Zootaxa 3550: 43–60 (2012)
www.mapress.com/zootaxa/

Article

ISSN 1175-5326 (print edition)
ZOOTAXA
ISSN 1175-5334 (online edition)

urn:lsid:zoobank.org:pub:214A5D4F-E406-4670-BBB6-2EA5931713E9

Deep-water decapod crustaceans studied with a remotely operated vehicle (ROV) in the Marquesas Islands, French Polynesia (Crustacea: Decapoda)

JOSEPH POUPIN[1, 4], LAURE CORBARI[2], THIERRY PÉREZ[3] & PIERRE CHEVALDONNÉ[3]

[1]*Institut de Recherche de l'École Navale, IRENav, groupe des écoles du Poulmic, CC 600, Lanvéoc, F-29240 BREST Cedex 9, France. E-mail: joseph.poupin@ecole-navale.fr*

[2]*UMR7138 Systématique, Adaptation, Évolution, Muséum national d'Histoire naturelle, 43 rue Cuvier, 75005 Paris, France. E-mail: laure.corbari@mnhn.fr*

[3]*UMR CNRS 7263 IMBE, Institut Méditerranéen de la Biodiversité et d'Écologie marine et continentale, Aix-Marseille Université, Station Marine d'Endoume, Rue de la Batterie des Lions, 13007 Marseille, France. E-mail: thierry.perez@imbe.fr, pierre.chevaldonne@imbe.fr*

[4]*Corresponding author*

Abstract

Decapod crustaceans were studied in the Marquesas Islands, French Polynesia, between 50–550 m by using a remotely operated vehicle (ROV) equipped with high resolution cameras and an articulated arm. Careful examination of videos and photographs combined with previous inventories made in the area with conventional gears allowed the identification of 30 species, including 20 species-level determinations. Species identified belong to shrimps (Penaeoidea, Stenopodidea, and Caridea), lobsters (Astacidea and Achelata), anomurans (Galatheoidea and Paguroidea), and brachyuran crabs (Dromioidea, Homolodromioidea, Raninoidea, Leucosioidea, Majoidea, Parthenopoidea, Portunoidea, and Trapezioidea). Most of these species were observed and photographed *in situ* for the first time. A discussion is given on the geographic distribution, density, ecology, and behavior.

Key words: French Polynesia, Marquesas Islands, Crustacea, Decapoda, marine deep-water species, underwater observations, species' habitats, ROV, ecology, inventory

Résumé

Les crustacés décapodes ont été étudiés aux îles Marquises, Polynésie française, entre 50-550 m avec un sous-marin commandé à distance (ROV) équipé de caméras haute résolution et d'un bras manipulateur. Un examen minutieux des vidéos et des photographies, combiné avec les inventaires précédemment effectués dans la région avec des moyens conventionnels, permettent d'identifier 30 espèces, dont 20 déterminées au niveau de l'espèce. Les espèces identifiées sont des crevettes (Penaeoidea, Stenopodidea et Caridea), des langoustes (Astacidea et Achelata), des anomoures (Galatheoidea et Paguroidea) et des crabes brachyoures (Dromioidea, Homolodromioidea, Raninoidea, Leucosioidea, Majoidea, Parthenopoidea, Portunoidea et Trapezioidea). La plupart de ces espèces ont été observées et photographiées *in situ* pour la première fois. Une discussion est proposée sur les distributions géographiques, les densités, l'écologie et les comportements observés.

Introduction

The Marquesas Islands (French Polynesia) represent a unique volcanic archipelago in the southwestern Pacific Ocean. The thirteen islands, shallows, and seamounts are almost devoid of coral reefs. They, however, display a drowned paleo-reef at a depth of ca. 95 m (Rougerie *et al.* 1992, Cabioch *et al*. 2001). The Marquesas waters are also remarkable for the high richness of its plankton and nutrients when compared to other oligotrophic Polynesian or South Pacific archipelagos. Isolation from other islands has produced a high proportion of endemic species

Accepted by P. Castro: 3 Oct. 2012; published: 15 Nov. 2012

(Allen 2008). The Marquesas area therefore is an area of considerable ecological, environmental, cultural and economic interests. Little scientific data are yet available, however, including information about marine biodiversity, particularly on the deep sea surrounding the islands.

Crustaceans of deep-water communities had been previously studied in the Marquesas between 50–1200 m by using conventional gear such as beam trawl, dredge, and traps. The last research cruises in the archipelago were those of the SMCB, R/V *Marara* (1986-1996), with 1620 traps set between 50–1050 m (Poupin 1996), and the MUSORSTOM 9 Expedition, on board R/V *Alis*, in August-September 1997, with 168 dredge and beam trawl stations between 60–1200 m (Richer de Forges *et al.* 1999). Crustacean specimens of these cruises are deposited in the Muséum national d'Histoire naturelle, Paris (MNHN) and they have been included in many taxonomic works, such as Ahyong (2002), Burukovsky (2006), Castro (1997, 2000, 2005, 2007), Castro *et al.* (2003), Crosnier (2002), Galil (2001a, b, c, 2003), Macpherson (2000), McLay (2001), and Poupin (2001). A list of species has been compiled by Poupin (2005) and is regularly updated (http://decapoda.free.fr/). Currently 153 species of Decapoda and Stomatopoda are known from 50 m and deeper in the Marquesas. The ecology of these species remains, however, poorly known.

In 2011–2012, a scientific expedition ("*Pakaihi i te Moana*", or "respect of the ocean" in the Marquesan language) was organized by the French Agence des Aires Marines Protégées (AAMP) in collaboration with the French Polynesian government, the Marquesas Islands local authorities, and four scientific institutions, the Centre National de la Recherche Scientifique (CNRS), Institut Français pour le Développement (IRD), Institut Français de Recherche pour l'Exploitation de la Mer (IFREMER), and the Muséum national d'Histoire Naturelle (MNHN). The overall goal of the expedition was to improve the knowledge and management of the marine life around these distant and relatively unspoiled islands. The expedition took place from November 2011 to February 2012, with four different legs. Leg 3, between 10–30 January 2012, concentrated on remote marine biodiversity, mainly with SCUBA dives in marine caves at depths of 10–50 m and submersible dives with a remotely operated vehicle (ROV) at depths of 50–550 m. Observations presented herein were made during the ROV dives of leg 3 only. The use of a ROV offered the great opportunity to observe for the first time the habitats, species associations, and population densities of some of the deep-water decapods previously listed. The present study provides a list of the species of decapods identified on videos and photographs, illustrating a few species *in situ*, and revealing some features of their ecology and behaviour.

Methods

The expedition vessel was R/V *Braveheart*, 39 m long, registered in New Zealand (Fig. 1a). It was custom-fitted to operate the ROV *Super Achille* built and owned by COMEX, Marseille, France (Fig. 1b–c). *Super Achille* can be deployed to a depth of 1000 m. It is equipped with high-definition cameras and has a 49 cm long, three-function articulated arm to collect benthic organisms. Observations during dives were made on control screens with the possibility to take high-definition photographs (Fig. 1d). Object measurements were made possible by two laser beams 60 mm from each other (Fig. 3c). Videos were recorded for further observations, with a maximum storage capacity of 60 minutes in high definition for each dive. Most of the determinations made for this study are based on *in situ* photographs. A few small specimens were also sampled with the ROV articulated arm.

Fourteen of the total 39 stations of leg 3 were explored with the ROV. These stations are listed and briefly described in Table 1; localities shown in Fig. 2.

Results

List of species

The supra-generic classification follows De Grave *et al*. (2009) updated in the WoRMS database (http://www.marinespecies.org/). Stations numbers are listed in Table 1. Reported depths were those recorded when the photographs were taken. The few small-sized species that were collected with the articulated arm (one for each Pandalidae, Palaemonidae, and Munididae, two for each Paguridae, and Trapeziidae) are indicated with MNHN

field numbers (*e.g.* LC95). These specimens will be available for study as part of the MNHN collections. Species previously collected in the Marquesas during the campaigns of R/V *Marara* and *Alis* are indicated with collections sites and depth ranges. Additional photographs of the species listed herein are available at http://decapoda.free.fr/marquesas.php

