Acanthemblemaria atrata and *Acanthemblemaria mangognatha*, new species of eastern Pacific barnacle blennies (Chaenopsidae) from Isla del Coco, Costa Rica, and Islas Revillagigedo, Mexico, and their relationships with other barnacle blennies

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Abstract

Two new species of chaenopsid blennies from the tropical eastern Pacific are described: *Acanthemblemaria atrata*, endemic to Isla del Coco, Costa Rica, and *Acanthemblemaria mangognatha*, endemic to Islas Revillagigedo, Mexico. Both are members of the **hancocki species group**, herein termed the "barnacle blennies" because of their habit of occupying vacant barnacle tests. The Coco barnacle blenny differs from other members of this group in having large iridescent blue spots on the upper lip, typically two common bilateral sensory pores, banded and dark color morphs, and in being relatively small. It is closely related to *A. hancocki* from the mainland of central America and *A. stephensi* from Isla de Malpelo. The Revillagigedo barnacle blenny differs from other members of the **hancocki species group** in having the central row of interorbital spines enlarged, and in having orange and purple lower jaws. It is closely related to *A. macrospilus* from southern Mexico and the Gulf of California. The two new species, together with their closest relatives, form a monophyletic group of five allopatric species restricted to the tropical eastern Pacific. Color photographs are provided for both new species, all other members of the **hancocki species group** (*A. balanorum, A. rivasi, A. castroi, A. macrospilus, A. hancocki,* and *A. stephensi*), and *A crockeri*, the sister species of this group.

Introduction

Tube blennies of the genus *Acanthemblemaria* are small reef fishes found throughout the Caribbean and tropical eastern Pacific. These blennies are well known for the prominent spination of several cranial bones, and their phylogenetic relationships have been hypothesized by **Hastings** (1990) and **Almany** and **Baldwin** (1996) based partly on the details of this head spination. Included in both of these phylogenetic analyses as "n. sp. A" is species described in this study. It and a second species described herein are members of the "**hancocki species group**," a monophyletic group of species concentrated in the tropical eastern Pacific (see **Hastings** 1990). This group, originally recognized by **Stephens** (1963) as including three eastern Pacific species (*A. hancocki, A. balanorum* and *A. macrospilus*), has grown with the addition of *A. castroi* from the Galápagos islands (**Stephens** *et al.* 1966), *A. rivasi* from the southwestern Caribbean (**Smith-Vaniz** and **Palacio** 1974), and *A. stephensi* from Isla de Malpelo (**Rosenblatt** and **McCosker** 1988).

All species in the **hancocki species group** typically live in vacant barnacle tests (as well as other shelter types for some species), a habit that may be reflected in their relatively robust bodies (**Smith-Vaniz** and **Palacio** 1974; **Hastings** 1990). We therefore propose the common name of "barnacle blennies" for this species group of *Acanthemblemaria*. In this paper we describe two new species of barnacle blennies, one from Isla del Coco and the second from Islas Revillagigedo, but first provide brief descriptions and color photographs of all other species of barnacle blennies, as well as *A. crockeri*, the closest relative of the group (**Hastings** 1990). Institutional abbreviations follow **Leviton** et ***al.*** (1985). All underwater photographs by **D.R. Robertson.**

1 - *Acanthemblemaria crockeri* Beebe et Tee-Van, 1938, the browncheek blenny. This species is distinctive in having highly branched supraorbital cirri, and is unique within the genus in having a large brown spot, outlined in black, covering the entire cheek region (Figs 1-2). This species is endemic to the Gulf of California, where it has been recorded from Cabo San Lucas northward along the Baja peninsula to Puertocitos, and along the eastern Gulf from Puerto Lobos, Sonora southward to Isla San Ignacio de Farallon. It is one of the most common tube blennies in the Gulf where it occupies a variety of shelter types on rocky reefs (**Thomson** *et al.* 1979). In part because of its abundance, it has been the focus of several ecological and systematic studies (e.g. **Stephens** 1963; **Lindquist** 1980, 1985; **Kotrschal** and **Lindquist** 1986; **Hastings** 1988).

2 - *Acanthemblemaria balanorum* Brock, 1940, the clubhead barnacle blenny. This species, originally described from Cabo San Lucas, Mexico, is easily distinguished from other members of the genus by the expanded or clublike tips on the frontal spines of large individuals, and the unique purple head coloration of breeding males (Figs 3-8). Its distribution was once thought to extend only from the southern Gulf of California (Bahia Santa Inez, Baja California Sur) to southern Mexico (Bahia Banderas; **Stephens** 1963). However, a single specimen from Bahia Piñas, Panama was reported by **Stephens** ***et al.*** (1966), and more recently, one of us (DRR) photographed this species at Isla Gorgona, Colombia (Figs 4-8). Consequently, *A. balanorum* has the widest known distribution of any species of the genus in the tropical eastern Pacific (Fig. 9). In the Gulf of California, this species occurs primarily in vacant barnacles, often in areas of strong surge (**Lindquist** 1985). The same is true at Isla Gorgona where *A. balanorum* occurs in abundance living in barnacles in the shallowest parts of the subtidal. It shares this habitat with *A. hancocki* (Fig. 8) which also is common at Isla Gorgona.

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3. - *Acanthemblemaria castroi* Stephens et Hobson, 1966, the Galápagos barnacle blenny. This species is endemic to the Galápagos Islands (Fig. 9) where it is often common on shallow rocky reefs (**Grove** and **Lavenberg** 1997). Among the eastern Pacific species of the genus, it is distinctive in having the infraorbitals prolonged posteriorly above the upper jaw, and the spines on the frontals fused into ridges. It shares both of these traits with its closest relative, *A. rivasi*, which is found in the southwestern Caribbean (**Hastings** 1990). The Galápagos barnacle blenny has two rows of white blotches along the sides (Figs 10-11), and like most species in the **hancocki species group**, it has fine blue spots on the head. It is the only member of the **hancocki group** with yellow spots on the snout, cheek, and lower jaw, and a thin bright blue *outer* margin on the iris (Figs 12-13). It is the largest species of the **hancocki species group**, reaching nearly 60 mm SL.

4. - *Acanthemblemaria rivasi* Stephens et Johnson, 1966, the spot jaw barnacle blenny. This species is the only member of the **hancocki species group** found outside of the eastern Pacific. It is restricted to the southwestern Caribbean, occurring in Venezuela, Colombia, Panama and Costa Rica (Fig. 9). It lives in a variety of habitats including vacant worm holes in both living and dead massive corals and in vacant barnacle tests (**Acero** 1984). Like *A. castroi* from the Galápagos Islands, it has the infraorbitals prolonged posteriorly above the jaw, and spines on the frontals fused into ridges in large adults (**Smith-Vaniz** and **Palacio** 1974, **Hastings** 1990). It has a distinctive color pattern (Figs 14-15): the head and body are predominantly brown, with a well demarcated white area on the lower part of the cheek, a row of dark spots posterior to the jaw, two rows of white spots or blotches along the body, and a bright red iris. It is the only member of the **hancocki species group** with a bright blue *inner* margin of the iris.

