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Chapter 8

Host preferences, colour patterns and distribution records of *Pseudocryptochirus viridis* Hiro, 1938 (Decapoda: Cryptochiridae)

Sancia E.T. van der Meij

Abstract

The coral gall crab *Pseudocryptochirus viridis* is an obligate symbiont of some species of the Indo-West Pacific coral genus *Turbinaria*. The colour pattern variation within the species is illustrated for the first time. Overviews of the coral host species and distribution records are provided, including new records from Indonesia, Malaysia and Australia.

Introduction

Coral gall crabs (Cryptochiridae) are obligate symbionts of stony corals (Scleractinia), residing in galls or pits in its host. Cryptochirids settle as megalopae on scleractinian corals, and somehow induce the host to grow over and around them (Utinomi, 1944; Castro, 1976). Despite their peculiar mode of life, little is known about their biology and ecology. The taxonomy of the Cryptochiridae was revised by Kropp (1990a), including a summary of all known coral host genera. Host specificity information at species level, however, remains incomplete.

This paper discusses the coral gall crab *Pseudocryptochirus viridis* Hiro, 1938, associated with stony corals of the genus *Turbinaria* (Dendrophylliidae). The colour patterns of juveniles and adults are described for the first time. An overview of the coral host species and distribution records is provided, including new records for Indonesia, Malaysia and Australia.

Material and methods

Coral gall crabs were collected in Bunaken National Marine Park (N. Sulawesi, Indonesia, Dec. 2008), around Ternate (Halmahera, Indonesia, Oct.-Nov. 2009), in Semporna (E. Sabah, Malaysia, Nov.-Dec. 2010), and around Lembeh Island (N. Sulawesi, Indonesia, Jan.-Feb. 2012). Corals of the genus *Turbinaria* were searched for specimens of *Pseudocryptochirus viridis*. Encountered gall crabs were collected and taken to the field station. After being photographed with a digital SLR camera with a 50 mm macro-lens, the crabs were preserved in 80% ethanol. All material is deposited in the Crustacea collection of Naturalis Biodiversity Center in Leiden (formerly Rijksmuseum van Natuurlijke Historie) (coded RMNH.Crus.D).

Results

Order Decapoda

Family Cryptochiridae Paulson, 1875

Genus *Pseudocryptochirus* Hiro, 1938

Pseudocryptochirus viridis Hiro, 1938

Material examined. Indonesia: RMNH.Crus.D.53235, N Sulawesi, Bunaken, Timur II, 1°36'30.66"N 124°46'58.2"E, in *T. mesenterina*, 20 Dec. 2008, collected by S.E.T. van der Meij; RMNH.Crus.D.54109, N Sulawesi, Lembeh, Tanjung Nanas I, 1°27'40.428"N 125°13'36.408"E, 15 m depth, in *T. mesenterina*, 30 Jan. 2012, collected by S.E.T. van der Meij; RMNH.Crus.D.54110, N Sulawesi, Lembeh, SE Sarena Kecil, 1°27'15.804"N 125°13'29.5314"E, 8 m depth, in *T. mesenterina*, 30 Jan. 2012, collected by S.E.T. van der Meij; RMNH.Crus.D.54111, N Sulawesi, Lembeh, Baturiri, 1°27'34.704"N 125°14'23.1"E, 11 m depth, in *Turbinaria* sp., 6 Feb. 2012, collected by S.E.T. Van der Meij; RMNH.Crus.D.54112-54113, N Sulawesi, Lembeh, Teluk Makawide, 1°29'5.0634"N 125°14'26.1234"E, 6 m depth, in *T. cf. mesenterina*, 9 Feb. 2012, collected by S.E.T. van der Meij; RMNH.Crus.D.54114, N Sulawesi, Lembeh, S Pulau Dua, 1°23'17.016"N 125°12'43.1274"E, 8 m depth, in *T. cf. mesenterina* (together with *Neotroglocarcinus* sp.), 13 Feb. 2012, collected by S.E.T. van der Meij; RMNH.Crus.D.53242, Tidore, Pilongga S, 0°42'44.1"N 127°28'47.3"E, 8 m depth, in *Turbinaria cf. reniformis*, 12 Nov. 2009, collected by S.E.T. van der Meij; RMNH.Crus.D.53236-53238, Ternate, Batu Angus, 0°50'48.5"N 127°21'58.98"E, <5 m depth, in *T. mesenterina*, 30 Oct. 2009, collected by B.W. Hoeksema; RMNH.Crus.D.53239, Ternate, Sulamadaha II, 0°52'2"N 127°19'45.8"E, 8 m depth, in *T. mesenterina*, 6 Nov. 2009, collected by

