The eastern Pacific species of the genus *Calcinus* Dana, 1851, with description of a new species from Clipperton Island (Decapoda, Anomura, Diogenidae)

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ABSTRACT
The eastern Pacific hermit crab species of the genus *Calcinus* Dana, 1851 are reviewed. *Calcinus mclaughlinae* n. sp. is described from Clipperton Island, and is considered a sibling species of *C. californiensis* Bouvier, 1898, known from the Gulf of California and the mainland coast of Mexico. Two other species, *C. explorator* Boone, 1930, mostly insular in distribution, and *C. obscurus* Stimpson, 1859, distributed from El Salvador to Peru, are also considered sibling. These four species are similar but can be clearly separated by coloration, and to some extent armature of the ocular acicles. They are morphologically close to the western Atlantic congener *Calcinus tibicen* (Herbst, 1791). The taxonomic status of *Calcinus chilensis* (H. Milne Edwards, 1836), reported from Chile, and questionably Peru, is considered uncertain.

KEY WORDS
Crustacea,
Decapoda,
Anomura,
Diogenidae,
Calcinus,
eastern Pacific,
Clipperton,
zoogeography,
sibling species,
new species.

RÉSUMÉ
Les espèces est-pacifiques du genre Calcinus *Dana, 1851 et description d'une nouvelle espèce de l'île de Clipperton (Decapoda, Anomura, Diogenidae).*
Les bernard-l'ermite du genre *Calcinus* Dana, 1851 du Pacifique Est sont revus. *Calcinus mclaughlinae* n. sp. est décrit de l'île de Clipperton et est considéré comme une espèce jumelle de *C. californiensis* Bouvier, 1898, du

MOTS CLÉS
Crustacea,
Decapoda,
Anomura,
Diogenidae,
Calcinus,
Pacifique Est,
Clipperton,
zoogéographie,
espèces jumelles,
espèce nouvelle.

golfe de Californie et de la côte mexicaine. Deux autres espèces, *C. explorator* Boone, 1930, principalement insulaire, et *C. obscurus* Stimpson, 1859, distribuée du Salvador au Pérou, sont également considérées comme jumelles. Ces quatre espèces sont similaires mais peuvent être reconnues par la coloration et, dans une certaine mesure, l'aspect de l'écaille oculaire. Elles ont des affinités morphologiques avec leur homologue de l'Atlantique Ouest, *Calcinus tibicen* (Herbst, 1791). Le statut taxonomique de *Calcinus chilensis* (H. Milne Edwards, 1836), signalé du Chili et peut-être du Pérou, est considéré comme incertain.

INTRODUCTION

Tropical hermit crabs of the genus *Calcinus* Dana, 1851 are common in intertidal and shallow waters, although a few species live at more than 100 m. Forty-three species are currently recognized in this genus worldwide. The Indo-West Pacific species have received greatest taxonomic attention in the last 30 years, and colour pattern has been confirmed to be a major, and sometimes only reliable diagnostic character. Numerous regions have been inventoried where several new species have been discovered, including Somalia (Lewinsohn 1981), Seychelles (McLaughlin & Hogarth 1998), Mauritius (Gherardi & McLaughlin 1994), Indonesia (Rahayu & Forest 1999), Australia (Morgan 1989, 1991; Morgan & Forest 1991), Taiwan (Shih & Yu 1995; Shih & Lee 1997; Shi 1998), Japan (Asakura 1992, 2002a, b; Asakura & Nomura 2001; Asakura & Tachikawa 2000, 2003; Asakura *et al*. 2002; Komai 2004), Hawaii (Haig & McLaughlin 1984), French Polynesia (Poupin 1997; Poupin & McLaughlin 1998; Poupin & Lemaitre 2003), and Easter Island (Haig 1974; Poupin *et al*. 2003). However, the eastern Pacific species of *Calcinus* have received less attention, and as result the identities and geographic distributions of some have remained unclear. For example, *C. explorator* Boone, 1932, from the Galápagos, is still inadequately defined, and some have considered that Boone's taxon might be a junior synonym of *C. obscurus* Stimpson, 1859 (e.g., Hendrickx & Harvey 1999: 368). The exact identity of numerous specimens collected in 1958 at Clipperton, tentatively attributed by Chace (1962) to *C. californiensis* Bouvier, 1898, is still unknown. *Calcinus chilensis* (H. Milne Edwards, 1836), from Chile, is yet another eastern Pacific species with an unclear status (Haig 1955: 15).

Based on new collections from Clipperton and Acapulco obtained during a French expedition in 2005, careful observations of live coloration were made. Together with a study of specimens deposited in several major museums, a review of *Calcinus* species from the eastern Pacific was undertaken to clarify their taxonomic status, distributions, and morphological affinities.

MATERIAL AND METHODS

Collections of *Calcinus* specimens were made in the eastern Pacific from January to March 2005, during a multidisciplinary scientific survey of Clipperton Island, organized by Jean-Louis Étienne (Étienne 2005a, b). Specimens were collected at low tide along the intertidal zone by snorkeling. Additional specimens were collected on the Mexican coast (Isla Roqueta, SW of Acapulco Bay). Museum specimens from the eastern Pacific were examined during visits to museums in Amsterdam, Leiden, Paris, and Washington D.C.

The offshore oceanic islands are those defined by Hendrickx & Harvey (1999), i.e. Alijos rock, Revillagigedo Is. (including Clarión and Socorro Is.), Clipperton I., Cocos I., Malpelo I., and Galápagos

Is. The term "insular" is used following the definition provided by Garth (1960, 1991, 1992), i.e. offshore oceanic islands plus Cape San Lucas region from Magdalena Bay west coast of Baja California (24°50'N) to Puerto Escondido, east coast of Baja California (25°50'N) (Fig. 7).

ABBREVIATIONS

AMNH	American Museum of Natural History, New York;
MNHN	Muséum national d'Histoire naturelle, Paris;
RMNH	Rijksmuseum van Natuurlijke Historie, Leiden;
ULLZ	University of Louisiana, Lafayette, Zoological Collections;
USNM	National Museum of Natural History, Smithsonian Institution, Washington D.C.;
ZMA	Zoological Museum of Amsterdam;
ovig.	ovigerous;
P2-P5	pereopods 2-5;
sl	shield length in mm, taken from tip of rostrum to the midpoint of posterior margin of shield.

SYSTEMATICS

Family DIOGENIDAE Ortmann, 1892
Genus *Calcinus* Dana, 1851

Calcinus californiensis Bouvier, 1898
(Fig. 1)

Calcinus californiensis Bouvier, 1898: 380 [type locality: San Jose I., Gulf of California]. — Glassell 1937: 252. — ?Haig *et al.* 1970: 16 (see Remarks). — Ball & Haig 1974: 101 (?part, see Remarks). — Moran 1984: 74, fig. 6. — Villalobos Hiriart *et al.* 1989: 28. — Snyder-Conn 1980: 278. — Hernández Aguilera *et al.* 1986: 192. — Rodríguez de la Cruz 1987: 89. — Kerstitch 1989: 88, photograph 220. — Alvarez del Castillo *et al.* 1992: 5. — Hernández Aguilera & Martínez Guzmán 1992: 4, table 1. — Hendrickx 1993a: 7; 1993b: 282, 309; 1995: 550; 1996: 614. — Correa-Sandoval & Rodríguez-Cortés 1998: 1138, 1143. — García-Madrigal del Socorro 1999: 924, table 1. — Hendrickx & Harvey 1999: 368. — Boschi 2000: 71. — ?Hernández Aguilera 2002: 312, table 1 (see Remarks). — Rodríguez Almaraz *et al.* 2002: 258.

TYPE MATERIAL. — **Gulf of California.** San José I., coll. L. Diguet, 5.VII.1898, 1 syntype ♂ 5.8 mm; 1 syntype ♀ 2.2 mm (MNHN-Pg 632).

OTHER MATERIAL EXAMINED (see Remarks for meaning of asterisks). — **Gulf of California.** Espíritu Santo I., trawl, 15-25 m, coll. L. Diguet, 1.VIII.1897, 1 ♂ 6.0 mm; 2 ♀♀ 4.2-4.7 mm (MNHN-Pg 633, labelled as "type" but not in Bouvier 1898). — Point Lobos, coll. & don. E. F. Ricketts, 20.III.1940, 3 ♂♂ 2.3-6.6 mm; 2 ♀♀ 3.4-4.0 mm (USNM 81950). — Pulmo Reef, coll. & don. E. F. Ricketts, 19.III.1940, 3 ♂♂ 1.7-3.0 mm; 1 ♀ 2.9 mm (USNM 81948); 2 ♂♂ 2.4-2.8 mm; 2 ♀♀ 2.2-2.3 mm (USNM 1076349). — San Josef, L. C. Gulf, coll. *Albatross*, 31.III.1911, 2 ♂♂ 4.6-4.7 mm; 1 ovig. ♀ 2.1 mm; 1 ♀ 2.3 mm (USNM 1076375). — "Basse Californie", 2 ♂♂ 6.3-6.5 mm; 2 ovig. ♀♀ 4.2-4.8 mm; 1 ♀ 5.9 mm (*MNHN-Pg 636).
Mexico. Sinaloa, Maztlán, Ola Atlas Bay, N of Derecke Point, 1 ovig. ♀ 4.2 mm (USNM 1076386); Nayarit, Isabel I., shore, coll. S. A. Glassell, 2.VII.1938, 1 ♂ 5.3 mm (USNM), 19.III.1933, 2 ♂♂ 2.3-3.6 mm; 3 ovig. ♀♀ 2.0-2.8 mm; 1 juvenile (*USNM 1076364). — Acapulco, Roqueta I., Jean-Louis Étienne Expedition, coll. J. Poupin, snorkeling 1-10 m, 8.III.2005, 5 ♂♂ 2.0-5.0 mm; 3 ovig. ♀♀ 2.6-2.8 mm; 2 ♀♀ 2.0-3.0 mm (MNHN-Pg 7616). — Unknown locality, coll. "Mexico, Sec. agricultura 1926", det. W. L. Schmitt, 2 ♂♂ 6.1-7.8 mm (*USNM 62385); 1 ♂ 3.6 mm (*USNM 62415); 1 ♂ 4.0 mm; 2 ♀♀ 2.3-3.4 mm (*USNM 62436).

DISTRIBUTION. — Gulf of California, mainland Mexico from Puerto Peñasco, Sonora (31°20'N) to Huatulco Bay, Oaxaca, and El Salvador (about 13°30'N). Insular records from Revillagigedo (Socorro I.) and tip of Baja California Sur, could be *C. mclaughlinae* n. sp. (see Remarks under that species).

HABITAT. — Lower intertidal, sometimes found in large aggregations (Glassell 1937; Kerstitch 1989), and shallow water to 15-25 m, often on *Pocillopora* coral.

DIAGNOSIS

Ocular acicle terminating in two to five spines, or rarely one. Anterodorsal plate of branchiostegite smooth, at most with one to two spinules subproximally. Upper margin of right chela smooth (Fig. 1D). Outer face of left chela regularly convex (Fig. 1C). Dactyls of P2-P3 with similar setation consisting of sparse, widely-spaced tufts of setae (Fig. 1E). Propodus of P3 with dorsolateral margin weakly angled; upper half of outer face slightly concave, forming faint sulcus. Dactyl of P3 0.6-0.7 times length of propodus, with six to eight small spines on ventral margin. Telson with posterior lobes each with single terminal spine.

