

**Notes on taxonomy and biology of the symbiotic shrimp
Vir euphyllius Marin et Anker, 2005
(Decapoda: Palaemonidae: Pontoniinae),
associated with scleractinian corals *Euphyllia* spp.
(Cnidaria: Caryophyllidae)**

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ABSTRACT: Recent collections of numerous specimens of shrimps associated with caryophyllid corals in Nhatrang Bay, Vietnam, add new data to the taxonomy and biology of the pontoniine shrimp *Vir euphyllius* Marin et Anker, 2005. A comparison of the morphology and coloration of the freshly collected specimens with the type material of *V. pareuphyllius* Marin et Anker, 2005 and *V. euphyllius* leads to the conclusion that *V. pareuphyllius* should be considered as junior synonym of *V. euphyllius*. A key to the species of the genus *Vir* Holthuis, 1952 is provided. In Nhatrang Bay, *V. euphyllius* is exclusively associated with three species of the caryophyllid coral genus *Euphyllia* Dana, 1846. The shrimps appear to live in heterosexual pairs and are possibly territorial and aggressive towards conspecifics.

KEYWORDS: *Vir*, *Euphyllia*, corals, Palaemonidae, symbiosis, Nhatrang Bay, Vietnam.

**Замечания к таксономии и биологии симбиотической
креветки *Vir euphyllius* Marin et Anker, 2005
(Decapoda: Palaemonidae: Pontoniinae),
ассоциированной со склерактиниевыми кораллами
Euphyllia spp. (Cnidaria: Caryophyllidae)**

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РЕЗЮМЕ: Новые сборы симбиотических креветок, ассоциированных с кораллами-кариофиллидами в заливе Нячанг, Вьетнам, существенно дополнили данные о таксономическом положении креветки-понтониины *Vir euphyllius* Marin et Anker, 2005. Сравнение морфологии и окраски собранных недавно животных с типовым материалом *Vir pareuphyllius* Marin et Anker, 2005 и *V. euphyllius* позволило заключить, что *V. pareuphyllius* является младшим синонимом *V. euphyllius*. В работе представлен ключ для определения видов рода *Vir* Holthuis, 1952. В заливе Нячанг особи *V. euphyllius* ассоциированы

исключительно с тремя видами кораллов рода *Euphyllia* Dana, 1852. Креветки заселяют хозяев гетеросексуальными парами, возможно, территориальны и агрессивны по отношению к конспецифичным особям.

КЛЮЧЕВЫЕ СЛОВА: *Vir*, *Euphyllia*, кораллы, Palaemonidae, симбиоз, Нячанг, Вьетнам.

The genus *Vir* Holthuis, 1952 was erected for *Palaemonella orientalis* Dana, 1852 (Holthuis, 1952). Since then four species, *Vir philippinensis* Bruce et Svoboda, 1984, *Vir colemani* Bruce, 2003, *Vir euphyllius* Marin et Anker, 2005 and *Vir pareuphyllius* Marin et Anker, 2005, have been described (Bruce et Svoboda, 1984; Bruce, 2003; Marin et Anker, 2005) and existence of further undescribed species has been mentioned (Marin et Anker, 2005). The two most recently described species, *V. euphyllius* and *V. pareuphyllius* were found in Nha-trang Bay, southern Vietnam, in association with hammer corals of the genus *Euphyllia* Dana, 1846 (Caryophyllidae) (Marin et Anker, 2005). These two species appeared to be morphologically very similar, differing mainly in the shape of the rostrum, different configuration of lobes on the distal margin of the carpus of the second pereopods, and the size of the mandibular palp (Marin et Anker, 2005). The color patterns of *V. euphyllius* and *V. pareuphyllius* were also very similar. Therefore, Marin et Anker (2005) did not exclude that these two species may actually belong to one and the same species, however, the available material did not allow any further conclusions.

More recent intensive investigations in Nha-trang Bay in September – November, 2005 resulted in the collection of additional material of *Vir* specimens from three coral hosts — *Euphyllia divisa* Veron et Pichon, 1980, *E. parancora* Veron, 1990 and *E. glabrescens* (Chamisso et Eysenhardt, 1821). In total, more than 50 specimens of these shrimps from 21 coral colonies were collected. A thorough comparison of morphology and coloration of all these specimens leads to the conclusion that *V. pareuphyllius* (described in Marin et Anker, 2005: 123) should be considered as junior synonym of *V.*

euphyllius (described in Marin et Anker, 2005: 118) by page priority. A rediagnosis of *V. euphyllius* and an updated key to species are provided. Some newly observed ecological and biological data on *V. euphyllius* is also presented.