5. - *Acanthemblemaria macrospilus* Brock, 1940, the Mexican barnacle blenny. This species was originally described as a subspecies of *Acanthemblemaria hancocki*. **Stephens** (1963) gave this taxon species-level status, and later considered populations from Isla del Coco and Islas Revillagigedo (herein described as new species), as members of this species based on their similar meristics and color pattern (**Stephens** *et al.* 1966). Even with these populations excluded, *A. macrospilus* exhibits a considerable degree of geographic variation in color. A distinctive color form (Figs 16-17), the Cortez morph, occurs in the central and southern Gulf of California, along the western side of the Gulf from Isla Coronado southward to Cabo San Lucas and along the eastern side from Isla San Pedro Nolasco southward to Isla San Ignacio de Farallon (Fig. 9). The Cortez morph has large dark blotches on the body, and breeding males have a dark chin, a black band along the base of the dorsal fin, and a bright orange band more distally on the dorsal fin. The Mexican morph (not illustrated here) occurs along the mainland coast of Mexico from Mazatlán southward to Puerto Esconido, Oaxaca, and at Islas Tres Marias (Fig. 9), the type locality of *A. macrospilus*. The Mexican morph differs from the Cortez morph in having the black on the dorsal fin typically restricted to a single spot or series of blotches, and red (rather than orange) on the distal portion of the anterior dorsal fin and a red (rather than black) band on the chin of breeding males.

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Figs 1 and **2**. - Underwater photographs of *Acanthemblemaria crockeri*.
Vues sous-marines de *Acanthemblemaria crockeri*.

Fig. 3. - Underwater photograph of *Acanthemblemaria balanorum* from the Gulf of California.
Vue sous-marine de *Acanthemblemaria balanorum*, Golfe de Cali-

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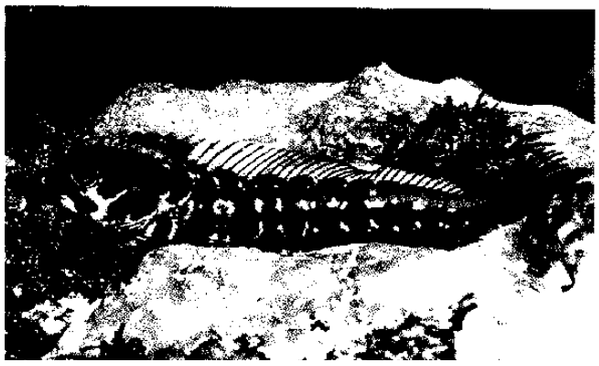

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Figs 4-7. - Underwater photographs of *Acanthemblemaria balanorum* from Isla Gorgona, Colombia.
Vues sous-marines de *Acanthemblemaria balanorum*, Isla Gorgona, Colombia.

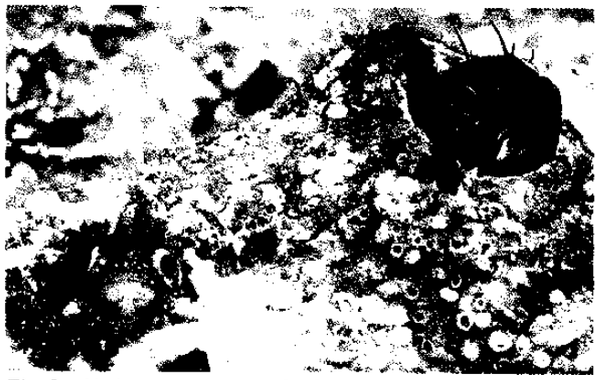

Fig. 8. - Underwater photograph of *Acanthemblemaria balanorum* (right) and *Acanthemblemaria hancocki* (left) taken at Isla Gorgona, Colombia.
Vue sous-marine de *Acanthemblemaria. balanorum* (droite) et *A. hancocki* à Isla Gorgona, Colombia.

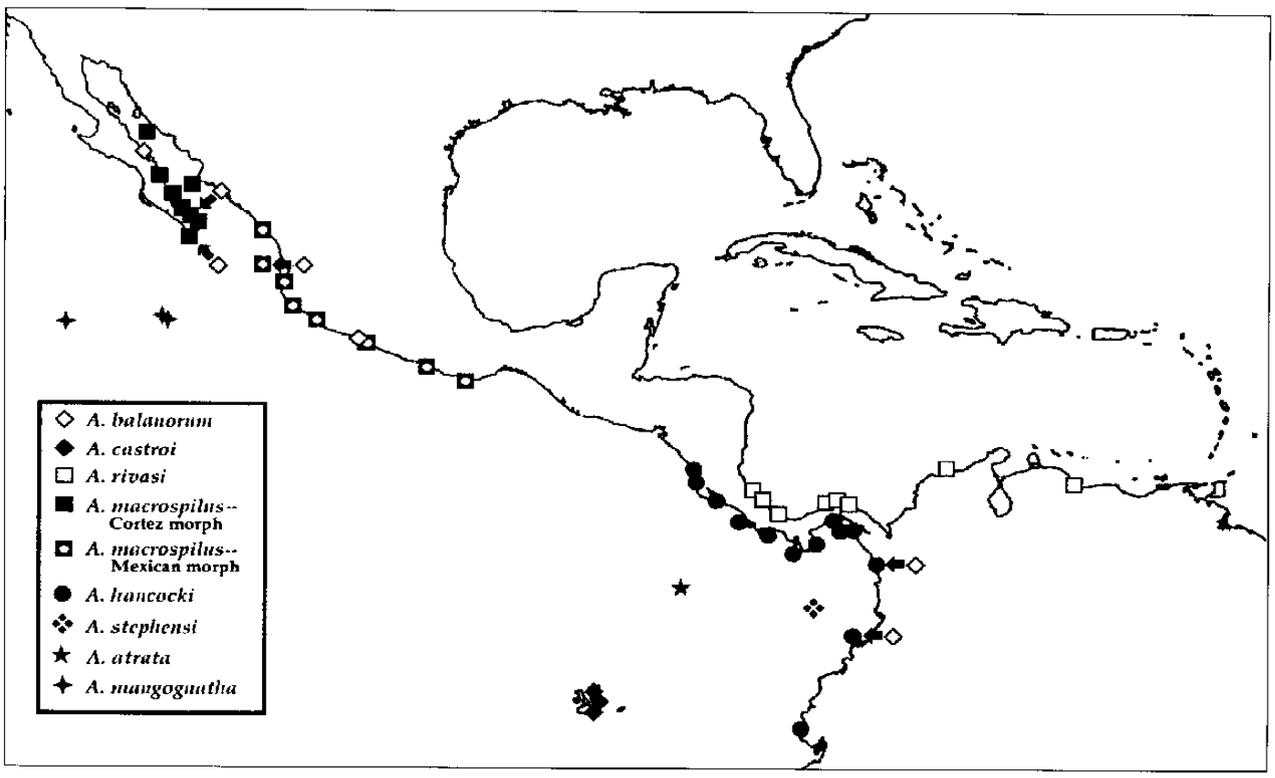

Fig. 9. - Distributions of members of the *Acanthemblemaria* **hancocki species complex.** Indicated localities are for specimens examined during this study and published records for *A. rivasi* (**Smith-Vaniz** and Palacio, 1974; **Acero**, 1984).
Distribution des membres du complexe de *Acanthemblemaria hancocki*. Les localités représentées sont celles des spécimens examinés au cours de ce travail et de celles publiées pour *A. rivasi* (**Smith-Vaniz** and **Palacio** 1974 ; **Acero** 1984).