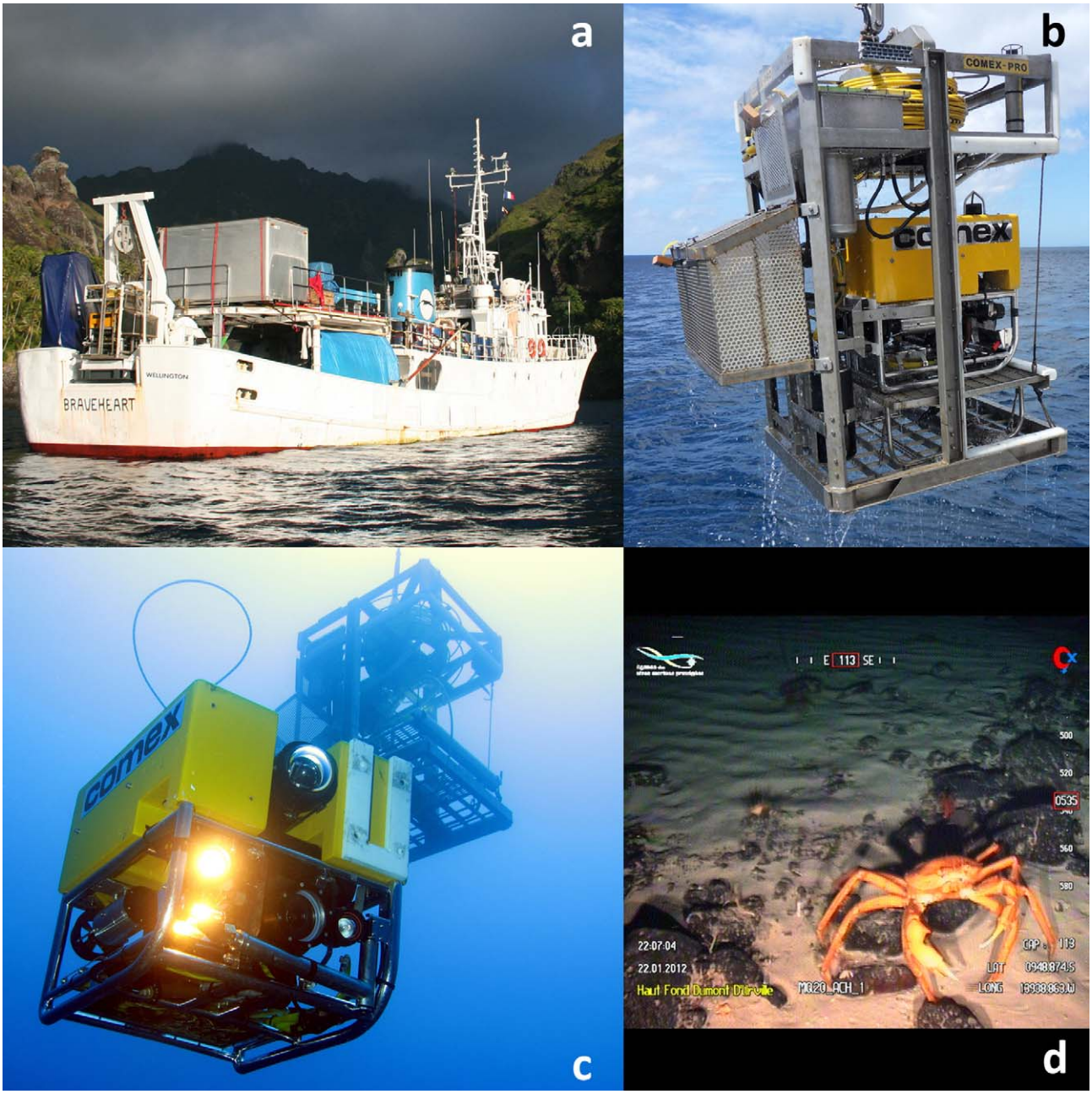

FIGURE 1. Equipment used for in situ observations between 50–550 m during the AAMP expedition to the Marquesas. a) R/V Braveheart, 39 m, at Fatu Hiva Island. The ROV is on the stern, under the gantry crane; the control cabin and remote video processing equipment are in the grey container, on the upper deck (photo J. Poupin); b) ROV *Super Achille* in its cage during a recovery operation. Organisms collected with the articulated arm are stored in the iron basket visible on the side of the ROV cage; the leash that links the cage to the ROV is 70 m long and it is wound on top of the cage (photo P. Chevaldonné); c) ROV out of its cage during a pre-dive at stn 19 (photo T. Pérez); d) Screen photograph taken during dive at stn 25, showing information available for each dive: course of R/V, latitude, longitude, depth, station number, island (photo COMEX).

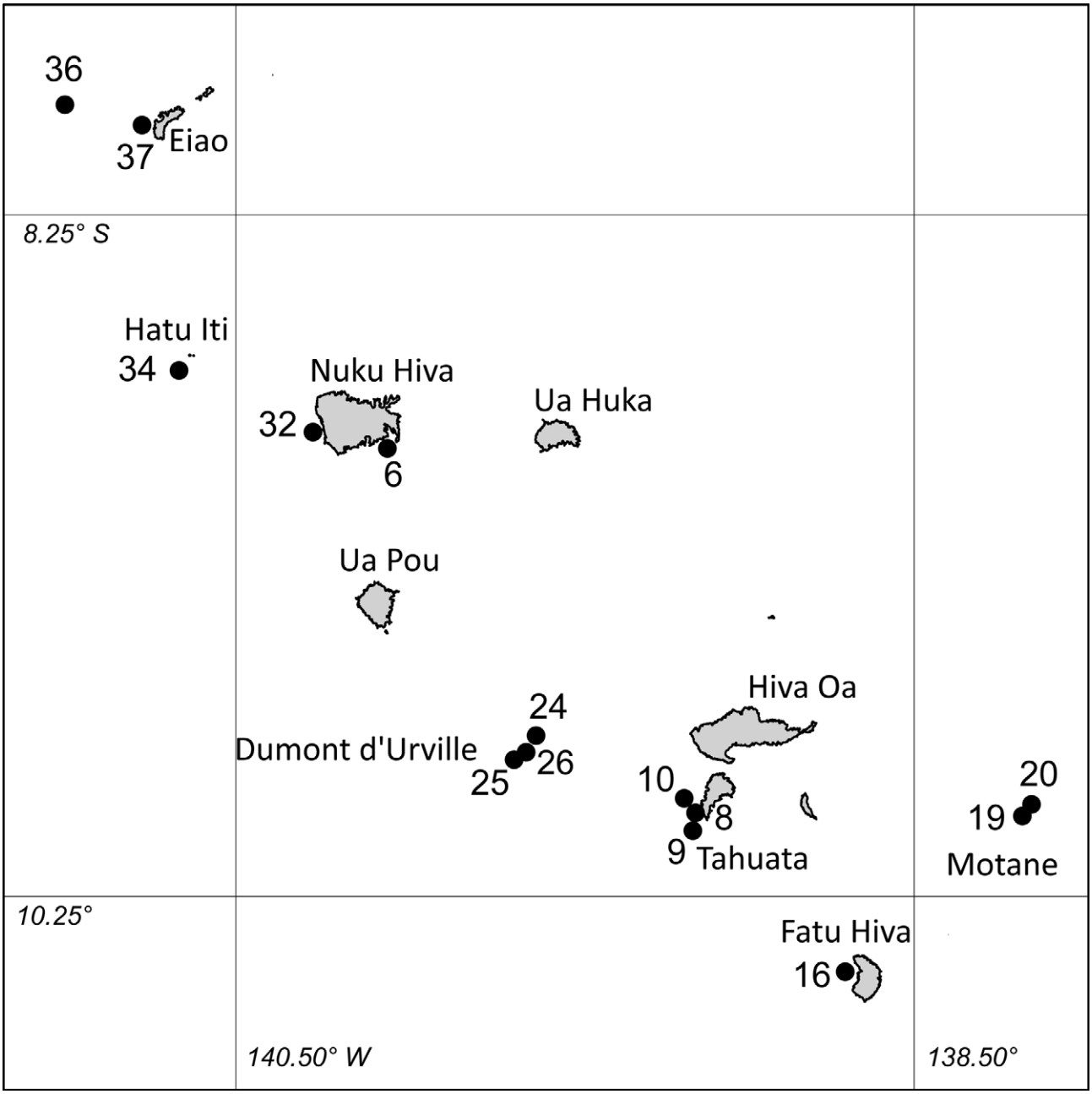

FIGURE 2. ROV stations in the Marquesas Islands, French Polynesia, during the AAMP expedition, leg 3, January 2012. Stations numbers are listed in Table 1.

ORDER DECAPODA Latreille, 1802

SUBORDER DENDROBRANCHIATA Bate, 1888

Superfamily Penaeoidea Rafinesque, 1815

Family Aristeidae Wood-Mason & Alcock, 1891

Aristaeopsis edwardsiana (Johnson, 1867). Stn 16, Fatu Hiva, 524 m (Fig. 3a). R/V *Alis*, beam trawl, Eiao, Nuku Hiva, Ua Pou, Fatu Hiva, 497–805 m.

TABLE 1. Station data for the 14 ROV dives conducted during the AAMP Expedition to the Marquesas, leg 3, January 2012.

Station number	Station name	Date (01/2012)	Latitude	Longitude	Depth range (m)	Location, description
6	MQ6-ACH	13	8°56.013'S	140°01.699'W	60–76	SE Nuku Hiva, E of Controleurs Bay, sandy bottom, flat
8	MQ8-ACH	14-15	9°58.989'S	139°07.887'W	50–60	W Tahuata, sandy bottom, flat
9	MQ9-ACH1	14	9°58.856'S	139°07.849'W	125–240	W Tahuata, sub-vertical rocky cliffs and bioclastic sand ledges, shelf edge at 120-150 m with caves in paleo-reef limestone
10	MQ9-ACH2	16	9°58.021'	139°08.896'W	278–370	W Tahuata, outer wall of paleo-reef, sub-vertical rocky cliffs interrupted by steep coarse-grained bioclastic sand ledges
16	MQ14-ACH	17-18	10°28.270'S	138°41.289'W	120–530	W Fatu Hiva, vertical wall with large overhangs interrupted by bioclastic sand ledges. Paleo-reef edge at 140 m. Strong currents at 500 m. Cold-water corals at 200 m
19	MQ17-ACH1	19	10°00.285'S	138°10.958'W	40–250	Motane (Eastern Bank 'Point 18'), vertical wall and coarse bioclastic sand ledges with coral rubbles from 250 to 120 m. Paleo-reef edge at 120 m with large rocky overhangs. Above 120 m, fine coral sand then live coral community
20	MQ17-ACH2	19	10°00.454S	138°11.333'W	400–500	Motane (Eastern Bank ' Point 18'), vertical wall and coarse bioclastic sand ledges with coral rubbles
24	MQ20-ACH1	22	9°48.033'S	139°37.897'W	315–340	Dumont d'Urville Seamount, summit of seamount, strong currents, large black volcanic rocks and coarse sand with coral rubbles (mostly deep-sea solitary *Rhizotrochus*)
25	MQ20-ACH2	22	9°48.882'S	139°38.873'W	550–550	Dumont d'Urville Seamount, side of seamount, gentle slope of muddy sand and occasional large volcanic rocks
26	MQ20-ACH3	22	9°48.700'S	139°38.545'W	430–450	Dumont d'Urville Seamount, side of seamount, gentle slope of muddy sand and occasional large volcanic rocks
32	MQ26-ACH	24-28	8°53.777'S	140°15.179'W	110–400	W Nuku Hiva, slope with muddy sand and occasional rocky outcrops from 400 to 350 m. Cold-water corals at 360 m. From 350 to 170 m coarse bioclastic sand, then a large vertical wall near 150 m (paleo-reef edge). Very strong tidal currents at 350 m
34	MQ28-ACH1	25	8°42.438'S	140°38.582'W	100–350	Hatu Iti rocks, slope of muddy sand (350 m) to coarse bioclastic sand (200 m). Few rocks at 180 m. Vertical wall from 160 to 120 m. Paleo-reef edge at 120 m then fine coral sand gently sloping up
36	MQ30-ACH1	26	7°59.864'S	140°44.894'W	120–300	NW Eiao, steep slope of coarse sand and small rocks at 120-170 m, cold-water corals at 165 m
37	MQ31-ACH1	27	7°56.054'S	140°59.010'W	120–300	Hinakura bank (off NW Eiao), steep sandy slope, a few rocks around 280 m, a rocky wall at 230-250 m,