Carapace length (CL, in mm), postorbital carapace length (PCL) and total body length (TL) are used as standard length. Material is deposited in author's collection in Laboratory of ecology and morphology of marine invertebrates, A.N. Severtzov Institute of ecology and evolution, Russian Academy of Sciences, Moscow (LEMMI).

Genus *Vir* Holthuis, 1952

Vir euphyllius Marin et Anker, 2005

Vir philippinensis. — Bruce et Svoboda, 1984: 87 (part: paratype female), fig. 66. — De Grave, 2000: 145 (part: specimens from Laing Islands) (not *V. philippinensis* Bruce et Svoboda, 1984).

Vir euphyllius Marin et Anker, 2005: 118, figs. 1–5 (type locality: Nha-trang Bay, Vietnam).

Vir pareuphyllius Marin et Anker, 2005: 123, figs. 6–8, 9a (type locality: Nha-trang Bay, Vietnam).

Type material. Vietnam: Nha-trang Bay: Tre Is., southern bay, near lighthouse, depth 15 m, on *Euphyllia* cf. *divisa*, scuba, coll. I. Marin, 29.06.2004 — 1 ovigerous female (CL 4.0 mm), ZMMU Ma 5452 (holotype of *Vir euphyllius*); 1 male (CL 2.8 mm), ZMMU Ma 5453 (allotype of *Vir euphyllius*), Tre Is., northern part of “Tre Bay”, depth 7 m, on *Euphyllia* cf. *parancora*, scuba, coll. I. Marin, 01.10.2003 — 1 female (CL 3.3 mm, dissected), ZMMU Ma 5457 (holotype of *Vir pareuphyllius*); 1 male (CL 2.5 mm), ZMMU Ma 5458 (allotype of *Vir pareuphyllius*).

Addition material. Vietnam: Nha-trang Bay: Tre I., southern bay, near lighthouse, depth 15 m, on *Euphyllia* cf. *divisa*, scuba, 29.06.2004 — 1 ovig. female (CL 3.2 mm), 1 ovig. female (CL 3.8 mm, dissected), 1 non-ovig. female (CL 3.4 mm), ZMMU Ma 5454–5455; Mun I., southern side, depth 15 m, on *Euphyllia* cf. *divisa*, scuba, 06.10.2003 — 1 ovig. female (CL 3.9 mm), ZMMU Ma 5456; Dun I., depth 15–20 m, on *E. parancora*, 11.11.2005 — 13 ovig. females, 8 males and 2 juveniles; Mot I., depth 10–15 m, on *E. glabrescens*, 6–11.11.2005 — 5 ovigerous females and 5 males; Mun I., depth 15–20 m, on *E. divisa* — 4 ovig. females and 4 males, 11.11.2005.