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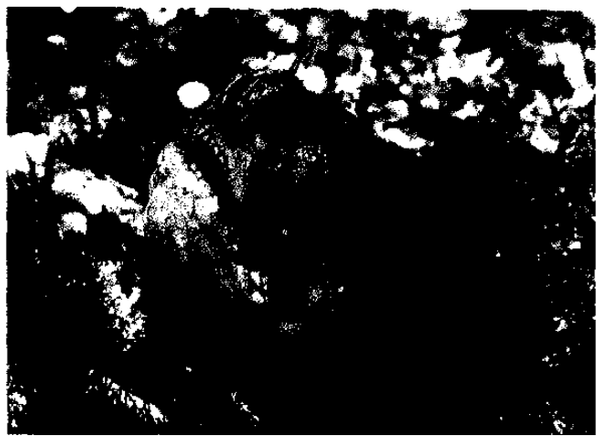

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Figs 10-13. - Underwater photographs of *Acanthemblemaria castroi* from the Galapagos Islands.
Vues sous-marines de *Acanthemblemaria castroi*, Galapagos Islands.

6. - *Acanthemblemaria hancocki* Myers et Reid, 1936, the Panamic barnacle blenny. This species is distinctive in having a brown spot high on each side of the head just posterior to the eye, a reddish orange spot on the pectoral-fin base, several rows of small dark spots along the sides, and a prominent orange iris (Figs 8, 18-20). Breeding males have a dark head, an orange chin and an orange dorsal fin. This species is found along the mainland from Port Parker, Costa Rica southward to Ecuador, and in nearshore islands such as Isla del Caño, Costa Rica, Islas Perlas, Panama, Isla Gorgona, Colombia, and Isla de la Plata, Ecuador (Fig. 9).

7. - *Acanthemblemaria stephensi* Rosenblatt and McCosker, 1988, the Malpelo barnacle blenny. This species is distinctive in having fine blue spots covering the head and body, and a dark head, a red wash on the snout and lips, and a red anterior dorsal fin in breeding males (Figs 21-23). The Malpelo barnacle blenny appears to be endemic to Isla de Malpelo (Fig. 9). Searches by one of us (DRR) at Isla Gorgona, close to the Colombian mainland, Bahia Piñas (in Panama near the Colombian border), and other sites in Panama (see **Rosenblatt** and **McCosker** 1988) have not revealed its presence anywhere other that at Malpelo.

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Figs 14-15. - Underwater photographs of *Acanthemblemaria rivasi* from the San Blas Islands, Panama.
Vues sous-marines de *Acanthemblemaria rivasi*, San Blas Islands, Panama.

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Figs 16-17. - Underwater photographs of *Acanthemblemaria macrospilus* from the Gulf of California.
Vues sous-marines de *Acanthemblemaria macrospilus*, Golfe de Californie.

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Figs 18-20. - Underwater photographs of *Acanthemblemaria hancocki* from Isla Taboguilla, Panama.
Vues sous-marines de *Acanthemblemaria hancocki*, Isla Taboguilla, Panama.

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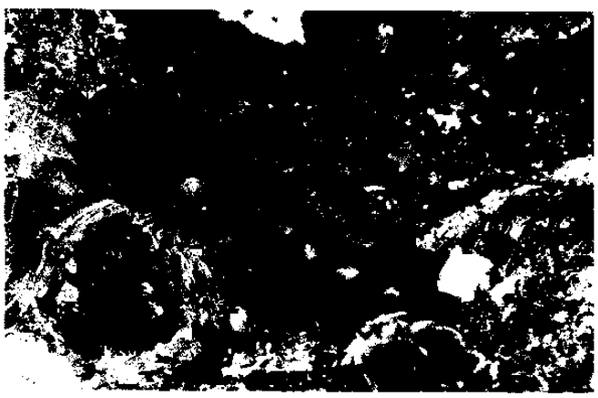

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Figs 21-23. - Underwater photographs of *Acanthemblemaria stephensi* from Isla Malpelo.
Vues sous-marines de *Acanthemblemaria stephensis*, Isla Malpelo.

8. - ***Acanthemblemaria atrata*** new species

Figs 24-29

Cocos barnacle blenny

Synonomy: *Acanthemblemaria macrospilus* (in part) **Stephens**, **Johnson** and **Hobson** 1966. *Acanthemblemaria* new species **Hastings** 1990; **Allen** and **Robertson** 1994; **Almany** and **Baldwin** 1996.

Holotype. USNM 346390, Chatham Bay, Isla del Coco, Costa Rica, 26.8 mm SL male, collected 7-9 November 1990 by **D. R. Robertson** and **G. R. Allen.**

Paratypes. USNM 346391, collected with the holotype (N = 26); UAZ 89-1-1, Isla del Coco, Isla Munuelita, collected at 5-10 m on 19-21 November 1989 by **A. Kerstitch** (N = 101, 16 of which have been cleared and stained, CS); ANSP 176236, same data as UAZ 89-1-1; SIO 97-215, same data as UAZ 89-1-1; LACM 32275, Isla del Coco, Bahia Wafer, 24 m, RV Searcher 535, 5 April 1972 (N = 4).

Other Material Examined (all from Isla del Coco). LACM 32256, Chatham Bay, 6 m, RV Searcher 511, 1 April 1972 (N = 118; 9 CS); LACM 32260, Isla Pajera, 12 m, Searcher 517, 2 April 1972 (N = 55; 3 CS); LACM 32271, Isla Iglesias, 31 m, Searcher 531, 4 April 1972 (N = 86; 4 CS); LACM 32283, Bahia Wafer, 11 m, RV Searcher 543, 6 April 1972 (N = 64; 10 CS); UCLA W58-378, Chatham Bay (N = 12); UCLA W 64-45, Chatham Bay (N = 16); UCLA W64-46, Chatham Bay, 9 March 1964 (N = 1).

Diagnosis

Unique within the **hancocki species group** of *Acanthemblemaria* in having one or two pairs of large iridescent blue spots on the upper lip and a relatively small body size (Table 1). Other diagnostic features include the presence of two common pores (sensory pores between the mandibular and preopercular series; see **Smith-Vaniz** and **Palacio** 1974, fig. 11), a closed wedge of spines on the posterior portion of the frontal, two rows of interorbital spines, the outer row of interorbital spines continuous, XXII-XXV dorsal-fin spines, 11-14 dorsal-fin rays (35-37 total dorsal-fin elements), II anal-fin spines and 23-26 anal-fin rays.

Description

Meristics. The number of elements and number of specimens (N) having each count are indicated parenthetically and * indicates counts for the holotype. These data include those values reported in Tables 2 and 3 of **Stephens** *et al.* (1966) for "Cocos Is". Dorsal-fin spines: XXII (N = 8), XXIII (40*), XXIV (73), XXV (5); dorsal-fin rays: 11(7), 12(53), 13(60), 14(6*); total dorsal-fin elements: 35(9), 36(54), 37(62*); anal-fin rays: 23(7), 24(57), 25(59*), 26(4); pectoral-fin rays: 12(1), 13(220*), 14(3); precaudal vertebrae: 9(1), 10(28), 11(19), 12(1); caudal vertebrae: 30(19), 31(20), 32(7), 33(1); total vertebrae: 40(1), 41(19), 42(21), 43(6).