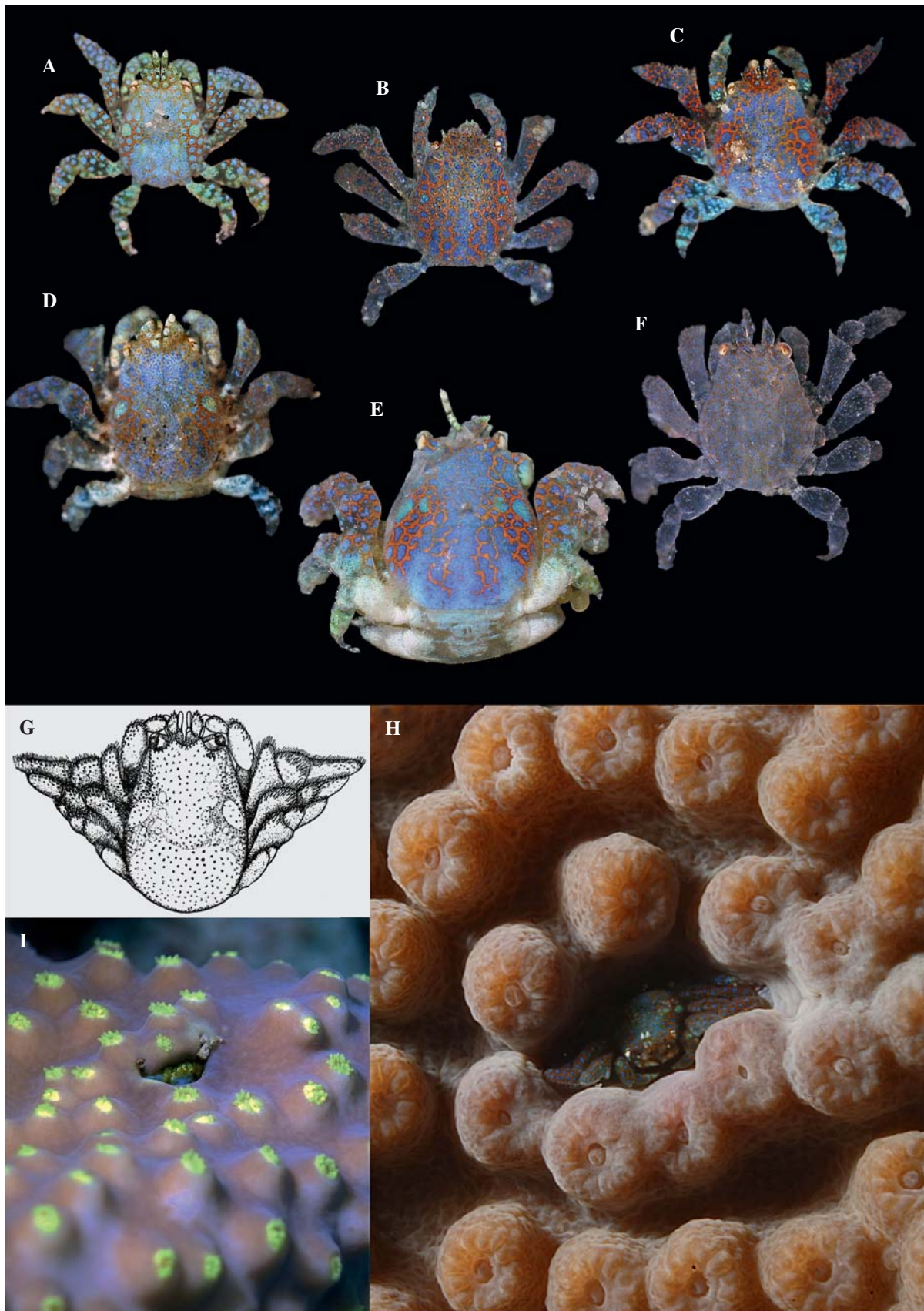


Fig. 1. A-F, colour patterns in *Pseudocryptochirus viridis* Hiro, 1938; F, recent moult; G, posture of *P. viridis* in gall, after Utinomi (1944, Fig. 3); H-I, in situ photographs of *P. viridis*. Photos by S.E.T. van der Meij (A-F), B.T. Reijnen (H) and B.W. Hoeksema (I).

S.E.T. van der Meij; RMNH.Crus.D.53240, Halmahera, Pasir Lamo W, 0°53'20.5"N 127°27'34.2"E, 14 m depth, in *T. mesenterina*, 8 Nov. 2009, collected by S.E.T. van der Meij; RMNH.Crus.D.53243, Halmahera, Teluk Dodinga E-N of Jere, 0°50'47.8"N 127°37'48.7"E, 3 m depth, in *T. cf. frondens* (Dana, 1846), 13 Nov. 2009, collected by S.E.T. van der Meij; RMNH.Crus.D.53244, Halmahera, Teluk Dodinga - Karang Galiasa Besar E, 0°50'45.6"N 127°35'7.4"E, 10 m depth, in *T. mesenterina*, 14 Nov. 2009, collected by S.E.T. van der Meij; Malaysia: RMNH.Crus.D. 53983, Semporna, SE of Tawau, Darby Rock, 04°06'42.8"N 118°13'39.7"E, 15 m depth, in *Turbinaria* sp., 30 Nov. 2010, collected by S.E.T. van der Meij; RMNH.Crus.D.53984, Semporna, SE of Tawau, Darby Rock, 04°06'42.8"N 118°13'39.7"E, 15-18 m depth, in *Turbinaria* sp., 30 Nov. 2010, collected by B.W. Hoeksema; RMNH.Crus.D.53985, Semporna, SE of Tawau, Hand Rock, 04°08'24.5"N 118°10'44.3"E, 20 m depth, in *Turbinaria* sp., 30 Nov. 2010, collected