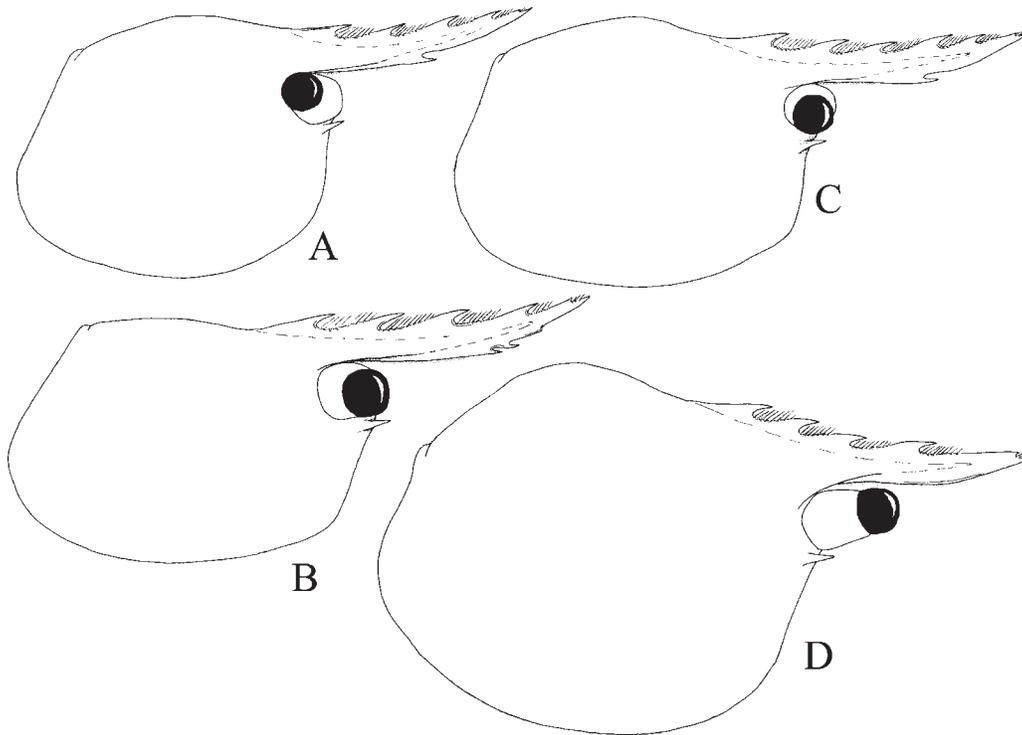


Fig. 1. Rostrum and carapace of *Vir euphyllius* Marin et Anker, 2005.

A — ovigerous female, PCL — 4.1 mm, from coral *Euphyllia parancora* Veron, 1990; B — mature male, PCL — 2.6 mm, from coral *Euphyllia parancora* Veron, 1990; C — ovigerous female, PCL — 3.6 mm, from coral *Euphyllia divisa* Veron et Pichon, 1980; D — ovigerous female, PCL 4.1 mm from coral *Euphyllia glabrescens* (Chamisso et Eysenhardt, 1821).

Рис. 1. Рostrum и карапакс *Vir euphyllius* Marin et Anker, 2005.

A — яйценосная самка, PCL — 4,1 мм, с коралла *Euphyllia parancora* Veron, 1990; B — половозрелый самец, PCL — 2,6 мм, с коралла *Euphyllia parancora* Veron, 1990; C — яйценосная самка, PCL — 3,6 мм, с коралла *Euphyllia divisa* Veron et Pichon, 1980; D — яйценосная самка, PCL — 4,1 мм, с коралла *Euphyllia glabrescens* (Chamisso et Eysenhardt, 1821).

New diagnosis. Medium sized pontoniine shrimp. Carapace smooth, conspicuously swollen in females (Fig. 1, 2A), only slightly inflated in males; with antennal spine; supraorbital, epigastrical and hepatic spines absent. Rostrum well developed, straight or slightly upturned distally, slightly extending beyond distal margin of antennular peduncle; with 0–2 ventral teeth; dorsal lamina extending posteriorly well behind orbital margin, with 4–5 well developed subequal teeth and minute distal tooth situated slightly behind the tip of the rostrum, each with setae distally, occasionally most posterior or 2 posterior teeth situated behind level of orbital margin; tip of the rostrum acute or bifid, with setae at notch. Mandible with 1- or 2-segmented palp. Second pereiopods (chelipeds) equal in length and similar in shape; merus slender, about 5 times longer than wide, distally with small rounded

projection; carpus slightly shorter than merus, widening distally; dorsolateral margin with 2 rounded lobes and distinct notch between them; fingers about half palm length, with hooked, acute tips; cutting edge of pollex sharp, with 2 large subtriangular and 3–4 small, irregular teeth on proximal half; cutting edge of dactylus sharp, with 2 large triangular teeth around mid-length, without proximal fossa. Third pereiopod slender, when fully extended exceeding mid-length of scaphocerite approximately by length of dactylus; carpus with disto-dorsal angle triangular, slightly projecting; propodus about 9 times longer than broad, twice longer than carpus, dorsal margin without setae or spines, ventral margin with minute setae and 2 small spines disto-ventrally; dactylus simple, with distinct angular projection proximally; unguis slender and curved.