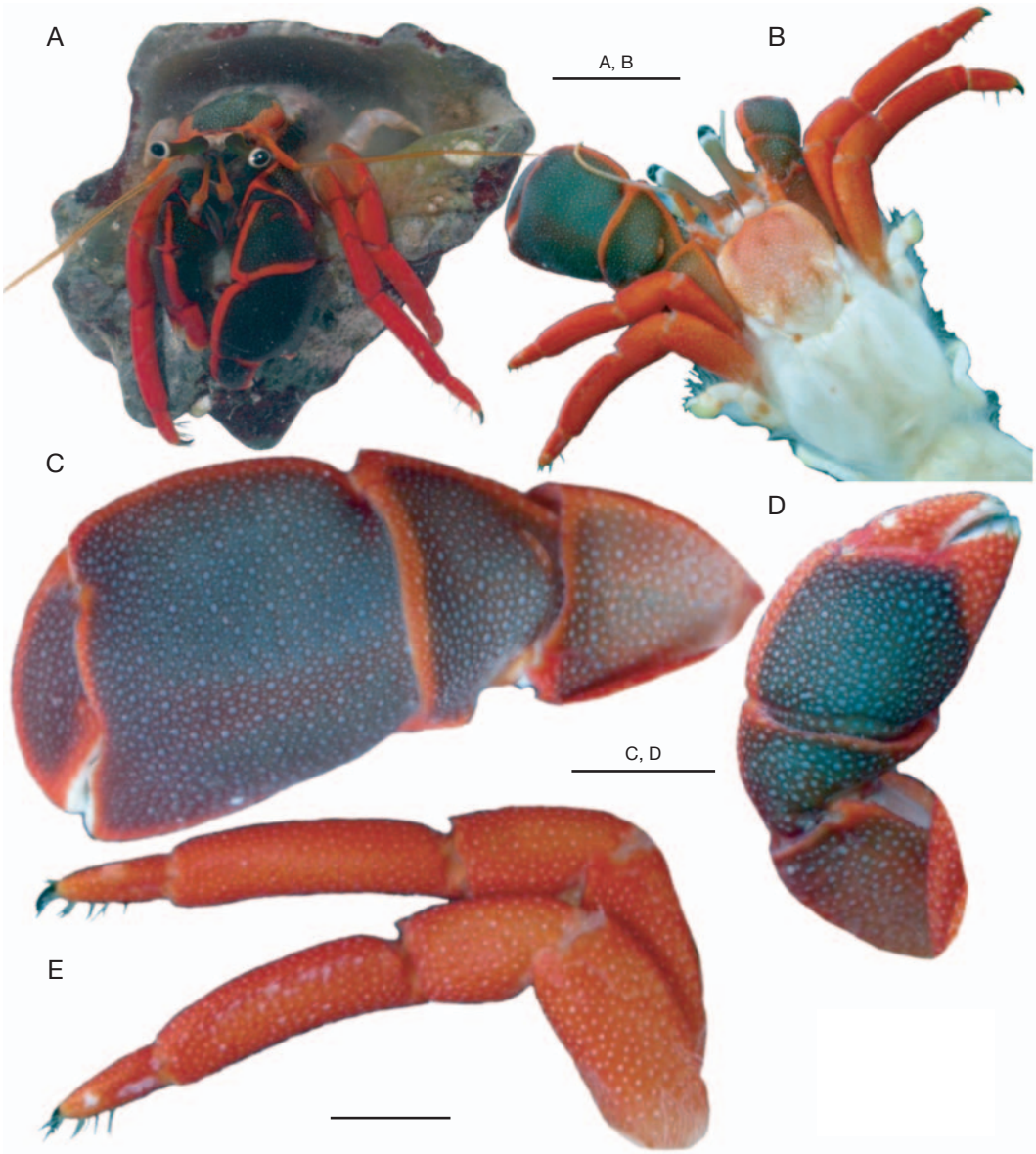

FIG. 1. — *Calcinus californiensis* Bouvier, 1898, Acapulco (MNHN-Pg 7616): **A**, live specimen in shell; **B**, dorsal aspect; **C**, left chela, outer face; **D**, right chela, outer face; **E**, left P2 and P3, outer face; **A**, ♂ 4.5 mm; **B-E**, recently preserved ♂ 5.0 mm. Scale bars: A, B, 5 mm; C-E, 2 mm.

Coloration (Fig. 1)

In life, shield black with red orange margins, turning quickly to orange after few days in preservative. Ocular acicles with orange hue at bases. Ocular peduncles dark brown to black, with narrow white band close to corneas. Antennular peduncles and flagella orange. Antennal peduncles, flagella, and antennal acicles bright red, with white-tipped spines. Chelipeds black on meri, carpi, palm of chelae, margins bright red. Dactyl of left cheliped

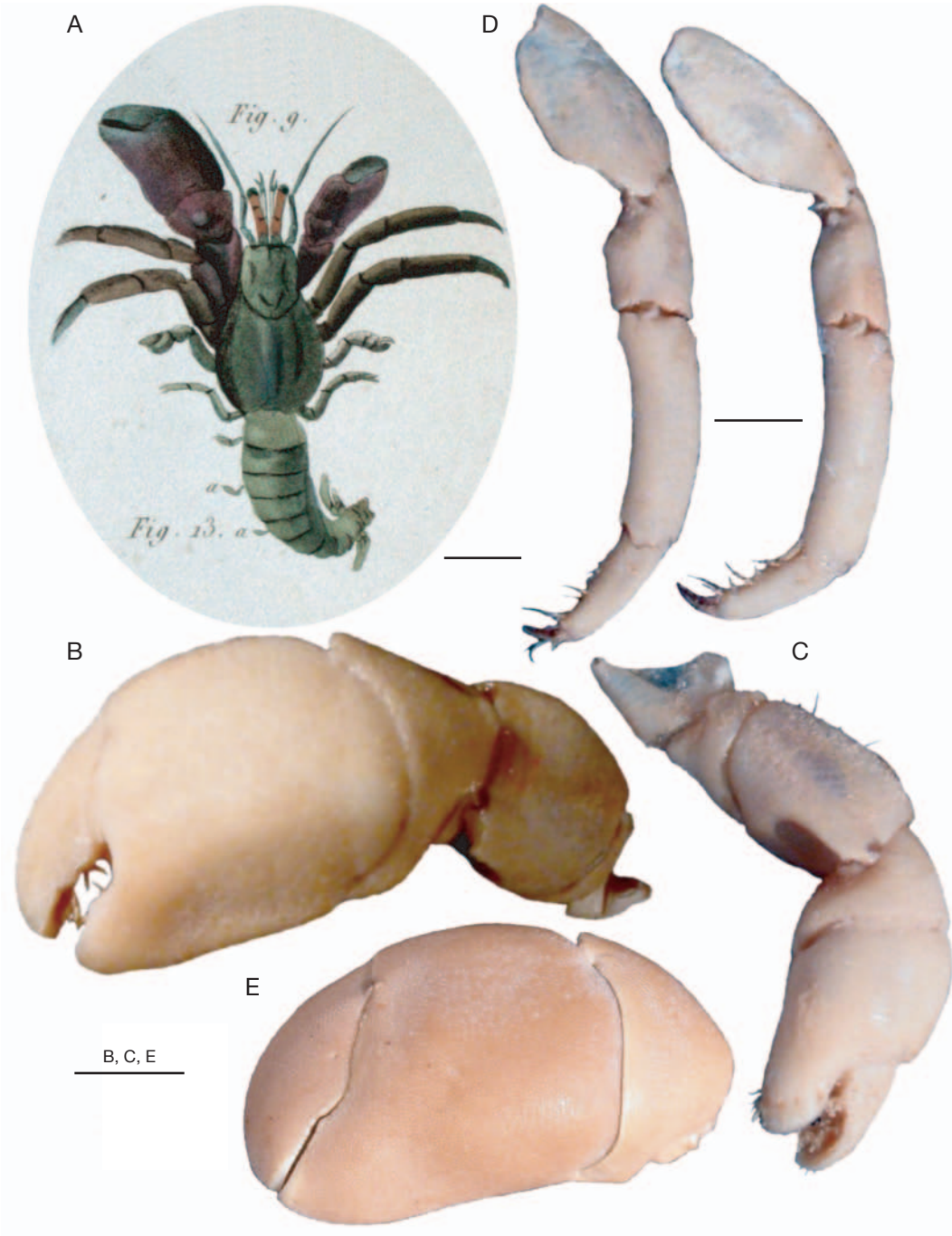

FIG. 2. — *Calcinus chilensis* (H. Milne Edwards, 1836), "Chile", syntype ♂ 5.2 mm (MNHN-Pg 635): **A**, coloration (from H. Milne Edwards, 1837: 230, pl. 22, fig. 9); **B**, left chela, outer face; **C**, right chela, outer face; **D**, right P2 and P3 (on right and left, respectively), outer face; **E**, *Calcinus* ?*chilensis*, Peru, Callao, ♂ 7.6 mm (USNM 1024522), left chela, outer face. Scale bars: A, 5 mm; B-E, 2 mm.

black on inner and outer faces, margins bright red; dactyl of right cheliped uniformly bright red; tip and cutting edges of fingers white. Ambulatory legs uniformly bright red; claws of dactyls black. Abdomen cream to white.

REMARKS

Calcinus californiensis is morphologically close to *C. mclaughlinae* n. sp. and, although this still must be proved by examination of living coloration, specimens of *C. californiensis* from west coast of Baja California (Haig *et al.* 1970; Ball & Haig 1974) and Socorro I. (Hernández Aguilera 2002) could belong in fact to *C. mclaughlinae* n. sp. Differences between the two are discussed under the latter species. The former is also morphologically close to *C. explorator* Boone, 1930 but the two can be easily separated by differences in coloration (Figs 1; 3). In *C. californiensis*, the distal white ring on the ocular peduncle is larger than in *C. explorator*; the chelipeds are black with bright red margins; the P2 and P3 are red. In *C. explorator*, the chelipeds are totally black, including the margins; the P2 and P3 meri, carpi, propodi are black; the dactyls are orange with a large black median ring, and a narrow black proximal ring. In the absence of coloration, the two species can usually be separated by the armature of the ocular acicles, with several spines in *C. californiensis*, whereas there is one in *C. explorator*; the P3 propodus with an upper margin less angled and the upper half of the outer face less concave in *C. explorator*. However, because of intraspecific variations, identification of preserved museum specimens based exclusively on morphology is not always possible. For this reason, a few specimens (marked with an asterisk under Other material examined) are herein only tentatively attributed to *C. californiensis*.

Calcinus chilensis (H. Milne Edwards, 1836) (Fig. 2)

Pagurus chilensis H. Milne Edwards, 1836: 279 [type locality: "Côte du Chili"]; 1837: 230, pl. 22, figs 9, 10. — Nicolet 1849: 191.

Calcinus chilensis – Stimpson 1858: 234. — Rathbun 1910: 597. — Porter 1935: 136. — Haig 1955: 15.

TYPE MATERIAL. — **Chile.** 1 syntype ♂ 5.2 mm, in poor condition (missing left P3) (MNHN-Pg 635).

OTHER MATERIAL EXAMINED (see Remarks). — **Peru.** Callao, 2 ♂♂ 7.5-7.6 mm (USNM 1024522).

DISTRIBUTION. — Chile (unknown locality), ?Peru.

HABITAT. — Not known, probably intertidal.

DIAGNOSIS

Ocular acicle terminating in spine. Anterodorsal plate of branchiostegite smooth, with one or two spinules subproximally. Upper margin of right chela smooth. Outer face of left chela excavated on lower half, convex on upper half (Fig. 2B). Left P3 unknown. Ventrodistal pilosity of right P2 and P3 similar, sparse (Fig. 2D). Propodus of right P3 with upper margin and upper half of outer face rounded; dactyl 0.75 times length of propodus, with eight spines on ventral margin. Telson with posterior lobes each with single terminal spine.

Coloration

In life, unknown. The coloration illustrated by H. Milne Edwards (1837: pl. 22, fig. 9), herein reproduced (Fig. 2A), is probably based on a preserved specimen.

REMARKS

Calcinus chilensis is known only by the incomplete, poorly preserved type specimen (MNHN-Pg 635), for which the exact locality where it was collected is unknown. Haig (1955) was the last to mention this taxon for the Chilean fauna, and suggested that type locality, "Chile", is possibly a labeling error. The taxon has not been listed in more recent reports of Chilean fauna (Retamal 1981; Retamal & Jara 2002).

Calcinus chilensis can be distinguished from all other eastern Pacific species by the shape of the left chela, which is elongated and excavated on the lower half of the outer face (Fig. 2B). Unfortunately, with only one specimen, it is impossible to evaluate the variability, if any, of this character. In other morphological characters, *C. chilensis* is similar to *C. explorator*. These two could possibly be conspecific, but without live coloration data this is impossible to determine.

Two discoloured specimens from Peru are herein tentatively attributed to *C. chilensis* because of the similar left chela (see Fig. 2E), the presence of only one spine on the ocular acicle, and collection locality (Callao, 12°S). A number of sibling species have been recognized in *Calcinus* recently, raising the possibility of the existence of new color variants along the eastern Pacific, especially in latitudes ranging from 10° to 25°S where scarce collections or observations have been made (Fig. 7). Such is needed to make comparisons of any new variants with *C. chilensis*.

Calcinus explorator Boone, 1930
(Fig. 3)

Calcinus explorator Boone, 1930: 28, pl. 3 [type locality: Española I. (= Hood I.), Galápagos]; 1932: 21, fig. 6. — Chace 1962: 624, figs 3, 4. — Haez *et al*. 1966: 29. — Snyder-Conn 1980: 278 (part, see Distribution). — Holthuis 1982: 320. — Hernández Aguilera *et al*. 1986: 192, 206. — Hendrickx 1992: 10; 1993b: 282, 309; 1995: 500. — Hernández Aguilera & Martínez Guzmán 1992: 4, table 1. — Correa-Sandoval & Rodríguez-Cortés 1998: 1138, 1143. — García-Madrigal del Socorro 1999: 924. — Hendrickx & Harvey 1999: 368. — Boschi 2000: 71. — Hickman & Zimmerman 2000: 58, photographs. — Hernández Aguilera 2002: 312, tab. 1. — Rodríguez Almaraz *et al*. 2002: 258.

Calcinus obscurus – Schmitt 1924: 170; 1939: 11, 25, 26. Non *C. obscurus* Stimpson, 1859.

TYPE MATERIAL (not seen, see Remarks). — **Galápagos.** Española I. (= Hood I.), Gardner Bay, stn 54, 1925 *Arcturus* Oceanographic Expedition, coll. W. Beebe, diving 4.5 m, possible holotype 1 ♂ (AMNH 12244), possible paratypes 8 specimens (AMNH 12245).
Others AMNH lots labeled as paratypes are: **Galápagos.** Eden I., 4 specimens (AMNH 12582), Genevosa I. (= Tower I.), 15 specimens (AMNH 6312). — **Cocos I.** 1 specimen (AMNH 6309), 2 specimens (AMNH 6313), 8 specimens (AMNH 12577).

