

The species of *Sicyonia* H. Milne Edwards (Crustacea: Penaeoidea) of the Gulf of California, Mexico, with a key for their identification and a note on their zoogeography*

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Abstract: From 1979 to 1982, a large scale survey of the marine and coastal fauna of the Gulf of California, México, was undertaken: 9 species of rock-shrimp of the genus *Sicyonia* were collected, totaling 5,190 specimens. A key to the 11 species of *Sicyonia* reported in the Gulf of California is given and the color of most species is also described, in many cases for the first time. Microphotographs or illustrations of the petasma are provided to permit easier identification of males. The zoogeography of the genus along the Pacific coast of America is discussed; *Sicyonia* has a very broad distribution, extending from the southern Oregonian Province as far south as Callao, Perú, in the Perú-Chilean Southern Hemisphere Province. The Gulf of California fauna is made up of several components including a warm-temperate species (*S. ingentis*), three endemic or almost endemic species (*S. disparri*, *S. disedwardsi* and *S. penicillata*) and a series of five tropical species (*S. picta*, *S. aliaffinis*, *S. disdorsalis*, *S. martini* and *S. laevigata*), the first three of which are widely distributed throughout the eastern Pacific region.

Since 1979, a large-scale survey of the marine coastal fauna of Southern Sinaloa was undertaken by the Laboratory of Benthic Invertebrates and Fishes of the Marine Station of the Instituto de Ciencias del Mar y Limnología, UNAM, at Mazatlán, Sinaloa, México. This research program included a two year survey of the Bay of Mazatlán (BBMAZ Project) and a three-leg sampling project (SIPCO Project) on the continental platform of southern Sinaloa. In 1982, the survey area was considerably increased and a major sampling cruise was organized in the Gulf of California (CORTES Project) which obtained a large series of samples from the continental platform. From all these sampling activities, a large series of rock-shrimp of the genus *Sicyonia* belonging to 9 distinct species was obtained. A review of the literature demonstrated that little information was available on the genus *Sicyonia* in the Gulf of California, although 2 other

species had been reported at least once for this area. A review of the material which has been collected during the study is presented herein, together with an identification key of the species known to occur in the Gulf of California.

MATERIAL AND METHODS

The material on which this study is based was obtained between May 1979 and May 1982 from trawling activity in the Bay of Mazatlán (BBMAZ) and on the continental platform of the Gulf of California (SIPCO: Off the coast of southern Sinaloa; CORTES: The rest of the Gulf of California). In some cases however, specimens of *Sicyonia* were found in oyster dredge or Van Veen grab samples. These peculiar sampling conditions are reported under "material examined".

The BBMAZ material was collected with a 3 m otter trawl (5.7 cm stretched mesh with a 2.5 cm inner cod-end) from the FC-I vessel of the Secretaría de Educación Pública, in Mazatlán. The SIPCO and CORTES materials

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were both obtained during research cruises aboard the R/V "El Puma" of the Instituto de Ciencias del Mar y Limnología, Universidad Nacional Autónoma de México, and were obtained with an 11.6 m commercial otter trawl (5.7 cm stretched mesh with a 2.5 cm inner cod-end).

Immediately upon capture, the material was sorted, separated by genus and species fixed in 8% formaldehyde solution. Color slides of fresh specimens were made for posterior description. Final identification was performed at the Laboratory using the literature available (Burkenroad, 1934; 1938; 1945; Anderson and Lindner, 1943; Cobb *et al.*, 1973; Arana and Méndez, 1978; Brusca, 1980; Pérez Farfante and Boothe, 1981) and black and white photographs of genital structures of selected specimens were taken with an automatic Leitz Photoautomat system mounted on a Wild M-8 binocular. Drawings were made with the help of a drawing tube mounted on the same equipment. In all figures, CL refers to carapace length measured from the orbital margin to the dorsal posterior margin.

In "material examined" information related to habitat, bathymetric range, color and commercial importance has been included under each species, and the number and letters in brackets after the names SIPCO and CORTES, refer to the station where the specimens were found. Currently known distribution of each species is also provided. Reference to previous records of each species in the literature is limited to the original description, including the type-locality, and in some cases to one or two additional references where the species has been illustrated. A short description of features such as size and position of the teeth on the carapace and the abdomen, and of the pectasma also given. In most cases, an illustration of the pectasma of the adult male (ventral view) is provided. The terminology used for describing it is simplified from Pérez Farfante and Boothe (1981) (Fig. 13). Figure 1 is a map of the study area with the location of each sampling station.

Specimens of all species have been deposited in the Reference Collection of Invertebrates of the Estación Mazatlán, ICML, UNAM.

TAXONOMY AND FAUNA

The genus *Sicyonia* was first described by

H. Milne Edwards (1830) for *S. carinata* (Olivier) and posteriorly changed to *Eusicyonia* by Stebbing (1914). Burkenroad, first adopted the position of Stebbing and created the subfamily Eusicyoninae, but later revalued the arguments presented by Stebbing and showed that the name *Sicyonia* had to be maintained (Burkenroad, 1945).

There are presently 19 species of *Sicyonia* reported for American waters: 9 on the Atlantic coast; 11 on the Pacific coast and one species is common to both coasts (Table 1). Corroboration of the presence of a population of *S. brevisrostris* on the Pacific coast is still missing and the only record so far is for a single specimen collected on the Pacific coast of México and reported by Burkenroad in 1934 (Huff and Cobb, 1979).

All species reported for the Pacific coast, with the exception of *S. brevisrostris*, have also been reported at least once in the Gulf of California. The following key allows distinguishing these species.

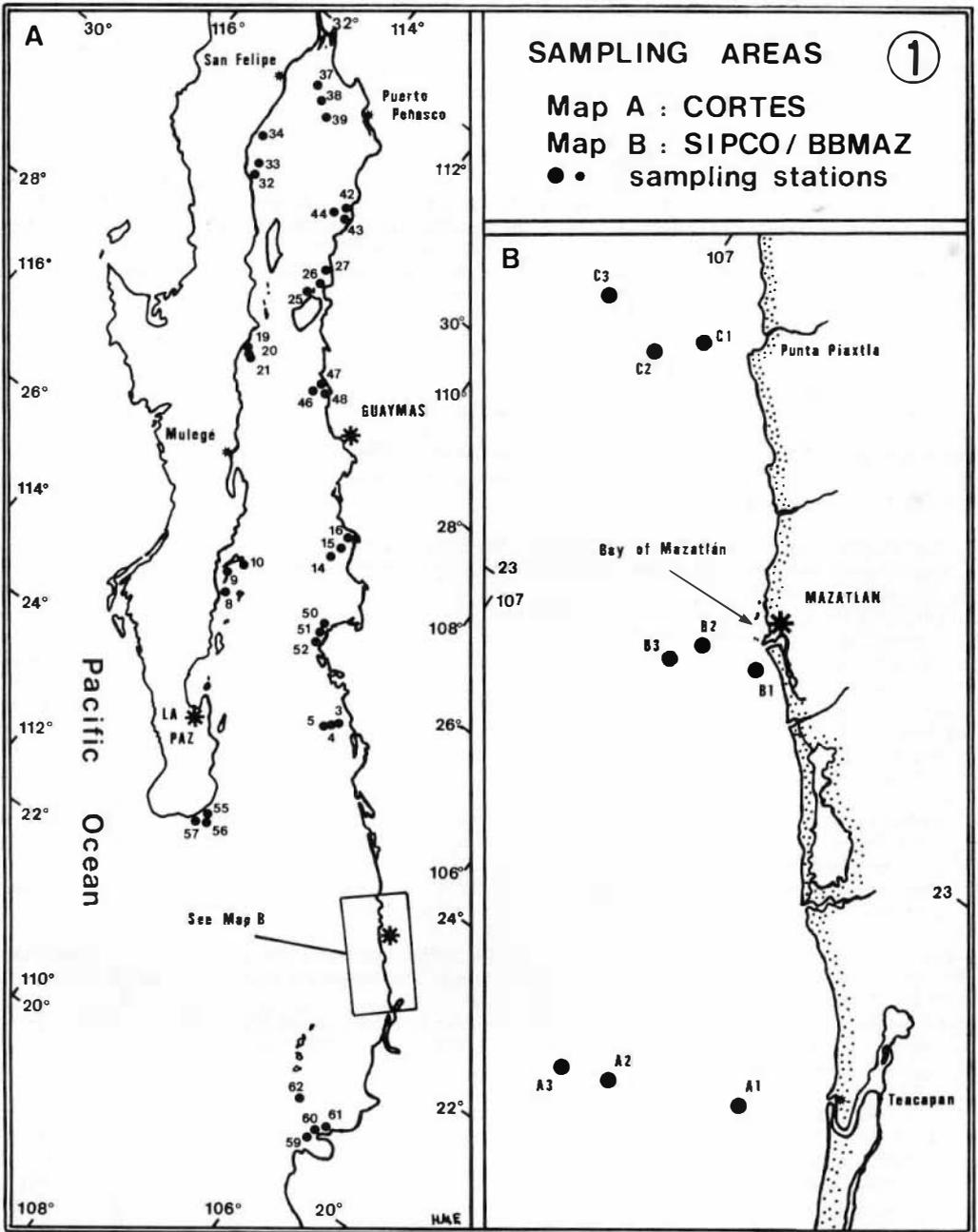
Sicyonia laevigata Stimpson, 1871
(Figs. 3 and 14)

Sicyonia laevigata Stimpson, 1871: 131 (type-locality, Charleston, South Carolina). *Eusicyonia laevigata*, Burkenroad, 1934: 76-80, figs. 21, 26 and 32. - *Sicyonia laevigata*, Huff and Cobb, 1979: 67-71, fig. 38.