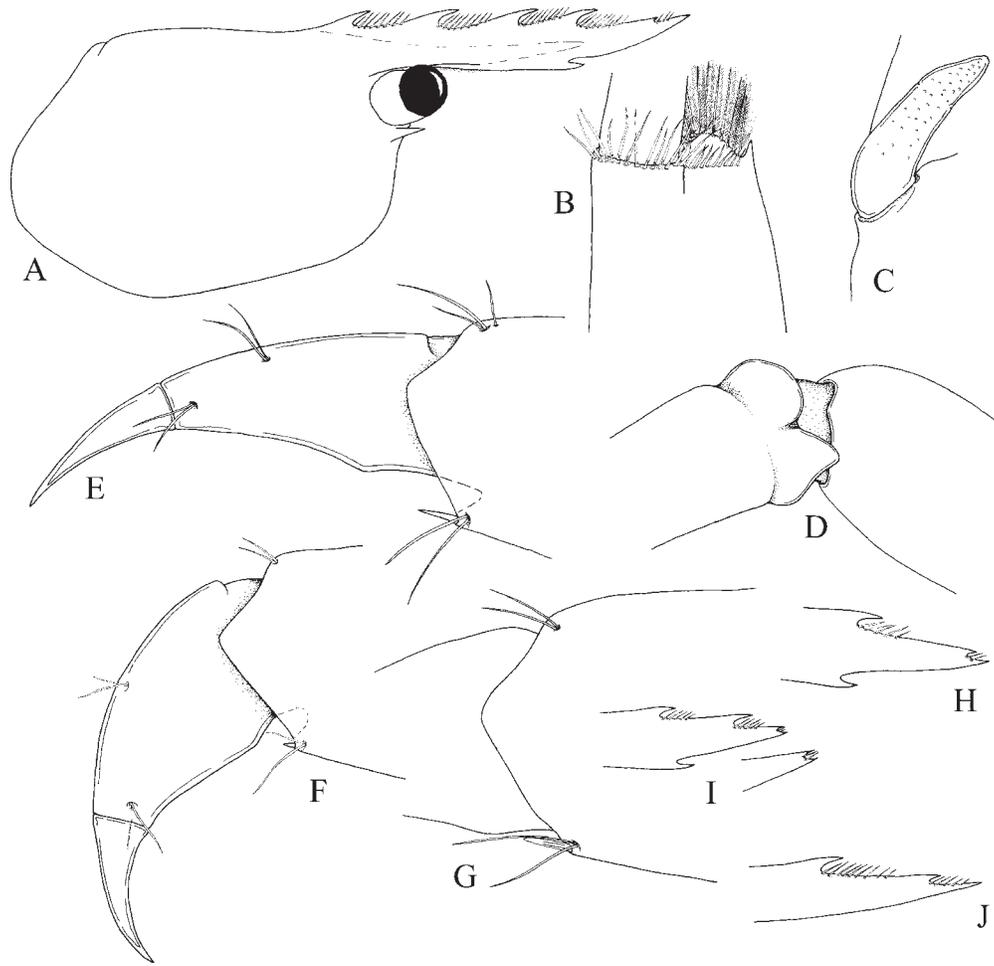


Fig. 2. *Vir euphyllius* Marin et Anker, 2005.

A — carapace and rostrum of mature male, PCL — 3.7 mm, from coral *Euphyllia divisa*; B — distal edge of basal antennular segment; C — mandibular palp; E — dactylus of third pereiopod of ovigerous female (PCL — 4.2 mm); D — carpo-propodal articulation of second pereiopod; F — dactylus of third pereiopod of ovigerous female (PCL — 3.7 mm); G — dactylus of third pereiopod of ovigerous female (PCL — 5.3 mm); H, I, J — distal part of rostrum of ovigerous females (PCL — 3.7; 5.3 and 4.5 mm respectively).

Рис. 2. *Vir euphyllius* Marin et Anker, 2005.

A — карапакс и рostrum половозрелого самца, PCL — 3,7 мм, с коралла *Euphyllia divisa*; B — дистальный край базального сегмента антеннул; C — мандибулярный щупик; E — дактилус третьих переопод яйценосной самки (PCL — 4,2 мм); D — карпо-проподальное сочленение вторых переопод; F — дактилус третьих переопод яйценосной самки (PCL — 3,7 мм); G — дактилус третьих переопод яйценосной самки (PCL — 5,3 мм); H, I, J — дистальная часть рostrума яйценосных самок (PCL — 3,7; 5,3 и 4,5 мм, соответственно).

Coloration. Body and most appendages translucent with tiny red chromatophores; eyestalks with two red longitudinal stripes on frontal margin; conspicuous white stripe present between eyes; antennal and antennular flagella translucent (Fig. 6; see also *in situ* color photo in Marin et Anker, 2005). The red longitudinal lines of the eyestalks are characteristic

of all species of the genus (except *Vir orientalis*; coloration of this species is still unknown) help with preliminary field identification of the representatives of the genus.