MATERIAL EXAMINED (see Remarks for meaning of asterisks). — **Galápagos.** Santiago I. (= James I.), 1975, coll. H. Kühl, poor condition, 2 ♂♂ 3.0-4.5 mm; 3 ♀♀ 2.3-4.0 mm; 2 juveniles 2.0-2.2 mm (RMNH 31343). — Santa Fe I. (= Barrington I.), 10.I.1972, M. L. Azzaroli leg., don. B. Lanza, 3 ♂♂ 4.0-6.0 mm (RMNH 31948). — Isabela I., Elizabeth Bay, 26.VII.1938, coll. W. L. Schmitt, 1 ♂ 2.3 mm; 4 juveniles in shells (USNM 77820). — Santa Cruz I., coll. Galápagos New York Expedition 1923, 2 ♂♂ 3.9-4.9 mm; 1 ♀ 4.4 mm (USNM 57722). — Isabela I., Tagus Cove, 29.X.1961, coll. J. Joseph and E. Forsbergh, Swansong cruise Inter-American Tropical Fish Commission, 2 ♂♂ 4.9-5.0 mm; 1 ♀ 2.2 mm; 8 specimens in shells (USNM 1076311); 17.II.1933, 1 ♂ 3.8 mm (*USNM 1076330), 26.I.1933, 1 ♂ 1.6 mm (*USNM 1076328); 24.I.1933, 8 ♂♂ 3.0-6.0 mm; 6 ovig. ♀♀ 3.0-5.3 mm; 3 ♀♀ 2.6-4.6 mm; 6 juveniles (*USNM 1076325); 8.II.1933, 1 ♂ 2.0 mm; 1 juvenile (*USNM 1076329); 14.II.1933, 1 juvenile (*USNM 1076331). — Marchena I., 2.XII.1934, coll. W. L. Schmitt, poor condition, 5 ♂ 2.3-5.0 mm; 14 ovig. ♀♀ 2.6-4.0 mm; 3 ♀♀ 3.0-4.0 mm; 3 juveniles (USNM 1076327). — Santiago I. (= James I.), Sullivan Bay, stn 15, 24.VII.1938, coll. W. L. Schmitt, 1 ♂ 2.6 mm (USNM 77830). — Fernandina I., coll. W. L. Schmitt, 25.VII.1938, 1 specimen in shell (USNM 77824); 1 ♂ 4.6 mm (USNM 1076324). — San Cristóbal (= Chathman I.), coll. W. H. Jones, VIII.1884, 1 ♂ 8.6 mm (USNM 9332). — Pinzon I. (= Duncan I.), 13.IV.1888, coll. *Albatross*, 3 ♂♂ 4.2-6.5 mm (USNM 1076326). — Santa Maria I. (= Charles I.), 6.XII.1934, coll. W. L. Schmitt, 1 ♀ 1.9 mm; 1 juvenile (*USNM 1076332). — "Galápagos", 4 ♂♂ 5.1-6.1 mm (USNM 33504)
Clipperton I. Side reef flat at low tide, depth 0-0.3 m (1 ft), 13.IX.1958, coll. C. Limbaugh, T. Chess, A. Hambly, 1 ♂ 2.8 mm (USNM 110971); rocky intertidal, 7-26.VIII.1958, coll. E. S. Reese, 85 ♂♂ 1.7-6.8 mm; 56 ovig. ♀♀ 2.3-5.0 mm; 42 ♀♀ 1.6-3.5 mm (USNM 110990); coll. Service de Santé des Armées, 4 ♂♂ 6.0-7.6 mm (MNHN-Pg 564); 1966, coll. Le Chuiton, 1 ♂ 6.9 mm (MNHN-Pg 651); leg. Chace, Smithsonian, 10 specimens (MNHN-Pg 653).
Jean-Louis Étienne Expedition to Clipperton 2004-2005, outer reef at low tide, I-II.2005, coll. J. Poupin, J. M. Bouchard, L. Albenga, 19 ♂♂ 1.9-8.5 mm; 4 ovig. ♀♀ 2.3-3.0 mm; 1 ♀ 2.2 mm; 1 juvenile 1.1 mm; 22 specimens in shells (MNHN-Pg 7617). — Outer reef, low tide, stn 4, 10°18.11'N, 109°14'W, coll. L. Albenga, J. M. Bouchard, L. Dugrais, 9.I.2005, 3 specimens in shells (MNHN-Pg 7618). — Outer reef, low tide, stn 33, 10°18.27'N, 109°14'W, coll. L. Albenga, L. Dugrais, 25.I.2005, 5 ♂♂ 2.2-7.5 mm; 1 ♀ 3.5 mm; 5 specimens in shells (MNHN-Pg 7619).
Clarión I. Stn 2, coll. A. W. Anthony, 3 ♂♂ 4.4-5.6 mm; 1 ♀ 5.3 mm (*USNM 42545). — Sulphur Bay, coll. W. L. Schmitt, stn 141-34, 1 ♂ 4.0 mm (*USNM 1076333).
Socorro I. Braithwaite Bay, shore collecting at landing place, 20.VII.1938, coll. W. L. Schmitt, 3 specimens in shells (USNM 78212). — Crayson Cove, intertidal zone, 7.III.1937, coll. W. Williams, "M. S. Stranger", 5 ♂♂ 2.2-4.5 mm (USNM 1076323). — Coll. *Albatross*, 8 ♂♂ 2.7-6.1 mm; 2 ovig. ♀ 3.9-5.1 mm; 2 ♀♀ 2.8-3.4 mm (USNM 33505).

Mexico. Nayarit, Isabel I. shore, 2.VII.1938, coll. S. H. Glassell, "Isabel Is. Mex.",2 ♂♂ 4.0-6.0 mm (USNM 1076312).
Cocos I. I.1902, coll. P. Biolley, 1 ♂ 5.8 mm (*USNM 33503).

DISTRIBUTION. — Revillagigedo (Socorro I., Clarión I.); Clipperton I.; Cocos I.; Galápagos (Española I., Fernandina I., Genovesa I., Isabela I., Marchena I., Santa Cruz I., Santa Maria I., Santa Fe I.); Gulf of California (Carmen I., Cabo Pulmo); Mexico (Tres Marías Is., Isabel I., Punta Mita, Chamela, Tenacatita). The species is also reported from Colombia by Snyder-Conn (1980: 278, undefined place) but it must have been confused here with *C. obscurus*.

HABITAT. — Collected at low tide in coral rubble; common in upper and median part of intertidal area, occasionally in lower part up to depth of few meters.

DIAGNOSIS
Ocular acicle terminating in one or rarely two spines, on one side only. Anterodorsal plate of branchiostegite smooth with one or two spinules subproximally. Upper margin of right chela smooth (Fig. 3D). Outer face of left chela regularly convex (Fig. 3C). Dactyls of P2 and P3 with similar setation consisting of sparse, widely-spaced tufts of setae (Fig. 3E). Propodus of P3 with dorsolateral margin rounded or weakly angled; upper half of outer face evenly convex or slightly depressed. Dactyl of P3 0.7-0.8 times length of propodus, with five to seven spines on ventral margin. Telson with posterior lobes each with single terminal spine.

Coloration (Fig. 3)
In life, shield black, paler on proximal half, fading quickly to orange after few days in preservative. Ocular acicles white on distal half, black at bases. Ocular peduncles black, with narrow white band close to corneas. Antennular peduncles black with distal half of terminal segments and flagella orange. Antennal peduncles black on first, to third segments, and orange on fourth and fifth segments, flagella, and antennal acicles. Chelipeds black on meri, carpi, and chelae, with white on cutting margins and tip of fingers (Fig. 3D). Ambulatory legs uniformly black on meri, carpi and propodi. Dactyls bright orange with large black median ring, and narrow black proximal ring (sometimes unclear); terminal claws black. Abdomen cream to white. Eggs red.

REMARKS
The type series of *Calcinus explorator* is defined by Boone (1932: 22) as: "The type, an adult male specimen and four additional specimens, one ovigerous". This material was checked for us in AMNH collections by C. B. Boyko (pers. comm.). According to place of collection, one male (AMNH 12244) labelled as "Paratype" must be the holotype. The paratypes are in AMNH 12245 but this lot includes eight specimens instead of four cited by Boone. Five others AMNH lots are labeled as "Paratypes": Galápagos, Eden I., 6.IV.1923, 4 specimens (AMNH 12582); Genovesa I. (= Tower I.), C. Hay leg., 15.IV.1930, 15 specimens (AMNH 6312); Cocos I., J. Chapin leg., 17.IV.1930, 1 specimen (AMNH 6309), 2 specimens (AMNH 6313); 31.III-2.IV.1925, 8 specimens (AMNH 12577). AMNH collection includes two additional uncataloged lots from the Vanderbilt Museum labeled as "*Pagurus explorator*", probably those cited by Boone (1930: 28): Galápagos, Genovesa I. (= Tower I.), Darwin Bay, 13.III.1926; Española I. (= Hood I.), 5.II.1928.

The black coloration of *Calcinus explorator* is very similar to that of *C. obscurus*. Some authors have discussed their possible synonymy (Chace 1962: 626; Hendrickx & Harvey 1999: 368). The two species, however, can be separated by the armature of the ocular acicles, one spine in *C. explorator*, and two to four spines in *C. obscurus*; and by subtle colour differences. The chelae are totally black in *C. explorator*, whereas there are orange tints on the margins in *C. obscurus* (Figs 3B; 5A); the dactyls of P2 and P3 are orange with a large median black ring and narrow proximal black ring in *C. explorator*, whereas this color pattern is variable in *C. obscurus* (Fig. 6); the distal white band on the ocular peduncles is narrower in *C. explorator* than in *C. obscurus*. *Calcinus explorator* is also morphologically close to *C. mclaughlinae* n. sp. The two can be distinguished based on coloration (Figs 3; 4), if still present on specimens. The specimens from Clarión I., Cocos I., and Galápagos, marked by an asterisk in Material examined, had lost coloration, and thus are

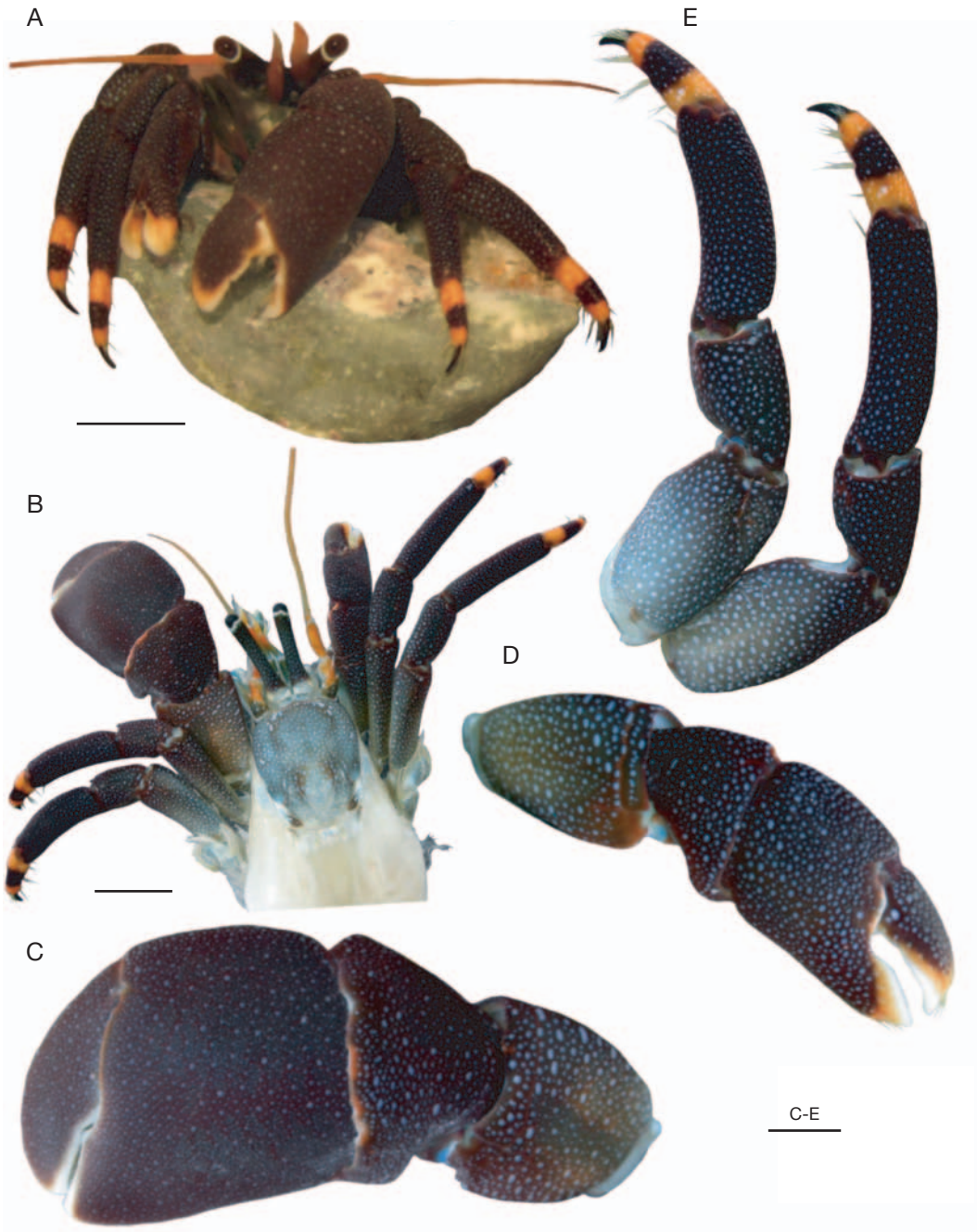

FIG. 3. — *Calcinus explorator* Boone, 1930, Clipperton (MNHN-Pg 7617): **A**, live specimen in shell; **B**, dorsal aspect; **C**, left chela, outer face; **D**, right chela, outer face; **E**, left P2 and P3, outer face; **A**, ♂ 2.4 mm; **B**-**E**, recently preserved ♂ 8.5 mm. Scale bars: A, C-E, 2 mm; B, 5 mm.

assigned to *C. explorator* based on the morphological differences cited by Chace (1962: 628). The distal margin of palm of left chela is oblique and almost continuous with the upper margin of fixed finger in *C. explorator*, whereas the distal margin of the palm is nearly transverse and makes an angle with the upper margin of fixed finger in *C. mclaughlinae* n. sp. (see Chace 1962: figs 4, 6). The upper part of the outer surface of the propodus of P3 is less flattened and concave in *C. explorator* than in *C. mclaughlinae* n. sp. However, due to intraspecific variation these two characters are often difficult to use reliably.