Cephalic sensory pores. Definitions of pore series follow **Smith-Vaniz** and **Palacio** (1974) and **Hastings** (1990). Number of specimens exhibiting each count are indicated parenthetically and * indicates the holotype. Counts for bilateral series are for the left side except for the holotype which includes both sides. Mandibular: 4(N = 32*); common 1(4), 2(28*); preopercular: 5(31*), 6(1); posttemporal: 4(32*); lateral supratemporal: 4(15*), 5(17); median supratemporal: 2(1), 3(14*), 4(1) ; anterior infraorbital: 3(32*); posterior infraorbital: 3(2), 4(30*); supraorbital: 3(12), 4(20*); frontal: 4(7), 5(10*), 6(8); commissural: 1(16*); anterofrontal: 1(1), 2(31*); nasal: 1(32*).

Measurements. The following measurements of the holotype were taken with dial calipers to the nearest 0.1 mm: SL = 26.8; predorsal length = 4.7; preanal length = 12.4; head length (tip of snout to upper insertion of gill membrane) = 5.8; head length (horizontal distance from tip of snout to gill membrane) = 6.5; orbital diameter = 1.8; iris diameter = 1.5; jaw length = 3.4; snout length = 1.4; supraorbital cirrus length = 1.0 (left) and 1.2 (right); nasal cirrus length = 1.0 (left) and 0.9 (right); maximum body depth = 4.3; body depth at anal-fin origin = 3.8; caudal peduncle depth = 1.6.

External morphology. One pair of supraorbital cirri, typically unbranched or branched once near tip, but never deeply branched. Nasal cirrus on anterior nostril moderate in length, branched once. First dorsal-fin spine simple, lacking a flap along its anterior margin. Anterior dorsal fin low, all spines approximately equal in length. Posterior dorsal-fin spines shorter than anterior spines and anterior dorsal-fin rays resulting in a notch between spinous and soft portions of dorsal fin. Pectoral fin rounded. Caudal fin truncate. Pelvic fin with a thin spine and three rays; second ray longest, third well-developed and only slightly shorter than first ray.

Head spination (terminology follows **Hastings** 1990). Well developed spines on several cranial bones of adults; spines smaller and less numerous in juveniles. Posterodorsal portion of frontal covered with short, pointed spines extending posteriorly in a wedge from level of insertion of second infraorbital to just anterior to central median supratemporal sensory pore. Spines along posterior margin of frontal wedge thickened, and sometimes ridgelike (holotype with 10-12 such spines on each side of wedge). Central portion of frontals posterior to orbit covered with spines (i.e., frontal wedge closed). Supraorbital margin of frontal with 8 to 14 short, rounded spines (10 to 11 in holotype). Interorbital margin of frontal with 2 to 4 spines (2 to 3 in holotype). Both lateral and central rows of interorbital spines present. Lateral row complete, extending in a more-or-less uninterrupted line to anterior edge of frontal in most specimens. Spines in central row relatively short, not on a raised ridge. Orbital margin of lateral ethmoid with 5 to 7 large, rounded spines (7 in holotype); ventralmost one or two spines separated from more dorsal spines by a small space. Large anterofrontal spine present just medial of first anterofrontal sensory pore. Some individuals (including holotype) with a smaller spine anterior to anterofrontal spine, but medial to a row of 4 to 5 spines along medial margin of anterior nostril. Anterior margin of nasals serrate, or with 3 blunt, anteriorly projecting spines (as in holotype).

Anterior margin of first infraorbital with 2 to 3 small spines adjacent to anterior nostril. Ventral margin of first infraorbital straight (not incised) and either smooth, weakly serrate, or with a series of closely-set rounded serrations (as in holotype). Lateral surface of first infraorbital with a central row of spines, and more posteriorly, one or more irregular ridges extending across second infraorbital. Orbital margin of first infraorbital with an enlarged spine near its juncture with lateral ethmoid. Orbital margin posterior to this spine with either 3 to 5 well developed spines (as in holotype), or 3 to 4 small spines that decrease in size posteriorly and continue as a row of bumps. Orbital margin of second infraorbital smooth (most individuals), undulate, or with a series of bumps (as in holotype). No spines along posterior margin of second infraorbital. Lateral surface of second infraorbital with no spines (most individuals), ridges, or a few small spines (5 in holotype).

Coloration. Two extreme color patterns, dark and banded, are apparent in life and in preservative, but a full range of intermediates are common. These color patterns are not strictly size or sex related although large males frequently exhibit the dark color pattern. For example, in LACM 32271, the dark morph includes 22 males and 6 females, while the banded morph includes 41 (usually smaller) males and 32 females. Small individuals typically have distinct blotches along the body.

Dark morph in preservative. The holotype exhibits an extreme version of the dark color morph. Entire body and virtually entire head dark, with dense, expanded melanophores, except for tip of lower jaw (with only scattered melanophores), anterior tips of urohyal, and region surrounding anus and genital papilla which lack

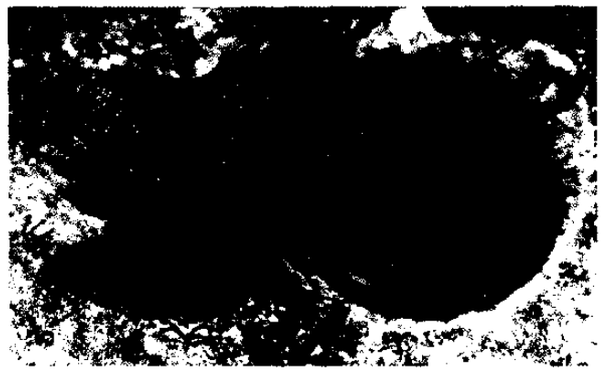
melanophores. Posterior end of upper jaw, adjacent cheek, inside of mouth at corner of jaw, and branchiostegal membranes darker than body and other parts of head. Dorsal fin uniformly dark anteriorly except for a darker blotch between first two spines. Central interspinal membrane with irregular clear areas lacking melanophores beginning between spines VI and VII; clear areas continuing posteriorly until they merge, resulting in a central clear band and dark proximal and distal bands on posterior dorsal fin. All dorsal-fin rays, including those passing through unpigmented area, lined with fine melanophores. Proximal portion of anal fin uniformly dark anteriorly. Distal tips of all anal-fin elements without melanophores. Posteriorly, fine melanophores line all anal-fin rays (similar to posterior dorsal fin). Several anal-fin rays with subdermal black spots just posterior to their insertions. Dark color of body extends uninterrupted from pectoral fin to base of caudal-fin membrane. Distal 80 percent of caudal-fin membrane without melanophores; all caudal-fin rays lined with fine melanophores (similar to posterior dorsal fin). Posterior caudal fin with a distal band covering approximately 30 percent of fin, the consequence of larger melanophores lining caudal-fin rays (melanophores absent from membrane). Base of pectoral fin and proximal 30 percent of fin uniformly dark; distally melanophores progressively less dense (tips of rays with few or no melanophores). Proximal 50 percent of pelvic fin uniformly dark; distally melanophores progressively less dense (tips of rays with few melanophores).

Most dark phase individuals with a larger light area on snout and lower jaw than in holotype (see Fig. 29A). This light area variable in size: either restricted to lower and upper lips, but often including snout and interorbit, and in some specimens, including distal portion of supraorbital cirrus. Some dark phase individuals with dark bands on body interspersed with lighter areas of less dense melanophores, and a dark saddle on nape. Median fins often lack pigment except for anterior dorsal fin which may be densely covered with melanophores. Most males with a black spot between dorsal-fin spines I and II. Females without a dorsal-fin spot, or rarely with a faint spot.