Remarks. *Vir euphyllius* presents a significant variation of the rostral formula, which can be expressed as 0-2 + 4-5/0-2, although most of the

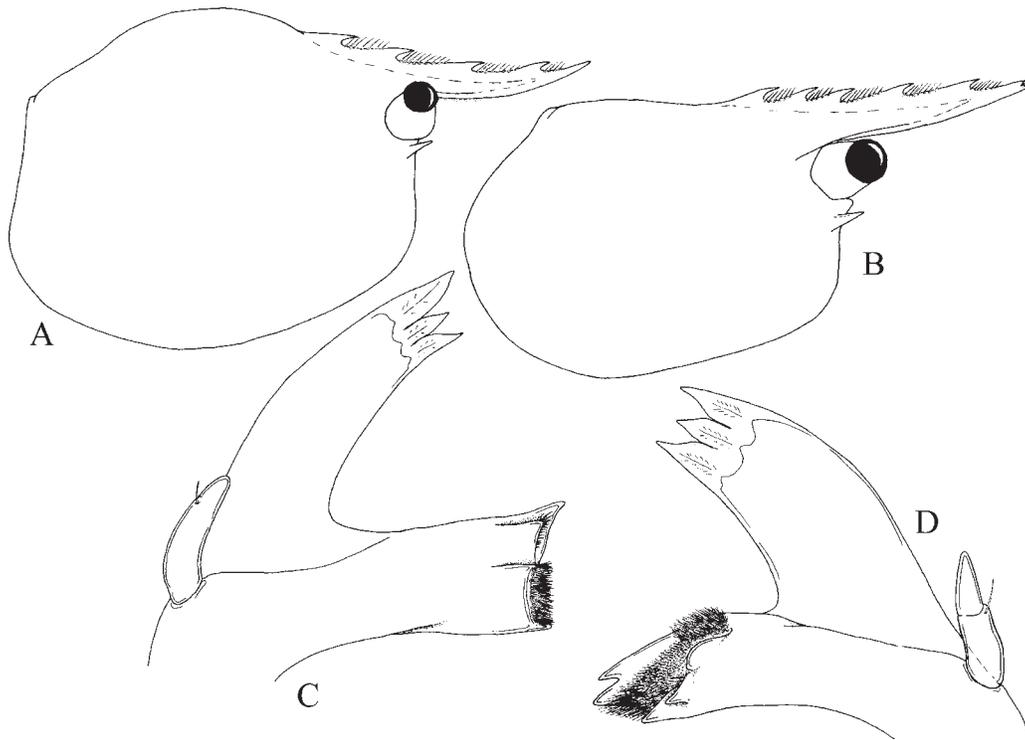


Fig. 3. Specimens of *Vir euphyllius* Marin et Anker, 2005 from coral *Euphyllia glabrescens* (Chamisso et Eysenhardt, 1821).

A — ovigerous female, PCL — 5.6 mm; B — mature male, PCL — 3.0 mm; C–D — mandibles of the male.

Рис. 3. Экземпляр *Vir euphyllius* Marin et Anker, 2005 с коралла *Euphyllia glabrescens* (Chamisso et Eysenhardt, 1821).

A — яйценосная самка, PCL — 5,6 мм; B — половозрелый самец, PCL — 3,0 мм; C–D — мандибулы самца.

examined specimens have the rostral formula 0+4–5/1 (Fig. 5). Similar variation in the number of rostral teeth, shape and length were also reported in other palaemonids, for instance, *Palaemon affinis* Milne-Edwards (Yaldwin, 1957), *Palaemon concinnus* Dana (De Grave, 1999) and *Onycochelis temiri* Marin (Marin, 2005). The disto-ventral spines of the propodus of the third pereopod vary from long (Fig. 2E) to reduced (Fig. 2F). No correlations between the body size and the length of this spine or the number of the rostral teeth were observed.

The previous report of a two-segmented mandibular palp in the holotype of *V. euphyllius* (Marin et Anker, 2005) should be considered as an error: a re-examination showed that this specimen has a one-segmented palp, as appears to be typical to this species. A two-segmented palp (Fig. 3D; Marin et Anker, 2005: fig. 6d) was observed in three dissected specimens (two males and one ovigerous female).