Calcinus explorator has been frequently reported from eastern Pacific Oceanic Islands such as Revillagigedo, Clipperton, Cocos, and Galápagos. Snyder-Conn (1980: 278), based on J. Haig unpublished identifications (M. Hendrickx pers. comm.), listed other localities where *C. explorator* co-occurs with *C. californiensis*, such as Gulf of California (Cabo Pulmo), Mexican continental islands (Tres Maria Is., Isabel I.), and Mexican coast (Bay Tenacatita). The presence of *C. explorator* in the Gulf of California has been confirmed by Rodríguez Almaraz *et al*. 2002 (Carmen I.), and along the Mexican coast by Hernández Aguilera *et al*. 1986 (Tres Maria Is., Chamela Bay), and Hendrickx & Harvey 1999 (Punta Mita). Co-occurrence of *Calcinus explorator* and *C. californiensis* along the Mexican mainland is confirmed in this study. Both species were positively identified based on morphology and color, in material examined from Nayarit, Isabel I. (coll. Glassell, 2.VII.1938, USNM).

Calcinus mclaughlinae n. sp.
(Fig. 4)

Calcinus ?californiensis – Chace 1962: 627, figs 5, 6 [Clipperton]. — Haez *et al*. 1966: 29. — ?Haig *et al*. 1970: 16. — ?Ball & Haig 1974: 101 [part]. — Hendrickx & Harvey 1999: 368 [part]. — ?Hernández Aguilera 2002: 312. Non *C. californiensis* Bouvier, 1898.

TYPE MATERIAL. — **Clipperton I.** Jean-Louis Étienne Expedition, outer reef, low tide and snorkeling 1-2 m, II.2005, coll. J. Poupin, holotype, 1 ♂ 4.4 mm (MNHN-Pg 7620).

Paratypes: same data, 10 ♂♂ 2.0-4.4 mm, 7 ovig. ♀♀ 2.0-3.0 mm; 2 ♀♀ 1.6-2.2 mm; 4 specimens in shells (MNHN-Pg 7621).

TYPE LOCALITY. — Clipperton Island.

ETYMOLOGY. — This species is dedicated to Patsy A. McLaughlin for her invaluable contributions to the systematics of the anomura. Her warm support to the first author when working at MNHN was a strong encouragement to continue in this field of research.

OTHER MATERIAL EXAMINED. — **Clipperton I.** Jean-Louis Étienne Expedition, outer reef, low tide, stn 4, 10°18.11'N, 109°14'W, 9.I.2005, coll. L. Albenga, J. M. Bouchard, L. Dugrais, and J. E. Blatteau, 2 ♂♂ 4.4-5.0 mm; 1 ovig. ♀ 2.5 mm; 5 specimens in shells (MNHN-Pg 7622). — Outer reef, scuba dive, 15 m, stn 8, 10°18.49'N, 109°14.1'W, 14.I.2005, 2 specimens in shells (MNHN-Pg 7623). — Outer reef, stn 20, 10°17.50'N, 109°13.55'W, 22.I.2005, 1 specimen in shell (MNHN-Pg 7624). — Scuba dive, 20 m, stn 41, 10°19.01'N, 109°13.75'W, 29.I.2005, 1 ♂ 1.5 mm (MNHN-Pg 7625). — Scuba dive 22 m, stn 45, 10°17.49'N, 109°13.52'W, 3.II.2005, 1 specimen in shell (MNHN-Pg 7626). — Coll. Centre de Recherche et Service de Santé des Armées, 2 ♂♂ 2.3-2.4 mm (MNHN-Pg 634). — Leg. Chace USNM, coll. 1958, 5 ♂♂; 5 ♀♀ (MNHN-Pg 631). — NW end reef, 14.VIII.1958, coll. Limbaugh, Chess, Reese, Hambly, and Wintersteen, size range males 1.3-4.2 mm, ovig. females 2.0-4.7 mm, females 1.4-3.0 mm, 1 ♂; 1 ovig. ♀ (USNM 110896). — Rocky intertidal areas, 7-26.VIII.1958, 39 ♂♂; 2 ovig. ♀♀; 30 ♀♀; 1 juvenile (USNM 110987). — NE side, 14 m (45 ft), 28.VIII.1958, 4 ♂♂; 1 ovig. ♀; 1 ♀ (USNM 110900. — NE corner, 14 m (45 ft), 30.VIII.1958, 2 ♂♂; 1 ovig. ♀ (USNM 110897). — NE side, low intertidal to 2 m (6 ft), 4.IX.1958, 1 ♀; 2 juveniles (USNM 110898). — Reef flat 0-0.3 m (1 ft), 13.IX.1958, 1 ♂ (USNM 110901). — East side reef flat, 14.IX.1958, 1 ovig. ♀ (USNM 110899).
West coast of Baja California Sur (see Remarks). Coll. A. W. Anthony, 23 ♂♂ 3.2-7.0 mm; 10 ovig. ♀♀ 2.8-5.6 mm; 4 ♀♀ 3.7-5.0 mm (USNM 42550).

DISTRIBUTION. — Clipperton Island, possibly Socorro I., and west coast of Baja California Sur.

HABITAT. — Lower intertidal to 22 m; on coral *Pocillopora*, and rubble. At Clipperton, usually found deeper than *C. explorator*, although the two can be found together.

DIAGNOSIS
Ocular acicle terminating in one or occasionally two or three spines. Upper margin of right chela

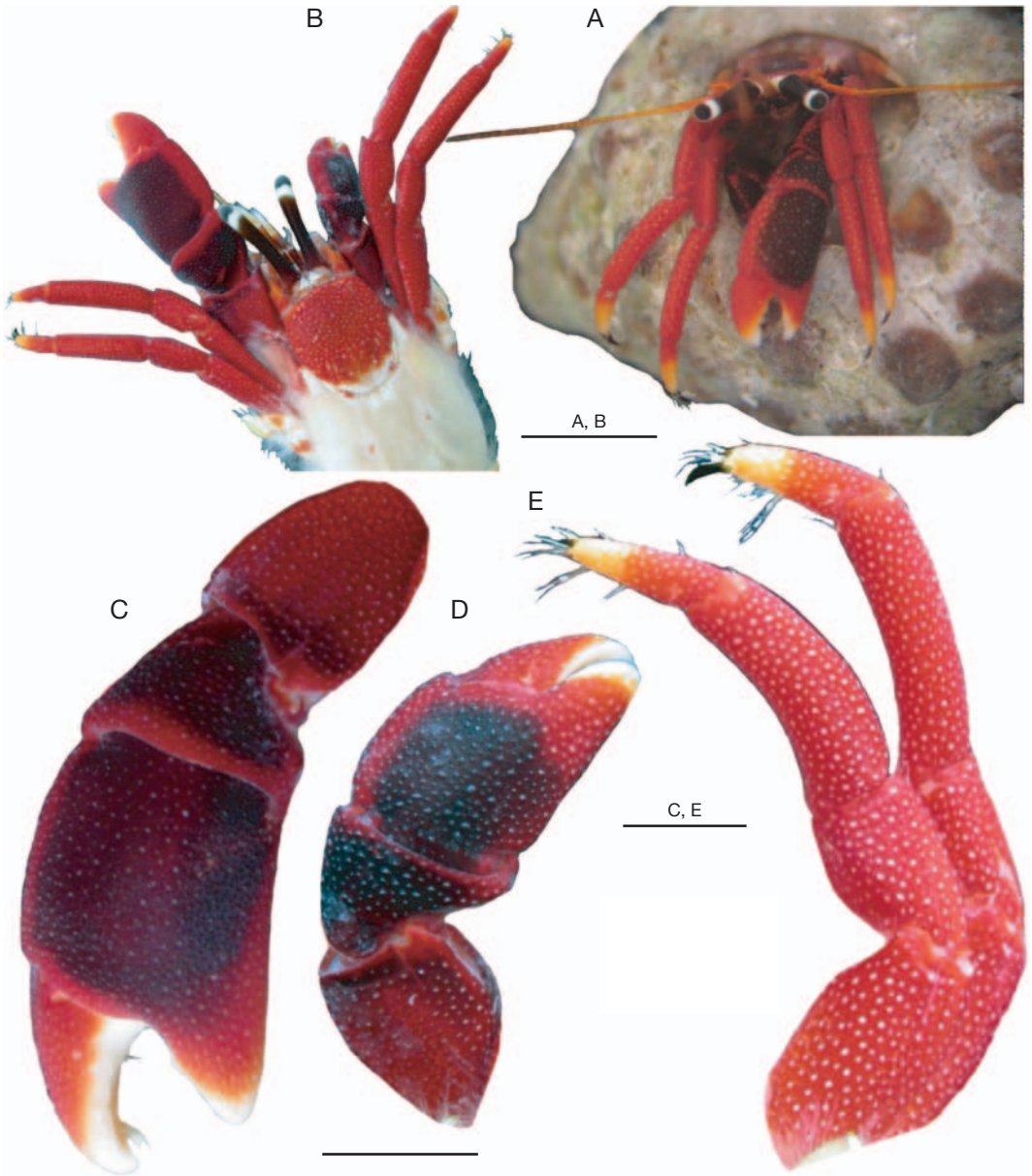

FIG. 4. — *Calcinus mclaughlinae* n. sp., Clipperton: **A**, live specimen in shell; **B**, dorsal aspect; **C**, left chela, outer face; **D**, right chela, outer face; **E**, left P2 and P3, outer face; **A**, paratype, ovig. ♀ 2.0 mm (MNHN-Pg 7621); **B**-**E**, recently preserved holotype ♂ 4.4 mm (MNHN-Pg 7620). Scale bars: A, B, 5 mm; C-E, 2 mm.

smooth. Outer face of left chela regularly convex. Dactyls of P2-P3 with similar setation consisting of sparse, widely-spaced tufts of setae. Propodus of P3 with upper part of outer face flattened or slightly concave, forming low sulcus. Dactyl of P3 0.7 times length of propodus, with six or seven small spines on ventral margin. Telson with posterior lobes each with single terminal spine. Ocular peduncles dark

brown to black with white distal band adjacent to corneas. Chelipeds black on meri, carpi, and palms of chelae, with margins bright red; dactyls of left and right chelae bright red, cutting edges white. Ambulatory legs bright red, with distal half of dactyls orange.

DESCRIPTION

Shield about 1.1 as long as broad. Rostrum acute, clearly overreaching level of broadly subtriangular lateral projections; anterior margins between rostrum and lateral projections concave. Anterodorsal plate of branchiostegite with dorsal margin smooth.

Ocular peduncles 0.8-1.0 times as long as shield, slightly constricted medially; peduncles each six times as long as diameter of corneas. Corneas weakly dilated. Ocular acicles well developed, subtriangular, terminating in simple spine, or rarely two or three spines.

Antennular peduncles reaching to distal 0.25-0.3 of ocular peduncles. Ultimate segment 0.3-0.4 times as long as shield.

Antennal peduncles shorter than antennular peduncle, reaching between midpoint and distal 0.3 of ocular peduncles. First segment with ventrolateral angle produced, bearing two to four spines. Second segment with laterodistal angle produced, terminating in bifid spine; distomesial angle unarmed or with spine. Third segment with strong spine at ventrodistal angle. Fourth segment with dorsodistal spine. Fifth segment unarmed. Antennal acicle reaching beyond proximal margin of fifth antennal segment, terminating in strong spine; dorsolateral margin with one or two spines distally, dorsomesial margin with row of three or four spines.