Material examined: A total of 7 specimens: BBMAZ, 27-IX-79, 3 ♂ juv., 3 ♀, Van Veen grab.- Punta Chile, Bay of Mazatlán, 9-II-82, 1 ♀.

Description: Antennal angle unarmed; dorsal carina of the second abdominal segment with a deep vertical notch at about mid distance from the anterior end; terminal portion of rostrum with 3-5 teeth, followed by 2 rostral teeth anterior to the orbital margin; dorsal carina of carapace bearing three teeth, the anteriormost slightly ahead of level of the hepatic tooth and much smaller than the two others which are placed behind the level of the hepatic tooth. Pectasma with the distolateral corners of the dorsal lobules almost straight.

Habitat and bathymetric range: On the east coast of America it has been found in protected



shallow bays and down to 90 m, with preference for shelly bottoms (Huff and Cobb, 1979). Specimens from the Gulf of California were collected from the low rocky intertidal zone; from 3 m deep on shelly bottom.

Color: According to Huff and Cobb (1979) the species is greyish-brown on the carapace

with irregular shaped white spots and an oblique band of dark maroon posteriorly; the rostrum is dark maroon and the abdomen is dark brownish-maroon mottled with white and green; there is a large green spot on the side of the carapace and the antennal flagellum is banded with maroon and cream (specimens from Northeastern Gulf of México).

Key to the species of *Sicyonia* from the Gulf of California

1. Dorsal carina of second abdominal segment with a deep notch; antennal spine absent 2
Dorsal carina of second abdominal segment without a notch; antennal spine present 3
2. Three dorsal teeth on the carapace, one of which (the closest to the rostrum) is distinctly smaller than the other two and separated from these by a space about equal to the width of the base of the middle tooth (Fig. 3); distolateral corners of the dorsal lobules of the petasma almost straight (Fig. 14) *S. laevigata*
Three dorsal teeth of about the same size on the carapace; no space between the base of these teeth (Fig. 2); distolateral corners of the dorsal lobules of the petasma curved inward (Fig. 18) *S. disparri*
3. Only one tooth on the carapace posterior to the level of the hepatic spine, this tooth either elevated or low . . . 4
Two teeth on the carapace posterior to the level of the hepatic spine 5
4. Dorsal carina very low, with the posterior teeth comparable in size to the rostral teeth and followed by a long low carina 7
Dorsal carina higher (although not in its entire length), with the posterior tooth more than twice as high as the rostral teeth, and sloping towards the posterior margin of the carapace 8
5. The dorsal carina of the first abdominal segment is produced into a sharp tooth pointing forward. 6
The anterior part of the dorsal carina of the first abdominal segment is not toothlike; distolateral corners of the ventral lobules of the petasma bifurcated (Fig. 15) *S. mixta*
6. Excluding the tip of the rostrum (which is bifurcate), there is a total of 5 dorsal teeth on rostrum and carapace (Fig. 5); petasma with distolateral corners of the ventral lobules thumblike (Fig. 19); thelycum with a broad emargination (Fig. 27) *S. disedwardsi*
Excluding the tip of the rostrum (which includes 2-3 small teeth), there is a total of only 4 dorsal teeth on rostrum and carapace (Fig. 6); distolateral corners of the lobules of the petasma long and fingerlike (Fig. 20); thelycum with a narrow emargination (Fig. 26) *S. penicillata*
7. Telson with one pair of small lateral spines near tip; ventral lobules of petasma with a strong distolateral projection bearing a shallow proximo-lateral prominence (Fig. 21) *S. ingentis*
Telson without lateral spines; ventral lobules of the petasma with a bifurcate distolateral lobe, each corner pointing outwards (Fig. 22) *S. disdorsalis*
8. Abdomen coarsely tuberculate; tooth on the carina of the first abdominal segment high and with apex hooked forward; posterior tooth on carapace high and sharp (Fig. 9); distolateral corners of the dorsal lobules of the petasma curved inward, almost touching (Fig. 23) *S. martini*
Abdomen smooth or at the most tuberculate; tooth on the carina of first abdominal segment sometimes sharp but never hooked; distolateral corners of the dorsal lobules of the petasma well separated. 9
9. Posterior tooth on the carapace high and with a sharply oblique posterior carina; the distance between the tip of this tooth and the posterior limit of the dorsal carina of the carapace is about 2-3 times the height of this tooth when measured at its tip 10
Posterior tooth on the carapace much lower and with the posterior carina almost flat; the distance between the tip of this tooth and the posterior limit of the dorsal carina of the carapace is about 5 times the height of this tooth when measured at its tip (Fig. 10); a conspicuous color ring on the side of the carapace . . . *S. picta*
10. First abdominal somite with a deep, complete anteromedian sulcus, which ventrally meets the posteromedian sulcus (Fig. 17); a conspicuous 9-shaped colour mark on the side of the carapace (Fig. 11) *S. aliaffinis*
First abdominal somite with an incomplete (sometimes absent) and shallow anteromedian sulcus; posteromedian sulcus complete although shallow (Fig. 16); no color mark on the side of carapace (Fig. 12) *S. affinis*

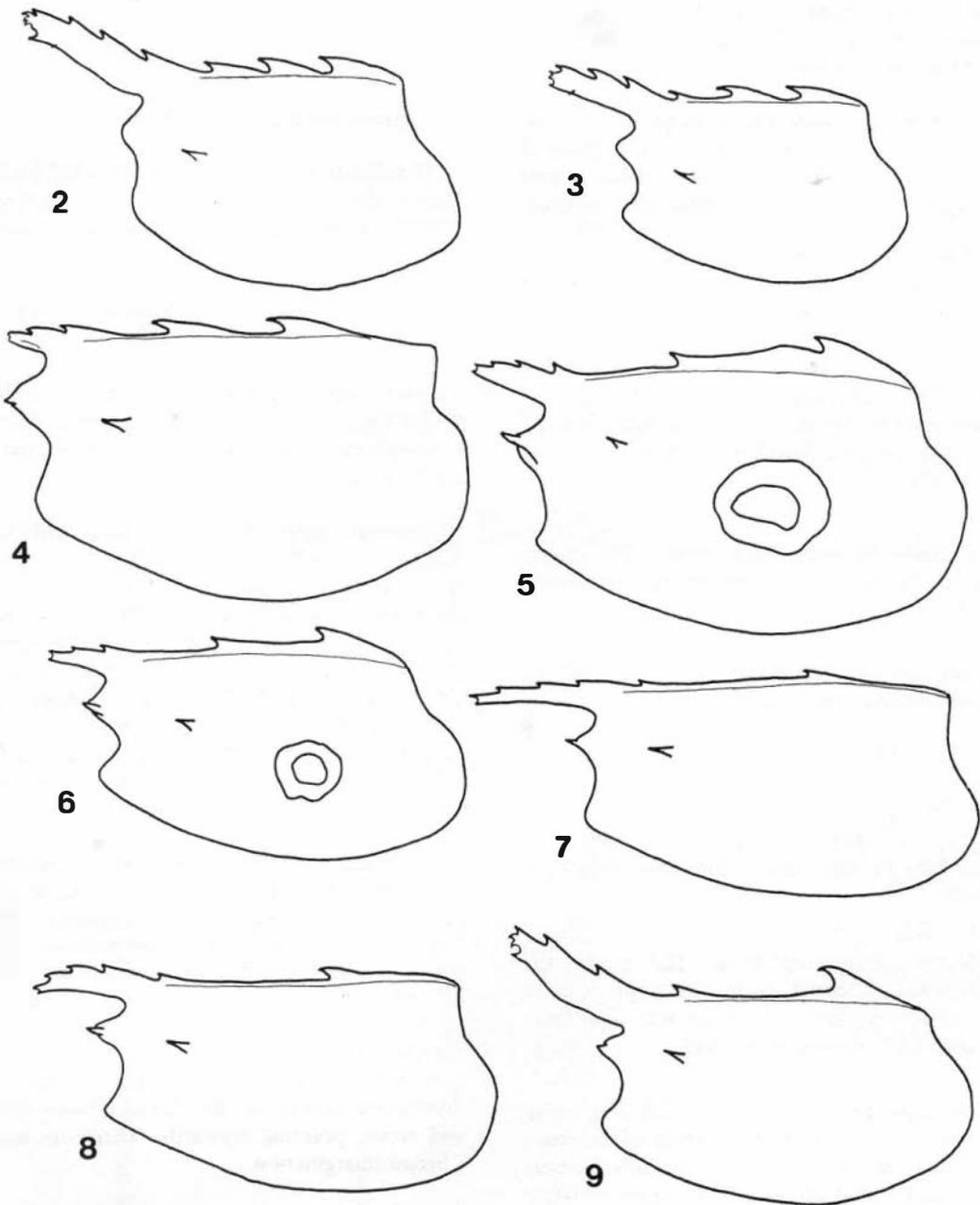
Commercial importance: None. No record of the species in commercial trawls.