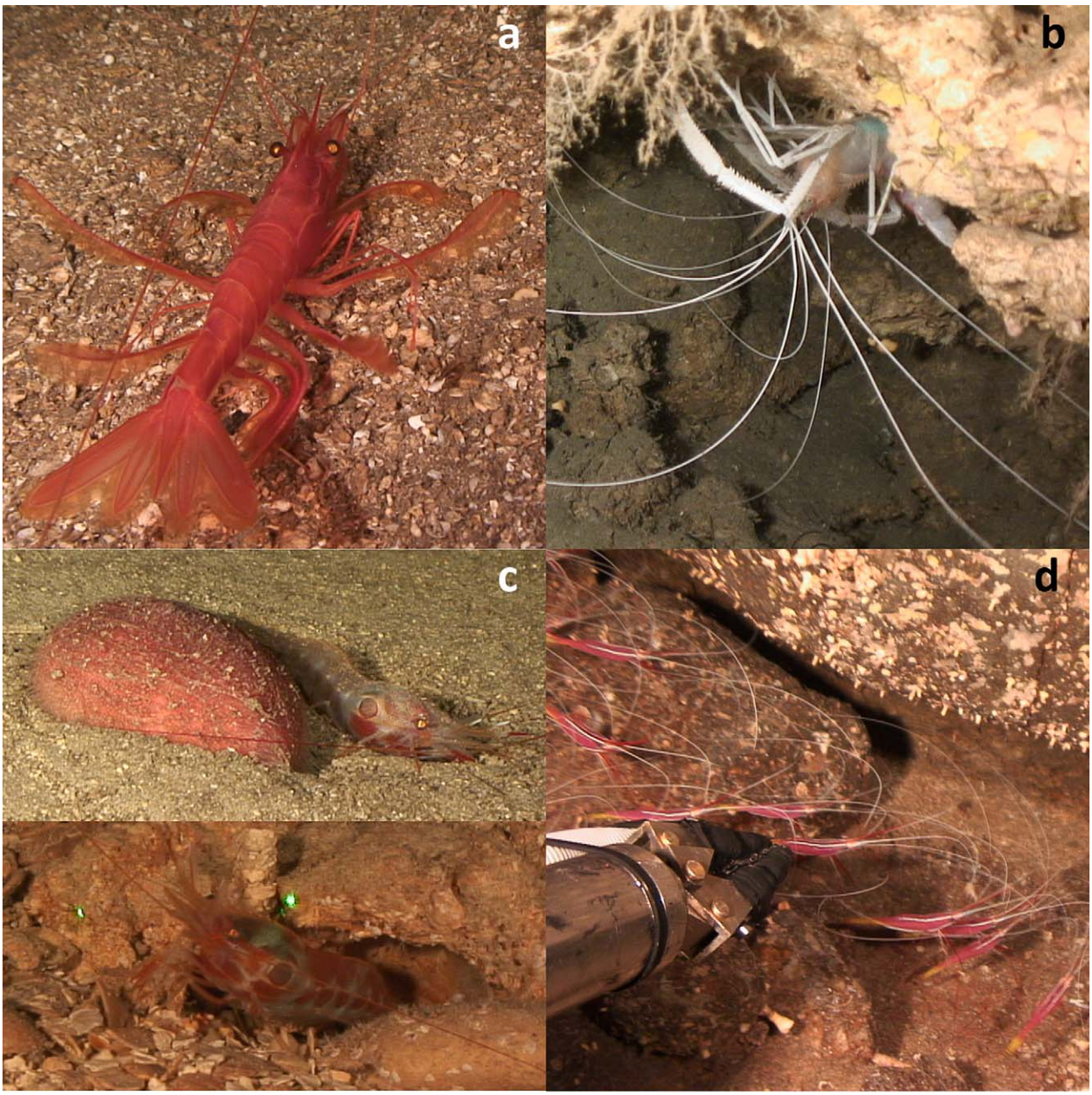

FIGURE 3. Shrimps photographed by ROV *Super Achille*: a) *Aristaeopsis edwardsiana* (Johnson, 1867), stn 16, Fatu Hiva, 524 m; b) *Stenopus pyrsonotus* Goy & Devaney, 1980, stn 32, Nuku Hiva, 129 m; c) *Heterocarpus* aff. *ensifer* A. Milne-Edwards, 1881, stn 32, Nuku Hiva, 380 m (distance between two laser green spots is 60 mm); d) *Plesionika flavicauda* Chan & Crosnier, 1991, stn 16, Fatu Hiva, 164 m.

SUBORDER PLEOCYEMATA Burkenroad, 1963

INFRAORDER STENOPODIDEA Bate, 1888

Family Stenopodidae Claus, 1872

Stenopus pyrsonotus Goy & Devaney, 1980: pre-dive at stn 32, Nuku Hiva, 129 m (Fig. 3b). R/V *Alis*, dredge, Hiva Oa, 85–87 m.

Remarks. *Stenopus pyrsonotus* is a shallow-water species common in caves the Marquesas between 20–35 m. This species was photographed by the ROV at 129 m, being its deepest record. A specimen of *S. pyrsonotus*

collected in 1997 with a dredge at 85–87 m off Hiva Oa (R/V *Alis*, unpublished record, MUSORSTOM 9, stn DW1217) confirms the observations made with the ROV.

INFRAORDER CARIDEA Dana, 1852

Family Palaemonidae Rafinesque, 1815

Cuapetes? sp. Stn 10, Tahuata, 300 m, on unidentified coral (specimen collected LC95).

Family Pandalidae Haworth, 1825

Heterocarpus aff. *ensifer* A. Milne-Edwards, 1881. Stn 32, Nuku Hiva, 380 m (Fig. 3c). R/V *Marara*, trap, Eiao, Fatu Hiva, Hiva Oa, Tahuata, Ua Pou, Nuku Hiva, 217–730m, mostly 300–400m.

Remarks. Specimens photographed with the ROV have a large red lateral patch on the cephalothorax, a distinctive character of *H. ensifer*. This patch is also present in *H. parvispinna* De Man, 1917, but this species has never been collected in the Marquesas, whereas *H.* aff. *ensifer* is common between 300–400 m (Poupin 2005: 66, fig. 33). *Heterocarpus ensifer* has a worldwide distribution in the Atlantic, Indian Ocean and Central Pacific (Hawaiian Is, Kiribati, and Marquesas). *Heterocarpus ensifer* is probably a complex of species (Crosnier & Forest 1973: 192, Chace 1985: 26, and Crosnier 1988: 71). According to Crosnier (1988) specimens from the Atlantic and southwestern Indian Ocean are referable to *H. ensifer* as described by A. Milne-Edwards (1881) from the Lesser Antilles, while *H.* aff. *ensifer* from the central Pacific have morphological variations that support a status as a separate species. Careful examinations of additional specimens from both regions and DNA sequencing are, therefore, needed to clarify the status of Pacific *H.* aff. *ensifer*.

Plesionika edwardsii (Brandt, 1851). Stn 10, Tahuata, 300 m (specimen collected LC94). R/V *Alis*, dredge, Hiva Oa, Nuku Hiva, 310–350m.

Plesionika flavicauda Chan & Crosnier, 1991. Stn 16, Fatu Hiva, 164 m (Fig. 3d).

Plesionika? sp. Stn8, Tahuata, 50–60 m.

INFRAORDER ASTACIDEA Latreille, 1802

Family Enoplometopidae de Saint Laurent, 1988

Enoplometopus crosnieri Chan & Yu, 1998. Stn 8, Tahuata, 50–60 m, in hole; stn 16, Fatu Hiva, 204 m (Fig. 4a). R/V *Marara*, Fatu Hiva, trap, 84–120 m.

Remarks. *Enoplometopus crosnieri* was photographed at 50–60 m and 204 m which extends significantly its previous depth range of 84–120 m (Chan & Ng 2008).

INFRAORDER ACHELATA Scholtz & Richter, 1995

Family Palinuridae Latreille, 1802

Palinustus unicornutus Berry, 1979. Stn 37, Eiao, 242 m (Fig. 4b).

Remarks. This species is rarely reported. For a long time it was known only from its type locality (Natal, South Africa) but Chan & Yu (1995) and Richer de Forges & Laboute (1995) have indicated that it is widely distributed in the Indo-west Pacific. In French Polynesia it was already reported from the Tuamotu, 250 m (Poupin 1996: 14, pl. 6f).

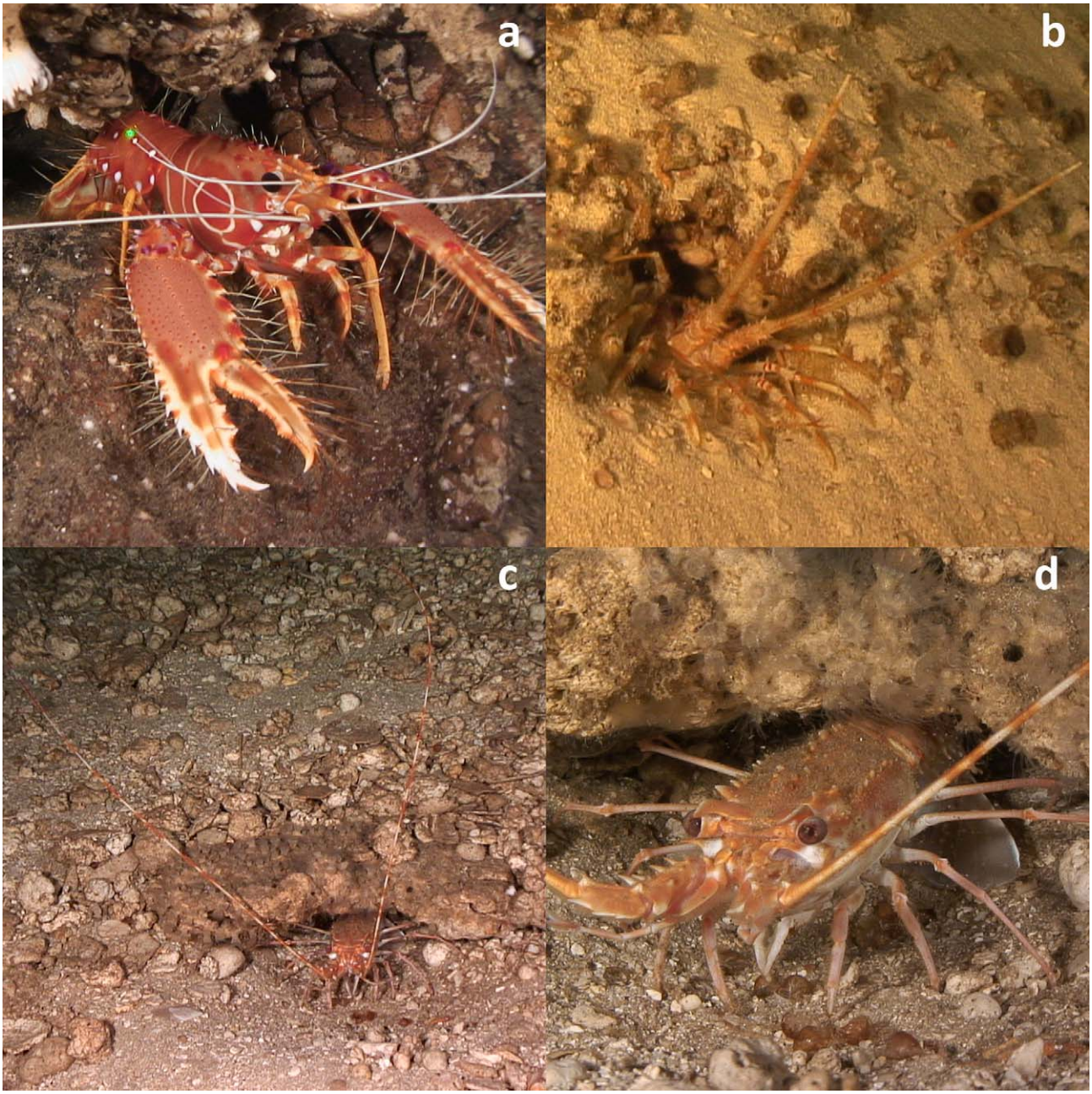

FIGURE 4. Lobsters photographed with ROV *Super Achille*: a) *Enoplometopus crosnieri* Chan & Yu, 1998, stn 16, Fatu Hiva, 204 m; b) *Palinustus unicornutus* Berry, 1979, stn 37, Eiao, 242 m; c–d) *Puerulus* sp. Chan et al. (in press), stn 36, Eiao, 227 m.