Left chela (Fig. 4C) 0.5-0.7 times as high as long. Dactyl slightly shorter than palm, covered with low granules; cutting edge smooth or with one or two obtuse calcareous teeth; dorsolateral margin smooth. Fixed finger with one submedian obtuse tooth on cutting edge; outer and lower faces with low granules. Palm with outer face regularly convex, finely granular; lower face with larger tubercles; inner face almost smooth; upper margin smooth. Carpus with prominent submedian tubercle on outer face; upper margin angled, dorsodistal angle unarmed. Merus stout, triangular in cross-section; ventromesial margin unarmed distally; ventrolateral margin with one stout spine distally; upper margin unarmed.

Right chela (Fig. 4D) smooth on upper margin of palm. Dactyl about as long as palm; cutting edge with one or two obtuse teeth proximally, distal half spoon-shaped; dorsal surface with low granules. Fixed finger with obtuse tooth on proximal cutting edge; distally hoof-shaped. Palm with outer face weakly convex, slightly granulated; inner face flat, almost smooth. Carpus with smooth upper margin, dorsodistal angle unarmed; outer face with 1 low submedian tubercle. Merus less broad than merus of left cheliped, outer face with numerous small pits, dorsal, ventromesial and ventrolateral margins unarmed distally.

Ambulatory legs similar from left to right P2 (Fig. 4E), reaching to tip of left cheliped when fully extended; dactyl 0.5-0.7 times as long as propodus; ventral margin with widely-spaced, sparse tufts of setae and six or seven minute spines; propodus with few long setae, and with or without minute movable spine at ventrodistal angle; carpus 0.5-0.6 times as long as propodus, with dorsodistal spine; merus about as long as propodus, with obtuse laterodistal spine. P3 (Fig. 4E) shorter than P2, reaching to base of fixed finger of left chela when fully extended; ventrodistal pilosity similar to that of P2, not brush-like; dactyl 0.6-0.7 times as long as propodus, ventral margin armed with six to eight minute spines; propodus with few setae and one or two minute movable spines at ventrodistal angle, dorsolateral margin angled, upper half of outer face flat to slightly concave, forming a low sulcus; carpus 0.6-0.7 times as long as propodus, with dorsodistal spine; merus 0.8-0.9 times as long as propodus, with obtuse laterodistal spine, sometimes absent.

Fourth pereopod semichelate, bordered with long setae on dorsal and ventral margins. Dactyl terminating in corneous claw; ventrolateral margin with row of spinules. Propodus with broad rasp on outer face consisting of several rows of corneous scales; ventral margin with row of stout spines. Carpus with dorsodistal spine. Merus unarmed. Fifth pereopod chelate, with rasp on propodus

and dactyl; carpus and merus unarmed, subovate in cross-section.

Abdomen with four unpaired biramous left pleopods in both sexes. Sixth abdominal tergite calcified, with dorsal face divided into four subequal areas by longitudinal and transverse furrows. Telson with posterior lobes asymmetrical, left more elongated than right; lobes with long setae marginally, each with one posterior spine slightly curved ventrally.

Size range
sl 1.3-5.0 mm; smallest ovigerous ♀ 2.0 mm.

Coloration (Fig. 4)
In life, shield black with bright red on margins. Ocular acicles bright red at base, white at tip. Ocular peduncles dark brown to black with white distal band adjacent to corneas. Antennular peduncles dark brown to black, with orange at articulations of segments and distal 0.5 of ultimate segment; flagella orange. Antennal peduncles, flagella, and antennal acicles orange overall. Chelipeds black on meri, carpi, palm of chelae, margins bright red; dactyls of left and right chelae bright red, white on cutting edges. Ambulatory legs bright red, distal half of dactyls orange, terminal claws black. Fifth and fourth pereopods cream to pale orange with darker orange hues on segments. Abdomen tan, sixth abdominal tergite, uropods and telson with scattered orange patches. In preservative coloration of shield (Fig. 4B) and outer face of chelae fading quickly to bright red or orange, but color pattern on P2-P3 dactyls still clear after several months.

REMARKS
Calcinus mclaughlinae n. sp. and *C. californiensis* can be considered sibling species distinguished by subtle differences in colour and morphology. When studying specimens of *Calcinus* from Clipperton Island, Chace (1962: 628) prudently reported his specimens as "*C.* ?*californiensis*". These have proved to be *C. mclaughlinae* n. sp. At that time Chace did not have available coloured specimens from the Mexican mainland for comparison. During the present study, specimens of *C. californiensis* were collected at Acapulco after the sojourn at Clipperton, and careful comparison of fresh specimens were made from both localities. *Calcinus mclaughlinae* n. sp. is clearly distinct from *C. californiensis* by evenly bright red fingers on left chela (Fig. 4A-C), and the dactyls of P2 and P3 which are bright red proximally, and orange distally (Fig. 4E). All living specimens of *C. californiensis* collected at Acapulco have the fingers of the left chela black with bright red margins (Fig. 1C), and the dactyls of P2 and P3 are evenly bright red (Fig. 1E). In the absence of coloration the two species can still be separated by the ocular acicle, with one or rarely two or three spines in *C. mclaughlinae* n. sp., whereas there are usually two to four spines in *C. californiensis*. However, as already noted by Chace (1962: 630), this character alone can sometimes be useless because of intraspecific variation.

The coloration of *Calcinus mclaughlinae* n. sp. is distinct from that of *C. explorator* (Figs 3; 4). However, uncoloured specimens of the two species can be confused because of same aspect of ocular acicle (one terminal spine). The few uncoloured specimens examined herein from the Revillagigedo (Clarión I.) and Cocos I. are very similar to *C. mclaughlinae* n. sp. by their overall morphology although tentatively assigned to *C. explorator* (see Remarks under *C. explorator*). For the time being, *C. mclaughlinae* n. sp. can be considered as endemic to Clipperton Island, although it is potentially an "insular endemic" *sensu* Garth (1960, 1991, 1992) i.e. distributed at least in the Revillagigedo and possibly also in the west coast of Baja California Sur (Punta Cala, Roca de la Vela, Punta Tosca, Magdalena Bay). *Calcinus californiensis* has previously been reported from these insular localities but has not been compared with live material from Clipperton (Haig *et al.* 1970; Ball & Haig 1974; Hernández Aguilera 2002). During the present study, a lot with 37 preserved specimens (USNM 42550) lacking colour were examined from Baja Magdalena, and are tentatively attributed to *C. mclaughlinae* n. sp. based on the presence of one spine on the ocular acicles. Two to four spines were observed in all specimens of *C. californiensis* from the Gulf and Mexican mainland.

Calcinus obscurus Stimpson, 1859
(Figs 5; 6)

Calcinus obscurus Stimpson, 1859: 83 [type locality: Panama]. — Nobili 1901: 26. — Holthuis 1954: 20, figs 5, 6. — Ball & Haig 1974: 101. — Prahl *et al.* 1979: 63. — Moran 1984: 74, fig. 6. — Lemaitre & Alvarez-León 1992: 46. — Moran & Dittel 1993: 611. — Hendrickx 1995: 550. — Hendrickx & Harvey 1999: 368. — Boschi 2000: 71.

Non *Calcinus obscurus* – Schmitt 1924: 170; 1939: 11, 25, 26 = *C. explorator* Boone, 1930.

TYPE MATERIAL. — Not seen; probably not extant. Stimpson (1859: 49) indicated that specimens he used had been chiefly supplied from the Museum of the Smithsonian Institution. His syntypes have not been found during this study, and probably were lost in the great Chicago fire of 1871 (see Manning 1993: 112).

MATERIAL EXAMINED (see Remarks for meaning of asterisks). — **El Salvador.** La Libertad, leg. G. Kruseman, summer 1952, 21 ♂♂ 2.6-8.3 mm; 9 ovig. ♀♀ 3.1-5.4 mm; 7 ♀♀ 2.2-5.4 mm (ZMA De100.355); 9 ♂♂ 2.5-7.0 mm; 3 ovig. ♀♀ 3.3-5.0 mm; 1 ♀ 3.0 mm (RMNH 9399). — La Libertad, coll. and leg. John Boursot, 10.XII.1953, 3 ♂♂ 7.5-9.6 mm (USNM 96289); VI.1953, 1 ♂ 3.4 mm; 1 ♀ 3.7 mm (USNM 96316). — La Libertad, shore collecting, 18.I.1933, 12 ♂♂ 1.8-5.3 mm; 12 ovig. ♀♀ 2.3-3.5 mm; 8 ♀♀ 2.8-4.0 mm (USNM 1076239); 21.I.1933, 2 ♂♂ 5.5-5.8 mm; 1 ♀ 4.4 mm (USNM 1076226).
Costa Rica. Puerto Culebra, shore collecting along S slough, 12.III.1933, 1 ovig. ♀ 2.0 mm (*USNM 1076234). — San Lucas I., coll. & don. M. Valerico, 15.I.1930, 2 ♂♂ 5.4-6.2 mm (*USNM 64134).
Panama. Perico I., coll. *Albatross*, 26.X.1904, 21 ♂♂ 3.2-6.2 mm; 6 ovig. ♀♀ 2.9-4.9 mm; 5 ♀♀ 3.1-4.9 mm; several others specimens damaged or in shells (USNM 40545). — Chopilla I., coll. L. G. Abele, 26.V.1969, 3 ♂♂ 7.8-9.8 mm; 1 ♀ 7.8 mm (USNM 267603); 3 ♂♂ 6.4-7.6 mm (USNM 267600); 1 ♂ 4.7 mm (USNM 267593); 1 specimen in shell (USNM 267590). — Taboguilla I., low tide, coll. L. G. Abele, A. Clarke, T. Dana, J. Graham, G. Powell, and A. Rodaniche, 30.IV.1969, 3 ♂♂ 4.4-6.4 mm; 1 ♀ 4.9 mm; 1 specimen damaged (USNM 267556); 2 ♂♂ 1.8-3.5 mm; 1 ovig. ♀ damaged; 2 ♀♀ 2.0-3.2 mm (USNM 267596); 12.VI.1969, several juveniles in shells (USNM 267602); 1 ♂ 3.4 mm (USNM 267554); 7.IV.1969, several juveniles, poor condition (USNM 267598). — East end of Panama Boulevard, intertidal, coll. L. G. Abele, 17.II.1969, 3 ♂♂ 1.7-3.7 mm (USNM 267599). — Intertidal, beyond Fort Kobke, Venado Beach, coll. L. G. Abele, A. Clarke and J. Graham, 8.V.1969, 1 ♂ 1.7 mm (USNM 267594); 1.VII.1969, 1 ♂ 5.6 mm; 1 specimen in shell (USNM 267597). — Panama city, Punta Paitilla, low tide, coll. L. G. Abele, J. Graham, N. Powell, and A. Soler, 7.VII.1969, 2 juveniles in shells (USNM 267595); 7.VII.1969, 16 ♂♂ 2.3-8.1 mm; 4 ovig. ♀♀ 3.3-4.3 mm; 2 ♀♀ 3.0-3.8 mm; several other specimens in shells (USNM 267557); 16.IX.1967, 2 ♂♂ 5.2-5.6 mm (USNM 267555); 14.IV.1969, 4 ♂♂ 2.5-4.2 mm; 3 ovig. ♀♀ 4.0-4.2 mm; 2 ♀♀ 3.5-3.6 mm (USNM 267592); 8.VI.1969, 1 ♂ 7.6 mm (USNM 267553); 31.XII.1968, 1 ovig. ♀ 3.9 mm (USNM 267601); 1.VII.1969, 6 ♂♂ 3.0-6.5 mm; several others specimens in shells (USNM 267589). — Bay of Panama, coll. F. H. Bradley, 5 ♂♂ 5.0-8.4 mm; 1 ♀ 4.2 mm (USNM 265349). — Taboga, coll. Meek and Hildebrand, 12.V.1915, 1 ♂ 6.8 mm; 1 ovig. ♀ 5.3 mm; 1 ♀ 5.2 mm (USNM 44192); coll. E. Deichmann, VII.1924, 1 ♂ 7.0 mm; 1 ♀ 5.3 mm (USNM 1076231); shore, low tide rocks, coll. E. Deichmann, V-VII.1924, 1 ♂ 7.8 mm; 1 ♀ 3.0 mm (USNM 1076243); 4 specimens in shells (USNM 1076233). — Panama city, coll. and don. "J. Zetek", I.(?)1914, 5 ♂♂ 3.0-7.3 mm (USNM 48794). — "Panama, Geay 1887, det. Forest 1949", 3 ♂♂ 5.8-6.2 mm (MNHN-Pg 804). — "Panama", 1 ♂ 4.6 mm (USNM 1076225); 1 ♂ 8.6 mm (MNHN-Pg 802); 1 ♂ 6.0 mm; 1 ♀ 7.0 mm (MNHN-Pg 803). — Bahia Honda, coll. W. L. Schmitt, stn 111, 9.III.1933, 1 ♂ 1.9 mm (*USNM 1076242); stn 114, 10.III.1933, 1 ♂ 1.8 mm (*USNM 1076241). — "Panama, Cocos Island", coll. Pinchot Exp. 1929, 1 ♂ 4.2 mm; 1 ovig. ♀ 4.2 mm (*USNM 63162).
Colombia. Port Utria, shore, coll. W. L. Schmitt, stn 418, 23.I.1935, 2 ♂♂ 4.5-5.3 mm; 2 ovig. ♀♀ 2.7-4.5 mm; 1 ♀ 2.8 mm (*USNM 1076232). — Octavia Bay, stn 433, 27.I.1935, 1 ♂ 4.5 mm (*USNM 1076240).
Ecuador. Salinas, 14.IX.1926, 9 ♂♂ 3.8-8.3 mm; 2 ovig. ♀♀ 6.5-6.8 mm; 3 ♀♀ 2.9-5.2 mm (USNM 1076227).
Peru. Máncora, intertidal, coll. W. L. Klawe, Inter. Am. Tropic. Tuna Com., 14.VI.1960, 1 ♂ 5.8 mm; 1 ovig. ♀ 6.4 mm (USNM 106445); Máncora, intertidal among stones, "W. K. Weyrauch no. 12.636", 23.IV.1959, 4 ♂♂ 4.4-5.7 mm (RMNH 14833).
West coast of South America. "Côtes ouest de l'Amérique du Sud, ancien envoi, *Patria ignota*, 1905, det. G. Nobili", 1 ♂ 9.0 mm; 3 ♀♀ 5.5-7.2 mm (*MNHN-Pg 805).