by S.E.T. van der Meij; RMNH.Crus.D.53986, Semporna, Ligitan Isl., Ligitan 3, 04°12'43.0"N 118°54'36.6"E, 15 m depth, in *T. mesenterina*, 03 Dec. 2010, collected by S.E.T. van der Meij; RMNH.Crus.D.53987, Semporna, Ligitan Isl., Ligitan 3, 04°12'43.0"N 118°54'36.6"E, 10-20 m depth, in *T. reniformis*, 03 Dec. 2010, collected by S.E.T. van der Meij; RMNH.Crus.D. 54049, Semporna, Tg. Pantau Pantau, Bumbun Isl., 04°26'54.1"N 118°46'31.0"E, 10 m depth, in *T. mesenterina* (together with *Neotroglocarcinus* sp.), 07 Dec. 2010, collected by S.E.T. van der Meij; RMNH.Crus.D. 53988, Semporna, NW Gaya Island, 04°38'32.5"N 118°44'6.0"E, shallow, in *T. cf. reniformis*, 10 Dec. 2010, collected by B.W. Hoeksema; RMNH.Crus.D. 53710, Semporna, S Boheydulang Isl., outer reef, 04°35'00.3"N 118°46'39.1"E, in *T. mesenterina*, 11 Dec. 2010, collected by S.E.T. van der Meij; RMNH.Crus.D.53709, Semporna, S Boheydulang Isl., outer reef, 04°35'00.3"N 118°46'39.1"E, in *T. mesenterina*, 11 Dec. 2010, collected by B.W. Hoeksema; RMNH.Crus.D.54050, Semporna, Church Reef 1, 04°40'54.9"N 118°39'28.4"E, 3 m depth, in *T. mesenterina*, 13 Dec. 2010, collected by S.E.T. van der Meij; RMNH.Crus.D. 53713, Semporna, Bakungan Isl., 04°45'11.1"N 118°29'16.0"E, in *Turbinaria* sp., 16 Dec. 2010, collected by S.E.T. van der Meij.