Puerulus sp. Chan *et al.* (in press). Stn 36, Eiao, 227 m (Fig. 4c–d). R/V *Marara*, trap, Tahuata, 320–430m.

Remarks. This species has been previously reported from the Marquesas as *Puerulus angulatus* (Bate, 1888) (Poupin 1996: 14, pl. 6g). A morphological re-examination coupled with DNA sequencing has shown, however, that the Marquesan specimens belong to a new species nested within the *Puerulus angulatus* complex of species (Chan *et al.* in press)

INFRAORDER ANOMURA MacLeay, 1838

Family Munididae Ahyong, Baba, Macpherson, Poore, 2010

Babamunida hystrix (Macpherson & de Saint Laurent, 1991). Stn 16, Fatu Hiva, 179 m (Fig. 5a); stn 32, Nuku Hiva, 192 m.

Babamunida plexaura? (Macpherson & de Saint Laurent, 1991). Stn 16, Fatu Hiva, 315–340 m, on *Madracis* sp. (Scleractinia, Oculinidae) (juvenile, specimen collected LC332). *B. plexaura*: R/V *Alis*, dredge, Hatutaa, Motu One, Ua Pou, 163–463m.

Munida? sp. Stn 37, Eiao, 213 m, on *Antipathes*? sp. (Antipatharia, Antipathidae)

Paramunida echinata Macpherson, 2000. Stn 37, Eiao, 300 m. R/V *Alis*, Eiao, Hiva Oa, Nuku Hiva, Ua Pou, 102–430m.

Family Diogenidae Ortmann, 1892

Bathynarius pacificus Forest, 1993. Stn 37, Eiao, 242 m (Fig. 5b). R/V *Marara*, trap, Fatu Hiva, 210 m.

Strigopagurus poupini Forest, 1995. Stn 34, Hatu Iti, 267 m (Fig. 5d). R/V *Marara*, trap, Fatu Hiva, 250 m; R/V *Alis*, dredge, beam trawl, Eiao, Fatu Hiva, Hiva Oa, Nuku Hiva, 163–408 m.

Family Paguridae Latreille, 1802

Catapaguroides? sp. A. Stn 32, Nuku Hiva, 363 m, on *Madrepora* sp. (Scleractinia, Oculinidae) (specimen collected LC392).

Lophopagurus? sp. B. Stn 32, Nuku Hiva, 363, on *Madrepora* sp. (Scleractinia, Oculinidae) (specimen collected LC393).

Family Parapaguridae Smith, 1882

Paragiopagurus bougainvillei (Lemaitre, 1994). Stn 37, Eiao, 188 m (Fig. 5c). R/V *Marara*, trap, Nuku Hiva, Tahuata, 190–250 m; R/V *Alis*, dredge, Ua Huka, 200–220m.

INFRAORDER BRACHYURA Linnaeus, 1758

Family Dynomenidae Ortmann, 1892

Metadynomene devaneyi (Takeda, 1977). Stn 24, Dumont d'Urville Seamount, 315–340 m. R/V *Alis*, beam trawl, Nuku Hiva, Ua Huka, 283–448m.

Remarks. *Metadynomene devaneyi* is known from the Hawaiian and Marquesas Is (Ng & McLay, 2010). In French Polynesia, a distinct species is reported from the Tuamotu Fangataufa atoll, 310 m, *Metadynomene tuamotu* Ng & McLay, 2010.

Family Latreilliidae Stimpson, 1858

Latreillia metanesa Williams, 1982. Stn 37, Eiao, 214 m (Fig. 6a–b), on *Antipathes*? sp. (Antipatharia, Antipathidae). R/V *Alis*, dredge, Ua Pou, 150–180 m (depth range in French Polynesia: 110–470 m).

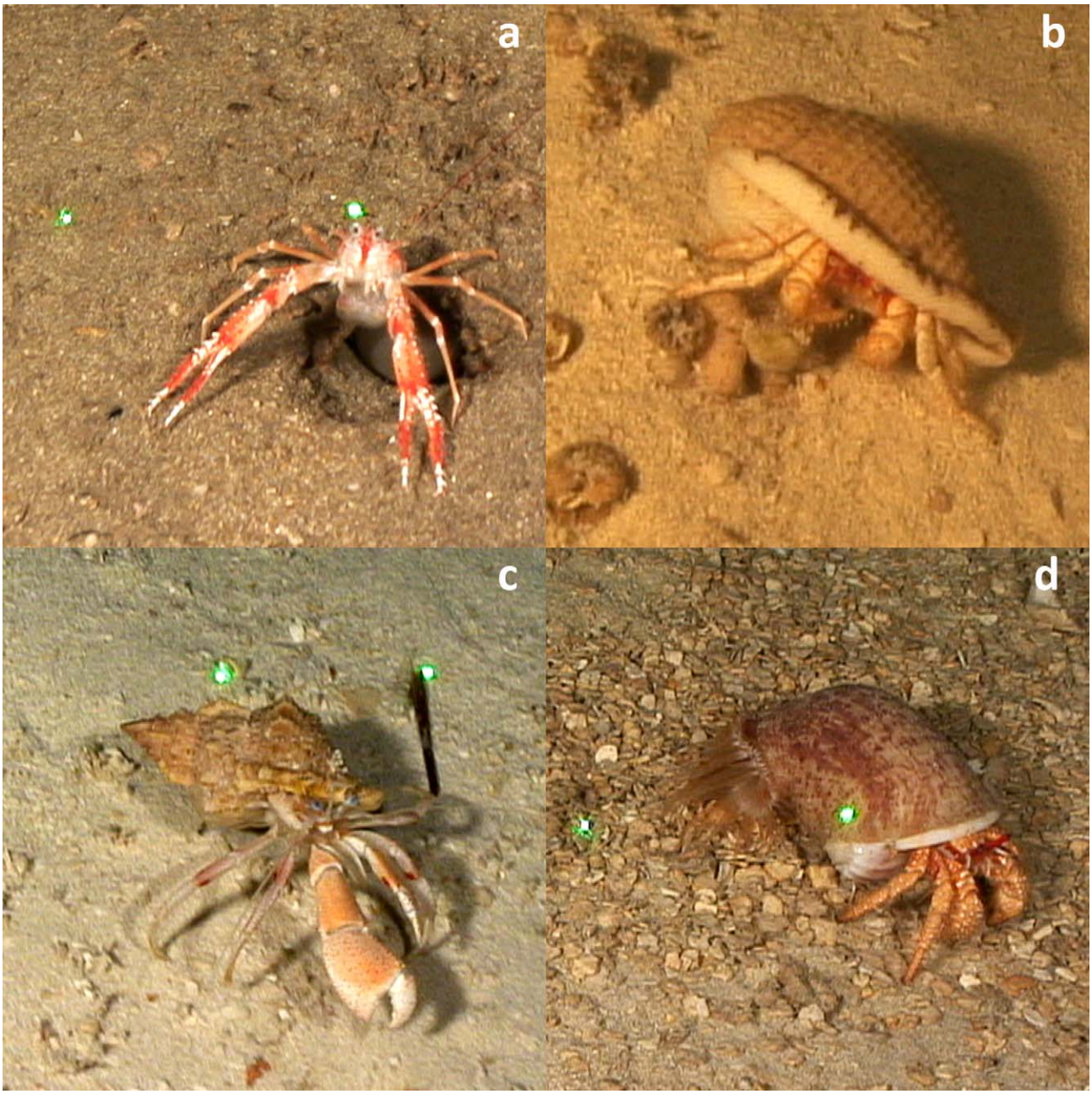

FIGURE 5. Anomurans photographed with ROV *Super Achille* (distance between the two laser green spots is 60 mm): a) *Babamunida hystrix* (Macpherson & de Saint Laurent, 1991), stn 16, Fatu Hiva, 179 m; b) *Bathynarius pacificus* Forest, 1993, stn 37, Eiao, 242 m; c) *Paragiopagurus bougainvillei* (Lemaitre, 1994), stn 37, Eiao, 188 m; d) *Strigopagurus poupini* Forest, 1995, stn 34, Hatu Iti, 267 m.

Family Raninidae De Haan, 1839

Notosceles chimmonis Bourne, 1922. Stn 34, Hatu Iti, 225 m (molt only). R/V *Marara*, trap, Eiao, 54–101m; R/V *Alis*, dredge, Hiva Oa, 210–258 m.

Family Leucosiidae Samouelle, 1819

Tanaoa serenei (Richer de Forges, 1983). Stn 34, Hatu Iti, 334 m (Fig. 6d). R/V *Marara*, trap, Eiao, Fatu Hiva, Hiva Oa, 256–580 m; R/V *Alis*, dredge, beam trawl, Dumont d'Urville Seamount, Eiao, Hatutaa Motu One, Nuku Hiva, Tahuata, 163–805 m.

Remarks. *Tanaoa serenei* (Richer de Forges 1983) was described based on specimens from Tahiti (R/V *Tainui*, trap, 400–500 m), Samoa, and Guam (Richer de Forges 1983: 634). Galil (2003: 402) has synonymised *T. serenei* with *T. distinctus* (Rathbun, 1894). Recently, however, Ng & Richer de Forges (2007: 16) concluded that the two species are distinct, with *T. distinctus* known with certainty only from the Hawaii Is. and *T. serenei* from French Polynesia, Wallis & Futuna, Samoa, Guam, and questionably from the Solomon Is. (as *T. distinctus*; in Galil 2007), and New Zealand (as *T. distinctus*; in Galil 2003 and Yaldwyn & Webber 2011).