DISTRIBUTION. — Eastern Pacific, from El Salvador (La Libertad, 13°29'N) to Peru (Máncora, 4°07'S), including Ecuador, Costa Rica, Panama, Colombia and Gorgona Is. Holthuis (1954: 22) reported a doubtful record (reference not indicated) from South California, probably based on *C. californiensis*. Lemaitre & Alvarez-León (1992: 46) listed "California" in the distribution of *C. obscurus*, based on Holthuis' reference. As suggested by Hendrickx & Harvey (1999: 368), this

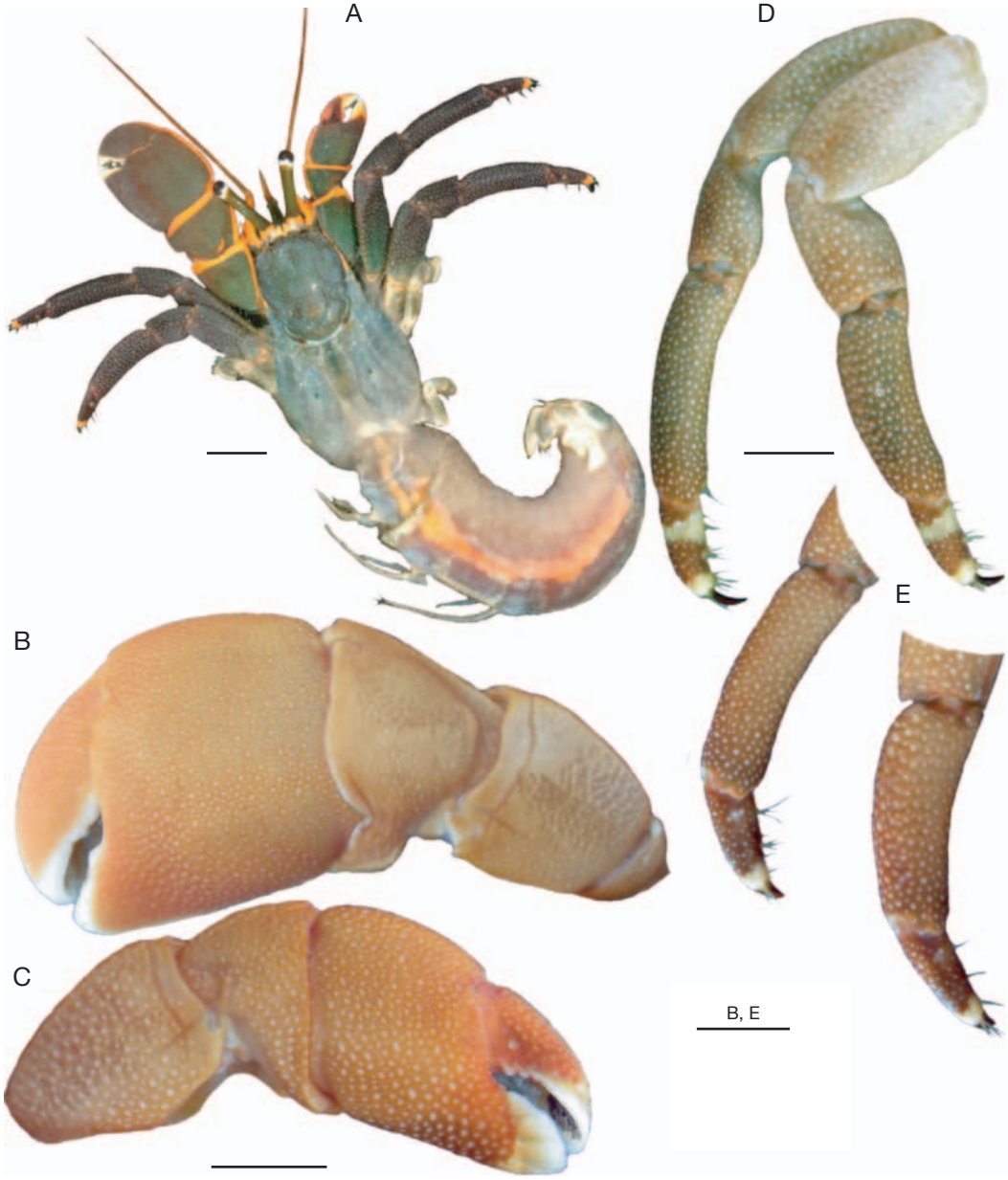

FIG. 5. — *Calcinus obscurus* Stimpson, 1859: **A**, live specimen removed from shell, dorsal view (photograph D. L. Felder); **B**-**E**, coloration strongly altered by preservative; **B**, left chela, outer face; **C**, right chela, outer face; **D**, left P2 and P3; **E**, propodi and dactyls of P2 and P3, showing alternate color pattern on dactyls; **A**, Panama, ♀ approximately 6.8 mm (ULLZ 5940); **B**-**D**, El Salvador, ♂ 6.2 mm (RMNH 9399); **E**, *ibidem*, ♂ 6.5 mm. Scale bars: A, 5 mm; B-E, 2 mm.

obscure record must be considered erroneous, and the northern limit of *C. obscurus* more confidently is La Libertad (13°29'N).

HABITAT. — Lower intertidal, among rocks, rubble, or algae; commonly found in large numbers (Stimpson 1859; Ball & Haig 1974).

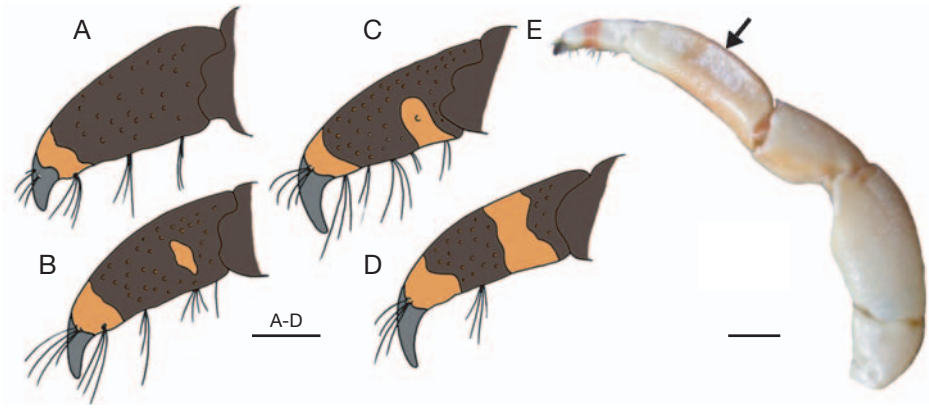

FIG. 6. — **A**-**D**, *Calcinus obscurus* Stimpson, 1859, variation of color pattern on P3 dactyl (coloration adapted from photographs): **A**, ♂ 7.5 mm, La Libertad, El Salvador (USNM 96289); **B**, ♂ 4.5 mm, Máncora, Peru (RMNH 14833); **C**, ♂ 6.4 mm, Taboguilla I., Panama (USNM 267556); **D**, ♂ 4.9 mm, Máncora, Peru (RMNH 14833); **E**, *Calcinus tibicen* (Herbst, 1791), outer face of P3 propodus, arrow indicates sulcus, ?♂ 7.0 mm, coll. Mus. Antilles 1978, Guadeloupe (MNHN). Scale bars: A-D, 1 mm; E, 2 mm.

DIAGNOSIS

Ocular acicle terminating in two to four spines, or rarely one. Anterodorsal plate of branchiostegite smooth, with one or two spinules subproximally. Upper margin of right chela smooth (Fig. 5C). Outer face of left chela regularly convex (Fig. 5B). Dactyls of P2-P3 with similar setation consisting of sparse, widely-spaced tufts of setae (Fig. 5D). Propodus of P3 with dorsolateral margin weakly angled, upper half of outer face weakly concave. Dactyl of P3 0.5-0.7 times length of propodus, with 6-8 spines on ventral margin. Telson with posterior lobes each with single terminal spine.

Coloration (Fig. 5A)

In life, shield black, posterior shield gray; ocular acicles orange with broad black band at bases. Ocular peduncles black, with narrow orange band proximally and narrow white band close to cornea. Antennular peduncles black with distal half of terminal segments and flagella orange. Antennal peduncles, antennal acicles, and flagella orange. Chelipeds with meri and carpi black, bordered with orange on upper and anterior margins; chelae black with orange on upper margins of palms and dactyls, tip of dactyls pale orange to white, cutting edges of fingers white. Ambulatory legs uniformly black on meri, carpi and propodi. Dactyls black with bright orange rings varying as follows: with single, narrow ring distally (Fig. 6A), or with submedian and distal rings (Fig. 6D), or with distal orange ring and variably developed intermediate submedian ring (Fig. 6B, C). Abdomen tan with orange hues, sixth abdominal tergite and telson gray, white at margins, uropods white. In preservative, coloration of shield, ocular peduncles and chelae fading quickly to orange. However, coloration of ambulatory legs is still visible after 36 years in some specimens, and color pattern of dactyls is still visible after 100 years in the case of specimens collected during a cruise of the USFC *Albatross* (USNM 40545).

REMARKS

Calcinus obscurus is closely allied, and easily confused with *C. explorator*. The differences between the two species are reported under the latter species. The easiest way to separate the two is by the armature of the ocular acicles, with two to four spines in *C. obscurus* instead of usually one spine in *C. explorator*. However, 3% of *C. obscurus* specimens examined have only one terminal spine on the ocular acicle, and thus this character should be used with caution to separate the two species. Coloration is overall black and very similar in *C. obscurus* and *C. explorator*, differing in minor

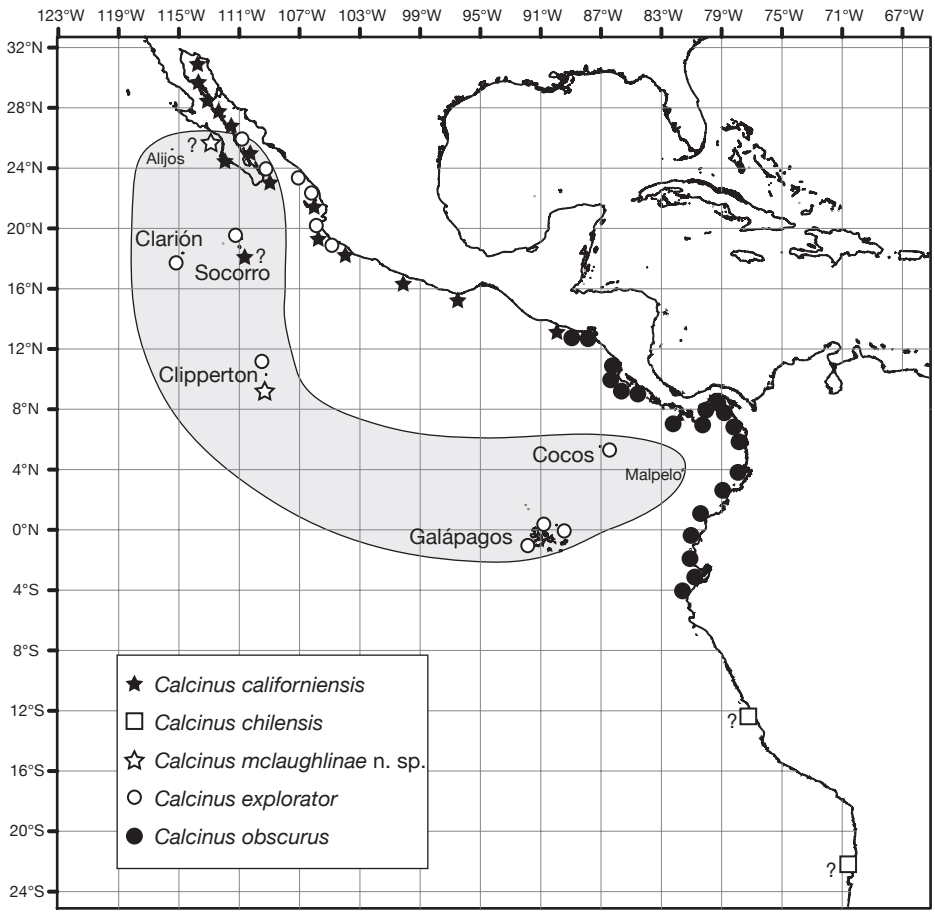

FIG. 7. — Geographic distribution of the eastern Pacific *Calcinus* species based on literature records, and material examined during this study. Shaded area represents "insular area" (see text); **?** indicates localities where specimens were identified without colour information.

details of the ocular peduncles, chelae, and dactyls of ambulatory legs (see Remarks under *C. explorator*). The most obvious color difference is the presence of orange margins on chelae in *C. obscurus* only (Figs 5A; 3C). The geographic distributions of the two are also different, with *C. obscurus* known from the mainland only from 13°29'N (La Libertad, El Salvador) to 4°07'S (Máncora, Peru), whereas *C. explorator* is insular (Cocos, Galápagos, Clipperton, Revillagigedo), and has been recorded at higher latitudes on the mainland between 25°55'N (Carmen I., Gulf of California) to 19°16'N (Tenacatita, Mexico).