Distribution: From the Bay of Mazatlán, Sinaloa, México south to Panamá; also along the Atlantic coast of America and throughout the Gulf of México, from Cape Hatteras, North Carolina, south to Colombia (Huff and Cobb,

1979).

Sicyonia disparri (Burkenroad, 1934)
(Figs. 2 and 18)

Eusicyonia disparri Burkenroad, 1934: 83-84, fig. 27. (Type-locality, Bahía Gonzaga, Baja California Norte). Burkenroad, 1938: 80-82, figs. 22 and 23.



Material examined: 4 specimens: CORTES, St. 55, 13-V-82, 1 ♂, 3 ♀, (one ♀ collected with an oyster dredge). Two females damaged; probably the same species, obtained in the same sample.

Description: Antennal angle unarmed; dorsal

carina of the second abdominal segment with a deep vertical notch at about mid distance from its anterior end; terminal portion of the rostrum with 4-5 teeth, followed by 3 rostral teeth, the lowest sometimes slightly behind the orbital margin; carapace with three dorsal teeth; the anteriormost comparable in size to

the other two; the three placed behind the level of the hepatic tooth. Petasma with the distolateral corners of the dorsal lobules turned conspicuously inward.

Habitat and bathymetric range: Beach level down to 65 m (Burkenroad, 1938). Material for this study was collected off Punta Gorda at a depth of 38 m on coarse sand bottom.

Color: The body is light red, except for the anterior part of the head, the rostrum and the posterior margin of the uropods dark brownish; teeth of the carina on the carapace and abdomen have a white tip; some small irregular white spots on the abdomen. No color mark on the side of the carapace. Walking legs and antennal flagellum reddish with white transverse bands.

Commercial importance: None. The species has so far never been reported in commercial trawls.

Distribution: Southern and Gulf coasts of Baja California (Burkenroad, 1938).

Sicyonia mixta Burkenroad, 1945.
(Figs. 4 and 15)

Sicyonia mixta Burkenroad, 1945: 3-5, figs. 1-4.- (Type-locality, San José, Baja California).

Material examined: None. The species has only been reported from the type locality (1 male holotype), from La Paz and from "California" (Burkenroad, 1945).

Description: Rostrum short with a bifurcate tip and one dorsal tooth; carina of carapace very low, bearing three teeth, the anteriormost the smallest and the two other approximately the same size and located behind the level of the hepatic spine. Dorsal carina of the first abdominal segment not produced into an anteriorly sharp tooth; carina of the second abdominal segment with a slight dorsal emargination. Distolateral corners of ventral lobules of petasma bifurcate; distolateral corners of dorsal lobules short and almost straight. Female not described.

Habitat and bathymetric range: No information.

Color: Not known.

Commercial importance: None.

Distribution: Southern tip of Baja California. Unpublished record of Rodríguez de la Cruz (1977) for the area of La Paz, Baja California Sur.

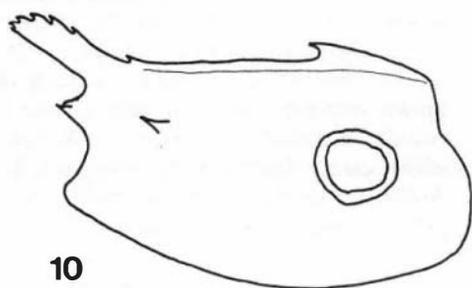
Sicyonia disedwardsi (Burkenroad, 1934).
(Fig. 5, 19 and 27)

Eusicyonia disedwardsi Burkenroad, 1934: 86-88, figs. 23, 29 and 34 (type-locality, Bahía Concepción, Baja California).- Burkenroad, 1938: 82-83.

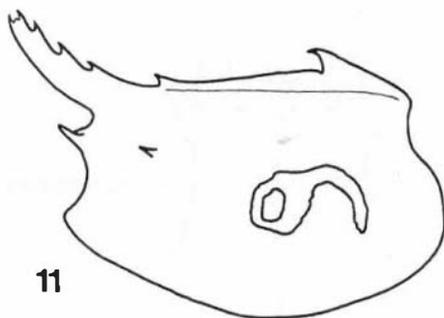
Material examined: 119 specimens: BBMAZ, 17-II-81, 3♂; SIPCO III, C2, 16-I-82, 1♀; Off Isla Altamura, Sinaloa, 20-VI-79, 2 ♂; Off Perihuate, Sinaloa, 31-VIII-79, 3♀; Off Río San Lorenzo, Sinaloa, 28-IV-80, 1♀; Off Teacapán, Sinaloa, 27-IV-80, 2♀; CORTES, St. 3, 3-V-82, 1♂, 1♀; CORTES, St. 8, 9 and 10, 4-V-82, 1♂, 4 ♀; CORTES, St. 19, 6-V-82, 44♂, 52♀, in oyster dredge; CORTES, St. 50 and 51, 12-V-82, 1♂, 3 ♀, in dredges; CORTES, St. 56, 13-V-82, 6♂, 7♀, in oyster dredge.

Description: Rostrum considerably elevated with a bifurcate tip and with 2-3 teeth on the dorsal margin; carina of the carapace high, bearing three teeth, the anteriormost the smallest and the other two behind the level of the hepatic spine; the carina is highest behind the posteriormost teeth and slopes sharply backwards. Distolateral corners of the ventral lobules of petasma thumb-like; distolateral corners of the dorsal lobules short and stout, pointing forwards. Thelycum with a broad emargination.

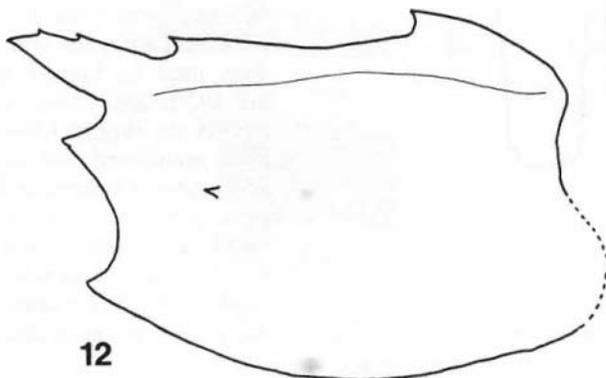
Habitat and bathymetric range: From 10 to 84 m (Burkenroad, 1938). The specimens of this survey were collected between 25 and 100 m. In the Bahía de Mazatlán, only 3 males were found at 25 m on fine silty sand. The material from the continental shelf (SIPCO and CORTES) was obtained from 28 to 100 m, most of it in oyster dredges (87%); in most cases, *S. disedwardsi* was found on hard bottoms



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of very coarse sand and shell valves or fragments, sometimes mixed with small stones or coral fragments.

Color: Body light-grey to light-brown, mottled with dark-grey, brown and black; lower part of the carapace and of the abdominal somites light red to yellowish-brown with white marks at the posterior edge of the somites; a white spot or band close to the anterior edge of the first somite. A large white mark on the side of the carapace, with a conspicuous central black ring surrounding a yellow spot. Walking legs white, sometimes with yellow or reddish patches. Antennal flagellum dark grey or brownish, sometimes with yellowish transverse bands.