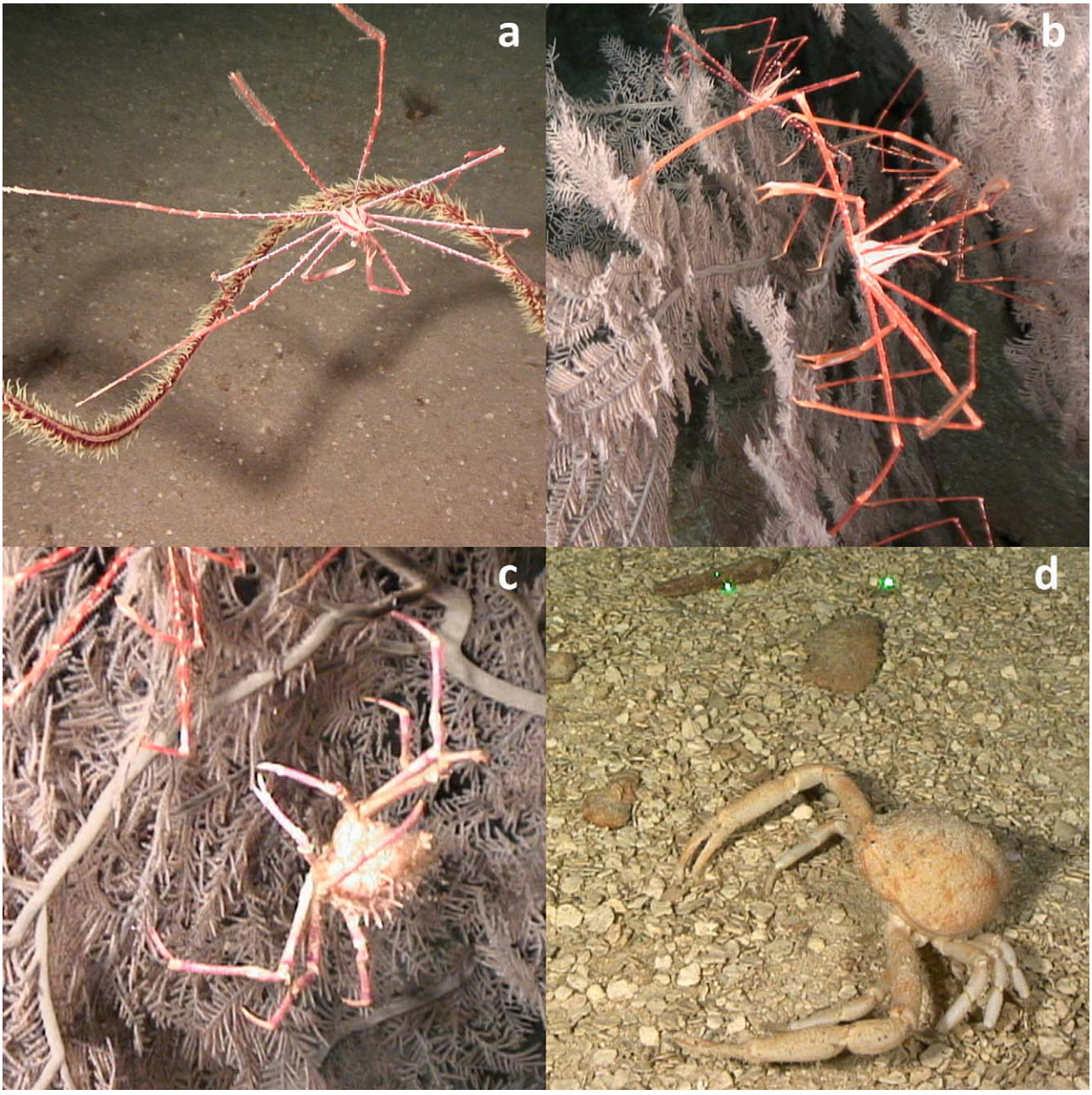

FIGURE 6. Brachyuran crabs photographed with ROV *Super Achille*: a–b) *Latreillia metanesa* Williams, 1982, stn 37, Eiao, 214 m, on antipatharian coral *Antipathes*? sp.; c) *Naxioides vaitahu* Poupin, 1995 (with a specimen of *L. metanesa*, top), stn 37, Eiao, 214 m, on antipatharian coral *Antipathes*? sp.; d) *Tanaoa serenei* (Richer de Forges, 1983), stn 34, Hatu Iti, 334 m (distance between the two laser green spots is 60 mm).

Family Epialtidae MacLeay, 1838

Naxioides vaitahu Poupin, 1995. Stn 37, Eiao, 214 m (Fig. 6c), on *Antipathes*? sp. (Antipatharia, Antipathidae). R/V *Marara*, trap, Fatu Hiva, Fatu Huku, Hiva Oa, Tahuata, 110–370 m (only known from the Marquesas).

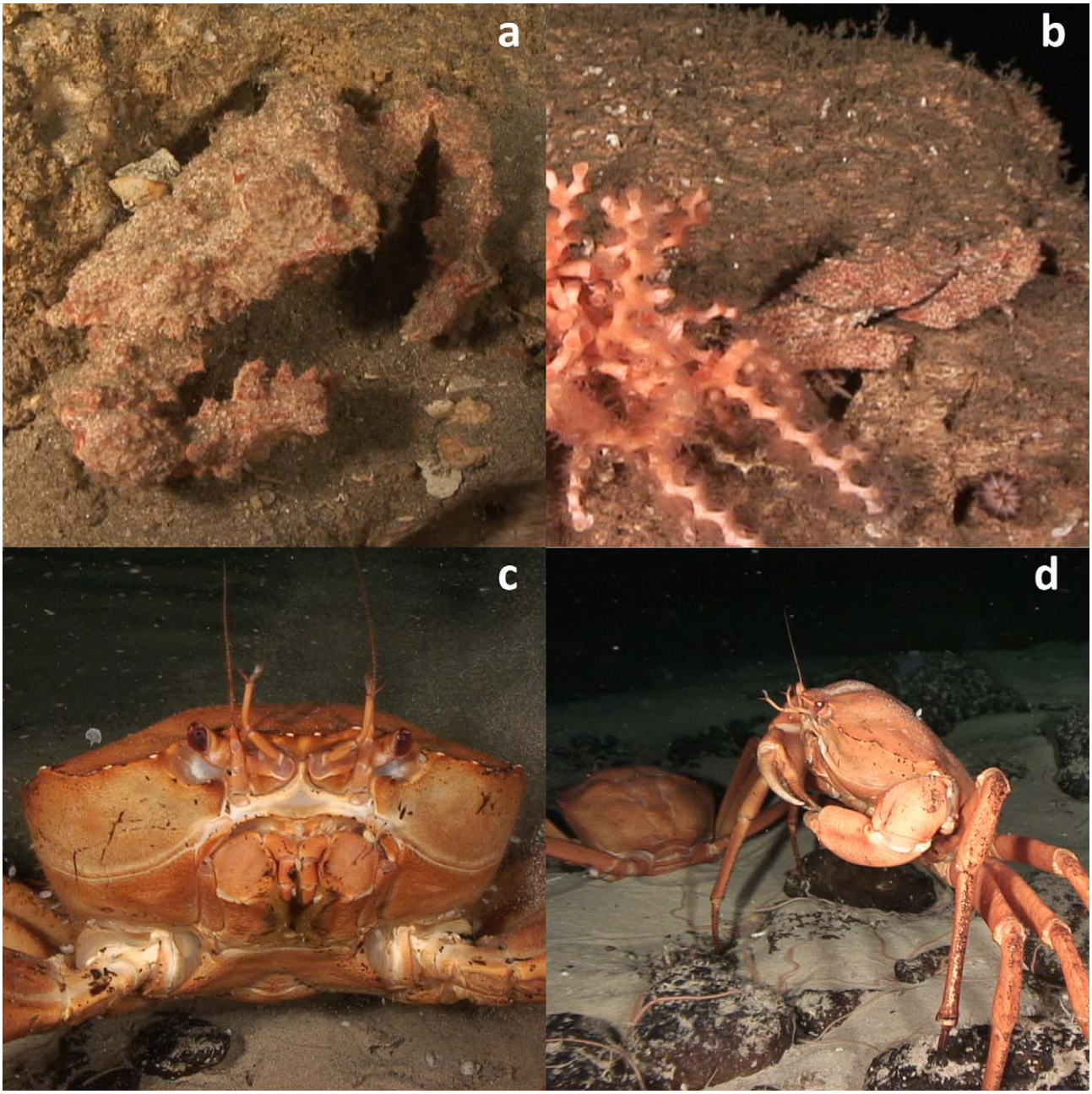

FIGURE 7. Brachyuran crabs photographed with ROV *Super Achille*: a) *Daldorfia* sp., stn 32, Nuku Hiva, 176 m; b) *Garthambrus stellata* (Rathbun, 1906), stn 32, Nuku Hiva, 363 m, on a rock at base of a scleractinian coral *Madrepora* sp.; c–d) *Chaceon poupini* Manning, 1992, stn 25, Dumont d'Urville Seamount, 526–535 m.

Family Inachidae MacLeay, 1838

Cyrtomaia ihlei Guinot & Richer de Forges, 1982. Stn 25, Dumont d'Urville Seamount, 550 m.

Family Parthenopidae MacLeay, 1838

Daldorfia sp. Stn 32, Nuku Hiva, 176 m (Fig. 7a).

Garthambrus stellata (Rathbun, 1906). Stn 32, Nuku Hiva, 363 m (Fig. 7b).

Family Geryonidae Colosi, 1923

Chaceon poupini Manning, 1992. Stn 25, Dumont d'Urville Seamount, 526–535 m (Fig. 7c–d). R/V *Marara*, trap, Eiao, Fatu Hiva, Fatu Huku, Hiva Oa, Tahuata, Ua Huka, Ua Pou, 370–1050m (only known from the Marquesas).