DISCUSSION

Four *Calcinus* species are now recognized with certainty from the eastern Pacific: *C. californiensis*, *C. explorator*, *C. mclaughlinae* n. sp., and *C. obscurus*. The status of *C. chilensis*, a taxon described from an undetermined locality in Chile, is uncertain pending availability of additional specimens from south, approximately between 12-24°S (Fig. 7). These four eastern Pacific *Calcinus* constitute a complex of sibling species that can confidently be separated using differences in coloration, as is frequently the case in many other species of this

genus. These four species share the following morphological characters: a smooth upper margin on the right chela; a regularly convex outer face on the left chela; similar weak setation distally on P2 and P3; and only one spine on each of the posterior lobes of the telson. Among the 43 valid *Calcinus* species currently recognized, these characters are found only in four other species: *C. tibicen* (Herbst, 1791) and *C. talismani* A. Milne-Edwards & Bouvier, 1892, from the west and east Atlantic, respectively, and *C. seurati* Forest, 1951 and *C. laevimanus* (Randall, 1840), both from the Indo-West Pacific. The eastern Pacific *Calcinus* are morphologically more strongly linked to their Atlantic congeners based on similarities of the propodus of P3, which has an angled upper margin, and an upper half on the outer face flattened to slightly concave, forming sometimes a low sulcus. In the Atlantic, *C. talismani* and *C. tibicen* each have a sulcus on the propodus of P3 which is particularly distinct in the latter species (Fig. 6E). In contrast, the Indo-West Pacific *C. seurati* and *C. laevimanus* lack such sulcus. It is probable that the Atlantic and eastern Pacific *Calcinus* are closer phylogenetically, and their differentiation is the result of speciation that occurred after the closure of the Panama isthmus three million years ago.

The geographic distribution of the eastern Pacific *Calcinus* is summarized in Figure 7. It is clear that *C. obscurus* and *C. californiensis* are typically continental, while *C. explorator* and *C. mclaughlinae* n. sp. are insular. The situation is not clear-cut in *C. explorator*, for which there are several records in Mexico (Gulf of California and mainland), or for *C. californiensis*, of which there are few insular records (Socorro I. and tip of Baja California Sur). Occurrence of *C. explorator* on the mainland is now well documented. It is possible that insular records of *C. californiensis* belong in fact to *C. mclaughlinae* n. sp., at least those collected in west coast of Gulf of California and Socorro I. Additional observations of color in live specimens is needed from these localities to fully evaluate the distributions of these two species.

The documentation of *Calcinus mclaughlinae* n. sp. from Clipperton Island, based only on slight differences in morphology and coloration, supports Garth's (1965) views that incipient insular speciation is occurring on the island. As diagnostic characters are refined, it is possible that other sibling species will be discovered or added to the insular fauna of the region. In anomurans, potential candidates from Clipperton Island are *Petrolisthes glasselli* Haig, 1957, with similar morphology but a strikingly distinct color pattern when compared to specimens from Colombia (Chace 1962: 623), and in brachyurans *Paractaea sulcata* (Stimpson, 1860) and *Microcassiope xantusii* (Stimpson, 1871), which exhibit minor but consistent differences in color when compared to mainland material (Garth 1965: 38).

Key to *Calcinus* Dana, 1851 species from the eastern Pacific

1. Ocular acicle with several terminal spines (rarely 1) 2
— Ocular acicle with 1 terminal spine (rarely 2) 3

2. P2 and P3 with meri, carpi and propodi black, and dactyls black with distal orange ring (sometimes with subproximal orange ring variably developed) ..... *C. obscurus*
— P2 and P3 with meri, carpi, propodi, and dactyls, bright red ..... *C. californiensis*

3. Outer face of left palm not evenly convex, excavated in lower half ..... *C. chilensis*
— Outer face of left palm evenly convex, not excavated 4

4. P2 and P3 with meri, carpi, and propodi black; dactyls orange with black median ring and narrow black proximal ring ..... *C. explorator*
— P2-P3 with meri, carpi, and propodi bright red; dactyls bright red proximally, orange distally ..... *C. mclaughlinae* n. sp.

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REFERENCES

ALVAREZ DEL CASTILLO M., HENDRICKX M. E. & RODRÍGUEZ C. S. 1992. — Crustáceos Decápodos de la laguna Barra de Navidad, Jalisco, México. *Proceedings of the San Diego Society of Natural History* 27: 1-9.

ASAKURA A. 1992. — New record of the intertidal hermit crab, *Calcinus guamensis* Wooster, 1982 from Japan, with comments on Japanese *Calcinus*. *Journal of Natural History Museum and Institute*, Chiba 2 (1): 37-40, fig. 1.

ASAKURA A. 2002a. — Hermit crabs of the genus *Calcinus* Dana, 1851 from Japan and adjacent waters (Crustacea, Decapoda, Anomura, Diogenidae): *C. arealotus* Rahayu & Forest, 1999. *Benthos Research* 57 (1): 11-20, figs 1-5.

ASAKURA A. 2002b. — Hermit crabs of the genus *Calcinus* Dana, 1851 (Crustacea, Anomura, Diogenidae) with a brush of setae on the third pereopods, from Japanese and adjacent waters. *Tropical Zoology* 15: 27-70, figs 1-21.

ASAKURA A. & NOMURA K. 2001. — Hermit crabs of the genus *Calcinus* Dana, 1851 from Japan and adjacent waters (Crustacea, Decapoda, Anomura, Diogenidae): *C. pulcher* Forest, 1958 and *C. lineapropodus* Morgan & Forest, 1991. *Crustacean Research* 30: 94-110, figs 1-8.

ASAKURA A. & TACHIKAWA H. 2000. — A new hermit crab of the genus *Calcinus* from Micronesia, including new information on *C. revi* (Decapoda, Anomura, Diogenidae). *Journal of Crustacean Biology* 20 (Special number 2): 266-280, figs 1-6.

ASAKURA A. & TACHIKAWA H. 2003. — Hermit crabs of the genus *Calcinus* Dana, 1851 from Japan and adjacent waters (Decapoda, Anomura, Diogenidae): *C. hazletti* Haig & McLaughlin, 1984 and *C. haigae* Wooster, 1984. *Crustaceana* 76 (6): 717-739, figs 1-13.

ASAKURA A., FURUMI H., NOMURA K. & TACHIKAWA H. 2002. — A brief review of records of *Calcinus gaimardii* (H. Milne Edwards, 1848) and *C. morgani* Rahayu & Forest, 1999 from Japanese waters, with note on color variants of *C. gaimardii* (Crustacea, Decapoda, Anomura, Diogenidae). *Biological Magazine*, Okinawa 40: 33-40, figs 1-2.

BALL E. E. & HAIG J. 1974. — Hermit crabs from the tropical eastern Pacific. I. Distribution, color, and natural history of some shallow-water species. *Bulletin of the Southern California Academy of Sciences* 73 (2): 95-104, fig. 1.

BOONE L. 1930. — Scientific results of the cruises of the yachts *Eagle* and *Ara*, 1921-1928, William K. Vanderbilt, commanding. Crustacea: Anomura, Macrura, Schizopoda, Isopoda, Amphipoda, Mysidacea, Cirripedia, and Copepoda. *Bulletin of the Vanderbilt Marine Museum* 3: 1-221, pls 1-83.

BOONE L. 1932. — The littoral crustacean fauna of the Galápagos Islands. *Zoologica*, New York 14 (1): 1-62, figs 1-19.

BOSCHI E. E. 2000. — Species of decapod crustaceans and their distribution in the American Marine Zoogeographic Provinces. *Revista de Investigación y Desarrollo Pesquero* 13: 1-136, figs 1-21.

BOUVIER E.-L. 1898. — Sur quelques crustacés anomoures et brachyoures recueillis par M. Diguet en Basse-Californie. *Bulletin du Muséum d'Histoire naturelle*, Paris 4: 371-384.

CHACE F. A. 1962. — The non-brachyuran decapod crustaceans of Clipperton Island. *Proceedings of the United States National Museum* 113 (3466): 605-635, figs 1-6.

CORREA-SANDOVAL F. & RODRÍGUEZ-CORTÉS D. E. 1998. — Análisis de la distribución geográfica de los anomuros (Crustacea: Decapoda) del Golfo de California, México. *Journal of Biogeography* 25: 1133-1144, figs 1-7.

DANA J. D. 1851. — Paguridea: Conspectus Crustaceorum quae in Orbis Terrarum circumnavigatione, Carolo Wilkes e Classe Reipublicae Foederatae Duce, lexit et descripsit J. D. Dana. *Proceedings of the Academy of Natural Sciences*, Philadelphia 5: 267-272.

ÉTIENNE J.-L. 2005a. — *Clipperton, l'atoll du bout du monde*. Éditions Seuil; Septième Continent, Paris, 207 p.

ÉTIENNE J.-L. 2005b. — Expédition Clipperton. At http://www.jeanlouisetienne.fr/clipperton/ (September 2005).

GARCÍA-MADRIGAL DEL SOCORRO M. 1999. — Anomuros (Anomura) del arrecife de Cabo Pulmo-Los Frailes y alrededores, Golfo de California. *Revista de Biologia Tropical* 47 (4): 923-928.

GARTH J. S. 1960. — Distribution and affinities of the brachyuran Crustacea, *in* The biogeography of Baja California and adjacent seas. Part II. Marine biotas. *Systematic Zoology* 9: 105-123, figs 1-3.

GARTH J. S. 1965. — The brachyuran decapod crustaceans of Clipperton Island. *Proceedings of the California Academy of Sciences* 4th ser., 33 (1): 1-46, figs 1-26.

GARTH J. S. 1991. — Taxonomy, distribution, and ecology of Galápagos Brachyura, chapter 5*, in* JAMES M. J. (ed.), *Galapagos Marine Invertebrates.* Plenum, New York: 123-145.

GARTH J. S. 1992. — The brachyuran crabs of the Revillagigedo Islands, Colima, Mexico, with remarks on insular endemism in the eastern tropical Pacific. *Proceedings of the San Diego Society of Natural History* 23: 1-3.

GHERARDI F. & MCLAUGHLIN P. A. 1994. — Shallow-water hermit crabs (Crustacea, Decapoda, Anomura, Paguridae) from Mauritius and Rodrigues Islands, with the description of a new species of *Calcinus. Raffles Bulletin of Zoology* 42 (3): 613-656, figs 1-7.

GLASSELL S. A. 1937. — The Templeton Crocker Expedition. XI. Hermit crabs from the Gulf of California and the west coast of Lower California. *Zoologica*, New York 22 (3): 241-263.

HAEZ G., WISSOCQ J. C., BARLOY J. J. & NIAUSSAT P. M. 1966. — Étude zoologique des espèces rapportées de la mission « Bougainville, groupe Rouge » Clipperton été 1966. Aperçu bio-géographique. *Rapport particulier. Division de Bio-Écologie et de la Section de Radio-Écologie marine du Centre de Recherche du Service de Santé des Armées* 25: 1-37 (mimeographed).

HAIG J. 1955. — The Crustacea Anomura of Chile. Reports of the Lund University of Chile Expedition 1948-49. 20. *Lunds Universitets Årsskrift* new series 2, 51 (12): 1-68, figs 1-13.

HAIG J. 1974. — *Calcinus pascuensis*, a new hermit crab from Easter Island (Decapoda, Anomura, Diogenidae). *Crustaceana* 27 (1): 27-30, figs 1-6.

HAIG J. & MCLAUGHLIN P. A. 1984. — New *Calcinus* species (Decapoda, Anomura, Diogenidae) from Hawaii, with a key to the local species. *Micronesica* 19 (1-2): 107-121, figs 1, 2 (dated 1983, published 1984).