Noteworthy, all three specimens are lacking ventral teeth on the rostrum (Fig. 3), and in each specimen, only one of the two mandibles bears a two-segmented palp, whereas the other mandible has a normal one-segmented palp. Two of the specimens (male and ovigerous female) occupied the same host, while the remaining male was found in a pair with an ovigerous female bearing a normal, one-segmented mandibular palp and a rostrum with one ventral tooth. A slightly aberrant pair with similar morphological features was previously described as *V. pareuphyllius* (Marin et Anker, 2005). Two-segmented palp is known in *V. orientalis* and also in *V. philippinensis* (Holthuis, 1953; Bruce et Svoboda, 1984). Therefore, it is possible that the presence of a two-segmented mandibular palp in some specimens of *V. euphyllius* as an atavistic feature. Fujino et Miyake (1968) noted the same phenomenon in some representatives of the genus *Palaemon* Weber, 1795.

Size and fecundity. The PCL of ovigerous females ranges between 3.2 and 5.6 mm; males are significantly smaller with PCL ranging from 2.8 to 4.3 mm. The largest specimen is an ovigerous female with CL 5.6 mm and TL about 19.0 mm. Eggs are small (about 0.5 × 0.4 mm) and numerous: two large females (5.0 and 4.8 mm) bear 335 and 312 eggs, respectively.

Hosts. In Nha Trang Bay, all specimens of *V. euphyllius* were collected from colonies of the genus *Euphyllia* (Caryophyllidae). Three species of the genus, *E. glabrescens*, *E. divisa* and *E. parancora*, are presently known as hosts.

Ecology. All observed corals of *Euphyllia* spp. were inhabited by *Vir* shrimps. Small colony usually harbors one heterosexual pair, consisting of a mature female and a male, while larger host colonies may be occupied by several mature shrimps of both sexes and subadults (up to 12 mature females and 7 males on one colony with approximate diameter 1.5 m). This distribution pattern suggests that *V. euphyllius* is characterized by some aggression to conspecifics and perhaps a joint (female–male pair) protection of the territory. Obviously, greater surface of larger colonies enables co-occurrence of several pairs of shrimps, each being possibly associated with a different corallite or a different patch of several corallites.

The shrimps were observed to move mostly on the surface of the tentacles. Alerted shrimps tried to hide in the crown of tentacles, moving among septae to the central valley of the corallite. The tentacles conceal almost completely the transparent body of the shrimps; only the distal carapace, eyes and chelipeds remain visible. Occasionally, alerted shrimps living far from the center of the corallite, moved to the opaque lateral side of the corallite. *Vir philippinensis* living on *Plerogyra sinouosa* (Dana) acts in a very similar way (personal observation). Regenerating chelipeds as well as damaged rostra were marked. The traumas of the chelipeds are more likely to be the result of aggressive intraspecific interactions (e.g., see Marin, 2006), while rostrum injuries are more likely caused by predators.

Dissected stomachs of three specimens (two females and a male) contained flake-like mass consisting of zooxanthellae, cnidocysts, diatoms and green algae, as well as separate parts of the appendages of small arthropods (possibly small crustaceans such as copepods, and amphipods). These observations suggest that the shrimps collect mucus from the polyp surface, occasionally ingesting other small organisms trapped in it, and also tweezing coral tissues.

Affinities. *Vir euphyllius* appears to be most similar to *V. colemani*. However, *V. colemani* may be separated from *V. euphyllius* by the shape of the



Fig. 4. Damaged rostrum of male of *Vir euphyllius* Marin et Anker, 2005 (PCL — 3.5 mm) from coral *Euphyllia parancora* Veron, 1990. The specimen has also regenerated second pereopods.

Fig. 4. Поврежденный роstrum самца *Vir euphyllius* Marin et Anker, 2005 (PCL — 3,5 мм) с коралла *Euphyllia parancora* Veron, 1990. Для этого экземпляра также отмечены регенерирующие вторые переоподы.

distal margin of the carpus of the second pereopods, absence of distoventral spine on the propodus of the third pereopods, color pattern and ecology (see Marin et Anker, 2005). The following key allows separating all species of the genus *Vir*.