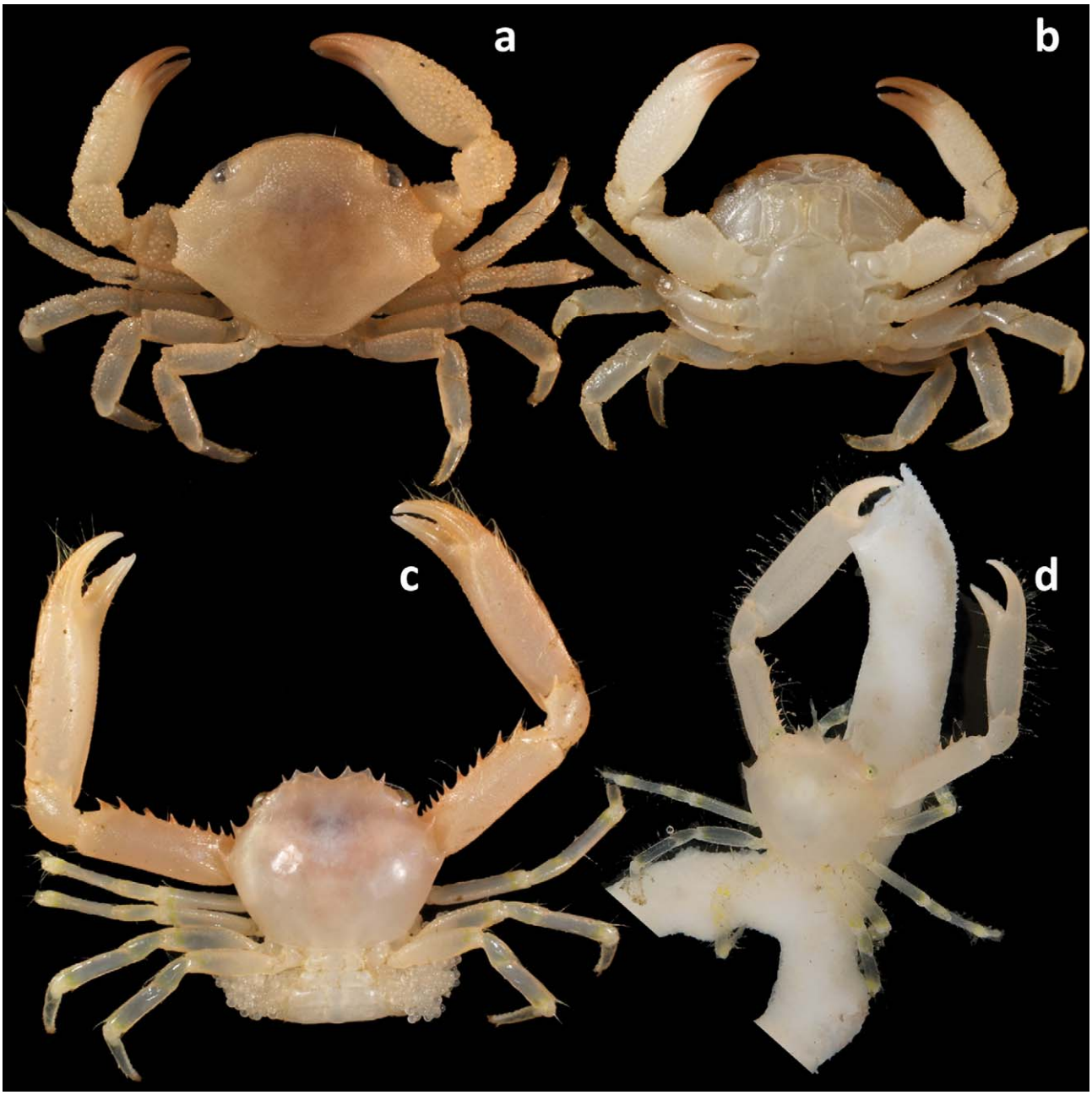

FIGURE 8. Brachyuran crabs collected with ROV *Super Achille*: a–b) *Calocarcinus habei* Takeda, 1980, stn 32, Nuku Hiva, 363 m, dorsal (a) and ventral (b) views (MNHN field number LC394); c–d) *Quadrella* aff. *coronata* Dana, 1852, stn 16, Fatu Hiva, 315–340 m, c) ovigerous female, dorsal view (MNHN field number LC169), d) specimen on a scleractinian coral *Madracis* sp. (MNHN field number LC281). a–c, photos J. Poupin, d) photo J. Starmer.

Family Trapeziidae Miers, 1886

Calocarcinus habei Takeda, 1980. Stn 32, Nuku Hiva, 363 m (Fig. 8a–b), on *Madrepora* sp. (Scleractinia, Oculinidae) (specimen collected LC394).

Quadrella aff. *coronata* Dana, 1852. Stn 16, Fatu Hiva, 315–340 m (Fig. 8c–d), on *Madracis* sp. (Scleractinia, Pocilloporidae) (specimens 2 spp. were collected LC 169, LC281).

Remarks. If our identification of *Quadrella* aff. *coronata* is confirmed when specimens collected are available for examination, it will represent a significant geographic extension for this species. This coral associated crab is widespread in the Indian Ocean, the Philippines, Papua New Guinea, and Vanuatu, from 2–26 m to 189–194 m (see Galil 1986; Castro 1999, 2009), and was recently reported at 442–491 m off Madagascar (Castro, in press: MIRIKY Expedition, Madagascar, stn CP3210, 29.6.2009, 12°44'S, 48°12'E, 442–491 m).

Discussion

Thirty species of Decapoda were identified based on ROV photographs or collected by the ROV articulated arm. Twenty of these species can be confidently identified to species level according to general morphology and details of coloration (*e.g. Paragiopagurus bougainvillei*, *Strigopagurus poupini*, fig. 5c–d). Sixteen (*e.g. Aristaeopsis edwardsiana*, *Stenopus pyrsonotus*, *Enoplometopus crosnieri*) had already been collected in the Marquesas at similar depths during the R/V *Marara* and R/V *Alis* campaigns which supports identification based on photographs and demonstrates the importance of conventional sampling in addition to ROV operations.

Except for *Quadrella* aff. *coronata*, species first listed for the Marquesas are already known from similar depths in other island groups in French Polynesia, which supports our identifications. These are (with previous French Polynesian records in parenthesis): *Plesionika flavicauda* (Austral, Society, Tuamotu, 100–260 m); *Palinustus unicornutus* (Tuamotu, 250 m); *Babamunida hystrix* (Austral, Tuamotu, 100–300 m); *Garthambrus stellata* (Tuamotu, 319 m); *Cyrtomaia ihlei* (Society, Tuamotu, 490–720 m); and *Calocarcinus habei* (unpublished record in MNHN collection, R/V *Alis* BENTHAUS Austral expedition, stn DW2009, Rurutu 320–450 m, identified by P. Castro).

Species known only from the Marquesas and thus potential endemic species are *Puerulus* sp., *Paramunida echinata*, *Naxioides vaitahu*, and *Chaceon poupini*.

Several crustaceans seen on ROV images were not identifiable. These are small hermit crabs seen wandering in the background, small "lobsters", whose chelae were seen for a short time at the entrances of their burrows, or isolated squat lobsters (Possibly *Eumunida* or *Paramunida*), noticed on rubble bottoms, camouflaged but revealed by swift, short movements. Conventional sampling techniques, especially traps, are the only way to capture specimens for correct identification of these species.

Density. Overall densities were low, crustaceans being scarcely observed on ROV images or even totally absent for some dives (*e.g.* stn 9, 20). Most species were observed as single specimens: *Aristaeopsis edwardsiana*, *Enoplometopus crosnieri*, *Palinustus unicornutus*, *Puerulus* sp., *Paramunida echinata*, *Bathynarius pacificus*, *Strigopagurus poupini*, *Paragiopagurus bougainvillei*, *Notosceles chimmonis*, *Metadynomene devaneyi*, *Tanaoa serenei*, *Naxioides vaitahu*, *Cyrtomaia ihlei*, *Daldorfia* sp., and *Garthambrus stellata*. Other species were seen in groups on ROV footage (maximum number of specimens in parenthesis): *Plesionika flavicauda* (24), *Heterocarpus* aff. *ensifer* (2), *Babamunida hystrix* (5), *Munida*? sp. (12), *Latreillia metanesa* (15), and *Chaceon poupini* (2).

The local density for the squat lobster *Babamunida hystrix* is tentatively estimated as 40 individuals/m^2 (Fig. 9) using laser measurements on a photograph that showed 5 specimens on an estimated surface of 0.125 m^2.

The large deep-sea red crab *Chaceon poupini* is known between 350–1050 m in the Marquesas, with maximum density at depths of 700–800 m (Poupin *et al*. 1991; Poupin & Buat 1992). It was observed only during one dive in the present expedition (stn 25, Dumont d'Urville Seamount, 526–535 m) out of six ROV dives conducted in the crab's depth range. ROV observations are useful for confirming previous hypotheses on the habitat of this species, which lives on rather flat and soft sandy bottoms with a few scattered large boulders (Fig. 7d). This is apparently the most favorable habitat for this species, which was not observed during ROV dives made on rocky cliffs. A few cup-shaped formations in the sediment were seen near crabs, and were possibly used as resting places. The density of the red crab was apparently low, with a maximum of only two individuals seen at the same time. These were large specimens of similar size, with at least one male whose carapace width was estimated at 16 cm from a laser measurement. By using the size/weight relationship available from previous work this size corresponds to a weight

of about 1.6 kg. The surface prospected during dive 25 can be estimated between 650–2250 m^2, which gives a local density of 8.9–30.8 crabs/ha or 14.3–49.5 kg/ha. This figure is higher than previous estimates made for the Marquesas based on attraction surface of the bait in the traps (3.4–10.3 kg/ha in Poupin *et al*. 1991), but it is in the range of densities estimated elsewhere from underwater photographs, as 14.5–55.5 kg/ha for *C. maritae* (Manning & Holthuis, 1981) off Namibia (Melville-Smith 1985) and 19.9–58.4 kg/ha for *C. quinquedens* (Smith, 1879) off northeastern United States (Wigley *et al.* 1975).