HAIG J., HOPKINS T. S. & SCANLAND T. B. 1970. — The shallow water anomuran crab fauna of southwestern Baja California, Mexico. *Transactions of the San Diego Society of Natural History* 16 (2): 13-32, figs 1, 2.

HENDRICKX M. E. 1992. — Distribution and zoogeographic affinities of decapod crustaceans of the Gulf of California, Mexico. *Proceedings of the San Diego Society of Natural History* 20: 1-11.

HENDRICKX M. E. 1993a. — Crustáceos Decápodos Bentónicos del Sur de Sinaloa, México. *Anales Instituto Biología, Universidad Nacional Autónoma de México* 64 (1): 1-16.

HENDRICKX M. E. 1993b. — Crustáceos decápodos del Pacífico Mexicano, *in* SALAZAR-VALLEJO S. I. & GONZÁLEZ N. E. (eds), *Biodiversidad Marina y Costera de México*. Comisión Nacional Biodiversidad y CIQRO, México: 271-318.

HENDRICKX M. E. 1995. — Anomuros, *in* FISCHER W., KRUPP F., SCHNEIDER W., SOMMER C., CARPENTER K. E. & NIEM V. H. (eds), *Guía FAO para la Identificación de especies para los fines de la pesca. Pacífico centro-Oriental.* Vol. I. *Plantas e Invertebrados*. FAO, Roma: 539-564.

HENDRICKX M. E. 1996. — Habitats and biodiversity of decapod crustaceans in the SE Gulf of California, México. *Revista de Biologia Tropical* 44 (2): 603-617, 1 fig.

HENDRICKX M. E. & HARVEY A. W. 1999. — Checklist of anomuran crabs (Crustacea: Decapoda) from the eastern tropical Pacific. *Belgian Journal of Zoology* 129 (2): 363-389.

HERNÁNDEZ AGUILERA J. L. 2002. — Crustáceos del archipiélago de Revillagigedo (Stomatopoda y Decapoda de Thalassinidea a Brachyura), Pacífico tropical oriental, *in* HENDRICKX M. E. (ed.), *Contributions to the Study of East Pacific Crustaceans*. Vol. 1. Instituto de Ciencias del Mar y Limnología, UNAM, Mazatlán: 301-315, fig. 1.

HERNÁNDEZ AGUILERA J. L. & MARTÍNEZ GUZMÁN L. A. 1992. — Notas acerca de la distribución de los estomatópodos y decápodos de aguas someras de Isla Clarión, archipiélago Revillagigedo, Colima, México. *Proceedings of the San Diego Society of Natural History* 19: 1-6, figs 1, 2.

HERNÁNDEZ AGUILERA J. L., LÓPEZ SALGADO I. & SOSA HERNÁNDEZ P. 1986. — Fauna carcinológica insular de Mexico. I. Crustáceos estomatópodos y decápodos de Isla Clarión. *Secretaria de Marina, Direccion General de Oceanographia Naval, Biologia Marina, INV OCEAN/B* 3 (1): 183-250, figs 1-3.

HICKMAN C. P. JR & ZIMMERMAN T. L. 2000. — *A Field Guide to the Crustaceans of Galápagos. An Illustrated Guidebook to the Common Barnacles, Shrimps, Lobsters, and Crabs of the Galápagos Islands.* Sugar Spring Press, Lexington, Virginia, 156 p.

HOLTHUIS L. B. 1954. — On a collection of Decapod Crustacea from the republic of El Salvador (Central America). *Zoologische Verhandelingen* 23: 1-43, figs 1-15, pls 1-2.

HOLTHUIS L. B. 1982. — A small collection of Decapod Crustacea from Galápagos Islands, *in* GRUPPO RICERCHE SCIENTIFICHE E TECNICHE SUBACQUEE (ed.), *Galápagos. Studi e Recerche. Spedizione "L. Mares – G.R.S.T.S*". Museo Zoologico dell'Universitá di Firenze, Firenze: 315-326.

KERSTITCH A. 1989. — *Sea of Cortez Marine Invertebrates. A guide for the Pacific Coast, Mexico to Ecuador.* Sea Challengers, Monterey, California, 112 p.

KOMAI T. 2004. — *Calcinus areolatus* Rahayu & Forest, an invalid taxon founded on juvenile or young stages of *Calcinus morgani* Rahayu & Forest (Crustacea, Decapoda, Anomura, Diogenidae). *Biological Magazine*, Okinawa 42: 25-38, figs 1-9.

LEMAITRE R. & ALVAREZ-LEÓN R. 1992. — Crustáceos decápodos del Pacífico colombiano: lista de especies y consideraciones zoogeográficas. *Annales del Instituto de Investigaciones Marinas de Punta de Betín* 21: 33-76.

LEWINSOHN C. 1981. — Researches on the coast of Somalia. *Calcinus tropidomanus* n. sp., a new hermit crab from Somalia. *Monitore zoologico italiano,* supplément no. 14, 10: 147-152, fig. 1.

MANNING R. B. 1993. — The scientific contributions of Williams Stimpson, an early American naturalist and taxonomist, *in* TRUESDALE F. (ed.), *History of Carcinology*. A. A. Balkema, Rotterdam; Brookfield: 109-117, figs 1-3.

MCLAUGHLIN P. A. & HOGARTH P. J. 1998. — Hermit crabs (Decapoda, Anomura, Paguridae) from the Seychelles. *Zoologische Verhandelingen* 318: 1-48, figs 1-52.

MILNE EDWARDS H. 1836. — Observations zoologiques sur les pagures et description d'un genre nouveau de la tribu des paguriens. *Annales des Sciences naturelles, Zoologie* 2e sér., 6: 257-288, pls 13-14.

MILNE EDWARDS H. 1837. — *Histoire naturelle des Crustacés, comprenant l'anatomie, la physiologie et la classification de ces animaux.* Librairie de Roret, Paris 2, 532 p., Atlas: 32 p., 42 pls.

MORAN D. A. 1984. — Additions to the known anomuran fauna of El Salvador, Central America (Crustacea: Decapoda). *Journal of Crustacean Biology* 4 (1): 72-84, figs 1-6.

MORAN D. A. & DITTEL A. I. 1993. — Anomuran and Brachyuran crabs of Costa Rica: annotated list of species. *Revista de Biologia Tropical* 41 (3): 599-617.

MORGAN G. J. 1989. — The hermit crabs (Decapoda, Anomura, Diogenidae, Paguridae) of southwestern Australia, with description of two new species. *Records of the Western Australian Museum* 14 (3): 391-417, figs 1-4.

MORGAN G. J. 1991. — A review of the hermit crab genus *Calcinus* Dana (Crustacea: Decapoda: Diogenidae) from Australia, with description of two new species. *Invertebrate Taxononomy* 5: 869-913, figs 1-63.

MORGAN G. J. & FOREST J. 1991. — Seven new species of hermit crabs from northern and western Australia (Decapoda, Anomura, Diogenidae). *Bulletin du Muséum national d'Histoire naturelle* 12 (3-4): 649-689, figs 1-15 (dated 1990, published 1991).

NICOLET H. 1849. — Zoologia, *in* GAY C. (ed.), *Historia fisica y politica de Chile*, Paris & Santiago 3: 1-547.

NOBILI G. 1901. — Viaggio del Dr. Enrico Festa nella repubblica dell' Ecuador e regioni vicine. XXIII. Decapodi e stomatopodi. *Bollettino dei Musei di Zoologia ed Anatomia Comparata della R. Università di Torino* 16 (415): 1-58.

PORTER C. E. 1935. — Catálogo de los Paguridos de Chile. *Revista Chilenea de Historia Naturale* 39: 134-137, fig. 18.

POUPIN J. 1997. — Les pagures du genre *Calcinus* en Polynésie française, avec la description de trois nouvelles espèces (Crustacea, Decapoda, Diogenidae). *Zoosystema* 19 (4): 683-719, figs 1-8.

POUPIN J. & LEMAITRE R. 2003. — Hermit crabs of the genus *Calcinus* Dana, 1851 (Decapoda, Anomura, Diogenidae) from the Austral Islands, French Polynesia, with description of a new species. *Zootaxa* 391: 1-20, figs 1-5.

POUPIN J. & MCLAUGHLIN P. A. 1998. — Additional *Calcinus* (Decapoda, Anomura, Diogenidae) from French Polynesia with three new species and a key to Indo-West Pacific species. *Crustacean Research* 27: 9-27, figs 1-4.

POUPIN J., BOYKO C. B. & GUZMÀN G. L. 2003. — *Calcinus* from Easter Island, with biogeographic considerations (Crustacea, Decapoda, Anomura, Diogenidae). *Memoirs of Museum of Victoria* 60 (1): 91-97, fig. 1.

PRAHL H. VON, GUHL F. & GRÖGL M. 1979. — *Gorgona*. Universidad de los Andes, Futura Grupo Editorial Ltd, Bogota, 279 p.

RAHAYU D. L. & FOREST J. 1999. — Sur le statut de *Calcinus gaimardii* (H. Milne Edwards, 1848) (Decapoda, Anomura, Diogenidae) et description de deux espèces nouvelles apparentées. *Zoosystema* 21 (3): 461-472, figs 1-4.

RATHBUN M. J. 1910. — The stalk-eyed Crustacea of Peru and the adjacent coast. *Proceedings of the United States National Museum* 38: 531-620, figs 1-3, pls 36-56.

RETAMAL M. A. 1981. — Catálogo ilustrado de los crustáceos decápodos de Chile. *Gayana Zoologia*, Universidad de Concepción 44: 1-110, figs 1-208.

RETAMAL M. A. & JARA C. 2002. — La Carcinología en Chile, *in* HENDRICKX M. E. (ed.), *Contributions to the Study of East Pacific Crustaceans.* Vol. 1. Instituto de Ciencias del Mar y Limnología, UNAM, Mazatlán: 195-208, figs 1, 2.

RODRÍGUEZ ALMARAZ G. A., GALLARDO TEJEDA W. & CAMPOS E. 2002. — Crustáceos decápodos intermareales de la Isla Carmen, Baja California Sur, México, con notas sobre su distribución ecológica, *in* HENDRICKX M. E. (ed.), *Contributions to the Study of East Pacific Crustaceans.* Vol. 1. Instituto de Ciencias del Mar y Limnología, UNAM, Mazatlán: 255-264, figs 1-4.

RODRÍGUEZ DE LA CRUZ C. M. 1987. — *Crustáceos decápodos del Golfo de California.* Secretaría de Pesca, México, 306 p.

SCHMITT W. L. 1924. — The Macrura and Anomura collected by the Williams Galápagos Expedition, 1923. *Zoologica*, New York 5 (15): 161-171, figs 39-41.

SCHMITT W. L. 1939. — Decapod and other Crustacea collected by the Presidential Cruise of 1938 (with introduction and station data). *Smithsonian Miscellaneous Collections* 98 (8): 1-28.

SHIH H. T. 1998. — [The *Calcinus* hermit crabs of Taiwan]. *Taiwan Natural Science* 59: 82-94, figs 1-35 (in Chinese).

SHIH H. T. & LEE S. C. 1997. — Identity of two hermit crabs, *Calcinus vachoni* Forest, 1958, and *Calcinus seurati* Forest, 1951, from the coral reefs of Taiwan (Crustacea, Decapoda, Anomura). *Journal of the Taiwan Museum* 50 (1): 21-31, figs 1-6.

SHIH H. T. & YU H. P. 1995. — New records of *Calcinus* hermit crabs (Decapoda, Anomura, Diogenidae) from Taiwan. *Zoological Studies* 34 (4): 241-247, figs 1-4.

SNYDER-CONN E. 1980. — Arthropoda: Crustacea Paguroidea and Coenobitoidea (Hermit Crabs), chapter 18, *in* BRUSCA R. C. (ed.), *Common Intertidal Invertebrates of the Gulf of California*. 2nd ed. The University of Southern Arizona Press, Tucson: 275-285, figs 1-12.

STIMPSON W. 1858. — Prodromus descriptionis animalium evertebratorum quæ in Expeditione ad Oceanum Pacificum Septentrionalem, a Republica Federata missa, Cadwaladara Ringgold et Johanne Rodgers Ducibus, observavit et descripsit. Pars VII. Crustacea Anomoura. *Proceedings of the Academy of Natural Sciences*, Philadelphia 10: 225-252 [63-90].

STIMPSON W. 1859. — Notes on North American Crustacea in the Museum of the Smithsonian Institution, no. 1. *Annals of the Lyceum of Natural History of New York* 7: 49-93, pl. 1.

VILLALOBOS HIRIART J. L., NATES RODRÍGUEZ J. C., CANTÚ DÍAZ BARRIGA A., VALLE MARTÍNEZ M. D., FLORES HERNÁNDEZ P., FERNÁNDEZ LIRA E. & SCHMIDTSDORF VALENCIA P. 1989. — *Listados faunísticos de México.* I. *Crustáceos estomatópodos y decápodos intermareales de las islas del Golfo de California, México*. Instituto de Biología Universidad Nacional Autónoma de México, México, ix + 114, 4 figs.

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