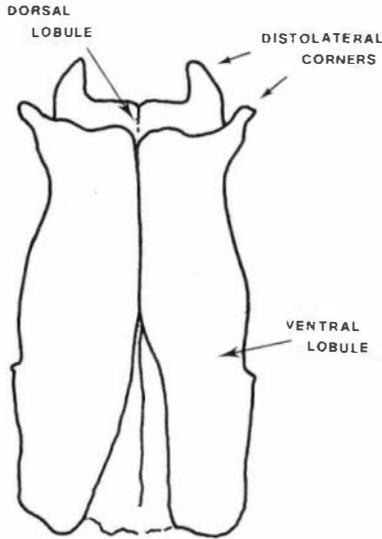
Commercial importance: *Sicyonia disedwardsi* is similar in size to *S. penicillata* which it closely resembles, but appears to be much less abundant in the area. No report of a commercial-size catch for this species.

Distribution: Gulf coast of Baja California (Burkenroad, 1938), from Cabo San Miguel south to Bahía San Lucas; on the eastern coast of the Gulf, from off Río Fuerte south to Teacapán, Sinaloa.

Sicyonia penicillata Lockington, 1879
(Figs. 6, 20 and 26)

Sicyonia penicillata Lockington, 1879: 164 (type-locality, Bahía Bolinas, (?Bahía Ballenas), Baja California). — *Eusicyonia penicillata*, Burkenroad, 1934: 88-92. figs. 30, 31 and 33.

Material examined: A total of 3,502 specimens, all of them collected during the CORTES I Cruise: St. 15, 5-V-82, 1♂, 6 ♀; St. 25, 7-V-82, 1♂, 1 ♀; St. 27, 7-V-82, 2 ♂, 2 ♀; St. 32 and 33, 8-V-82, 1♂, 9 ♀; St. 34, 8-V-82, 41♂, 47 ♀; St. 37, 9-V-82, 14♂, 21 ♀; St. 38, 9-V-82, 328 ♂, 417 ♀; St. 39, 9-V-82, 1182 ♂, 1333 ♀; St. 43, 10-V-82, 8♂, 14 ♀; St. 44, 10-V-82, 1♂; St. 47 and 48, 11-V-82, 2♂, 12 ♀.



Description: Rostrum with 2 terminal and 1-2 teeth behind the bifurcate tip, usually almost horizontal sometimes considerably elevated; carina of the carapace with three teeth, high, much higher behind the posteriormost tooth which is the highest; two of the dorsal teeth on the carapace are placed behind the level of the hepatic tooth; distolateral corners of petasma long and finger-like. Thelycum with a narrow emargination.

Habitat and bathymetric range: All specimens were captured in the Gulf of California (CORTES) with an otter trawl at a depth of 26 to 103 m. Most of them (95% of the total) were obtained from sampling operations along the northernmost transect (St. 37, 38 and 39), where the bottom is of green clayish mud. Other substrates include very fine to coarse sand with shell fragments, and fine silty sand. Burkenroad (1938) reported the species from beach level under stones, to 67 m. In the present survey, as many as 94% of the specimens came from between 60 and 103 m. Schmitt (1924) reported the species from Isla Carmen, Gulf of California, at 18 m.

Color: The species is greyish, sometimes with an olive green tone; the greyish appearance

is produced by dense patches of small grey and black stains on a white background; the posterior edges of the abdominal somites, the anterior edge of the first and the inferior edge of the carapace are white; a large, white area on the side of the carapace, with a central brown ring surrounding a yellow-white center (which is sometimes obsolete). Walking legs white, except for the merus which is yellowish. Antennal flagellum with alternate black and yellow-orange transversal bands.

Commercial importance: There seems to be no published records of the importance of *Sicyonia penicillata* to the fisheries in the Gulf of California although Japanese fishing ships used to harvest them commercially in the 1930s and 1940s (Brusca, 1980). Recent reports on shrimp fishery in this area, at the most mentioned the species as of secondary importance (Rodríguez de la Cruz, 1981) or as a part of the by-catch (Rosales, 1976). Hendrickx (1984) reports capture of up to 66 kg/hour in commercial trawls in the northern Gulf of California where the species seems to be the most abundant.

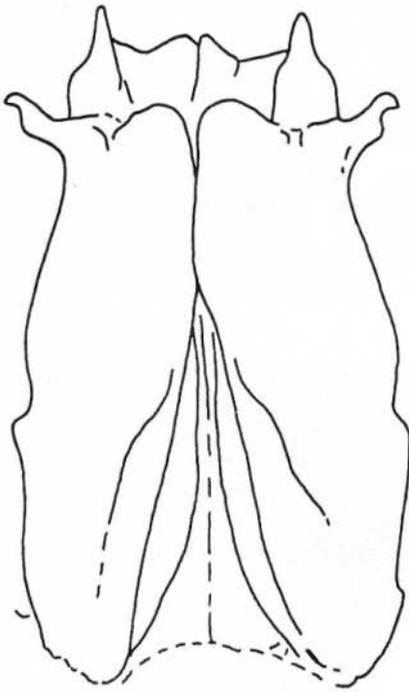
Distribution: From Isla Cedros and Laguna Ojo de Liebre, on the west coast of Baja California Sur, and throughout the Gulf of California, from its northernmost end south to Bahía San Lucas (Burkenroad, 1938; Brusca, 1980); at the tip of Baja California, and to Punta Arbolata (26°51' N - 110°05' W), Sinaloa, on the mainland side of the Gulf.

Sicyonia ingentis (Burkenroad, 1938).
(Figs. 7 and 21)

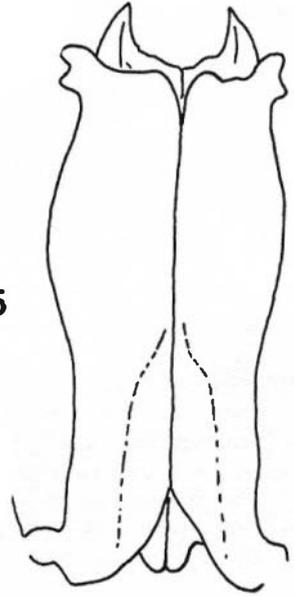
Eusicyonia ingentis Burkenroad, 1938: 88-90, figs. 31-34 (type-locality, off east coast of Cedros Island, west coast of Baja California).

Material examined: 154 specimens: BBMAZ, 27-XI-79, 1♂, Van Veen grab; BBMAZ, 4-I-80, 3♂, 2♀; BBMAZ, 26-IX-79, 1♀; SIPCO, C2, 24-IV-81, 16♂, 19♀. SIPCO, B1, 25-IV-81, 2♀; SIPCO, B2, 25-IV-81, 2♂, 2♀; SIPCO, C2, 16-I-82, 21♂, 16♀; SIPCO, B2, 17-I-82, 1♂, 1♀. CORTES, St. 39, 9-V-82, 25♂, 24♀; CORTES, St. 44, 10-V-82, 1♂ 1♀; CORTES, St. 50, 12-V-82, 3♀; CORTES, St. 51,

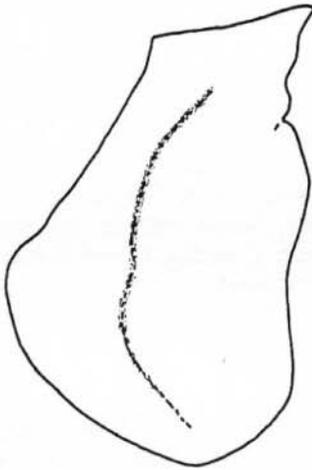
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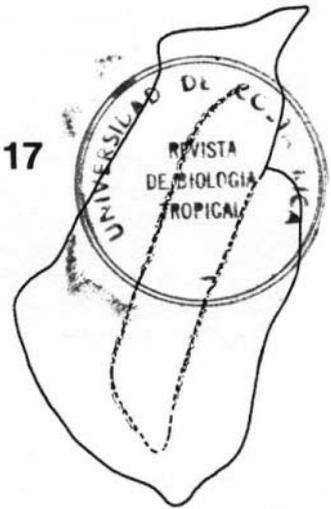
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12-V-82, 2 ♂, 7 ♀; Off Río San Lorenzo, Sinaloa, 28-IV-80, 2 ♂, 2 ♀.

Description: Rostrum with a bifurcate tip and armed with three dorsal teeth; carapace with a very low carina bearing two low teeth, one before and one behind the level of the

hepatic tooth. Petasma: ventral lobules with a strong distolateral projection bearing a shallow proximolateral prominence; dorsal lobules with distolateral corners as long as the distolateral corners of the ventral lobules and diverging. Telson armed with a subterminal pair of lateral spines.