Coral host

Order Scleractinia

Family Dendrophylliidae Gray, 1847

Genus *Turbinaria* Oken, 1815

The genus *Turbinaria* is in serious need of a revision. Bernard's (1896) monograph of *Turbinaria* was a turning point in the study of this genus, and was highly criticized by later coral taxonomists for recognizing too many species that actually represent various morphotypes resulting from ecophenotypical variation. Current authors (Veron and Pichon, 1980; Cairns *et al.*, 1999; Cairns, 2001) recognize 13 to 15 valid species of *Turbinaria* compared to the 58 listed by Bernard (1896), many of which are now considered to be either junior synonyms or species of uncertain status. The identifications of the *Turbinaria* in this paper should therefore be treated with some caution, although the majority of *Turbinaria* corals from which *P. viridis* was collected seem to belong to two species currently regarded as *T. reniformis* Bernard, 1896 and *T. mesenterina* (de Lamarck, 1816).

Fize and Serène (1957) list many *Turbinaria* species as hosts for *P. viridis*. Some of these have been synonymized and the identity of other *Turbinaria* species remains unresolved (table I). Fize and Serène (1957) did remark that all hosts of *P. viridis* consisted of *Turbinaria* corals with small polyps (up to approximately 3 mm), which excludes *T. peltata* (Esper, 1794) and most likely *T. patula* (Dana, 1846). Besides *P. viridis*, *Turbinaria* corals also host the gall crabs *Neotroglocarcinus dawydoffi* (Fize and Serène, 1956) and *N. hongkongensis* (Shen, 1936).

Table 1. Overview of the coral hosts of *Pseudocryptochirus viridis* Hiro, 1938.

Coral host	Reference
<i>Turbinaria frondens</i> (Dana, 1846) (as <i>T. contorta</i> Bernard, 1896; <i>T. danae</i> Bernard, 1896; <i>T. Edwardsii</i> [edwardsi] Bernard, 1896; <i>T. pustulosa</i> Bernard, 1896)	Hiro, 1938; Utinomi, 1944; Fize and Serène, 1957; Garth, 1964; this study
<i>T. mesenterina</i> (de Lamarck, 1816) (as <i>Turbinaria tubifera</i> Bernard, 1896)	Utinomi, 1944; Wei <i>et al.</i> , 2006; this study
<i>T. cf. patula</i> (Dana, 1846)	Kropp, 1988
<i>T. reniformis</i> Bernard, 1896 (as <i>T. veluta</i> Bernard, 1896)	Fize and Serène, 1957; this study
<i>T. stellulata</i> (de Lamarck, 1816)	Kropp, 1988
<i>T. agaricia</i> Bernard, 1896 (identity unclear)	Fize and Serène, 1957
<i>T. mollis</i> Bernard, 1896 (identity unclear)	Fize and Serène, 1957
<i>T. crater</i> (Pallas, 1766) (identity unclear)	Fize and Serène, 1957

Turbinaria often occurs in protected environments with turbid water. Because of these conditions the colour of *Turbinaria* corals may appear greyish-brown, but in fact the colour ranges from orange-grey (Maerz and Paul, 1950, pl. 11, B7) to more purple-grey (Maerz and Paul, 1950, pl. 4, D2). Often a yellowish growth line along the coral edge is visible. In some species polyp tentacles are yellow.