Banded morph in preservative. Body with 5 to 7 broad bands of melanophores separated by intervening bands either lacking melanophores (Fig. 29B), or more typically with less dense melanophores. Nape with a dorsal saddle extending ventrally to below level of eye. In some, nape saddle set off by a distinct unpigmented area posterior to eye and jaw (Fig. 29B). In some, a row of three dark spots extends from posterior corner of jaw across lower opercular region.

Life colors. The range of life colors is illustrated in Figs 24-28. Dark areas on head, body and fins range from brown, black or dark black (in dark morph). Lips, snout, and interorbit white, pink, or scarlet. Head and body suffused with fine blue spots; these spots not as obvious in dark morph and in dark bands of banded morph. Interorbit, snout, and lips with a series of larger iridescent blue spots in both morphs; largest blue spots on upper lip often evident in preserved specimens. Posterior portion of body similar in color to anterior portion of body, or with a distinct yellowish cast (Fig. 28).

Sexual dimorphism. As in other species of *Acanthemblemaria*, males and females are readily distinguishable by the shape of the genital papilla (**Böhlke**, 1957, fig. 2). Males have a long, pointed papilla, while females have a shorter, broader papilla with a fimbriate anal margin. Surprisingly both males and females exhibit the full range of variation in color pattern, from the banded morph to the dark morph (see above). It is not known if life colors of the two sexes exhibit such widely overlapping ranges. Males typically have a black spot between dorsal fin spines I and II which usually is absent in females. Females have a dark chin band that is absent in males. Unlike some other members of the *hancocki* species group, *A. atrata* does not exhibit sexual differences in body size (Table 1).



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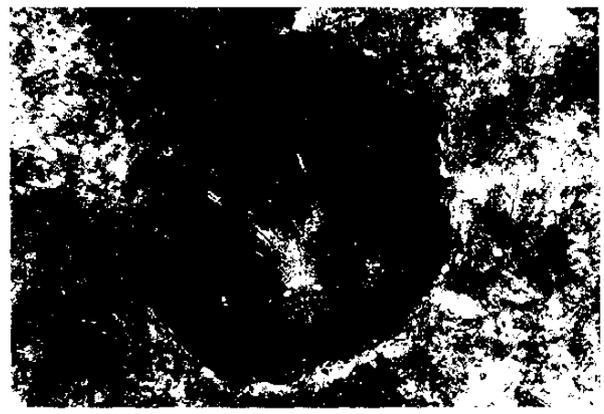

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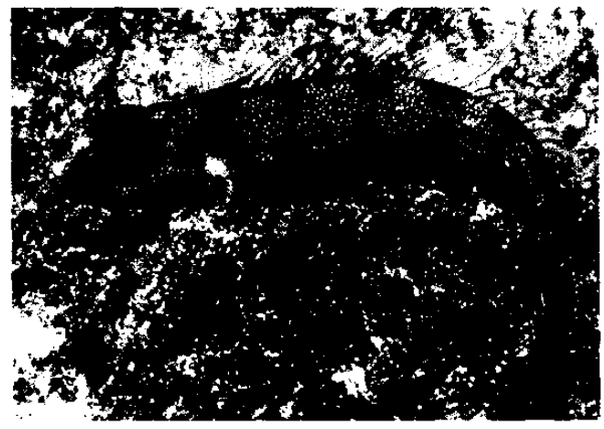

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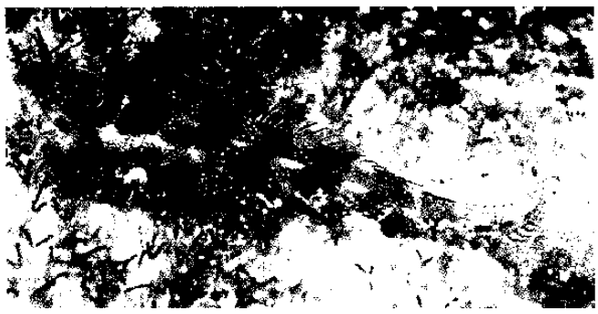

Figs 24-28. - Underwater photographs of *Acanthemblemaria atrata* from Isla del Coco.
Vues sous-marines de *Acanthemblemaria atrata*, Isla del Coco.

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Etymology

The name *atrata* is Latin for dressed in black, in reference to the unique dark color morph. The common name of Coco barnacle blenny refers to both its distribution and its habit of dwelling in vacant barnacle tests.

Distribution

Acanthemblemaria atrata, like several other species of small benthic reef fishes (**Allen** and **Robertson** 1994), is endemic to Isla del Coco, Costa Rica (Fig. 9). There it is common in shallow water, but also occurs to depths of at least 31 meters. Other chaenopsids recorded from Isla del Coco include *Emblemaria nivipes*, *Coralliozetus boehlkei*, and *C. springeri*.