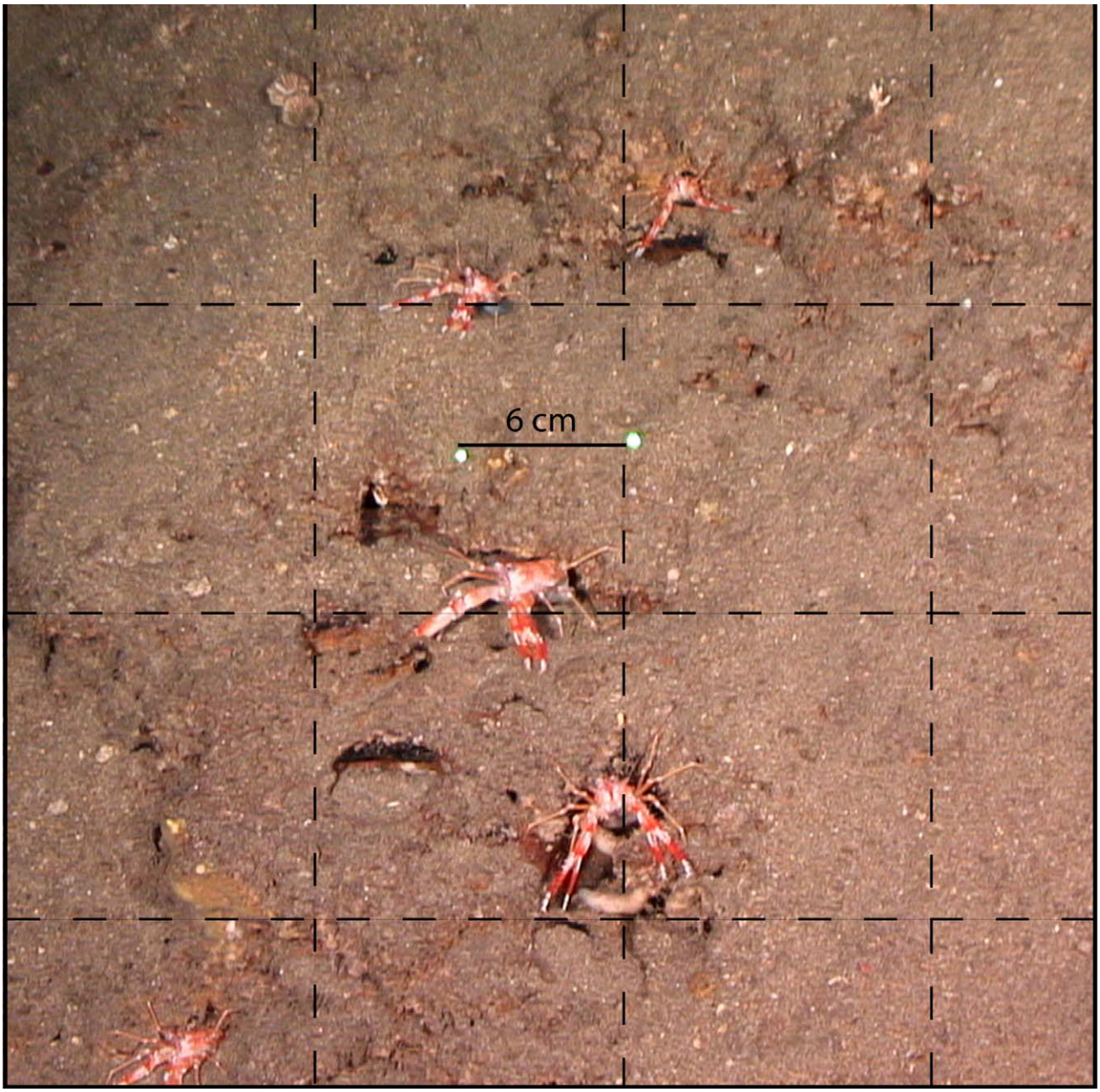

FIGURE 9. Density of *Babamunida hystrix* (Macpherson & de Saint Laurent, 1991), estimated from ROV *Super Achille* photograph (Stn 16, Fatu Hiva, 179 m). Distance between the two laser points is 60 mm; density of 5 individuals/0.125 m2 (40 individuals/m^2).

Ecology and behavior. As a result of the method of sampling (ROV) the records of the group of species sampled are those of crustaceans that do not need to hide because of their colour, large size or because they are distasteful to predators for one reason or another. One would not expect to detect camouflaged species that burrow into the surface for example, or species which carry some kind of shield obscuring them from observation.

Several species were observed living in association with corals. Most obligate associates are the small-size species that were collected with the ROV's articulated arm. They were observed closely associated with the coral

branches and were not flushed off the corals during the lift of the ROV to the surface. These associated decapods were *Cuapetes*? sp. (on unidentified coral); *Babamunida plexaura*? (juvenile, on *Madracis* sp.); *Catapaguroides*? sp. A and *Lophopagurus*? sp. B (on *Madrepora* sp.), *Calocarcinus habei* (on *Madrepora* sp.) and *Quadrella* aff. *coronata* (on *Madracis* sp.). Large-size species observed in association with corals on ROV videos are the squat lobster, possibly *Munida* sp., and the brachyuran crabs *Naxioides vaitahu* (Fig. 6c) and *Latreillia metanesa* (Fig. 6a–b). These three species were on branches of antipatharian corals *Antipathes*? sp. Although this kind of association is well known for the squat lobsters (Baba *et al*. 2008), it is reported here for the first time for the crabs *N. vaitahu* and *L. metanesa*. These are most certainly not obligate associations as, for *L. metanesa* at least, a few individuals were occasionally filmed moving freely on the bottom.

Carrying behavior in the Latreillidae has been discussed by Castro *et al*. (2003: 617). *Latreillia metanesa* is of special interest because the dactylus of the last walking appendage (pereopod 5) forms a subchela against the distal portion of propodus when flexed and could be used in carrying objects for camouflaging, as in *Eplumula phalangium* (De Haan, 1839) and other latreilliids. This behavior is not observed in the *L. metanesa* photographs perhaps because most of the specimens were sheltered in a coral *Antipathes*? sp. Videos and Fig. 6b show that the subchelae of pereopod 5 are used to hang on the coral when moving instead of carrying an object.

The hermit crab *Strigopagurus poupini*, was photographed carrying a large sea anemone on its shell (Fig. 5d), probably a member of Hormathiidae or Actiniidae (D. Fautin pers. comm.). This association was not reported in the description of *S. poupini* by Forest (1995), but it was previously known for two other congeners, *S. bilineatus* Forest, 1995, and *S. boreonotus* Forest, 1995.

At stn 16, Fatu Hiva, 164 m, a group of 24 individuals of *Plesionika flavicauda* (Fig. 3d) was seen in apparent interaction with a small grouper *Cephalopholis igarashiensis* Katayama, 1957. The shrimps seemed to surround the grouper at a safe distance, the fish being sheltered under a small rocky outcrop.

The swimming behavior of a specimen of *Aristaeopsis edwardsiana*, total length estimated at 200 mm, was observed for several minutes off Fatu Hiva, 524 m, showing the importance of pleopods 1–5 for locomotion. The large red crab *Chaceon poupini* was also observed for several minutes running on the Dumont d'Urville Seamount trying to escape the ROV's light beams, its long legs appearing well adapted for quick and long displacements on such soft and flat bottoms.

A few species were observed living in burrows or crevices, as in the case of the lobsters *Enoplometopus crosnieri*, *Puerulus* sp., and *Palinustus unicornutus* (Fig. 4). The squat lobster *Babamunida hystrix* (Fig. 5a, 9) was also seen in burrows, a behavior already observed for *Babamunida kanaloa* Schnabel, Martin & Moffitt, 2009 during manned submersible dives throughout the Hawaiian chain, at depths of 145–272 m (Schnabel *et al*. 2009).

Because of known ecological and evolutionary relationships between deep-sea and shallow-cave communities (Hart *et al*. 1985), the volcanic Marquesas, surrounded by deep waters, were anticipated to display cave communities harboring deep-sea species. Contrary to expectations, the survey of Marquesas shallow-water cave crustaceans conducted by SCUBA diving during the same expedition (unpublished data) so far only shows very little overlap in species composition with the ROV observations. The notable exception is that of *Stenopus pyrsonotus*, observed in shallow caves and at 129 m (stn 32) not far from the Nuku Hiva paleo-reef edge. Deep-water species can on occasions be found in shallow caves in other part of the world (*e.g.* Calado *et al.* 2004). It is possible that the significant difference in thermal regime on either sides of the Marquesas thermocline makes it more difficult for deep-sea species to acclimate to shallow caves. It is also likely that our survey was too preliminary to accurately demonstrate possible relationships between deep-sea and shallow-cave communities.

Acknowledgments

Our warmest thanks go to the ROV pilots, G. Pachoud and J. Morvan (COMEX), whose skills and patience were the key to the success of this expedition. Mastering the ROV trajectory at depth of ca. 500 m requires a perfect positioning of the boat, which was accomplished in a professional manner by the crew of R/V *Braveheart* and her captain, N. Jolly. Thanks to all for their work on board and for doing their best to make this cruise as comfortable as possible. Appreciated help and company was also provided by the remaining scientific party, J. Starmer, L. Albenga, B. Buge and V. Heros.

P. Castro, T.-Y. Chan, T. Komai, and X. Li helped in the identification of some of the photographed crustaceans. Some of the corals were identified through the kindness of J.-F. Flot, A. Baco, M. Kitahara and F.

Benzoni. D.G. Fautin made some valuable comments to help identify the sea anemones. S. Ahyong, P. Castro, B. Richer de Forges, and one anonymous reviewer have helped to improve the final version of the manuscript.

This project was sponsored and coordinated by the Agence des Aires Marines Protégées (AAMP), Brest, France, particularly through the personal involvement of S.D. Duron and P. Watremez.

References

Ahyong, S.T. (2002) Stomatopoda (Crustacea) from the Marquesas Islands: Results of the MUSORSTOM 9. *Zoosystema*, 24(2), 347–372.

Allen, G.R. (2008) Conservation hotspots of biodiversity and endemism for Indo-Pacific coral reef fishes. *Aquatic Conservation: Marine and Freshwater Ecosystems*, 18(5), 541–556.

Baba, K., Macpherson, E., Poore, C.B., Ahyong, S.T., Bermudez, A., Cabezas, P., Lin, C.-W. Nizinski, M., Rodrigues, C. & Schnabel, K.E. (2008) Catalogue of squat lobsters of the world (Crustacea: Decapoda: Anomura - families Chirostylidae, Galatheidae and Kiwaidae). *Zootaxa*, 1905, 1–220.

Burukovsky, R.N. (2006) Taxonomy of *Nematocarcinus* (Decapoda, Nematocarcinidae) species from waters off the Marquesas. *Zoologicheskii Zhurnal*, 85(9), 1060–1066. [in Russian].

Cabioch, G., Wallace, C.C., McCulloch, M.T., Zibrowius, H., Laboute, P. & Richer de Forges, B. (2011) Disappearance of *Acropora* from the Marquesas (French Polynesia) during the last deglacial period. *Coral Reef*, 30, 1101–1105.

Calado, R., Chevaldonné, P. & dos Santos, A. (2004) A new species of the deep-sea genus *Bresilia* (Crustacea: Decapoda: Bresiliidae) discovered from a shallow-water cave in Madeira. *Journal of the Marine Biological Association of the U. K.*, 84, 191–199.

Castro, P. (1997) Trapeziid crabs (Brachyura: Xanthoidea: Trapeziidae) of French Polynesia. *In*: B. Richer de Forges (Ed.), Le benthos des fonds meubles des lagons de Nouvelle-Calédonie. *Études et Thèses* (ORSTOM, Paris), 3, 109–139.

Castro, P. (1999) Trapeziid crabs (Crustacea, Brachyura, Xanthoidea, Trapeziidae) of the Indian Ocean and the Red Sea. *Zoosystema*, 21(1), 93–120.

Castro, P. (2000) Crustacea Decapoda: A revision of the Indo-west Pacific species of palicid crabs (Brachyura Palicidae). *In*: Crosnier A. (Ed.), Résultats des Campagnes MUSORSTOM, volume 21. *Mémoires du Muséum national d'Histoire naturelle* (Paris), 184, 437–610.

Castro, P. (2005) Crabs of the subfamily Ethusinae Guinot, 1977 (Crustacea, Decapoda, Brachyura, Dorippidae) of the Indo-West Pacific region. *Zoosystema*, 27(3), 499–600.