KEY TO THE KNOWN SPECIES OF THE GENUS *Vir* HOLTHUIS, 1952

1. Mandible with 2-segmented palp. Rostrum with more than 6 dorsal teeth 2
- Mandible with 1-segmented palp. Rostrum with 4–5 dorsal teeth 3
2. Rami of the lateral antennular flagellum with 6 segments. Propodus of third pereopod about 7 times as long as wide, very setose distally. Free-living or associated with pocilloporid corals ..
..... *Vir orientalis*
- Rami of the lateral antennular flagellum with 11–13 segments. Propodus of third pereopod about 11 times as long as wide, sparsely setose distally. Associated with bubble coral, *Plerogyra sinouosa* *Vir philippinensis*
3. Distolateral margin of carpus of second pereopods with 2 distinct lobes. Propodus of third pereopods with distoventral spine (sometimes minute). Pereopods transparent. Associated with hammer corals, *Euphyllia* spp.
..... *Vir euphyllius*

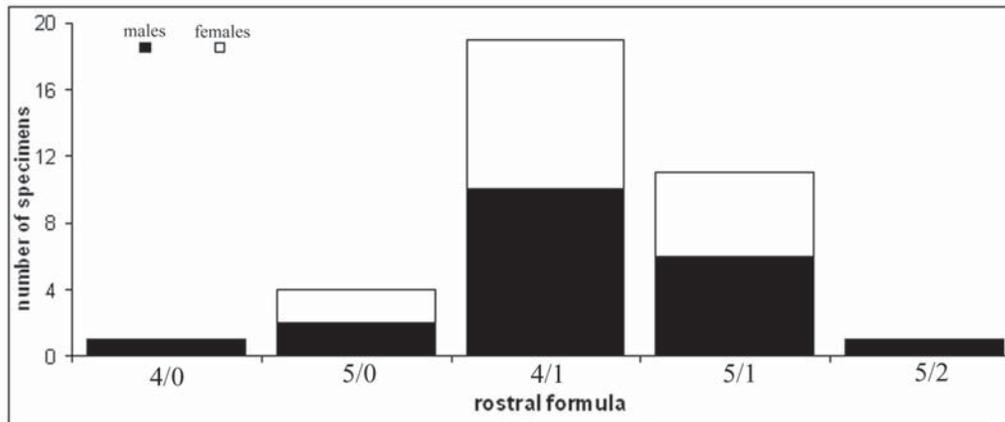


Fig. 5. Rates of different number of rostral teeth in *Vir euphyllius* Marin et Anker, 2005. Rostral formula comprises well developed teeth only. Specimens having rostrum with 4 well developed teeth and additional minute dorsal distal tooth and one ventral tooth were applied to group “4/1” and so on.

Рис. 5. Соотношение различного числа роstralных зубцов у *Vir euphyllius* Marin et Anker, 2005. В роstralную формулу включены только хорошо развитые зубцы. Экземпляры с роstralом, несущим 4 хорошо развитых зубца, дополнительный мелкий дорсальный зубчик и один венральный зубец, отнесены к группе «4/1» и так далее.

— Distal margin of carpus of second pereiopods with 1 lobe. Propodus of third pereiopods without distoventral spine. Pereiopods articulations with purple spots. Associated with bubble coral, *Plerogyra sinuosa* *Vir colemani*

Distribution. Western Pacific: Nhatrang Bay, Vietnam (Marin et Anker, 2005; present study); Cebu, Philippines (Bruce et Svoboda, 1984) and Hansa Bay, Papua New Guinea (De Grave, 2000).

Discussion

Presently, the genus *Vir* includes four species. *Vir orientalis* is known as free-living or associated with pocilloporid corals (Chace et Bruce, 1993; Fransen, 1994; De Grave, 2000), while the other three species are associated with corals of the family Caryophyllidae. *Vir philippinensis* and *V. colemani* are both associated with the bubble coral *Plerogyra sinuosa* (e.g., Bruce et Svoboda, 1984; Bruce, 2003), while *Vir euphyllius* is associated with three species of the hammer corals of the genus *Euphyllia* (Marin et Anker, 2005; present study). Thus most *Vir* species seem to be monoxenous, i.e., restricted to one host species (*V. philippinensis*, *V. colemani*) or closely related species from one

genus (*V. euphyllius*). Therefore, it may be assumed that the specimens reported as *V. orientalis* or *V. philippinensis* from other hosts, such as the caryophyllid coral *Physogyra lichtensteini* Edwards et Haime, 1851 (Fransen, 1994; De Grave, 2000) or the fungiid coral, *Fungia* sp. (Bruce et Svoboda, 1984), possibly represent undescribed species.