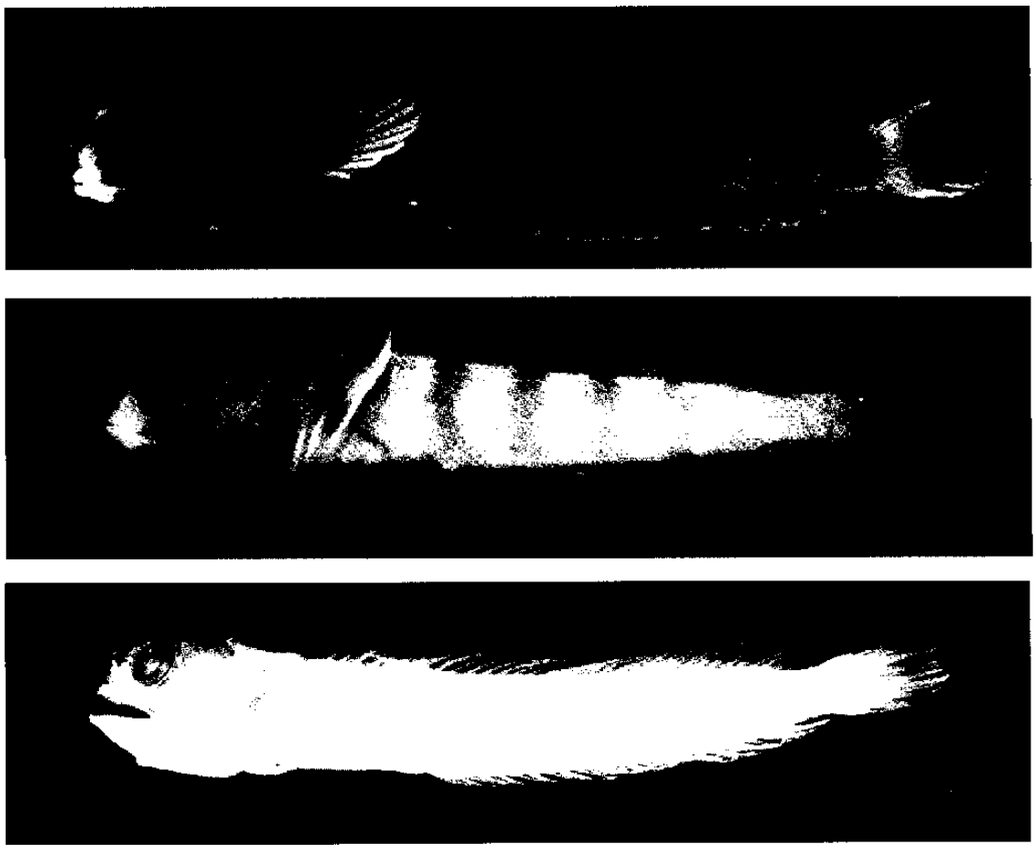

Fig. 29. - Type specimens of *Acanthemblemaria atrata* and *A. mangognatha*. A) *A. atrata* paratype: dark morph, male, 23.2 mm SL (LACM 32275); B) *A. atrata* paratype: banded morph, female, 22.0 mm SL (LACM 32271); C) *A. mangognatha* holotype: male, 30.9 mm SL (USNM 346392).
Spécimens types de *Acanthemblemaria atrata* et *Acanthemblemaria mangognatha*. A) *A. atrata* : morphe sombre, mâle, 23,2 mm LS ; B) *A. atrata* paratype ; morphe rayée, femelle, 22.0 mm LS ; C) *A. mangognatha* holotype : mâle, 30.9 mm LS.

Table 1.

Body sizes (mm standard length) of males and females of five species of *Acanthemblemaria*. Data for *A. macrospilus* include both the Cortez and Mexican morphs. P values are for a t test comparing means of males and females for each species.

	Males			Females			P
	Mean (S)	Range	N	Mean (S)	Range	N	
A. macrospilus	35.8 (5.7)	17.1-49.7	182	32.6 (3.5)	20.7-40.6	162	< 0.001
A. mangognatha	25.0 (4.3)	17.8-33.3	25	20.5 (2.2)	17.5-24.2	18	< 0.001
A. hancocki	25.3 (5.3)	16.9-41.5	108	25.2 (3.3)	18.0-32.8	103	0.89
A. stephensi	32.8 (3.9)	21.8-39.0	17	31.3 (51.6)	29.3-36.1	29	0.14
A. atrata	20.8 (3.1)	14.9-32.0	189	20.5 (2.0)	15.9-31.7	131	0.37

9. - ***Acanthemblemaria mangognatha*** new species
Figs 30-35
Revillagigedo barnacle blenny

Synonomy: *Acanthemblemaria hancocki* **Ricker** 1959. *Acanthemblemaria macrospilus* (in part) **Stephens** 1963, **Stephens** *et al.* 1966.

Holotype. USNM 346392, Henslow Bay, Isla Socorro, Islas Revillagigedo, Mexico (18 48' N, 111 02' W). 30.9 mm SL male, collected 20-21 February 1990 by **D. R. Robertson**.

Paratypes. USNM 346393, collected with the holotype (N = 5); UAZ 90-1-1 (N = 14), Isla Socorro, Islas Revillagigedo, Mexico, 29 October 1990, collected by **A. Kerstitch**; ANSP 176237, same data as 90-1-1; SIO 97-216, same data as UAZ 90-1-1; LACM 31783-46, Isla Socorro, Mexico, RV Searcher 54, 15-17 Feb. 1971 (N = 6).

Other Material Examined (all Islas Revillagigedo). LACM 31778-117, Isla San Benedicto, Mexico, RV Searcher 49, 9 February 1971 (N = 2); LACM 31780-109, Isla Socorro, Mexico, RV Searcher 51, 13-14 February 1971 (N = 2); LACM 31781-27, Isla Socorro, Mexico, RV Searcher 52, 14 February 1971 (N = 25); LACM 32097-39, Isla Clarion, Mexico, 18 21' N, 114 43'W, RV Searcher 297, 10 November 1971 (N = 42); SIO 70-394, Isla San Benedicto, Mexico; SIO 70-392, Isla Socorro, Mexico, (N = 38); SIO 72-67, Isla Socorro, Mexico (N = 29); SIO 77-397, Isla Socorro, Mexico (N = 1).

Diagnosis

Unique within the **hancocki species group** of *Acanthemblemaria* in having the anterior one third of the lower jaw orange in color, posterior two thirds of the lower jaw purple, and the supraorbital cirrus of some large specimens deeply branched. Other diagnostic features include a closed wedge of spines on the posterior portion of the frontal, two rows of interorbital spines, the outer interorbital row incomplete, and the central interorbital row with large spines on a raised ossified ridge, XXIII-XXV dorsal-fin spines, 12-14 dorsal-fin rays (35-38 total dorsal-fin elements), II anal-fin spines and 24-27 anal-fin rays.

Description

Meristics. The number of elements and number of specimens (N) having each count are indicated parenthetically and * indicates counts for the holotype. These data include those values reported in Table 2 of **Stephens** *et al.* (1966) for "Is. Revillagigedo". Dorsal-fin spines: XXIII (N = 3), XXIV (23*), XXV (2); dorsal-fin rays: 12(6), 13(20*), 14(1); total dorsal-fin elements: 36(5), 37(22*), 38(2); anal-fin rays: 24(5), 25(21*), 26(2), 27(1); pectoral-fin rays: 10(1), 13(42*).

Cephalic sensory pores. Definitions of pore series follow **Smith-Vaniz** and **Palacio** (1974) and **Hastings** (1990). Number of specimens exhibiting each count are indicated parenthetically and * indicates the holotype. Counts for bilateral series are for the left side only except for the holotype which includes both sides. Mandibular: 4(N = 21*), 5(1*); common 1(22*); preopercular: 5(22*); posttemporal: 3(1), 4(21*); lateral supratemporal: 3(11), 4(11*); median supratemporal: 3(22*); anterior infraorbital: 3(22*); posterior infraorbital: 4(2), 5(18*), 6(2*); supraorbital: 3(4), 4(18*); frontal: 3(5*), 4(8*), 5(6), 6(2); commissural: 1(12*), 2(10); anterofrontal: 2(22*); nasal: 1(22*). The holotype has the usual four mandibular pores on the right side, but five on the left, the result of a small pore adjacent to the third mandibular pore. The holotype also has asymmetrical frontal pores (5 on left and 4 on right) and posterior infraorbital pores (6 on left and 5 on right).

Measurements. The following measurements of the holotype were taken with dial calipers to the nearest 0.1 mm: SL = 30.4; predorsal length = 5.4; preanal length = 14.2; head length (tip of snout to upper insertion of gill membrane) = 6.6; head length (horizontal distance from tip of snout to gill membrane) = 8.0; orbital diameter = 2.0; iris diameter = 1.8; jaw length = 3.9; snout length = 1.6; supraorbital cirrus length = 2.4 (left) and 1.1 (right); nasal cirrus length 1.7 (left) and 1.3 (right); maximum body depth = 4.1; body depth at anal-fin origin = 4.1; caudal peduncle depth = 1.8.

External morphology. One pair of supraorbital cirri, unbranched in most specimens (38 cirri including right cirrus of holotype), occasionally branched once (6 cirri), twice (2 cirri including left cirrus of holotype), and rarely deeply branched and palmate (resembling cirrus of *A. crockeri*, Figs 1-2). USNM 346393 includes one male with 9 cirri tips on left side and 8 tips on right side, and one male with 14 and 20 tips. Nasal cirrus on anterior nostril long (reaching middle of interorbital region when adpressed) and branched once in most specimens; a few specimens with 3 or 4 tips. First dorsal-fin spine simple, lacking a flap along anterior margin. Anterior dorsal fin low, all spines typically equal in length; one specimen (UAZ 90-1-1) with first five spines shorter than more posterior spines. Posterior dorsal-fin spines shorter than anterior spines and anterior dorsal-fin rays resulting in a notch between spinous and soft portions of dorsal fin. Pectoral fin rounded. Caudal fin truncate. Pelvic fin with a thin spine and three rays; second ray longest, third ray well-developed and only slightly shorter than first ray.