Castro, P. (2007) A reappraisal of the family Goneplacidae MacLeay, 1838 (Crustacea, Decapoda, Brachyura) and revision of the subfamily Goneplacinae, with the description of 10 new genera and 18 new species. *Zoosystema*, 29(4), 609–773.

Castro, P. (2009) Shallow-water Trapeziidae and Tetraliidae (Crustacea: Brachyura) of the Philippines (Panglao 2004 Expedition), New Guinea, and Vanuatu (Santo 2006 Expedition). *The Raffles Bulletin of Zoology*, 20, 271–281.

Castro, P. (in press) Brachyuran crabs (Crustacea, Brachyura: Crossotonotidae, Ethusidae, Euryplacidae, Goneplacidae, Latreilliidae, Palicidae, Tetraliidae, Trapeziidae) of the MAINBAZA, MIRIKY, and ATIMO VATAE expeditions to the Mozambique Channel and Madagascar. *In*: Chan, T.-Y., Ng, P.K.L. & Ahyong, S. (Eds), *Tropical Deep Sea Benthos*, vol. 27. *Mémoires du Muséum national d'Histoire naturelle* (Paris).

Castro, P., Williams, A.B. & Cooper, L.L. (2003) Revision of the family Latreilliidae Stimpson, 1858 (Crustacea, Decapoda, Brachyura). *Zoosystema*, 25(4), 601–634.

Chace, F.A. (1985) The Caridean Shrimps (Crustacea: Decapoda) of the *Albatross* Philippines Expedition, 1907–1910. Part 3: Families Thalassocarididae and Pandalidae. *Smithsonian Contribution to Zoology*, 411, 1–143.

Chan, T.-Y. & Ng, P.K.L. (2008) *Enoplometopus* A. Milne-Edwards, 1862 (Crustacea: Decapoda: Nephropoidea) from the Philippines, with description of one new species and a revised key to the genus. *Bulletin of Marine Science*, 83(2), 347–365.

Chan, T.-Y. & Yu, H.P. (1995) The rare lobster genus *Palinustus* A. Milne Edwards, 1880 (Decapoda, Palinuridae), with description of a new species. *Journal of Crustacean Biology*, 15(2), 376–394.

Chan, T.-Y., Ma, K.Y. & Chu, K.H. (in press) The deep-sea spiny lobster genus *Puerulus* Ortmann, 1897 (Crustacea: Decapoda: Palinuridae), with descriptions of five new species. *In*: Chan, T.-Y., Ng, P.K.L. & Ahyong, S. (Eds), *Tropical Deep Sea Benthos*, vol. 27. *Mémoires du Muséum national d'Histoire naturelle* (Paris).

Crosnier, A. (1988) Sur les *Heterocarpus* (Crustacea, Decapoda, Pandalidae) du sud-ouest de l'océan Indien. Remarques sur d'autres espèces ouest-pacifique du genre et description de quatre taxa nouveaux. *Bulletin du Muséum national d'Histoire naturelle* (Paris), sér. 4, 10(1), 57–103, pls. 1–4.

Crosnier, A. (2002) Portunidae (Crustacea, Decapoda, Brachyura) de Polynésie française, principalement des îles Marquises. *Zoosystema*, 24(2), 401–449.

Crosnier, A. & Forest, J. (1973) Les crevettes profondes de l'Atlantique oriental tropical. *Faune tropicale*, ORSTOM, 19, 1–409.

De Grave, S., Pentcheff, N.D., Ahyong, S.T., Chan, T.-Y., Crandall, K.A., Dworschak, P.C., Felder, D.L., Feldmann, R.M., Fransen, C.H.J.M., Goulding, L.Y.D., Lemaitre, R., Low, M.E.Y., Martin, J.W., Ng, P.K.L., Schweitzer, C.E., Tan, S.H., Tshudy, D. & Wetzer, R. (2009) A classification of living and fossil genera of decapod crustaceans. *The Raffles Bulletin of Zoology*, supplement 21, 1–109.

Forest, J. (1995) Crustacea Decapoda Anomura: Révision du genre *Trizopagurus* Forest, 1952 (Diogenidae) avec l'établissement de deux genres nouveaux. *In:* Crosnier A. (Ed.), Résultats des campagnes MUSORSTOM volume 13.

Mémoires du Muséum national d'Histoire naturelle (Paris), 163, 9–149.
Galil, B.S. (1986) *Quadrella* (Brachyura: Xanthoidea: Trapeziidae) review and revision. *Journal of Crustacean Biology*, 6(2), 275–293.
Galil, B.S. (2001a) A revision of *Myra* Leach, 1817 (Crustacea: Brachyura: Leucosioidea). *Zoologische Verhandelingen*, 75(24), 409–446.
Galil, B.S. (2001b) A revision of the genus *Arcania* Leach, 1817 (Crustacea: Brachyura: Leucosioidea). *Zoologische Verhandelingen*, 75(11), 169–206.
Galil, B.S. (2001c) The Calappidae of the Marquesas Islands with a description of a new species of *Mursia* (Crustacea, Decapoda, Brachyura). *Zoosystema*, 23(3), 499–505.
Galil, B.S. (2003) Four new genera of leucosiid crabs (Crustacea: Brachyura: Leucosiidae) for three new species and nine species previously in the genus *Randallia* Stimpson, 1857, with a redescription of the type species, *R. ornata* (Randall, 1939). *Proceedings of the Biological Society of Washington*, 116(2), 395–422.
Galil, B.S. (2007) The deep-water Calappidae, Matutidae and Leucosiidae of the Solomon Islands, with a description of a new species of *Euclosia* Galil, 2003 (Crustacea, Decapoda, Brachyura). *Zoosystema*, 29(3), 555–563.
Hart, C.W., Jr., Manning, R.B. & Iliffe, T.M. (1985) The fauna of Atlantic marine caves: evidence of dispersal by sea floor spreading while maintaining ties to deep waters. *Proceedings of the Biological Society of Washington*, 98, 288–292.
Macpherson, E. (2000) Crustacea Decapoda: Species of the genera *Crosnierita* Macpherson, 1998, *Munida* Leach, 1820, and *Paramunida* Baba, 1998 (Galatheidae) collected during the MUSORSTOM 9 cruise to the Marquesas Islands. *In*: Crosnier A. (Ed.), Résultats des campagnes MUSORSTOM, volume 21. *Mémoires du Muséum national d'Histoire naturelle* (Paris), 184, 415–423.
McLay, C.L. (2001) The Dromiidae of French Polynesia and a new collection of crabs (Crustacea, Decapoda, Brachyura) from the Marquesas Islands. *Zoosystema*, 23(1), 77–100.
Melville-Smith, R. (1985) Density distribution by depth of *Geryon maritae* on the northern crab grounds of south west Africa/ Namibia determined by photography in 1983, with notes on the portunid crab *Bathynectes piperitus*. *South African Journal of Marine Science*, 3, 55–62.
Ng, P.K.L. & McLay, C.L. (2010) *Metadynomene tuamotu*, a new species of dynomenid crab from French Polynesia (Crustacea: Decapoda: Brachyura). *Zootaxa*, 2405, 48–54.
Ng, P.K.L. & Richer de Forges, B. (2007) A new genus and new species of leucosiid crab from New Caledonia, with a note on the validity of *Tanaoa serenei* (Richer de Forges, 1983) (Crustacea: Decapoda: Brachyura). *Zootaxa*, 1662, 15–24.
Poupin, J. (1996) *Atlas des crustacés marins profonds de Polynésie française. Récoltes du navire* Marara, *1986/1996*. Rapport Scientifique du Service Mixte de Surveillance Radiologique et Biologique, SMSRB, 59 pp., pls. 1–20. [http://hal.archives-ouvertes.fr/hal-00411280]
Poupin, J. (2001) New collections of *Ciliopagurus* from French Polynesia, with the description of a new species from the Marquesas Islands (Crustacea: Decapoda: Anomura: Diogenidae). *The Raffles Bulletin of Zoology*, 49(2), 291–300.
Poupin, J. (2005) *Systématique et Ecologie des Crustacés Décapodes et Stomatopodes de Polynésie française*. Mémoire d'Habilitation Diriger des Recherches, Universit de Perpignan, 115 pp. [http://tel.archives-ouvertes.fr/tel-00085049]
Poupin, J. & Buat, P. (1992) Discovery of deep-sea crabs (*Chaceon* sp.) in French Polynesia (Decapoda: Geryonidae). *Journal of Crustacean Biology*, 12(2), 270–281.
Poupin, J., Buat, P. & Ellis, T. (1991) *Les Crabes Profonds îles les Marquises (Chaceon* sp. *nov., Decapoda, Geryonidae).* Rapport Scientifique du Service Mixte de Surveillance Radiologique et Biologique, 40 pp. [http://hal.archives-ouvertes.fr/hal-00723795].
Richer de Forges, B. (1983) *Randallia serenei* (Crustacea, Decapoda, Brachyura), espèce nouvelle de Leucosiidae du Pacifique. *Bulletin du Muséum national d'Histoire naturelle* (Paris), sér. 4, 5(2), 633–640.
Richer de Forges, B. & Laboute, P. (1995) Langoustes, langoustines et cigales de mer de Nouvelle-Calédonie. *In*: Richer de Forges, B. (Ed.), Les fonds meubles des lagons de Nouvelle-Calédonie (Sédimentologie, benthos). Études & Thèses, ORSTOM, 2, 45–82.
Richer de Forges, B., Poupin, J. & Laboute, P. (1999) La campagne MUSORSTOM 9 dans l'archipel des îles Marquises (Polynésie française). Compte rendu et liste des stations. *In*: Crosnier A. (Ed.), Résultats des campagnes MUSORSTOM, volume 20. *Mémoires du Muséum national d'Histoire naturelle* (Paris), 145, 9–29.
Rougerie, F., Wauthy, B. & Rancher, J. (1992) Le récif barrière ennoy des Iles Marquises et l'effet d'le par endo-upwelling. *Comptes Rendus de l'Académie des Sciences de Paris*, sér. 2, 315, 677–682.
Schnabel, K.E., Martin, J.W. & Moffitt, R.B. (2009) Additions to the decapod crustacean fauna of the Hawaiian Islands, III. A new species of the genus *Babamunida* (Crustacea: Galatheidae) from Hawaii based on morphological and molecular evidence. *Zootaxa*, 2130, 21–30.
Wigley, R.L., Theroux, R.B. & Murray, H.E. (1975) Deep-Sea red crab, *Geryon quinquedens*, survey off northeastern United States. *Marine Fisheries Review*, 37, 1–21.
Yaldwyn, J.C. & Webber, W.R. (2011) Annotated checklist of New Zealand Decapoda (Arthropoda: Crustacea). *Tuhinga*, 22, 171–272.