Colour pattern

Hiro (1938) named the species *Pseudocryptochirus viridis* for its bluish-green colour. The colour pattern of *P. viridis* (Fig. 1A-F) is rather uniform, with juvenile crabs appearing more cyan-green, especially on the legs. The eyestalks are bluish with four brown longitudinal stripes, whereas the eyes themselves are off-white with a horizontal red band. Antennules have white bands on an overall transparent background. The eye region, including the antennules, sometimes appears yellowish (Fig. 1I). The light blue background of the carapace seems to deepen to azure when the individual matures. The mesobranchial region of the carapace is marked on both sides with an emerald green spot, or sometimes two or three smaller spots clustered together. In some specimens the reddish-brown marbled pattern is more pronounced than in others (Fig. 1B). The colour of the dorsal surface of the walking legs is like the carapace. One specimen (Fig. 1F) appears to have recently moulted or is in an intermoult stage. Closer examination shows the reddish-brown dotted pattern, including azure blue spots, on the generally transparent carapace. No sexual dimorphism has been observed in carapace colouration.

The maximum carapace length of *P. viridis* according to Fize and Serène (1957) is 4.5 mm for females and 2.0 mm for males. Utinomi (1944) mentions maximum carapace length/breadth dimensions of 5.8/5.2 for females and 2.5/2.1 mm for males.

Distribution

Gall crabs were collected from *Turbinaria* corals at depths between 3 and 20 m. An infested coral usually hosts many crabs, mostly (ovigerous) females. An overview of published distribution records is given in table II. Bunaken, Lembah and Ternate are new Indonesian records for *P. viridis*, and Semporna is the first record for Malaysia. An additional specimen was observed in *T. reniformis* on Hastings Reef off Cairns (Great Barrier Reef, Australia), which is a new record for Australia. The holotype of *T. reniformis* Bernard, 1896 (NHM 1892.12.1.374), from the Great Barrier Reef, has an empty gall (Bernard, 1896). Based on the shape of the pit, the coral was most

Table 2. Distribution records of *Pseudocryptochirus viridis* Hiro, 1938.

Country	Location	Reference
Australia	Hastings Reef, off Cairns	This study
China	Hong Kong (gall only)	Scott, 1984
Indonesia	Banda Neira, Banda Island	Kropp, 1994
	Moluccas	Serène <i>et al.</i> , 1974
	Bunaken, Lembeh (N Sulawesi), Ternate (Halmahera)	This study
Japan	Tanabe Bay	Hiro, 1938
	Yaeyama Islands; Ryukyu Islands	Utinomi, 1944
Malaysia	Semporna (E Sabah)	This study
Marshall Islands	Eniwetok Atoll	Garth, 1964
Micronesia	Palau (Palao)	Utinomi, 1944
	Guam, Palau, Pohnpei	Kropp, 1990a
New Caledonia	Loyalty Islands	Juncker and Poupin, 2009
Taiwan	Hung-Chung Peninsula; Orchid Island	Wei <i>et al.</i> , 2006
	Penghu Island (the Pescadores); ?Pratas Island (Dongsha Island)	Utinomi, 1944
Vietnam	Nha Trang	Fize and Serène, 1957

likely inhabited by *P. viridis*. This distribution record corresponds with the herein reported observation of *P. viridis* on Hastings Reef.

Discussion

Females of many species of gall crabs are permanently confined by their host, e.g., *Hapalocarcinus marsupialis* Stimpson, 1859 and *Fungicola* spp. associated with Pocilloporidae and Fungiidae, respectively. Unlike their congeners, the females of *Pseudocryptochirus viridis* can leave their pit, which is merely a shallow, crescent-shaped depression within the coral. Specimens of *P. viridis* show a characteristic position when lodged in their gall, with most of the carapace and the anterior three pereopods exposed (Fig. 1G). They are positioned on roughly the same level as the surface of the host coral.

Their bright colours could make the gall crabs more detectable for predators. Figure 1I shows how the eye region of *P. viridis* appears to be yellow, just like the polyp tentacles of its *Turbinaria* host, making the gall crab visually blend in the coral. There is only one published record of a gall crab in a fish stomach (Kropp and Manning, 1987), which the authors consider a doubtful record in terms of actual predation.

The currently known distribution of *P. viridis* ranges from Vietnam in the west to the Marshall Islands and New Caledonia in the east (table II). The distribution ranges of some of its host species (e.g., *T. mesenterina* and *T. reniformis*) also include the east coast of Africa and the southern Red Sea (Pichon *et al.*, 2010), but so far no records of *Turbinaria*-associated cryptochirid fauna are available from those regions.

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