Head spination (terminology follows **Hastings** 1990). Well developed spines present on several cranial bones of adults. Spines smaller and less numerous in juveniles. Posterodorsal portion of frontal covered with short, pointed spines. This wedge-shaped field of spines extends from level of insertion of second infraorbital posteriorly to just anterior to central median supratemporal sensory pore. Spines along posterior margin of frontal wedge large and thickened, especially in large specimens (holotype with 8 large spines along posterior margin of each side). Central portion of frontals posterior to orbits covered with spines (i.e., frontal wedge closed). Central spines small and parse in anterior portion of wedge. Supraorbital margin of frontal with short, rounded spines or serrations (10 on each side in holotype). Interorbital margin of frontal with a otch through which supraorbital cirrus passes. Anterior of notch, frontal with 1 or 2 spines (1 in holotype). Interorbit with both lateral and central rows of spines; central row with large, well-developed spines, fused basally into a raised bony ridge in most specimens. Central interorbital row contiguous with a row of equally large or larger spines on nasals. Lateral interorbital row incomplete, intersecting interorbital margin in most specimens. Orbital margin of lateral ethmoid with 5 to 7 large, rounded spines, ventralmost one or two separated from more dorsal spines by a small space. Large anterofrontal spine medial of first anterofrontal sensory pore. Some individuals (right side only in holotype) with a smaller spine anterior to anterofrontal spine, but medial to a row of 4 to 5 large

spines along medial margin of anterior nostril (5 in holotype). Anterior margin of nasals with 3 to 4 blunt serrations or anteriorly projecting spines.

Anterior margin of first infraorbital with 2 to 3 small spines adjacent to anterior nostril. Ventral margin of first infraorbital straight (not incised), smooth (in small specimens), serrate centrally, or fully serrate, with a series of closely-set rounded serrations (in holotype). Lateral surface of first infraorbital with a central row of spines, and more posteriorly, a second irregular row. Orbital margin of first infraorbital with an enlarged spine near junction with lateral ethmoid. Orbital margin posterior to this spine smooth or with low serrations. Orbital margin of second infraorbital smooth or with a few low serrations ventrally. No spines along posterior margin of second infraorbital. Lateral surface of second infraorbital with a single row of low spines near junction with first infraorbital.

Color in preservative (Holotype). Snout, upper jaw and interorbital region with uniform fine melanophores. Interorbit and frontal wedge with denser melanophores. Cheek with fine melanophores, concentrated above jaw at level of orbit, in an ill-defined saddle on nape, and in a crescent on operculum. Anterior tip of lower jaw, rami of lower jaw, and medial urohyal region without melanophores. Fold between central urohyal region and rami of lower jaw, fold beneath maxilla, and branchiostegal membranes with dense melanophores. Inside of mouth, especially along palatine tooth rows, with scattered melanophores, except for roof medial of palatine tooth rows which lacks melanophores. Scattered melanophores along inside of lower jaw (except anterior portion). Nostril tubes without melanophores; nasal cirri and supraorbital cirri with scattered melanophores. Isthmus (anterior of pelvic fins) and belly including vent with no melanophores. Pectoral axil with an oval concentration of melanophores. Body without melanophores except for a series of eight blotches along midline. First oval, located beneath adpressed pectoral fin, second oval, third a small dash (at level of anus), fourth round, fifth a small dash, sixth dumbbell shaped on left side and oval on right side, seventh elongate (at level of end of dorsal and anal fins), and eighth elongate oval (on caudal peduncle). Nine dorsal saddles: first, second, and third connected to first three lateral botches by scattered melanophores; remaining saddles restricted to dorsal-fin base. Dorsal fin with a black spot between spines I and II; otherwise anterior dorsal fin scattered evenly with melanophores (sparse below and anterior of spot), extending posteriorly to spine VI. Posteriorly dorsal-fin membrane without melanophores; melanophores along fin rays appear as irregular bands on dorsal fin, especially near distal fin margin. Anal fin without melanophores except for a prominent submarginal band extending for full length of fin. Caudal fin with a few small melanophores along a few rays. Pectoral-fin membrane with a few scattered melanophores basally, and a few melanophores along rays. Pelvic fin lacking melanophores except for a few along third ray.

Other specimens. The degree of melanophore development is roughly correlated with size. Smallest specimens with relatively few melanophores on head and body, slightly larger specimens with some melanophores on head and weakly developed lateral blotches, and still larger specimens with dark heads and well developed lateral botches. In some specimens (e.g., LACM 31783) head and body covered with dense expanded melanophores although lateral blotches remain evident. All except darkest males lack melanophores on tip and rami of lower jaws; darkest males with a few scattered melanophores in these areas. All males with a dark dorsal-fin spot; dorsal-fin spot obscured in darkest males which have dark melanophores covering anterior dorsal fin. Females apparently lack a dorsal-fin spot. Some females (e.g., LACM 31783) with a dark band of melanophores crossing urohyal region, but not rami of lower jaws. Other females (e.g., UAZ 91-1-1) lack this band.

Specimens from Isla Clarion (LACM 32097) differ somewhat in coloration from those from Isla Socorro and Isla San Benedicto. Dorsal fin of Clarion males with a black spot between spines I and II, but with a clear area surrounded by melanophores beginning posterior to spine II and extending posteriorly to spines IV to VII. Body without distinct blotches; few to many irregularly scattered melanophores along sides.

Life colors. Life colors variable (Figs 29-34). In all individuals, tip of lower jaw deep orange; more posteriorly, lower jaw purple. Inner margin of iris orange. Body of relatively pale individuals translucent, with dark blotches along midline and dark saddles (Fig. 30), snout gray to brown, and cheek with dark blotches and white spots or blotches (Figs 29-30). Snout purple and head covered with fine iridescent blue spots in some individuals (Fig. 32). Other individuals especially dark (Figs 33-35), with expanded melanophores partially or completely obscuring other color patterns on head.

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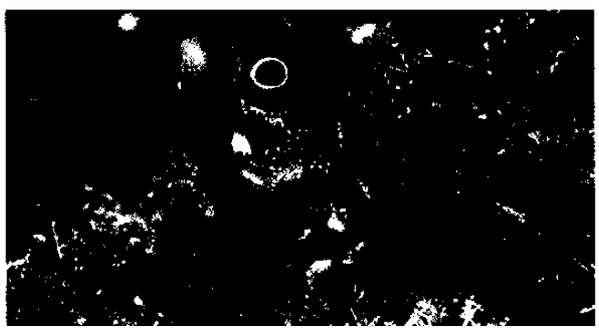

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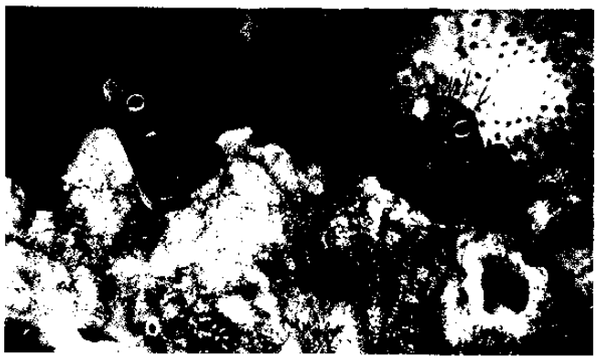
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Figs 30-35. - Underwater photographs of *Acanthemblemaria mangognatha* from the Islas Revillagigedos.
Vues sous-marines de *Acanthemblemaria mangognatha*, Islas Revillagigedos.