Habitat and bathymetric range: From 7 to 110 m (Burkenroad, 1938). Material collected during the present study is from between 15 and 100 m; substrate includes sand and silty sand (BBMAZ), silty sand and clayish silt (SIPCO) and silty sand and clayish green mud in the northern Gulf of California (CORTES). As many as 88% of the specimens were collected between 55 and 100 m. The species is reported as the dominant invertebrate in mid depth samples (59-65 m) off the coast of Los Angeles and Orange Counties, California, with a preference for the Palos Verdes Shelf area where bottom structure is of silty sand and sandy silt (Mearns and Greene, 1974).

Color: Carapace and dorsal part of the abdomen reddish-brown, with the posterior part of the abdomen reddish; lower half of the abdomen light red with narrow white bands at the posterior edge of the somites and at the anterior edge of the first one. No color mark on side of carapace. Walking legs white, with some reddish patches; a light red band followed by a light yellow band at the distal end of the merus; yellow band continued on the proximal end of the carpus. Antennal flagellum reddish (probably with white transverse bands).

Commercial importance: *Sicyonia ingentis* has been harvested in the Santa Barbara, California area since 1966. The harvest has been irregular and the demand for the product is low. The Santa Barbara-Ventura area is the only one where concentration of shrimp have so far been reported to be large enough to support a fishery (Frey, 1971). In the southeastern Gulf of California, the specimens obtained from commercial trawls are probably confused with *S. disdorsalis*, the dominant species in this area, which it closely resembles. Mathews (1981) reported an occasional fishery for *Sicyonia ringens* [sic] at Magdalena Bay, along the Pacific coast of Baja California. This is probably a *lapsus calami* for there is no such species in the area.

Distribution: Along the west coast of California, from Monterey Bay south to Isla Cedros on the Pacific coast of Baja California; in the Gulf of California, along the coast of Sinaloa from off Río San Lorenzo, south to Mazatlán (Frey, 1971; Pérez Farfante and Boothe, 1981; Hendrickx and van der Heiden, 1983). Also

collected in the northern Gulf and off Río Fuerte, Sinaloa.

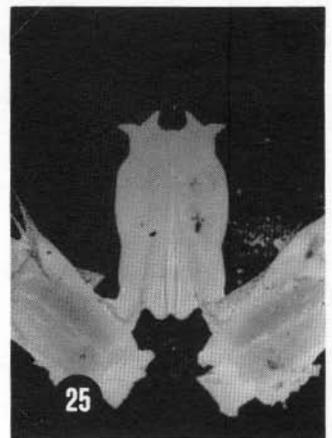
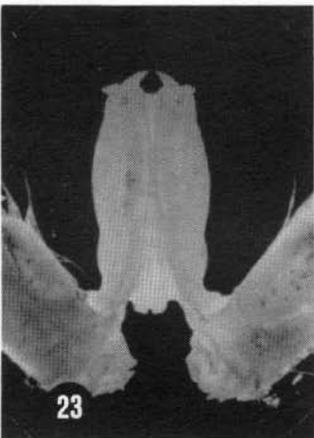
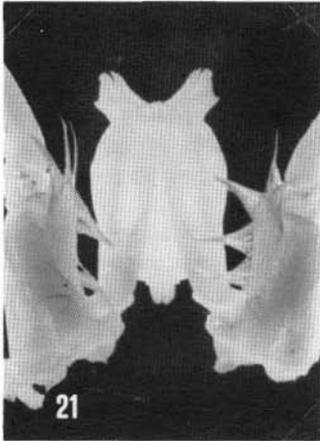
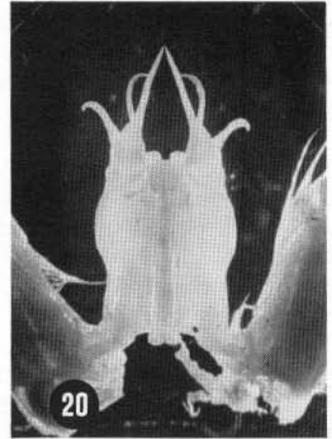
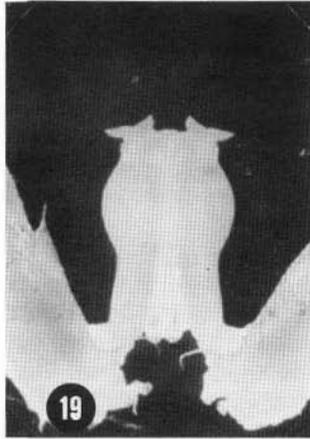
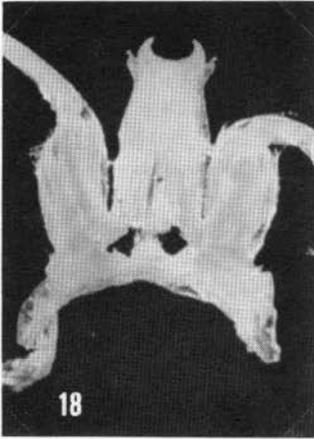
Sicyonia disdorsalis (Burkenroad, 1934)
(Figs. 8 and 22)

Eusicyonia disdorsalis Burkenroad, 1934: 96-99; figs. 25 and 26 (type-locality, Pearl Islands, Gulf of Panamá).

Material examined: 1212 specimens: BBMAZ, 25-V-79, 1 ♀; BBMAZ, 25-VI-79, 1 ♀; BBMAZ, 27-IX-79, 3 ♂, 5 ♀; BBMAZ, 24-X-79, 27 ♂, 32 ♀; BBMAZ, 27-XI-79, 7 ♂, 12 ♀; BBMAZ, 4-I-80, 4♂, 7♀; BBMAZ, 25-I-80, 13 ♂, 45 ♀; BBMAZ, 29-IV-80, 13 ♂, 7 ♀; BBMAZ, 30-IV-80, 10 ♂, 15 ♀; BBMAZ, 3-VI-80, 3 ♀; BBMAZ, 26-VI-80, 38 ♂, 65 ♀; BBMAZ, 28-X-80, 1 ♀; BBMAZ, 20-I-81, 2 ♀; BBMAZ, 14-III-81, 2 ♂, 2 ♀; BBMAZ, 17-III-81, 44 ♂, 50 ♀; Off southern Sinaloa, 3-II-79, 14 ♂, 74 ♀; SIPCO, C2, 16-1-82, 1 ♀; SIPCO, B1, 25-IV-81, 14 ♂, 26 ♀; SIPCO, C2, 23-VIII-81, 128 ♂, 130 ♀; SIPCO, B1, 25-IV-81, 26 ♂, 38 ♀; SIPCO, C1, 16-1-82, 73 ♂, 211 ♀; SIPCO, B1, 17-I-82, 13 ♂, 41 ♀; CORTES, St. 3, 3-V-82, 1 ♂, 2 ♀; CORTES, St. 50, 12-V-82, 3 ♂; CORTES, St. 51, 12-V-82, 3 ♂, 5 ♀.

Description: Rostrum about horizontal or slightly elevated, bearing 3-4 teeth behind the bifurcate tip; carina of the carapace low, bearing two teeth, the anteriormost smaller and placed in front of the level of the hepatic spine. Although still very low, the carina of the carapace is higher behind the posterior tooth than behind the anterior one. Petasma: distolateral corners of the ventral lobules bifurcate; distolateral corners of the dorsal lobules with converging tips delimiting an hexagonal gap.

Habitat and bathymetric range: From 5 to 42 m (Burkenroad, 1938); from 3 to 27 m (Brusca, 1980); from 17 to 100 m (Arana and Méndez, 1978). Material collected in the present study came from between 9 and 90 m although most of the specimens came from between 24 and 72 m. *Sicyonia disdorsalis* is the dominant species of the genus in Bahía de Mazatlán, where it occurred on sand (fine and very fine) and silty sand. The specimens from the continental shelf of Sinaloa were collected on fine and silty sand.



Color: Dorsal part of the body dark grey to brownish, sprinkled with small irregular lighter spots; the spots smaller towards the lower edge of the carapace which is lighter than the rest of the body; inferior half of the abdominal

somites light brown to purple, with posterior edges and the anterior edge of the first somite ivory-white. No color mark on the side of the carapace. Walking legs ivory or pinkish, with a purple-brown band followed by a conspicuous

yellow band at the distal end of the merus; yellow band continued on the proximal end of the carpus. Antennal flagellum dark brown with irregular light stripes, apparently more numerous in smaller specimens.

