edged forward-projecting ridge that protrudes from the mouth. Two to four widely spaced canines dorsally on each side of dentary.

Oculoscapular canal pore pattern A', B, C, D (single), F, HK, and L'. Preopercular canal pores M', N, O'. Superficial neuromasts few, not forming long rows; a few scattered below eye and on cheek.

Urogenital papilla of males elongate with rounded tip, female papilla bilobed with larger opening (Fig. 1b).

Most preserved adults retain five broad dusky bars on flanks between tip of pectoral and base of caudal fin. Large males dark gray-brown with paler interspaces. Adult females paler gray-brown, bar pattern often not well-defined and combined with a longitudinal band. Median fins with pale streak (Fig. 1) and pale upper margin of caudal fin usually evident on both sexes. Juveniles and young adults with five black bars contrasting with much paler brown interspaces and four narrow crossbars on caudal fin; young males in breeding (?) coloration with narrow black streak running between snout and bases of pectoral fin below eye, one to three black blotches on base of pectoral fin and several dark bars crossing top of head (Fig. 1a).

## DISCUSSION

Miller (1966, 1976) listed five valid species of *Sicydium* for Central America including southern Mexico: *S. salvini* Ogilvie-Grant (both slopes of central Panama to Ecuador), *S. gymnogaster* Ogilvie-Grant (Atlantic slope, Mexico to Honduras), *S. altum* Meek (Atlantic slope, Costa Rica), *S. multipunctatum*, Regan (Pacific slope, Mexico to Honduras), *S. pittieri* Regan (Pacific slope, Costa Rican and Panama). None of these species have been recorded from outside of this region.

However, *Sicydium* and other lotic gobies lay demersal eggs which on hatching are swept to sea and later return in massive migrations as transparent larvae to river mouths (Erdman 1967, Gilbert y Kelso 1971, Silva y Acero 1990). It is thus plausible that a single species maintains populations on both the Central American mainland and in the Antilles. No critical analysis has confirmed this however,

and the validity of Antillean nominal species is not clear. Brockmann, in an unpublished thesis (1965), considered the *Sicydium* on the Atlantic versant of Panama to be *S. antillarum* Ogilvie-Grant, described originally from Barbados in the West Indies. Both *Sicydium antillarum* and the Costa Rican *S. altum* share papillae along the premaxillary teeth. Brockmann noted that a paratype of *altum* had 74 longitudinal and 20 transverse scale rows as opposed to 63-68 and 23-25 scale rows of his *antillarum* and thus, considered *S. altum* a valid species. Schultz (1949) recorded both *S. antillarum* and *S. punctatum* (including *S. montanum* Hubbs) from northern Venezuela. Hildebrand (1935) placed *S. antillarum*, *S. caguitae* (Evermann y Marsh) and *S. buscki* Evermann y Clark in the synonymy of *S. plumieri*. Erdman (1961) also included *S. punctatum* as a synonym of *S. plumieri* based on Puerto Rican specimens, but Brockmann, on examining Erdman's material of "*S. plumieri*", found it to consist of three or four species: *plumieri*, *antillarum*, *punctatum* and perhaps *caguitae*. If three or four species of *Sicydium* coexist on one island, a study of the systematics and distribution of *Sicydium* species throughout the Antilles could prove highly enlightening. Silva y Acero (1990) described the biology of populations of *Sicydium* with dental papillae from streams east of the Río Magdalena, Colombia. The specimens were tentatively considered *S. antillarum* following Brockmann (1965). The longitudinal scale count of the Colombian material however, is far lower (51-57) than Brockmann's Panama material (63-68), and probably represents another species.

In eastern Panama near the Colombian border Brockmann (1965) identified *Sicydium punctatum* Perugia, described from Martinique, also in the Antilles. This species lacks dental papillae, has large scales (longitudinal series 51-56, transverse series 18-19), 17-19 pectoral rays and a pale or white caudal peduncle. *Sicydium adelum* also lacks papillae and has tricuspid teeth, but differs from Brockmann's *S. punctatum* in having much smaller scales (61-68; 20-23), 20-22 pectoral rays, and lacking a pale brown or white caudal peduncle.

Brockmann (1965) also compared two syntypes of *S. pittieri* from the Pacific slope of Costa Rica with the previously described *S. salvini* from Panama. He concluded that the

cited differences in scalation, coloration and dentition were due to differences in size, sex and condition of the specimens and placed *S. pittieri* in the synonymy of *S. salvini*.