Sexual dimorphism. As in other species of *Acanthemblemaria*, males and females are readily distinguishable by the shape of the genital papilla (**Böhlke** 1957, fig. 2). Males have a long, pointed papilla, while females have a shorter, broader papilla with a fimbriate anal margin. Males have a black spot on the anterior dorsal fin that appears to be absent in females, and some females have a dark band on the chin. Males are also larger in size (Table 1).

Etymology

The name *mangognatha* is from *mango*, a tropical fruit with rich orange flesh, and *gnathos*, Greek for jaw, in reference to the unique coloration on the lower jaw. The common name of "Revillagigedo barnacle blenny" refers to both its distribution and its habit of dwelling in vacant barnacle tests.

Distribution

Acanthemblemaria mangognatha is endemic to Islas Revillagigedo, Mexico (Fig. 9). It is know from Isla Socorro, Isla San Benedicto, and Isla Clarion. Specimens from the latter island, not designated as types, have a unique dorsal-fin coloration in preservative (see above), but their life colors are unknown. This and a single specimen of *Coralliozetus angelicus* (**Stephens** *et al.* 1966) are the only species of chaenopsids reported from Islas Revillagigedo.

Species-Specific Color Differences in Barnacle Blennies

Features of coloration can be used to distinguish each of the species of the *hancocki* species group, including the two new species. All members of the group have fine iridescent blue dots over the head and/or body, but the following color elements appear to be species specific. *Acanthemblemaria balanorum* is unique in having a purple wash on the head of breeding males (Figs 3-8), *A. castroi* in having large yellow spots on the head and body and a blue *outer* margin of the iris (Figs 10-13), *A. rivasi* in having a bright blue *inner* margin of the iris and a brown body color broken by large white blotches (Figs 14-15), *A. macrospilus* in having large dark blotches along the body (Figs 16-17), *A. hancocki* in having rows of small dark spots and blotches along the body and a reddish orange spot on the pectoral axil (Figs 18-20), *A. stephensi* in having especially fine blue spots on the head and body (Figs 21-23), *A. atrata* in having a pair of large iridescent blue spots on the upper lip (Figs 24-28), and *A. mangognatha* in having distinct orange and purple regions on the lower jaw (Figs 30-35).

Comparisons and Relationships of Barnacle Blennies

The two species described herein, *A. atrata* and *A. mangognatha*, appear to be most closely related to *A. macrospilus*, *A. hancocki*, and *A. stephensi*, sharing with them loss of the second row of dentary teeth and presence of a dark band on the lower jaw of females (**Hastings** 1990), although this band is not present in all females of *A. mangognatha*. The strong similarity of these species is reflected in their taxonomic history. All were once considered conspecific, but distinctive populations have since been elevated to species status. The Mexican barnacle blenny, *A. macrospilus*, first described as a subspecies of the Panamic barnacle blenny, *A. hancocki*, was elevated to specific status by **Stephens** (1963). Similarly the Coco and Revillagigedo barnacle blennies, once considered conspecific with *A. macrospilus* (**Stephens** *et al.* 1966), are herein described as distinct species. The Malpelo barnacle blenny was unknown prior to its description as *A. stephensi* (Rosenblatt et McCosker, 1988).

Hastings (1990) was unable to resolve the relationships within this group. Further study indicates that two character states assumed to be unique to *A. hancocki* and *A. stephensi* (**Hastings** 1990) are also present in *A. atrata*. Most individuals of the Coco barnacle blenny have a continuous lateral row of interorbital spines (i.e., this row of spines does not intersect the interorbital margin) and relatively short supraorbital cirri. Thus, *A. atrata* may be more closely related to *A. stephensi* and *A. hancocki* than to *A. macrospilus*. The Revillagigedo barnacle blenny appears to be most closely related to *A. macrospilus*. Both have a well developed central row of interorbital spines that are born on an ossified ridge, and similar body blotches, although these are less well developed in *A. mangognatha*.

These hypothesized relationships are consistent with the present day distributions of these allopatric species (Fig. 9). *Acanthemblemaria hancocki* occurs along the coasts of Central and South America, while its hypothesized closest relatives, *A. atrata* and *A. stephensi*,

are endemic to islands offshore of this region. *Acanthemblemaria macrospilus* occurs farther to the north, along the Pacific coast of southern and central Mexico and in the Gulf of California. Its hypothesized closest relative, *A. mangognatha*, is endemic to islands offshore of this region. This phylogenetic hypothesis is consistent with a north-south divergence within this clade followed by dispersal to and speciation on Isla del Coco and Isla de Malpelo by the southern form, and Islas Revillagigedo by the northern form. The sequence of branching within the southern species group is uncertain. The two island endemics could have diverged simultaneously or sequentially from the mainland species (*A. hancocki*), or they could have diverged in a stepping stone fashion, first colonizing one island and then the other. The similar dark color pattern on the body of these island endemics compared to the spotted color pattern of the mainland species supports the latter phylogenetic hypothesis.

Clearly, this group of 5 closely related, allopatric species radiated rapidly. Further clarification of their relationships will require a more detailed analysis of morphological and molecular data.

Acknowledgments

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RÉSUMÉ

Acanthemblemaria atrata et *Acanthemblemaria mangognatha*, nouvelles espèces de Blennies associées aux Balanes (Chaenopsidae) du Pacifique oriental, Isla del Coco, Costa Rica, et Islas Revillagigedo, Mexico et leurs relations avec les autres « Blennies des Balanes ».

Les deux espèces sont des endémiques de ces îles et membres du groupe d'espèces **hancocki**, nommées ici « Blennies des Balanes », car elles se logent dans des squelettes de Balanes.

La Blennie de l'Ile Coco s'écarte des autres membres du complexe par de grands points d'un bleu métallique sur la lèvre supérieure, des morphes rayées et de couleur sombre, et une taille relativement petite. Elle est très proche de *A. hancocki* des rivages continentaux de l'Amérique centrale et de *A. stephensi* de l'Ile de Malpelo. La Blennie des Iles Revillagigedo se distingue des autres espèces du complexe par les épines de la rangée centrale de l'interoperculaire qui sont volumineuses et par la mâchoire inférieure orange et violacée. Elle est étroitement apparentée à *A. macrospilus* du Mexique méridional au Golfe de Californie. Les deux espèces nouvelles avec leurs voisines les plus proches parentes forment un groupe de cinq espèces allopatriques limitées au Pacifique tropical oriental. Des photographies en couleur sont incluses pour les deux espèces nouvelles et les autres membres du **groupe d'espèces hancocki** (*balanorum, rivasi, castroi, macrospilus, hancocki* et *stephensi*) et *A. crockeri*, l'espèce soeur de ce groupe.