Commercial importance: *Sicyonia disdorsalis* is the dominant species in the southeastern part of the Gulf of California and has been reported as common in the *Penaeus* by-catch by several authors (Paul and Hendrickx, 1980). However, there is no exploitation of this species at present, probably due to the comparatively higher profit than can be made with other penaeid shrimps (*Penaeus*, *Xiphopenaeus* and *Trachypenaeus*) and the poor acceptance by consumers of this hard-shell shrimp. In the Southern Hemisphere of Pacific America, the importance of the genus *Sicyonia* in fishery activities has recently increased; *S. disdorsalis* represented about 5.8% of the total catch of penaeid shrimp in northern Perú in 1977 (Arana and Méndez, 1978).

Distribution: From Bahía San Lucas, Baja California Sur, south to Callao, Perú (Burkenroad, 1938; Arana and Méndez, 1978). Reported in Brusca (1980) from the Gulf of California, south of Isla Tiburón. Material from the present study came from off the coast of Sinaloa, between Río Fuerte and Mazatlán.

Sicyonia martini Pérez Farfante and Boothe,
1981

(Figs. 9 and 23)

Sicyonia martini Pérez Farfante and Boothe, 1981: 424-432, figs. 1-4 (type-locality, SW of Punta Ana María, Golfo de Panamá).

Material examined: 39 specimens: BBMAZ, 15-III-81, 1 ♂, 1 ♀; BBMAZ, 30-IV-81, 1 ♀; SIPCO, C2, 24-IV-81, 2 ♂, 2 ♀; SIPCO, C1, 24-IV-81, 4 ♂, 22 ♀; Off Mazatlán, 21-IV-81, 4 ♂, 2 ♀.

Description: Rostrum with 3-5 terminal teeth followed by 2-3 dorsal teeth; rostrum horizontal or slightly elevated in males but strongly elevated in females; dorsal carina of the carapace low, with two teeth, the anteriormost the smallest and at the same level or slightly anterior to the level of the hepatic

spine, the posteriormost much higher and sloping towards the posterior ridge of the carapace; first abdominal segment with a sharp and very high sigma-like tooth on the dorsal carina. Abdomen coarsely granulated. Distolateral corners of dorsal lobules of petasma strongly curved inward, almost touching.

Commercial importance: None. A relatively small species with a strongly calcified carapace. It has been reported in as many as 50 localities throughout its range, usually in small quantities.

Habitat and bathymetric range: From 9 to 242 m, on substrates of sand, rock, mud and coralline debris (Pérez Farfante and Boothe, 1981). Specimens from the Bay of Mazatlán were collected from 14 m on fine sand. The rest came from between 32 and 66 m; substrates made of very fine sand or mud (silt or clay).

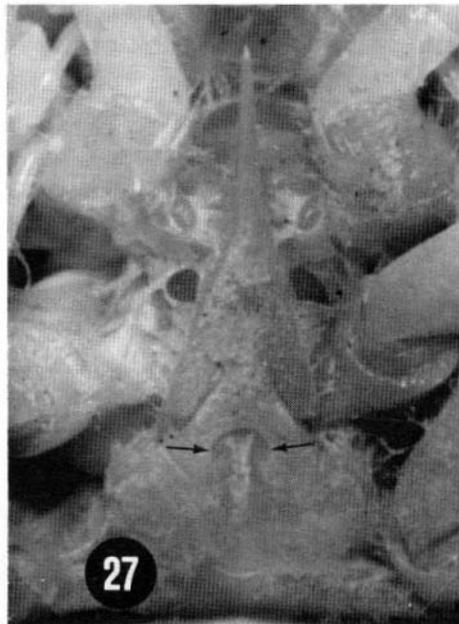
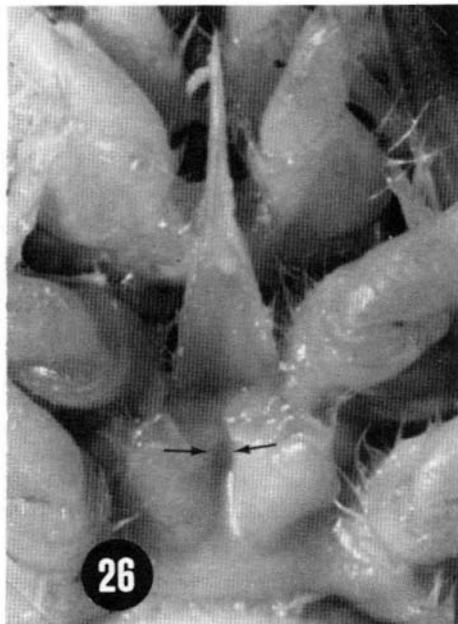
Color: Not known. According to the color of specimens preserved in formaldehyde, there seems to be no color ring or mark on the side of the carapace of fresh specimens.

Distribution: From Isla Santa Margarita, Baja California Sur, and from the Gulf of California, as far north as Tastiota, Sonora, southward to the Gulf of Panamá (Pérez Farfante and Boothe, 1981).

Sicyonia picta Faxon, 1893
(Figs. 10 and 24)

Sicyonia picta Faxon, 1893: 210 (type-locality off the coast of Panamá). - *Eusicyonia picta*, Burkenroad, 1934; 95-96, fig. 35. - *Sicyonia picta*, Arana and Méndez, 1978: 27-29, figs. 10-13.

Material examined: 134 specimens: BBMAZ, 14-III-81, 2 ♂, 6 ♀; BBMAZ, 30-IV-81, 1 ♂, 5 ♀; Off Mazatlán, Sinaloa, 21-IV-81, 1 ♂, 1 ♀; Off southern Sinaloa, 1979, 3 ♂, 5 ♀; SIPCO, C1, 24-IV-81, 3 ♀; - SIPCO, c2, 24-IV-81, 10 ♂, 18 ♀; CORTES, St. 10, 4-V-82, 1 ♂; CORTES, St. 39, 9-V-82, 6 ♂, 10 ♀; CORTES, St. 50, 12-V-82, 6 ♂, 10 ♀; CORTES, St. 51, 12-V-82, 18 ♂, 28 ♀.



Description: Rostrum with 2-3 terminal and 3-4 dorsal teeth; carina of the carapace low, with one small tooth located between the level of the orbital margin and the level of the hepatic spine, a larger second tooth behind the level of that spine and followed by a much higher carina. Ventral lobules of petasma with thumb-like distolateral corners; dorsal lobules with distolateral corners short and almost straight, the gap between these projections is octogonal-like.

Habitat and bathymetric range: From beach level to 310 m (Burkenroad, 1938). Arana and Méndez (1978) reported the species down to 400 m. Material for the present study came from between 27 and 103 m; substrates include fine to coarse sand off the coast of Sinaloa and shell fragments on coarse sand off the coast of Isla Carmen. As many as 87% of the specimens were from the eastern shelf where sediments are predominantly sandy.

Color: Dorsal part of the body light red to light orange; sides of the carapace and of the abdomen lighter than the rest; abdominal somites with posterior edges and anterior edge of the first somite white. A large circular red ring on the side of the carapace, beneath the carina of the posteriormost tooth, some-

times encircled in a nine-shaped white mark. Walking legs white. Antennal flagellum with alternate white and brownish red transverse bands.

Commercial importance: Occasional in catches from off the coast of Perú and Ecuador (Arana and Méndez, 1978). In the Gulf of California, there is so far no report of a commercial-size catch of this species.

Distribution: In the Gulf of California it has been found at Bahías Gonzaga, Santa Inéz and Los Angeles, and at Arena Bank, Baja California (Burkenroad, 1938; Brusca, 1980). It also occurs along the east coast of the Gulf from the northern Gulf south to Mazatlán, with the southernmost limit at Isla Lobos de Afuera, Perú (Arana and Méndez, 1978).

Sicyonia diaffinis (Burkenroad, 1934)
(Figs. 11 and 25)

Eusicyonia aliaffinis Burkenroad, 1934: 92-95, fig. 24 (type-locality, off Chiapas, 14°48'40" N - 92°54'40" W, Pacific coast of México).

Material examined: A total of 9 specimens: BBMAZ, 17-III-81, 1 ♂; BBMAZ, 30-IV-81, 1 ♀;

Off the coast of southern Sinaloa, March 1980, 1 ♀; Off Estero del Pabellón, Sinaloa, 29-IV-80, 5 ♀; CORTES, St. 3, 3-V-82, 1 ♀.

Description: Rostrum with 2 teeth behind the terminal tip which is bi- or trifurcate, the second tooth located at the level of the orbital margin; dorsal carina of carapace high, bearing two teeth, the anteriormost smaller and located at the level of the hepatic spine; the posteriormost the highest and followed by a high carina which slopes sharply toward the hinder edge of carapace. Ventral lobules of petasma with thumb-like distolateral corners; corners of the dorsal lobules slightly curved inwards.