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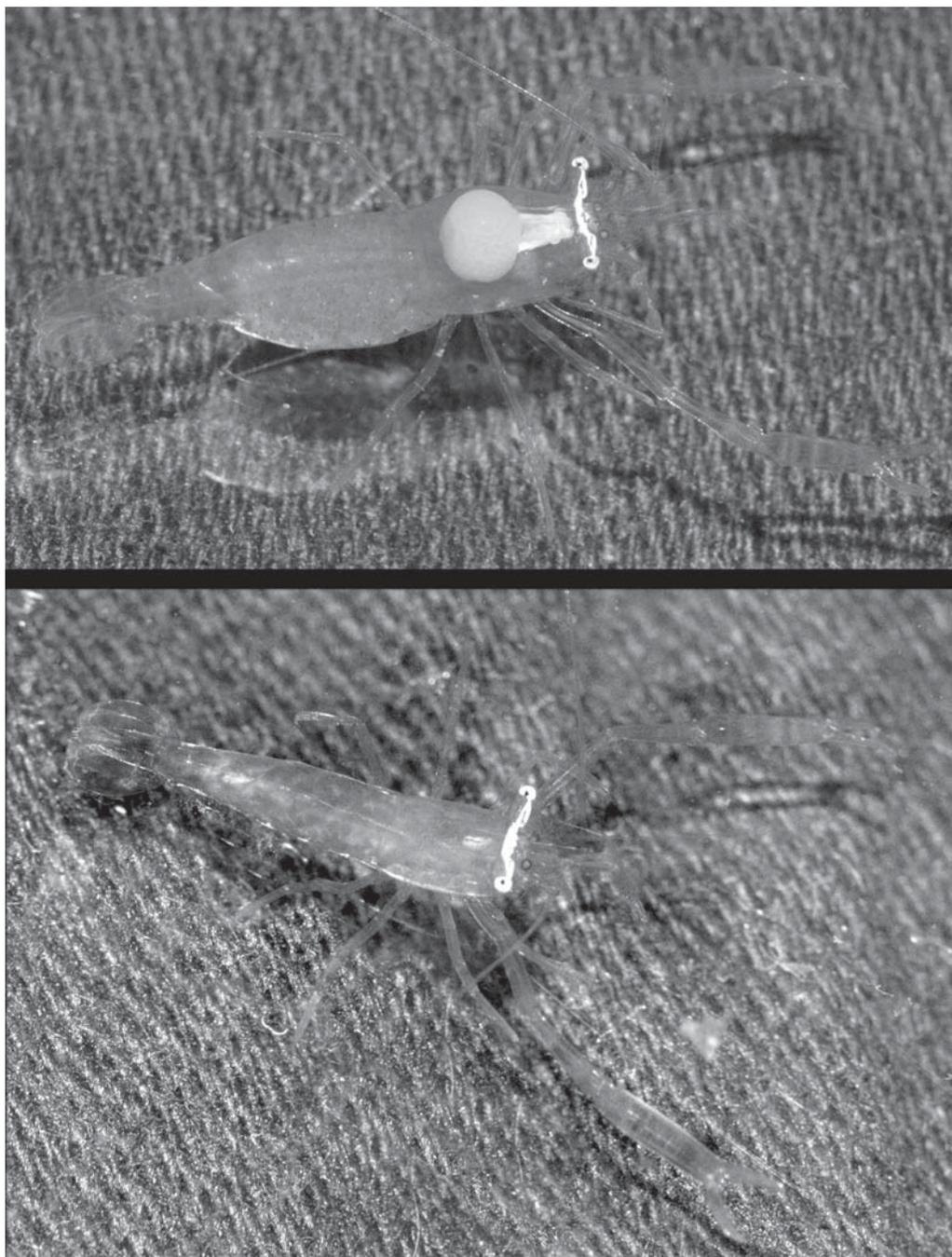


Fig. 6. Coloration of specimens of *Vir euphyllius* Marin et Anker, 2005 from corals *Euphyllia divisa* Veron et Pichon, 1980 (upper female) and *Euphyllia parancora* Veron, 1990 (lower male).

Рис. 6. Окраска особей *Vir euphyllius* Marin et Anker, 2005 с кораллов *Euphyllia divisa* Veron et Pichon, 1980 (самка сверху) и *Euphyllia parancora* Veron, 1990 (самец внизу).

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