*Sicydium altum*, nearly always found with *S. adelum*, has different coloration and scale counts (71-80 longitudinal scales), but differs in having conspicuous dental papillae, very long, slender enameloid crown with small cusps all of equal length (Figs. 2, 3), alternate-type tooth replacement, more premaxillary teeth (93-100 vs. 61-78), a wider mouth (16.9-22.5 vs. 13.7-16.6 percent of SL) and greater maximum size. The following color notes were made on specimens of *Sicydium* during courtship activities in the Sixaola drainage of Costa Rica, although we were unaware at the time that both *S. altum* and *S. adelum* were syntopic at the site: males yellow-green above, pale blue below head, on belly and on lower one-half of interspaces between dusky crossbars.

*Sicydium salvini* from the Pacific slope of Costa Rica and Panama has rather similar premaxillary dentition to *S. adelum*, although the median tooth cusp is much larger (Figs. 2, 3). That species also has no papillae and similar scale counts (60-71 longitudinal scales), but the interradial membranes of both dorsal fins and scales are spotted and the body is speckled with dark spots. *Sicydium salvini* attains a larger size (at least 90 mm SL) than *S. adelum* (75.5 mm SL).

*Sicydium cocoensis* from Isla del Coco has double dental papillae, a long, slender enameloid tooth crown with moderately long, blunt lateral cusps and a minute median cusp (Figs. 2, 3), tooth replacement of alternate type, large scales (54-60 longitudinal rows) and spots on cheeks, pectoral fin base and body.

Specimens of a *Sicydium* species from the Atlantic slope of Honduras lack dental papillae, but differ from *S. adelum* in their larger scales (50-54 longitudinal rows) and spotted soft dorsal fin, pectoral fins, head and body. Farther north on the Atlantic side, *S. gymnogaster* has 60-74 longitudinal scales, spots on the body, but not on the fins (Regan 1906).

*Sicydium hildebrandi* from Colombia has a crenate upper lip, long, slender enameloid tooth crowns and tooth replacement of the alternate type. *Sicydium plumieri* from Puerto Rico has dental papillae, long, slender enameloid tooth crowns and tooth replacement of the alternate type (Mochizuki *et al.* 1991 and comparative material).

Therefore, on the basis of material examined during this study, two distinct lineages of *Sicydium* are shown to exist which exhibit trenchant differences in premaxillary dentition including tooth structure and mode of replacement. Details of tooth replacement were not investigated, nor was it the purpose of this study to confirm the relationships between *altum*-*antillarum*" and *pittieri-salvini*. In the lack of dental papillae and other differences, *S. adelum* clearly differs from the lineage containing *S. antillarum* and *S. plumieri*, the two widespread Antillean species. Nor do any other descriptions of nominal Antillean *Sicydium* forms fit the new Central American species.

**Etymology:** From the Greek *adelos* meaning unseen, unknown, obscure, in reference to its similar appearance to the syntopic *S. altum*.

**Distribution:** Known only from the Atlantic slope of Costa Rica in the Parismina drainage southward to the Sixaola drainage. Apparently the new species does not occur in the Changuinola drainage, Panama just south of the Río Sixaola; Brockmann (1965) only recorded *S. antillarum* from that region. *Sicydium adelum* has been taken only between 10 and 800 m elevation.

#### ACKNOWLEDGEMENTS

I appreciate the assistance of A. Baez, E. & M. Bussing, A. Corrales, C. de Paco, K. Gocke, C. Jiménez, H. Nanne, A. Ramírez, R. Retana, S. Salas and P. Siegfried for collecting material; R. Lavenberg and J. Seigel (LACM) for providing radiographs; O. Achí for drawing the figures and Rita Vargas for handling the electron microscopy. Previous drafts of this paper greatly benefited from the critical scrutiny of anonymous reviewers.

#### RESUMEN

Se describe una nueva especie de chupapiedra del género *Sicydium*, con base en 346 especímenes recolectados entre 10 y 800 m de altura en la vertiente Atlántica de Costa Rica. La especie nueva se encuentra generalmente en los mismos sitios que su congénere, *S. altum*. Se compara *S. adelum* con otras especies de *Sicydium* costarricense (*S. altum*, *S. salvini* y *S. cocoensis*) con especial énfasis en los detalles de dentadura del premaxilar -detalles de los cuales

son de la mayor importancia en el entendimiento del parentesco de las especies de este género.

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