Habitat and bathymetric range: From 21 to 50 m (Burkenroad, 1938); from 90 m (Brusca, 1980). The material from the present study was obtained from 13 to 50 m on soft bottoms (fine sand to silty sand).

Color: Light brown to ivory with large irregular dark brown patches on the dorsal part of the carapace, the abdomen and the rostrum; inferior half of the abdominal somites lighter, sometimes reddish towards the posterior segments, posterior edges and anterior edge of the first segment cream-colored to whitish. A conspicuous nine-shaped dark brown mark on the side of the carapace, mingled with a bright yellow stain. Walking legs cream-colored, with a few light brown patches. Antennal flagellum dark brown with irregular light brown rings.

Commercial importance: None in the Gulf of California area. Arana and Méndez (1978) reported *S. aliaffinis* occasionally captured in great numbers in the Golfo de Guayaquil, Ecuador; up to date no commercial harvest of this species.

Distribution: From southwest of Isla Santa Margarita, on the west coast of Baja California (Pérez Farfante and Boothe, 1981), and from Isla Angel de la Guarda (Brusca, 1980) and off Bahía Santa María, Sinaloa, south to Teacapán, Sinaloa, in the Gulf of California. Off Chiapas, México (Burkenroad, 1934). Also reported from the Golfo de Guayaquil, Ecuador, south to Bahía de Sechura, Perú (Arana and Méndez, 1978).

Sicyonia affinis Faxon, 1893.
(Fig. 12)

Sicyonia affinis Faxon, 1893: 209 (type-locality, Cocos Island, Costa Rica). *Sicyonia affinis* Arana and Méndez, 1978: 23-25, figs. 2, 3 and 5.

Material examined: None. The species is reported from off Mazatlán, Sinaloa by Rodríguez de la Cruz (1977). However, it has not been collected during the present study and this apparently unique record for the Gulf of California is therefore considered as questionable. Pérez-Farfante and Boothe (1981) reported 14 specimens for this species, including the syntypes of Faxon. This apparently rare species has also been reported from the Pacific coast of South America (Arana and Méndez, 1978).

Description: Rostrum with 2 teeth on the dorsal margin and a bifurcate tip; dorsal carina of the carapace high with one tooth between the orbital margin and the hepatic spine and another tooth, much higher, behind the level of this spine; the carina slopes sharply behind the level of the posteriormost tooth. Petasma not seen.

Habitat and bathymetric range: From 85 to 185 m (Burkenroad, 1934).

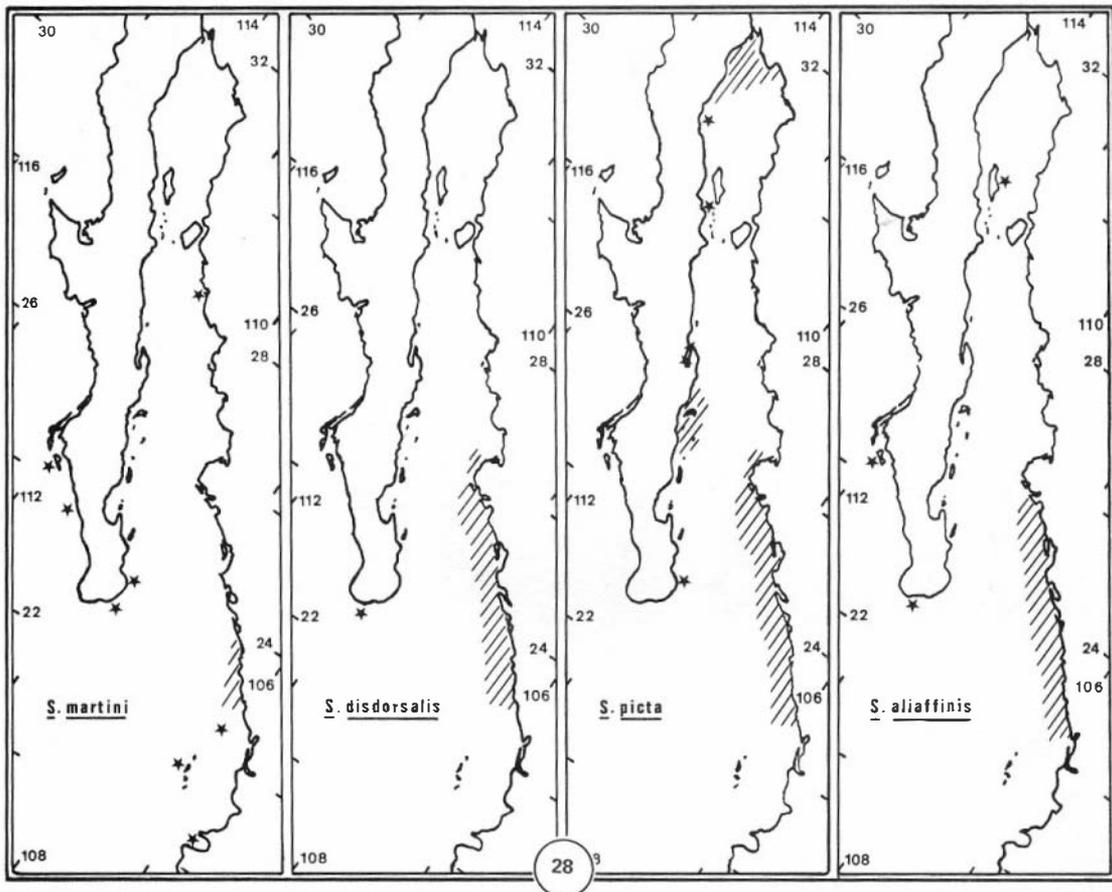
Color: According to Faxon (1893) the species is light greenish-yellow banded with vermilion on the branchial regions and abdomen. Appendages red, antennary flagellum transversally banded with light and dark.

Commercial importance: The species is reported as occasional in trawling activities in South America where it has no commercial importance (Arana and Méndez, 1978).

Distribution: Islas Malpelo (Colombia) and Isla del Coco (Costa Rica), south to Paita, Perú (Arana and Méndez, 1978); Mazatlán, Sinaloa, according to Rodríguez de la Cruz (1977).

ZOOGEOGRAPHY

On the Pacific coast of America, the genus *Sicyonia* is known from Monterey Bay (36°

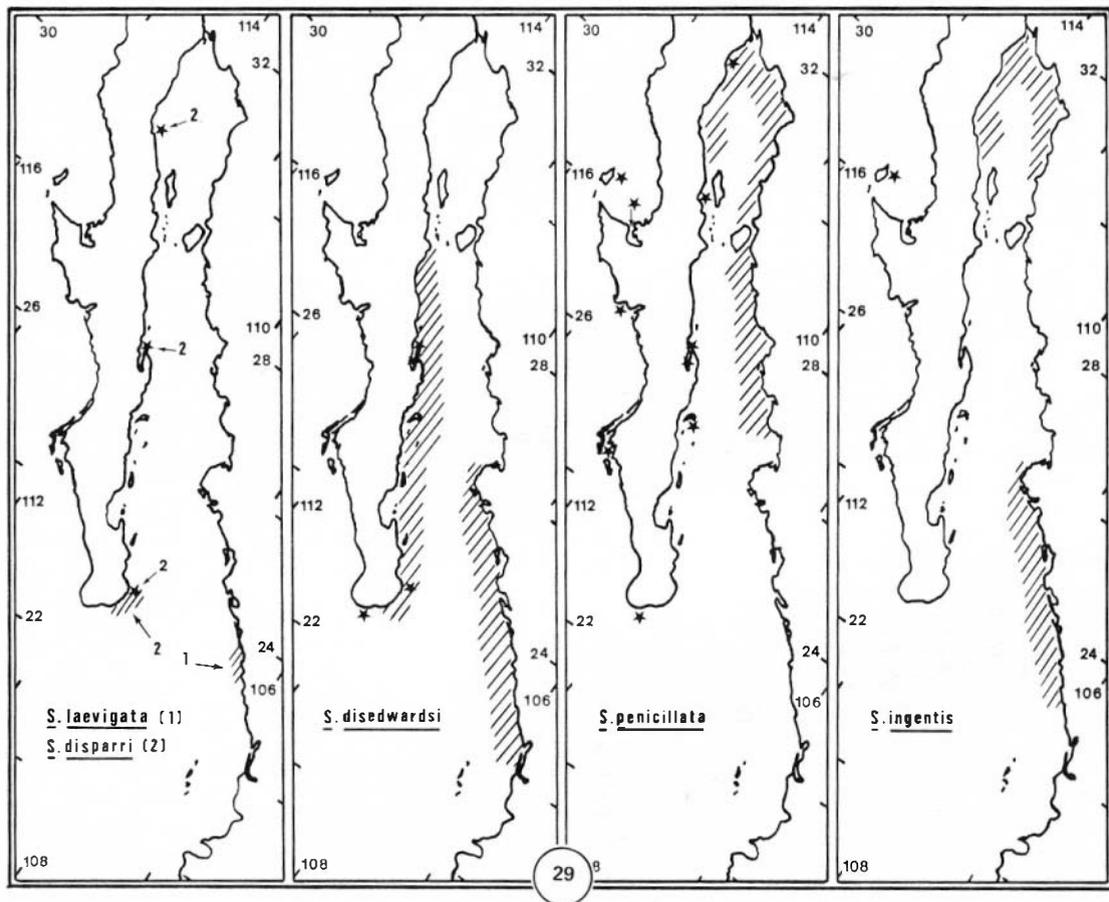


45° N), California (*S. ingentis*), as far south as Callao (12°02' S), Perú, (*S. disdorsalis*), thus covering almost 49 grades of latitude and extending from the southern Oregon Province (which has its southern limit at Point Concepción, California), throughout the San Diego, Mexican, Cortés and Panamic Provinces and well within the warm-temperate Peru-Chilean Province which starts in the area of Paita, Perú (Provinces by Briggs, 1974; Fig. 30).

Including the Gulf of California records, of all the species of *Sicyonia* occurring along the Pacific coast of America, *S. picta* and *S. disdorsalis* have the broadest distribution (approximately 32° N to 7° S and 26° N to 12° S latitude), almost matching the distribution for the entire genus. Three species seem to be restricted to the Gulf of California area: *S. disedwardsi* is apparently a gulf endemic distributed evenly along both coasts in the southern part; *S. disparri*, a species which has been found associated with coarse sub-

strates along the peninsular coast, could well be another gulf endemic; *S. penicillata* is predominantly a gulf species but it also occurs along the Pacific coast of the peninsula as far north as Isla Cedros. *Sicyonia aliaffinis* also has a broad distribution, ranging from the northern Gulf of California to the area of Paita, Perú, where two other species have their southernmost limit (*S. affinis* and *S. picta*). Among the species with an intermediate distribution range are *S. martini*, *S. laevigata* and *S. affinis*, although an unconfirmed record exists in the southeastern Gulf of California for this latter species (Fig. 30).

Thus the Gulf of California fauna of *Sicyonia* is made up of several components. Widely distributed tropical species include *S. picta*, *S. aliaffinis* and *S. disdorsalis*, while two other species, *S. martini* and *S. laevigata*, are tropical species restricted to the Mexican and Panamic Provinces. The warm-temperate component is represented by *S. ingentis* and



another group of three species can be considered, in so far as it is known, as endemic (*S. disparri* and *S. disedwardsi*) or almost endemic (*S. penicillata*) to the Gulf. It should be stressed that *S. ingentis* is not a common species in the Gulf, although it was found along the southeastern coast and in the northern part. Thus, the affinity of the *Sicyonia* fauna of the Gulf of California is clearly tropical and consequently, from the "Sicyonia" point of view, the Cortés Province of Briggs should be linked with the Eastern Pacific Region (the Panamic Region of Brusca, 1980) instead of being included in the Californian warm-temperate Region (see: Briggs, 1974). This is more in accordance with the idea of a "subtropical" Cortés Province (Brusca, 1980) with a high percentage of tropical species (see: Rosenblatt, 1974).

The zoogeographic distribution of the species of *Sicyonia* in the Gulf of California area has been represented in figures 28 and 29.

These distributions are derived from the data obtained in the present study (striped area) and from localities previously reported in the literature (Lockington, 1879; Faxon, 1893; Schmitt, 1924; Burkenroad, 1934, 1938; 1945; Frey, 1971; Huff and Cobb, 1979; Brusca, 1980; Pérez Farfante and Boothe, 1981; Hendrickx and van der Heiden, 1983; stars).

Despite the numerous records of *Sicyonia* in the Gulf of California (*sensus largo*), it is difficult to recognize a general distribution pattern for each species. In some cases, a clearly northern, central or southern dominance can be foreseen. Thus, *S. penicillata* is predominantly a northern form extending into the Central Gulf and northwards around the tip of Baja California. This species is associated with soft bottoms (northern Gulf and continental shelf of Sonora), but does not seem to occur in southern Sinaloa where the sampling has been the most intensive.

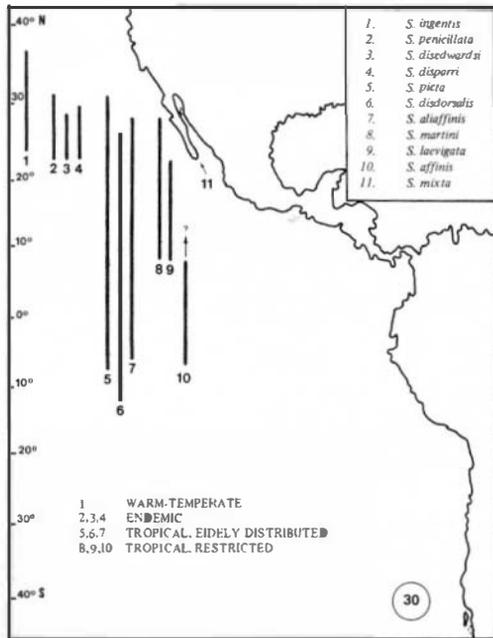
Sicyonia picta and *S. ingentis* have both been found in the northern and central Gulf, although in reduced numbers at the highest latitudes. The two species have totally different affinities, the former being a tropical species with a very broad distribution while the latter is a warm-temperate species with a rather restricted distribution and a maximum population occurrence off southern California; they both coexist in the Gulf of California in an area that represents their respective northern and southern distribution limits. *Sicyonia aliaffinis* is a southern Gulf species, occasionally found in the central Gulf, while *S. disdorsalis* is restricted to the southern Gulf where it is the dominant species. *Sicyonia disedwardsi* is another central and southern Gulf species.

Except in the case of *S. ingentis*, which is distributed from Monterey Bay, California, southwards to the Gulf of California, all the species of *Sicyonia* have their northernmost advances in the Gulf and up to date five of them (*S. laevigata*, *S. disparri*, *S. disedwardsi*, *S. disdorsalis* and *S. picta*) have not been reported for the Pacific coast of Baja California (Figs. 28 and 29).

As far as it can be concluded from this study, four species of *Sicyonia* can be considered as the most abundant members of the genus on the American coastal shelf of the Pacific and are, at times, taken in commercial abundance: *S. ingentis*, a northern hemisphere warm-temperate species; *S. penicillata*, a Gulf of California-Baja California endemic, which predominates in the northern half of the Gulf; *S. disdorsalis*, a widely distributed tropical species which dominates in the southeastern Gulf of California and off the coast of northern Perú; *S. aliaffinis*, another widely distributed tropical species, which is sometimes abundant off the coast of Ecuador.

ACKNOWLEDGEMENTS

I wish to express my gratitude to I. Pérez Farfante for confirmation of identifications of selected specimens of *Sicyonia*; acknowledgements are also extended to all scientists, students and crew members that took an active part in collecting the material during the BBMAZ, SIPCO and CORTES Cruises.



RESUMEN

Entre el período de 1979 a 1982, se inició un estudio general de la fauna marina y costera del Golfo de California. Durante este estudio, se colectaron 9 especies del "camarón de roca" del género *Sicyonia* y se obtuvo un total de 5.190 especímenes. Se incluye una clave de identificación para las 11 especies de *Sicyonia* informadas para el Golfo de California. El color que presenta la mayoría de las especies también ha sido descrito, en muchos casos, por primera vez y las fotografías o ilustraciones del petasma, facilitan la identificación de los machos de cada especie.

La distribución zoogeográfica del género a lo largo de la costa Pacífica de América es extremadamente amplia y se observa que *Sicyonia* está distribuida desde la parte sur de la Provincia de Oregon hasta Callao, Perú, en la Provincia Peruano-Chilena del Hemisferio Sur. La fauna del Golfo de California está formada de varios componentes incluyendo una especie de la fauna templado-cálida (*S. ingentis*), tres especies endémicas o casi endémicas (*S. disparri*, *S. disedwardsi* y *S. penicillata*) y una serie de 5 especies tropicales (*S. picta*, *S. aliaffinis*, *S. disdorsalis*, *S. martini*

y *S. laevigata*), de las cuales las tres primeras están ampliamente distribuidas a través de la región del Pacífico Este.

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